

Material Product Data Sheet

8 % Yttria Stabilized Zirconia Agglomerated and HOSP Powders

Powder Products:

**Metco™ 204C-NS Premium,
Metco 204NS-G Premium, Metco 204D,
Metco 204NS, Metco 204B-NS, Metco 204AF,
Metco 204AF-1, Amdry 204NS-1, Metco 204C-NS,
Metco 204F, Metco 204NS-G, Metco 204NS-AP,
SPM 2000, SPM 2000-1**

1 Introduction

Yttria stabilized zirconia ($8Y_2O_3-ZrO_2$) powders manufactured by Oerlikon Metco's HOSP™ process combine the advantages of pre-alloyed, fused and crushed powders together with the free flowing, consistent shape of spray dried powders.

Densification via the HOSP process ensures high deposit efficiency during the coating process, reducing application time and overspray waste. Powders are spheroidal with excellent flow, chemical homogeneity and structural stability. Compositions are manufactured from high purity raw materials, and produce coatings that provide long-lasting, reliable service.

Many of Oerlikon Metco's HOSP YSZ products are manufactured using very high purity, white materials (see section 2.1). Coatings of these products offer extended coating life through improved sintering resistance. It is the exceptional purity of these materials, with minimized levels of low-melting trace constituents that improves coating performance, even at temperatures significantly above 1200 °C (2200 °F).

1.1 Typical Uses and Applications

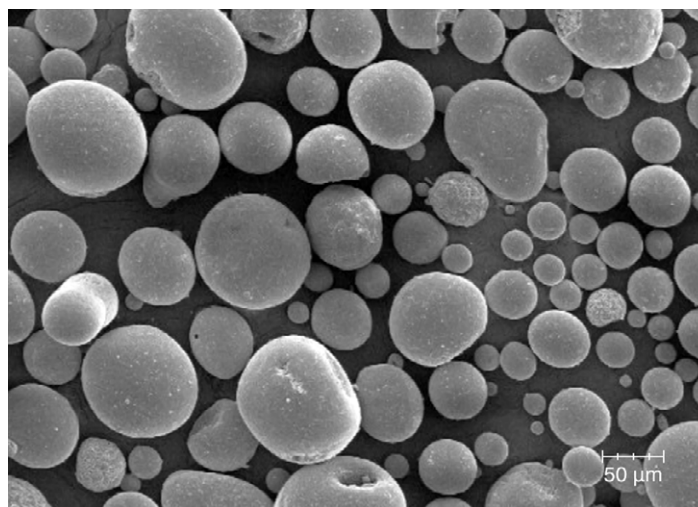
Usually used as a thermal spray coating for:

- Top coat (insulating layer) in a thermal barrier coating (TBC) system for industrial and flight gas turbine engine components such as combustion liners, transition pieces, afterburners, heat shields, turbine airfoils.
- Thermal protection at temperatures up to 900 °C (1650 °F) on metallic diesel and gasoline engine components such as cylinder heads, piston crowns, exhaust and intake valves, turbochargers.
- In general, these materials are used as the insulating layer in a two-part TBC system, consisting of a thermal sprayed bond coat and YSZ top coat. For some applications, they are used as intermediate layers between an oxidation-resistant bond coat and a more porous, low-K TBC system.

Quick Facts

Classification	Ceramic, zirconia based
Chemistry	$ZrO_2 \cdot 8Y_2O_3$
Manufacture	Agglomerated & HOSP
Morphology	Spheroidal
Apparent Density	$2.3 \pm 0.2 \text{ g/cm}^3$
Service Temperature*	High Purity Products: $\leq 1350 \text{ °C}$ (2460 °F) Other Products $\leq 1250 \text{ °C}$ (2280 °F)
Melting point	2800 °C (5072 °F)
Purpose	Thermal protection
Process	Atmospheric Plasma Spray, ChamPro™ (LVPS, LPPS, VPS)

* With suitable bond coat



Photomicrograph of a typical yttria-stabilized zirconium oxide material manufactured using Metco's HOSP process.

2 Material Information

2.1 Chemical Composition

Product	ZrO ₂ ^a	Y ₂ O ₃	SiO ₂ (max)	TiO ₂ (max)	Al ₂ O ₃ (max)	Fe ₂ O ₃ (max)	Other Oxides (max)	Monoclinic Phase (max)
Metco 204C-NS Premium	Balance	7.0 – 8.0	0.05	0.05	0.05	0.05	0.5	10
Metco 204NS-G Premium	Balance	7.0 – 8.0	0.05	0.05	0.05	0.05	0.5	6
Metco 204D	Balance	7.0 – 8.0	0.15	0.15	0.15	0.15	1.0	10
Metco 204NS	Balance	7.0 – 8.0	0.3	0.2	0.2	0.2	1.0	10
Metco 204B-NS	Balance	7.0 – 8.0	0.3	0.2	0.2	0.2	1.0	~ 10
Metco 204AF	Balance	7.0 – 8.0	0.3	0.2	0.2	0.2	1.0	10
Amdry 204NS-1	Balance	7.0 – 8.0	0.7	0.2	0.2	0.2	1.0	10
Metco 204C-NS	Balance	7.0 – 8.0	0.7	0.2	0.2	0.2	1.0	~ 10
Metco 204F	Balance	7.0 – 8.0	0.7	0.2	0.2	0.2	1.0	~ 6
Metco 204AF-1	Balance	7.0 – 8.0	0.7	0.2	0.2	0.2	1.0	10
Metco 204NS-G	Balance	7.0 – 8.0	0.7	0.2	0.2	0.2	1.0	~ 6
Metco 204NS-AP					Proprietary			
SPM 2000					Proprietary			
SPM 2000-1					Proprietary			

^a Maximum 2.5% HfO₂ included in this value

2.2 Additional Powder Characteristics

Product	Nominal Range μm	D 90%	D 50%	D 10%	Color
Metco 204C-NS Premium	-147 +45	107 – 120	68 – 77	39 – 49	White
Metco 204NS-G Premium	-125 +11	93 – 103	50 – 57	21 – 25	White
Metco 204D	-90 +16	85 – 99	47 – 57	20 – 30	White
Metco 204NS	-125 +11	90 – 109	49 – 59	20 – 28	White
Metco 204B-NS	-75 +45	88 – 93	57 – 62	36 – 42	White
Metco 204AF	-45 +15	36 – 45	20 – 30	10 – 20	White
Amdry 204NS-1	-125 +11	90 – 109	49 – 59	20 – 28	Off-White
Metco 204C-NS	-147 +45	107 – 120	68 – 77	39 – 49	Off-White
Metco 204F	-45 +15	36 – 45	20 – 30	10 – 20	Off-White
Metco 204AF-1	-45 +15	36 – 45	20 – 30	10 – 20	Off-White
Metco 204NS-G	-125 +11	90 – 105	52 – 64	22 – 34	Off-White
Metco 204NS-AP					Proprietary
SPM 2000					Proprietary
SPM 2000-1					Proprietary

Particle size analysis by laser diffraction (Microtrac) in accordance with ASTM B822.

2.3 Key Selection Criteria

- Choose the product that meets the required customer material specification.
- Oerlikon Metco has many products in our portfolio that can meet a wide range of customer design criteria.
- Powders products with fine particle distributions typically produce dense coating microstructures, while materials with coarser distributions produce more porous coating microstructures.
- Products designated as Premium provide extended coating life as a result of high sintering resistance and low shrinkage. These materials can also be used in moderately higher temperature TBC applications. Coatings are the whitest in color of all TBC materials in the Metco YSZ portfolio of products.
- Metco 204D offers excellent purity and performance. It can be used as cost-efficient alternatives for aerospace and power generation applications when customer specifications allow for such substitutions.
- Metco 204AF is designed to produce dense microstructures with smooth, as-sprayed surface textures.
- Amdry 204NS-1, Metco 204AF-1, Metco 204NS-G and Metco 204C-NS are slightly lower purity products. Coatings of these materials will be light cream in color, compared to coatings of other products in this datasheet, which will be white to near white.
- Metco 204F has a very fine particle size distribution that can produce coatings with dense or dense, vertically cracked microstructures when applied using atmospheric plasma spray equipment. Metco 204F can also be applied by the combustion powder Thermospray™ process, using a Metco 6P-II spray gun at low feed rates.
- SPM-designated products are proprietary and specifically designed to produce unique coating microstructures when applied with plasma equipment at high power.
- Metco 204NS-AP is also a proprietary product that has been tailored to produce coating having unique microstructures sprayed using very specific plasma coating conditions.

2.4 Related Products

- Coatings of 7 to 8 % yttria stabilized zirconia exhibit better volume stability and can be used at higher service temperatures than magnesia- or calcia-stabilized materials, such as the Metco 201 and the Metco 210 families of materials.
- HOSP densified products exhibit higher coating deposit efficiencies than many competitive materials using alternative manufacturing technologies.
- HOSP densified products show better material feed characteristics than angular (fused and crushed) materials, such as Metco 214A.
- Coatings of 7 to 8 % yttria stabilized zirconia have better thermal cyclic properties compared to coatings of fully stabilized products such as Metco 202NS.
- Coatings of these materials are somewhat more prone to chemical attack from sodium, sulfur and chlorine contaminants than ceria-stabilized materials (Metco 205NS).
- Coatings of these materials are less resistant to erosion and scuffing, and have a somewhat lower hot hardness than coatings of zirconia yttria titania (Metco 143), but can be used at higher service temperatures.
- When high coating porosities are required, agglomerated and sintered YSZ materials may be more appropriate. Metco 22xx series products are high purity agglomerated and sintered powders, equivalent to the HOSP products designated as Premium in this datasheet. Metco 23xx series have chemistries equivalent to today's industry standard for YSZ chemistries.
- Metco 6700 is a spray dried, flame-stabilized YSZ material that has a particle size distribution much finer than other Metco yttria-zirconia based materials. It is designed to be applied using the Metco ChamPro™ PS-PVD process, giving rise to dense coating structures, including segmented structures similar to EB-PVD.
- Oerlikon Metco also offers a complete portfolio of bond coat materials, including MCrAlY materials most often used as a bond coat for these thermal barrier materials.

2.5 Customer Specifications

Product	Customer Specifications	
Metco 204C-NS Premium	GE A50A558 ^a	
Metco 204D	U. S. Military USAF 461204	
Metco 204NS-G Premium	GE A50A557	U. S. Military USAF 461206 (material only for intermediate coat)
Metco 204NS	Avio 4800M/40 Canada Pratt & Whitney CPW 673 Chromalloy BZ-003 Type 52 GE A50TF278, CI B, 10042376 GE A50TF278, CI D GE 1042376 GKN Aerospace PM 819-20 Hamilton Sundstrand ESR 1487 Honeywell EMS 57750, Type I, CI 1	Honeywell M3966, Type II Honeywell M3978 Pratt & Whitney PWA 1375 Siemens PD83336AA, Sec. 7.2 & 7.2.2 SiemensPD83336AB, Sec. 5.3 & 5.3.1 Siemens PD83336Z2, Sec. 7.3 & 7.3.2 Solar Turbines ES9-110B, Class A U. S. Military SA-ALC 97P1271
Metco 204B-NS	Avio 4800M/38 GE A50TF204, CI B GKN Aerospace PM 819-55 Honeywell 91547-52564 App. A Sec 1.3 Honeywell EMS 10479, Paragraph 8.3.2 Light Helicopter LHM 3314	Rolls-Royce Corporation EMS 56722 Rolls-Royce OMAT 3/185A Rolls-Royce plc MSRR 9507/46 Rolls-Royce plc RRMS 40000 DMR 33.098 Pratt & Whitney MC-2024
Metco 204AF	Pratt & Whitney PWA 36318	
Amdry 204NS-1	Canada Pratt & Whitney CPW 673 Chromalloy BZ-003 Type 52 GE A50TF278, CI B Hamilton Sundstrand ESR 1487 Honeywell EMS 57750, Type I, CI 1 Pratt & Whitney PWA 1375	Siemens PD83336AA, Sec. 7.2 & 7.2.2 SiemensPD83336AB, Sec. 5.3 & 5.3.1 Siemens PD83336Z2, Sec. 7.3 & 7.3.2 Turbine Airfoil Coating and Repair TACR 05-366 Type 5 & 6 Turbine Airfoil Coating and Repair MS201-1
Metco 204C-NS	GE A50A558 GE A50TF278, CI A	Power Systems Manufacturing LLC PSM-410-2 Appendix I
Metco 204NS-G	GE A50A557 GE A50TF278, CI B, F50TF50, CI B GE A50TF278, CI C	Siemens HTCT 650564
Metco 204NS-AP	Alstom HMHD 658042, Except TiO 0.1%	
SPM 2000	GE A50AG1 GE A50TF278, CI B	GE A50TF278, CI D
SPM 2000-1	GE A50AG1, CI A	GE A50TF278, CI B

^a Fulfills requirements but not approved

3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification	Typical Data
Recommended coating processes	APS (Atmospheric Plasma Spray) or ChamPro™ (Controlled Atmosphere Plasma Spray)
Recommended bond coat	Suitable high-temperature materials that are compatible with the substrate. MCrAlY bond-coats are recommended.
Typical porosity range	8 – 20%
Thermal conductivity	0.8 – 1.3 W/mK
Thermal expansion	10 x 10 ⁻⁶ /K 5.6 x 10 ⁻⁶ /°R
Specific Heat	450 ± 20 J/kgK
Post finishing	Typically used as-sprayed. May be SiC or diamond ground
Microstructure characteristics	Homogeneously porous and finely microcracked

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 Atmospheric Plasma Spray Guns

Metco 9MBM

Metco 11MB

Metco 8MB

Metco F4MB-XL series

iPro™-90

Metco SM F-100 Connex

Metco SM F-220

TriplexPro™ series

SinplexPro™ series

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Metco 204C-NS Premium	1084635	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204NS-G Premium	1084634	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204D	1097241	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204NS	1000577 1000591	5 lb (approx. 2.25 kg) 12.5 lb (approx. 5.7 kg)	Stock Stock	Global Global
Metco 204B-NS	1000590	5 lb (approx. 2.25 kg)	Stock	Global
Metco 204AF	1050349	12.5 lb (approx. 5.7 kg)	Stock	Global
Amdry 204NS-1	1001585	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204C-NS	1001593	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204F	1043121	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204AF-1	2410200	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204NS-G	1000800	12.5 lb (approx. 5.7 kg)	Stock	Global
Metco 204NS-AP ^a	1037601	12.5 lb (approx. 5.7 kg)	Stock	Global
SPM 2000 ^a	1019245	12.5 lb (approx. 5.7 kg)	Stock	Global
SPM 2000-1 ^a	1029027	12.5 lb (approx. 5.7 kg)	Stock	Global

^a Available only to OEM qualified buyers

4.2 Handling Recommendations

- Store in the original container in a dry location.
- Tumble contents gently prior to use to prevent segregation.
- Fine powder products are more susceptible to moisture pick-up, which may lead to powder clumping and non-flowing powder. Open bottles should be kept in a drying oven.
- Powder bottles may be heated at less than 200 °F (93°C) in a drying oven. Powder should not be heated for more than 8 hours.
- Powder may be screened over a coarse mesh screen to further improve flowability

4.3 Safety Recommendations

See the applicable SDS (Safety Data Sheet) in the localized version applicable to 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 204C-NS Premium	50-149
Metco 204NS-G Premium	50-149
Metco 204D	50-149
Metco 204NS	50-149
Metco 204B-NS	50-149
Metco 204AF	50-1552
Amdry 204NS-1	50-1552
Metco 204C-NS	50-1552
Metco 204F	50-1552
Metco 204AF-1	50-1552
Metco 204NS-G	50-1552
Metco 204NS-AP	50-1552
SPM 2000	50-819
SPM 2000-1	50-819

Information is subject to change without prior notice.