

THINNER THAN AN EGGSHELL: TUNGSTEN WALL THICKNESS OF 100 μm

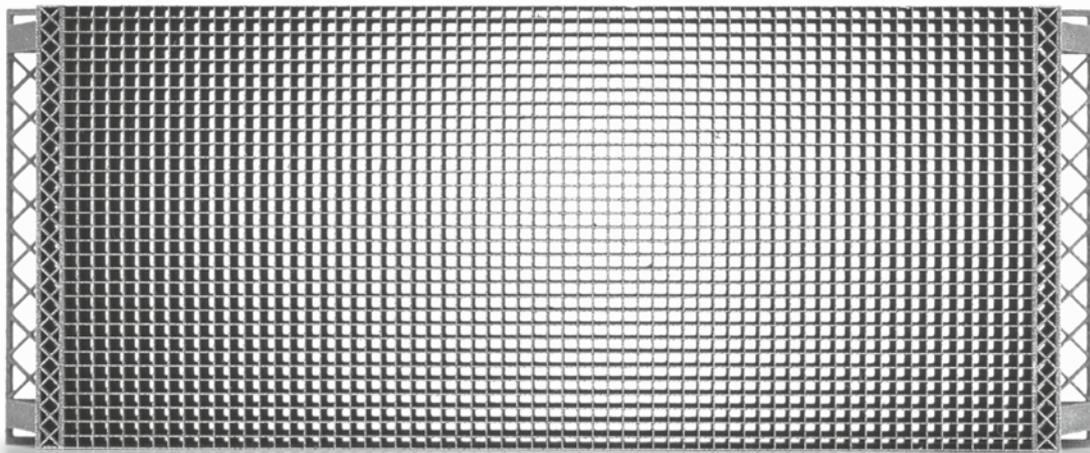


Figure 1: example of a 3D-printed tungsten 2D ASG with high aspect ratio septa/100 μm thick walls.

The 100 μm thick walls of **Dunlee anti-scatter grids** are thinner than an eggshell yet extremely resistant to heat and radiation. Dunlee is one of the first and, for over ten years, one of the only companies to focus on the additive manufacturing of **high-precision, pure tungsten parts** on an industrial scale.

Author: Dr. Jorrit Jorritsma, Anna-Maria Meyer

More than 10 years' experience in the 3D printing of tungsten parts

Anti-scatter grids (ASGs) used in Computed Tomography (CT) scanners were one of the first applications identified for the 3D printing of pure tungsten, over 10 years ago. CT scanners consist of an X-ray source facing an arc-shaped array of detectors. Ideally, each detector records the amount of X-ray photons that reach the detector after traveling along a straight-line

path from the X-ray source to the detector. However, objects positioned between the X-ray source and detector scatter some of the incident X-rays. The ASGs positioned in close proximity to the detectors shield them from the scattered radiation, thus improving image quality. Advancements in CT include higher image quality and lower doses. Moreover, there is a greater demand for higher-performing ASGs due to the larger patient coverage.

Exacting requirements in terms of and repeatability

By combining our CT application and 3D tungsten manufacturing knowledge, we were able to establish a stable volume production of large-area 2D tungsten ASGs with walls down to 100 μm in thickness and aspect ratios up to 300. While Dunlee's focus is still on expanding the manufacturing volume of high-precision, 3D-printed tungsten parts for the collimation of high-energy radiation targeting the CT/PET/SPECT market, new applications are also possible since this unique manufacturing capability allows the use of pure tungsten for the first time.

Stable volume production thanks to strong technology partnerships

The strong partnership with our 3D printer supplier, a well-established system builder in the additive manufacturing industry, forms the foundation. In 2007 the first DMLS printer was installed successfully for initial prototype tests, and eight printers equipped with fine detail resolution functionality are running 24/7 today. All our printers have been released for the mass production of high-accuracy tungsten parts. They exhibit a high level of beam quality and performance stability.

Final steps to achieving maximum accuracy

In addition to 3D printing machines, Dunlee has also invested heavily in post-processing and measurement equipment as well as in-house verification and validation to ensure short design cycles. The company's capabilities and expertise should not be underestimated as they are instrumental for quality assurance.

Summary: leading capabilities for the 3D printing of pure tungsten

The 3D printing of complex tungsten parts with feature sizes down to 100 μm on an industrial footprint is a very challenging process and requires advanced capabilities that only Dunlee is ready to offer:

- Special and advanced optics installed on all of our printers to focus the laser beam on a very small point
- Advanced post-processing methods including electrical discharge machining and wet chemical etching to make sure the dimensions and tolerances of the 3D-printed tungsten parts are within specification
- Dedicated tooling and tight process control for every critical process step
- Extensive process integration knowledge to better understand possible interactions among process steps and ways to minimize them
- Detailed knowledge of application requirements to be able to better understand and verify parameters that are critical to quality

In summary, Dunlee is the only supplier able to mass-produce 3D-printed pure tungsten parts with a high degree of accuracy. Since more and more highly specialized industries show great interest in this unique service, expansion of capacity and capabilities/service at Dunlee will be continued.



Figure 2: DMLS factory for mass-production of high-precision 3D-printed tungsten parts.

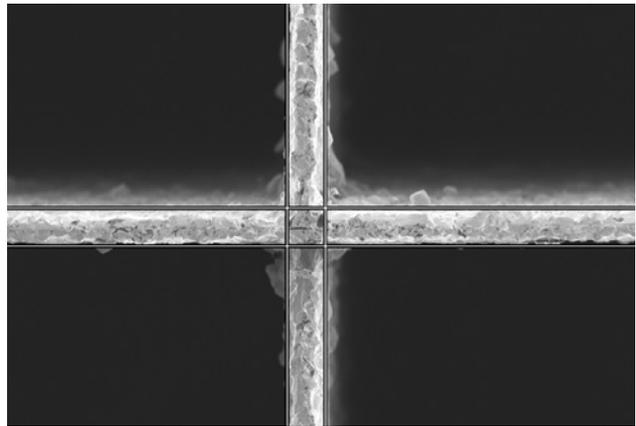


Figure 3: a close-up of a 3D-printed tungsten 2D ASG showing two intersecting tungsten walls of 100 μm in thickness.

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marketing.dunlee@philips.com
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Contact us for more information.

Philips Medical Systems Nederland B.V.
Tel.: +31 65 4784225 • sales.dunlee@philips.com
Veenpluis 6 • 5684 PC Best • The Netherlands

dunlee.com