

Material Product Data Sheet

Tungsten- and Tungsten Carbide-Based Matrix Composites

Powder Products: Metco™ 54133A-0, Metco 54005, Metco 50060D, Metco 54124A-90, Metco 1801A

Pliable Paste: Metco POW C

Metco 54133A-0 and Metco 54124A-90 are protected by US Patent No. 10760343 with additional patents pending.

1 Introduction

Oerlikon Metco's range of tungsten- and tungsten carbide-based materials are formed as Metal Matrix Composites (MMC) during liquid metal infiltration and solidification. These matrix materials are primarily used in the construction of Polycrystalline Diamond Compact (PDC) drill bit bodies and bearings.

Hard matrix materials provide high strength and wear resistance and are compatible with other processes such as brazing. In order to create a soft machinable matrix, Metco 1801A crystalline tungsten powder is included in specific regions of the mold.

Tungsten carbide-based materials are included to promote MMC properties in specific regions of the drill bit body promoting exceptional erosion resistance when formed into a MMC. Metco 54133A-0 and Metco 54124A-90 are body powders, Metco 54005 is a face powder. Metco POW C is applied as a paste to specific regions.

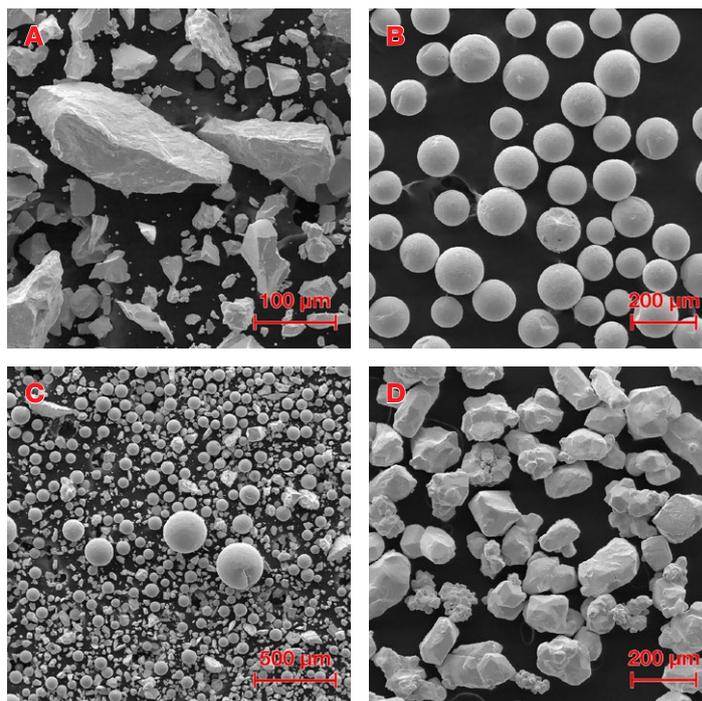
Metco 50060D is a tungsten carbide-based powder that forms a wear resistant surface on bearings used within down-hole motors.

1.1 Typical Uses and Applications

- Materials formed into a MMC using vibration and liquid infiltration processes to promote exceptional erosion resistance in specific regions of the drill bit body for:
 - Polycrystalline Diamond Compact drill bits
 - Bearing surfaces on downhole drill string motors
- Specific areas where these materials are recommended:
 - Metco 54005: Around cutter pockets on blade faces, and generally where hydraulic energies are highest
 - Metco POW C: Areas similar to those of Metco 54005 for non-horizontal areas and areas hard to cover sufficiently with a powder materials, e.g., blade root areas and pockets on the back of blades

Quick Facts

Classification	Tungsten- or Tungsten Carbide-based
Chemistry	W or WC and/or WC/W ₂ C
Manufacture	Blended
Morphology	Angular or spheroidal
Service temperature	≤ 900 °C (1650 °F)
Melting point	2900 to 3400 °C (5250 to 6150 °F)
Purpose	Strength and Wear Resistance
Process	Vibration and Liquid Metal Infiltration



SEM photomicrographs showing typical morphology of these materials.
A: Metco 54133A-0, **B:** Metco 50060D, **C:** Metco 54005, **D:** Metco 1801A

- Metco 54133A-0: Throughout the mold and resulting drill bit
- Metco 54124A-90: Throughout the drill bit after liquid metal infiltration
- Metco 50060D: Primarily on bearing applications for downhole motors
- Metco 1801A: Used post liquid metal infiltration at the top of the mold to interface with other composites such as steel inserts

2 Material Information

2.1 Chemical Composition

Product	Chemical Composition (nominal wt. %)		
	WC ^a	Ni	W
Metco 54124A-90	Balance	1 to 15	---
Metco 54133A-0	Balance	1 to 5	---
Metco 54005	100	---	---
Metco 50060D	100	---	---
Metco 1801A	0	---	100
Metco POW C	100	---	---

^a as WC and/or WC/W₂C.

2.2 Particle Size Distribution and Other Physical Properties

Product	Nominal Range (µm)	Morphology	Manufacturing Method	Color	Shelf Life	Base
Metco 54124A-90	-177 +44	Angular	Blended	Gray-Black	---	---
Metco 54133A-0	-177 +38	Angular	Blended	Gray-Black	---	---
Metco 54005	-420 +44	Spherical	Blended	Gray-Black	---	---
Metco 50060D	-149 +74	Spherical	Blended	Gray-Black	---	---
Metco 1801A	-250 +44	Angular	Blended	Gray	---	---
Metco POW C	-420 +44 ^a	Spherical	Blended and kneaded into a paste	Gray-Black	3 months	Aqueous (no VOCs)

Screen analysis per ASTM Standard B214 for particle sizes 45µm and above; size analysis for particles sizes below 45 µm via laser diffraction (Microtrac)

^a Solids constituent.

2.3 Key Selection Criteria

- Choose Metco 54005 powder for local application around cutter pockets, on the face of the blade and generally where hydraulic energies are highest. In similar locations Metco POW C pliable paste can be applied with the added of advantage in being able to be applied to specific and non-horizontal locations within the bit. The volatile constituents in POW C do not in any way inhibit the infiltration process nor leave any residue.
- Choose either Metco 54133A-0 or Metco 54124A-90 for use throughout the mold and the resulting drill bit.
 - Metco 54133A-0 provides exceptional strength and extends bit life, thereby reducing the number of necessary repair cycles. It is also able to withstand higher than specified operating loads and torques, as well as increased blade height compared to conventional products. When well-chosen for the application, the number of necessary repair cycles is reduced compared to conventional products.
- Choose Metco 54124A-90 when low environmental costs and a high value proposition for low to medium stress applications, including requirements for tender bit markets.
- Choose Metco 50060D powder for applications for infiltrated with a non-ferrous alloy to provide a highly erosion-resistant composite that is typically used in bearing applications. It flows freely and is ideally suited to fill tight annular spaces and results in minimal porosity after casting.
- Choose, Metco 1801A powder for post liquid metal infiltration to create forms at the top of the mold and for interfaces with other composites. It is readily machinable and both chemically and mechanically compatible.

2.4 Related Products

- When molten, Metco 1549 alloy infiltrates powders to form MMCs used on drill bits and bearings. Metco 1549 is provided in chunks,
- Metco 8530 silver-based (AWS BAG 24) brazing rod, disc and wire, forms a joint between the PDC cutters and MMCs on steel drill bits. Metco 8528 (AWS BAG 7) wire, is used for the same application but brazes at a lower temperature and is more fluid on brazing, but does not form joints that are as strong as Metco 8530.
- Metco Flux 125 is added to the top of Metco 1549 during mold assembly, during melting and liquid metal infiltration. The flux reduces oxides formed over the melting range of the alloy, benefiting casting and header integrity.
- Metco FLUX 6 is a boron-modified flux used dry or in a paste. It can be used in combination with Metco 8530 (AWS BAG 24) and Metco 8528 (AWS BAG 7) braze alloys.
- Metco 81025 and Metco 81022 composite rods are used to repair matrix and steel drill bits. Local repair can be achieved using GTAW (TIG) or oxy-fuel welding.
- Metco 81586 composite rod and Metco 51151B powder are diamond-containing materials that can be applied to the gage of steel drill bits and used to repair matrix and steel drill bits using oxy-fuel welding.
- Metco CLAY 010, Metco Clay 011, Metco Clay 012 and Metco Clay 013 are used in mold making to create detailed features and blending of geometries.

3 Key Processing Information

Please contact your Oerlikon Metco account representative for application support information on these products.

4 Commercial Information

4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Metco 54124A-90	1520490	50 lb (approx. 22.7 kg)	Stock	Global
Metco 54133A-0	1517870	50 lb (approx. 22.7 kg)	Stock	Global
Metco 54005	1305385	5 lb (approx. 2.25 kg)	Special Order	Global
Metco 50060D	1303862	50 lb (approx. 22.7 kg)	Special Order	Global
Metco 1801A ^a	1303865	50 lb (approx. 22.7 kg)	Special Order	Global
Metco POW C	1306924	2 lb (approx. 0.9 kg)	Special Order	Global

^a When purchasing many of these products from an Oerlikon Metco facility in Germany, an authorized German export license (BAFA) is required. Please contact your Oerlikon Metco Account Representative or Customer Service for more information.

4.2 Handling Recommendations

- For powder products:
 - Store in the original container in a dry location.
- For Metco POW C:
 - Refrigerate product upon receipt and when not in use.
 - Any opened package that has been left unrefrigerated for extended periods (e.g., > 24 h) should not be used.
 - Any used or unused product that has passed the expiration date should not be used.

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 No.
Metco 54124A-90	50-2581
Metco 54133A-0	50-2414
Metco 54005	50-2414
Metco 50060D	50-2414
Metco 1801A	50-2417
Metco POW C	50-2538

Information is subject to change without prior notice.