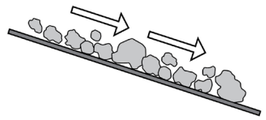
HARDFACING OVERVIEW

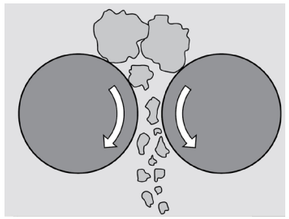
VARIOUS TYPES OF WEAR

Hardfacing is used wherever there is wear. It protects parts and applications that are exposed to various types of wear.
It will not only restore old worn down material but can be used in a preventive way in new production. This can save large costs in production with a lower cost base material and instead hardface the areas exposed to wear. Its important to know that high hardness alone is not something that gives you better wear protection. This is achieved by using the correct hardfacing material for the right application. This catalogue will give you the help you need to choose the correct filler metal for your application.

Abrasion from mineral wear
The result of particles sliding against a surface.
Gravel industry, energy plants, mining, agricultural applications etc.

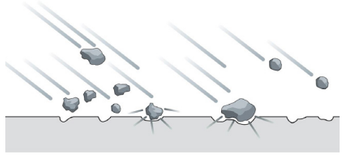


High Abrasion combined with **pressure**
Mineral crushers, mining, scrapers, mixer paddles etc.

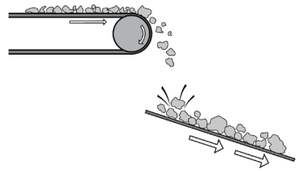


Thermal fatigue cracking
Occurs when a part are repeatedly heated and cooled and thermal expansion reoccurs. Hot forging tools, hot rollers

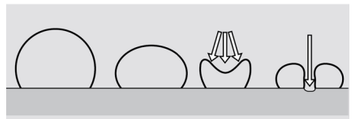
Erosion
Similar to arbasion but occurs when particles or liquid strike the surface in high speed. Dregdging pumps, sludging etc.



Impact combined with **abrasion**
The result of particles hitting a surface or a part hitting other hard objects.
Crushers, excavators, quarries etc

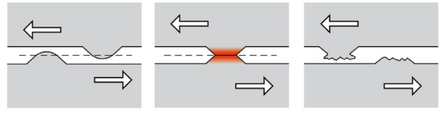


Cavitation
When changes of pressure in liquids lead to base metal fatigue and eventually results in lack of material(cavities). Typical for turbine blades, water turbine components etc.



Corrosion
When talking about corrosion the term "cladding" with stainless or nickel base alloys are most common. For hardfacing corrosion is mostly combined with other type of wear. Ex Paper and pulp industry where a combination of abrasion and corrosion occurs. Transport screws, mixer blades etc.

Friction
Metal to metal wear under high temperature, pressure and friction.
Shafts, gear teeth, vaults etc. Cobalt alloys are often used for these applications.



TERMINOLOGY

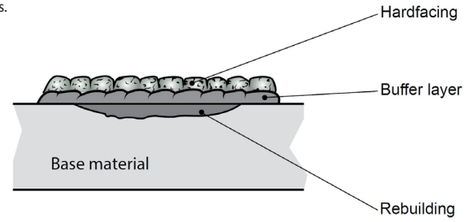
Here we explain a number of important terms to better understand hardfacing.

Rebuilding
When restoring old worn down and damaged material you normally use a filler metal of the same alloy of the base metal. This however depends on the base metal and its compatibility with the filler metal. You need to take in account the service temperature of the part where there can be differences in thermal expansion between the base and the filler metal. Also the risk of cold cracking can be an issue. This however depends on the base material type and if it needs certain preheating and interpass temperatures.

Buffer layer
This is used as a layer between the base material and the hardfacing material for below reasons.

- To create a good bond to the base material
- When welding on old hardfaced surfaces or difficult to weld base materials
- To avoid shrincage cracks from the hardfacing material down to the base metal
- To increase resistance to impact
- To limit dilution
- When you have limitations with preheating.

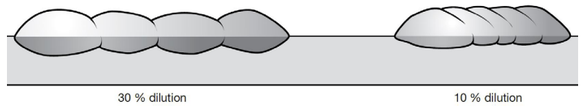
We recommend Austenitic stainless steel buffer layers of 307 type and with high Mn like FD 250K or HMn E.



Hardfacing
Hardfacing is used where parts are exposed to one or many medias.
Abrasive wear, corrosive media, cavitation, impacts, erosion, heat, shocks, pressure or a mix of them all.
The deposit becomes harder than the base material and resistant against the wears its exposed to.
The hardfacing deposit can be of one layer or multiple layers to achieve the right hardness and wear resistance..

Dilution
When hardfacing the goal is to have as little dilution as possible in order to get the deposit as resistant as possible. The more dilution you get the less wear resistant the hardfacing deposit will become due to change of its chemistry. Normally you need to weld 2-3 layers before requested hardness and wear resistance is achieved but this is off course depending on the application. To avoid unnecessary dilution there are a few factors to take in consideration.

- Heat input, the less heat you use the less diltuion. That is why you always wants to weld as cold as possible
- Welding technique, multipass welds give less dilution that single pass beads. Use an overlap of 50% between weld passes to get a good controlled dilution
- Welding speed, higher speed decreases the dilution
- Stick out, normally you use a longer stick out to decrease the dilution
- Polarity, when welding some types of MMA electrodes you can use AC or DC- to get less dilution. Also with some FCW types you can use DC-.



Shrincage cracks
When welding abrasive resistant chromium carbide wires with a lot of hard phases you will get cracks across the weld bead when cooling down. This is perfectly normal but if the part is then exposed to continuous impact loads and shock it can make the cracks continue down to the base material. This can often be avoided with a buffer layer in these cases. Other wires may not be allowed to crack due to the need to guarantee a good anti corrosion resistance. Then the cracking can be avoided by a good combination of preheating and recooling.

Pre heating
Preheating is depending on what base material to be welded. Normally hardfacing applications involve unalloyed steel, low alloyed steel, high alloyed steel and austenitic manganese steels(Hadfield steels). When welding Manganese steels you should not use preheating at all as it can get brittle over 150°C.
Preheating reduces the risk of hydrogen cracking, tensions and gives the heat affected zone a softer structure.
To determine the correct preheating temperature you need to know the carbon equivalent and the composition in the base material.

Carbon equivvalent (Ceq)	Weldability	Preheating	Postheating
Ceq< 0.35	Good	<100°C	Not required
Ceq 0.35-0.6	Ok	150-250°C	Advantage
Ceq >0.6	Special precautions	> 250°C	Required