



# HI-ALLOY COLD SPRAY

## METAL ALLOY POWDER APPLICATION PROCESS

**DESCRIPTION:** The Hi-Alloy "Cold Spray" metal alloy powder application process is a process by which a worn or undersized part may be renewed without danger of warpage, distortion, and/or metallurgical changes in the part to be built-up. This is called a "Cold" process because tiny metal alloy particles are sprayed onto a part preheated to 200° - 300° F., and the base metal temperature is held to under 650° F. during the application process.

There are two distinctly different powder groups, the Two Step group and the One Step group. The Two Step process is the original cold spray process. The powders in this group are designed specifically for the restoration of shafts turning in a machine lathe and require the application of a Bond Coat or Base Powder prior to application of the Top Coat or Finish Powder. The One Step process is based on newer technology. The powders in this group are self-bonding and, in most cases, do not require the application of a base powder. They work equally well to the Two Step powders for shaft restoration in the machine lathe, but may also be applied to flat, contoured, or round parts which cannot be turned in a machine lathe. Surfaces to be built-up can be undercut in the lathe, rough ground, grit blasted, filed, or sanded with coarse grit paper or cloth to prepare them for powder application.

## TWO STEP PROCESS - APPLICATION PROCEDURES

### STEP 1 - SURFACE PREPARATION:

- A. The worn area of the part to be restored should be thoroughly cleaned.
- B. The part should be situated in the machine lathe to turn as true as possible.
- C. Using a 90° point on a cutting tool; undercut the worn area a minimum of at least .020" depth on the radius. The undercut should extend at least ½" beyond both ends of the worn area. Note: brass and bronze should be undercut a minimum of .030" on the radius.
- D. CAUTION: DO NOT TOUCH THE UNDERCUT AREA AFTER MACHINING.



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E. Bevel shoulders at both ends of the undercut area with a 45° angle.

F. Threading the undercut area is important. Using a 60° angle, thread the undercut area according to the following table:

Depth of Undercut (on radius)	Pitch	Depth of Thread	Threads per Inch
0.015"	0.015"	0.0075"	67
0.025"	0.025"	0.0125"	40
0.040"	0.040"	0.020"	25
0.050"	0.050"	0.025"	20
0.060" and above	0.060"	0.030"	16

G. Thoroughly clean and degrease the area to be built-up with a non residue cleaner and do not touch the area after cleaning, even the small amount of residue left by a fingerprint can cause a failure.

NOTE: Leave a small land, about 1/16", between the end of the threads and the end of the beveled shoulders at the ends of the undercut.

### STEP 2 - APPLICATION

A. Recommended Work Speeds

Diameter of Work piece	Recommended RPM
Up To ½"	130-280
2"	100-235
3"	70-165
4"	50-115
5"	40-95
6"	30-80
7"	26-66
8"	23-57

For larger shafts adjust the RPM to produce surface speed of 55-130' per minute.

NOTE: The higher RPM's usually produce more dense deposits.

B. Set lathe to the recommended work speed.

C. Set a pair of calipers to approximately .030" over the desired finish diameter.

D. Attach a container of MB-1 BONDcoat powder to the torch hopper.



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E. Set the Oxygen regulator to 6-7 lbs. of pressure and the Acetylene regulator pressure to 5-6 lbs. Light the torch and adjust the flame to neutral or slightly carburizing. (Allow a slight feather on the inner cone of the flame).

NOTE: When using MB-4 Finishing or Top Coat powder or One Step Aluminum Bronze Powder, adjust flame to excess oxygen to eliminate excessive smoking.

### **F. PREHEATING**

1. Apply cleaning solvent again to assure cleanliness of the part.

2. With work piece turning in the lathe, preheat the work area to 200° F. (Use a Tempil Stick to test)

NOTE: Shafts of 2" and larger take longer to fully absorb preheat. Allow such sizes to turn in the lathe for 2 minutes after preheating, and then test again for 200° F.

**G. CAUTION: MAINTAIN A WORK DISTANCE OF 6" TO 7" FROM TORCH TIP TO WORKPIECE.**

H. Starting about ¾" before the undercut area; apply a thin coat of MB-1 BONDCOAT to the work piece and continue approximately ¾" beyond the end of the undercut area.

NOTE: By moving slowly across the work area a thin layer of .005" to .007" of BONDCOAT will be achieved in one pass producing a strong autogenic bond.

I. Remove the container of MB-1 BONDCOAT from the torch hopper and attach a container of the powder selected for the Finishing or Top Coat.

**J. CAUTION: MAINTAIN A WORK DISTANCE OF 6" TO 7" FROM TORCH TIP TO WORKPIECE.**

K. Moving slowly, start spraying at one end of the BONDCOAT toward the other end, and continue applying pass-on-pass until the build-up is approximately .020" over the desired finished diameter. **CAUTION: DO NOT OVERHEAT.** The bond is adversely affected when temperature in the work piece exceeds 750° F. Use a 600° to 650° F. Tempil Stick to check the temperature of the work piece during the spraying operation. Should the work piece temperature reach 650° F., stop spraying for several minutes and allow the work piece to cool in the lathe to around 250° F. before continuing.

## **STEP 3 - FINISHING**

Starting in the center of the build-up area, and using the same turning speeds, machine toward the outside using a sharp carbide tool to machine build-ups of MB-2, MB-4, and MB-6. MB-3 and MB-5 must be finished by grinding due to their high hardness and wear resistance.



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### **ONE STEP PROCESS - APPLICATION PROCEDURES**

#### **FOR MACHINE LATHE APPLICATION**

Follow the Two Step Process Application Procedures through Step 1 - Surface Preparation, and Step 2 - Application through "G". Beginning with "H" the procedures should read as follows for the "One Step Process."

H. Starting about  $\frac{3}{4}$ " before the undercut area, apply two thin coats of powder to the work piece moving the torch back and forth rapidly and continuing approximately  $\frac{3}{4}$ " beyond the end of the undercut area.

I. Spraying slowly, continue applying pass-on-pass until a build-up of approximately .020" over the finish diameter is achieved. CAUTION: DO NOT OVERHEAT. The bond is adversely affected when temperature in the work piece exceeds 750° F. Use a 600° - 650° F. Tempil Stick to check the temperature of the work piece during the spraying operation. Should the work piece temperature reach 650° F., stop spraying for several minutes and allow the work piece to cool in the lathe to around 250° F. before continuing.

#### **STEP 3 - FINISHING**

The Hi-Ductile powder is easily machinable with conventional cutting tools. Start in the center of the buildup area and machine toward the outside using the same lathe speed used for powder application.

The Hi-Friction powder is difficult to machine, will dull tools rapidly, and will leave a rough surface because of the carbides in the deposit. Grinding would be the preferred finishing method.

The Hi-Abrasion powder is not machinable and must be ground to finished size.

The One Step Aluminum Bronze powder is easily machinable with conventional cutting tools and will work harden during the machining process.

#### **FOR NON-LATHE APPLICATION**

On flat, round, or contoured surfaces, the base metal surface must be roughened by sanding, filing, grinding, or grit blasting to a roughness at least equal to 80 grit sandpaper. The surface must then be thoroughly cleaned and degreased. Position the part so the torch may be held upright. Preheat work area to 200° - 250° F. Move the torch back and forth slowly spraying the entire area until the desired build-up is achieved. CAUTION: DO NOT OVERHEAT. (See Section I above).