

Material Product Data Sheet

Tungsten Carbide – Chromium Carbide – Nickel

Thermal Spray Powder Products:

WOKA 3701, WOKA 3702, WOKA 3702-1, WOKA 3703, WOKA 3707

1 Introduction

WOKA™ 3700 series materials are agglomerated and sintered powders for thermal spray, containing 73% tungsten carbide and 20% chromium carbide as hard phase materials in a nickel matrix that functions as a binder for the carbide particles. The particle shape is mainly spheroidal.

WOKA 3702-1 has an adjusted, tighter chemical composition and a lower apparent density than the standard WOKA 3700 series materials. This results in higher deposition efficiencies and denser coatings for improved corrosion resistance while maintaining the good oxidation and wear properties of coatings produced using the WOKA 3700 series materials.

These materials are applied using the HVOF or plasma spray process whenever resistance to wear and corrosion in hydrous solutions is required; e.g., for oil and gas applications and in the paper industry. Coatings of these materials are thermally stable up to 700 °C (1290 °F). The finer grades produce very tough and dense coatings that are often used in the “as sprayed” condition without further finishing.

HVOF coatings of these materials are dense and show good bonding strength.

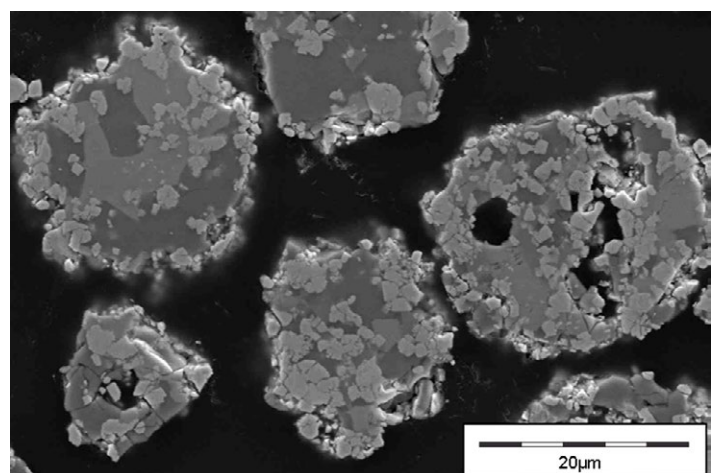
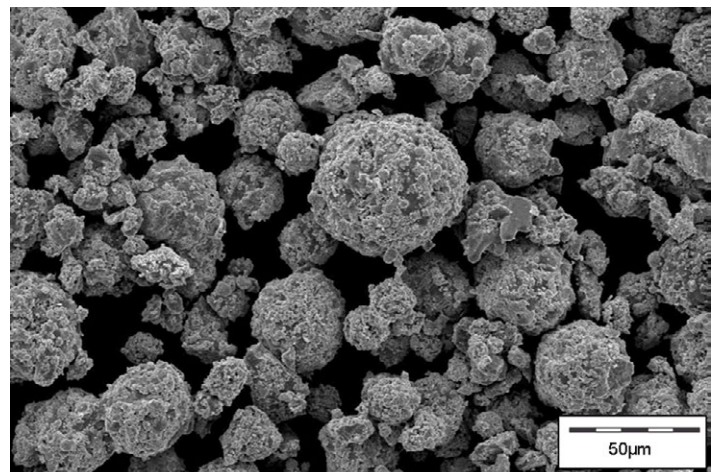
1.1 Typical Uses and Applications

Recommended for applications requiring dense, smooth coatings with excellent oxidation and corrosion resistance at service temperatures up to 700 °C (1290 °F), such as:

- Pins for Oil and Gas
- Mud pump rotors
- Paper rollers
- Pump rotors, seals and bearings
- Slush pump piston rods
- Deflector rolls
- Dump valves
- Forging tools
- Oil field equipment
- Compressor shafts

Quick Facts

Classification	Carbide, tungsten-based
Chemistry	WC 20Cr ₃ C ₂ 7Ni
Manufacture	Agglomerated and sintered
Morphology	Spheroidal
Apparent Density	3.8 – 4.9 g/cm ³
Flowability	Free-flowing
Service Temperature	< 700 °C (1290 °F)
Purpose	Corrosive / oxidative wear resistance
Process	HVOF or atmospheric plasma spray



SEM Photomicrographs showing the morphology (top) and the microstructure (bottom) of WOKA 3703 powder.

2 Material Information

2.1 Chemical Composition (all products)

Product	Weight Percent (nominal)					
	Formula	W	Cr	Ni	C _{TOTAL}	Fe
WOKA 3701	WC 20Cr ₃ C ₂ 7Ni	Balance	19.0 – 24.0	5.5 – 8.5	5.7 – 6.5	< 0.5
WOKA 3702	WC 20Cr ₃ C ₂ 7Ni	Balance	19.0 – 24.0	5.5 – 8.5	5.7 – 6.5	< 0.5
WOKA 3702-1	WC 20Cr ₃ C ₂ 7Ni	Balance	17.5 – 20.5	6.0 – 8.0	6.5 – 8.0	< 0.5
WOKA 3703	WC 20Cr ₃ C ₂ 7Ni	Balance	19.0 – 24.0	5.5 – 8.5	5.7 – 6.5	< 0.5
WOKA 3707	WC 20Cr ₃ C ₂ 7Ni	Balance	19.0 – 24.0	5.5 – 8.5	5.7 – 6.5	< 0.5

2.2 Particle Size Distribution

Product	Nominal Range µm	Primary Carbide Size µm	Apparent Density (g/cm ³)
WOKA 3701	-53 +20	Medium	4.3 – 4.9
WOKA 3702	-45 +15	Medium	4.3 – 4.9
WOKA 3702-1	-45 +15	Medium	3.8 – 4.4
WOKA 3703	-45 +11	Medium	4.2 – 4.8
WOKA 3707	-45 +20	Medium	4.3 – 4.9

Size analysis below 20 µm using laser diffraction (Microtrac), Size analysis 20 µm and above using sieve. Other particle size distributions are available on request.

2.3 Key Selection Criteria

Main selection criteria for choosing a WOKA 3700 series material:

- Particle size distributions are optimized for a variety of HVOF guns on the market today. See Section 2.5 for recommendations.
- WOKA 3702-1 is an optimized material designed for high deposition efficiency and coatings with lower porosity. It is the material of choice to meet coating economic targets or when very dense coatings with improved corrosion resistance are required.
- Desired as-sprayed surface roughness. For the smoothest possible surface, choose a product with the lowest particle size distribution appropriate for the spray process and spray gun to be used. In addition, finer particle size fractions lead to finer as-sprayed surfaces.

2.4 Related Products

- For applications where a higher hardness is required choose a tungsten carbide material with a cobalt-chromium matrix such as WOKA 365x series products (see datasheet DSMTS-0025) or WOKA 360x series products (see datasheet DSMTS-0051).
- If better corrosion resistance in HCl solutions is required, use a tungsten carbide material with a cobalt-chromium matrix such as WOKA 365x series products, (see datasheet DSMTS-0025) or WOKA 360x series products (see datasheet DSMTS-0051).
- If higher service temperature is required or better corrosion resistance in NaOH solutions, choose a chromium carbide with a nickel-chromium matrix such as WOKA 71xx, WOKA 72xx or WOKA 73xx series products (see datasheets DSMTS-0027, DSMTS-0031 and DSMTS-0058, respectively).

2.5 Recommend Spray Guns

Product	Diamond Jet	WokaJet / WokaStar / JP5000	K2	Jet Kote	Top Gun / HV2000	Atmospheric Plasma
WOKA 3701			●	●		
WOKA 3702	●	●	●	●	●	
WOKA 3702-1	●	●	●	●	●	
WOKA 3703	●					
WOKA 3707	●	●				

3 Coating Information

3.1 Key Thermal Spray Coating Information

Characteristic	Typical Data ^a	
Recommended Process	HVOF or Atmospheric Plasma Spray	
Microhardness	HV0.3	900 – 1350
Macrohardness	HR15N	> 90
Wear Rate	ASTM G65 B	< 3 mm ³ < 0.00018 in ³
Porosity	< 2%	
Corrosion Resistance	Excellent in NaCl (1M), H ₂ SO ₄ (0.5M) and NaOH (1M); Fair in HCl (1M)	
Maximum Service Temperature	700 °C	1290 °F
Deposition Efficiency	32 – 50%	

^a Depending on the process and spray gun used, spray parameters used 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

HVOF	Atmospheric Plasma
Water-Cooled DiamondJet	Metco 9MB series
WokaJet series	Metco F4MB-XL series
WokaStar series	TriplexPro series
	SinplexPro series

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
WOKA 3701	1041170	5 kg (approx. 11 lb)	Special Order	Europe
	1041158	10 lb (approx. 4.5 kg)	Special Order	Americas
WOKA 3702	1041117	5 kg (approx. 11 lb)	Stock	Europe
	1041071	10 lb (approx. 4.5 kg)	Special Order	Americas
WOKA 3702-1	1081343	5 kg (approx. 11 lb)	Stock	Global
WOKA 3703	1041150	5 kg (approx. 11 lb)	Stock	Europe
	1041185	10 lb (approx. 4.5 kg)	Stock	Americas
WOKA 3707	1041118	5 kg (approx. 11 lb)	Special Order	Europe
	1041072	10 lb (approx. 4.5 kg)	Special Order	Americas

Note: For products available in both kilogram and pound weights, the kilogram package will be supplied to unspecified regions (Africa, Asia/Pacific, Japan and Middle East) unless the pound package is specifically requested by the customer.

4.2 Handling Recommendations

- Store in the original container in a dry location.
- Tumble contents prior to use to prevent segregation.
- Open containers should be stored in a drying oven to prevent moisture pickup.

4.3 Safety Recommendations

See SDS 50-890 (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).

oerlikon
metco