Uddeholm Elmax® SuperClean
Welding recommendations

GENERAL

Uddeholm Elmax SuperClean is a high chromium-vanadium-molybdenum-alloyed steel with high wear resistance, high compressive strength, corrosion resistant and very good dimensional stability In Uddeholm Elmax SuperClean it has however been able to achieve this unique combination of properties by a powder-metallurgy-based production.

Welding of PM-steels is normally not recommended, due to the chance of failure, but good results when welding can be achieved if proper precautions are taken (joint preparation, choice of consumables and welding procedure). If the tool is to be polished, it is necessary to use a filler material that has the same chemical composition as the base material.

RECOMMENDED FILLER MATERIAL

Welding Method	Gas Tungsten Arc Welding GTAW (TIG)	Gas Metal Arc Welding GMAW (MIG/MAG)	Shielded Metal Arc Welding SMAW (MMA)	Laser	Comments
Filler material	Tyrax TIG UTP A696	Not Recommended	Not recommended	Tyrax Laser Weld	
	Type AWS ER 312				Use soft filler material for buffering layer
Hardness as welded	60 - 64 HRC A696 58 - 62 HRC Caldie			55 – 60 HRC	

DIMENSIONS FILLER MATERIAL

Type	TIG	Laser
Dia. Ø **mm** Dia. Ø **Inch**	1.6 1/16	0.2 – 0.6 0.008 – 0.024
Tyrax TIG	X	
UTP A 696	X	
Tyrax Laser Weld		X

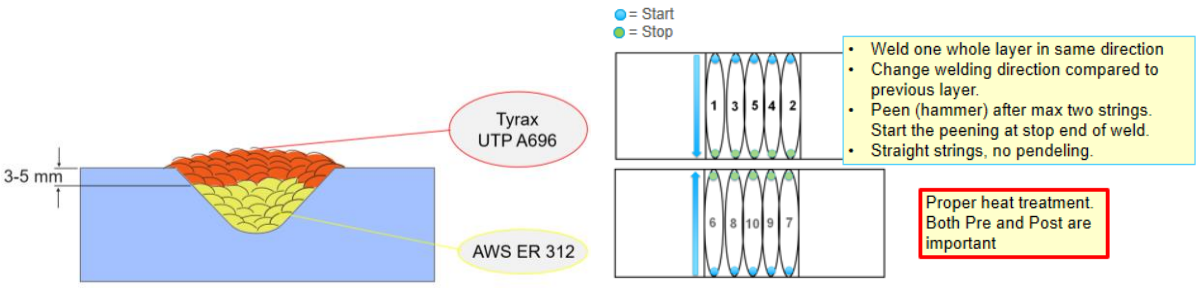
PARAMETERS

Condition	Soft Annealed 215 HB	Hardened 58 - 60 HRC	Comment
Preheating Temperature	350°C ± 25°C 660°F ± 50°F	350°C ± 25°C 660°F ± 50°F	The temperature should be kept constant during the welding operation. Start with buffering layers if not all cracks are removed. Minor repairs up to 3 strings can be made without buffering layer.
Interpass temperature	Max 150°C, 270°F above preheating temperature	Max 150°C, 270°F above preheating temperature	The temperature of the tool in the vicinity of the weld. When passed, the tool will have a risk for distortion, soft zones or cracking in and around the weld (the HAZ).
Cooling rate	20 - 40°, 35 - 70°F C/h The first 2 hours then freely in air <70°C, 160°F		
Post treatment	Soft anneal Harden Temper	Temper 25°C, 50°F below previous tempering temperature	Holding time when tempering, 2h. The temperature depends on the last used tempering temperature. When soft annealing and hardening, see heat treatment specification in Uddeholm Elmax product brochure.*

* Note. We have seen that in many cases a high temperature tempering, 2h, of ~750°C (1380°F) functions instead of a complete soft annealing when welding in soft annealed material.

PROCEDURES

- Clean weld area.
- Preheat material to 350°C ± 25°C / 660°F ± 50°F and maintain temperature during welding.
- Do not let the temperature in the vicinity of the weld (the HAZ) increase more than 150°C / 270°F above the preheating temperature. There is a risk of lowering (softening) the hardness of the base material or/and cracking in the HAZ. Use temple sticks or other temperature-measuring devices.
- For finishing layers use consumables which give suitable hardness.
- Wait a few minutes between each layer of strings, both for soft and hard filler, in order to let the layer equalize and minimize stresses, if possible use pre-heating furnace**.** Peen to minimize stresses.
- If possible, change welding direction 180° between each layer.
- Cool slowly after welding, 20 - 40°C/h, 35 - 70 °F/h for the first two hours and then freely in air < 70°C / 160°F.
- Temper 25°C / 50°F below previous tempering temperature for two hours.
- Tools welded in the annealed condition must undergo a full soft annealing immediately after welding. Allow tool to cool to room temperature before soft annealing. If a complete soft annealing cannot be done, which we recommend, a high temperature tempering at 750°C / 1380°F could be used. Be aware of that the working properties of the material will be somewhat reduced, if the high temperature tempering is used instead of the soft annealing.
- Shield Metal Arc Welding SMAW (MMA) and MIG Welding is not recommended.



Use these guideline recommendations along with
“Welding of Uddeholm Tool Steel” for complete instructions.

UDDEHOLM
a voestalpine company