

Cooling Helium-Based Process Gas for 3D Metal Printing



A SilcoTek® Case Study with:



The Objective:

A company specializing in laser powder bed fusion (LPBF) metal printing required a sanitary-type shell & tube heat exchanger to cool Helium-based process gas used in their advanced 3D printing process. The process gas, Helistar A1025, is a critical mixture comprising of 90% Helium, 7.5% Argon, 2.5% CO₂.

The solution needed to meet the precise cooling requirements of the printing operation, cooling the process gas from 110°C down to 20°C.

The Challenge:

1. Custom Connections and Cleaning Requirements: The customer specified the need for KF50 flanges along with a removable bundle to facilitate cleaning due to soot accumulation, a byproduct of their 3D printing process. Exergy's specific design and manufacturing process does not allow for a removable tube bundle, resulting in a solution that allowed for easy cleaning of the heat exchanger without the removal of a small-diameter tube bundle.
2. Uncertain Soot Properties: The customer lacked specific data on the soot characteristics but noted its tendency to agglomerate and coalesce on metal surfaces, posing risks to the exchanger's performance and cleanliness.
3. Material Compatibility and Process Integration: The heat exchanger needed to:
 - Resist fouling caused by the soot.
 - Offer surfaces that minimized soot adherence and facilitated cleaning.
 - Maintain compactness and seamless integration into the existing LPBF system.

The Solution:

Exergy provided a customized 73 Series shell & tube heat exchanger (p/n 05257-03) with the following features:

- 3-inch OD shell x 20-inch length, offering ample surface area (13.41 ft²) for efficient heat transfer while weighing just over 10 lbs.
- 316L stainless steel construction coated with Dursan®, providing:
 - Non-stick properties for reduced fouling and easy soot removal.
 - Enhanced corrosion resistance against the Helistar A1025 gas mixture.
 - Improved cleanability, minimizing downtime for maintenance.
- KF50 flanges for seamless integration with the customer's existing system setup.

The Results and Benefits:

In addition to increasing corrosion resistance, SilcoTek's Dursan coating drastically reduces the surface energy of stainless steel, rendering coated surfaces hydrophobic, non-stick, and much easier to clean. Non-stick properties can easily be measured by viewing a water droplet under magnification and measuring the angle between the flat metal surface and water droplet. Below is a comparison of untreated stainless steel and Dursan-coated stainless steel (Figure 1).

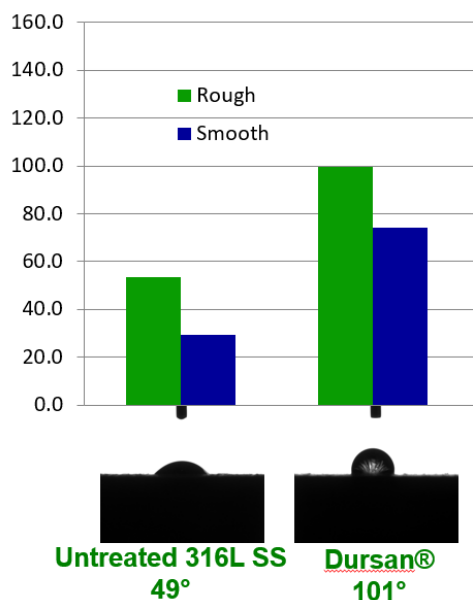


Figure 1. Water contact angle of 316L SS and Dursan.



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