

Material Product Data Sheet

Nickel Chromium Tungsten Molybdenum Superalloy Powders

Thermal Spray Powder Products: Diamalloy 4006, Diamalloy 4276

1 Introduction

Diamalloy™ 4006 is a nickel-based superalloy powder containing a substantial amount of glassy phases in the sprayed coatings that impart a combination of high wear and corrosion resistance. While many thermal spray materials produce coatings that protect metallic substrates from wear or corrosion at higher temperatures, most do not excel at both. Diamalloy 4006 is unique in that respect, fulfilling a significant need for several applications.

The glassy (amorphous/microcrystalline) alloy phases in coatings of Diamalloy 4006 result from tailored additions of refractory metals (molybdenum and tungsten) and metalloids (boron and carbon) in the powder. This imparts excellent resistance to abrasion, sliding wear, scuffing and galling to the coatings, in addition to providing corrosion resistance in aqueous acidic and alkaline mediums.

Diamalloy 4276 is a nickel-based superalloy powder, similar to Hastelloy C276, that produces coatings with superior corrosion resistance. Optimized for HVOF application, coatings of Diamalloy 4276 are among the most versatile for corrosion control. They resist crevice corrosion, pitting and wide range of media, including sulfuric acid and chlorine.

1.1 Typical Uses and Applications

Diamalloy 4006:

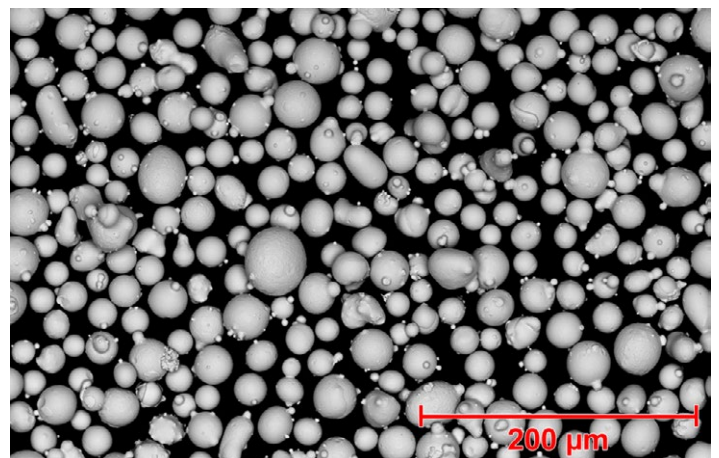
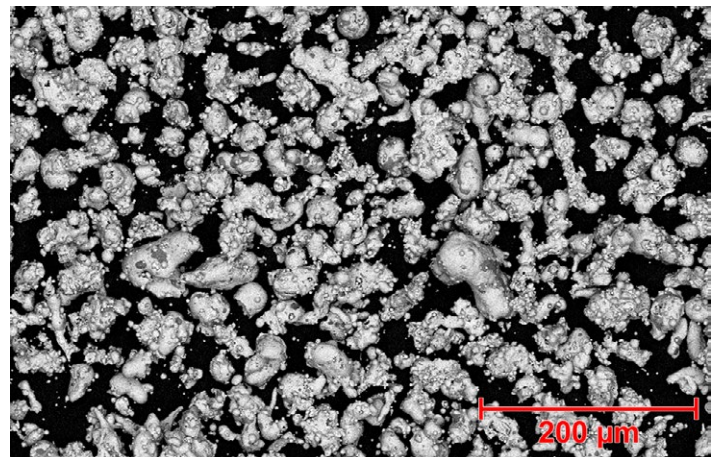
- Sliding wear and corrosion protection with high hot hardness; resists scuffing and galling
- Oxidation resistance up to 980 °C (1800 °F)
- Corrosion and wear resistance up to 875 °C (1600 °F)
- Petrochemical applications: pump plungers, liners, sleeves, compressor rods
- Chemical processing applications: gate valves, pump components, plungers, compressor rods
- Pulp and paper manufacture: digesters, liquor tanks
- Gas turbine applications: ducts, bleed manifold rings
- Rocket engine components

Diamalloy 4276:

- Corrosion resistant bond coat for paper and printing roll applications
- Resists crevice corrosion and pitting; sulfuric acid and chlorine environments

Quick Facts

Classification	Alloys, nickel-based
Chemistry	NiCrWMo
Manufacture	Gas or water atomized
Morphology	Irregular or spheroidal
Purpose	Wear and corrosion protection
Service Temperature	
Oxidation:	≤ 980 °C (1800 °F)
Corrosion & Wear:	≤ 875 °C (1600 °F)
Process	HVOF



Top: Morphology of water-atomized Diamalloy 4006 Bottom: Morphology of gas-atomized Diamalloy 4276

2 Material Information

2.1 Chemical Composition

Product	Chemical Composition (nominal wt. %)							
	Ni	Cr	W	Mo	Cu	Fe	C	B
Diamalloy 4006	Bal.	20.5	10.0	9.0	4.0	< 1.0	0.75	0.75
Diamalloy 4276	Bal.	15.5	4.5	16.0	---	4.0	---	---

2.2 Particle Size Distribution and Other Characteristics

Product	Nominal Particle Size Distribution (µm)	Morphology	Manufacturing Method
Diamalloy 4006	-53 +11	Irregular	Water Atomized
Diamalloy 4276	-53 +20	Spheroidal	Gas Atomized

Particle size equal to or above 45 µm determined by sieve analysis; below 45 µm by laser diffraction (Microtrac)

2.3 Key Selection Criteria

- Choose Diamalloy 4006 for applications where the glassy, amorphous phases in the coating are desired for additional wear or scuff resistance, or resistance to alkaline environments.
- Diamalloy 4276 is similar in chemical composition to Hastelloy C276. Coatings of this material exhibit excellent corrosion protection in a wide range of mediums and applications.

2.4 Related Products

The following NiCr alloy products are primarily intended for oxidation and corrosion resistant applications, but not wear applications. The exception is Metco 4538 which features oxidation resistance and hardness.

- Metco 4538 [Ni 22Fe 16Cr 1.5Si] produces hard coatings that can be used for heat and oxidation resistance at service temperatures up to 1000 °C (1850 °F).
- Amdry 625, Amdry 713C, Amdry 718, Amdry 718 Cl.B, Amdry 1718, Diamalloy 1005 and Diamalloy 1006 are nickel chromium based superalloys similar to Inconel 625, Inconel 713C and Inconel 718. Coatings of these materials have excellent high temperature oxidation and corrosion resistance for restoration and repair of superalloy substrates.
- Metco 44 [Ni 16Cr 8Fe] produces machinable “stainless” coatings useful for salvage and build-up applications on corrosion-resistant steels, nickel or nickel alloy substrates where high hardness is not required.
- Diamalloy 4004NS [Ni 14Cr 9.5Co 5Ti 4Mo 4W 3Al] is similar to Rene 80. Coatings are oxidation and corrosion resistant up to 1000 °C (1850 °F). Applications include

surface restoration of various worn or damaged turbine hot section components.

- Amdry 961, Amdry 962, Amdry 964, Amdry 9621, Amdry 9624 and Amdry 9625 products [NiCrAlY or NiCoCrAlY] produce coatings generally used in aerospace applications and generally post-coat diffusion heat treated. They are effective in hot corrosive or oxidizing environments at high temperatures, such as to protect gas turbine blades or vanes, and as oxidation resistant bond coats for thermal barrier coating systems.
- Metco 442 [NiCrAlMoSiBF₂FeTiO₂] produce hard “stainless” type, self-bonding coatings with excellent wear resistance and very good corrosion and oxidation resistance.
- Metco 444 [NiCrAlMoFe] produces coatings that are self-bonding, machinable with excellent resistance to oxidation and corrosion.
- Metco 461NS [NiCrAlCoY₂O₃] produces coatings that are self-bonding, oxidation and corrosion resistant that can be used at temperatures up to 980 °C (1800 °F). It is recommended for salvage and repair, or as a bond coat for thermal barrier coating systems.
- Amdry 960 and Metco 443NS [NiCrAl] produce coatings recommended for resistance to oxidation and corrosion at high temperatures. Applications include salvage and build-up of worn or mis-machined nickel, nickel alloy or machinable corrosion-resistant steel parts.
- Amdry 4535, Metco 43 series and Metco 5640NS [NiCr] products produce dense coatings that resist oxidation and corrosive gases at temperatures up to 980 °C (1800 °F). They are used to resist heat and prevent scaling of carbon and low alloy steels in hot atmospheres.

2.5 Recommended Spray Guns

Product	Diamond Jet (water-cooled)	WokaJet/WokaStar /JP5000
Diamalloy 4006	●	●
Diamalloy 4276	●	●

3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification	Typical Data – Diamalloy 4006 ^a		
Recommended Process	HVOF		
Deposit Efficiency	%	55	
Macrohardness	HR15N	88 – 89	
Microhardness	HV0.3	650 – 700	
Porosity	vol. %	1 – 2	
Surface Roughness Ra	as sprayed	μm	5.3 – 5.8
		μin	210 – 230
	ground	μm	0.12 – 0.45 ^b
		μin	4.7 – 17.7 ¹
Thickness Limit	mm	not established	
	in		
Finishing Method	Grind using 60 grit SiC or Al ₂ O ₃ wheel. Smoother finishes can be obtained with an Al ₂ O ₃ wheel.		

^a Data is provided is typical and variability can be expected. Changes in spray process, spray equipment or spray parameters can significantly change coating results.

^b converted from RMS

3.2 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 HVOF Spray Guns

WokaJet series
 WokaStar series
 DiamondJet series
 Praxair / Tafa JP5000

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Diamalloy 4006	1000797	5 lb (approx. 2.25 kg)	Stock	Global
Diamalloy 4276	1076125	10 lb (approx. 4.5 kg)	Stock	Global

4.2 Handling Recommendations

- Store in the original container in a dry location.
- Tumble contents gently prior to use to prevent segregation.
- Open containers should be stored in a drying oven to prevent moisture pickup.
- Remove desiccant prior to use, if applicable.

4.3 Safety Recommendations

See the SDS (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 (Resources – Safety Data Sheets).

Product	SDS No.
Diamalloy 4006	50-287
Diamalloy 4276	50-1324

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Inconel is a registered trademark of Huntington Alloys Corp.
Rene is a registered trademark of Teledyne Industries, Inc.

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