

Material Product Data Sheet

Nickel Graphite Abradable Powders

Thermal Spray Powder Products:

Metco™ 307NS, Metco 307NS-2, Metco 307NS-3, Metco 308NS, Metco 308NS-1, Metco 308NS-3, Metco 309NS-3, Durabrade™ 2211ZB, Durabrade 2221, Durabrade 2222, Durabrade 2223, Durabrade 2224, Durabrade 2231, Durabrade 2241

1 Introduction

Oerlikon Metco Nickel Graphite powders produce abradable coatings for clearance control applications where the rotating component may come into contact with the coating as a result of design intent or operational surges. The coatings are designed to minimize the wear to the rotating components while maximizing gas path efficiency by providing clearance control in seal areas.

An industry standard for more than 30 years, combustion powder Thermospray™ coatings of nickel graphite have proven reliability in gas turbine applications and are approved by all major gas turbine OEM's.

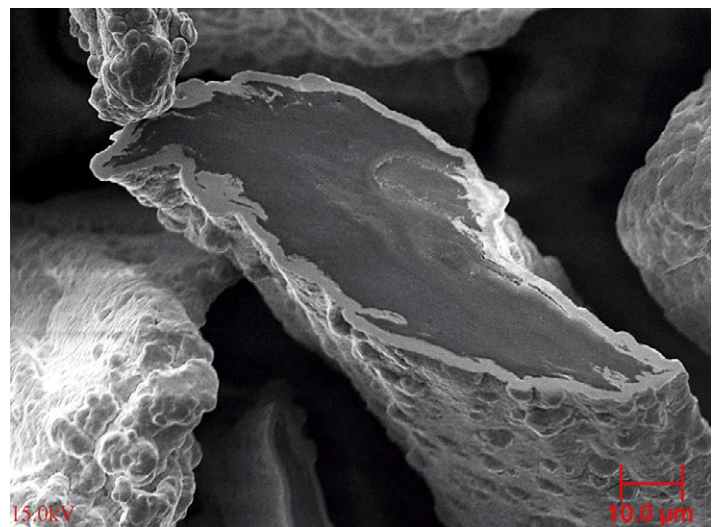
The composite powders are manufactured using the hydro-metallurgy autoclave process that encapsulates the graphite core inside a nickel shell to form a continuous cladding (see image at right). This provides a high-quality binder-free composite powder with no tendency for segregation during transport, storage or spraying.

1.1 Typical Uses and Applications

- Coating service temperature capability approaching 480 °C (900 °F)
- Available in a variety of chemistries and particle sizes to produce a wide array of coating properties for gas turbine compressor section applications
- Suitable for abradable coatings to rub against nickel alloy and steel
- Some grades are suitable for abradable coatings to rub against bare untipped titanium alloys
- Produces self-lubricating coatings that can be used for friction reducing bearing applications

Quick Facts

Classification	Abradable, nickel based
Chemistry	Ni-C
Manufacture	Chemically clad
Morphology	Irregular
Apparent Density	1.2 – 2.0 g/cm ³
Service Temperature	≤ 480 °C (900 °F)
Purpose	Clearance control or friction reducing bearing coatings
Process	Combustion Powder Thermospray™



Photomicrograph showing a typical nickel graphite powder structure of graphite encapsulated inside a nickel shell.

2 Material Information

2.1 Chemical Composition, Particle Size Distribution and Apparent Density

Metco Products	Equivalent Durabrade Products	Weight Percent		Particle Size Distribution (µm)	Apparent Density (g/cm ³)
		Ni	Graphite		
---	Durabrade 2211ZB	60	40	-90 +30	1.2
Metco 307NS	Durabrade 2222	75	25	-90 +30	1.4
Metco 307NS-2	Durabrade 2223	75	25	-90 +20	1.4
Metco 307NS-3	Durabrade 2221	75	25	-90 +30	1.4
---	Durabrade 2224	75	25	-90 +20	1.4
Metco 309NS-3	Durabrade 2231	80	20	-106 +45	1.7
Metco 308NS	***	85	15	-90 +30	2.0
Metco 308NS-1	---	85	15	-90 +30	2.0
Metco 308NS-3	Durabrade 2241	85	15	-106 +30	2.0

Notes:

The brand and material designations relate to OEM specifications for these powders. Please refer to section 2.4. All reported values are nominal Upper particle size analysis using sieve in accordance with ASTM B214; lower size analysis using laser diffraction (Microtrac)

2.2 Key Selection Criteria

- Although many of the powders are chemically identical and fall within the typical sizes shown in section 2.1, particle size distributions vary within these ranges in accordance with specific OEM requirements as indicated in section 2.4.
- Durabrade 2211ZB is primarily used for specialized applications (only for GE specification B50TF164, Class A and B and with GE approval) as a blend with NiCrAl (Metco 443NS or Amdry 960) typically in a proportion of 32.5% abrasible to 67.5% NiCrAl by weight.
- Nickel graphite materials with 75 wt% nickel content produce abrasible coatings that are cut by bare, untipped titanium blades and knife edges.
- Materials with 85 wt% nickel content, such as Metco 308NS, are used when higher erosion resistance is important. Higher erosion resistance is related to a decrease in abrasibility.
- Durabrade 2231, with 80 wt% nickel content, produces coatings that exhibit abrasibility and erosion resistance halfway between coatings made from nickel graphite powders having 85 wt% and 75 wt% nickel content.
- Depending on the application, spray parameters can be designed to produce coatings with varied graphite and porosity contents.

2.3 Related Products

- For abrasible applications against bare titanium blades and blisks:
 - Coatings produced from 75/25 nickel graphite provide better corrosion resistance than coatings produced from Metco 310NS, Metco 311NS and Metco 313NS.
 - Metco 320NS, comprised of aluminum, silicon and hexagonal boron nitride, produces coatings that have better corrosion and erosion resistance than nickel graphite coatings. Coatings produced from Oerlikon Metco 2042 have higher in-service temperature capability than nickel graphite and Metco 320NS while providing excellent abrasibility.
 - All nickel graphite coatings are combustion sprayed while Oerlikon Metco 2042 and Metco 320NS are plasma sprayed.
- When titanium compatibility is not required:
 - When coatings having superior corrosion resistance and higher temperature capability are required, NiCrAl/Bentonite materials (Metco 312, Metco 314, Durabrade 2311 and Durabrade 2313) as well as Metco 301NS and Oerlikon Metco 2043 are a better choice.

2.4 Customer Specifications

Product	Customer Specification
Metco 307NS	GKN Aerospace PM 819-41 Honeywell EMS 57739, CI II Honeywell FP 5045, Type XII MTU MTS 1535 Pratt & Whitney PWA 1352-1
Metco 307NS-2	Avio 4800M/10 MTU MTS 1121 Rolls-Royce OMAT 3/91A Rolls-Royce plc MSRR 9507/6
Metco 307NS-3	Avio 4800M/28 GE B50TF52, CI B GKN Aerospace PM 819-81 Snecma DMR 33.084
Metco 308NS	Honeywell FP 5045, Type XI Pratt & Whitney PWA 1352-2
Metco 308NS-1	Rolls-Royce Corporation EMS 56755 Rolls-Royce Corporation PMI 1097
Metco 308NS-3	Avio 4800M/9 GE B50TF53, CI B GKN Aerospace PM 819-34 MTU MTS 1071 Rolls-Royce plc MSRR 9507/16
Metco 309NS-3	GE B50TF172, CI A GKN Aerospace PM 819-45 Honeywell EMS 57739
Durabrade 2211ZB	GE B50TF164, CI A & B
Durabrade 2221	GE B50TF52, CI B MTU MTS 1070 Snecma DMR 33.084
Durabrade 2222	Pratt & Whitney PWA 1352-1
Durabrade 2223	MTU MTS 1121 Rolls-Royce plc MSRR 9507/6
Durabrade 2224	Pratt & Whitney PWA 1352 Rolls-Royce Corporation EMS 56754 Rolls-Royce plc MSRR 9507/12
Durabrade 2231	GE B50TF172, CI A Honeywell EMS 57739
Durabrade 2241	GE B50TF53, CI B MTU MTS 1071 Rolls-Royce plc MSRR 9507/16

Note: Some OEM's approve both Metco and Durabrade products. Always choose the material that meets the customer or OEM specification required for the application.

3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification ^a			Metco 307NS Metco 307NS-2 Metco 307NS-3 Durabrade 2221 Durabrade 2222 Durabrade 2223 Durabrade 2224	Metco 309NS-3 Durabrade 2231	Metco 308NS Metco 308NS-1 Metco 308NS-3 Durabrade 2241
Recommended Process			Combustion Powder Thermospray™ (all materials)		
Deposit Efficiency	(approx.)	%	70 – 85	75 – 85	75 – 85
Density	(approx.)	g/cm ³	3.2	3.5	4.9
Weight	(approx.)	kg/m ² /0.1 mm	0.32	0.35	0.49
		lb/ft ² /0.001 in	0.017	0.018	0.025
Constituent	vol. %	Nickel	50	60	70
		Graphite	25	20	15
		Porosity	25	20	15
Surface Roughness	as-sprayed	µm Ra	25 – 33	27 – 33	25 – 30
		µin Ra	1000 – 1300	1100 – 1300	1000 – 1200
	machined	µm Ra	12 – 15	12 – 15	10 – 12
		µin Ra	500 – 600	500 – 600	400 – 500
Macrohardness ^b	nominal	HR15Y	40	50	60
Thickness Limitation			None	None	None
Service Temperature	max	°C	480	480	480
		°F	900	900	900

^a All reported values are nominal based on standard spray conditions and parameters.

^b See additional information in section 3.3 "Measurement of Coating Hardness"

3.2 Additional Processing Information

- Some OEM's require that nickel graphite coatings are sprayed at an angle less than 90° relative to the coated surface, depending on part geometry and application requirements. Check OEM coating specifications and drawings.
- Coating properties such as hardness, tensile bond strength and erosion resistance are reduced when sprayed at angles less than 90° relative to the coated surface.
- Deposit efficiency will be reduced when nickel graphite is sprayed at angles less than 90° relative to the coated surface.
- Nickel graphite may be applied in ID applications using the Oerlikon Metco 6PT-II-1 or the 6PT-II-2 extension module for the 6P-II combustion spray gun.

- The actual ID standoff distance will depend on the coating properties required and the grade of nickel graphite used.
- Oerlikon Metco Coating Solution Centers can provide assistance in parameter development for specific applications.

3.3 Measurement of Coating Hardness

For abrasible coatings such as those in this publication using the HR15Y scale is a good indicator of proper spraying technique. To achieve consistent and more accurate results, special consideration must be given to surface preparation, coating thickness and the number of hardness impressions used. For assistance on proper measurement of abrasible coating hardness, please contact Oerlikon Metco.

3.4 Recommended Coating Finishing

Specification	Setting
Tool	Sharp point tungsten carbide machining tool
Work Speed / Traverse Rate	Slow / Slow
Feed Rate	Light
Condition	Dry

Important note: Coatings should not be ground. Pressure and heat generated by grinding will compress the coating and alter its properties.

3.5 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 Combustion Powder Spray Guns

Metco 6P-II series

Metco 6PT-II-1 *

Metco 6PT-II-2 *

* Extension modules for which a 6P-II spray gun is required

4 Commercial Information

4.1 Ordering Information and Availability

	Order No.	Package Size	Availability	Distribution
Metco 307NS	1000299	5 lb (approx. 2.25 kg)	Stock	Global
Metco 307NS-2	1000370	5 lb (approx. 2.25 kg)	Stock	Global
Metco 307NS-3	1000356	5 lb (approx. 2.25 kg)	Stock	Global
Metco 308NS	1000302	25 lb (approx. 11.3 kg)	Stock	Global
Metco 308NS-1	1000448	5 lb (approx. 2.25 kg)	Stock	Global
Metco 308NS-3	1000357	5 lb (approx. 2.25 kg)	Stock	Global
Metco 309NS-3	1000444	5 lb (approx. 2.25 kg)	Stock	Global
Durabrade 2211ZB	1043518 1043517	10 lb (approx. 4.5 kg) 5 kg (approx. 11 lb)	Stock Special Order	Global Global
Durabrade 2221	1043522 1043525	2.5 kg (approx. 5.5 lb) 10 lb (approx. 4.5 kg)	Stock Stock	Global Global
Durabrade 2222	1043529 1043531	10 lb (approx. 4.5 kb) 75 kg (approx. 165 lb)	Special Order Special Order	Global Global
Durabrade 2223	1043533 1043536	2.5 kg (approx. 5.5 lb) 10 lb (approx 4.5 kg)	Stock Special Order	Global Global
Durabrade 2224	1043539	2.5 kg (approx. 5.5 lb)	Special Order	Global
Durabrade 2231	1043541	10 lb (approx. 4.5 kg)	Special Order	Global
Durabrade 2241	1043543 1043546	100 kg (approx. 220 lb) 10 lb (approx. 4.5 kg)	Stock Stock	Global Global

4.2 Handling Recommendations

- Store in the original container in a dry location.
- Carefully tumble contents prior to use to prevent segregation, but avoid breakdown of friable components.
- Open containers should be stored in a drying oven at temperatures to prevent moisture pickup.
- Avoid prolonged storage at elevated temperatures.

4.3 Safety Recommendations

See the correct 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 No.
Metco 307NS	50-156
Metco 307NS-2	50-156
Metco 307NS-3	50-156
Metco 308NS	50-429
Metco 308NS-1	50-429
Metco 308NS-3	50-429
Metco 309NS-3	50-430
Durabrade 2211ZB	50-1055
Durabrade 2221	50-1054
Durabrade 2222	50-1054
Durabrade 2223	50-1054
Durabrade 2224	50-1054
Durabrade 2231	50-1056
Durabrade 2241	50-1056