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# 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.

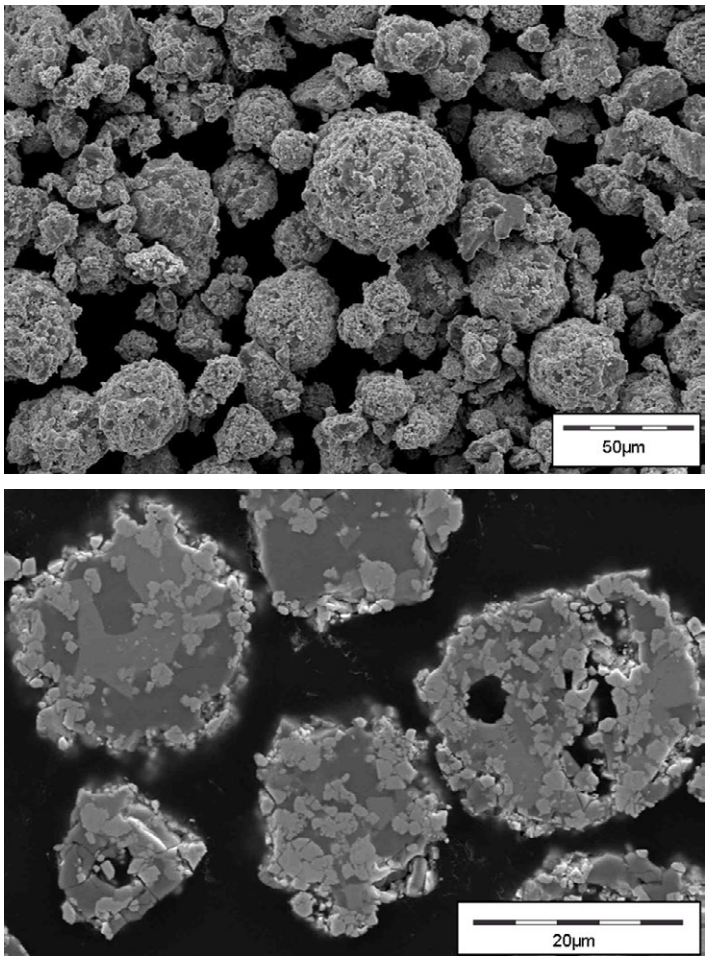
HVOF coatings of these materials are dense and show good bonding strength.

### 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 20$Cr_3C_2$ 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 $20Cr_3C_2$ 7Ni | Balance | 19.0 – 24.0 | 5.5 – 8.5 | 5.7 – 6.5 | < 0.5 |
| WOKA 3702 | WC $20Cr_3C_2$ 7Ni | Balance | 19.0 – 24.0 | 5.5 – 8.5 | 5.7 – 6.5 | < 0.5 |
| WOKA 3702-1 | WC $20Cr_3C_2$ 7Ni | Balance | 17.5 – 20.5 | 6.0 – 8.0 | 6.5 – 8.0 | < 0.5 |
| WOKA 3703 | WC $20Cr_3C_2$ 7Ni | Balance | 19.0 – 24.0 | 5.5 – 8.5 | 5.7 – 6.5 | < 0.5 |
| WOKA 3707 | WC $20Cr_3C_2$ 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), $H_2SO_4$ (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<br>1041158 | 5 kg (approx. 11 lb)<br>10 lb (approx. 4.5 kg) | Special Order<br>Special Order | Europe<br>Americas |
| WOKA 3702 | 1041117<br>1041071 | 5 kg (approx. 11 lb)<br>10 lb (approx. 4.5 kg) | Stock<br>Special Order | Europe<br>Americas |
| WOKA 3702-1 | 1081343 | 5 kg (approx. 11 lb) | Stock | Global |
| WOKA 3703 | 1041150<br>1041185 | 5 kg (approx. 11 lb)<br>10 lb (approx. 4.5 kg) | Stock<br>Stock | Europe<br>Americas |
| WOKA 3707 | 1041118<br>1041072 | 5 kg (approx. 11 lb)<br>10 lb (approx. 4.5 kg) | Special Order<br>Special Order | Europe<br>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).

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