

Material Product Data Sheet

Nickel – Chromium Powders and Wires

Powder Products:

**Metco™ 43C-NS, Metco 43F-NS, Metco 43VF-NS,
Metco 442, Metco 443NS, Metco 444,
Metco 5640NS, Amdry™ 510, Amdry 4535**

Solid Wires (alloyed):

Metco 8450, Metcoloy™ 33

Cored Wires (powder filled):

Metco 8443, Metco 8452

1 Introduction

Oerlikon Metco offers multi-purpose nickel-chromium based alloys for thermal sprayed bond-coats and repair. Available in the form of powder or wire, the portfolio consists of atomized (alloyed) powders, composite powders, clad powders, solid wires and cored wires.

The nickel-chromium (Ni-Cr) alloy coatings exhibit dense, smooth surfaces, and improve the bond strength of top coats of ceramic and other materials that do not readily bond to the substrate, thus enhancing long-lasting coating performance. They can be used on new surfaces, or to rebuild damaged metallic surfaces, either alone with post-machining to dimension or prior to the top coat.

High chromium content in these materials enhances their oxidation and corrosion resistance at elevated temperatures. Other minor alloying elements such as Mo, Mn, Al, B, Si are added for different functions depending on the application. Molybdenum provides scuff and sliding wear resistance, while aluminum promotes oxidation resistance. Free aluminum in the composites and clad powders promotes self-bonding by an exothermic reaction.

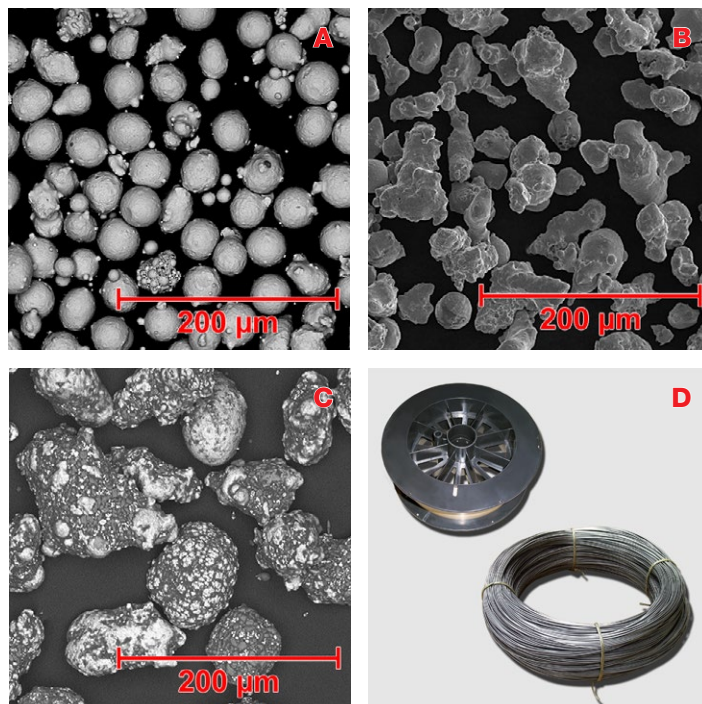
Customers can have various choices of alloys to reduce the dissimilarity in chemical composition with the substrate and mismatch in coefficient of thermal expansion (CTE) between the bond coat and the substrate. In most cases, material selection is dependent on the specific coating environment; however, all of these materials can be used for bond coats.

1.1 Typical Uses and Applications

- Bond coatings to improve the adherence of a subsequently sprayed ceramic top coat deposits

Quick Facts

Classification	Alloy, nickel based
Chemical formula	NiCr (various)
Manufacture	
Powders	Atomized or clad
Wires	Solid drawn wire or composite wire
Morphology (Powders)	Spheroidal or irregular
Service temperature	1000 °C (1830 °F)
Purpose	Corrosion-resistant bond coat or salvage and restoration
Process	Atmospheric plasma spray, HVOF, combustion powder Thermospray™, electric arc wire spray or combustion wire spray



Typical morphologies for powder products: **A.** Spherical gas atomized powders. **B.** Irregular water atomized powders. **C.** Irregular mechanically clad powders. **D.** Packaging for wire products. **Top:** Dorn-style spool (plastic reel). **Bottom:** Coil.

- Intermediate coatings to mitigate thermal expansion coefficient mismatch
- Oxidation and corrosion resistant bond coat for other thermal sprayed coatings
- Bond coat for thermal barrier coatings in turbine engine components and heat treating fixtures.
- Salvage and restoration

2 Material Information

2.1 Chemical Composition (nominal wt. %)

Product	Ni	Cr	Al	Mo	Fe	Nb + Ta	Mn	B	Si	Ti	Al ₂ O ₃	Organic (max)	Other (max)
Powders:													
Metco 43C-NS	Bal.	19.5	---	---	1.0	---	1.5	---	1.2	---	---	---	0.5
Metco 43F-NS	Bal.	19.5	---	---	1.0	---	1.5	---	1.2	---	---	---	0.5
Metco 43VF-NS	Bal.	19.5	---	---	1.0	---	1.5	---	1.2	---	---	---	0.5
Metco 5640NS	Bal.	19.5	---	---	0.5	---	1.25	---	0.75	---	---	---	0.5
Amdry 4535	Bal.	19.5	---	---	0.25	---	0.25	---	0.75	---	---	---	0.4
Metco 442	Bal.	9.0	6.0	5.0	2.0	---	---	2.0	2.0	---	3.0	N.R.	N.R.
Metco 444	Bal.	9.5	5.75	5.75	5.25	---	---	---	---	---	---	3.0	4.0
Metco 443NS	Bal.	18.5	6.0	---	---	---	---	---	---	---	---	4.0	7.0
Amdry 510	Bal.	22.0	10.0	---	---	---	---	---	---	---	---	---	2.0
Wires:													
Metco 8450	Bal.	20.0	---	---	---	---	---	---	---	---	---	---	0.2
Metcoloy 33	Bal.	16.0	---	---	22.0	---	---	1.0	---	---	---	---	1.0
Metco 8443	Bal.	18.0	6.0	---	---	---	2.0	---	---	---	---	---	N.R.
Metco 8452	Bal.	50.0	---	---	---	---	---	---	---	---	---	---	N.R/

N.R. = Not Reported

2.2 Particle Size Distribution (Powders) and Other Characteristics

Product	Nominal Particle Size Distribution (µm) or Wire Diameter	Morphology	Manufacturing Method
Powders:			
Metco 43C-NS	-106 +45	Irregular	Water Atomized
Metco 43F-NS	-63 +10	Irregular	Water Atomized
Metco 43VF-NS	-45 +5	Irregular	Water Atomized
Metco 5640NS	-125 +45	Spheroidal	Gas Atomized
Amdry 4535	-53 +11	Spheroidal	Gas Atomized
Metco 442	-125 +45	Irregular	Mechanically Clad
Metco 444	-125 +45	Irregular	Mechanically Clad
Metco 443NS	-125 +45	Irregular	Mechanically Clad
Amdry 510	-44 +22	Spheroidal	Gas Atomized
Wires:			
Metco 470 AW	1.6 mm (14 gauge / 0.063 in)	Solid Wire	Drawn
Metco 8450	1.6 mm (14 gauge / 0.063 in)	Solid Wire	Drawn
Metcoloy 33	3.2 mm (0.063 in)	Solid Wire	Drawn
Metco 8443	1.6 mm (14 gauge / 0.125 in)	Cored Wire	Powder Filled
Metco 8452	1.6 mm (14 gauge / 0.063 in)	Cored Wire	Powder Filled

For powder products, particle size equal to or above 45 µm determined by sieve analysis; below 45 µm by laser diffraction (Microtrac)

2.3 Recommended Processes

Product	APS	HVOF-GF	HVOF-LF	CPS	EAW	CWS
Powders:						
Metco 43C-NS	•			•		
Metco 43F-NS	•			•		
Metco 43VF-NS	•	•	•	•		
Metco 5640NS	•			•		
Amdry 4535	•	•	•	•		
Metco 442	•			•		
Metco 444	•			•		
Metco 443NS	•			•		
Amdry 510		•	•			
Wires:						
Metco 8450					•	
Metcoloy 33						•
Metco 8443					•	
Metco 8452					•	

APS = Atmospheric Plasma Spray; **HVOF-GF** = Gas-Fuel High Velocity Oxygen Fuel Spray (water-cooled); **HVOF-LF** = Liquid-Fuel High Velocity Oxygen Fuel Spray; **CPS** = Combustion Powder Thermospray™; **EAW** = Electric Arc Wire Spray; **CWS** = Combustion Wire Spray

2.4 Key Selection Criteria

- Choose the product that meets the required customer material specification.

Atomized Powders:

- Metco 43C-NS, Metco 43F-NS and Metco 43VF-NS are Ni-20Cr alloy powders manufactured by water atomization with a characteristic irregular particle shape.
- Amdry 4535 and Metco 5640NS are nickel-chromium alloy powders of similar chemistry, manufactured using gas atomization and using premium nickel raw materials. Their spheroidal shape ensures freely flowing powder feed during thermal spray processing.
- Amdry 510 is a gas atomized NiCrAl alloyed powder. Coatings sprayed with Amdry 510 have a long service life against spallation and exhibit superior resistance to oxidation and corrosive gas attack.

Composites Powders:

- Metco 442 and Metco 444 are composites powders of nickel, chromium, molybdenum and aluminum. Aluminum in combination with nickel produces an exothermic reaction when sprayed that leads to a very good bond strength and better interparticle bonding. Thick coatings of these materials can be applied without cracking or delamination, even when applied using combustion powder Thermospray™. On the other hand, thin coatings can be applied with minimal surface preparation.

Clad Powders:

- Metco 443NS is an aluminum clad nickel chromium alloyed powder that undergoes an exothermic reaction when sprayed. The reaction is vigorous enough to assure more consistent bonding to the substrate and better interparticle bonding than that obtained in non-exothermic materials.
- Plasma-sprayed Metco 443NS coatings are self-bonding and can be used for high temperature oxidation- and corrosion-resistant coatings. It is recommended as a bond coat for ceramic top coats and for salvage and buildup of worn or mismachined parts made of nickel, nickel alloys or machinable corrosion-resistant steels. In contrast to plasma-sprayed coatings, thermosprayed Metco 443NS coatings are not self-bonding. They should only be used on surfaces that have been properly prepared using a standard method of surface preparation. These coatings are recommended as a bond coat for ceramic top coats.

Solid and Cored Wires:

- Metcoloy 33, Metco 8450 are pre-alloyed solid wires. Metco 8443, Metco 8452 are powder-filled cored wires. Cored wires are produced by a thin strip forming process out of metallic elements with chemical homogeneity assured throughout the entire wire roll. The wire types offer enhanced feeding and productivity. Wire spraying can be more cost effective than powder spraying, and has added advantage of being more portable for on-site applications. The products are appropriate for general use coatings and additional products for very specific coating applications using electric arc wire spray guns.

Metco 43 series, Metco 5640NS and Amdry 4535:

- Coatings of these materials are recommended for:
 - As oxidation and corrosive gas resistant bond coats for service temperatures up to 1000 °C (1830 °F).
 - Dense, abrasion and oxidation resistant coatings for salvage and buildup applications, such as on carbon and low alloy carbon steel substrates.
- Coatings of these materials can withstand service temperatures up to 1000 °C (1830 °F).
- Choose Metco 5640NS or Amdry 4535 for coatings with better hot gas corrosion and oxidation resistance compared to coatings of the water atomized products.
- Products with finer particle size distributions generally produce coatings with finer as-sprayed surfaces finishes, which may be desirable when post-coat machining of the coating will be performed.
- For application using HVOF, choose Metco 43VF-NS or Amdry 4535.

Metco 442 and Metco 444:

- Use these materials for:
 - Hard bearing surfaces such as bearing journals, fuel pump rotors and sleeves
 - Machine bedways and wear rings for fretting resistance (intended motion)
 - Jet engine parts for fretting resistance (no intended motion); exhaust fans, hydroelectric valves for low temperature particle erosion (Metco 444)
- Choose these materials for stainless-type coatings with good wear, corrosion and oxidation resistance.
- Both materials produce “one-step” coatings that are not highly technique dependent. They can be applied with minimum preparation requirements and produce thin coatings or thick coatings without cracking.
- Choose Metco 442 when coatings of higher hardness are needed and finishing by grinding is acceptable.
- Choose Metco 444 when a machinable coating is desired, or when a coating of somewhat higher service temperature is required.

Metco 443NS and Amdry 510:

- Applications where these materials are recommended include:
 - As a bond coat for abradable coatings for machine element clearance control and turbine engine components.
 - Salvage and restoration of worn or mismachined nickel, nickel alloy or machinable corrosion-resistant steel substrates.
- Metco 443NS has a coarse particle size distributions and can be applied using atmospheric plasma spray (APS) or combustion powder Thermospray™. APS coatings of these powders are self-bonding.

- Amdry 510 has a fine particle size distribution and can be applied using HVOF when low porosity and low oxide content are required in the coatings. Coatings sprayed with Amdry 510 provide better oxidation resistance, corrosion resistance and longer service life than Metco 443NS.

Metcoloy 33, Metco 8450, Metco 8443, Metco 8452:

- These wire materials are suitable for:
 - Salvage and build-up of machinable carbon steel and corrosion-resistant steels
 - Particle erosion resistance at high temperatures
 - Select compositions such as Metco 8443 are appropriate for oxidation and hot gas corrosion at elevated temperatures
 - Metco 8452 is appropriate for corrosion resistance in oxidizing and reducing environments, such as boiler applications.
- Metco 8450 is a good candidate for bond coats under ceramic coatings in high temperature or chemically aggressive environments.
- Metco 8452 is recommended for waterwalls and superheaters in boilers. It can also be used as a bond coat in alkaline conditions.
- Metco 8443 provides high temperature oxidation and hot gas corrosion resistance at temperatures up to 980 °C (1800 °F).

2.5 Related Products

- Self-bonding coatings with minimal surface preparation can be accomplished using mechanically clad powders such as Metco 404NS, Metco 1101 and Metco 2101ZB. These materials can be used to produce coatings with improved oxidation and thermal shock resistance in gas turbine applications.
- When a good, general purpose bond coat or buildup material is needed, particularly in applications where corrosion resistance or temperature is less of a concern, consider a nickel-aluminum material. Materials are available for thermal spray coating application using powder or wire feedstock materials.
- For applications where very high oxidation or hot corrosion resistance is needed, Oerlikon Metco has a large portfolio of MCrAlY alloys. These materials can be used as bond coats or as corrosion coatings in higher temperature environments, and can be post-coat diffused for improved bonding and service characteristics.

2.6 Customer Specifications

Product Name	Customer Specifications
Metco 43C-NS	Boeing BMS 10-67, Type VI Canada Pratt & Whitney CPW 215 GE B50TF40, CI A MTU MTS 1050 Pratt & Whitney PWA 1315 Rolls-Royce Corporation EMS 56760 Rolls-Royce plc 9507/8 Snecma DMR 33-078 U. S. Military A-A 59315/7
Metco 43F-NS	Canada Pratt & Whitney CPW 217 GE B50TF40, CI B Jet Avion JA 1317 Pratt & Whitney PWA 1317 Rolls-Royce plc 9507/27 Snecma DMR 33-079 U. S. Military A-A 59315/6
Metco 43VF-NS	Pratt & Whitney PWA 1319 U.S. Military A-A-59315/20 Type I, Class I
Metco 5640NS	GE B50TF40, CI A
Metco 444	Chromalloy BZ-003 Type 45 Honeywell EMS 52432, Class XXIX Honeywell M3976 Rolls-Royce Corporation EMS 56762 Rolls-Royce Corporation PMI 1270
Metco 443NS	Avio 4800M/12 Canada Pratt & Whitney CPW 369 Chromalloy BZ-003 Type 4 GE B50A890 GE B50TF119, Class A GKN Aerospace MTL 116 GKN Aerospace PM 819-47 Honeywell 91547-M3956 Honeywell EMS 57748, Type I, Class 2 Honeywell FP 5045, Type XVIII MTU MTS 1077 Pratt & Whitney PWA 1347 Rolls-Royce Corporation EMS 56772 Rolls-Royce OMAT 3/135 Rolls-Royce plc MSRR 9507/14 Rolls-Royce plc RRMS 40038 Snecma DMR 33.018
Metco 8443	Chromalloy BZ-003 Type 31 GE B50TF119 GE Standard Practice Task 70-49-39-340-038 C07-043 GKN Aerospace PM 819-71 MTU MTS 1578 Pratt & Whitney PWA 36947 Rolls Royce OMAT 3/271A

3 Coating Information

3.1 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

Combustion Powder	Metco 6P-II series
Atmospheric Plasma	Metco F4MB-XL series Metco 9MBM TriplexPro series SinplexPro series
HVOF-GF	Diamond Jet (waer cooled) series
HVOF-LF	WokaJet series WokaStar series
Combustion Wire	Metco 16E Metco 5K series
Electric Arc Wire	SmartArc PPG series Metco LD Schub 5

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Wire Diameter (if applicable)	Package Size	Package Type	Availability	Distribution
Powders:						
Metco 43C-NS	1000054	---	5 lb (approx. 2.25 kg)	Plastic Jar	Stock	Global
Metco 43F-NS	1000068	---	5 lb (approx. 2.25 kg)	Plastic Jar	Stock	Global
Metco 43VF-NS	1000438	---	5 lb (approx. 2.25 kg)	Plastic Jar	Stock	Global
Metco 5640NS	1030107	---	5 lb (approx. 2.25 kg)	Plastic Jar	Stock	Global
Amdry 4535	1001066	---	10 lb (approx. 4.5 kg)	Plastic Jar	Stock	Global
Metco 442	1000445	---	5 lb (approx. 2.25 kg)	Plastic Jar	Special Order	Global
Metco 444	1000326	---	5 lb (approx. 2.25 kg)	Plastic Jar	Stock	Global
Metco 443NS	1000300	---	5 lb (approx. 2.25 kg)	Plastic Jar	Stock	Global
Amdry 510	1002396	---	10 lb (approx. 4.5 kg)	Plastic Jar	Stock	Global
Wires:						
Metco 8450	1057815	1.63 mm (14 ga / 0.063 in)	15 kg (approx. 33 lb)	Dorn Spool	Stock	Global
Metcoloy 33	1002465	3.18 mm (0.125 in)	25 kg (approx. 55.1 lb)	Coil	Stock	Global
Metco 8443	1001599	1.63 mm (14 ga / 0.063 in)	25 lb (approx. 11.3 kg)	Dorn Spool	Stock	Global
Metco 8452	1057887	1.63 mm (14 ga / 0.063 in)	12.5 kg (approx. 27.5 lb)	Dorn Spool	Special Order	Global

4.2 Handling Recommendations

- Store in the original container in a dry location.
- For powder products, tumble contents gently prior to use to prevent segregation.
- Open containers of powder 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) for the product and 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 No.
Metco 43C-NS	50-112
Metco 43F-NS	50-112
Metco 43VF-NS	50-112
Metco 5640NS	50-112
Amdry 4535	50-112
Metco 442	50-172
Metco 444	50-174
Metco 443NS	50-173
Amdry 510	50-424
Metco 8450	50-1146
Metcoloy 33	50-243
Metco 8443	50-571
Metco 8452	50-1145