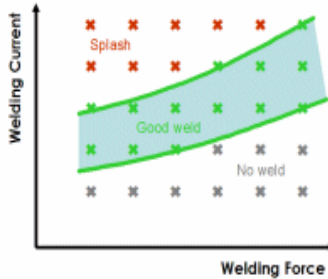




WELDING ADVANCED HIGH STRENGTH STEELS

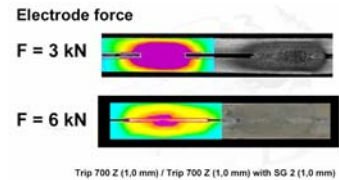
Advanced high strength steels (AHSS) include dual phase (DP), transformation induced plasticity (TRIP), martensitic and boron-alloyed steels, and are also known as ultra high strength steels (UHS). When resistance welded, the relatively high levels of carbon equivalents, and their high inherent cooling rates, can cause high hardness, weld brittleness, low cross tension strength and difficulty in pulling a weld button (partial or complete interfacial fractures).



Weldability lobes help in determining weldability. The width of the lobe gives an indication of the tolerance of the weld schedule in production, and is generally narrower in AHSS. Slightly lower currents are used for AHSS, because of higher electrical resistance, and expulsion can occur earlier than in low carbon steels. The use of TiCaps™ can widen the welding lobe. Higher electrode forces are particularly required at shorter weld times, and can help reduce internal porosity and nugget shrinkage. Longer weld times can help.

Rapid cooling can cause unfavourable **Fracture Modes**. Shortening the hold time can reduce the quench hardening effect, retaining more heat in the weld. However, reducing force on thicker materials can cause hot tearing of the weld nugget. Pulsed welding (especially an immediate but lower secondary pulse) and longer weld times introduce more heat into the surrounding metal and are beneficial. In some TRIP steels, it is advisable for a cool period after the weld before a temper pulse to reheat and temper the hardened material. Generally, in production, dissimilar materials and gauges, with different properties, are being welded together, and simulation becomes necessary. The insertion of a low carbon interface can improve welding properties by diluting hardening characteristics.

Generally, **Weld Strength** increases with material strength. However, in higher AHSS, cross tension strength may only be 50% of shear strength. In addition, martensitic material in the HAZ can soften due to tempering. In spot welding, the design should stress shear strength and avoid peel and tension loading.



Weld Shrinkage and porosity occur mainly in the centre of the nugget, caused by incomplete forging during solidification. **Surface cracks** tend to arise from liquid metal penetration (often CuZn alloys), and/or weakened grain boundaries, and these may reduce service life.

Production Considerations. Pulsed weld schedules (with upslope, downslope, cooling (for TRIP) and no cooling (DP)) are generally superior. Higher electrode forces are generally necessary. Ensure electrodes are well aligned, part fit-up is good and gaps are minimized. Larger diameter electrodes and fixtures can reduce problems with taper fit and component flexing under higher loads. For consistent and best results, material characteristics and thickness combinations should be examined prior to welding, and procedures predetermined. Good welding parameters will permit good weld nuggets to be pulled in testing.

Huys Industries gratefully acknowledges the financial assistance and technical insights of:

