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metco

Product Data Sheet

Martensitic Matrix Hardfacing Alloy with Fine Scale, Extremely Hard Molybdenum Borides and Vanadium Carbides

Powder Products: Metco 1030A, Metco 1030B
Wire Products: Metco 8224

US patent protected with additional patents pending

1 Introduction

Metco™ 1030x series products and Metco 8224 are revolutionary new materials developed using the Scoperta™ Computational Design Process as a chromium-free and heat-treatable hardfacing overlay. They provide the best performance in aggressive environments where impact and abrasive wear are critical sources of material failure. The chromium-free composition enables a safer, cleaner processing environment for the applicator.

Metco 1030x and Metco 8224 are heat-treatable, meaning overlays of these materials preserve excellent performance before and after standard quench and temper heat treatments.

In terms of wear resistance, the high density of complex borides and vanadium carbides within the martensitic matrix allows the overlays to approach the wear performance of WC-Ni at a lower price point in applications where corrosion is not a critical concern. The extremely fine lamellar structure of the complex borides and the spherical morphology of the vanadium carbides result in impact performance that is 20 times that of WC-Ni and more than 4 times better than either chromium carbide overlays or nanostructured forming steels.

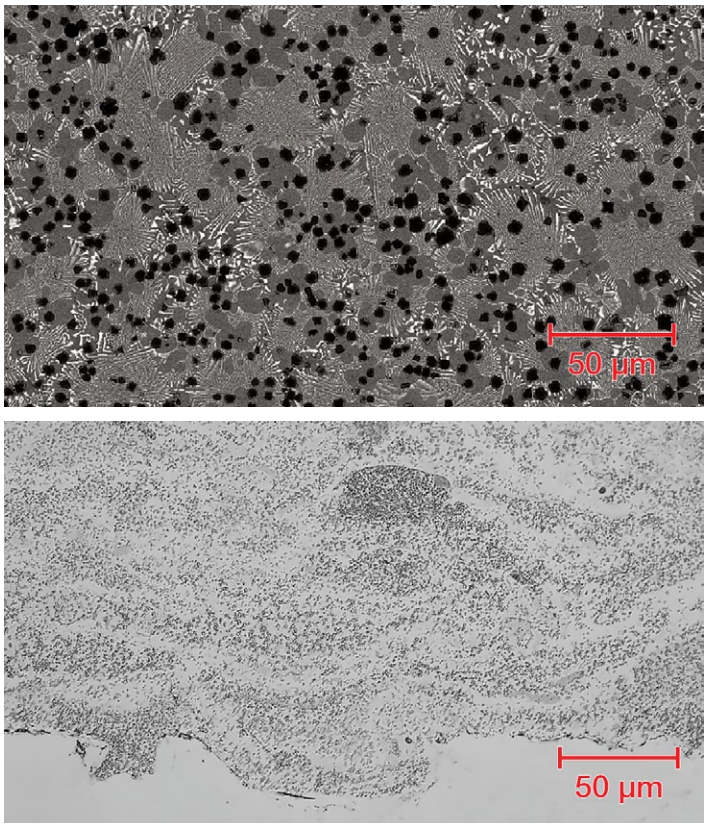
1.1 Typical Uses and Applications

These products are suggested for use in any application where abrasion resistance is required. The revolutionary improvement in impact resistance and toughness will typically result in an extended lifetime over tungsten carbide and chromium carbide coatings. Specific applications include:

- Shaker screens
- Ground engaging tools for mining applications
- Grouser riser (track pads)
- Chute blocks
- Wear plates
- Mill liners
- Slurry pipes
- Shovel wear packages
- Communition
- Other mining applications

Quick Facts

Classification	Alloy, iron-based
Chemistry	Proprietary martensitic alloy
Manufacture	Composite wire or gas atomized powder
Abrasion Resistance	0.04 to 0.09 g lost (ASTM G65A low stress abrasion)
Impact Resistance	> 10 000 impacts @ 20 J without failure
Overlay Hardness	63 to 68 HRC
Hard Phase	33 % to 50 %
Purpose	Impact and abrasion resistance
Processes	GMAW, BMAW, Laser Cladding, PTA



Top: Typical as-welded coating microstructure of Metco 1030x or Metco 8224.
Bottom: Typical HVOF-sprayed coating microstructure of Metco 1030B

- Harvester blades and disks
- Sugar hammers
- Disk harrows
- Agricultural shear bars
- Ground engaging tools for agricultural applications

2 Material Information

2.1 Properties and Characteristics

Product	Nominal Chemistry	Product Form	Size	Recommended Process	Previously Sold As
Metco 1030A	Proprietary	Powder	-150 +53 µm	PTA, Laser Cladding	Vecalloy 600
Metco 1030B			-53 +20 µm	Laser Cladding, HVOF	
Metco 8224		Composite Wire	1.2 mm (0.045 in)	GMAW	
			1.6 mm (0.063)	GMAW	
			2.8 mm (0.109 in)	GMAW, BMAW	

2.2 Key Selection Criteria

Overlays of Metco 1030 and Metco 8224 uniquely pair the toughness required for high impact applications with the high wear resistance to rival the best coatings available. These typically discordant properties are achieved by forming a high fraction of tough, lamellar complex borides while avoiding long needle-like particles known to cause problematic embrittlement in chromium carbide overlays and many nanostructured steel alloys.

- **Homogeneity:** These materials are deposited as a single alloy with carbides and borides thermodynamically driven to precipitate homogeneously throughout the weld thickness, ensuring a homogeneous coating structure and consistent performance in applications where corrosion is not a major concern

- **Fine-Scale Microstructure:** The thermodynamically-grown carbides and borides in Metco 1030x and Metco 8224 deposits range in size from 1 to 10 µm, which results in deposits that exhibit impact and abrasion resistance. Computational metallurgy allows us to design these phases to grow from the liquid at a small and consistent size, shape and distribution. This fine-scale microstructure has many beneficial effects such as preventing small sand particles from attacking the matrix directly and distributing thermal stresses more evenly upon cooling. However, perhaps the most important benefit of the microstructure exhibited by Metco 1030x and Metco 8224 overlays is the ability to withstand impact and high stresses. Almost every application which is commonly understood to be an abrasive environment is also exhibits high stress and significant levels of impact. Metco 1030x and Metco 8224 overlays provide excellent performance n these applications.

- **Matrix Hardness:** High stress gouging, which occurs in many applications such as ground engaging tools, is capable of deforming a soft matrix and essentially machining away any carbide particles. Overlays of Metco 1030x and Metco 8224, however, are engineered to form a hard martensitic matrix and are resistant to this form of damage.

- **Consistent Performance:** The homogeneous microstructure results in consistent performance from the surface of the weld down to the weld interface. For example, ASTM G65 testing on the weld surface and halfway into the weld thickness generate the same results. The entire weld thickness will perform according the performance specifications of the material.

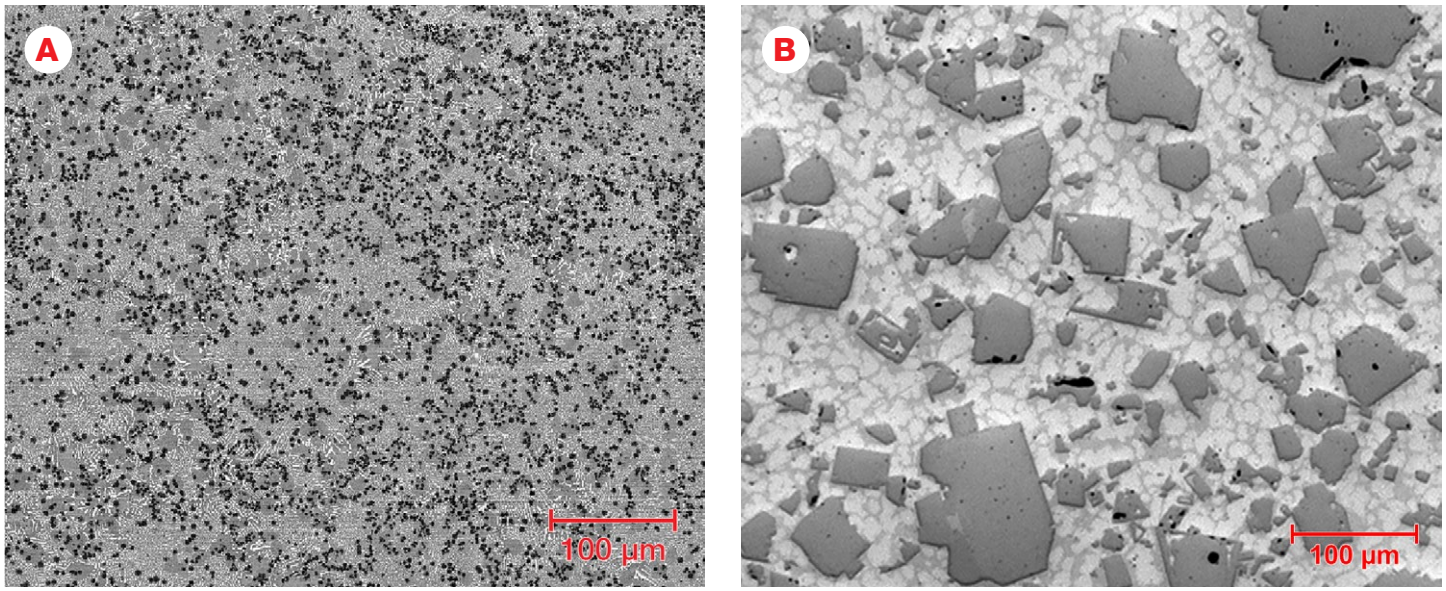
2.3 Related Products

- When welding using GMAW, Metco 8224 combines high impact resistance with excellent abrasion resistance. For higher impact resistance, consider Metco 8233. If better gouging resistance is needed, combined with resistance to high-stress abrasion, consider Metco 8226.

- When applying coatings via PTA or Laser Cladding, Metco 1030A outperforms Metco 1051A in abrasion resistance, but Metco 1051A can provide better impact resistance.

- When superior impact resistance is needed, consider Metco 1040A.

- In addition, Oerlikon Metco produces a wide range of other products designed for mining applications. Products are available in wire and powder form appropriate for application using thermal spray, PTA, laser cladding and other welding processes. Please contact your Oerlikon Metco Account Manager for more information.



Microstructure comparison of Metco 8224 deposit **[A]** versus WC-Ni GMAW deposit **[B]**. Note the fine hard phase and more homogeneous structure created by Metco 8224 versus the very large hard phase particles in the WC-NI GMAW deposit.

3 Key Coating Information

3.1 Using Metco 8224 Wire

Metco 8224 is currently available as cored wire in 0.045 in (1.1 mm), and 0.063 in (1.6 mm) diameters for GMAW and in 0.109 in (2.8 mm) diameter for BMAW. Additional welding wire diameters are available upon request. The suggested welding parameters and expected results for Metco 8224 are provided here.

Please note: Metco 8224 can be deposited as stringer beads or oscillated beads. However, it is recommended that Metco 8224 only be deposited as a single layer. Multiple layer deposits can reduce the impact resistance of the overlay.

3.1.1 Preheating Guidelines, Interpass Temperature, and Post Weld Heat Treatment:

Preheat temperatures should be done in accordance with the substrate requirements to minimize the heat affected zone. Allow the part to cool below 260 °C (500 °F) before welding Metco 8224. Metco 8224 can be austenitized [850 to 950 °C (1560 to 1740 °F)] and water or oil quenched without significant decrease in properties. Metco 8224 can also be tempered up to 150 °C (300 °F) after quenching.

Process	GMAW	GMAW	BMAW
Wire Diameter	1.2 mm (0.045 in)	1.6 mm (0.063)	2.8 mm (0.109 in)
Current	DCEP	DCEP	DCEP
Desired weld thickness	3 to 6 mm (0.12 to 0.24 in)	3 to 8 mm (0.12 to 0.31 in)	6 to 10 mm (0.24 to 0.39 in)
Voltage	25 to 27 V	25.5 to 27 V	25 to 26.5 V
Amperage	≈ 155 A	≈ 225 A	≈ 430 A
Shielding gas	98% Ar / 2% O_2	98% Ar / 2% O_2	N/A
Stickout	19 mm (0.75 in)	28 mm (1.1 in)	38 mm (1.5 in)
Preheat	See Preheating Guidelines (above)		
Interpass Temperature	≤ 150 °C (300 °F)	≤ 150 °C (300 °F)	N/A
Torch drag angle	5° to 15°	5° to 15°	5° to 15°
Expected hardness	65 to 68 HRC	65 to 68 HRC	64.5 to 68 HRC
Expected ASTM G65	0.07 to 0.09 g loss	0.07 to 0.09 g loss	0.065 to 0.09 g loss
Acceptable Dilution	5% to 15%	5% to 15%	5% to 40%

3.2 Using Metco 1030x Powder

3.2.1 Laser Cladding Parameters

Beam Size	6 x 6 mm	24 x 6 mm
Shielding gas	Argon	Argon
Power	4 kW	7.5 kW
Powder feed	35 g/min (4.6 lb/h)	80 g/min (10.6 lb/h)
Expected hardness (approx.)	68 to 70 HRC	68 to 70 HRC

These parameters where developed using a Coherent 4000L and Coherent 8000L. Please note that optimum parameters can vary significantly with different laser equipment, and that these parameters can only serve as a starting point. Laser welds can be deposited with multiple layers to achieve the desired total thickness. A 24 mm (1 in) wide beam size can be used to deposit a 5 to 6 mm (0.20 to 0.24 in) thick single pass weld.

3.2.2 Plasma Transferred Arc (PTA) Parameters

Powder size	-150 +53 µm
Voltage	28 V
Amperage	180 A
Expected thickness (approx.)	3 mm (0.12 in)
Expected hardness (approx.)	66 to 68 HRC
Expected ASTM G65A	0.048 g loss

Please note that parameters can vary significantly with different PTA equipment and these parameters can only serve as a starting point. PTA welds can be deposited with multiple layers to achieve the desired total thickness.

3.2.3 Gas-Fuel HVOF Coating Results (hydrogen fuel)

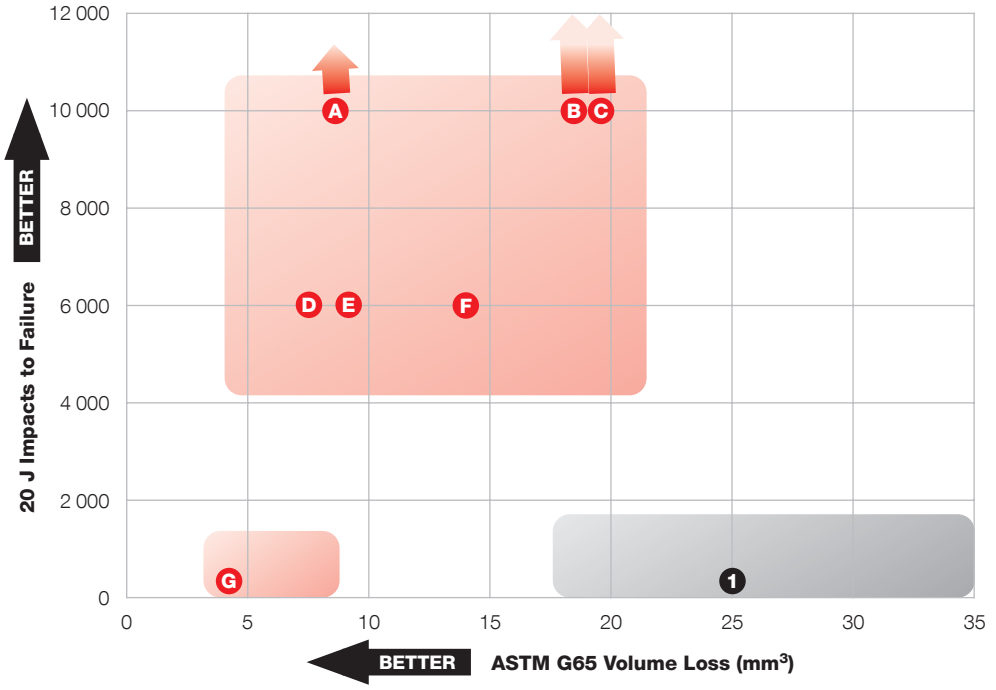
Powder size	-53 +20 µm
Abrasion resistance	0.13 g loss (ASTM G65B)
Metal-to-metal wear resistance	0.12 mm^3 (ASTM G77)
Microhardness	609 to 885 HV300
Macrohardness	79 to 88 HR15N
Surface roughness (as-sprayed)	7.3 to 8.3 µm (286.5 to 326.6 µin)
Porosity	< 1 vol. %
Oxides	13 to 17 vol. %
Bond strength	32.65 to 36.14 MPa (4736 to 5242 psi)

Please note that these results where achieved using a DiamondJet 2600 spray gun and hydrogen fuel gas. Results can vary significantly with different HVOF equipment and parameters. For specific parameters, please contact Oerlikon Metco.

3.3 Coating Development

For specific coating application requirements, the services of Oerlikon Metco's Coating Solution Centers are available. Please contact your Oerlikon Metco Account Manager for more information.

Impact vs. Abrasion Resistance of Hard Facing Materials



A Metco 8224
GMAW, BMAW
Cr-free, heat treatable

B Metco 1040A
PTA, Laser Cladding
Mn steel compatible,
non-cracking, non magnetic

C Metco 8233
BMAW, SAW
Mn-steel compatible
non-magnetic

D Metco 1030A
PTA, Laser Cladding
Cr-free, heat treatable

E Metco 8226
GMAW
gouging resistant

F Metco 1051A
PTA, Laser Cladding

G PlasmaDur 51027
PTA, 60/40 WC-Ni

1 Chromium Carbides (CCO)
GMAW. BMAW, SAW

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Form	Size	Package Size	Availability	Distribution
Metco 1030A	1097796	Powder	-150 +53 µm	10 lb (4.5 kg)	Stock	Global
Metco 1030A	2325859	Powder	-150 +53 µm	10 kg (22.5 lb)	Stock	Global
Metco 1030B	1300146	Powder	-53 +20 µm	10 lb (4.5 kg)	Special Order	Global
Metco 8224	1300401	Wire	1.2 mm (0.045 in)	25 lb (11 kg) spool	Stock	Global
Metco 8224	1501815	Wire	1.6 mm (0.063 in)	12.5 kg (27.5 lb) wire basket	Stock	Global
Metco 8224	1302400	Wire	2.8 mm (0.109 in)	50 lb (22 kg) spool	Special Order	Global
Metco 8224	1300402	Wire	2.8 mm (0.109 in)	500 lb (225 kg) Drum	Special Order	Global

4.2 Handling Recommendations

- Store in the original container in a dry location
- For powders, tumble contents prior to use to prevent segregation
- Open containers of powder should be stored in a drying oven to prevent moisture pickup

4.3 Safety Recommendations

See SDS (Safety Data Sheet) in the localized version applicable to 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 Index No.
Metco 1030A	50-2023
Metco 1030B	50-2023
Metco 8224	50-2204

The Oerlikon Metco Difference:

Metco 1030x and Metco 8224 were developed using our patented and proprietary **Scoperta™** high throughput computational metallurgical process to evaluate millions of candidate alloy compositions. Potential candidates are then experimentally evaluated using an advanced screening process where both properties and alloy microstructure are measured.

The combined **Scoperta** computational and experimental approach allows Oerlikon Metco to rapidly design the final material with a much better accuracy than conventional empirically-based methodologies.

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