

Material Product Data Sheet

Iron Nickel Aluminum Composite Thermal Spray Powders

Thermal Spray Powder Products: Amdry 959, Metco 452, Metco 453

1 Introduction

Metco™ 452, Metco 453 and Amdry™ 959 are self bonding iron-nickel aluminum composite powders. The self-bonding characteristic relies on an exothermic reaction of the aluminum during spraying that results in micro-welding of the coating to the surface. This phenomenon improves the bond strength and allows thick, low shrink coatings. In addition, the aluminum component improves the overall oxidation resistance of the coating.

The presence of nickel promotes high temperature hot corrosion and oxidation resistance. Iron increases the hardness and wear resistance of these ferrous-based coatings.

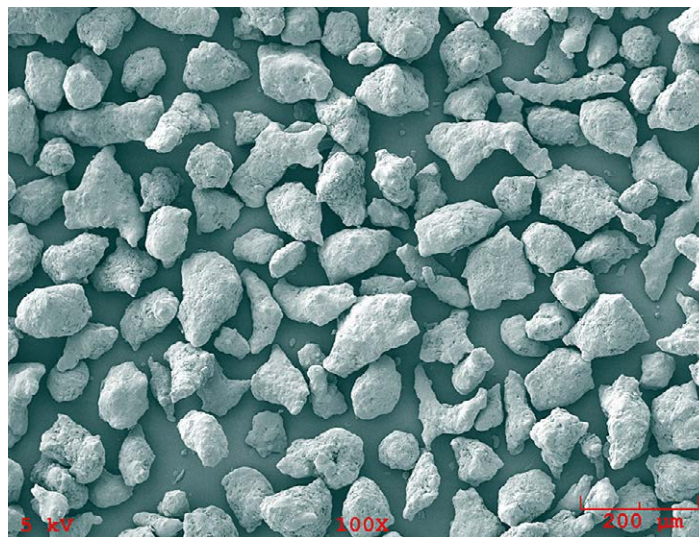
The addition of molybdenum in Metco 453 improves coating finishing capabilities and toughness.

1.1 Typical Uses and Applications

- A rapid and cost-effective means of salvage and restoration of carbon steels, corrosion resistant steels and cast iron components.
- Good for bond coats for ceramic, nickel chromium and stainless steel thermal spray top coats.
- Typical components where these coatings are used are machine bedways, wear rings, press fits bearing seats, exhaust valve seats, exhaust mufflers, heat treating fixtures, diesel components such as firedecks, connecting rods, saddle areas and caps, engine blocks, exhaust manifolds, mounting surfaces and cylinder heads.

Quick Facts

Classification	Composite, iron-based
Chemical formula	FeNiAl[Mo]
Manufacture	Mechanically clad
Purpose	Salvage and bond coats
Morphology	Irregular
Melting point	815 °C (1500 °F)
Process	Atmospheric Plasma Spray or Combustion Powder Thermospray™



SEM photomicrograph of Metco 452 Composite Powder

2 Material Information

2.1 Chemical Composition, Particle Size Distribution and Manufacturing Method

	Chemical Composition (nominal weight %)				
	Fe	Ni	Al	Mo	Others + Organic Binder
Amdry 959	Balance	37	5.8	–	3
Metco 452	Balance	35	6	–	3
Metco 453	Balance	30	6	6	4

2.2 Particle Size Distribution, Flow and Apparent Density

	Nominal Particle Size Distribution (μm)	Hall Flow (s/50 g)	Apparent Density (g/cm^3)
Amdry 959	-125 +45	25 (max)	3.00 – 3.15
Metco 452	-125 +45	20 – 30	2.60 – 3.30
Metco 453	-125 +45	20 – 40	2.55 – 3.15

Particle size analysis using sieve in accordance with ASTM B214

2.3 Key Selection Criteria

- Amdry 959 and Metco 452 can produce thick coatings without cracking or lifting, with minimal dependence on spray technique and substrate temperature control.
- Amdry 959 and Metco 452 can be used as an oxidation-resistant barrier under ceramic top coats.
- Amdry 959 produces high strength, free-machining coatings that can be used in the as-sprayed condition. The coatings also have superior bond strength.
- Metco 453 produces extremely tough coatings. Its molybdenum constituent also enhances high temperature scuff resistance.
- As with other self-bonding nickel aluminum composite materials, coatings of these materials will not reliably self-bond to substrates of copper, alloys with a high copper content, molybdenum or tungsten.

2.4 Related Products

- In general, coatings of iron-nickel alloys have better machinability and wear resistance than coatings of nickel-based alloys. At the same time, nickel-based alloys have better oxidation and corrosion resistance at elevated temperatures.
- For applications where better corrosion resistance at higher operating temperatures is required, Metco 450NS and Amdry 956 are recommended. These are self-bonding nickel aluminum composite powders that produce coatings that can be used up to 980 °C (1800 °F). These materials also produce free-machining coatings, similar to Amdry 959.
- When a nickel aluminum material with superior oxidation and corrosion resistance is desired, Metco 450P, a

premium nickel aluminum composite powder, is recommended. At the same time, Metco 450P produces coatings that have machinability similar to that of Metco 452, Metco 453 and Amdry 959.

- For applications requiring denser coatings but similar corrosion, oxidation and wear resistance, Metco 404NS, a self-bonding nickel aluminum composite powder, is recommended. However, the maximum operating temperature of Metco 404NS coatings is lower and can be used up to 650 °C (1200 °F).
- When somewhat better high temperature corrosion resistance is required, Metco 447NS, a molybdenum-nickel-aluminum composite powder, can be used. However, coatings of Metco 447NS may be more difficult to machine.
- Metco 443NS and Amdry 960 are (NiCr) 6Al self-bonding materials that produce coatings that have superior oxidation resistance compared to coatings of Metco 452, Metco 453 and Amdry 959. Metco 443NS and Amdry 960 can be used for oxidation resistant bond coats for ceramic top coats.
- Nickel-based electric arc wires, such as Metco 8400 and Metco 8401, can be considered as alternative products to iron-nickel powders. Coatings applied using electric arc wire have high spray rates combined with low consumable cost. The coatings are very machinable, have low internal coating stresses and can be sprayed to greater thicknesses than coatings applied using other spray processes. They can be used as bond coats or for dimensional restoration on nickel and nickel-alloy substrates.



3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification		Amdry 959		Metco 452		Metco 453
Recommended Process		Atmospheric Plasma Spray or Combustion Powder Thermospray™				
Surface Roughness	Ra					
As Sprayed	µm (µin)	7.6 – 12.7	(300 – 500)	10.1 – 20.3	(400 – 800)	10.1 – 20.3 (400 – 800)
Machined	µm (µin)	N/A		0.5 – 1.5	(20 – 60)	0.5 – 1.5 (20 – 60)
Ground	µm (µin)	N/A		0.4 – 0.8	(15 – 30)	0.4 – 0.8 (15 – 30)
Lapped	µm (µin)	N/A		0.2 – 0.5	(8 – 20)	0.2 – 0.5 (8 – 20)
Macrohardness	HRB	80 – 90		80 – 90		60 – 80
Microhardness	HV0.3	150 – 250		150 – 250		150 – 250
Density	g/cm ³	6.4 – 6.8		6.4 – 6.8		6.4 – 6.8
Porosity	vol. %	< 2		< 2		< 2
Oxide Content	vol. %	8 – 15		8 – 15		8 – 15
Thickness Limit	mm (in)	2.5 mm	(0.100)	2.5 mm	(0.100)	1 – 2 mm (0.040 – 0.080))

Values given are typical; however, significant variability can be expected depending on the chosen spray process, spray gun, gun hardware, spray parameters and coating thickness applied.

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

Atmospheric Plasma

Metco 3MB series

Metco 9MB series

Metco F4 series

SinplexPro series

Combustion Powder

Metco 5P-II

Metco 6P-II series

4 Commercial Information

4.1 Ordering Information and Availability

	Order No.	Package Size	Availability	Distribution
Amdry 959	1001050	5 lb (approx. 2.25 kg)	Stock	Global
Metco 452	1000584	5 lb (approx. 2.25 kg)	Stock	Global
Metco 453	1000594	5 lb (approx. 2.25 kg)	Stock	Global

4.2 Handling Recommendations

- Keep powder dry and in a closed container.
- Tumble contents prior to use to prevent segregation.
- The fineness and high surface area of thermal spray powders give them a tendency to pick up moisture that may obstruct their flow.
- Flowability may be maintained by storing the powder in a warm cabinet or restored by drying the powder by heating the container (seal removed and lid loosened) at 93 °C (200 °F) for 2 hours prior to use.

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
Amdry 959	50-183
Metco 452	50-183
Metco 453	50-195