

Material Product Data Sheet

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

Powder Products:

**WOKA 50001, WOKA 50005, WOKA 50007,
WOKA 50009, WOKA 50024, WOKA 50028,
WOKA 50816**

1 Introduction

WOKA™ Fused Tungsten Carbides (CTC) are irregularly shaped, two-phase tungsten carbide powders. Formation of WC and W₂C phases occurs during eutectic solidification, forming an acicular microstructure.

WOKA CTC 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 that can tolerate some impact resistance.

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.

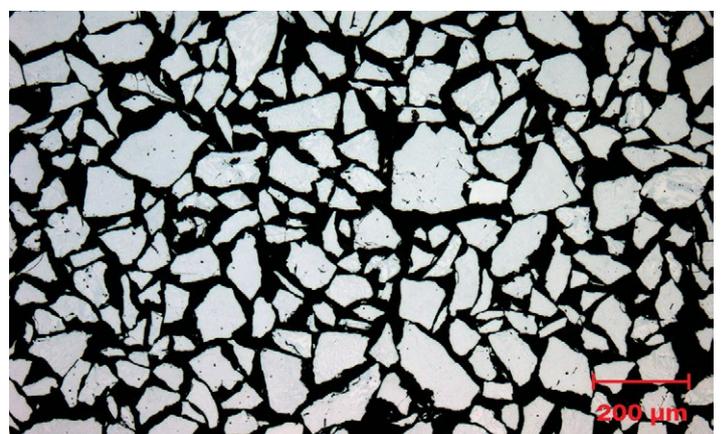
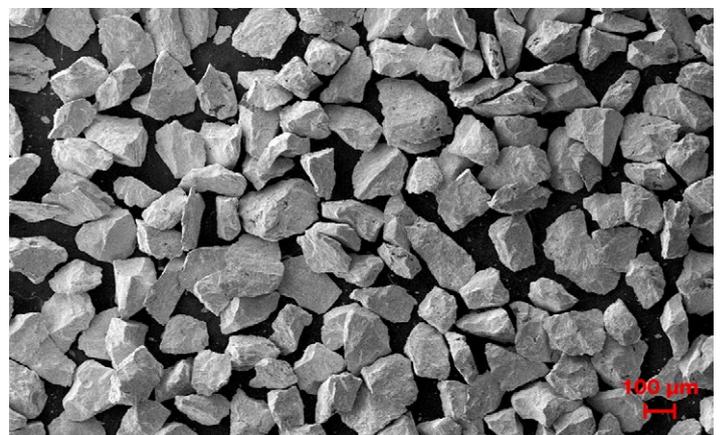
As hard phase materials, these products have a hardness of 2000 to 2300 HV0.1. CTC offers a good compromise of hardness versus sufficient ductility. CTC products are appropriate for many different applications with different wear conditions.

1.1 Typical Uses and Applications:

- Construction equipment wear plates
- Tunneling equipment
- Agricultural harvester blades, ploughshares, lifting shares or shear bars
- Oil and gas tool joints, PDC and steel body drill bits
- Biomass and wood processing knives and cutters
- Mining equipment crushers and milling rolls
- Heavy equipment mixer blades, decanters or extruder screws

Quick Facts

Classification	Carbide, tungsten-based (CTC)
Chemistry	W ₂ C-WC
Manufacture	Fused and crushed
Morphology	Irregular
Apparent Density	7.5 – 9.5 g/cm ³
Tap Density	8.5 – 9.5 g/cm ³
Bulk Density	8 – 10 g/cm ³
Hardness	2000 – 2300 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



Photomicrographs of WOKA CTC. Top: Outer morphology showing irregularly shaped particles. Bottom: Inner structure.

2 Material Information

2.1 Chemical Composition

Product	Chemical Composition (nominal wt.%)			
	W	C	Fe	Total All Other
WOKA 50001	Balance	3.8 – 4.2	0.5 (max)	0.2 (max)
WOKA 50005	Balance	3.8 – 4.2	0.5 (max)	0.2 (max)
WOKA 50007	Balance	3.8 – 4.2	0.5 (max)	0.2 (max)
WOKA 50009	Balance	3.8 – 4.2	0.5 (max)	0.2 (max)
WOKA 50024	Balance	3.8 – 4.2	0.5 (max)	0.2 (max)
WOKA 50028	Balance	3.8 – 4.2	0.5 (max)	0.2 (max)
WOKA 50816	Balance	3.8 – 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 50001	-53 +20 µm	Fused and crushed (CTC)	7.5 – 9.5	WOKA FTC; WOKA WSC
WOKA 50005	-90 +45 µm			
WOKA 50007	-150 +63 µm			
WOKA 50009	-125 +45 µm			
WOKA 50024	-212 +150 µm			
WOKA 50028	-700 +300 µm			
WOKA 50816	-1.6 +1 mm			

- 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, including the use of this methodology for sizes above 850 µm
- Other particle size distributions are available on request

2.3 Recommended Hardfacing Process

Product	Laser Cladding	PTA	Spray and Fuse Powder Welding	Oxy-Acetylene	SMAW (MMA)	GMAW (MIG)	GTAW (TIG)
WOKA 50001	◐		◐				
WOKA 50005	●	◐	●				
WOKA 50007	◐	●		●		◐	◐
WOKA 50009	●	◐	●				
WOKA 50024		◐		●		●	●
WOKA 50028				●	●		
WOKA 50816				●			

● = Recommended process; ◐ = Acceptable process. See Section 2.4 for further information.

2.4 Key Selection Criteria

- These are fused and crushed powders.
- Coarser materials, such as WOKA 50024, WOKA 50026 or WOKA 50816 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 50005 or WOKA 50009 are the preferred choices for laser cladding.
- WOKA 50001 can be used for laser cladding when a finer carbide size is desired.
- WOKA 50007 can be used for laser cladding when a coarser carbide size is desired.
- WOKA 50007 is recommended for PTA applications.
- WOKA 50005 or WOKA 50009 can be used for PTA applications when a finer carbide particle size is desired.
- WOKA 50024 can be used for PTA applications when a coarser carbide 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 spherical cast tungsten carbide (CTC-S), sintered and crushed tungsten carbide (SCTC), monocrystalline tungsten carbide (MTC), carbide sinter pellets (CTCP) and hard metal (HM) grit. Please review their respective data-sheets 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	HV0.1	2000 – 2300	
Hardphase / Matrix Blend Ratio			30 to 70 %	

- Overlays containing CTC provide excellent abrasive wear resistance in harsh environments in combination with fair impact resistance.
- Based on the sensitivity of CTC 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 irregular morphology of CTC materials produce very dense and homogeneous surfaces, even with larger melt pools.
- CTC carbides resist settling within the deposit. As such, they can be used alone or they can be blended with spheroidal carbides to produce more repeatable surfacing results.

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
WOKA 50001	1065261	5 kg (approx. 11 lb)	Special Order	Global
WOKA 50005	1075043	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50007	1075044	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50009	1075046	25 kg (approx. 55 lb)	Special Order	Global
	1094769	5 kg (approx. 11 lb)	Special Order	Global
WOKA 50024	1065592	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50028	1065254	25 kg (approx. 55 lb)	Special Order	Global
WOKA 50816	1067487	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 50-910 (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).