

Material Product Data Sheet

Spherical Cast, Two-Phase Tungsten Carbide Blend Materials for Hard Face Applications

Powder Products:
WOKA 50051, WOKA 50054, WOKA 50055,
WOKA 50057, WOKA 50059, WOKA 50072

1 Introduction

WOKA™ Spherical Fused Tungsten Carbides (CTC-S) are spheroidally shaped, two-phase tungsten carbide powders produced by a special melting process. This makes them the most wear resistant fused tungsten carbide products available on the market.

WOKA CTC-S materials are designed to be the hard phase constituent of a wear-resistant surface. Depending on the surfacing process, they can be blended with self-fluxing alloys or used a filler material for rods, wires, electrodes or infiltration applications. Overlays containing these materials offer excellent abrasive wear resistance in harsh environments, combined with good impact resistance.

These carbides have a fine, non-acicular structure with a higher hardness compared to conventional cast (fused) tungsten carbide.

While usable in high-heat processes (PTA or conventional arc welding), these materials can exhibit phase transformation that can result in deposit embrittlement and cracking. Therefore, the best deposit results are obtainable with low heat input processes such as laser cladding and oxy-acetylene welding.

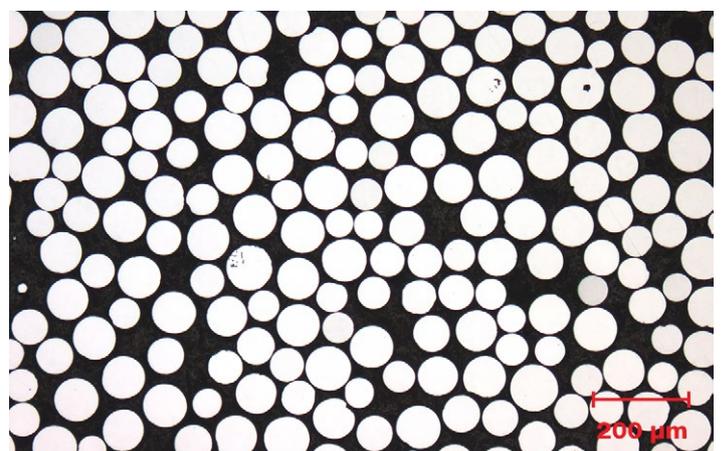
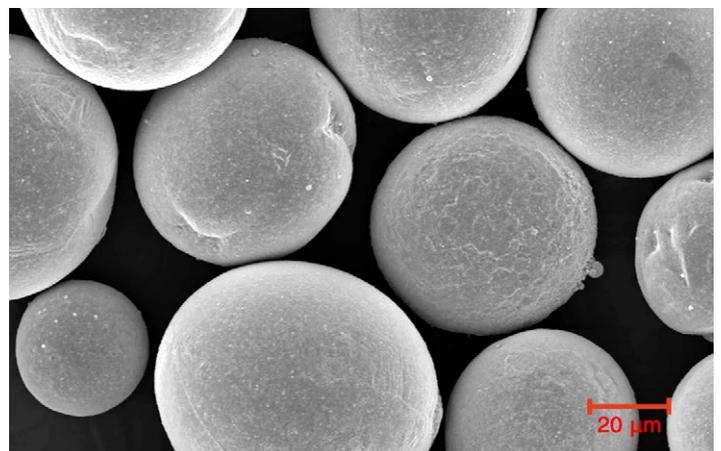
As hard phase materials, these products have a hardness of 2700 to 3100 HV0.1. CTC-S offers the best compromise of excellent hardness versus good ductility. There is a very broad portfolio of applications for these products with different wear conditions.

1.1 Typical Uses and Applications:

- Construction, earth moving and tunneling equipment
- Agricultural plowshares, lifting shares and shear bars
- Oil and gas tool joints, PDC and steel body drill bits
- Recycling and mining crushers and milling rolls
- Heavy equipment mixer blades, decanters and extruder screws

Quick Facts

Classification	Carbide, tungsten-based (CTC-S)
Chemistry	W ₂ C-WC
Manufacture	Fused, crushed and plasma densified
Morphology	Spheroidal
Apparent Density	9.0 – 11.0 g/cm ³
Tap Density	9.5 – 10.5 g/cm ³
Bulk Density	16 – 17 g/cm ³
Hardness	2700 – 3100 HV0.1
Service Temperature	< 500 °C (930 °F)
Purpose	Hard phase blend component for wear resistance
Process	Oxy-acetylene welding, arc welding, spray and fuse powder welding, PTA, laser cladding



SEM photomicrograph of WOKA CTC-S products. Top: morphology. Bottom: inner structure.

2 Material Information

2.1 Chemical Composition

Product	Chemical Composition (nominal wt.%)			
	W	C	Fe	Total All Other
WOKA 50051	Balance	3.7 – 4.2	0.5 (max)	0.2 (max)
WOKA 50054	Balance	3.7 – 4.2	0.5 (max)	0.2 (max)
WOKA 50055	Balance	3.7 – 4.2	0.5 (max)	0.2 (max)
WOKA 50057	Balance	3.7 – 4.2	0.5 (max)	0.2 (max)
WOKA 50059	Balance	3.7 – 4.2	0.5 (max)	0.2 (max)
WOKA 50072	Balance	3.7 – 4.2	0.5 (max)	0.2 (max)

2.2 Particle Size Distribution, Manufacturing Method, Density and Former Product Designation

Product	Nominal Particle Size Distribution	Manufacturing Method	Nominal Apparent Density Range (g/cm ³)	Other Designation (for reference)
WOKA 50051	-53 +20 µm	Fused, crushed and plasma densified (CTC-S)	9.0 – 11.0	WOKA FTC-S; WOKA WSC-S
WOKA 50054	-106 +45 µm			
WOKA 50055	-90 +45 µm			
WOKA 50057	-150 +63 µm			
WOKA 50059	-125 +45 µm			
WOKA 50072	-600 +300 µm			

- Particle size of 45 µm and below determined by laser diffraction (Microtrac), size above 45 µm determined by sieve analysis in accordance with ASTM B214
- Other particle size distributions are available on request

2.3 Recommended Hardfacing Process

Product	Laser Cladding	PTA	Powder Welding	Oxy-Acetylene	SMAW (MMA)	GMAW (MIG)	GTAW (TIG)
WOKA 50051	☐						
WOKA 50054	●	☐					
WOKA 50055	●		☐				
WOKA 50057	☐	●				☐	☐
WOKA 50059	●	☐					
WOKA 50072				●	●	☐	

- = Recommended process; ☐ = Acceptable process. See Section 2.4 for further information.

2.4 Key Selection Criteria

- These materials are fused and crushed and then spherodized using plasma densification. The spheroidal shape improves flowability and the increased apparent density results in a higher quantity of the hard phase material in the deposit with better wear resistance.
- Because of its the high particle density and spherical shape, it is necessary to mix WOKA 50055 with an irregularly shaped powder (ex: CTC) for powder welding.
- Coarser materials, such as WOKA 50057 or WOKA 50072 are appropriate as a hard phase filler material in nickel- or iron-based hard facing welding rods, electrodes and wires. They can also be 'dropped-in' (gravity fed) into the melt pool; however, Oerlikon Metco recommends using our hard facing rods that incorporate carbide materials for better and more homogeneous surfacing results.
- When used for arc welding, including GMAW (MIG) and SMAW (MMA), these carbides are sensitive to phase transformation where by tungsten and carbon can be lost into the matrix, resulting in cracking or embrittlement of the deposit.
- The carbides do not transform in the low temperature regime of oxy-fuel welding, so these weld deposits do not exhibit unfavorable transformation effects.
- Products with finer particle size distributions are appropriate for blending in ratios of 30 % to 70 % with cobalt-, iron- or nickel-based self-fluxing alloy powders for PTA and laser cladding applications.
- WOKA 50054 or WOKA 50055 are the preferred choices for laser cladding.
- WOKA 50051 can be used for laser cladding when a finer carbide size is desired.
- WOKA 50057 is recommended for PTA applications.
- WOKA 50054 or WOKA 50059 can be used for PTA applications when a finer carbide particle size is desired.
- When PTA welding, phase transformation of these materials can be quite high, especially when using matrix alloys with high chromium or iron content. This effect leads to embrittlement of the matrix alloy, thereby producing cracks within the deposits.

2.5 Related Products

- Oerlikon Metco offers a variety of other tungsten carbide products appropriate for use as blend materials. These include fused tungsten carbide (CTC), sintered and crushed tungsten carbide (SCTC), monocrystalline tungsten carbide (MTC), carbide sinter pellets (CTCP) and hard metal (HM) grit. Please review their respective datasheets for further information and their appropriate use for various surfacing processes.
- Oerlikon Metco also offers pure chromium carbide products that can be used as a blend materials for higher temperature applications, or when additional corrosion resistance is needed.
- In addition to blend materials, Oerlikon Metco offers a wide range of carbide-containing hard facing products for use with various processes. Please see the appropriate datasheet or contact your sales representative for more information. These products include:
 - Spray and fuse products applied using thermal spray processes that contain tungsten carbide with a nickel-based, self-fluxing alloy matrix, such as Metco 36C, Metco 31C-NS, Metco 32C, Metco 34F and WOKA 7703, among others.
 - Ready-to-use blends of carbide hard phase and self-fluxing matrix materials for PTA and laser cladding.
 - A variety of carbide-containing tubular rods for oxy-acetylene welding, as well as carbide-containing electrodes, wires and flexible rope for arc welding.

3 Coating Information

3.1 Key Overlay Characteristics

Characteristic			
Microhardness	CTC-S	HV0.1	2700 – 3100
Hardphase / Matrix Blend Ratio			30 to 70 %

- Overlays containing CTC-S provide excellent abrasive wear resistance in harsh environments in combination with fair to good impact resistance, depending on the application technology.
- Based on the sensitivity of CTC-S to phase transformation, the best-performing overlays will be produced using processes with lower heat input such as laser cladding, standard oxy-acetylene welding or GTAW (TIG) welding.
- The spheroidal morphology and higher specific bulk material density of these products can result in a higher risk of settling within the deposit. Therefore, it is recommended to mix these products with irregularly shaped carbide materials, such as CTC, to improve processing stability and result in a more homogeneous deposit.
- Using laser cladding, deposits containing CTC-S can exhibit the highest abrasion resistance of all tungsten carbide blend materials, while offering good impact resistance.
- The risk of settling using laser cladding is quite low, so CTC-S materials can be used without the addition of irregularly-shaped carbide materials.

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
WOKA 50051	1065266	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50054	1065268	5 kg (approx. 11 lb)	Special Order	Global
WOKA 50055	1065519	5 kg (approx. 11 lb)	Special Order	Global
WOKA 50057	1065269	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50059	1065270	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50072	1065518	25 kg (approx. 55 lb)	Special Order	Global

4.2 Handling Recommendations

- Store in the original, closed container in a dry location.
- Opened containers should be stored in a drying oven to prevent moisture pickup
- Tumble contents prior to use to avoid separation.

4.3 Safety Recommendations

See SDS 50-908 (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).