

Material Product Data Sheet

Tungsten Carbide 9% Cobalt 5% Chromium 1% Nickel

Thermal Spray Powder Products:

**Woka 3601, Woka 3602, Woka 3603, Woka 3604,
Woka 3606, Woka 3607, Woka 3610, Woka 3619,
Woka 3622, Woka 3632, Woka 3644**

1 Introduction

Woka™ 3600 series products are agglomerated and sintered powders for thermal spray that contain 85 % tungsten carbide as a hard phase material and a cobalt-chromium-nickel matrix, which functions as a binder for the carbide particles. The particle shape is primarily spheroidal.

These materials can be applied using the HVOF or atmospheric plasma spray process whenever extremely wear-resistant coatings are required for low temperature applications in corrosive mediums, such as mining rollers of carrier belts. Coatings are thermally stable up to a maximum of 500 °C (930 °F). Products with finer particle distributions produce very tough and dense coatings that can often be used in the “as-sprayed” condition without further finishing.

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

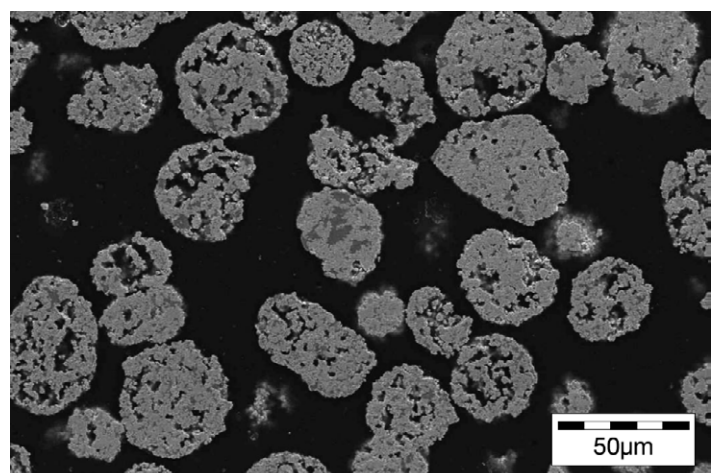
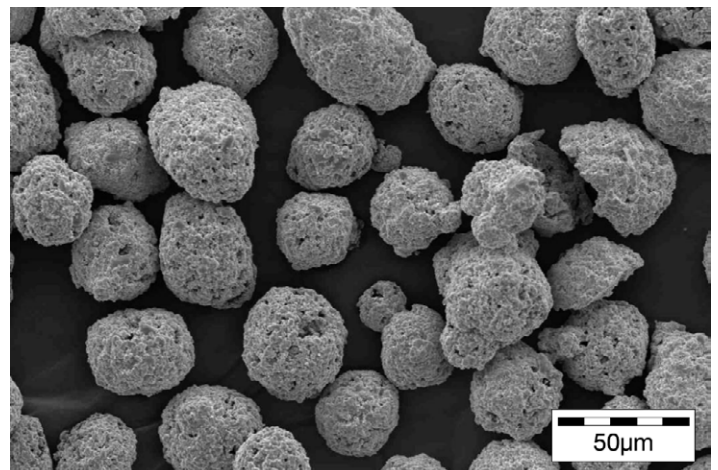
1.1 Typical Uses and Applications

Woka 3600 series materials are the best choice whenever corrosion-resistant coatings, coupled with high abrasion resistance, are needed. Corrosion resistance equals or surpasses galvanic chromium plating, especially in HCl environments. Typical applications include:

- Carrier belt rollers
- Paper machinery rolls
- Pump seals
- Slush pump piston rods
- Dump valves
- Hydraulic rods
- Polished rod liners
- Thermal sprayed alternative to hard chromium plating

Quick Facts

Classification	Carbide, tungsten-based
Chemistry	85WC 9Co 5Cr 1Ni
Manufacture	Agglomerated and sintered
Morphology	Spheroidal
Purpose	Corrosive wear resistance
Apparent Density	4.5 – 5.4 g/cm ³
Flowability	Free-flowing powder
Service Temperature	≤ 500 °C (930 °F)
Process	HVOF or atmospheric plasma spray



SEM Photomicrographs showing powder morphology (top) and microstructure (bottom) of Woka 3607 powder.

2 Material Information

2.1 Chemical Composition

	Weight Percent (nominal)					
	W	Co	Cr	Ni	C (total)	Fe (max)
Woka 3600 Series (all products)	Balance	7.5 – 10.5	4.4 – 5.6	0.5 – 1.5	4.8 – 5.6	0.2

2.2 Particle Size Distribution and Apparent Density

	Nominal Range (µm)	Primary Carbide Grain Size	Apparent Density (g/cm ³)
Woka 3601	-53 +20	Medium	4.8 – 5.4
Woka 3602	-45 +15	Medium	4.7 – 5.3
Woka 3603	-45 +11	Medium	4.7 – 5.3
Woka 3604	-30 +10	Medium	4.5 – 5.1
Woka 3606	-53 +15	Medium	4.7 – 5.3
Woka 3607	-45 +20	Medium	4.7 – 5.3
Woka 3610	-25 +5	Medium	4.5 – 5.1
Woka 3619	-63 +20	Medium	4.7 – 5.3
Woka 3622	-25 +10	Medium	4.5 – 5.1
Woka 3632	-30 +5	Medium	4.7 – 5.3
Woka 3644	-75 +20	Medium	4.7 – 5.3

- Particle size distribution: Analysis by sieve per ASTM B214 for all upper limits and lower limits for particle sizes ≥ 20 µm. Lower limit analysis for particle sizes < 20 µm based on laser scattering per ASTM C 1070 (Microtrac). All particle sizes can be 10 wt. % max above specified upper or below specified lower values.
- Other size distributions available on request.

2.3 Key Selection Criteria

- Choose a product for a specific application based on:
 - The process and spray gun to be used (refer to Section 2.5).
 - The desired as-sprayed surface roughness. For smoother surfaces, choose the lowest particle size distribution possible.
- Materials that contain both chromium carbide and tungsten carbide, such as Woka 75xx or Woka 37xx series products (see datasheets DSMTS-0056, DSMTS-0059, respectively).
- For applications where service temperatures are greater than 500 °C (930 °F), but less than 700 °C (1290 °F), choose a material that contains both chromium carbide and tungsten carbide, such as Woka 75xx or Woka 37xx series products (see datasheets DSMTS-0056, DSMTS-0059, respectively).

2.4 Related Products

- For better corrosion resistance in alkaline (NaOH), sulfuric acid (H₂SO₄) or saline (NaCl) solutions the following products are recommended:
 - Chromium carbide materials such as Woka 71xx, Woka 72xx or Woka 73xx series products (see datasheets DSMTS-0027, DSMTS-0031 and DSMTS-0058, respectively).
 - When service temperatures exceed 700 °C (1290 °F), choose a chromium carbide material 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 Recommended Spray Process and Spray Guns

	HVOF					APS	
	DiamondJet	WokaJet / WokaStar / JP5000	K2	Jet Kote	Top Gun / HV2000	CJS	TriplexPro / 9MB / F4, etc.
Woka 3601		●	●	●			
Woka 3602	●	●	●		●		
Woka 3603	●						
Woka 3604	●					●	
Woka 3606	●	●					
Woka 3607	●						
Woka 3610	●						
Woka 3619							●
Woka 3622	●						
Woka 3632	●						
Woka 3644							●

3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification	Typical Data ^a	
Recommended Process	HVOF	
Microhardness	HV0.3	1050 – 1400
Macrohardness	HR15N	> 92
Wear Rate	ASTM G65 B	< 4 mm ³
Porosity	< 1 – 2 %	
Corrosion Resistance	Excellent in NaCl (1M), good in HCL (1M), H ₂ SO ₄ (0.5M) and NaOH (1M)	
Deposition Efficiency	32 – 52 %	
Maximum Service Temperature	500 °C	930 °F

¹ Depending on the HVOF spray gun used, parameter 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 Diamond Jet	Metco 9MB series
WokaJet series	Metco F4 series
WokaStar series	TriplexPro series
JP5000 (Praxair / Tafa)	

4 Commercial Information

4.1 Ordering Information and Availability

	Order No.	Package Size	Availability	Distribution
Woka 3601	1041169	5 kg (approx. 11 lb)	Stock	Europe
	1041157	10 lb (approx. 4.5 kg)	Stock	Americas
Woka 3602	1041112	5 kg (approx. 11 lb)	Stock	Europe
	1063628	25 kg (approx. 55 lb)	Special Order	Global
	1041066	10 lb (approx. 4.5 kg)	Stock	Americas
Woka 3603	1041149	5 kg (approx. 11 lb)	Special Order	Europe
	1041184	10 lb (approx. 4.5 kg)	Stock	Americas
Woka 3604	1041113	5 kg (approx. 11 lb)	Stock	Europe
Woka 3606	1063543	5 kg (approx. 11 lb)	Special Order	Europe
	1049659	10 lb (approx. 4.5 kg)	Special Order	Americas
Woka 3607	1041114	5 kg (approx. 11 lb)	Stock	Europe
	1041068	10 lb (approx. 4.5 kg)	Special Order	Americas
Woka 3610	1041115	5 kg (approx. 11 lb)	Special Order	Europe
Woka 3619	1065462	5 kg (approx. 11 lb)	Special Order	Europe
Woka 3622	1041116	5 kg (approx. 11 lb)	Special Order	Europe
Woka 3632	1042982	10 lb (approx. 4.5 kg)	Special Order	Americas
Woka 3644	1067512	5 kg (approx. 11 lb)	Special Order	Europe

Note: Packaging in kilograms will be supplied to unspecified regions (Africa, Asia/Pacific, Japan and Middle East) unless the packaging in pounds 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 50-872 (Safety Data Sheet) 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).