

# Uddeholm QRO 90<sup>®</sup> Supreme

## Welding recommendations

### GENERAL

Uddeholm QRO 90 Supreme is a high-performance, chromium-molybdenum-vanadium alloyed hot work tool steel. The combination of high temperature strength, temper resistance and thermal conductivity exhibited by Uddeholm QRO 90 Supreme is unparalleled. Thus Uddeholm QRO 90 Supreme has given improved service life in die casting and extrusion of nonferrous metals

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    | Dievar TIG Weld<br>QRO 90 TIG Weld<br>Unimax TIG Weld | Dievar MIG Weld<br>QRO 90 MIG Weld   | QRO 90 Weld                           | Dievar Laser Weld | Dievar TIG Weld and Dievar Laser Weld is recommended when the surface are going to be polished or photo-etched |
|                    | Type<br>AWS ER 312<br>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                      |
|-------------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|----------------------------|
|                   | 1.0<br>0.040 | 1.6<br>1/16 | 2.4<br>3/32 | 3.2<br>3/32 | 1.2<br>3/64 | 2.5<br>3/32 | 3.25<br>1/8 | 4.0<br>5/32 | 0.3 – 0.7<br>0.012 – 0.028 |
| Dievar TIG Weld   | X            | X           | X           | X           |             |             |             |             |                            |
| QRO 90 TIG Weld   | X            | X           | X           |             |             |             |             |             |                            |
| Unimax TIG Weld   |              | X           |             |             |             |             |             |             |                            |
| Dievar MIG Weld   |              |             |             |             | X           |             |             |             |                            |
| QRO 90 MIG Weld   |              |             |             |             | X           |             |             |             |                            |
| QRO 90 Weld       |              |             |             |             |             | X           | X           | X           |                            |
| Dievar Laser Weld |              |             |             |             |             |             |             |             | X                          |

### PARAMETERS

| Condition              | Soft Annealed<br>160 HB   | Hardened<br>45 – 52 HRC                                   | Comment  |
|------------------------|---|---|--|
| Preheating Temperature | 330°C ± 25°C<br>625°F ± 50°F  | 330°C ± 25°C<br>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<br>above preheating temperature                          | Max 150°C, 270°F<br>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<br>Harden<br>Temper   | Temper 25°C, 50°F<br>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 QRO 90 Supreme 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  $150^{\circ}\text{C}$  /  $270^{\circ}\text{F}$  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  $180^{\circ}$  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  $< 70^{\circ}\text{C}$  /  $160^{\circ}\text{F}$ .
- Temper  $25^{\circ}\text{C}$  /  $50^{\circ}\text{F}$  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  $750^{\circ}\text{C}$  /  $1380^{\circ}\text{F}$  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.

### *Dies welded in their production equipment.*

This is something, which we **do not recommend**, but we are aware of that it happens and therefore we have made the following guideline.

Pre-heat, preferably with Propane, to at least  $150^{\circ}\text{C}$  /  $300^{\circ}\text{F}$ , around the area that are going to be welded. After finished welding, let the dies go down to  $< 70^{\circ}\text{C}$  /  $160^{\circ}\text{F}$ . Do a second heating, preferably with Propane, to at least  $200^{\circ}\text{C}$  /  $390^{\circ}\text{F}$ .

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