COLMONOY® technical data sheet

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No. Ni.-1.1B

COLMONOY NO. 6
A Nickel-Base Hard-Surfacing Alloy Containing 10% Chromium Boride Crystals
Hardness RC 56-61

NOMINAL COMPOSITION

Carbon	– 0.65%	Silicon	– 4.35
Chromium	– 13.50	Iron	– 4.00
Boron	– 3.00	Nickel	– Balance

PHYSICAL PROPERTIES

Specific Gravity: 7.8
Density: 0.28 lbs. per cu. in.
Melting Range:
Solidus – 1740°F (950°C)
Liquidus – 1900°F (1040°C)
Modulus of Elasticity: 32,000,000 psi (tension and compression)
Ultimate Compressive Strength: 300,000 psi (average)
Tensile Strength: 30,000 psi (average)
Charpy Impact Strength: Average value of 1.5 lbs. (Special specimens having 1/2" radius notch, and polished to remove all possibility of stress concentrations, as referenced in Metal Progress, May, 1959, "Impact Testing for Calculating Tool Steels")
Magnetic Permeability: 1.005
Coefficient of Friction: 0.10 (6-micro-inch surface finish)
Average Coefficient of Thermal Expansion 122-1202°F (50-650°C): 8.14 x 10^{-6}. In./In./Deg.
Thermal conductivity, Btu/ft²/in/°F/hr – 104
Specific heat, Btu/lb/°F (77-212°F) – 0.190
Heat Treatability, Forgeability, Toxicity: None
Electrical Resistivity is similar to Inconel alloy 600.

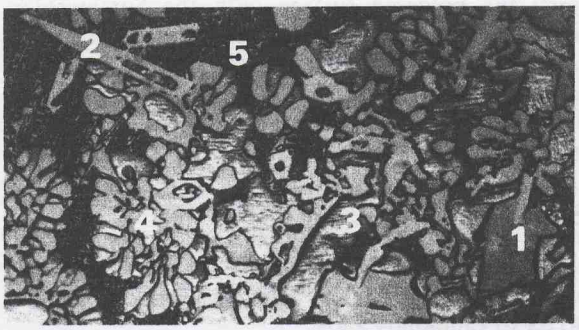
Hardness (Rockwell C) of oxyacetylene rod deposit*:

Room Temperature	600°F 315°C	800°F 425°C	1000°F 540°C	1200°F 650°C
56-61	55	52	48	44

*These hardnesses also apply to Sprayweld deposits and castings. Deposits by electric arc, TIG (GTAW) and PTA processes have lower hardnesses, depending on extent of base metal dilution.

DESCRIPTION

Colmonoy No. 6 is the original nickel-base hard-surfacing alloy. It was the success it was largely because it contained chromium boride crystals, which have a hardness of DPH 4100. They are created through a proprietary two-stage exothermic process. The chemistry has been duplicated by others, but none have duplicated the peculiar microstructure with its diamond-like chromium borides.



Photomicrograph identifying the constituents listed below. 480X

Microstructural Constituents and Microhardness:

1. Chromium Boride	4100 DPH
2. Chromium Carbide	2500 DPH
3. Primary Solid Solution	450 DPH
4. Secondary Solid Solution	800 DPH
5. Eutectic	1000 DPH

Colmonoy No. 6 is rated excellent in resistance to abrasion, corrosion, and galling and good on impact. It has excellent red hardness and has no peer in weldability. A very stable alloy, it does not anneal. Its low coefficient of friction makes it excel in metal-to-metal wear. It can be hot-formed while in the plastic condition (between the solidus and liquidus temperatures).

AVAILABLE FORMS

Sprayweld® Powder
Plasma Transferred Arc (PTA) Powder
Bare Rod
Castings
Ingot

APPLICATION METHODS

With the Sprayweld Process:

This method combines the controlled application of metal spraying and the metallurgical bonding of welding.

Prepare the surface to be sprayed by grit blasting. This ensures the mechanical bonding of the sprayed overlay, to prevent separation during fusing.

Litho in USA
Litho in USA

These extrusion auger blades are used to handle abrasive polishing and cutting media. At left, new blade. Center: severely worn blade. Right: blade rebuilt with Colmonoy No. 6. User says blades lasted "eight to ten times as long" with hard surfacing.

Spray the prepared surface with the Spraywelder pistol. It may be hand-held or mounted in a lathe for the overlaying of cylindrical parts. The recommended maximum thickness of a sprayed overlay is about .080 in. This includes an allowance for 20 percent shrinkage upon fusing, and .010 in. for finishing.

Fuse the sprayed overlay with an oxyacetylene torch or in a controlled-atmosphere furnace. The mechanically-bonded sprayed material now becomes fused, or welded, overlay; the part has an intregal surface of Colmonoy alloy.

With Plasma Transferred Arc equipment:
When ordering powder, indicate that it will be applied by the PTA process. Follow equipment manufacturer's instructions.

With oxyacetylene welding:
The surface to be overlaid must be clean; this is usually achieved most easily and effectively by grinding. Use a neutral flame. Preheating to approximately 600°F (315°C) is recommended on heavy sections, to minimize overlay stress checks. Apply using a brazing technique; the overlay is tinned to the surface. Do not puddle with base metal. Use Colmonoy Flux 6-20 on all cast irons and metals containing more than 2 percent chromium.

With electric arc welding:
Uncoated Colmonoy rod can be applied by DC electric arc (reverse polarity) to form overlays. Use 150-180 amperes with 3/16-in. dia. rod and 180-210 amperes with 1/4-in. dia. rod. Follow suggestions for preheat and bead pattern given for TIG welding (below).

With TIG (GTAW) welding:
The surface to be overlaid must be clean. Preheat steels as necessary to maintain adequate weld crater; always preheat when carbon content of base metal is more than 0.25 percent. (Don't exceed 700°F (370°C).) Use pure dry (–40°F dew point) argon shielding gas, and 1 percent thoriated tungsten electrodes. Move rod in an elliptical pattern, laying beads 1-1/2 to 2 times rod diameter, overlapping them well. When part gets hot, change to a crescent-shaped movement, to avoid overdilution. Two layers should be made. The part must be slow-cooled, or even postheated, to prevent overlay cracking.

FINISHING THE OVERLAY:

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° 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.

Grinding should be done wet, whenever possible. Due to the abrasive resistant qualities of the alloy, considerable pressure is required to remove stock, resulting in high surface temperature which may produce surface checks. In general, economical grinding of this alloy can best be done by taking light fast cuts with a green silicon carbide wheel; roughly dressed for roughing, medium dressed for finishing.

Lapping should be done dry. Silicon carbide, boron carbide and diamond dust will do a good cutting job provided they are embedded in a cast-iron or steel wheel. Used loose they will cut the nickel matrix before the chromium borides and carbides, giving the surface an etched appearance. Apply with steady pressure and avoid over-heating.

See Data Sheet Tech-2 for more finishing information.

BASE METALS THAT CAN BE OVERLAID

All steels having less than .25% carbon, and gray cast iron; Meehanite, malleable, ingot and wrought iron; nickel, Monel alloy 400, Inconel alloy 600, Nichrome, Chromel and 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. For overlaying martensitic steel, see Colmonoy Technical Data Sheet SW-3.

SOME TYPICAL USES

Colmonoy No. 6 is applicable to the hard surfacing of shafts, sleeves, valve trim and the like. A few specific examples of successful uses include:

Ball joints	Conveyor parts	Plug gauges
Bearings	Deep hole drills	Pump shafts
Brick augers, dies	Feeder shoes	Rocker arms
Bushings	Glass plungers	Screw conveyors
Cams	Mill guides	Sprockets
Center tips	Mixing blades	Trip dogs
Chuck jaws	Pistons	Valves, disks, seats

WARNING: Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. Read the product labeling and see American National Standard Z49.1 "Safety in Welding and Cutting" published by the American Welding Society.