oerlikon
metco

Material Product Data Sheet
Tungsten Carbide – 10 % Cobalt 4 % Chromium Powders

Powder Products:
Metco™ 5163, Metco 5164, Metco 5165, Metco 5847, Metco 5847-45, Woka™ 3651, Woka 3652, Woka 3652 FC, Woka 3653, Woka 3654, Woka 3654 FC, Woka 3654 FC-1, Woka 3655, Woka 3657, Woka 3660 FC, Woka 3661 FC

1 Introduction

These products are spheroidal, agglomerated and sintered powders for thermal spraying containing 86 % tungsten carbide as hard material and a cobalt-chromium matrix, which functions as a binder material for the carbide particles.

The products are particularly suitable for applications where both wear and corrosion resistance is required. Chromium in the matrix improves corrosion resistance while the fine carbide grains provide the abrasive, erosive and fretting wear properties of a tungsten carbide-cobalt based material.

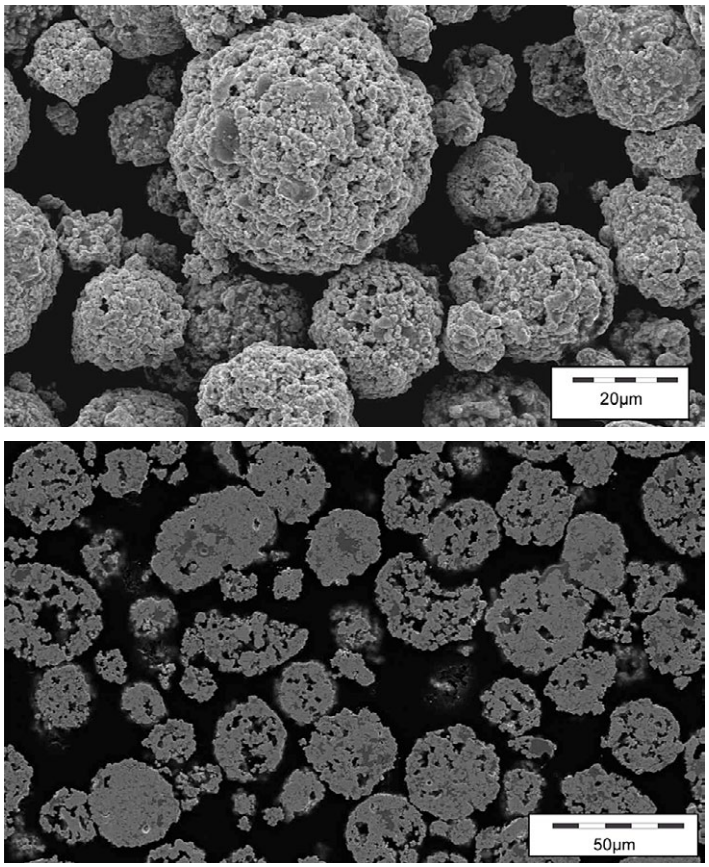
Thermal sprayed coatings of these materials are excellent alternatives to hard chromium plating. The coatings provide excellent wear and corrosion resistance and can be ground and superfinished to surface finishes that are similar to chromium plating. HVOF coatings of these materials are dense, show good bond strength. They also exhibit smooth, as-sprayed surfaces that are useful in applications where grinding cannot be done or is not required.

1.1 Typical Uses and Applications

These Oerlikon Metco products are known as some of the best thermal spray powders for use in wear applications at service temperatures below 500 °C (930 °F) in aqueous corrosive media. Typical applications include:

- Compressor shafts
- Landing gears
- Pump seals
- Flap actuators
- Corrugating rollers
- Polished rod liners
- Hydroturbine buckets
- Ball, gate and dump valves
- Hydraulic rods
- Slush pump piston rods
- Paper manufacturing rolls
- Downhole drilling applications
- Alternative to hard chromium plating

Quick Facts	
Classification	Carbide, tungsten-based
Chemistry	86WC 10Co 4Cr
Manufacture	Agglomerated and sintered
Morphology	Spheroidal
Purpose	Corrosive wear resistance
Apparent density	2.9 – 5.8 g/cm^3
Flowability	Free-flowing powder
Service Temperature	≤ 500 °C (930 °F)
Process	HVOF, Atmospheric Plasma or Combustion Powder Thermospray™



SEM Photomicrographs showing outer morphology (top) and inner morphology (bottom) of Woka 3652 powder.

2 Material Information

2.1 Chemical Composition in Weight Percent (nominal)

	W	Co	Cr	C (total)	Iron (max)
Metco 5163	Balance	9.0 – 11.0	3.5 – 4.8	4.8 – 5.8	1.0
Metco 5164	Balance	9.0 – 11.0	3.4 – 4.8	4.8 – 5.5	1.0
Metco 5165	Balance	9.0 – 11.0	3.5 – 4.8	4.8 – 5.5	1.0
Metco 5847	Balance	9.0 – 11.0	3.2 – 4.8	5.0 – 5.5	1.0
Metco 5847-45	Balance	9.0 – 11.0	3.2 – 4.8	5.0 – 5.5	1.0
Woka 3651	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3652	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3652 FC	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3653	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3654	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3654 FC	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3654 FC-1	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3655	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3657	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3660 FC	Balance	8.5 – 11.5	3.4 – 4.6	4.8 – 5.6	0.2
Woka 3661 FC	Balance	8.5 – 11.5	3.4 – 4.6	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)
Metco 5163	–45 +15	Medium	3.7 – 4.1
Metco 5164	–45 +11	Medium	3.7 – 4.1
Metco 5165	–38 +16	Medium	3.7 – 4.1
Metco 5847	–53 +11	Fine / Medium Blend	3.0 – 3.5
Metco 5847-45	–45 +11	Fine / Medium Blend	3.0 – 3.5
Woka 3651	–53 +20	Medium	4.7 – 5.3
Woka 3652	–45 +15	Medium	4.7 – 5.3
Woka 3652 FC	–45 +15	Fine	4.9 – 5.5
Woka 3653	–45 +11	Medium	4.6 – 5.2
Woka 3654	–30 +10	Medium	4.6 – 5.2
Woka 3654 FC	–30 +10	Fine	4.5 – 5.6
Woka 3654 FC-1	–30 +15	Fine	4.5 – 5.6
Woka 3655	–38 +10	Medium	4.5 – 5.1
Woka 3657	–45 +20	Medium	4.7 – 5.3
Woka 3660 FC	–25 +5	Fine	4.6 – 5.2
Woka 3661 FC	–20 +5	Fine	4.6 – 5.2

- 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 particle size distributions are available on request for Woka-brand products.

2.3 Key Selection Criteria

- Select a material appropriate for the recommended spray process and gun to be used. (refer to Section 2.5).
- For the lowest possible 'as-sprayed' surface roughness, choose a material with the lowest possible particle size distribution and carbide particle grain size.
- For aerospace specifications, materials with low apparent densities are preferred to achieve low coating Almen values. These include Metco 5164, Metco 5165, Metco 5847 and Metco 5847-45.
- Metco 5847 and Metco 5847-45 are recommended for applications requiring a high Almen deflection and a coating with a high fatigue tolerance. Metco 5847 can be applied at spray angles between 75° to 90° relative to the substrate. For sharper spray angles, Metco 5847-45 is recommended and minimum Almen requirements can be obtained at spray angles as sharp as 55°.
- Metco 5164 and Metco 5165 are tightly controlled materials with high deposit efficiencies. Apparent densities and particle size distributions are optimized to meet Almen deflection requirements for hard chromium alternative applications where compressive stresses are required. The grain size distribution of Metco 5164 has been optimized for use with Jet Kote and DiamondJet guns, whereas Metco 5165 is optimized for use with liquid fuel HVOF guns. These materials should be chosen for new aerospace applications.
- Metco 5163 is a tightly controlled product that sprays with high deposition efficiency. It is recommended for areas requiring minimal compressive stress. Typically, this products is recommended for industrial applications requiring high abrasive wear resistance in conjunction with corrosion resistance. It is also recommended for aerospace applications where coating specifications do not have an Almen deflection requirement.
- Choose the material that meets the required customer or OEM material and/or process specification (refer to Section 2.6).
- Products designated with "FC" contain fine carbides. The finer carbides are homogeneously distributed within the matrix material and also serve to increase coating hardness. Those with lower particle size distributions produce coatings with good as-sprayed surfaces that require minimal polishing or post-coat machining and are recommended for use on components with complex geometries that may be difficult to machine such as corrugating rolls.
- Woka 3660 FC and Woka 3661 FC sprayed coatings can achieve an as-sprayed surface roughness of Ra 1.5 to 2.5 µm. This makes these products perfect for use when surface finishing may be too costly, such as on corrugating rollers, or when a very smooth finished surface is needed, such as for hydraulic rods. To spray these fine materials, specific parameters are required. Please ask your Oerlikon Metco Account Representative for a parameter sheet.
- With the exception of Woka 3653 and Woka 3655, Woka series materials are not designed for use in aerospace and/or turbine applications and cannot be certified to these specifications. These materials are excellent choices for coatings on machine parts such as pump seals, valves, polished rods and shafts. Woka 3655 does meet several aerospace specifications; however, Metco 5165 should be considered for any new aerospace applications because it offers advantages such as ease of application with liquid fuel HVOF guns and very good deposit efficiency.

2.4 Related Products

- For better corrosion resistance in alkaline (NaOH), sulfuric acid (H_2SO_4) or saline (NaCl) solutions the following products are recommended:
  - Chromium carbide materials such as Woka 71xx, Woka 72xx or Woka 73xx series products.
  - Materials that contain both chromium carbide and tungsten carbide, such as Woka 75xx or Woka 37xx series products.
- 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.
- 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.

2.5 Recommended Spray Process and Spray Guns

	HVOF							APS
	Diamond Jet	Diamond Jet Vortex ID-125	WokaJet / WokaStar / JP5000	K2	Jet Kote	Top Gun / HV2000	CJS	9MB, F4, TriplexPro, etc.
Metco 5163	●		●	●	●	●	●	●
Metco 5164	●				●	●	●	●
Metco 5165			●	●				●
Metco 5847	●							
Metco 5847-45	●							
Woka 3651			●	●	●			
Woka 3652	●		●			●		
Woka 3652 FC	●		●			●		
Woka 3653	●							
Woka 3654	●						●	
Woka 3654 FC	●						●	
Woka 3654 FC-1	●						●	
Woka 3655	●		●	●	●			
Woka 3657	●		●	●	●			
Woka 3660 FC	●		●					●
Woka 3661 FC	●		●					

HVOF = High Velocity Oxygen Fuel Spray; APS = Atmospheric Plasma Spray

2.6 Customer Specifications

Product	Approved Specifications [a]	Fulfills Requirements [b]
Metco 5163	SAE International AMS 7882, Method 1 & 2	
Metco 5164	SAE International AMS 2447-9, Rev. C SAE International AMS7882 Rev. D, Method 3 Safran PCS 2561 Issue 4	Boeing BMS 10-67 Type XVII (chemical and physical only) Goodrich LGMS 9011 Messier Bugatti IFC 40-818-03E (Section 6.3 only)
Metco 5165 [c]	SAE International AMS 7882, Method 2	Boeing BMS 10-67 Type XVII (chemical and physical only) Goodrich LGMS 9011 Messier Dowty (Canada) PCS 2561 Messier Bugatti IFC 40-818-03E (Section 6.3 only)
Metco 5847	Boeing BMS 10-67, Type XVII Goodrich LGMS 9011 Type II Messier Dowty PCS-2560 Messier Dowty PCS-2561 SAE International AMS 2447-9 SAE International AMS 7882, Method 1	Liebherr LAT4-4012
Metco 5847-45	Boeing BMS 10-67, Type XVII Goodrich LGMS 9011 Type II Messier Dowty PCS-2561 SAE International AMS 7882, Method 3	Liebherr LAT4-4012
Woka 3655	Messier Dowty PCS 2561 Goodrich 212-006	

[a] Oerlikon Metco can provide certification that the product meets these approved specifications or certification for the specification is not required
[b] Material fulfills these specifications but is not approved for certification
[c] Product is recommended as an alternative to Praxair 1350VM

3 Coating Information

3.1 Key Thermal Spray Coating Information

Specification	Typical Data [a]
Recommended Spray Process [b]	HVOF, Atmospheric Plasma Spray or Combustion Powder Thermospray™
Microhardness (HV0.3)	750 – 1450
Macrohardness (HR15N)	> 90
Wear Rate (ASTM G65 B)	< 4 mm^3
Porosity	< 1 %
Corrosion Resistance	NaCl (1M): Good
	HCl (1M): Fair,
	H_2SO_4 (0.5M): Fair
	NaOH (1M): Fair
Deposition efficiency	40 – 60 %
Maximum Service Temperature	500 °C 930 °F

[a] Depending on the spray process, spray gun used, parameter used and coating thickness applied.
[b] Depending on the product particle size distribution chosen

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
Water-cooled DiamondJet series
WokaJet series
WokaStar series

4 Commercial Information

4.1 Ordering Information and Availability

	Order No.	Package Size	Availability	Distribution
Metco 5163	1068887	10 lb (approx. 4.5 kg)	Stock	Global
Metco 5164	1069663	10 lb (approx. 4.5 kg)	Stock	Global
Metco 5165	1072270	10 lb (approx. 4.5 kg)	Stock	Global
Metco 5847	1001601	5 lb (approx. 2.25 kg)	Stock	Global
Metco 5847-45	1089994	5 lb (approx. 2.25 kg)	Stock	Global
Woka 3651	1041264	5 kg (approx. 11 lb)	Stock	Global
Woka 3652	1041265	5 kg (approx. 11 lb)	Stock	Europe
	1041254	10 lb (approx. 4.5 kg)	Stock	Americas
Woka 3652 FC	1050441	5 kg (approx. 11 lb)	Stock	Global
Woka 3653	1041266	5 kg (approx. 11 lb)	Stock	Europe
	1041255	10 lb (approx. 4.5 kg)	Stock	Americas
Woka 3654	1041267	5 kg (approx. 11 lb)	Special Order	Global
Woka 3654 FC	1062880	5 kg (approx. 11 lb)	Stock	Global
Woka 3654 FC-1	1093594	5 kg (approx. 11 lb)	Special Order	Global
Woka 3655	1058137	5 kg (approx. 11 lb)	Stock	Global
	1069455 [a]	5 kg (approx. 11 lb)	Special Order	Global
Woka 3657	1041268	5 kg (approx. 11 lb)	Special Order	Global
Woka 3660 FC	1064114	5 kg (approx. 11 lb)	Stock	Global
Woka 3661 FC	1069195	5 kg (approx. 11 lb)	Special Order	Global

[a] Required for Messier Dowty specification
Note: Products are available in other regions on a special order basis. For products available in both kg and lb weights, the kg package will be supplied to unspecified regions (Africa,Asia/Pacific, Japan and Middle East) unless the lb 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 the correct SDS (Safety Data Sheet) for the product of interest 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).

Product	SDS No.
Metco 5163	50-1375
Metco 5164	50-1375
Metco 5165	50-1375
Metco 5847	50-2011
Metco 5847-45	50-655
Woka 3651	50-906
Woka 3652	50-906
Woka 3652 FC	50-906
Woka 3653	50-906
Woka 3654	50-906
Woka 3654 FC	50-906
Woka 3654 FC-1	50-906
Woka 3655	50-906
Woka 3657	50-906
Woka 3660 FC	50-2002
Woka 3661 FC	50-2002

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