

Hard Metal Overlay Processes – a comparison

This document first gives brief descriptions of the processes which are commonly used throughout the world for the application of welded hard metal overlays for wear protection, and then compares them with our “HD” process:-

There are four widely-used, traditional methods of applying hard metal overlays:

1. The Open Arc Process:

Overlays are applied using a tubular wire electrode filled with hard metal powder and flux.

2. The Submerged Arc Process:

Overlays are applied using a tubular wire electrode filled with hard metal powder. The overlay is deposited under a thick layer of powdered flux, which is continuously fed from a hopper.

3. The Bulk Welding Process:

Overlays are applied using a solid wire electrode, a gas shield, and an external powder feed of hard metal, which is continuously fed into the arc from a hopper.

4. The Gas Shielded Arc Process:

Overlays are applied using a tubular wire electrode filled with hard metal powder, and a gas shield.

In all of these four processes, most of the hard metal is melted in the electric arc and reforms as a crystalline structure during solidification.

Advantages:-

- High deposition rates result in relatively low cost wear plate.
- Overlays are suitable for the manufacture of high volumes of wear resistant components used in locations where accessibility for the replacement of worn components is good, and the consequences of premature failure are minor.

Disadvantages:-

- These overlays are often deposited by multi-head welding machines running at very high power levels, typically 800 to 1000 Amps. Consequently, penetration by the overlay into the steel plate base material is substantial, typically 2mm to 3mm deep. This penetration results in significant dilution of the hard metal by mild steel,

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therefore full hardness and wear resistant properties are achieved only on the second or third layer.

- Prominent “check-cracking” of the deposit occurs shortly after solidification, especially in processes 1 & 2.
- Plate shrinkage is very significant, and is not predictable.
- Hard metal overlays, and the plates to which they are applied, tend to be brittle.

The overlays manufactured by Wear Resistance Ltd are unique:

The “HD” Process:

The HD [high density] process was developed by Wear Resistance Limited and is exclusive to our company. It is an electric arc process, but applied by single-head purpose-built welding machines running at relatively low power levels. The process and the welding equipment have fundamental differences to any other weld overlay process, which result in very significant benefits.

The deposits contain very high proportions of Tungsten Carbide or Chromium Carbide grit. Most of the grit remains in its original form, and is fully fused into the surrounding Chromium Iron or Chromium Carbide “matrix”.

The main factor which determines the wear resistant properties of an overlay is the proportion of hard metal carbides [especially Tungsten Carbide] contained in the overlay. Hardness is another factor, but it is not the most important one. For example, there are many materials [e.g. High-Chromium Irons] which have similar hardnesses to good quality hard metal overlays, but their service life under highly abrasive or erosive conditions is generally a fraction of that achieved by our overlays.

We strongly recommend that, when deciding which type of overlay to use, their chemical constituents are carefully considered. Unfortunately, some manufacturers are reluctant to supply this information.

Advantages of the HD Process:-

- Unlike in the traditional methods of application, the maximised content of Carbide grit in HD overlays is evenly distributed throughout the full thickness of the deposit. This even applies to our Tungsten Carbide deposits. This is not the case in Processes 1 to 4 [page 1, above], where the heavy particles of Tungsten Carbide, combined with high welding power levels and therefore a large, fluid weld pool causes most of the relatively low content of Tungsten Carbide grit to sink to the bottom of the overlay.
- Minimised penetration into the base material, typically 0.25mm to 1.5mm deep.
- Full hardness and wear resistant properties are developed on the first layer.
- Deposits are less brittle than in Processes 1 to 4 [page 1].

- Check cracking does occur, but it is finer, and much less prominent.
- Shrinkage of the steel base plate material is greatly reduced and is predictable. This enables us to fit any number of countersunk bolts into the plate before any hard surfacing takes place, with certainty that after processing they will fit the holes in the support structure to which they will be attached in service.
- The relatively low heat input and minimised penetration has minimal effect on the properties of the integral bolts. There has never been a breakdown caused by failure of our integral bolts, since we introduced them over 40 years ago.
- Un-rivalled service life, particularly in the case of our Tungsten Carbide deposits.
- One of our Tungsten Carbide overlays, [Grade WRST/Ni], is suitable for use in applications which experience heavy impact as well as heavy abrasion, for example on replaceable inserts [or “caps”] used at the two main crushing points of Grizzly Bars used in steel making Sinter Plants. Most other Tungsten Carbide overlays are not suitable where heavy impact will occur.
- Layer thicknesses of between 3mm and 6mm can be applied, and multiple layers are routine.
- HD overlays are ideal for all types of applications, especially those where maximum service life is required, or the consequences of premature failure are severe in terms of downtime and unavailability of plant.

Disadvantages of the HD Process:-

- Single-head welding machines running at relatively low power levels result in lower deposition rates and therefore higher deposition costs.
- The maximised content of the expensive hard metal carbides results in relatively higher initial purchase cost. However, the pay-back comes in the form of increased service life, reduction in service requirements and reduced plant down-time.

Summary:-

- The high quality products of Wear Resistance Limited coupled with first rate customer service result in un-rivalled cost-effectiveness.
- Integral bolts are robust and simple to use.
- The HD process and our integral bolts are both unique products. The combination of the two has for many years been the method of choice of major fan manufacturers for wear plates fitted to high-speed rotating impellers of all sizes, in the most severe operating environments, as well as in many other demanding applications in other industries.
- The relatively low-cost, low and medium quality, mass-produced wear plates manufactured throughout the world serve a useful purpose and are appropriate for use in areas where initial cost is the over-riding factor. The HD overlays manufactured by Wear Resistance Ltd are the most capable and the most cost-effective in **all** environments, including the most severe working conditions.