oerlikon
metco

Material Product Data Sheet
Cobalt Molybdenum Chromium Silicon (Tribaloy) Alloy Powders

Thermal Spray Powder Products:
Diamalloy 3001, Metco 68F-NS-1,
Metco 4800, Diamalloy 3002NS,
Metco 66F-NS

1 Introduction

Diamalloy™ 3001, Diamalloy 3002NS, Metco™ 66F-NS, Metco 68F-NS-1 and Metco 4800 are cobalt alloys containing molybdenum, chromium and silicon. Their good coating properties result from the formation of hard precipitates (cobalt-molybdenum-silicon based intermetallic Laves phases) that are dispersed in a softer cobalt-based alloy matrix. These alloys have compositions similar to Tribaloy T-400 (Diamalloy 3002NS and Metco 66F-NS) and Tribaloy T-800 (Diamalloy 3001, Metco 68F-NS-1 and Metco 4800). They differ metallurgically from typical cobalt-chromium-tungsten alloys that are hard because of carbides within their structures.

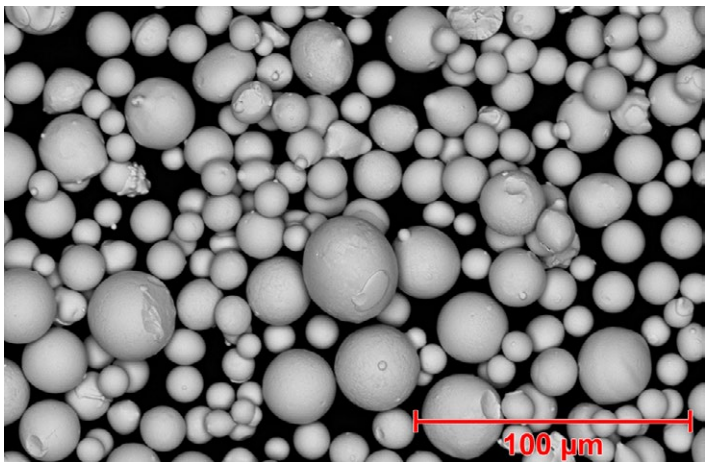
The coatings exhibit unique corrosion resistance, oxidation resistance, excellent abrasive wear resistance and high service temperature capability with good hot hardness. Coatings exhibit a low coefficient of friction particularly suitable where lubrication is low or non-existent.

Diamalloy products are sized for application using HVOF while the Metco products are sized for plasma spray. Metco 4800 is appropriate for both HVOF and plasma spray. Coating properties depend strongly on the volume percentage of Laves phases. Subsequent heat treatment (annealing) at high temperature improves coating properties substantially.

1.1 Typical Uses and Applications

- Coatings are hard with good corrosion resistance in acidic media and good oxidation resistance in air up to relatively high temperatures.
- Coatings exhibit excellent galling and wear resistance and even resist fretting with inadequate lubrication.
- Excellent tribological performance when rubbing against itself, stainless steel, gray cast iron, aluminum, superalloys and hard chromium plated surfaces.
- Applications include pump components, gas turbine applications to combat fretting, landing gears, ball and roller bearings, sleeve bearings, journal bearings, piston rings, camshafts, high and low pressure nozzles, valve seats, valve faces and exhaust fan blades.

Quick Facts	
Classification	Alloy, cobalt based
Chemical formula	CoMoCrSi
Manufacture	Atomized
Morphology	Irregular or spheroidal
Apparent density	3.3 – 5.1 g/cm^3
Melting range	1230 – 1600 °C (2246 – 2912 °F)
Purpose	Corrosion, oxidation and wear protection over a wide range of temperatures
Process	Atmospheric plasma spray or HVOF



SEM photomicrographsof Metco 4800, a gas atomized product with a tailored, tightly controlled particle size distribution.

2 Material Information

2.1 Chemistry

Product	Nominal Chemical Composition (wt. %)				Similar To
	Co	Mo	Cr	Si	
Diamalloy 3001	Balance	28.5	17.5	3.4	Tribaloy T-800
Metco 68F-NS-1	Balance	28.5	17.5	3.4	Tribaloy T-800
Metco 4800	Balance	28.5	17.5	3.4	Tribaloy T-800
Diamalloy 3002NS	Balance	28.5	8.5	2.6	Tribaloy T-400
Metco 66F-NS	Balance	28.5	8.5	2.6	Tribaloy T-400

2.2 Particle Size Distribution, Manufacturing Method and Morphology

Product	Nominal Particle Size Distribution (µm)	Apparent Density (g/cm^3)	Manufacturing Method	Morphology	Recommended Coating Process
Diamalloy 3001	–45 +5.5		Gas Atomized	Spheroidal	HVOF
Metco 68F-NS-1	–45 +10	5.1	Gas Atomized	Spheroidal	APS
Metco 4800	–45 +10	4.8	Gas Atomized	Spheroidal	HVOF or APS
Diamalloy 3002NS	–45 +5.5	3.3	Water Atomized	Irregular	HVOF
Metco 66F-NS	–45 +10		Water Atomized	Irregular	APS

Upper particle size analysis via sieve, lower particle size analysis via laser diffraction (Microtrac), except Diamalloy 3001, for which the entire analysis is via laser diffraction.
APS = Atmospheric Plasma Spray; HVOF = High Velocity Oxy-Fuel Spray

2.3 Key Selection Criteria

- Choose the product sized for the desired spray process and that meets the required customer material and process specifications.
- HVOF-applied coatings of Diamalloy 3001 and Diamalloy 3002NS have higher macrohardness, microhardness, bond strength and apply with higher deposit efficiencies compared to their APS-applied respective counterparts of Metco 68F-NS-1 and Metco 66F-NS.
- Metco 4800 can be applied by either HVOF or atmospheric plasma spray. It has a tightly controlled, tailored particle size distribution that offers a unique alternative to the other products discussed above. It is recommended as the preferred choice for new coating applications.
- Good oxidation resistance, up to 760 °C (1400 °F) in air, can be achieved using Diamalloy 3002NS or Metco 66F-NS.
- For the highest oxidation temperatures, up to 980 °C (1800 °F), Metco 4800, Diamalloy 3001 or Metco 68F-NS-1 are the best choices because of their higher chromium content.
- All of these materials offer good corrosion resistance in most acidic and saline environments; however, for the best corrosion resistance in these environments with better as-sprayed wear resistance, choose Metco 4800, Diamalloy 3001 or Metco 68F-NS-1.

2.4 Related Products

- Oerlikon Metco's family of Stellite-type products such as Amdry X40, Metco 45C-NS , Metco 45VF-NS, Amdry MM509 and Diamalloy 4060NS produce dense, well-bonded coatings that resist oxidation and high temperature wear. They can often be used in applications that are similar to Tribaloy-type materials.
- Coatings of Diamalloy 4006 and Metco 700 [NiCrWMo] offer sliding wear and corrosion protection up to 875 °C (1600 °F). Coatings resist scuffing and galling.
- Coatings of products such as WOKA 31XX series [WC 12Co] and WOKA 32XX series [WC 17Co], as well as other Metco, Amdry and Diamalloy products in our portfolio have higher hardness and better wear resistance. However, these materials can only be used at service temperatures up to 500 °C (930 °F) and do not offer corrosion resistance that is as good as the Tribaloy-type materials.
- Products such as WOKA 36XX series, Amdry 5843, Diamalloy 5849, Diamalloy 5847-1, Oerlikon Metco 5847 and Oerlikon Metco 5842 [WC 10Co 4Cr] are recommended for applications below 500 °C (930 °F) where both wear and corrosion resistance are required. The cobalt-chromium matrix provides higher corrosion resistance than cobalt matrixes.
- If wear and oxidation resistance at temperatures up to 800 °C (1470 °F) is required, products such as WOKA 71XX, WOKA 72XX OR WOKA 73XX products (Cr_3C_2-NiCr) are recommended. Coatings of these materials have good corrosion resistance in chloride, acidic and alkaline environments.
- For excellent high temperature oxidation and corrosion resistance, but very limited wear resistance, choose nickel-chromium based superalloys such as Amdry 713C, Amdry 718, Amdry 718 Cl.B, Amdry 1718, Diamalloy 1005, Diamalloy 1006 or Diamalloy 1006-1. These products have chemistries similar to Inconel alloys.
- Amdry 963, Amdry 962, Amdry 964, Amdry 9621, Amdry 9624 and Amdry 9625 are MCrAlY materials that are usually used in aerospace applications as protective coatings that resist hot corrosion or oxidizing environments at high temperatures, such as hot section gas turbine blades and vanes.
- For fretting applications where it is only possible to coat one part, Amdry 958 or Metco 56NS are good choices.

2.5 Customer Specifications

Product	Approved Specifications [a]	Fulfills Requirements [b]
Diamalloy 3001	GE B50TF190, Cl A	Volvo PM 819-15
Metco 68F-NS-1	Avio 4800M/25 CFM International CP 6021 (by work order only) GE B50TF190, Cl A GE Std. Prac. C07-031 GKN Aerospace PM 819-15 Honeywell EMS 52432, Cl XV Rolls-Royce Corporation EMS 56713 Rolls-Royce plc RRMS 40025	
Metco 4800	GE B50A939A GE B50TF190, Cl A (for F50TF69 only) Jet Avion 13003 Siemens DGTLV 511133001 Ind. C Sec. 6	
Diamalloy 3002NS	SAE International AMS 2447-2	GE B50A918
Metco 66F-NS	CFM International CP 6020 GE B50TF155, Cl A GKN Aerospace PM 819-62 Honeywell EMS 52432, Cl XVI Rolls-Royce Corporation EMS 56712 Rolls-Royce Corporation PMI 132 Rolls-Royce plc RRMS 40024	

[a] Oerlikon Metco can provide certification that the product meets these approved specifications
[b] Material fulfils these specifications but is not approved for certification

3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification		Diamalloy 3001	Metco 66F-NS	Diamalloy 3002NS	Metco 68F-NS-1
Recommended Process		HVOF (Gas or Liquid Fuel)	APS	HVOF (Gas Fuel)	APS
Macrohardness	HRC	50 – 55	40	44 – 57	45
Microhardness	HV0.3	600 – 650	450	500 – 700	525
Coating Density	g/cm^3	7.5	7.5	7.5	7.5
Coating Porosity [a]	vol. %	Negligible	< 5	Negligible	< 5
Oxide Content	vol. %	Varies with spray parameters	< 2	Varies with spray parameters	< 2
Bond Strength [b]	MPa psi	65 9425	48 6975	68 9850	45 6525
Microstructure Characteristics		Hard Laves phases in a softer cobalt-based matrix			
Abrasion Resistance [c]	%	82	N.R.	80	N.R.
Coating Weight	kg/m^2/0.1 mm lb/ft^2/0.001 in	0.74 0.038	0.74 0.038	0.74 0.038	0.74 0.038
Surface Roughness As sprayed	µm Ra µin Ra	5 – 9 200 – 350	5 – 9 200 – 350	5 – 9 200 – 350	5 – 9 200 – 350
Spray Rate	g/min lb/h	23 3	N.R.	15 – 30 2 – 4	N.R.

All reported values are nominal based on standard spray conditions and parameters.
N.R. = not reported

[a] Post coat heat treatment at 1175 °C (2150 °F) for 5 min improves decreases or almost eliminates coating porosity and improves coating wear properties
[b] On low carbon steel substrates
[c] In aluminum oxide/water slurry normalized against fused coatings of Metco 15E (NiCrBSiFe)

3.2 Finishing Information

Coatings can ground or ground and lapped. Good finishes have been obtained by wet grinding using 60 grit silicon carbide wheels. No expensive diamond-based wheels are required.

Grinding Process	Grinding Parameter	Typical Data	
Cylindrical Grinding	Wheel Speed	1680 – 1980 m/min	5500 – 6500 ft/min
	Work Speed – Roughing	15 – 20 m/min	50 – 70 ft/min
	Work Speed – Finishing	20 – 30 m/min	70 – 100 ft/min
	Traverse – Roughing	6 – 13 mm	0.25 – 0.50 in
	Traverse – Finishing	2.0 – 4.3 mm	0.08 – 0.17 in
Surface Grinding	Wheel Speed	1680 – 1980 m/min	5500 – 6500 ft/min
	Cross Feed – Roughing	1.5 – 3.3 mm	0.06 – 0.13 in
	Cross Feed – Finishing	0.5 – 0.8 mm	0.02 – 0.03 in
	Table Speed	12 – 30 m/s	40 – 100 ft/min

3.3 Coating Parameters

Please contact your Oerlikon Metco Account Representative for parameter availability. For specific coating application requirements, the services of Oerlikon Metco's Coating Solution Centers are available.

Recommended Spray Guns		
HVOF Gas Fuel	**HVOF Liquid Fuel**	**Atmospheric Plasma**
DiamondJet series	WokaJet series	Metco 9MB series
	WokaStar series	Metco 3MB series
		Metco F4 series
		TriplexPro series

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Diamalloy 3001	1000792	5 lb (approx. 2.25 kg)	Stock	Global
Metco 68F-NS-1	1000568	5 lb (approx. 2.25 kg)	Stock	Global
Metco 4800	1079452 2356203	5 lb (approx. 2.25 kg) 40 lb (approx 18 kg)	Stock Special Order	Global Global
Diamalloy 3002NS	1000806	5 lb (approx. 2.25 kg)	Special Order	Global
Metco 66F-NS	1000442	5 lb (approx. 2.25 kg)	Stock	Global

4.2 Handling Recommendations

- Store in the original container in a dry location.
- Open containers should be stored in a drying oven below 38°C (100 °F) to prevent moisture pickup.
- Tumble contents prior to use to prevent segregation.

4.3 Safety Recommendations

See the SDS (Safety Data Sheet) in the version localized for the country where the material will be used. SDS are available from the Oerlikon web site at www.oerlikon.com/metco (Resources – Safety Data Sheets).

Product	SDS
Diamalloy 3001	50-320
Metco 68F-NS-1	50-320
Metco 4800	50-320
Diamalloy 3002NS	50-244
Metco 66F-NS	50-244

www.oerlikon.com/metco
info.metco@oerlikon.com