

# Material Product Data Sheet

## 415 Martensitic Stainless Steel Powder for Additive Manufacturing

### Powder Products: MetcoAdd 415 Series

#### 1 Introduction

MetcoAdd™ 415 is a family of soft-martensitic stainless steel powders with chemistry similar to 1.4313 / X3CrNiMo 13-4 according to DIN EN 10088 or AISI 415 or UNS S41500.

This material composition has basic pitting and crevice corrosion resistance, moderate sulphide stress cracking resistance and better toughness than most martensitic grades. The combination of good corrosion resistance and excellent strength and toughness makes it a perfect candidate for mechanically highly stressed components in wet corrosive environments. The material is ferromagnetic. The recommended operating temperature ranges from -60 °C to 300 °C (-75 to 570 °F).

For reference purposes, Oerlikon has processed MetcoAdd 415F and MetcoAdd 415G powders at partner customers using corresponding standard machines and processing parameters to provide the data in section 3: Key Processing Information. The properties may be optimized based on application-specific requirements and corresponding further parameter development.

MetcoAdd 415F has been designed for use in Laser Powder Bed Fusion (PBF-LB) processing while MetcoAdd 415G is tailored for use with Directed Energy Deposition (DED) systems.

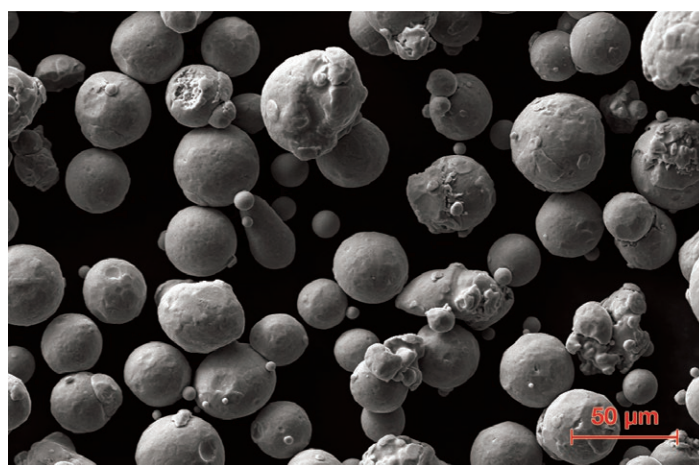
#### 1.1 Typical Uses and Applications

- Power Generation: Components for hydro turbines and gas turbines
- Oil & Gas: Gas compressor components and valve bodies
- Industrial: Pump components and fittings

#### Quick Facts

Classification	Martensitic Stainless Steel, iron-based
Chemistry	Fe 13Cr 4Ni 0.5Mo 0.45Si 0.03C
Manufacture	Inert gas atomized (Argon)
Morphology	Spherical
Apparent Density	3.5 to 4.5 g/cm <sup>3</sup> (depending on size cut)
Solidus	1400 °C (2552 °F)
Liquidus	1450 °C (2642 °F)
Process	Laser Powder Bed Fusion (PBF-LB) Directed Energy Deposition (DED) <sup>a</sup> Electron Beam Melting (EBM) Kinetic Fusion Additive Manufacturing

<sup>a</sup> For additive manufacture printing build-up and/or repair only.



Typical photomicrograph MetcoAdd 415F gas-atomized powder that shows the spherical outer morphology of these products.

## 2 Material Information

### 2.1 Chemical Composition

Product	Weight Percent (nominal)						
	Fe	Cr	Ni	Mo	Si	C (max)	TAO <sup>a</sup> (max)
MetcoAdd 415F	Balance	13	4	0.5	0.45	0.03	0.3
MetcoAdd 415G	Balance	13	4	0.5	0.45	0.03	0.3

<sup>a</sup> TAO = Total All Others

### 2.2 Particle Size Distribution and Hall Flow

Product	Nominal Range (µm)	D90 (µm)	D50 (µm)	D10 (µm)	Hall Flow (s/50 g)
MetcoAdd 415F	-45 +15 µm	42 – 50	30 – 35	19 – 25	< 20
MetcoAdd 415G	-106 +45 µm	95 – 105	65 – 75	48 – 55	< 18

For the nominal size range, particle size analysis 45 µm or above measured by sieve (ASTM B214), analysis below 45 µm by laser diffraction (ASTM C 1070, Microtrac). Fractional analysis (D90, D50, D10) are nominal values by laser diffraction. Hall flow according to ASTM B213.

### 2.3 Key Selection Criteria

- Choose the product with the particle size distribution best suited for the additive manufacturing system that will be used.
- MetcoAdd 415F has been designed for use in PBF-LB systems.
- MetcoAdd 415F might also be used for additive manufacturing using kinetic fusion.
- MetcoAdd 415G has been optimized for use with the DED process and might also be used in the EBM process.

### 2.4 Related Products

- Oerlikon Metco offers a number of other steel powders for additive manufacturing applications, including 15-5PH, 17-4PH, Type 316L stainless steels, maraging steels and hot-work tools steels.
- We also offer other Ni, Co, Fe and Ti alloy powders for additive manufacturing that have been optimized for either powder-fed or powder-bed processes. Please contact your Oerlikon Metco Account Representative for more information.
- Oerlikon Metco can produce MetcoAdd 415 series powders in other particle size distributions upon request for large volume users.

### 2.5 Specifications

Product	Specification (similar to)
MetcoAdd 415 series	DIN EN 1.4313 / X3CrNiMo 13-4 UNS S41500

### 3 Key Processing Information

#### 3.1 Typical Heat-Treated Properties (MetcoAdd 415G, MetcoAdd 415F) at Room Temperature <sup>a,b,c</sup>

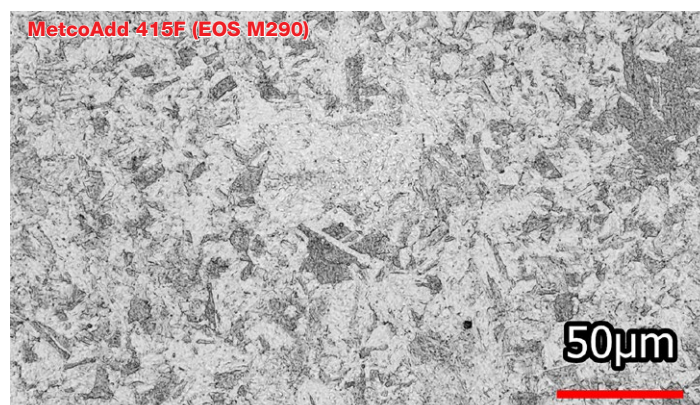
Specification		DED Process MetcoAdd 415G	PBF-LB Process MetcoAdd 415F
Ultimate Tensile Strength (MPa),	ISO 6892-1	--- / 773 (Z)	790 (XY) / 800 (Z)
Yield Strength (MPa)	ISO 6892-1	--- / 734 (Z)	730 (XY) / 740 (Z)
Elongation at break (%)	ISO 6892-1	--- / 15 (Z)	21 (XY) / 21 (Z)
Hardness (HRC)	ISO 6508	29	23
Charpy Notch Impact (J)	ISO 148-1	--- / 31 (Z)	119 (XY) / 114 (Z)

<sup>a</sup> Data is shared for reference purposes only and is not sufficient to design or certify parts. No warranty or guarantee is made or implied for these results.

<sup>b</sup> Heat treatment prior to testing was 1040 °C ( 1900 °F) held for 3.5 h and rapid air cooled. Tempering at 590 °C (1090 °F) for 5 h and air cooled.

<sup>c</sup> DED processing of MetcoAdd 415G was performed on a DMG Mori Lasertec 65 3D by Sulzer AG, Zürich, Switzerland; PBF-LB processing of MetcoAdd 415F was performed on an EOS M290 with 50 µm layer thickness by AM Metals GmbH, Halsbrücke, Germany.

#### 3.2 Post Heat Treatment, Vertical Build Direction



#### 3.3 Processing Recommendations

- Due to the ferritic / martensitic nature of the MetcoAdd 415 family of materials, processing should always be carried out at elevated temperatures above 150 °C (300 °F) by corresponding heating of the build platform in PBF-LB processes or heating of the previously deposited layers in the DED process.
- The properties, particularly the toughness and ductility of printed structures built using MetcoAdd 415G in the DED process can be further optimized by minimizing the ingress of air and/or oxygen during the build process.

#### 3.4 Additive Manufacturing Services

Oerlikon AM is an excellent source for pilot and production run additive manufacturing services and is ready to serve your needs. Please contact your Oerlikon Metco account manager for more information or contact Oerlikon AM directly through their web site at [www.oerlikon.com/am](http://www.oerlikon.com/am).

### 4 Commercial Information

#### 4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
MetcoAdd 415F	2280143	5 kg (approx. 11 lb)	Stock	Global
MetcoAdd 415G	2280144	5 kg (approx. 11 lb)	Stock	Global

#### 4.2 Handling Recommendations

- Blend contents prior to use to prevent segregation.
- Store in the original container or an approved alternative that is tightly closed.
- Powder from previously opened containers should be stored in a humidity-controlled environment.

#### 4.3 Safety Recommendations

See the SDS 50-2785 (Safety Data Sheet) in the localized version applicable to the country where the material will be used. SDS are available from the Oerlikon web site at [www.oerlikon.com/metco](http://www.oerlikon.com/metco) (Resources – Safety Data Sheets).