

## Material Product Data Sheet

### Cobalt Chromium [Nickel Tungsten Silicon] Carbon Alloy Powders (Similar to Stellite, Ultimet, Mar M 509)

#### Powder Products:

**Amdry™ MM509, Amdry MM509-C, Amdry X40, Diamalloy™ 4060NS, Metco™ 1220 series, Metco 45C-NS, Metco 45VF-NS, MetcoClad™ 21, MetcoClad 23**

#### 1 Introduction

Oerlikon Metco's CoCr[NiWSi]C products are inert gas atomized powders that are chemically homogeneous, exhibit minimal satellites and are freely flowing. They are designed and provide excellent results for a variety of applications such as laser cladding, thermal spray and PTA. These materials form coatings that are appropriate for wear and corrosion resistance in relatively high-temperature service conditions.

MetcoClad 21 and MetcoClad 23 have chemistries that are similar to Stellite 21 and Ultimet, respectively. Designed for laser cladding, they exhibit low dilution and deposits are nearly 100% dense.

Metco 1220 series and Diamalloy 4060NS have chemical compositions similar to that of Stellite 6. Metco 1220 series materials are designed for laser cladding, whereas Diamalloy 4060NS is designed for HVOF applications.

Amdry MM509 series is similar in chemistry to Mar M 509 cast alloy and are best applied using atmospheric plasma spray.

Amdry X40, Metco 45C-NS and Metco 45VF-NS are similar in chemistry to Stellite 31 (Stellite X40) and are designed to be applied using atmospheric plasma spray.

Amdry X40 and Amdry MM509 series can also be used as complimentary additive to Oerlikon Metco's ADB brazing alloys to facilitate crack and surface repairs.

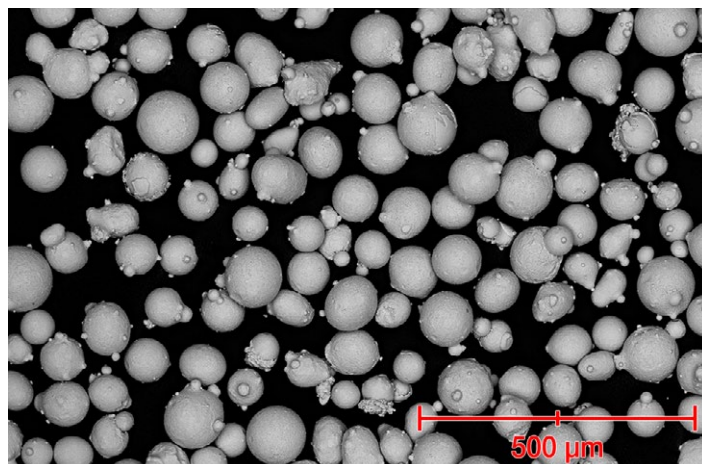
#### 1.1 Typical Uses and Applications

##### Laser cladding:

- Excellent resistance to galling on self-mating surfaces such as valve seats
- Erosion resistance resulting from cavitation
- High-temperature corrosion and erosion resistance
- Abrasive wear resistance

#### Quick Facts

Classification	Alloy, cobalt-based
Chemistry	CoCrC[WC][MoNiC][MoWNi]
Manufacture	Gas atomized
Morphology	Spheroidal
Melting Range	Various (see section 2.3)
Purpose	Wear and corrosion resistance at relatively high temperatures; repair and restoration
Process	Laser Cladding, PTA, HVOF, atmospheric plasma spray, combustion powder spray, brazing



Gas-atomized MetcoClad 21 showing typical morphology of these products

#### Thermal spray:

- Resistance to abrasive grains, hard surfaces, fretting and particle erosion at high temperatures for components such as piston rings, exhaust valves and seats, forging tools, hot crushing rolls, pump components, turbine vanes and air seals
- Surface restoration of worn or damaged gas turbine components such as airfoils, combustors, blades and vanes
- Gas turbine hot section applications such as combustion liner components
- Salvage and build-up applications on cobalt-based alloys

#### Brazing:

- Filler metal to facilitate wide-gap activated diffusion brazing applications such as crack repair on gas turbine hot section blades and vanes

## 2 Material Information

### 2.1 Chemical Composition

Product	Weight Percent (nominal)											
	Co	Cr	Mo	W	Ni	C	Si	Ta	Ti	Zr	Fe	Other
Metco 1220A	Balance	28.5	---	4.5	---	1.08	1.6	---	---	---	≤ 3.0	< 0.5
Metco 1220B	Balance	28.5	---	4.5	---	1.08	1.6	---	---	---	≤ 3.0	< 0.5
Metco 1220C	Balance	28.5	---	4.5	---	1.08	1.6	---	---	---	≤ 3.0	< 0.5
Diamalloy 4060NS	Balance	28.5	---	4.5	---	1.08	1.6	---	---	---	≤ 3.0	< 0.5
MetcoClad 21	Balance	27.0	5.5	---	2.75	0.2	≤ 1.0	---	---	---	≤ 3.0	< 1.0
Amdry X40	Balance	25.5	---	7.5	10.5	0.50	---	---	---	---	---	N.R.
Metco 45C-NS	Balance	25.5	---	7.5	10.5	0.50	---	---	---	---	---	N.R.
Metco 45VF-NS	Balance	25.5	---	7.5	10.5	0.50	---	---	---	---	---	N.R.
MetcoClad 23	Balance	25.5	5.0	2.0	9.0	0.08	0.06	---	---	---	3.5	< 0.1
Amdry MM509	Balance	23.5	---	7.0	10.0	0.6	---	3.5	0.23	0.45	---	< 0.3
Amdry MM509-C	Balance	23.5	---	7.0	10.0	0.6	---	3.5	0.23	0.45	---	< 0.3

N.R. = Not reported

### 2.2 Particle Size Distribution

Product	Nominal Range $\mu\text{m}$	Maximum Particle Size ( $\mu\text{m}$ ) Provided in Wt. %								
		150 $\mu\text{m}$	125 $\mu\text{m}$	106 $\mu\text{m}$	75 $\mu\text{m}$	53 $\mu\text{m}$	45 $\mu\text{m}$	20 $\mu\text{m}$	11 $\mu\text{m}$	5 $\mu\text{m}$
Metco 1220A	-150 +53	+ 3%	---	---	---	- 3%	---	---	---	---
Metco 1220B	-106 +45	---	0	+ 3%	---	---	- 3%	---	---	---
Metco 1220C	-53 +20	---	---	---	---	+ 5%	---	- 5%	---	---
Diamalloy 4060 NS	-45 +11	---	---	---	---	---	+ 5%	---	- 2%	---
MetcoClad 21	-125 +45	---	+ 3%	---	---	---	- 2%	---	---	---
Amdry X40	-125 +45	---	+ 5%	---	---	---	- 5%	---	---	---
Metco 45C-NS	-75 +45	---	---	---	+ 5%	---	- 10%	---	---	---
Metco 45VF-NS	-45 +5	---	---	---	---	---	+ 1%	---	---	- 2%
MetcoClad 23	-125 +53	+ 1%	+ 5%	---	---	- 4%	- 0.5%	---	---	---
Amdry MM509	-45 +5	---	---	---	---	---	+ 5%	---	---	- 10%
Amdry MM509-C	-125 +45	---	+ 5%	---	---	---	- 15%	---	---	---

Analysis for particle sizes 45  $\mu\text{m}$  and above by sieve (ASTM B214); Analysis for particle sizes below 45  $\mu\text{m}$  by laser diffraction (Microtrac)

### 2.3 Other Properties

Product	Melting Range	Similar To
Metco 1220A	1260 – 1357 °C (2300 – 2475 °F)	Stellite 6
Metco 1220B	1260 – 1357 °C (2300 – 2475 °F)	Stellite 6
Metco 1220C	1260 – 1357 °C (2300 – 2475 °F)	Stellite 6
Diamalloy 4060 NS	1260 – 1357 °C (2300 – 2475 °F)	Stellite 6
MetcoClad 21	1295 – 1435 °C (2363 – 2615 °F)	Stellite 21
Amdry X40	1340 – 1395 °C (2445 – 2545 °F)	Stellite 31
Metco 45C-NS	1340 – 1395 °C (2445 – 2545 °F)	Stellite 31
Metco 45VF-NS	1340 – 1395 °C (2445 – 2545 °F)	Stellite 31
MetcoClad 23	1332 – 1354 °C (2430 – 2470 °F)	Ultimet
Amdry MM509	1383 – 1454 °C (2521 – 2649 °F)	Mar M 509
Amdry MM509-C	1383 – 1454 °C (2521 – 2649 °F)	Mar M 509

## 2.4 Recommended Processes

Product	HVOF	Atmospheric Plasma Spray	Combustion Powder Thermospray	Laser Cladding	PTA	Brazing (Superalloy Filler Metal)
Metco 1220A	X	X	X	✓	✓	X
Metco 1220B	X	✓	X	✓	✓	✓
Metco 1220C	X	✓	X	✓	X	X
Diamalloy 4060 NS	✓	✓	✓	X	X	X
MetcoClad 21	X	✓	X	✓	✓	X
Amdry X40	X	✓	X	✓	✓	✓
Metco 45C-NS	X	✓	✓	X	X	X
Metco 45VF-NS	X	✓	X	X	X	X
MetcoClad 23	X	✓	X	✓	✓	X
Amdry MM509	X	✓	X	X	X	✓
Amdry MM509-C	X	✓	X	✓	✓	✓

## 2.5 Key Selection Criteria

### Metco 1220 series

- Deposits have good resistance to seizing, galling and cavitation over a wide temperature range, and combat adhesive, abrasive or erosive wear combined with corrosion at relatively high temperatures. They provide good thermal oxidation resistance at temperatures up to 1000 °C (1800 °F). Deposits resist oxidizing acids, but perform poorly in strong reducing acids such as hydrochloric with the degree of resistance dependant on the acidic concentration and temperature. Self-mating surfaces exhibit a very low coefficient of friction ( $\approx 0.12$ ).
- Choose Metco 1220A or Metco 1220B for laser cladding deposits of standard thickness.
- Choose Metco 1220C for deposits as thin as 0.5 mm (0.02 in). Its finer particle size distribution can save processing time and cost, as the time to grind to dimension is reduced.

### Diamalloy 4060NS

- Diamalloy 4060NS is used as a general restoration and repair material when compatibility with Stellite 6 is desired. When applied using HVOF, it forms dense, wear-resistant and oxidation-resistant coatings that may be used for turbine hot section applications such as combustion liners.

### MetcoClad 21

- Choose MetcoClad 21 for applications where superior corrosion resistance is required, compared to the Metco 1220 series, especially in reducing environments. It also resists oxidizing acids like acetic, formic phosphoric and low-concentration sulfuric.
- Laser clad deposits of MetcoClad 21 have superior properties compared to conventionally welded overlays.
- In addition to high resistance to cavitation and galling, deposits of MetcoClad 21 resist high temperature

metal-to-metal sliding wear with a low coefficient of friction and can be used on applications such as automotive piston rings.

- Laser clad surfaces exhibit superior impact resistance compared deposition using PTA (plasma transferred arc) welding.

### Amdry X40, Metco 45C-NS and Metco 45VF-NS

- Amdry X40, Metco 45C-NS and Metco 45VF-NS are similar to Stellite 31 (Stellite X40) and are generally applied using atmospheric plasma spray. They have the same elemental composition, but are differentiated by particle size. Coatings are resistant to wear by abrasive grains, hard surfaces, fretting and particle erosion at high temperatures. They are recommended for salvage and build-up applications. The coatings are useful in gas turbine engines at high temperatures up to 850 °C (1550 °F), and for metal working components which require a combination of mechanical integrity and hot wear resistance.
- Metco 45C-NS can be applied using atmospheric plasma spray or combustion powder spray. It differs from Metco 45VF-NS in that it produces thicker coatings that are softer. The thickness limitation of Metco 45C-NS coatings is 1.8 mm (0.070 in). Thicker coatings may require specialized spray techniques.
- Metco 45VF-NS is intended to be used for thin coatings, up to a maximum thickness of 0.4 mm (0.015 in). The coatings produced are smoother and harder than coatings produced using Metco 45C-NS and Amdry X40.
- Amdry X40 can also be used as a complimentary superalloy filler metal in brazing applications.

### MetcoClad 23

- MetcoClad 23 is designed for good wear and corrosion resistance and produce excellent laser clad deposits. The

alloy derives its mechanical properties from solid solution strengthening and minor carbide precipitation. It has excellent work hardening characteristics that offer better protection against high stress abrasion. When deposited using laser cladding, MetcoClad 23 exhibits almost no porosity and excellent wear resistance. MetcoClad 23 can be applied using plasma transferred arc (PTA). Relatively dense overlays can be obtained on compatible substrates.

- Choose MetcoClad 23 for applications where wear and erosion impact the surface at temperatures below 600 °C (1112 °F). It is recommended for applications, such as hydraulic piston rods, applied using laser cladding.

### Amdry MM509 and Amdry MM509-C

- These products were designed as complimentary filler metals for repair and wide-gap brazing applications.
- Amdry MM509 and Amdry MM509-C are similar to Mar M 509 casting alloy that contains carbide-forming elements. As coatings, they are best applied using atmospheric plasma spray and is primarily used for surface restoration of worn or damaged gas turbine parts such as airfoils, combustors, blades and vanes.

## 2.6 Related Products

- When coating application by electric arc wire spray is desired, Metco 8100 [Co 32Cr 13W 2.5C 2.5Fe 2.5Ni] is a cored wire that can be used to produce coatings where wear, corrosion and oxidation resistance is required at temperatures up to 900 °C (1650 °F).

- The CoMoCrSi alloys (Triballoy family) are particularly suitable where lubrication is low or nonexistent. They are known for their excellent high temperature sliding wear, corrosion, oxidation and general wear properties. Characterized by molybdenum-rich phases dispersed in a softer cobalt matrix, coatings perform well in reducing environments such as hydrochloric, formic and sulfuric acids; oxidizing environments, such as ferric chloride; non-oxidizing environments, such as phosphoric and acetic acid and saltwater. Excellent sliding wear resistance is combined with good hot corrosion resistance and moderate oxidation resistance at temperatures up to approximately 800 °C (1470 °F). Oerlikon Metco products include:

Product	Similar To	Recommended Spray Process	
		HVOF	APS <sup>a</sup>
Diamalloy 3001NS	Triballoy 800	✓	✗
Metco 68F-NS	Triballoy 800	✗	✓
Diamalloy 3002NS	Triballoy 400	✓	✗
Metco 66F-NS	Triballoy 400	✗	✓

<sup>a</sup>APS: Atmospheric Plasma Spray

- Oerlikon Metco offers a complete portfolio materials for wear resistance, corrosion resistance, general surface build-up and restoration, including nickel-based superalloy materials. Please contact your Oerlikon Metco Account Representative for further information.

## 2.7 Customer Specifications

Product Name	Customer Specifications
Amdry MM509	Chromalloy B-88 GE B50A988, CI B GE Part # 372A4430P001 Pratt & Whitney Component Repairs MS 1068 Pratt & Whitney PWA 1185-2
Amdry X40	Chromalloy BZ-003 Type 25 GE B50TF185, CI A
Metco 45C-NS	Canada Pratt & Whitney CPW 218 Chromalloy CP 6029 GKN Aerospace PM 819-18 MTU MTS 1228 Pratt & Whitney PWA 1318 Rolls-Royce OMA 3/81B Rolls-Royce plc MSRR 9507/3 Rolls-Royce plc RRMS 40037 SAE International AMS 5791 Snecma DMR 33.007
Metco 45VF-NS	Canada Pratt & Whitney CPW 236 CFM International CP 6002 GKN Aerospace PM 819-16 Honeywell M3963 MTU MTS 1346 Pratt & Whitney PWA 1316 Rolls-Royce plc MSRR 9507/23 Rolls-Royce plc RRMS 40043 Snecma DMR 33.008 U. S. Military MIL-P-83348, Composition C, Type 1, Class 1
Diamalloy 4060NS	GE B50A960 *
Amdry MM509	Canada Pratt Whitney CPW 549-2 GE B50A988, Class B Pratt Whitney PWA 1185-2 Tulsa Airfoil Repair MS 1068
Amdry MM509-C	GE B50A988, Class A

\* Meets the requirements of this specification, but not approved.

## 3 Application Information

### 3.1 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

Atmospheric Plasma	HVOF	Combustion Powder
Metco 3MB series	DiamondJet series	Metco 5P-II
SinplexPro	WokaJet series	Metco 6P-II series
Metco F4MB-XL series	WokaStar series	

## 4 Commercial Information

### 4.1 Ordering Information and Availability

Product	Order No.	Package Size	Availability	Distribution
Metco 1220A	1301056	5 kg (approx. 11 lb)	Stock	Global
Metco 1220B	1301057	5 kg (approx. 11 lb)	Stock	Global
Metco 1220C	1301058	5 kg (approx. 11 lb)	Stock	Global
Diamalloy 4060NS	1037003	10 lb (approx. 4.5 kg)	Stock	Global
Diamalloy 4060NS	1300203	5 kg (approx. 11 lb)	Stock	Global
MetcoClad 21	1083480	10 lb (approx. 4.5 kg)	Special Order	Global
Amdry X40	1002391	5 lb (approx. 2.2 kg)	Special Order	Global
Metco 45C-NS	1000081	5 lb (approx. 2.2 kg)	Stock	Global
Metco 45VF-NS	1000083	5 lb (approx. 2.2 kg)	Stock	Global
MetcoClad 23	1089348	10 lb (approx. 4.5 kg)	Stock	Global
Amdry MM509	1002099	5 lb (approx. 2.2 kg)	Stock	Global
Amdry MM509-C	1059330	10 lb (approx. 4.5 kg)	Stock	Global

### 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 SDS (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](http://www.oerlikon.com/metco) (Resources – Safety Data Sheets).

Product	SDS No.
Metco 1220A	50-2247
Metco 1220B	50-2247
Metco 1220C	50-2247
Diamalloy 4060NS	50-505
MetcoClad 21	50-1653
Amdry X40	50-114
Metco 45C-NS	50-114
Metco 45VF-NS	50-114
MetcoClad 23	50-1828
Amdry MM509	50-1023
Amdry MM509-C	50-1023

Stellite is a registered trademark of Kennametal Inc.  
Ultimet is a registered trademark of Haynes International, Inc.

Information is subject to change without prior notice.