

# Material Product Data Sheet

## Aluminum Silicon Graphite Abradable Powders

### Thermal Spray Powder Products: Metco™ 310NS, Metco 311NS, Metco 313NS

#### 1 Introduction

Aluminum silicon alloy–graphite powders are composite powders providing consistent quality clearance control coatings for gas turbine engines.

Clearance control coatings are used in applications where rotating components 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.

Coatings produced from aluminum silicon graphite offer a good balance of abrasability and erosion resistance. The graphite component adds lubricity, reducing material transfer from the coating to the rotating component.

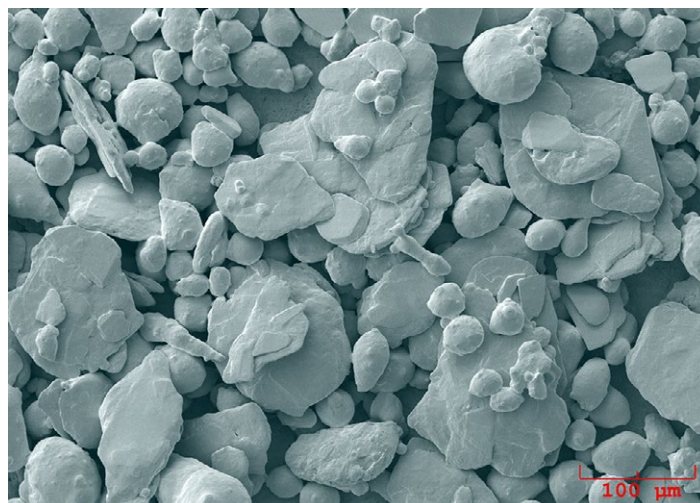
Metco 310NS should be applied using the Combustion Powder Thermospray™ process. Metco 311NS and Metco 313NS should be applied via the Atmospheric Plasma Spray process.

#### 1.1 Typical Uses and Applications

- Specifically developed for abradable coatings in clearance control applications, particularly in the compressor section of gas turbine engines
- Coatings from these powders are suited to rub against titanium, nickel alloy and steel components
- Aluminum silicon graphite coatings are generally used in low temperature applications with operating temperatures up to 415 °C (780 °F)
- Metco 310NS provides higher temperature capability up to approximately 480 °C (900 °F)

#### Quick Facts

Classification	Abradable, aluminum based
Chemistry	AlSi-C
Manufacture	Mechanically Clad
Morphology	Flake and rounded
Apparent density	0.94 – 1.1 g/cm <sup>3</sup>
Service temperature*	≤ 415 – 480 °C (780 – 900 °F)
Purpose	Clearance control coatings
Process	Combustion Powder Thermospray™ or Atmospheric Plasma Spray



Photomicrograph of Metco 313NS Powder

## 2 Material Information

### 2.1 Chemical Composition

Product	Weight Percent (nominal)			
	Al	Si	Graphite	Organic Binder
Metco 310NS	64	7	22	7
Metco 311NS	61	6	24	9
Metco 313NS	42	5	45	8

### 2.2 Particle Size Distribution and Apparent Density

Product	Nominal Range $\mu\text{m}$	Apparent Density ( $\text{g}/\text{cm}^3$ )
Metco 310NS	-125 +5	1.1
Metco 311NS	-180 +8	1.0
Metco 313NS	-180 +8	0.94

Upper particle size analysis of Metco 310NS using sieve in accordance with ASTM B214. Particle size analysis of Metco 311NS, Metco 313NS and lower particle size analysis of Metco 310NS using laser diffraction (Microtrac).

### 2.3 Key Selection Criteria

- Plasma sprayed coatings of Metco 311NS and Metco 313NS are denser than combustion sprayed coatings such as Metco 310NS and have been proven to have greater erosion resistance.
- When plasma sprayed bond coats are used, plasma sprayed Metco 311NS and 313NS can provide an easier transition for the spraying of the topcoat as compared to M310NS.
- In general, Aluminum Silicon Graphite abrasives should be considered for MRO applications only. Oerlikon Metco offers a number of improved products for abrasible coating applications having significantly better corrosion and other service characteristics than coatings of Aluminum Silicon Graphite. These improved products should be strongly considered for new applications (see section 2.4).

### 2.4 Related Products

Metco 320 gives better corrosion resistance than Aluminum Silicon Graphite materials and, overall, is a better selection for new applications at service temperatures up to 450 °C (840 °F). At higher temperatures of up to 550 °C (1020 °F) and if compatibility with titanium blades is required, Metco 2042 is the material of choice. For lower service temperatures up to 325 °C ( 620 °F ), Aluminum Silicon Polyester materials such as Metco 601NS should be considered. See the corresponding material product data sheets for further information.

### 2.5 Customer Specifications

Product	Customer Specification	
Metco 310NS	Honeywell FP 5045, Type XXIV Rolls-Royce Corporation PMI 1268 Rolls-Royce plc MSRR 9507/30	Rolls-Royce Corporation EMS 56764 Rolls-Royce OMAT 3/175
Metco 311NS	Rolls-Royce Corporation EMS 56765 Rolls-Royce plc MSRR 9507/67	Rolls-Royce OMAT 3/254
Metco 313NS	Canada Pratt & Whitney CPW 555 Rolls-Royce OMAT 3/187 Rolls-Royce plc 9507/44	GKN Aerospace PM 819-64 Rolls-Royce plc RRMS 40027

### 3 Coating Information

#### 3.1 Key Thermal Spray Coating Information

Specification			Typical Data		
			Metco 310NS	Metco 311NS	Metco 313NS
Recommended Process <sup>a</sup>			●	▲	▲
Recommended Bond Coat			Metco 450NS or Amdry 956		
Density	(approx.)	g/cm <sup>3</sup>	1.8	2.0	2.0
Weight	(approx.)	kg/m <sup>2</sup> /0.1 mm	0.18	0.20	0.20
		lb/ft <sup>2</sup> /0.001 in	0.009	0.010	0.010
Constituent	(vol. %)	Aluminum Alloy	65	65	70
		Graphite	10	22	22
		Porosity	25	13	8
Finish	as-sprayed	µm aa	10 – 13	17 – 22	18 – 20
		µin aa	400 – 500	650 – 850	700 – 800
	machined	µm aa	4 – 6	5 – 7.5	2.5 – 5
		µin aa	150 – 250	200 – 300	100 – 200
Macrohardness <sup>b</sup>	HR15Y	50 nominal	55 – 75	55 – 80	
Thickness Limitation			None	None	None
Service Temperature	max	°C	480	415	415
		°F	900	780	780
Post Finishing <sup>c</sup>	tool		single point carbide machining tool, typically “d” shape		
	work speed	m/s	~ 2.0		
		ft/min	~ 390		
	condition		dry		

<sup>a</sup> Combustion Powder Spray ●, Atmospheric Plasma Spray ▲

<sup>b</sup> See additional information in section 3.2 “Ageing Effects and Measurement of Coating Hardness”

<sup>c</sup> Coatings should not be ground. Pressure and heat generated by grinding will compress the coating and alter its properties

#### 3.2 Ageing Effects and Measurement of Coating Hardness

**Ageing Effects:** The aluminum alloy in these products is sensitive to over-ageing as is evidenced by decreased coating hardness when exposed for several hours to temperatures at or above 315 °C (600 °F). Despite the ageing tendency, lower hardness does not reflect an inferior coating. The typical physical properties listed should be used as the initial indicator of a correctly applied coating.

**Hardness Testing:** 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.

#### 3.3 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.

TriplexPro™ parameters offer significantly better throughput that reduce processing time and material use.

#### Recommended Spray Guns

Combustion Powder	Atmospheric Plasma
Metco 6P-II series	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
Metco 310NS	1000353	5 lb (approx. 2.25 kg)	Stock	Global
Metco 311NS	1000574	5 lb (approx. 2.25 kg)	Stock	Global
Metco 313NS	1000569	5 lb (approx. 2.25 kg)	Stock	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.

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

Product	SDS No.
Metco 310NS	50-157
Metco 311NS	50-409
Metco 313NS	50-410