



LaserForm[®] CoCr (B)

Cobalt-chromium-molybdenum alloy fine-tuned for use with DMP Flex 100, DMP Flex 200, ProX[®] DMP 200 and ProX[®] DMP 300 metal printers producing industrial parts with high corrosion and wear resistance that also require high temperature resistance. In addition to various industrial applications, LaserForm CoCr (B) is also suitable for medical applications.

LaserForm CoCr (B) is formulated and fine-tuned specifically for 3D Systems DMP Flex 100, DMP Flex 200, ProX[®] DMP 200 and ProX[®] DMP 300 metal 3D printers to deliver high part quality and consistent part properties. The print parameter database that 3D Systems provides together with the material has been extensively developed, tested and optimized in 3D Systems' part production facilities that hold the unique expertise of printing 500,000 challenging metal production parts in various materials year over year. For a 24/7 production operation 3D Systems' thorough Supplier Quality Management System guarantees consistent, monitored material quality for reliable process results.

Material Description

Cobalt-chromium-molybdenum alloys are known for their high strength and hardness and retain these properties even at elevated temperatures. In addition, they spontaneously form a protective passive film, which makes LaserForm CoCr (B) both corrosion resistant and biocompatible.

These benefits make LaserForm CoCr (B) the ideal material for dental crowns, bridges and removable partial dentures (RPD), for medical tools and devices, molds and dies, industrial, high wear applications and parts requiring high strength at elevated temperatures.

Classification

The chemical composition of LaserForm CoCr (B) conforms to the requirements of the ISO 5832-4 and ISO 22674 and is indicated in the table below in % of weight.

Mechanical Properties

| MEASUREMENT | CONDITION | METRIC | | | U.S. | | |
|---|-----------|-------------------------|--------------------------------------|-------------------------------------|------------------------------|--------------------------------------|-------------------------------------|
| | | AS-BUILT ^{1,2} | AFTER SOLUTION ANNEAL ^{1,2} | AFTER STRESS RELEASE ^{3,4} | AS-BUILT ^{1,2} | AFTER SOLUTION ANNEAL ^{1,2} | AFTER STRESS RELEASE ^{3,4} |
| Young's modulus (GPa ksi) | ASTM E8M | | | | | | |
| Horizontal direction - XY Vertical direction - Z | | 220 ± 40 170 ± 40 | 240 ± 40 220 ± 40 | 230 ± 20 180 ± 40 | 31900 ± 5800 24700 ± 5800 | 34800 ± 5800 31900 ± 5800 | 33600 ± 3100 26700 ± 5100 |
| Ultimate strength (MPa ksi) | ASTM E8M | | | | | | |
| Horizontal direction - XY Vertical direction - Z | | 1150 ± 80 1090 ± 40 | 1050 ± 50 1040 ± 50 | 1180 ± 110 1080 ± 70 | 165 ± 12 160 ± 6 | 150 ± 7 150 ± 7 | 170 ± 15 155 ± 10 |
| Yield strength Rp0.2% (MPa ksi) | ASTM E8M | | | | | | |
| Horizontal direction - XY Vertical direction - Z | | 840 ± 80 630 ± 40 | 590 ± 40 570 ± 40 | 930 ± 100 750 ± 50 | 120 ± 12 90 ± 6 | 85 ± 6 85 ± 6 | 135 ± 15 110 ± 10 |
| Elongation at break (%) | ASTM E8M | | | | | | |
| Horizontal direction - XY Vertical direction - Z | | 6 ± 2 15 ± 4 | 33 ± 6 35 ± 6 | 12 ± 4 16 ± 6 | 6 ± 2 15 ± 4 | 33 ± 6 35 ± 6 | 12 ± 4 16 ± 6 |
| Reduction of area (%) | ASTM E8M | | | | | | |
| Horizontal direction - XY Vertical direction - Z | | 13 ± 8 19 ± 8 | 31 ± 6 32 ± 6 | 13 ± 7 17 ± 5 | 13 ± 8 19 ± 8 | 31 ± 6 32 ± 6 | 13 ± 7 17 ± 5 |
| Hardness, Rockwell C | ASTM E18 | 32 ± 5 | 26 ± 5 | 39 ± 7 | 32 ± 5 | 26 ± 5 | 39 ± 7 |

¹ Parts manufactured with standard parameters on DMP Flex 100 and ProX[®] DMP 200

² Values based on average and double standard deviation

³ Parts manufactured with standard parameters on DMP Flex 200

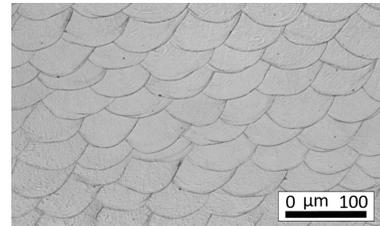
⁴ Values based on average and 95% tolerance interval with 95% confidence



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Thermal Properties⁵

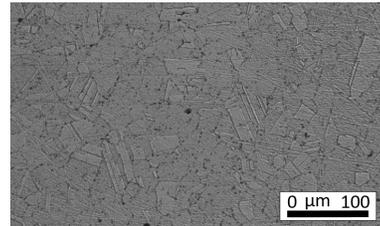
| MEASUREMENT | CONDITION | METRIC | U.S. |
|---|---------------------------------|-------------|-------------|
| Thermal conductivity (W/(m.K) Btu/(h.ft.°F)) | at 20°C / 120 °F | 14 | 8 |
| CTE - Coefficient of thermal expansion (µm/(m.°C) µ inch/(inch . °F)) | in the range of 20 to 600 °C | 14 | 7.8 |
| Melting range (°C °F) | | 1350 - 1430 | 2460 - 2610 |



Microstructure as built

Electrical Properties⁵

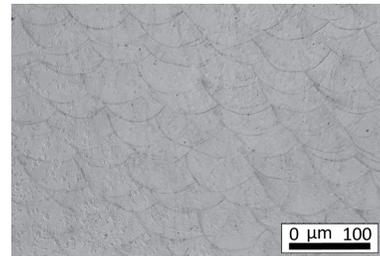
| MEASUREMENT | METRIC | U.S. |
|--|--------|-------|
| Electrical resistivity (µΩ.m µΩ.in) | 0.87 | 34.41 |



Microstructure after solution anneal

Physical Properties

| MEASUREMENT | METRIC | U.S. |
|---|--------|-------|
| Density | | |
| Relative, based on pixel count ⁶ (%) | >99 | |
| Absolute, theoretical ⁵ (g/cm ³ lb/in ³) | 8.30 | 0.300 |



Microstructure after stress release

Chemical Composition

| ELEMENT | % OF WEIGHT |
|---------|-------------|
| Co | Bal. |
| Cr | 28.00-30.00 |
| Mo | 5.00-6.00 |
| Ni | 0.00-0.10 |
| Fe | 0.00-0.50 |
| C | 0.00-0.02 |
| Si | 0.00-1.00 |
| Mn | 0.00-1.00 |
| Cd | 0.00-0.02 |
| Be | 0.00-0.02 |
| Pb | 0.00-0.02 |

⁵ Values based on literature

⁶ Parts manufactured with standard parameters on a DMP Flex 100, DMP Flex 200 and ProX[®] DMP 200



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Warranty/Disclaimer: The performance characteristics of these products may vary according to product application, operating conditions, or with end use. 3D Systems makes no warranties of any type, express or implied, including, but not limited to, the warranties of merchantability or fitness for a particular use.

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