



*Fusing Colmonoy 52SA onto B.O.P. Ram*

## Description:

Colmonoy 52 alloys include 52SA, 52M, 53, 53HV, and 52DJ. These alloys are a premium nickel-based powder produced by inert gas atomization. Colmonoy 52 alloys can be spray deposited and fused to achieve a hardness range of **Rockwell C 45-50**.

Colmonoy 52 alloy deposits have moderate hardness, increased ductility, better impact resistance, but slightly less resistance to abrasion than Colmonoy 62 Alloys. These alloys are non-sparking, non-magnetic, non-galling and have low coefficient of friction. They are easily applied to ferrous metals, but have a slight tendency to warp annealed work to which they are applied. Colmonoy 52 alloys can be fused by torch, induction, or vacuum and controlled atmosphere furnaces. Fusing temperature is approximately 1950°F (1065°C).

The Colmonoy 52 alloys are used extensively throughout the petroleum industry. Applications include pump shafts, centrifugal pump parts, gates and seats, B.O.P. rams, sleeves and wear rings. Additional applications outside of the petroleum industry are camshaft lobes, glass plungers, cement industry gate and globe valve components, mining crusher shafts, dragline rollers and metalworking dies used for forming and drawing.

Colmonoy 52 alloys are not generally used to protect against corrosion alone. The alloys are not

# Colmonoy® 52 Alloys: (52SA, 52M, 53, 53HV, 52DJ)

Premium Nickel-Based  
Hard-Surfacing Alloys with  
Increased Ductility, Better  
Impact Resistance, and  
Moderate Hardness

resistant to ferric chloride and hot or concentrated hydrochloric acid. Also, they should not be used in sodium sulfite liquor and lactic acid (milk products).

## Specification Equivalents:

UNS N99645, NACE MR-01-75 and AWS A5.21  
Classification ERNiCr-B (applicable to chemistry only).

## Nominal Composition - % by Weight:

| B   | C   | Cr   | Fe  | Si  | Ni  |
|-----|-----|------|-----|-----|-----|
| 2.3 | 0.5 | 13.8 | 4.0 | 3.4 | Bal |

## Forms Available:

Colmonoy 52 alloys are supplied as atomized powder for application with Wall Colmonoy's Spraywelder™ System, Fusewelder® Torch and other commercially available thermal spray, HVOF and puddle torch systems.

| Alloy         | Mesh Size           | Application  |
|---------------|---------------------|--------------|
| Colmonoy 52SA | 140 mesh - 30 µm    | Spray-n-Fuse |
| Colmonoy 52M  | 140 mesh - 325 mesh |              |
| Colmonoy 53   | 140 mesh - 15 µm    |              |
| Colmonoy 53HV | 230 mesh - 20 µm    | HVOF         |
| Colmonoy 52DJ | 270 mesh - 15 µm    |              |

### Colmonoy 52SA, 52M, 53:

Colmonoy 52SA, 52M and 53 are designed for spray and fuse applications, using combustion thermal spray systems such as the J-3 Spraywelder and Fusewelder.

Colmonoy 52M is designed for use with thermal spray systems that are more oxidizing, 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)

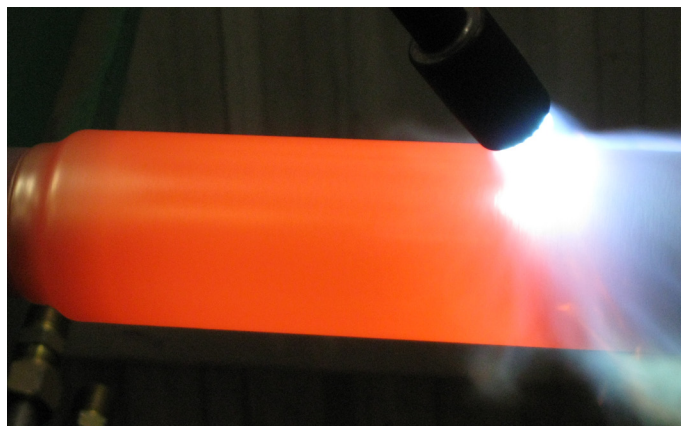
### Colmonoy 52DJ and 53HV:

Colmonoy 52DJ and 53HV are designed for use in HVOF Systems and do not require fusing. (Tables 4, 5 & 6)

Colmonoy 52DJ and 53HV 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 1500°F (815°C).

Colmonoy 52DJ and 53HV 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 1950°F (1065°C).

Coatings of Colmonoy 52DJ and 53HV can be ground with silicon carbide or machined with CBN or carbide tooling.



Colmonoy 52 being fused onto a downhole pump plunger

Colmonoy 53HV and 52DJ can be utilized as a chromium plating replacement. Though not as hard (45-50HRC), the coating is more dense ( $\geq 98\%$ ) and far less prone to cracking.

**Table 1: Physical Properties (approximate):**

|  |                                   |
|--|-----------------------------------|
| <b>Density</b>   | 0.294 lb/cu in                    |
|  | 8.138 g/cc                        |
| <b>Specific Gravity</b>                                      | 8.14                              |
| <b>Melting Point</b>   | 1950°F                            |
|  | 1065°C                            |
| <b>Specific Heat</b>   | 0.11 Btu/lb/°F (70-212°F)         |
|  | 0.4605 kJ/kg/°C (25-100°C)        |
| <b>Thermal Coef. of Expansion</b>                            | $8.4 \times 10^{-6}$ (122-1202°F) |
|  | $8.4 \times 10^{-6}$ (50-600°C)   |
| <b>Thermal Conductivity</b>                                  | 104 Btu/ft <sup>2</sup> /hr/in/°F |
| <b>Coefficient of Friction</b><br>(6 - micro surface finish) | 0.1                               |
| <b>Magnetic Permeability</b>                                 | 1.005 N/A <sup>2</sup>            |
| <b>Modulus of Elasticity,</b><br>(Tension or Compression)    | $32 \times 10^6$ psi              |

**Table 2: Room Temp. Mechanical Properties:**

Deposits produced by Spray-n-Fuse

|   |              |
|---|--------------|
| <b>Compressive strength, (ave.)</b>   | 275,000 psi  |
|   | 1,896.06 Mpa |
| <b>Tensile strength, (ave.)</b>   | 60,000 psi   |
|   | 413.69 Mpa   |
| <b>Charpy impact*, (ave.)</b>   | 3.0 ft-lb    |
|   | 4.0 N-m      |
| *Specimens having 1/2-inch-radius notch and polished to remove all possibility of stress concentrations |              |

**Table 3: Room & Elevated Temp. Hardness:**

Deposits produced by Spray-n-Fuse

| <b>Test Temp</b><br><b>(°F / °C)</b> | <b>Rockwell C</b><br><b>Hardness</b> |
|--------------------------------------|--------------------------------------|
| 70 / 21                              | 45-50                                |
| 600 / 315                            | 46                                   |
| 800 / 425                            | 45                                   |
| 1000 / 540                           | 42                                   |
| 1200 / 650                           | 38                                   |

## Application Methods:

Colmonoy 52 alloys are easily applied to all steels having less than .25% carbon, gray cast iron; Meehanite, malleable, ingot and wrought iron; nickel, Monel<sup>a</sup> alloy 400, Inconel<sup>a</sup> alloy 600, Nichrome, Chromel<sup>b</sup>. 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. Generally, 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 52. Quenching may be possible, but [Technical Services](#) should be consulted about your individual situation and needs.

Hardenable base metals may be overlayed, but must be annealed isothermally after uniform austenitizing to prevent cracking of the deposits of Colmonoy 52. (Consult [Technical Services](#) for further details).

## Application by Spraywelder:

Colmonoy 52 powder 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 53 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. Reference Fusewelder Brochure and Manual for more information.

## Application by High Velocity Oxygen Fuel Thermal Spray Processes

**Table 4: JP 5000 Parameters for Spraying Colmonoy 53HV\***

|                    |               |
|--------------------|---------------|
| Gun barrel:        | 4"            |
| Spray distance:    | 14"           |
| Coating thickness: | >0.060"       |
| Spray rate:        | 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:<br>incoming -<br>outgoing - | 70°F<br>120°+/-<br>10F |                |                    |

\* 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                                       | 45-50              |
| Porosity   | <2%                |
| Bond Strength  | >13,000 psi        |
| Surface Finish<br>(as sprayed)<br>(ground)               | 240-300Ra<br><10Ra |
| Coefficient of Friction<br>(6-micro-inch surface finish) | 0.1                |

**Table 6: Hybrid Diamond Jet Parameters with methane (CH<sub>4</sub>) for spraying Colmonoy 52DJ\***

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 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 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. 1/32"). Use a fine feed, about 0.003" per revolution, with a depth of cut about 0.015" at 15 SFPM. Set tool about 1/32" below center. For finishing, grind the tool with the same slight lead and rake angles and with about a 1/16" radius. Use a fine feed, about 0.003" per revolution, with a maximum cut of 0.005" at approximately 45 SFPM.

Grinding is used after machining to remove the last 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 52 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 utilize 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 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 Corporation (USA) 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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