## Overlays

### Introduction

Overlay is a term used to describe a metal coating. The overlay material is usually applied to a metal surface for a variety of reasons. Corrosion and erosion resistance are two common applications.

Overlays permit the use of relatively inexpensive materials for the workpiece while applying the relatively expensive overlay to the surfaces exposed to adverse conditions.

A summary of several overlay techniques is given below.

### Spray and Fuse Powders

The spray and fuse (flame spray) hardfacing process uses manual or automatic equipment to deposit finely divided, semi-molten particles. Hardfacing with oxy-acetylene gas allows thin, hard coatings to be applied quickly and uniformly. Deposits ranging from 0.020 to 0.060 in. (0.51 to 1.5 mm) thick can be made by building up several layers at a rate of 0.005 to 0.010 in. (0.13 to 0.25 mm) per pass. Maximum build-up is about 0.080 in. (2 mm). Deposit thickness is controlled by the traverse speed of rotation (when done between centers on cylindrical parts), powder flow, and the number of layers applied. Coatings applied by cold spraying are under a certain degree of tensional stress and, for this reason, the fusing operation should immediately follow spraying. This procedure eliminates any risk of the coating cracking before the heat required for fusing is applied. Fusion is carried out using a conventional oxyacetylene torch provided with a large multi-jet nozzle designed to spread the heat over a wide area.

### Plasma Spray Surfacing Powders

Plasma spray surfacing is a non-transferred arc process that uses the arc plasma to melt the powder particles and a high-velocity gas flow to propel the particles onto the base metal. The resulting deposit normally 0.005 to 0.010 in. (0.13 to 0.25 mm) thick, contains voids. Densities of 90 to 95 percent can be obtained, however, this depends on the alloy and the procedure used. Because of the high arc temperatures, this process can be used to apply refractory coatings that cannot be applied with the spray and fuse process. Although both the plasma spray and spray and fuse processes produce coatings that are bonded to the base metal, the coatings applied with the plasma spray process have superior bond strength. Just about any material that does not sublimate can be sprayed. Even though the arc flame is extremely hot, very little heat build-up occurs on the part during spraying. Coatings thus can be applied to finished parts without distorting them. Very smooth coatings can be obtained, and finishing is often unnecessary. Powders can be applied manually or by mechanized equipment.

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### Manual Torch Powders

Manual powder torches enable the application of many hardfacing alloys. By following general oxy-acetylene surfacing practice, deposits that are smooth, thin and dense can be obtained. Powder application and fusion take place in one operation. Deposit thickness is controlled by powder flow rate and movement of the torch. A dilution of 1 to 5% in the deposit occurs from this process. Deposits ranging from 0.030 to 0.125 in. (0.76 to 3.2 mm) thick can be applied at a rate of 0.050 in. (1.3 mm) per pass. "Sweating" of the base metal during surfacing generates a fusion type bond with the hardfacing alloy. Ease of application and material recovery are enhanced because of close control of the powder flow into the welding flame.

### Plasma Transferred Arc (PTA) Surfacing Powders

PTA surfacing is a welding process, not a metal spray or coating process. The deposits are homogeneous and fuse to the work piece forming a metallurgical bond. Deposits between 0.025 and 0.25 in. (0.63 to 6.4 mm) thick can be produced rapidly in a single pass. Penetration into the base metal can be controlled closely to very low levels. However, a dilution of 5 to 20% in the deposit can be expected. PTA surfacing fits especially well into high-speed production applications requiring thin weld overlays. Heavy deposits can be made at deposition rates up to 10 to 12 lb. (4.5 to 5.5 kg) per hour. A maximum 1-1/2 in (38.1 mm) bead width can be deposited, although a bead width of not more than 3/4" (19mm) gives the best results. High deposition rates with smooth deposits that reduce material usage and finishing time significantly lower total surfacing costs, compared with other methods (such as gas tungsten arc and oxy-acetylene. PTA surfacing is a mechanized process for applying a fully fused deposit. The process makes use of a constricted arc and uses powdered alloy. The alloy is carried from a powder feeder to the plasma torch in a stream of argon gas. The powder is directed away from the torch into the arc effluent, where it is melted and fusion-bonded to the base metal. A direct current (dc) power source connected between the tungsten electrode and the work piece provides energy for the transferred arc. A second dc power source connected between the tungsten electrode and the arc-constricting orifice supports a non-transferred arc. This non-transferred arc supplements the heat of the transferred arc and serves as a pilot arc to initiate the transferred arc. Argon is passed through a gas diffuser to provide a blanket of shielding gas in and around the arc zone.

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