WALLCOLMONOY
SURFACING ALLOYS

Colmonoy® 42SW Sprayed on a Sucker Rod Ring Plunger

Colmonoy® 42SA, 42M, 42SC, 42H, 43F, 42P

Nickel-Based Hard-Surfacing Super Alloys with Improved Corrosion Over Generic Ni-Cr-B Alloys

Description:

Colmonoy® 42SA, 42M, 42SC, 42H1, 42H2, 43F, 42P are produced by inert gas atomisation and can be spray deposited and fused to achieve a hardness range of **Rockwell C 35-40.** Colmonoy 43F has a hardness range of **Rockwell C 38-43.** Colmonoy® 42 when PTA or laser deposited can achieve a nominal hardness of **Rockwell C 35-40**.

Colmonoy® 42 and 43 alloys are recommended for hard surfacing parts to resist abrasion, corrosion, erosion, heat, and wear. The alloys are non-sparking, non-magnetic, and non-galling. They are easily applied to ferrous metals, but have a slight tendency to warp annealed work to which they are applied. Due to its range of plasticity, it is well adapted to the hot forming of irregular surfaces. The alloys coefficient of friction are low.

Colmonoy® 42 and 43 alloys contain additional melting point depressants which alloy for a lower fusing temperature than competitive alloys of this hardness range. Fusing temperature is approximately 982°C (1800°F).

Additional fluxing agents also provide superior bonding to easily oxidised materials such as aluminum bronze, and allow for furnace fusing in nitrogen rich atmospheres. The special morphology of the hard phases provide good abrasion resistance, while maintaining excellent resistance to cracking or chipping.

Colmonoy® 42 and 43 alloys are used throughout the glass and petroleum industries. Applications in the glass industry include glass plungers, blank moulds, blow moulds, neck rings, bottom plates, guide rings and baffle plates. Petroleum applications include sucker rod ring plungers, centrifugal pump parts, heat exchanger tubes and wear rings. Colmonoy® 42 and 43 alloys can be used in other industries for plug and gate valves, camshaft lobes, dragline rollers and metalworking dies in which fairly good machinability is required.

Deposits which have low to moderate hardness have increased crack resistance and slightly less resistance to abrasion than harder alloys such as Colmonoy® 52. Deposits can be finished by grinding or machined with carbide tooling.

Specification Equivalents:

UNS N99644, NACE MR-01-75 and AWS A5.21 Classification ERNiCr-A (applicable to chemistry only).

Nominal Composition - % by Weight:

B	C	Cr	Fe	Si	Ni
1.8	0.5	10.0	2.5	3.2	Bal

Forms Available:

Colmonoy® 42 and 43 alloys are supplied as atomised powder for application with Wall Colmonoy's Spraywelder™ System, Fusewelder™ Torch and other commercially available Thermal Spray, PTA, Laser, HVOF and Puddle Torch systems.

Colmonoy® Alloy	Micron Size	Application
42SA	-106+38 µm	Spray & Fuse
42M	-125+45 µm	
42SC	-90+45 µm	
43F	-106+20 µm	
42-P1	-180+63 µm	PTA / Laser
42-P2	-150+53 µm	
42-P3	-125+45 µm	
42-H1	-63+20 µm	HVOF
42-H2	-53+20 µm	

Colmonoy® 42SA, 42M, 42SC, 43F:

Colmonoy® 42SA, 42M, 42SC and 43F are designed for spray and fuse applications, using combustion thermal spray systems such as the J-3 Spraywelder™ and Fusewelder™.

Colmonoy® 42M is designed for use with thermal spray systems that are more oxidising, thereby requiring a coarser material to achieve a quality coating.

Fused coatings form a metallurgical bond with the substrate providing inter-particle cohesive strength and substrate-to-coating adhesive strength with very low porosity. The coatings show good resistance to wear and impact and their hot hardness is excellent. (Table 3)

Colmonoy® 42-H1 and 42-H2:

Colmonoy® 42-H1 and 42-H2 alloys are designed for use in HVOF Systems and do not require fusing. (Table 4)

Colmonoy® 42-H1 and 42-H2 alloys are used for sucker rod ring plungers, centrifugal pump parts, heat exchanger tubes and other non-point loading applications. The coating is well suited for applications requiring abrasion and corrosion resistance, particularly in the as-sprayed condition when fusing is not possible. The coatings are also used to protect against particle erosion up to 815°C (1500°F).

Colmonoy® 42-H1 and 42-H2 alloys cannot be hardened by fusing. A metallurgical bond can be achieved, and coating integrity can be increased by torch, induction or furnace fusing. The fusing temperature is approximately 982°C (1800°F).

Table 1: Physical Properties (approximate):

Density	8.138 g/cc
	0.294 lb/cu in
Specific Gravity	8.50
Melting Point	1167°C
	2132°F
Specific Heat	0.4187 kJ/kg/°C (25-100°C)
	0.10 Btu/lb/°F (77-212°F)
Thermal Coef. of Expansion	8.56 10^{-6} (50-600°C)
	8.56 10^{-6} (122-1202°F)
Thermal Conductivity	15W / m-K
Coefficient of Friction (6 - micro surface finish)	0.1
Magnetic Permeability	1.005 N/A^2
Modulus of Elasticity, (Tension or Compression)	31 x 10^6 psi

Table 2: Room Temp. Mechanical Properties:
Deposits produced by Spray & Fuse

Compressive strength, (ave.)	1551.3 Mpa
	225,000 psi
Tensile strength, (ave.)	689.50 Mpa
	100,000 psi
Charpy impact*, (ave.)	6.78 N-m
	5.0 ft-lb
*Specimens having 12.7mm (1/2-inch-radius) notch and polished to remove all possibility of stress concentrations	

Table 3: Room & Elevated Temp. Hardness:
Deposits produced by Spray & Fuse

Test Temp (°C / °F)	Rockwell C Hardness
21 / 70	35 - 40
316 / 600	34
427 / 800	33
538 / 1000	29
649 / 1200	26

Coatings of Colmonoy® 42H alloys can be ground with silicon carbide or machined with CBN or carbide tooling.

Colmonoy® 42H alloys can be utilised as a chromium plating replacement. Though not as hard (35-40HRC), the coating is more dense (≥98%) and far less prone to cracking.

Application Methods:

Colmonoy® 42 and 43 alloys are easily applied to all steels having less than .25% carbon, grey cast iron; Meehanite, malleable, ingot and wrought iron; nickel, Monel[a] alloy 400, Inconel[a] alloy 600, Nichrome, Chromel[b]. Most high-temperature alloys can be overlaid without special precautions.

Steel having more than .25% carbon can also be overlaid, but requires controlled slow cooling after fusion, in suitable insulation such as Sil-O-Cel, mica, etc. Do not apply to ferrous metals that require subsequent hardening and tempering, because the dimensional change associated with the formation of martensite will crack the deposits of Colmonoy® 42 and 43 alloys. Hardenable base metals may be overlayed, but must be annealed isothermally after uniform austenitising to prevent cracking of the deposits of Colmonoy® 42 and 43 alloys. (Consult Technical Services for further details).

Application by Spraywelder™:

Colmonoy® 42 alloys are applied by use of the Spraywelder™, which is the recommended thermal spray system designed by Wall Colmonoy to produce dense coatings. The powder is sprayed on the part to be hard surfaced as in ordinary metal spraying procedure, and the overlay is then fused to the base metal by torch, induction or furnace. This is ideal when deposits of uniform thickness are being applied over a large area. Reference Spraywelder™ Brochure and Manual for more information.

Application by Fusewelder™:

Colmonoy® 43F powder is applied by Fusewelder™ or similar torch. The Fuseweld™ Process is a coating application method to apply metallurgically bonded coatings to the edges and corners of moulds and blanks. Small shafts, the leading edge of flights for augers and centrifuge scrolls, keyways, splines, and cams can all be efficiently coated or rebuilt with this process.

Application by High Velocity Oxygen Fuel (HVOF) Thermal Spray Processes:

Table 4: JP 5000 / 8000 Parameters for Spraying Colmonoy® 42H powders*

Gun barrel:	102mm (4")
Spray distance:	365mm (14")
Coating thickness:	>1.5mm (>0.060")
Spray rate:	4.5-5.4kg/hr (10-12 lb./hr).

Spray Parameters	Supply Pressure	Flow	System Pressure **
Oxygen	210 psi	1925 scfh	140+/-10 psi
Fuel (K1 kerosene)	170 psi	6.0 gph	121+/-10 psi
Powder (nitrogen carrier)	50 psi	19-20 scfh	not applicable
Combustion	N/A	not applicable	103+/-5 psi
Water Temperature: incoming - outgoing -	21°C 50°+/-10°C		

* Some modifications to the parameters may be needed to compensate for longer hoses.

** System pressures are based on supply pressure and flow settings and are present for the purpose of monitoring the condition system consumables; located at the bottom of the control console.

Table 5: Typical Unfused Coating Characteristics:

Process	JP 5000
Macro Hardness HRC	35-40
Porosity	<2%
Bond Strength	>13,000 psi
Surface Finish (as sprayed) (ground)	240-300Ra <10Ra
Coefficient of Friction (6-micro-inch surface finish)	0.1

Machining, Grinding and Lapping:

There are several techniques used for material removal that produce high quality finished products. Machining can be done, using cubic boron nitride tooling. Use GE's BZN compacts (such as BRNG-43T) or Kennametal's CNMA 433KC-210. Use a negative rake tool, with a 15-degree lead angle. It should have a 1.2mm (3/64-in.) radius and T-land edge preparation. Set tool at centreline of work. Feed at 0.005-0.010 IPR, with depth of cut up to 3.18mm (0.125-in.), at 200-300 SFM or higher.

The coatings can be machined with difficulty by carbide-tipped tools, such as Kennametal K6, Carboloy 883 or equivalent. For roughing, grind the tool with a slight lead and rake angle, and a slight radius (approx. 0.79mm (1/32")). Use a fine feed, about 0.075mm (0.003") per revolution, with a depth of cut about 0.38mm (0.015") at 15 SFPM. Set tool about 0.79mm (1/32") below centre. For finishing, grind the tool with the same slight lead and rake angles and with about a 1.6mm (1/16") radius. Use a fine feed, about 0.076mm (0.003") per revolution, with a maximum cut of 0.13mm (0.005") at approximately 45 SFPM.

Grinding is used after machining to remove the last 0.13-0.15mm (0.005-0.006") of material. Actually, the entire finishing is most commonly done by grinding, which eliminates machining. Grinding produces a near-frictionless mirror finish. Such smooth surfaces usually wear better, because they generate less heat and friction. Whereas a diamond wheel is preferred, green silicon carbide wheels (hardness H to K) can be used. Use 24 to 36 grit for roughing and 60 grit or finer for finishing. Grind wet when possible; do not let the wheel get loaded; dress frequently. Take light, fast cuts. (Manufacturer can provide full details for grinding.)

Dry lapping can be used to give the alloy an excellent finish. Silicon carbide, boron carbide and diamond dust are all capable of cutting the Colmonoy® coating, but they must be embedded in a cast iron or steel wheel to properly lap fused deposits of Colmonoy® 42 and 43 alloys. Apply with a steady pressure and avoid overheating. If the lapping compounds are used loose, they will cut the nickel matrix before the chromium carbides, giving the surface an etched appearance.

Safety:

When handling powders do so in such a way to avoid creating a dust cloud; avoid inhalation or contact with skin or eyes. Conduct coating operations in a properly ventilated area. For more information, consult 11.8 (Ventilation), *AWS Thermal Spraying: Practice, Theory, and Application* available from American Welding Society, OSHA Safety and Health Standards available from U.S. Government Printing Office, and the manufacturer's Safety Data Sheet (SDS).

Warning: Thermal spray torches and heating torches used for application of this product utilize compressed gasses or liquid fuels including oxygen, air, flammable fuel gas, or flammable liquid fuel. Follow your employer's safety procedures when using and handling these gases and equipment. Infrared and ultraviolet radiation (light) emitted from flame and hot metal can injure eyes and burn skin. HVOF and HVAF systems can produce noise levels that can damage hearing. Use appropriate personal protective equipment.

Danger: Plasma transferred arc (PTA) welding is a welding process used for application of this product. Follow your employers safety procedures and the equipment manufacturers instructions when PTA welding. Electric shock can kill. Properly install and ground electrical equipment prior to use. Infrared and ultraviolet radiation emitted from the hot metal or welding arc can injure eyes and burn skin. Use appropriate personal protective equipment.

Warning: Laser cladding processes may use high power levels when applying this product. Follow your employer's safety procedures and the equipment manufacturer's instructions when laser cladding. Refer to AISI Z136.1 "Safe use of Lasers" and consult your employer's Laser Safety Officer regarding the proper use of personal protective equipment.

Storage Requirements:

Keep thermal spray powders in a closed container and protect against moisture pick-up. The containers should be tumbled before using the powder. If moisture is absorbed from the atmosphere, it can be removed and flowability can be restored by drying the powder, with the seal removed and lid loosened, at 66-93°C (150-200°F) for two hours prior to use.

The information provided herein is given as a guideline to follow. It is the responsibility of the end user to establish the process information most suitable for their specific application(s). Wall Colmonoy assumes no responsibility for failure due to misuse or improper application of this product, or for any incidental damages arising out of the use of this material.

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