

# X1 Metal 316i™

60% 316 Steel Infiltrated with 40% Bronze



ExOne's 3D printed X1 Metal 316i™ is a matrix material composed of 60% 316 steel infiltrated with 40% bronze. The lower yield strength of the material enables it to be easily machined and polished. This material also exhibits enhanced corrosion resistance properties.

## Applications

This material system has low magnetic properties which makes it particularly useful for applications in the food and medical industries. The copper alloy acts as a natural antibacterial agent making it easy to decontaminate printed parts. Since the matrix material is easy to polish, additional applications exist in bath and kitchen hardware prototypes and low volume production.

## Composition

Stainless Steel: Alloy 316

Bronze: 90% Cu / 10% Sn

## Printing

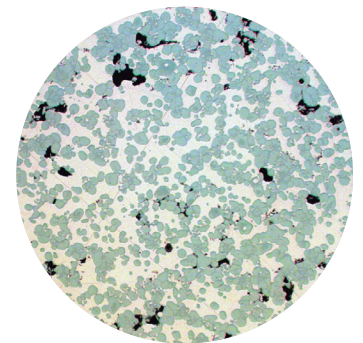
Using binder jetting technology, ExOne's state-of-the-art 3D printing machines produce parts directly from 3D CAD models by precisely controlling the jetting of binder onto a powder bed, and then subsequently spreading new layers of powder. This process is repeated until the part is completed. This 3D printing process offers increased design flexibility, reduced manufacturing cost and shortened lead times.

## Post Processing

After printing is complete, the parts are cured in an oven, which enables the parts to be handled. After curing, the parts are sintered and infiltrated with bronze above 1100°C. Cool down can be varied to control the machinability and hardness of the material.



Printed part



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## Typical Material Properties

Material Properties	Test Method	X1 Metal 316i™
Tensile Strength		
Ultimate Strength		84 ksi (580 MPa)
Yield Strength (0.2% offset)	ASTM E8	41 ksi (283 MPa)
Elastic Modulus		19.5 Mpsi (135 GPa)
Elongation		14.5%
Hardness	ASTM E18	60 HRB
Fractional Density		95%+ approximate
Density	MPIF 42	0.284 lbs/in <sup>3</sup> (7.86 gm/cm <sup>3</sup> )
Machinability		Conventionally machinable
Weldability		Use silicone bronze rod & TIG weld
Thermal Conductivity (Room Temp.)		11 BTU/hr ft <sup>2</sup> °F (19 W/m °K)
Specific Heat (at 600 °C)	ASTM E1269-11	0.131 BTU/lb °F (548 J/kg °K)
Thermal Expansion Coefficient at 600 °C	ASTM E831-14	10.37 x 10 <sup>-6</sup> / °F (18.6 x 10 <sup>-6</sup> / °K)

Note: Typical expected properties.

## Surface Finish

After sintering:  $\approx 600 \mu\text{in } R_a$  (15  $\mu\text{m } R_a$ )

Bead blasting:  $\approx 300 \mu\text{in } R_a$  (7.5  $\mu\text{m } R_a$ )

Barrel finishing:  $\approx 50 \mu\text{in } R_a$  (1.25  $\mu\text{m } R_a$ )



After Sintering



Bead Blasting



Barrel Finishing

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Corporate Headquarters  
The ExOne Company  
Pennsylvania, USA  
[americas@exone.com](mailto:americas@exone.com)  
+1 877 773 9663

European Headquarters  
ExOne GmbH  
Gersthofen, Germany  
[europe@exone.com](mailto:europe@exone.com)  
+49 821 65063-0

Asian Headquarters  
ExOne KK  
Kanagawa, Japan  
[asia@exone.com](mailto:asia@exone.com)  
+81 465 44 1303