

# Material Product Data Sheet

## Chromium Carbide – Nickel Chromium Powder Blends

**Thermal Spray Powder Products:**  
**Amdry™ 367, Diamalloy™ 3004, Metco™ 81NS,**  
**Metco 81VF-NS, Metco 82VF-NS**

### 1 Introduction

These chromium carbide materials are blends of chromium carbide and nickel-chromium powders. The nickel-chromium alloy serves as a matrix that improves overall coating integrity and corrosion resistance, while the chromium carbide constituent serves as a hard phase that assures wear resistance.

Coatings of these materials effectively combat solid particle erosion (SPE), high temperature wear (abrasion, erosion, fretting and cavitation) and hot corrosion.

Coatings applied using the HVOF process are dense and very well-bonded, with a more homogeneous structure than can be obtained using than conventional atmospheric plasma spray. Coatings applied using a TriplexPro series plasma gun using high-energy conditions result in coatings that are similar to HVOF coatings in terms of density and homogeneous structure; however, HVOF coatings have higher bond strength and more favorable residual coating stresses. Post-spray annealing of  $\text{Cr}_3\text{C}_2$ -(Ni 20Cr) HVOF coatings at temperatures up to 725 °C (1340 °F) for approximately 1 h leads to supersaturation of the matrix as a result of carbide dissolution into the matrix. This effect increases the HV300 coating microhardness by 100 to 200 points.

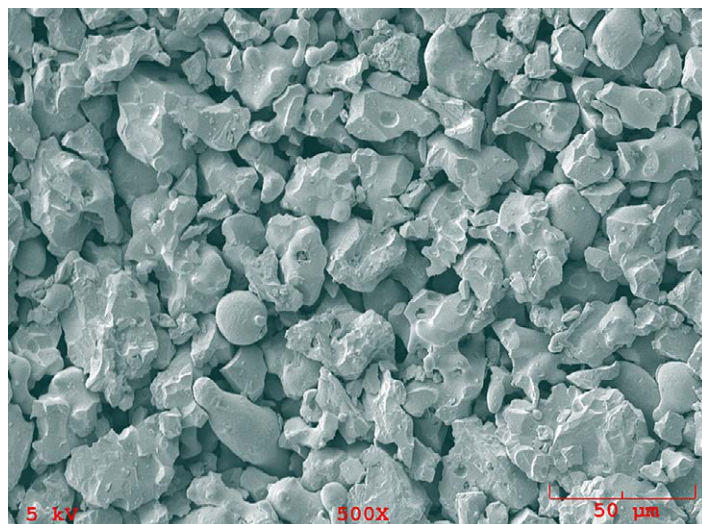
#### 1.1 Typical Uses and Applications

These materials are recommended for resistance to wear at temperatures up to 870 °C (1600 °F):

- Turbine air seal rings
- Turbine baffle dampers
- Turbine inner nozzle supports
- Turbine exhaust valve seats
- Turbine struts
- Hot crushing rolls
- Forging tools
- Hot forming dies

#### Quick Facts

Classification	Carbide, chromium-based
Chemistry	$\text{Cr}_3\text{C}_2$ -(Ni 20Cr)
Manufacture	Blended
Morphology	Irregular or blocky
Service Temperature	< 870 °C (1600 °F)
Purpose	Wear resistance
Process	HVOF, Atmospheric Plasma Spray



SEM Photomicrographs of a typical powder morphology

## 2 Material Information

### 2.1 Chemical Composition

Product	Nominal Chemistry	Weight Percent (nominal)			
		Cr	Ni	C	Other (max)
Amdry 367	Cr <sub>3</sub> C <sub>2</sub> 10(Ni 20Cr)	Balance	7.5	11.75	1.5
Diamalloy 3004	Cr <sub>3</sub> C <sub>2</sub> 25(Ni 20Cr)	Balance	18.75	9.75	2.25
Metco 81NS	Cr <sub>3</sub> C <sub>2</sub> 25(Ni 20Cr)	Balance	18.75	9.75	2.25
Metco 81VF-NS	Cr <sub>3</sub> C <sub>2</sub> 25(Ni 20Cr)	Balance	18.75	9.75	2.25
Metco 82VF-NS	Cr <sub>3</sub> C <sub>2</sub> 7(Ni 20Cr)	Balance	5.5	12.0	2.25

### 2.2 Particle Size Distribution and Primary Carbide Grain Size

	Nominal Range $\mu\text{m}$	Primary Carbide Grain Size
Amdry 367	-45 +5	Coarse
Diamalloy 3004	-45 +5.5	Coarse
Metco 81NS	-106 +11	Coarse
Metco 81VF-NS	-45 +5	Coarse
Metco 82VF-NS	-45 +5.5	Coarse

Size analysis using laser diffraction (Microtrac).

### 2.3 Key Selection Criteria

- Select a material appropriate for the recommended spray process and spray gun to be used (refer to Section 2.5)
- For the lowest possible as-sprayed surface roughness, choose the material with the lowest particle size distribution.
- Choose the material that meets the required customer or OEM material and/or process specification (refer to Section 2.6).
- Metco 81NS is designed to be applied using atmospheric plasma spray. It produces reasonably smooth as-sprayed surfaces that are resistant to wear by abrasive grains, hard surfaces and fretting. It has also been used as an cutting coating for the dynamic member of clearance control applications, such as jet engine knife edge seals.
- Metco 81VF-NS offers several advantages over Metco 81NS, when thin coatings are satisfactory, in that the as-sprayed coatings are very smooth and can often be used without post finishing. Metco 81VF-NS produces thin, dense, hard and smooth coatings that are extremely resistant to wear and oxidation.
- Diamalloy 3004 is designed to be applied using the HVOF spray process. It is recommended if hard, dense and well-bonded coatings are required. Because of the high thickness limit of more than 0.63 mm (0.025 in), which is substantially greater than observed for standard chromium carbide coatings, Diamalloy 3004 coatings are much less technique dependent. Coatings may be used for many applications with no subsequent finishing as a result of its fine as-sprayed surface roughness.
- Metco 82VF-NS is the best choice within this product group for resistance to high temperature fretting and wear. It is designed to meet the processing requirements for high-energy plasma (Pratt & Whitney PWA 257-2 coating specification) and intended for use in thin coating applications. Coatings are slightly harder than coatings of Metco 81VF-NS and can be used at higher service temperatures up to 980 °C (1800 °F).
- Amdry 367 was designed for high resistance to sliding wear, fretting, abrasion and particle erosion at service temperatures up to 850 °C (1560 °F). Amdry 367 coatings are slightly harder than coatings of Metco 82VF-NS.

## 2.4 Related Products

- Tungsten carbide materials produce coatings that are generally harder and more wear resistant than coatings of chromium carbide materials; however, tungsten carbide coatings have a much lower maximum service temperature of 500 °C (930 °F).
- Diamalloy 3007 is a clad material containing 80 % chromium carbide and 20 % nickel chromium matrix. HVOF coatings of Diamalloy 3007 have outstanding properties in applications with erosion, heavy abrasion or heavy friction wear at service temperatures between 540 – 850 °C (1000 – 1560 °F). Coatings exhibit the highest microhardness and macrohardness of all Oerlikon Metco chromium carbides and have very smooth as-sprayed finishes. It is an excellent choice for solid particle erosion resistance in applications such as steam turbines.
- HVOF sprayed Metco 5241 has a deposition efficiency (DE) similar to Diamalloy 3004 and up to 50 % higher than Diamalloy 3007 (Figure 1). Metco 5241 coatings have lower oxide-content, and lower carbon loss during spraying (Figure 2), with excellent erosion and oxidation properties up to 900 °C (1650 °F), good wear properties and corrosion resistance, and can be superfinished to 0.25 µm (1 µin).
- Woka 7100 series of products are spheroidal, agglomerated and sintered powders for thermal spray that contain 80 % chromium carbide as a hard, wear-resistant phase and nickel – 20 % chromium matrix. Particle size distributions for Woka 7100 series are optimized for a variety of HVOF guns.
- Like the Woka 7100 series products, Woka 7200 series products are similar in manufacture and chemistry, but with a 25 % Ni-Cr matrix. Coatings of these materials are somewhat lower in hardness, but have higher ductility, with similar corrosion resistance.
- Woka 7300 series and Amdry 5260 materials are agglomerated, sintered and plasma-densified materials with a 25 % Ni-Cr matrix. The powders have higher apparent densities, which lead to higher deposition efficiencies and denser coatings.

## 2.5 Recommended Spray Guns

	<b>HVOF</b>	<b>Atmospheric Plasma</b>
	<b>DiamondJet</b>	<b>3MB / 9MB / F4 / TriplexPro</b>
Amdry 367		●
Diamalloy 3004	●	
Metco 81NS		●
Metco 81VF-NS	●	●
Metco 82VF-NS	●	●

## 2.6 Customer Specifications

Product Name	Customer Specifications
Amdry 367	Canada Pratt & Whitney CPW 400 Pratt & Whitney PWA 1367
Diamalloy 3004	Alstom MHD 657095 Rolls-Royce Corporation EMS 39662 Rolls-Royce plc RRMS 40026
Metco 81NS	Avio 4800M/6 GE B50TF137, CI B GKN Aerospace PM 819-07 Honeywell EMS 57753, Type I Jet Avion JA 1307 MTU MTS 1124 Pratt & Whitney PWA 1307 Rolls-Royce OMAT 3/80A Rolls-Royce plc MSRR 9507/2 Rolls-Royce plc RRMS 40029 Snecma DMR 33.005 Williams WIMS 642
Metco 81VF-NS	Chromalloy BZ-003 Type 37 GE B50A893 GE B50TF137, CI A GKN Aerospace PM 819-05 Honeywell 91547-M <sup>3</sup> 965 Honeywell EMS 52417, Table 1 Class B Honeywell EMS 57753, Type II MTU MTS 1125 Rolls-Royce Corporation EMS 39662 Rolls-Royce OMAT 3/190 Rolls-Royce plc MSRR 9507/17 SAE International AMS 7875 Siemens PD83269A4 Snecma DMR 33.006 U. S. Military A-A-59315/39 Type III U. S. Military MIL-P-83348 Table 3 Comp C Williams WIMS 643
Metco 82VF-NS	Pratt & Whitney PWA 1364

## 3 Coating Information

### 3.1 Key Thermal Spray Coating Information

Characteristic	Typical Data <sup>a</sup>	
Recommended Process	HVOF or Atmospheric Plasma Spray	
Microhardness	HV0.3	550 – 800
Macrohardness	HRC	40 – 55
Porosity	1 – 5%	
Density	6.0 – 6.6 g/cm <sup>3</sup>	
Bond Strength	34.5 – 83 MPa	5000 – 12000 psi
Maximum Service Temperature	870 °C	1600 °F
Thickness Limit	< 0.4 mm	< 0.15 in
Deposition Efficiency	30 – 70%	

<sup>a</sup> Depending on the spray process, spray gun and parameters used

### 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 Spray Guns	
HVOF	Atmospheric Plasma
DiamondJet	Metco 3MB series
	Metco 9MB series
	Metco F4 series
	TriplexPro series

## 4 Commercial Information

### 4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Amdry 367	1031929	5 lb (approx. 2.27 kg)	Stock	Global
Diamalloy 3004	1000793	5 lb (approx. 2.27 kg)	Stock	Global
Metco 81NS	1000065	5 lb (approx. 2.27 kg)	Stock	Global
Metco 81VF-NS	1000085	5 lb (approx. 2.27 kg)	Stock	Global
Metco 82VF-NS	1000573	5 lb (approx. 2.27 kg)	Special Order	Global

### 4.2 Handling Recommendations

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

Product	SDS No.
Amdry 367	50-850
Diamalloy 3004	50-131
Metco 81NS	50-131
Metco 81VF-NS	50-131
Metco 82VF-NS	50-510

### 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](http://www.oerlikon.com/metco) (Resources – Safety Data Sheets).