

Uddeholm Mirrax® 40

Welding recommendations

GENERAL

Uddeholm Mirrax 40 is a remelted stainless tool steel supplied pre-hardened to 40 HRC. Uddeholm Mirrax 40 is produced using the electroslag remelting (ESR) process – an additional step in the steelmaking process that ensures very clean steel with low Sulphur content (0.003% max.) and non-metallic inclusions. Consequently, Uddeholm Mirrax 40 is capable of being polished to a very high surface finish. Uddeholm Mirrax 40 is a part of the Uddeholm Stainless Concept.

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	Mirrax TIG Weld Stavax TIG Weld Tyrax TIG Weld	Mirrax MIG Weld Tyrax MIG Weld	Böhler FOX 20 MVW	Mirrax Laser Weld Tyrax Laser Weld	Mirrax TIG Weld and Mirrax Laser Weld is recommended when the surface are going to be polished or photo-etched
	Type AWS ER 312 AWS ER NiCrMo-3		E 29 9 R		Use soft filler material for buffering layer
Hardness as welded	48 – 58 HRC	48 – 52 HRC	48 – 52 HRC	48 – 52 HRC	

DIMENSIONS FILLER MATERIAL

Type	TIG		MIG	MMA			Laser
Dia. Ø mm	1.0	1.6	1.2	2.5	3.25	4.0	0.2 – 0.6
Dia. Ø Inch	0.040	1/16	3/64	3/32	1/8	5/32	0.008 – 0.024
Mirrax TIG Weld	X	X					
Stavax TIG Weld	X	X					
Tyrax TIG Weld		X					
Mirrax MIG Weld			X				
Tyrax MIG Weld			X				
Böhler FOX 20 MVW				X	X	X	
Mirrax Laser Weld							X

PARAMETERS

Condition	Soft Annealed 160 HB	Hardened 45 – 52 HRC	Comment
Preheating Temperature	330°C ± 25°C 625°F ± 50°F	330°C ± 25°C 625°F ± 50°F	The temperature should be kept constant during the welding operation. Start with buffering layers if not all cracks are removed
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 Mirrax 40 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 $330^{\circ}\text{C} \pm 25^{\circ}\text{C}$ / $625^{\circ}\text{F} \pm 50^{\circ}\text{F}$ 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, $20 - 40^{\circ}\text{C}/\text{h}$, $35 - 70^{\circ}\text{F}/\text{h}$ for the first two hours and then freely in air $< 70^{\circ}\text{C}$ / 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.

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