

50X Photomicrograph of a fused Colmonoy 62 coating applied to produce a dense, metallurgically bonded coating

Description:

Colmonoy 62 alloys include 62M, 62SA, 62C, 62H1, 62H2, 62H3, 63F and 63H1. They are atomised nickel-based powder alloys recommended for hardsurfacing new parts to resist wear, corrosion, heat and galling. The alloys are also used for repair of worn or out of tolerance parts. Colmonoy 62 alloys are spray deposited and fused to achieve a hardness range of **Rockwell C 55-64**.

The benefit of this range of alloys is its combined effects of abrasion and corrosion resistance. Colmonoy 62 alloys can be fused by torch, induction, or vacuum and controlled atmosphere furnaces.

Applications include hardsurfacing shafts, sleeves, pump plungers, pump valves, gate valves, sucker rod couplings, bed knives, cams, camshafts, plug gauges, bushings, mill guides, mixer blades, seal rings and conveyor screws.

Colmonoy 62 alloys are not generally used to protect against corrosion alone. The alloys are not resistant to ferric chloride and hot or concentrated nitric acid and should not be used in sodium sulfite liquor or lactic acid (milk products).

Deposits of Colmonoy 62 alloys cannot be cold worked; however, they can be hot formed while in the plastic state during fusion (approximately 970-1024°C).

Colmonoy® 62 Alloys: (62M, 62SA, 62C, 62H1, 62H2, 62H3, 63F, 63H1)

Nickel-Based Hard-Surfacing Alloys for Wear, Corrosion, Heat, and Galling Resistance

Specification Equivalents:

UNS N99646, NACE MR-01-75 and AWS A5.21
Classification ERNiCr-C (applicable to chemistry only).

Nominal Composition - % by Weight:

B	C	Cr	Fe	Si	Ni
3.2	0.7	15.5	4.0	4.2	Bal

Forms Available:

Colmonoy 62 alloys are supplied as atomised powder for application with the Spraywelder™ System, Fusewelder® Torch and other commercially available thermal spray, HVOF and puddle torch systems.

Alloy	Mesh Size	Application
Colmonoy 62M	125 µm - 45 µm	Spray / Fuse
Colmonoy 62SA	106 µm - 38 µm	
Colmonoy 62C	90 µm - 38 µm	
Colmonoy 63F	106 µm - 20 µm	
Colmonoy 62H1	63 µm - 20 µm	HVOF
Colmonoy 62H2	53 µm - 20 µm	
Colmonoy 62H3	45 µm - 20 µm	
Colmonoy 63H1	63 µm - 20 µm	

Colmonoy 62M, 62SA, 62C, 63F:

Colmonoy 62M, 62SA, 62C and 63F are designed for spray and fuse applications, using combustion thermal spray systems such as the J-3 Spraywelder and Fusewelder.

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 62M is designed for use with thermal spray systems that are more oxidising, thereby requiring a coarser material to achieve a quality coating.

Colmonoy 62H1, 62H2, 63H3 and 63H1:

Colmonoy 62H1, 62H2, 63H3 and 63H1 are designed for use in HVOF Systems and do not require fusing. (Table 4)

Colmonoy 62H powders and 63H1 are used for 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 62H powders and 63H1 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 1025°C (1875°F).

Coatings of Colmonoy 62H powders and 63H1 can be ground with silicon carbide or machined with CBN or carbide tooling.

as a chromium plating replacement. Though not as hard (55-61HRC), the coating is more dense ($\geq 98\%$) and far less prone to cracking.

Properties:

Table 1: Physical Properties (approximate):

Density	7.778 g/cc 0.281 lb/cu in
Specific Gravity	7.8
Melting Point	1025°C 1875°F
Specific Heat	0.7955 kJ/kg/°C (25-100°C) 0.190 Btu/lb/°F (77-212°F)
Thermal Coef. of Expansion	8.1×10^{-6} (50-650°C) 8.1×10^{-6} (122-1202°F)
Thermal Conductivity	15 W / m-K
Coefficient of Friction (6 - micro surface finish)	0.1
Magnetic Permeability	1.005
Modulus of Elasticity (Tension or Compression)	32×10^6

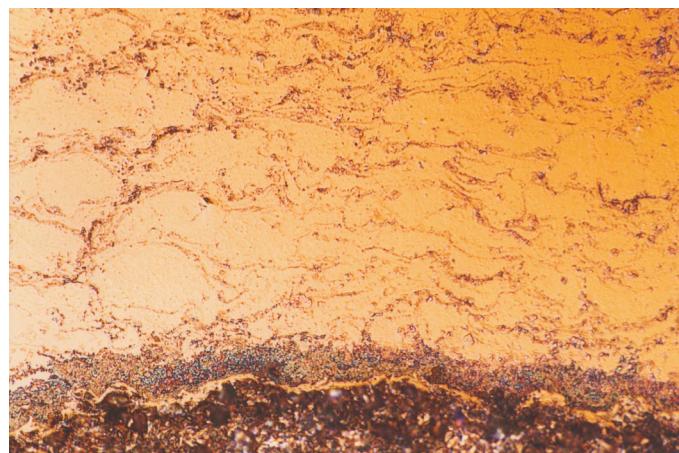
Table 2: Room Temp. Mechanical Properties:
Deposits produced by Spray-n-Fuse

Compressive strength, (ave.)	2,068.43 MPa 300,000 psi
Tensile strength, (ave.)	206.84 MPa 30,000 psi
Charpy impact*, (ave.)	2.0 N-m 1.5 ft-lb

*Specimens having 12.7mm (1/2-inch) notch and polished to remove all possibility of stress concentrations

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

Test Temp (°C / °F)	Rockwell C Hardness
21 / 70	55-64
315 / 600	57
425 / 800	54
540 / 1000	49
650 / 1200	45



Photomicrograph (500X) of Colmonoy 63H1

Application Methods:

Colmonoy 62 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 62 alloys. Hardenable base metals may be overlayed, but must be annealed isothermally after uniform austenitising to prevent cracking of the deposits of Colmonoy 62 alloys. (Consult [Technical Services](#) for further details).

Application by Spraywelder:

Colmonoy 62 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 63F 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 molds 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 Thermal Spray Processes:

Table 4: JP 5000 / 8000 Parameters for Spraying Colmonoy 62H powders* and 63H1*

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°C+/- 5°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 / 8000
Macro Hardness HRC	55 - 61
Porosity	<2%
Bond Strength	>90 MPa >13,000 psi
Surface Finish (as sprayed) (ground)	240-300Ra <10Ra
Coefficient of Friction (6-micro-inch surface finish)	0.1

Table 6: Hybrid Diamond Jet Parameters with methane (CH_4) for spraying Colmonoy 62H powders* and 63H1*

DJ8-9 Powder Injector
 DJ2701 Extended Air Cap (1/4" throat)
 9MP-DJ Powder Feeder set at 6.0 lb / hr

Spray Parameters	Pressure (psi)	Flow (SCFH)
Air	110	42
Oxygen	150	30
Fuel	110	68

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

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 centerline 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 0.076mm (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 62 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 Material Safety Data Sheet (MSDS).

Warning: Sprayweld type torches used for application of this product utilise compressed gases including oxygen and a flammable fuel gas. Follow your employers 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. Use appropriate 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 Limited. (UK) 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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b Registered trademark of Concept Alloys.

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