INTRODUCTION TO HARDFACING

* STOODY

50 HARDFACING TIPS

In 1922 STOODY introduced the concept of "resurfacing worn out parts, instead of replacing them" with wear resistant high Chromium-Manganese alloys. Since that introduction STOODY has developed 100's of Hardfacing and specialty alloys, to be applied by various processes, designed to repair and/or prevent wear. Hardfacing is the most economical way to improve the service life and efficiency of metal parts subject to wear. Simply choosing a premium quality product will not by itself guarantee the desired result. Being familiar with the type of base metal, the type of wear, the welding process, and how to control the application are all equally important factors in achieving success. The following guidelines will assist in maximizing the benefit of your Hardfacing applications.

BASE METAL IDENTIFICATION

1) Know your base metal before welding. The type of steel being welded on, and the carbon and total alloy content, will often determine how the base metal must be treated. Different base metals can be compared to people of different nationalities. Some respond well to cold and dislike being overheated; others like hot and can't stand getting cold at all; or if faced with getting cold, must be gently eased into that condition. The following are some common base metals that will be encountered: low, medium and high carbon steels; alloy steels and high strength low alloy steels; wear resistant and (AR) abrasion resistant steels; Manganese steels, Stainless steels, both 300 and 400 series; Tool, Die and Mold steels; and Cast Irons.
2) Preheating is often required when welding on higher carbon and alloy steels, wear resistant/abrasion resistant steels, all Tool steels, Cast Irons and 400 series Stainless steels. Preheating minimizes distortion, shrinkage, cracking, spalling (lifting) of the weld deposit, and greatly reduces thermal shock to the part. The preheat temperature is influenced by the carbon and alloy content of the base metal. The higher the carbon and alloy content, the higher the required preheat temperature recommendation. Reference the equipment manufacturer's recommendations or Metals Handbooks for preheat recommendations. In general steel with a Carbon content of between; 0.60 and 0.85% should be preheated to 850° F, 0.45 and 0.60% should be preheated in the range of 200 and 450° F, and up to 0.45% a preheat is optional (but may be required in cold weather.)
3) In addition to the above advantages, preheat is most often used to retard the cooling rate of the base metal. Quick cooling from arc welding temperatures will often result in the part becoming brittle in the heat-affected zone from rapid air quenching. Preheating will greatly reduce this tendency in higher carbon and alloy steels.
4) Austenitic Manganese steel is a non-magnetic alloy (if work-hardened it may have a very weak magnetic pull) that is very tough and will work harden under high impact loads. For this reason, Manganese steels are often found in equipment and machinery that use high impact loads to render and crush rock, as in roll and impact crushers, swing hammers, and car shredders. Manganese steels are often used alone, if the impact loads are very severe. Manganese steel is low in abrasion resistance, prior to work hardening. This may require that hardfacing be applied in some applications, to assure good wear life.
5) The tough properties of Manganese steel can be lost if base metal temperature exceeds 500°F (260°C). Avoid prolonged and concentrated heat input in any single area. Overheating Manganese steel leads to a brittle condition. Apply with a Semi-Automatic process when possible.
6) Manganese steel does not require preheat, except in cold weather. Then only warm the base metal to 70° to 80° F (21° to 27°C).
7) Manganese steel base metals should only be welded with manganese alloy consumables. Avoid using carbon steel materials, which will cause the weld deposits to be brittle and result in spalling (lifting of the deposits).
8) When rebuilding Manganese steel it is good practice to remove approximately 1/8" (3.2mm) of the work-hardened surface prior to welding. Failure to do this may result in under bead cracking, and weld metal spalling.

WEAR FACTOR IDENTIFICATION

9) Types of Wear:
   - Abrasion-Gouging (high impact); high stress grinding; low stress scratching.
   - Adhesive Wear (usually a metal to metal condition); scuffing; scoring; galling and seizing (frictional wear).
   - Cavitation Erosion - metal loss due to implosion of vapor cavities at the metallic part surface, in liquid systems: pumps, impellers, propellers and hydroturbine runners.
   - Fretting Corrosion - encountered when closely fitted metal parts are subjected to vibrational loading and stress.
   - Corrosion, both Galvanic and Chemical;
   - High temperature
   - High compression loads

   Singlely or in combination, the above factors will determine the choice of material for the best wear life.
10) If restoration of dimension is required prior to hard facing, select a build-up material that is compatible with both the base metal and the final overlay.
11) The overall alloy content of hardfacing materials determines hardness and the percentage of carbide present in the matrix. Generally, the higher the carbon and alloy content, the higher the wear factor for that alloy.
12) Hardness is not the major factor in determining wear resistance of a hardfacing alloy. The percentage of carbide and carbide structure present in the matrix will determine how well a hardfacing material will resist wear.
13) Hardfacing alloys can contain one or more of the following types of carbide in the matrix: Iron, Chromium, Molybdenum, Tungsten, Columbium (Niobium), Vanadium, or Titanium. When an alloy has a design chemistry with more that one type of carbide former present, it is called a Complex Carbide.
14) Weld deposit hardness shown, unless otherwise specified, is normally based on two layer weld deposits. Some alloys are designed for multiple layers or for single layers only.
15) Decide which "Wear Group" and the number of layers / hardness, as a general rule, the higher the deposit hardness the fewer build-up layers can be applied. (*The limitations may not apply if the deposit has a regular, evenly spaced cross checking (crack) pattern, running* across *the weld.)*

Mode of Wear or Repair: Group Identity	
Group 1: Repair	Build-Up and Joining Alloys
Group 2: Wear	Metal to Metal Wear
Group 3: Wear	Metal to Earth for Moderate to Severe Impact & Abrasion
Group 4: Wear	Metal to Earth for Extreme Abrasion and Low Impact
Group 5: Wear	Abrasion Accompanied by Corrosion and/or High Temperatures

Deposit Hardness	Number of Layers
62 - 66 HRc	1
55 - 62 HRc	2
50 - 55 HRc	3-possible
40 - 50 HRc	4-possible
20 - 40 HRc	Multiple