

Material Product Data Sheet

Nickel Chromium Aluminum Yttrium (NiCrAlY) Thermal Spray Powders

Thermal Spray Powder Products:
Amdry™ 962, Amdry 9621, Amdry 9624,
Amdry 9625, Amdry 963, Amdry 964

1 Introduction

NiCrAlY alloys are a family of thermal spray coating materials that are known for their excellent resistance to oxidation and hot corrosion. Coatings of these materials are used as bond coats for ceramic top coats or by themselves to resist corrosion at temperatures up to 980 °C (1800 °F) if applied using atmospheric plasma spray (APS), or up to 1050 °C (1920 °F) if applied using HVOF or ChamPro™ controlled atmosphere plasma spray (LPPS™, LVPS™ or VPS).

The chromium and aluminum in these coatings provide protection through the formation of an oxide scale. The addition of yttrium acts to improve the adhesion of this oxide layer. This dense, well-adherent scale is critical for the prolonged life of high temperature ceramic coating systems such as thermal barrier coatings and ceramic abrasible systems. The alumina acts as an oxygen diffusion barrier that helps to minimize bond coat oxidation.

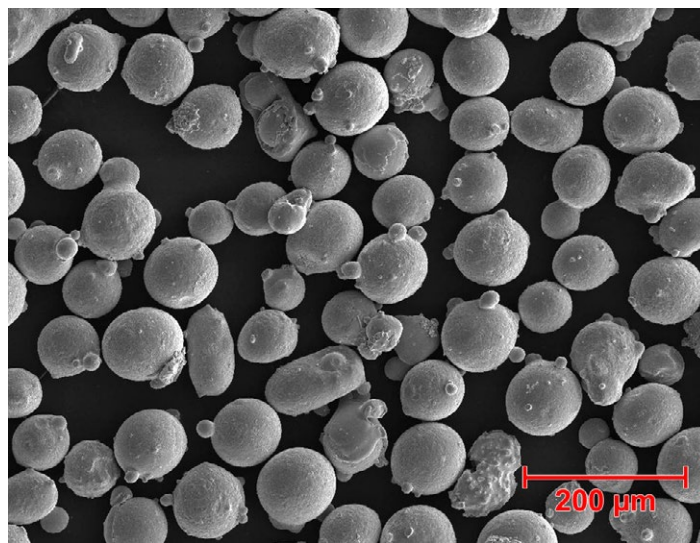
The chromium oxide scale is beneficial to combat hot corrosion and sulfidation. In these applications, higher chromium to aluminum ratios are typically better for chromium oxide scale formation.

1.1 Typical Uses and Applications

- Bond coat for thermal barrier and ceramic abrasible applications
- Coatings applied to iron, nickel or cobalt substrates to minimize oxidation and extend life at higher temperatures
- Resist oxidation and hot corrosion on aerospace and industrial gas turbine components, such as airfoils, turbine buckets, blades and shrouds.
- Restore mis-machined and worn parts that see high temperatures in an oxidizing atmosphere.
- Protect heat-treating fixtures
- Protect exhaust manifolds and ducts

Quick Facts

Classification	MCrAlY, nickel-based
Chemistry	NiCrAlY
Manufacture	Gas atomization
Morphology	Spheroidal
Purpose	Oxidation and hot corrosion resistance
Service Temperature	
APS	≤ 980 °C (1800 °F)
HVOF or ChamPro	≤ 1050 °C (1920 °F)
Process	Atmospheric plasma spray, HVOF or ChamPro™



SEM photomicrograph of Amdry 962 showing the powder exterior morphology typical of these gas atomized products.

2 Material Information

2.1 Chemical Composition

Product	Weight Percent (nominal)			
	Ni	Cr	Al	Y
Amdry 962	Bal.	21.0 – 23.0	9.0 – 11.0	0.8 – 1.2
Amdry 9621	Bal.	21.0 – 23.0	9.0 – 11.0	0.8 – 1.2
Amdry 9624	Bal.	21.0 – 23.0	9.0 – 11.0	0.8 – 1.2
Amdry 9625	Bal.	21.0 – 23.0	9.0 – 11.0	0.8 – 1.2
Amdry 963	Bal.	24.0 – 25.0	5.0 – 7.0	0.3 – 0.5
Amdry 964	Bal.	30.0 – 32.0	10.0 – 12.5	0.4 – 0.9

2.2 Particle Size Distribution

Product	Nominal Size Distribution (µm)
Amdry 962	-106 +53
Amdry 9621	-90 +45
Amdry 9624	-37 +11
Amdry 9625	-74 +45
Amdry 963	-90 +45
Amdry 964	-106 +37

Particle size distribution: Analysis by sieve per ASTM B214 for all upper limits; values of 38 µm and lower based on laser scattering per ASTM C 1070 (Microtrac). Other size distributions are available on request, including HVOF sizing for increased surface roughness in bond coat applications.

2.3 Key Selection Criteria

- The key differences between these materials are the particle size distributions and the percentages of key elements in the alloys. Choose the material best suited for the spray process to be used (please refer to Section 2.5) and the service environment.
- In many cases, the requirement to meet a specific customer/OEM specification will dictate which material should be used (see Section 2.6).
- Amdry 962 and the Amdry 962x family of materials have a general-purpose chemistry that is used for many applications requiring high-temperature oxidation resistance.
- Amdry 963 has lower aluminum and higher chromium content that may be better suited to service environments where hot corrosion or sulfidation is an issue.
- Amdry 964 has higher chromium and aluminum content in the nickel matrix and may see longer service life, depending on the environment and/or the composition of the substrate. HVOF cuts are available on a custom-order basis.

2.4 Related Products

- Oerlikon Metco also offers a number of NiCoCrAlY and CoNiCrAlY products. The benefit of these materials are chemistries that produce coatings with a balanced combination of high temperature oxidation resistance and hot corrosion resistance (see datasheets DSMTS-0092 and DSMTS-0093).
- For bond coat and salvage and repair applications at service temperatures below 980 °C (1800 °F) an MCrAlY material may not be required and a nickel aluminum, nickel chromium aluminum or nickel chromium material should be considered. For information on these products, please see datasheets DSMTS-0029 (Ni 20Al), DSMTS-0043 (Ni 5Al), DSMTS-0091 (NiCrAl) and DSMTS-0109 (Ni 20Cr).
- Alternative choices for lower temperature salvage applications may be materials similar to Hastelloy, Inconel or Tribaloy. Coatings of these materials are typically harder and more wear resistant than MCrAlY materials. See data-sheets DSMTS-0079 (Tribaloy type), DSMTS-0085 (Inconel type) and DSMTS-0086 (Hastelloy type).
- Other proprietary MCrAlY materials supplied by Oerlikon Metco are customer-specific and supplied to OEM-qualified users. Please refer to datasheet DSMTS-0094).
- For qualifying volumes, Oerlikon Metco is capable of developing and producing unique customized MCrAlY chemistries and particle size distributions to meet specific requirements. Please contact your Oerlikon Metco Account Representative for further information.
- Oerlikon Metco offers a substantial portfolio of thermal barrier ceramic products that meet various requirements and customer specifications for which these NiCrAlY materials are often used as a bond coat. Please refer to datasheets DSMTS-0001 (HOSP™ 8% YSZ), DSMTS-0037 (MgO-ZrO), DSMTS-0038 (CeO-ZrO) and DSMTS-0047 (agglomerated and sintered 8% YSZ).
- These NiCrAlY materials are also used as bond coats with Oerlikon Metco's high temperature, ceramic abrasable materials (see datasheet DSMTS-0014).

2.5 Recommended Spray Process and Spray Guns

Product	Atmospheric Plasma Spray	HVOF	ChamPro™ (LVPS™, LPPS™, VPS)
Amdry 962	●		
Amdry 9621	●		
Amdry 9624		●	●
Amdry 9625	●		
Amdry 963	●		
Amdry 964	●	a	

^a An HVOF cut of Amdry 964 is available on a custom order basis

2.6 Customer Specifications

Product	Customer Specifications
Amdry 962	CFM International CP 6023
	Chromalloy BZ 003 Type 53
	GE B50A892
	GE B50TF162
	GE B50TF192, Class A
	GKN Aerospace PM 819-44
	MTU MTS 1333
	Snecma DMR 33.090
	Turbomeca LA 657 Ed. 1, PD 2, Ind. 0
U. S. Military USAF 461204 (material only for bond coat)	
Amdry 9621	GE B50AG16, Class A, except Section 4
Amdry 9625	Honeywell EMS 57737, Type II
	Honeywell M3960
Amdry 963	Rolls-Royce Corporation EMS 56719
	Rolls-Royce Corporation PMI 1351
	Rolls-Royce plc RRMS 40050
Amdry 964	Chromalloy BZ 003 Type 40
	Honeywell 91547-52564 (Bond Coat)
	Honeywell EMS 52439, Class E
	Honeywell EMS 57737, Type 1
	Light Helicopter LHM 3315

3 Coating Information

3.1 Key Thermal Spray Coating Information

Please consult Oerlikon Metco Coatings Solutions Centers (CSC) when coating and application development support is required for NiCrAlY coatings. CSC has experience in optimizing spray parameters for specific customer needs. Types of support that CSC can provide include information on higher surface profile coatings, low oxide coatings, high density coatings, heat-treatment recommendations, material coverage, material deposition, and thickness limits.

3.2 Post-Coating Heat Treatment

Post-coat heat treatment of NiCrAlY coatings allows the coating to densify as well diffuse into the substrate, enhancing bond strength. Post-coat heat treatment also results in precipitation of intermetallic phases of Beta Ni-Al that act as reservoirs for the formation of dense, protective alumina scales.

The heat treatment procedure for a NiCrAlY coating depends on the substrate chosen and the OEM specification. If no heat treatment specification is defined, a diffusion heat treatment in a controlled atmosphere of 2 – 4 hours at 1080 – 1200 °C (1975 – 2200 °F) can be used as a start-ing point.

A benefit of NiCrAlY coatings is their high percentage of aluminum content compared to that of the substrate material. Too high a concentration of aluminum in superalloy substrates results in brittle phases and reduced mechanical strength. Since coatings are not structural by nature, they can have high levels of aluminum to promote Thermally Grown Oxide (TGO) development and maintenance of an aluminum reservoir in service.

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		
Atmospheric Plasma	HVOF	ChamPro
Metco 9MB series	DiamondJet series	Metco O3CP
Metco F4 series	WokaStar series	
TriplexPro series	WokaJet series	
SimplexPro series		

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Amdry 962	1001052	5 lb (approx. 2.25 kg)	Stock	Global
Amdry 9621	1019247	5 lb (approx. 2.25 kg)	Stock	Global
Amdry 9624	1032598	5 lb (approx. 2.25 kg)	Special Order	Global
Amdry 9625	1001053	5 lb (approx. 2.25 kg)	Stock	Global
Amdry 963	1001054	5 lb (approx. 2.25 kg)	Stock	Global
Amdry 964	1001055	5 lb (approx. 2.25 kg)	Stock	Global

4.2 Handling Recommendations

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

4.3 Safety Recommendations

See the SDS (Safety Data Sheet) for the product of interest 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 Index No.
Amdry 962	50-424
Amdry 9621	50-424
Amdry 9624	50-424
Amdry 9625	50-424
Amdry 963	50-794
Amdry 964	50-795

Information is subject to change without prior notice.