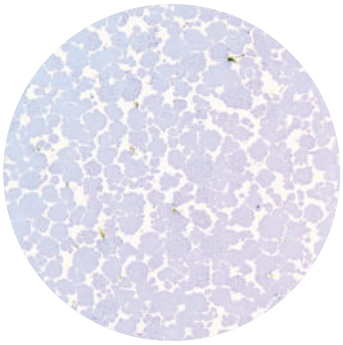
420 Stainless Steel Infiltrated with Bronze

ExOne™ DIGITAL PART MATERIALIZATION

ExOne's 3D Printed 420 Stainless Steel infiltrated with Bronze is a matrix material composed of 60% stainless steel and 40% bronze infiltrant. This material offers good mechanical properties, is available in both an annealed and non-annealed condition, is able to be machined, welded and polished, and offers excellent wear resistance.



420 SS / Bronze

Applications

This material system is ideally suited for parts exposed to highly abrasive environments such as pump components, and parts for down-hole drilling and mining equipment. Additional applications include industrial components, molds, tooling, art objects and decorative hardware.

Printed part

Composition

Stainless Steel: Alloy 420
Bronze: 90% Cu / 10% Sn

Printing

Using binder jetting technology, ExOne's state-of-the-art 3D Printing machines produce parts directly from 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.

Typical Material Properties

Material Propertes	Test Method	420SS / Bronze	
		Annealed	Non-Annealed
Tensile Strength	ASTM E8		
Ultimate Strength		72 ksi (496 MPa)	99 ksi (682 MPa)
Yield Strength (0.2% offset)		62 ksi (427 MPa)	66 ksi (455 MPa)
Elastic Modulus		21.4 Mpsi (147 GPa)	21.4 Mpsi (147 GPa)
Elongation		7.0%	2.3%
Hardness	ASTM E18	93 HRb	97 HRb
Fractional Density	MPIF 42	95%+	95%+
Density		0.284 lbs/in^3 (7.86 g/cm^3)	0.284 lbs/in^3 (7.86 g/cm^3)
Machinability		Conventionally machinable	Refer to ExOne for recommendations
Weldability		Use silicone bronze rod & TIG weld	Use silicone bronze rod & TIG weld
Thermal Conductivity	ASTM E1530	13 BTU/hr ft °F (22.6 W/m°K)	13 BTU/hr ft °F (22.6 W/m°K)
Specific Heat	ASTM E1263	0.114 BTU/lb °F (478 J/kg°K)	0.114 BTU/lb °F (478 J/kg°K)
Thermal Expansion Coefficient	ASTM E228	7.4 x 10^{-6}/°F (13.4 x 10^{-6}/°K)	7.4 x 10^{-6}/°F (13.4 x 10^{-6}/°K)

Surface Finish

After sintering: ≈ 600 µin R_a (15 µm R_a)
Bead blasting: ≈ 300 µin R_a (7.5 µm R_a)
Barrel finishing: ≈ 50 µin R_a (1.25 µm R_a)

Printed part, raw finish

Printed part, polished

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