WALLCOLMONOY
SURFACING ALLOYS

Tungsten carbide inserts being cemented into place using Colmonoy® 25F

Colmonoy® 25 Alloys:
(25F, 25E, 25P1, 25P2, 25P3)

Nickel-Based Hard-Surfacing Alloy for Fuseweld™, PTA and Laser Applications

Description:

Colmonoy 25 alloys include 25F, 25E, 25P1, 25P2 and 25P3 are nickel-based alloys recommended for hard-surfacing parts to resist wear, corrosion, heat and galling. Deposits, which have moderate hardness of **Rockwell C 25-31**, may be machined with carbide tooling. Also, deposits have good ductility.

Colmonoy 25 alloys are widely used in the Oil & Gas down hole tools industry, primarily for dressing and re-dressing steel and non-magnetic stabilisers. Its fast flow and easy wetting properties enable heavy deposits to be overlayed quickly allowing for efficient cementing of tungsten carbide tiles on standard steel as well as non-magnetic parts such as stabilisers, sleeves and steering pads.

Nominal Composition - % by Weight:

B	Si	Ni
1.8	2.7	Bal

Forms Available:

Colmonoy 25 alloys are supplied as an atomised powder which can be deposited using the Wall Colmonoy Fusewelder® Torch (or other similar thermal spray powder oxyacetylene torches) and for application by Plasma Transfer Arc (PTA) and Laser Cladding process.

Alloy	Particle Size / Mesh Size	Application
Colmonoy 25F	106 – 20µm 140-625 mesh	Fuseweld™
Colmonoy 25E	90 – 20µm 170 - 625 mesh	
Colmonoy 25P1	180 - 75 µm 80 - 200 mesh	PTA / Laser
Colmonoy 25P2	150 – 63µm 100 - 230 mesh	
Colmonoy 25P3	125 - 53 µm 120 - 270 mesh	

Properties

Table 1: Physical Properties (approximate)

Specific Gravity	8.6

Application Methods:

Colmonoy 25 alloys are corrosion, heat and wear resistant. Colmonoy 25 alloys are easily applied to ferrous metals and have little tendency to warp annealed work to which it is applied. Its coefficient of friction is low. The alloys should not be applied to the base metals which are required to be subsequently hardened and tempered; the formation of martensite with its resulting expansion will crack the welded Colmonoy deposit.

Hardenable base metals may be overlaid but must be isothermally annealed after uniform austenitization (immediately after welding) to prevent cracking of the welded deposit. It can be applied easily to all steels having less than 0.25% 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.

Steels having more than 0.25% carbon also can be overlaid but require controlled slow cooling after fusion, in suitable insulation such as Sil-O-Cel, mica, etc. Consult manufacturer for information on overlaying martensitic steel.

Note: Colmonoy 25 alloys cannot be hardened or strengthened by additional heat treatment.

Application by Fusewelder®:

Colmonoy 25 alloys are 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, key-ways, splines, and cams can all be efficiently coated or rebuilt with this process.

First completed section of as-welded stabiliser by Colmonoy® 25F

Application by PTA:

There are numerous Plasma Transferred Arc Welding systems on the market and a wide range of welding parameters can be used with Colmonoy 25 alloys to produce excellent weld overlays.

Wall Colmonoy recommends that a pure argon plasma gas be used in combination with an argon hydrogen shielding gas and an argon carrier gas.

Actual welding parameter settings will depend on the base metal, its thickness, geometry and metallurgical condition as well as the desired properties/geometry of the weld overlay and the type of PTA equipment being used.

Preheat Temperature by Class for steels

Class	Description	up to ½"	½" to 1"	1" to 2"	Interpass
10xx	C steels	100 – 600	100 – 700	100 – 800	200 – 700
13xx	Mn steels	350 – 500	400 – 600	450 – 700	450 – 600
23xx	Ni steels	200 – 400	200 – 500	300 – 700	300 – 600
31xx	Ni – Cr steels	200 – 600	300 – 700	400 – 900	>400
32xx	Ni – Cr steels	300 – 900	400 – 1000	500 – 1100	500 – 900
33xx	Ni – Cr steels	500 – 900	600 – 1000	700 – 1100	700 – 900
34xx	Ni – Cr steels	900 – 1100	900 – 1100	900 – 1100	900 – 1100
4140	Cr – Mo steel	600	700	800	600 – 800
4340		600	800	900	700 – 900
46xx		400 – 600	500 – 700	600 – 800	≅ 600
4820		600	700	800	600 – 800
5120		100 min	200 – 300	250 – 350	≅ 300
5145		400 – 500	450 – 550	500 – 600	≅ 500
86xx		100 – 400	200 – 500	300 – 600	≅ 400
High strength alloy steels (quenched and tempered)					
A533, B		50 – 200	100 – 350	200 – 450	100 – 350
A542		150 – 300	200 – 350	250 – 450	200 – 350
HY-130		75 – 225	75 – 275	200 – 375	200 – 350

Preheat and weld inter-pass temperature can affect the quality of the weld deposit and its wear properties.

This nickel-based matrix is tough and does not undergo complex volumetric changes that are cooling rate dependant. However, depending on the type of steel the base metal may transform. Adjustments can be made to preheat, inter-pass and post weld heating temperatures to prevent or minimize stress cracks if desired. (Consult Technical Services for further details).

Application by Laser Cladding:

Laser cladding utilises a laser beam as a heat source to weld a surfacing material to a substrate. Surface cladding powder is delivered to the weld zone through a powder feeder with an inert gas carrier. The power level of the laser, the powder feed rate, pre-heat of the base metal, and 3-dimensional movement speeds must be balanced to produce a metallurgically bonded, low dilution, crack free, porosity free clad overlay.

Properly applied laser clad overlays can have significantly higher hardness than a corresponding thermal spray applied coating of the same material. Alloy selection for the laser cladding process should take this into consideration.

Laser cladding can be conducted in a sealed, inert environment, or in an open shop environment. In the latter case, the use of argon or helium carrier gases with argon and/or helium shielding gases are recommended. Nitrogen is not an inert gas and it is not recommended for general use in laser cladding.

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 deposits of Colmonoy 25 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:

Do not heat any part of the cast iron over 815ºC during welding as this will cause oxidation of the surface and create hard spots adjacent to the deposit. If this critical temperature is approached, welding should be stopped and the part allowed to cool to 315-425ºC. The powder is applied by pressing the lever on the torch, which admits the powder to the gas stream. After passing through the flame, the molten particles are deposited on the work. When a small amount of alloy has been deposited, the powder is stopped (by releasing the lever), and the torch flame used to fuse the deposited material to the base metal. This spray-fuse cycle is repeated until sufficient build-up has been achieved. On all except large mass parts, the Fusewelder® Torch does all the heating required: pre-heating, spraying and fusing. Deposits as easily finished by grinding or by filing.

Warning: Thermal spray torches and heating 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.

Danger: Plasma transferred arc (PTA) welding is a welding process used for application of this product. Follow your employer's safety procedures and the equipment manufacturer's 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 flow ability 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.

a Registered trademark of Special Metal Corporation.
b Registered trademark of Concept Alloys.

Updated September 2015