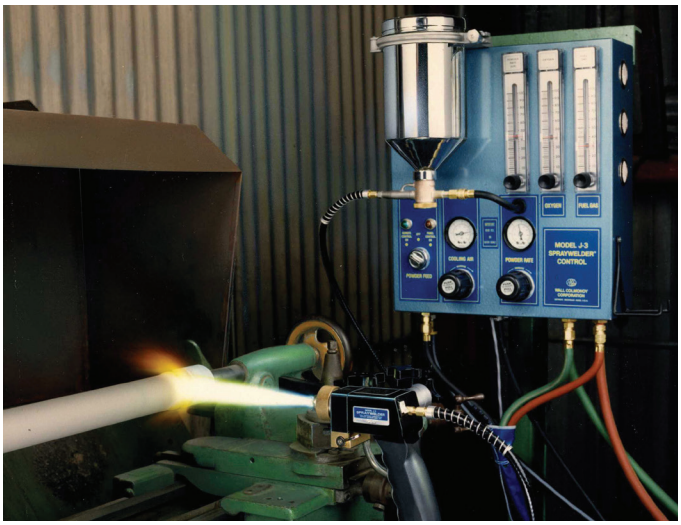
WALLCOLMONOY
SURFACING ALLOYS

WALLCOLMONOY
TECHNICAL DATA SHEET



The Model J-3 Spraywelder™ System

The 5-Step Sprayweld™ Process:

1. Surface Preparation
2. Preheating
3. Spraying
4. Fusing
5. Finishing

General:

In the Wall Colmonoy Sprayweld™ process, a powdered alloy is flame sprayed on a part, and then the sprayed overlay is fused to the base metal by torch or furnace heat. This creates a smooth, non-porous, welded hard surface within 0.25 mm (0.01") of finished dimensions.

1. Surface Preparation:

UNDERCUTTING is frequently necessary to produce an even depth of overlay, as on an unevenly worn surface, or to provide room for a sufficiently thick overlay to take the expected wear, as on parts not originally built to include a hard-surface overlay.

1. The depth of the undercut should be determined by the amount of wear permitted in service. To this it is advisable to add 0.13 mm (.005") (per side, in the case of cylindrical shapes). This is because 0.13 mm (.005") is considered the minimum for a sound overlay. The recommended maximum overlay depth that may be fused at one time is 1.91 mm (.075") (as fused). This would finish to about 1.52 mm (.060").

2. When undercutting to a shoulder, be sure to feather up to the shoulder at a 30° angle (from the surface) (figure 5-1). If an external corner is going to be sprayed, it should have a radius of at least 0.8 mm (1/32").

If rough threading is to be used in preparing the surface instead of grit blasting, the shoulder angle should be reduced to 15°.

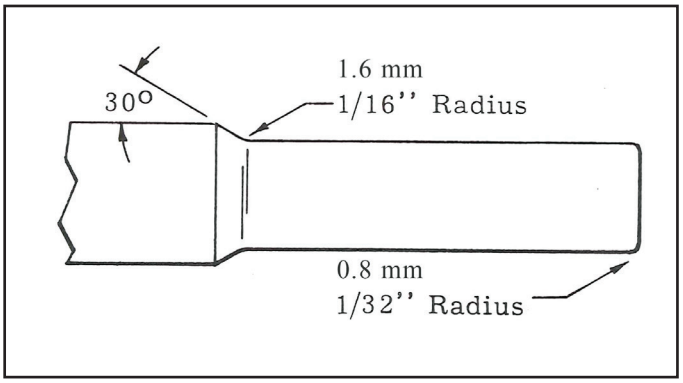


Figure 5-1. Undercutting to a shoulder

GRIT BLASTING is the preferred method of preparing a surface for the sprayed overlay.

It is important that satisfactory surface preparation be obtained to provide a good mechanical bond between the sprayed overlay and base metal during the spraying operation. This prevents the lifting or peeling of the overlay during the fusing operation.

The recommended minimum blasting pressure is 3.5 bars (50 psi) for a pressure blaster and 5.5 bars (80 psi) for a suction blaster.

1. The surface to be sprayed must have all plating, carburizing, nitriding, and all other surface treatment removed. Parts should be degreased, if necessary (this is necessary to prevent contamination of grit).

2. If the hardness of the surface is over 30 Rockwell C, anneal the part before blasting. With the surface hardness less than 30 Rockwell C, it is blasted with crushed angular chilled iron grit. Grit size can range from SAE No. 12 to No. 16. Use grit on the smaller end of this range in preparing for thin overlays, and the larger grit for heavier ones. Always blast more area than you expect to spray: blast surfaces around external corners, and beyond the shoulder of undercut areas.

The grit blast cabinet must be kept clean – use clean air and an adequate exhaust system to remove all fine grit and dust. Do not blast rusty or scaled parts in cabinet. If such parts are blasted therein, clean cabinet prior to use for surface preparation.

3. If grit blasting cannot be done, it is possible to prepare the surface by rough threading. It is the 'second-best' method, and can't be used at all on stainless steel base metals.

Threading should be done with a standard (U.S.) thread tool, cutting 32 to 40 threads per 25.4 mm (1"), not over 0.2 mm (.008") deep. Work must be turned slowly, and tool should be below center of the work. Allow tool to drag, in order to tear the surface. Metal slivers should be removed by running a clean file lightly over the surface. Threading should be done on the undercut shoulder areas, and a little beyond, to ensure good adherence at the overlay edges.

SPECIAL PRECAUTIONS should be taken to have a clean, oil-free surface for spraying.

Parts should be wrapped after grit blasting or rough threading to keep them free of grease or finger marks. It is best to spray as soon after blasting as possible to prevent rust or oxide from forming. If there's any doubt about the cleanliness of the surface, it should be washed by flooding and brushing it with an approved non-toxic solvent.

If there are holes, keyways, or slots in the work piece that are to remain "as is", they should be plugged during grit blasting with wood. To prevent their being sprayed, they should be plugged again, with carbon. The top surface of the carbon plug should be level with the desired height of the finished overlay.

Often there are surface areas, adjacent to where metal spraying is to be done, that must be kept free of any sprayed deposit. Nicrobraz® Green Stop-Off™ may be applied to these areas by brushing or dipping. This is a surface active material that prevents bonding. It is a lacquer-base liquid and the residue may be removed by grit blasting, wire brushing, polishing or pickling. A similar water-based material is also available.

2. Pre-heating:

Pre-heating is a function of the base metal. Please see SW-2.

3. Spraying:

The spraying operation (figure 5-2) should proceed as follows (refer to section 4 for operating instructions):

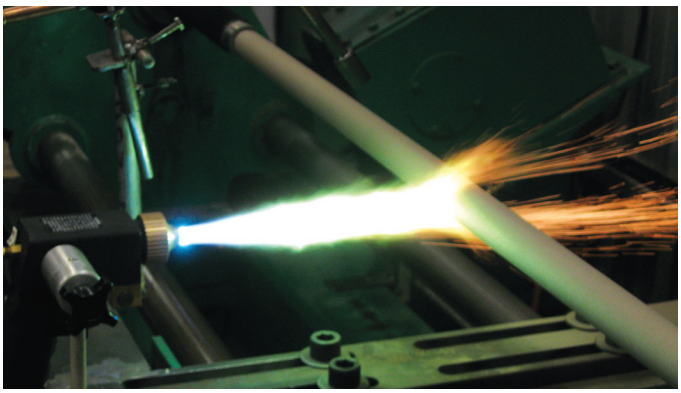


Figure 5-2. Spraying the overlay.

In standard operation, the tip of the outer flame envelope is usually held about 25.4 mm (1") from the work surface. However, the base metal, diameter, or geometry of the part might require that this distance be modified. The distance from work surface to gun tip falls in the range of 200 - 280 mm (8 - 11"). Users of earlier Spraywelder™ models should follow directions on the hopper panel. The gun may be mechanically or hand-held. The essential thing is to produce a uniform overlay which will require a minimum of finishing. The part should be rotated at about 30 - 37 M/min (100 to 120 SFM). Multiple passes are best; apply thin layers 0.05 to 0.25 mm (0.002" to 0.010") for best results.

In figuring the thickness of the sprayed overlay, allowance should be made for 20% shrinkage upon fusing. The part sprayed will tend to expand from the heat of the gun flame and allowance must be made for this expansion. It is best to check a wall thickness

for reference rather than the diameter whenever a tubular part is being processed.

An allowance of at least 0.25 mm (.010") per side for finishing should be made.

Example 0.9 mm (0.10") radial undercut requiring:

+ .025 mm (0.10") allowance for finish
  1.55 mm (.045")
  .018 mm (.009") allowance for 20% shrinkage on fusing
  1.33 mm (.054")
+ 0.13 mm (.005") safety factor
  1.46 mm (.059") Total before fusing

The part should be pre-heated to about 205-260°C (400 to 500°F) when working under the following conditions: when spraying internal diameters, when spraying heavy sections, and when spraying heavy deposits. This precaution will prevent cracking of the sprayed mechanical bond. Fuse immediately after spraying.

4. Fusing the Colmonoy® Overlay:

Fusing (figure 5-3) can be accomplished in one of several ways. Regardless of the method used, the principle involved is to bring the Colmonoy® overlay and base surface under it to a temperature range of 1010 - 1120°C (1850°F - 2050°F) at which point it will wet and bond to the base metal without losing its shape or running. Cylindrical parts should be turned at approximately 6 - 15 M/min (20 - 50 SFM), depending on part diameter and thickness of overlay. The various equipment and methods which can be used are:

OXYACETYLENE TORCH is the preferred method. Use a multi-flame tip which produces a soft bushy flame.Adjust to neutral flame. If the part is cylindrical, and its entire surface is overlaid, start at the end farthest from the chuck that holds the part. Hold the torch flame 45° to axis of the work during the entire fusing process so that the heat is "driven' toward the secured end. Preheat slowly until the overlay reaches a dull red color (minimum of 705°C (1300°F)). Then move the torch closer to the surface and heat to the fusing temperature. The overlay will assume a shiny, glassy appearance: the torch should be moved just ahead of the shiny surface until the whole overlay is fused.

Torch movement should be constant; slowly enough to heat the overlay to its bonding temperature but fast enough to prevent too much heat being applied in one place, which would cause the overlay to sag.

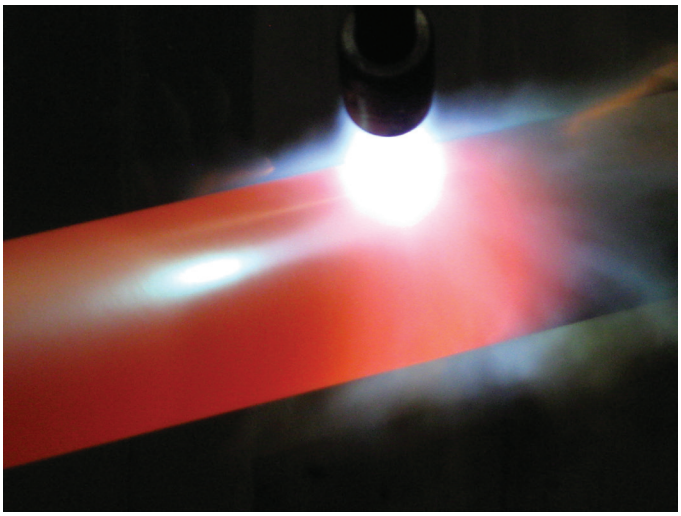


Figure 5-3. Fusing the overlay.

If the overlay does not extend to the end of the workpiece, start heating about 50 mm (2") away from the overlay, to insure full heat penetration of the base metal and prevent the overlay from rolling back as it is heated. Then, concentrate the heat on the beginning of the overlay. This fusion method is very easy to learn and one or two practice parts will be sufficient to insure proficiency.

CONTROLLED ATMOSPHERE FURNACE In this method the sprayed part is put in a furnace having a neutral or reducing atmosphere, at a temperature of approximately 1025 to 1095°C (1875 to 2000°F). The exact temperature and degree of control required depends on the atmosphere being used and the position of the sprayed surface. Only pure, dry hydrogen is recommended as the furnace atmosphere. It is advisable to watch the part (if possible) through the furnace peep hole and when the overlay assumes a glassy appearance, the part should be carefully removed. This method is used on parts with irregular cross section where the torch method is not practical.

It is best to work out a temperature and time cycle using a simulated work piece, prior to furnace fusing the production work. This is advisable because different types and purity of atmosphere will require slightly different time and temperature combinations. Also the fusing temperature of an alloy may vary slightly from one lot to the next.

INDUCTION if equipment is available and a number of the same parts are to be fused, this method can be used.

SPECIAL FUSING PROCEDURES To eliminate porosity in the center areas of overlays on cast iron or steel parts of heavy cross section, the fusing should be done in one of the following ways:

1. On large, flat parts, start at an outside edge and fuse approximately 13 mm (0.5") from edge, and all around the perimeter. The fusing flame should then be transferred to the center of the sprayed area, and fusion started there. Fusion should proceed outwards until it blends into the area first fused.

2. Large, irregular surfaced parts should be pre-heated in a furnace. Heat as quickly as possible, bringing the part to between 1000 to 1200°F (540 to 650°C). Fuse immediately upon removing with a multi-flame oxyacetylene torch. Use extra torches to maintain the amount of preheat and to speed fusing.

3. Sprayweld™ powders containing particles of tungsten carbide do not clearly show, by the typical "glassy look", when they are actually fusing to the base metal. The danger is that, in missing that visual signal, too much heat is applied causing the overlay to sag. One way to provide that signal is to spray a light coat of Spraywelder™ powder containing no tungsten carbide over the sprayed overlay. Use Colmonoy® 6 over Colmonoy® 75. Use Wallex® 50 over Wallex® 55.

Inspection by Heat Checking:

To assure that the overlay has been properly bonded, it is advisable to "heat check" all parts. This test is used to determine whether or not the operator has fused the Spraywelder™ powder sufficiently to effect a complete bond with the base metal. Protective glasses must be worn. The heat checking method is as follows:

1. The part to be checked should be at room temperature.

2. Set it up in turning fixture if surface to be checked is cylindrical.

3. The oxyacetylene torch flame is momentarily passed over the surface of the rotating part. Use the same size multi-flame tip required for the fusion operation and have the cone of the flame almost touching the Spraywelder™ powder overlay. The torch should be moved along at the rate of about 1 inch per second. The "heat checking," in effect, sets up a momentary thermal stress in the Spraywelder™ powder overlay and if it is not bonded, it will break loose from the base metal. If no cracking occurs in the overlay, the bond is satisfactory.

5. Finishing:

The Spraywelder™ powder overlay should be finished as follows:

MACHINING Colmonoy® 6 and 72 can be machined using cubic boron nitride tools, such as GE's BZN compacts (BRNG-43T) or Kennametal's CNMA 433KC-210. Use a negative rake tool with 15° lead angle. Should have a 19.05 mm (0.75") radius and T-land edge. Set tool at centerline of work. Feed at 0.0127 - 0.254 mm per revolution (0.0005 – 0.010 inches per revolution), depth of cut up to 0.762 mm (0.030"), at least 61 - 91 M/min (200 - 300 SFM).

All other alloy grades (except those containing tungsten carbide) can be machined with Carboloy 883 or Kennametal K6 tools. Tool should have slight lead and rake angles, and a radius of 0.8 mm (1/32"). Feed about 0.076 mm per revolution (0.003 inches per revolution), depth of cut about 0.38 mm (0.015"), at 4.5 to 13.7 M/min (15 to 45 SFM). Machining can produce a 0.3 to 0.4 µm (12 to 16-microinch) finish. The last 0.13 mm (0.005") can be ground, to produce a 0.1 to 0.3 µm (4 to 12-microinch) finish.

GRINDING All Spraywelder™ powder deposits can be ground. Use green silicon carbide grinding wheels of H, I or J hardness. Wet grinding is recommended. For roughing use 24-grit wheels. For finishing use 60-grit or finer. Refer to Technical Data Sheet Tech-2 for wheel recommendations.

LAPPING The nickel-based and cobalt-based alloys can be given a 0.05 µm (2-microinch) finish by dry lapping. Silicon carbide, boron carbide, and diamond dust will do the cutting job. They must be imbedded 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 a steady pressure and avoid overheating.

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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