AFM 1B ERCoCr-C
AFM 1M ERCCoCr-C
AWS/SFA A5.21
AFM 1C ECoCr-C
AWS/SFA A5.13

Description:

AFM #1 Cobalt is designed for applications that require extreme abrasion resistance at elevated temperatures, but where impact resistance is not a consideration. It has a higher carbon and tungsten content than other cobalt alloys causing the weld deposit to have a higher volume of carbides within its microstructure. Although the weld deposits of **AFM #1 Cobalt** are not as "tough" as those of **AFM #6 Cobalt**, they are much harder and have excellent resistance to solid particle erosion.

Typical Applications:

Seals, rotors, steam turbine parts, mixer blades, extrusion dies, saw blades, rolling mill guides, pump impellers, carbon scrapers, engine crossheads, hydropulper disc parts.

Chemical Composition Requirements (%):

AFM 1B ERCoCr-C:

C	2.0-3.0	Mo	1.0
Mn	1.0	Fe	3.0
Si	2.0	W	11.0-14.0
Cr	26.0-33.0	Co	BAL
Ni	3.0	Total Other	0.50

AFM 1M ERCCoCr-C:

C	2.0-3.0	Mo	1.0
Mn	2.0	Fe	5.0
Si	2.0	W	11.0-14.0
Cr	25.0-33.0	Co	BAL
Ni	3.0	Total Other	1.0

AFM 1C ECoCr-C:

C	1.7-3.0	Mo	1.0
Mn	2.0	Fe	5.0
Si	2.0	W	11.0-14.0
Cr	25.0-33.0	Co	BAL
Ni	3.0	Total Other	1.0

Available Sizes:

Bare & Coated: 3/32 (2.4), 1/8 (3.2), 5/32 (4.0), 3/16 (4.8), 1/4 (6.4), 5/16 (8.0)
Wire: .045 (1.2), 1/16 (1.6)

AFM 6B ERCoCr-A
AFM 6M ERCCoCr-A
AWS/SFA A5.21
AFM 6C ECoCr-A
AWS/SFA A5.13

Description:

AFM #6 Cobalt is our most popular and useful cobalt alloy, offering excellent balance between impact, heat, corrosion and metal-to-metal abrasion resistance. It offers outstanding anti-galling properties, superior high temperature hardness and resistance to cavitation erosion making it perfect to use as valve trim in steam engines or repairing worn machine parts. It is ideal for many hardsurfacing applications because of its resistance to mechanical and chemical degradation at extreme temperatures.

Typical Applications:

High pressure-high temperature valves, agitators, chain saw bars, digestors, hot oil pump parts, extruder screws, scraper knives, hot trimming dies, hot punches.

Chemical Composition Requirements (%):

AFM 6B ERCoCr-A:

C	0.9-1.4	Mo	1.0
Mn	1.0	Fe	3.0
Si	2.0	W	7.0-9.5
Cr	26.0-32.0	Co	BAL
Ni	3.0	Total Other	0.50

AFM 6M ERCCoCr-A:

C	0.7-1.4	Mo	1.0
Mn	2.0	Fe	5.0
Si	2.0	W	3.0-6.0
Cr	25.0-32.0	Co	BAL
Ni	3.0	Total Other	1.0

AFM 6C ECoCr-A:

C	0.7-1.4	Mo	1.0
Mn	2.0	Fe	5.0
Si	2.0	W	3.0-6.0
Cr	25.0-32.0	Co	BAL
Ni	3.0	Total Other	1.0

Available Sizes:

Bare & Coated: 3/32 (2.4), 1/8 (3.2), 5/32 (4.0), 3/16 (4.8), 1/4 (6.4), 5/16 (8.0)
Wire: .045 (1.2), 1/16 (1.6)

AFM 12B ERCoCr-B
AFM 12M ERCCoCr-B
AWS/SFA A5.21
AFM 12C ECoCr-B
AWS/SFA A5.13

Description:

AFM #12 Cobalt is similar to **AFM #6 Cobalt**, however **AFM #12 Cobalt** offers greater resistance to hot and cold abrasion at elevated temperatures. Weld deposits are harder than **AFM #6 Cobalt** deposits because of a higher carbide volume within its microstructure. It is excellent for abrasion and corrosion resistance, but only moderate impact. It is commonly used for cutting edges.

Typical Applications:

Tipping saw blades, chipping knives, paper slitters, cutter rolls, drawing dies, turbine blades, impeller pumps, conveyor screws, valve seats, cold working tools.

Chemical Composition Requirements (%):

AFM 12B ERCoCr-B:

C	1.2-1.7	Mo	1.0
Mn	1.0	Fe	3.0
Si	2.0	W	7.0-9.5
Cr	26.0-32.0	Co	BAL
Ni	3.0	Total Other	0.50

AFM 12M ERCCoCr-B:

C	1.2-2.0	Mo	1.0
Mn	2.0	Fe	5.0
Si	2.0	W	7.0-10.0
Cr	25.0-32.0	Co	BAL
Ni	3.0	Total Other	1.0

AFM 12C ECoCr-B:

C	1.0-1.7	Mo	1.0
Mn	2.0	Fe	5.0
Si	2.0	W	7.0-9.5
Cr	25.0-32.0	Co	BAL
Ni	3.0	Total Other	1.0

Available Sizes:

Bare & Coated: 3/32 (2.4), 1/8 (3.2), 5/32 (4.0), 3/16 (4.8), 1/4 (6.4), 5/16 (8.0)
Wire: .045 (1.2), 1/16 (1.6)

AFM 21B ERCoCr-E
AFM 21M ERCCoCr-E
AWS/SFA A5.21
AFM 21C ECoCr-E
AWS/SFA A5.13

Description:

AFM #21 Cobalt offers excellent high temperature strength and stability. The addition of molybdenum gives it work hardening capability, making **AFM #21 Cobalt** excellent for hit trimming dies, extrusion dies and hot shears. It has good anti-galling properties and excellent resistance to cavitation erosion and corrosion thereby making **AFM #21 Cobalt** an excellent choice for fluid seats.

Typical Applications:

Hot forming dies, hot working tools, pump shafts, high pressure-high temperature valves, valve seats, mixer blades, mill cutters, pump mill screws, gas turbines.

Chemical Composition Requirements (%):

AFM 21B ERCoCr-E:

C	0.15-0.45	Mo	4.5-7.0
Mn	1.5	Fe	3.0
Si	1.5	W	0.50
Cr	25.0-30.0	Co	BAL
Ni	1.5-4.0	Total Other	0.50

AFM 12M ERCCoCr-E:

C	0.15-0.40	Mo	4.5-7.0
Mn	2.0	Fe	5.0
Si	1.5	W	0.50
Cr	25.0-30.0	Co	BAL
Ni	1.5-4.0	Total Other	1.0

AFM 21C ECoCr-E:

C	0.15-0.40	Mo	4.5-6.5
Mn	1.5	Fe	5.0
Si	2.0	W	0.50
Cr	24.0-29.0	Co	BAL
Ni	2.0-4.0	Total Other	1.0

Available Sizes:

Bare & Coated: 1/8 (3.2), 5/32 (4.0), 3/16 (4.8), 1/4 (6.4), 5/16 (8.0)
Wire: .045 (1.2), 1/16 (1.6)

Typical Physical and Mechanical Properties

Alloy		AFM #1 Bare AFM #1 CTD	AFM #6 Bare AFM #6 CTD	AFM #12 Bare AFM #12 CTD	AFM #21 Bare AFM #21 CTD
HARDNESS ROCKWELL C	Oxy-fuel	52 – 55 1 Layer	42 – 45 1 Layer	48 – 51 1 Layer	NA
	TIG	51 – 54 2 Layers	40 – 43 2 Layers	46 – 49 2 Layers	25 – 27 2 Layers 45 Work Hardened
	Metal Arc	50 – 53 2 Layers	39 – 42 2 Layers	41 – 44 2 Layers	24 – 26 2 Layers 45 Work Hardened
WEAR RESISTANCE	Metal to Metal	Excellent	Excellent	Excellent	Excellent
	Impact	Not Recommended	Excellent	Good	Excellent
	Erosion	Excellent	Excellent	Excellent	Excellent
	Corrosion	Excellent	Excellent	Excellent	Excellent
	Cold Abrasion	Excellent	Good	Excellent	Good
	Hot Abrasion	Excellent	Good	Excellent	Good
Machinability		Use Carbide Tools	Use Carbide Tools	Use Carbide Tools	Use Carbide Tools
Density lbs/in³		0.312	0.303	0.308	0.300
Melting Point		2300ºF	2350ºF	2345ºF	2460ºF
Tensile Strength		111,000 psi	134,000 psi	141,000 psi	117,000 psi

Preheat and Postheat Treatment*

Base Metal	Preheat Temp.	Postheat
Low Carbon Steel (up to 0.40% C) for thin sections only	Not Required	Air-Cool
Low Carbon Steel (up to 0.40% C) for thick sections only and High Carbon Steel (over 0.40% C) for thin sections only and Low Alloy Steel (up to 10% alloy) for thin sections only	200°F - 600°F	Slow-Cool
High Carbon Steel (over 0.40% C) for thick sections only and Low Alloy Steel (up to 10% alloy) for thick sections only	300°F - 600°F	Slow-Cool
Air-Quench Steels	1100°F - 1200°F	Slow-Cool
High Chromium-Nickel (Austenitic) Stainless Steels (304, 309, 316, etc.) thin sections only	Not Required	Air-Cool
High Chromium-Nickel (Austenitic) Stainless Steels (304, 309, 316, etc.) thick sections only	200°F - 500°F	Slow-Cool
High Chromium (Martensitic) Stainless Steels (410, 416, 420, etc.) thick sections only	400°F - 600°F	Maintain at 400°-600°F for 4 hrs. per inch thickness, then reduce heat 90°F per hour till cool
High Chromium (Ferritic) Stainless Steel (430, 442, 446, etc.) thick sections only	200°F - 600°F	Maintain at 200°-600°F for 4 hrs. per inch thickness, then reduce heat 90°F per hour till cool
High Temperature Nickel Alloys (400, 600, 601, 625, 718, etc.)	200°F - 500°F	Stress-Relieve

*In many cases, preheating or postheat treatment is not necessary. However, it will reduce the chances of cracking in both the base metal and the weld deposit. The preheat or postheat temperatures will depend upon the carbon content of the base metal. The higher the carbon content – the higher the preheat temperature.

Welding Parameters and Data

Recommended Current Settings (SMA) (Coated)		
Diameter	DC+ (reverse polarity)	AC
1/8	85-100	90-120
5/32	120-150	135-160
3/16	150-175	160-180
1/4	200-250	220-270

Approximate Coverage Per Pound of Cobalt Alloy		
Thickness of Deposit (in.)	Pounds Per Square Inch	
	Bare	Coated
1/8	26	18
3/16	17	12
1/4	13	9