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PRODUCT DATA SHEET Welding Clean Up **Stainless Steels**

Austral Wright Metals supply products for the clean up of welded stainless steel fabrications to restore full corrosion resistance after welding.

| PRODUCT | PURPOSE | PACKAGING |
|---------------------------|------------------------------------------------------------------------------|-------------------|
| S-Weld Clean | Pickling gel for stainless steel welds. | 2.5 kg 25 kg |
| S-Weld Passivator | Passivating gel for stainless steel. | 2.5 kg 25 kg |
| S-Weld Neutraliser | Neutralising solution for wash water from acidic pickling & passivation gels | 5, 20, 300 litres |

We recommend the use of **S-Weld Clean** after welding to pickle off the oxide colour formed during welding. This will restore the full corrosion resistance of the assembly. **S-Weld Clean** is a thick gel which can be applied to vertical surfaces and is quick, easy and economical to use. Simply brush on (brush provided), wait about 10 minutes, then rinse off.

S-Weld Passivator can also be used to quickly reform the passive layer on the pickled areas. It is also useful to treat a finished assembly to ensure there are no corrosion problems from carbon steel pickup, sulphide inclusions etc. Allow a dwell time of 2 – 4 hours.

S-Weld Neutraliser can be used to neutralise acidic wash water after pickling or passivating. Add it to the wash water, which turns a faint pink colour as it becomes neutral. Consult your local authority for disposal options for the wash water. Please note that although **S-Weld Neutraliser** will neutralise the solution, the metals dissolved from the stainless steel will remain in the wash water. Approximate amounts of residual species in the wash water after applying 250 g/m² of pickling gel and washing with 20 litres/m² of water are:

| Species | Approximate concentration, mg/litre |
|----------|----------------------------------------|
| Iron | 300 |
| Chromium | 75 |
| Nickel | 35 |
| Fluoride | 750 |
| Nitrate | 1,250 |

Acid pickling and passivation products are safe to use provided proper procedures are followed. Please ensure the safety precautions in the leaflet with the product are followed.

The technical reasons for pickling and passivation are often the source of confusion. Please consult the reverse of this sheet for a detailed explanation.

Pickling & Passivation of Stainless Steel Welds Explained

The heat of welding causes a thick oxide layer to form on the surface of stainless steel in the heat affected zone (HAZ) and weld metal. This oxide is chromium rich, and chromium diffuses up from the body of the steel to react with atmospheric oxygen to form the oxide. The oxide is visible, and varies from a pale straw colour to black – the deeper the colour, the thicker the oxide.

When a stainless steel is exposed to the atmosphere or to most aqueous environments, a very thin passive layer forms on the surface. This layer is also chromium and oxygen rich, and is sometimes referred to as an oxide layer, but it is different to the oxide layer formed at high temperatures. It is much thinner, and is not visible. It is also beneficial, in that it protects the stainless steel against corrosion. The high temperature oxide does not protect against corrosion.

The higher the chromium content of the steel, the stronger the protection provided by the passive layer. Hence where the corrosion conditions are more severe, 25% chromium steels will be used in preference to 18% chromium steels such as grades 304 and 316. Other elements contribute to the passive layer, which is why grade 316 contains 2% of molybdenum – to give it significantly better corrosion resistance than grade 304.

Underneath the high temperature oxide film there is a very thin layer of steel which is lower in chromium content – the chromium has diffused up to the surface and is in the oxide layer. This denuded zone does not have the corrosion resistance of the bulk stainless steel. Hence to get the full corrosion resistance for the grade, it is necessary to remove the denuded zone after welding.

Because the denuded layer is so thin, it can be removed easily, either by abrasion (grinding, brushing or polishing) or by pickling. The simplest sign that the layer has been removed is that all the visible oxide has gone. The denuded layer is so thin that it will also be removed when the visible oxide is taken off. If pickling, this only applies if the acid mixture is aggressive enough to remove the denuded layer as well as the oxide, which is why most proprietary formulations contain hydrofluoric acid – nitric acid is not enough. S-Weld Clean is a mixture of nitric acid and hydrofluoric acid. Use of nitric acid only would remove the oxide, but leave the denuded layer, and the corrosion resistance of the steel at the HAZ would be lower than on the bulk material.

Beware of treatments such as shot blasting or brushing, which leave the denuded layer on the surface, or even push it into the surface. These treatments can cause rapid corrosion of the stainless. Brushing may be advisable to remove adherent welding slag before using a pickling acid such as S-Weld Clean.

After treatment with S-Weld Clean and thorough rinsing the surface of the steel does not have a passive film. The film forms spontaneously in air or water, rapidly initially, with no further growth after about 24 hours. During that time it is susceptible to disruption by airborne particles, particularly chlorides such as salt near the sea. Corrosion may result where the particles settle on the surface.

Consequently it may be advisable for critical work to treat with S-Weld Passivator after using S-Weld Clean and thorough rinsing. The passivation step rapidly builds the passive film, making the steel fully corrosion resistant quickly. Passivation will also dissolve any carbon steel contamination of the surface, picked up during handling and working, which will rust and cause staining and corrosion attack on the stainless steel. The third beneficial effect of passivation is to dissolve sulphide inclusions, which are always present in steels, and which may nucleate pitting corrosion where they intersect the surface. It is often beneficial to treat the full job with S-Weld Passivator, not just the welds.

The distinction between pickling and passivation of stainless steel is that the former dissolves metal from the surface, while the latter generates the passive layer on the surface. Nitric acid is not aggressive enough to dissolve stainless steels, hence the use of hydrofluoric acid in pickling formulations.

In summary, to restore the full corrosion resistance of a stainless steel after welding it is essential to remove the chromium denuded layer and visible high temperature oxide mechanically or by pickling with hydrofluoric acid. A subsequent passivation step in nitric acid will speed the regeneration of the passive film, which would otherwise form spontaneously.