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metco

Material Product Data Sheet
Tungsten Carbide – Nickel Chromium Self-Fluxing Powders

Powder Products:
Metco™ 31C-NS, Metco 32C, Metco 34F, Metco 34FP, Metco 36C, WOKA 7703, WOKA 7705G Diamalloy™ 2002

1 Introduction

These materials consist of a self-fluxing alloy blended with a hard phase constituent of tungsten carbide in a gas atomized cobalt or nickel matrix. Coatings of these materials are resistant to abrasive grains, hard surfaces, fretting and particle erosion. The products in this data sheet use either agglomerated and sintered or sintered and crushed tungsten carbide.

In a two-stage process, the material is first applied by thermal spray and then fused to develop a dense coating with minimal porosity and oxides that is metallurgically bonded to the substrate. Coatings of Metco 34, Metco 34FP and Diamalloy 2002 can be used unfused condition resulting in no metallurgical bond to the substrate. The addition of boron and silicon in the matrix enables fusing at lower temperatures, without the need for additional flux to wet the substrate and coalesce during fusing while minimizing the dissolution of the tungsten carbide in the coating.

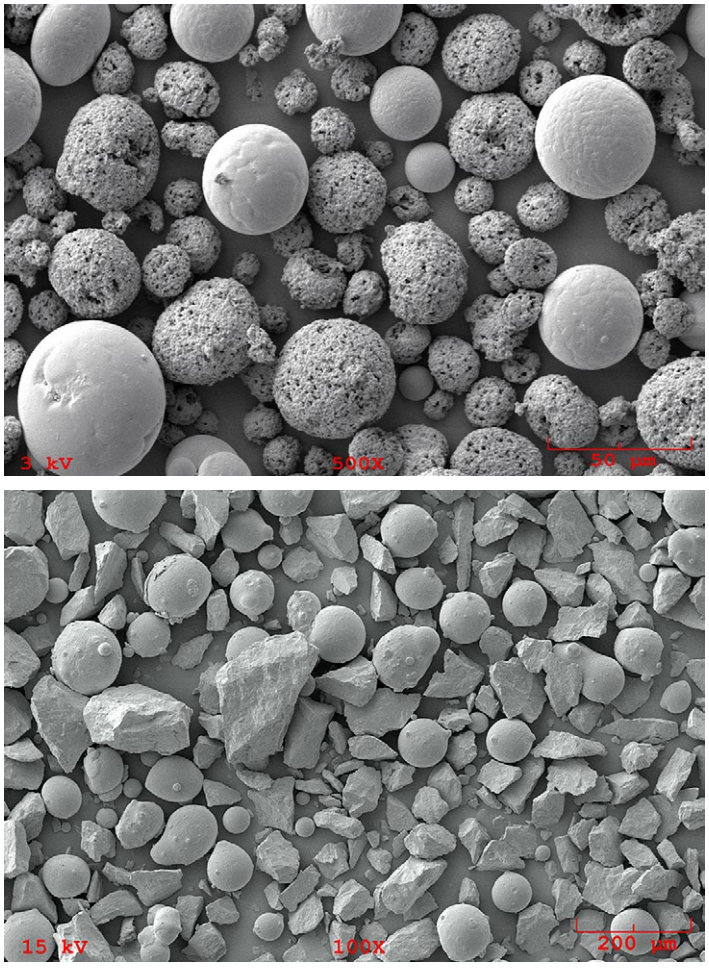
These products have various amounts and formulations of hard phase and matrices which allow the user to choose the material that is best suited for the wear application and environment. The powders may be applied to mild steels, heat-treatable steels, stainless steels and nickel-based alloys.

1.1 Typical Uses and Applications

These alloys are used in turbomachinery, automotive, petrochemical, hydroelectric and agricultural applications on components such as:

- Plug gages
- Pump seals
- Cam followers
- Rocker arms
- Exhaust fans
- Piston rods
- Shafts
- Wire-drawing capstans
- Slipways
- Hydroelectric valves
- Harvester blades

Quick Facts	
Classification	Self-fluxing alloy, nickel-based with hard phase
Chemistry	Various (See Section 2.1)
Manufacture	Blended
Morphology	Spheroidal or spheroidal/irregular
Service Temperature	≤ 540 °C (1000 °F)
Purpose	Wear protection
Spray Process	Combustion Powder Thermospray™, Atmospheric Plasma Spray, HVOF
Fusing Process	Manual torch, induction, furnace



Top: Blended product with agglomerated carbide and gas atomized matrix.
Bottom: Blended products with cast and crushed carbide and gas atomized matrix.

2 Material Information

2.1 Chemical Composition

Product	Hard Phase					Matrix						
	Phase %	Nominal Composition (wt. %)				Phase %	Nominal Composition (wt. %)					
		WC	Co	Fe	Ni		Ni	Cr	Fe	B	Si	C
Metco 31C-NS	35	88	12	---	---	65	70	17.5	4	4	4	0.5
Metco 32C	80	88	12	---	---	20	70	17.5	4	4	4	0.5
Metco 34F	50	88	12	---	---	50	70	17.5	4	4	4	0.5
Metco 34FP	50	88	12	---	---	50	70	17.5	4	4	4	0.5
Metco 36C	35	92	---	---	8	65	70	17.5	4	4	4	0.5
WOKA 7703	40	88	12	≤ 1	---	60	Bal.	15	3.5	3.2	4.4	0.7
WOKA 7705G	40	88	12	≤ 1	---	60	Bal.	15	3.5	3.2	4.4	0.7
Diamalloy 2002	50	88	12	---	---	50	66	18	7	4	4	1

2.2 Particle Size Distribution, Manufacturing Method, Recommended Spray Process

Product	Nominal Particle Size Distribution (µm) [a]	Primary Carbide Size	Carbide Manufacturing Method [b]	Recommended Spray Process [c]
Metco 31C-NS	–125 +45	Coarse	Agglomerated	APS, CPS
Metco 32C	–125 +45	Coarse	Agglomerated	APS, CPS
Metco 34F	–53 +15	Fine	Agglomerated	APS, CPS
Metco 34FP	–53 +15	Fine	Agglomerated	APS, CPS
Metco 36C	–150 +45	Coarse	Mechanically Clad	APS, CPS
WOKA 7703	-106 +45	Medium	Sintered & Crushed	CPS
WOKA 7705G	-45 +11	Medium	Sintered & Crushed	HVOF
Diamalloy 2002	-45 +11	Fine	Agglomerated	HVOF

[a] Measurement of upper particle size by sieve per ASTM B214; particle size below 45 µm by laser diffraction (Microtrac).
[b] Matrix for all materials is manufactured via gas atomization
[c] APS = Atmospheric Plasma Spray; CPS = Combustion Powder Spray; HVOF = High Velocity Oxy-Fuel Spray

2.3 Key Selection Criteria

- All of the products herein are designed to resist wear by particle erosion, abrasion and abrasive grains. The key selection criteria for the products will be based on the size of the carbide, the spacing between carbides and the mean size of the abrasive particles. This relationship is often referred to as the “mean free path”.
- The spheroidal morphology of Metco 31C-NS, Metco 32C, Metco 34F, Metco 34FP and Diamalloy 2002 improves flowability during spraying and imparts better erosion and abrasion resistance to the coatings.
- The sintered and crushed carbide hard phase used in Metco 36C, WOKA 7703 and WOKA 7705G results in tungsten carbide grains that are larger, more angular in shape and with higher apparent density. These carbides exhibit better distribution in the matrix with less dissolution, resulting in reduced coating brittleness and a lower tendency to crack. Coatings show high abrasive resistance with fair impact strength.
- Metco 32C contains the most tungsten carbide among these materials. This high concentration makes the coating extremely wear resistant, but porous after spraying. Application of a final coat of Metco 15E is recommended to prevent oxidation of the carbide during fusing.
- Metco 31C-NS and Metco 36C have the highest amount of matrix materials, which provides the coating with a higher total nickel content compared to the other materials. Metco 36C contains the highest nickel content and has no cobalt present in the powder.
- Metco 34F, Metco 34FP and Diamalloy 2002 are best when thin and smooth coatings are desired. Each of these materials can be used in the unfused condition, typically when the workpiece cannot tolerate fusing temperatures.
- Diamalloy 2002 is the only material herein that is applied using the HVOF spray process, which produces coatings that are hard and dense. The HVOF process utilizes lower heat input than atmospheric plasma spray to form the coating; thus the carbide dissolution is negligible. The coating is known to effectively resist wear by hard surfaces and fretting.
- Metco 36C coatings are shown to be the most wear resistant of the Oerlikon Metco self-fluxing coatings as a result of the very large and blocky sintered and crushed tungsten carbide particles used in the powder that are less affected by the heat of fusing.
- Metco 34F and Metco 34FP are similar in terms of coating characteristics and performance. The choice between these materials should be based on customer requirements.

2.4 Related Products

- For applications where tungsten carbide may not be required for improved resistance to abrasion and fretting, Oerlikon Metco manufactures a wide array of wear and corrosion resistant nickel and cobalt based self-fluxing alloys such as Metco 12C, Metco 14E and Metco 18C.
- Tungsten carbide cobalt materials do not perform well in conditions where strong acids are present. However, the use of nickel and chromium matrixes improves resistance in acidic mediums. Oerlikon Metco offers self-fluxing materials that contain nickel rather than cobalt to improve resistance to corrosion in low pH environments.

3 Coating Information

3.1 Key Thermal Spray Coating Characteristics

Characteristic		Metco 31C-NS	Metco 32C	Metco 34 Metco 34FP [a]	Metco 36C	WOKA 7703 WOKA 7705G	Diamalloy 2002 [a]
Spray Process for Listed Data		●	●	■	●	●	◆
Recommended Spray Process		■●	■●	■●	■●	●	◆
Matrix Macrohardness							
As sprayed	HRC	62	62	54 – 58	---	---	53
Fused	HRC	---	---	59 – 62	58 – 60	---	---
Carbide Macrohardness							
Embedded	HRC	75	75	75	75	---	---
Porosity After Fusing		Negligible	Porous [b]	Negligible	Negligible	Negligible	Negligible
Fused Shrink	%	20	20	12	---	---	---
Thickness Limit [d]	mm	0.5	2.0	0.6	1.3	2.0	1.3
	in	0.02	0.08	0.024	0.05	0.08	0.05

● Combustion Powder Thermospray™ ■ Atmospheric Plasma Spray ◆ HVOF

[a] Coatings of Metco 34, Metco 34FP and Diamalloy 2002 can be used unfused, however such coatings would not have a metallurgical bond to the substrate
[b] A final coat of Metco 15E is recommended to fill in porosity prior to fusing
[c] Carbide microhardness = 2000 to 2300 HV0.1
[d] Slow cooling of the coated workpiece is recommended, particularly for higher thicknesses; when necesary, it may be possible to apply additional coating material after fusing of the original coating and pre-coat preparation, e.g., grit blasting, for the additional layer

3.2 Processing Notes

Spray and fuse coatings using Metco tungsten carbide self-fluxing alloys can be applied to mild steels, heat treatable steels, stainless steels and nickel-based alloy substrates. While some of these substrates require no special precautions, others require specific preheating or cooling procedures to avoid cracking of the coating. Some alloy substrates are not compatible for spray and fuse coatings. Please contact your Oerlikon Metco Sales Representative for further information.

3.3 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		
Combustion Powder	**Atmospheric Plasma**	**HVOF**
Metco 5P-II	Metco 3MBM	DiamondJet series
Metco 6P-II series	Metco 9MBM	WokaJet series
Metco 6PT-II series *	Metco F4MB-XL series	WokaStar series
	SinplexPro series	

* Extension modules for the 6P-II spray gun; a 6P-II spray gun is required

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Metco 31C-NS	1000443	5 lb (approx. 2.25 kg)	Stock	Global
Metco 32C	1000050	5 lb (approx. 2.25 kg)	Stock	Global
Metco 34F	1000086	5 lb (approx. 2.25 kg)	Stock	Global
Metco 34FP	1000057	5 lb (approx. 2.25 kg)	Special Order	Global
Metco 36C	1000305	5 lb (approx. 2.25 kg)	Stock	Global
WOKA 7703	1059548	5 kg (approx. 11 lb)	Stock	Global
WOKA 7705G	1091883	5 kg (approx. 11 lb)	Stock	Global
Diamalloy 2002	1000788	5 lb (approx. 2.25 kg)	Special Order	Global

4.2 Handling Recommendations

- Store in the original container in a dry location.
- Carefully tumble contents prior to use to prevent segregation, but avoid breakdown of friable components.
- Open containers should be stored in a drying oven at temperatures above 38 °C (100 °F) to prevent moisture pickup. Avoid prolonged storage at elevated temperatures.

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 31C-NS	50-105
Metco 32C	50-106
Metco 34F	50-107
Metco 34FP	50-107
Metco 36C	50-109
WOKA 7703	50-971
WOKA 7705G	50-971
Diamalloy 2002	50-107

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