

# Material Product Data Sheet

## Tungsten Carbide – 12 % Nickel Powders

### Thermal Spray Powder Products:

**Woka™ 3401, Woka 3402, Woka 3403, Woka 3404, Woka 3406, Woka 3408**

#### 1 Introduction

Woka 3400 products are spheroidal, agglomerated and sintered powders for thermal spray containing a uniform distribution of 88 % tungsten carbide with medium sized carbide grains as a hard phase and 12 % nickel as a binder metal. The finer powder particle size distributions produce very tough and dense coatings that can often be used in the “as-sprayed” condition without post-coat finishing.

Coatings made from tungsten carbide materials resist fretting, abrasion, hammer and sliding wear. Woka 3400 series products are most often used for abrasion-resistant coatings in dry environments. Their use at atmospheric temperatures above 500 °C (930 °F) is not recommended to prevent oxidation of the tungsten carbide. The corrosion resistance of WC-Ni is generally better than that of WC-Co coatings in similar environments, but not as good as coatings of WC-Co-Cr. Woka 3400 series coatings exhibit higher hardness compared to coatings of WC-17Ni (Woka 3500 series products), but have lower toughness. They have lower hardness but better toughness than coatings from Woka 3300 series materials (WC-10Ni). The absence of cobalt allows Woka 3400 series coatings to be used in radioactive environments.

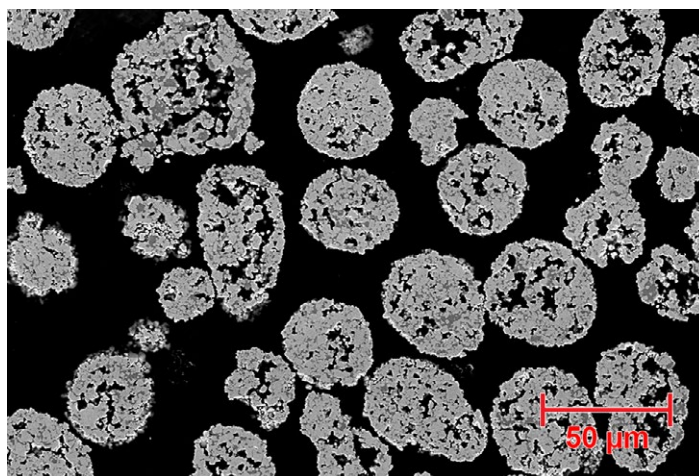
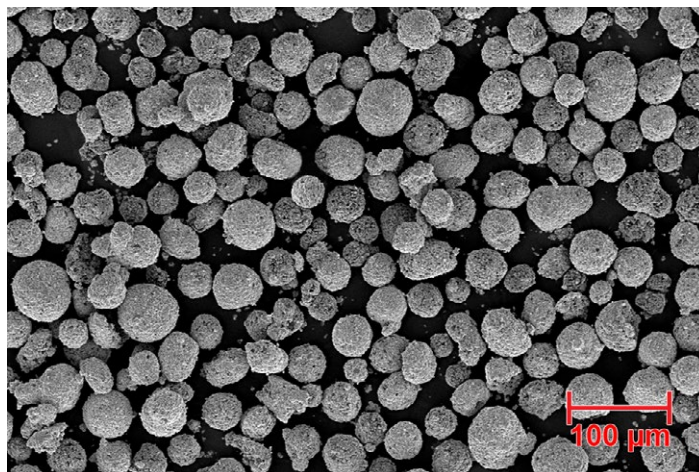
HVOF coatings of these materials are dense, show good bond strength and are more homogeneous than coatings applied using atmospheric plasma spray or combustion powder Thermospray™ coatings.

#### 1.1 Typical Uses and Applications

- Ball valves in oxidizing environments
- Gate valves
- Oil field equipment
- Parts used in submerged seawater conditions

#### Quick Facts

Classification	Carbide, tungsten-based
Chemistry	WC 12Ni
Manufacture	Agglomerated and sintered
Morphology	Spheroidal
Apparent Density	4.6 – 5.4 g/cm <sup>3</sup>
Service Temperature	< 500 °C (930 °F)
Purpose	Wear resistance
Process	HVOF



SEM Photomicrographs showing the morphology (top) and the microstructure (bottom) of Woka 3401 powder.

## 2 Material Information

### 2.1 Chemical Composition (all products)

Product	Weight Percent (nominal)			
	W	C	Ni	Fe
Woka 3400 Series	Balance	5.2 – 6.0	10.5 – 13.5	< 0.2

### 2.2 Particle Size Distribution

Product	Nominal Range $\mu\text{m}$	D95 $\mu\text{m}$	D5 $\mu\text{m}$	Primary Carbide Size $\mu\text{m}$
Woka 3401	-53 +20	53	20	Medium
Woka 3402	-45 +15	45	15	Medium
Woka 3403	-45 +11	45	11	Medium
Woka 3404	-30 +10	30	10	Medium
Woka 3406	-45 +20	45	20	Medium
Woka 3408	-30 +5	45	5	Medium

Size analysis below 20  $\mu\text{m}$  using laser diffraction (Microtrac), Size analysis 20  $\mu\text{m}$  and above using sieve. Other particle size distributions are available on request.

### 2.3 Key Selection Criteria

Main selection criteria for choosing a Woka 7100 series material are:

- Particle size distributions are optimized for a variety of HVOF guns on the market today. See Section 2.5 for recommendations.
- 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

- Like Woka 34xx products, Woka 33xx series [WC 12Ni] and Woka 35xx series [WC 17Ni] products are also tungsten carbide materials with nickel as the binder matrix instead of cobalt. Coatings are resistant to fretting under impact and frictional loads at service temperatures up to 500 °C (930 °F). All of these products can be used in radioactive environments as they are cobalt-free.
- Coatings of Woka 33xx series [WC 12Ni] have higher hardness but lower toughness than coatings of Woka 34xx series.
- Coatings of Woka 35xx series [WC 17Ni] have higher toughness but lower hardness than coatings of Woka 34xx series.
- Metco 5810, Diamalloy 2004 and Woka 31xx series products [WC 12Co, spheroidal, agglomerated and sintered]

produce coatings with higher hardness and wear-resistance compared to Woka 34xx products. Applications include exhaust fans, pump housings and steel rolls.

- Metco 5143, Diamalloy 2005NS and Woka 32xx series products [WC 17Co spheroidal, agglomerated and sintered] produce coatings that are tougher and more fret-resistant than coatings of Woka 34xx series products as a result of their higher metallic binder content. Applications include landing gears, mid-span stiffeners, extrusion dies and sucker rod couplings. These materials are not recommended for use in corrosive media.
- When higher hardness, wear-resistance and corrosion resistance is required than provided by coatings of Woka 34xx series materials, choose products such as Woka 365x series and Metco 5847 [WC 10Co 4Cr spheroidal, agglomerated and sintered] or Woka 360x series materials [WC 9Co 5Cr 1Ni]. They are ideal materials for hard chrome replacement.
- Woka 75xx series products [Cr<sub>3</sub>C<sub>2</sub> 37WC 18 metal alloy] are materials with a mixture of chrome and tungsten carbide in a metal alloy matrix. The coatings exhibit higher hardness, better abrasion resistance and very good corrosion resistance in harsh environments with complex corrosive media. Coatings can be used at service temperatures up to 700 °C (1290 °F).

## 2.5 Recommended Spray Guns

Product	Diamond Jet	WokaJet / WokaStar / JP5000	K2	Jet Kote	Top Gun / HV2000	CJS
Woka 3401		●	●			
Woka 3402	●	●	●	●		
Woka 3403	●				●	
Woka 3404	●					●
Woka 3406	●	●		●		
Woka 3408	●					●

## 3 Coating Information

### 3.1 Key Thermal Spray Coating Information

Characteristic	Typical Data <sup>a</sup>	
Recommended Process	HVOF	
Microhardness	HV0.3	1000 – 1250
Macrohardness	HR15N	> 90
Wear Rate	ASTM G65 B	< 6.5 mm <sup>3</sup> < 0.0004 in <sup>3</sup>
Porosity	< 1 %	
Corrosion Resistance	Better than WC 12Co coatings, but poor compared to WC 10Co 4Cr coatings	
Maximum Service Temperature	500 °C	930 °F
Deposition Efficiency	35 – 50 %	

<sup>a</sup> Depending on the HVOF 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 HVOF Spray Guns

DiamondJet series  
WokaJet series  
WokaStar series

## 4 Commercial Information

### 4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Woka 3401	1059073	5 kg (approx. 11 lb)	Special Order	Global
Woka 3402	1059519	5 kg (approx. 11 lb)	Stock	Global
Woka 3403	1065926	5 kg (approx. 11 lb)	Special Order	Global
Woka 3404	1065070	5 kg (approx. 11 lb)	Special Order	Global
Woka 3406	1063542	5 kg (approx. 11 lb)	Special Order	Global
Woka 3408	1058534	5 kg (approx. 11 lb)	Special Order	Global

### 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 50-885 (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](http://www.oerlikon.com/metco) (Resources – Safety Data Sheets).