

**Heat Treatment  
Recommendations for  
Uddeholm Mirrax<sup>®</sup> ESR**

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# Heat treatment recommendations for Uddeholm Mirrax ESR – Premium stainless mould steel

• Vacuum • Salt bath/Fluidised bed • Atmosphere furnace / Muffle furnace

## PREHEATING

1. 650°C (1200°F), equalize
2. 850°C (1550°F), equalize
3. 920°C (1700°F), equalize

Soaking time at temperature must be adapted to size and shape of the mould. Third pre-heat only needed for larger moulds

## HARDENING

1000–1025°C (1830–1880°F), normally 1020°C (1870°F)

For very large moulds 1000°C (1830°F) is recommended.

Holding time after the tool or part has fully heated through at the hardening temperature; minimum 30 minutes, maximum 1 hour.

## QUENCHING

- Vacuum, cooling in gas with sufficient overpressure
- Salt bath at 350–500°C (660–930°F) then cool in air blast
- High speed gas/circulating atmosphere

For all above mentioned quenching media the cooling rate shall exceed 20°C/min (36°F/min) between 1020–540°C (1870–1000°F) at the surface.

*Temper immediately after quenching when the tool or part reaches 50–70°C (120–160°F).*

*Uddeholm Mirrax ESR has a very good hardenability, why step quenching is recommended. See last page for more information.*

## TEMPERING

Choose tempering temperature according to the hardness required by reference to tempering graph on next page. Lowest recommended tempering temperature 250°C (480°F). Temper minimum twice with intermediate cooling to room temperature. Tempering three times is recommended for very large moulds.

*Examples:*

### **Low temperature tempering cycle:**

1<sup>st</sup> Tempering at 250–300°C (480–570°F) for achieving ~50 HRC

2<sup>nd</sup> Same procedure as first tempering

3<sup>rd</sup> Same procedure as first tempering

### **High temperature tempering cycle:**

1<sup>st</sup> Tempering at 520°C (970°F)

2<sup>nd</sup> According to required hardness

3<sup>rd</sup> Tempering at 520°C (970°F)

Holding time at temperature minimum 2 hours.

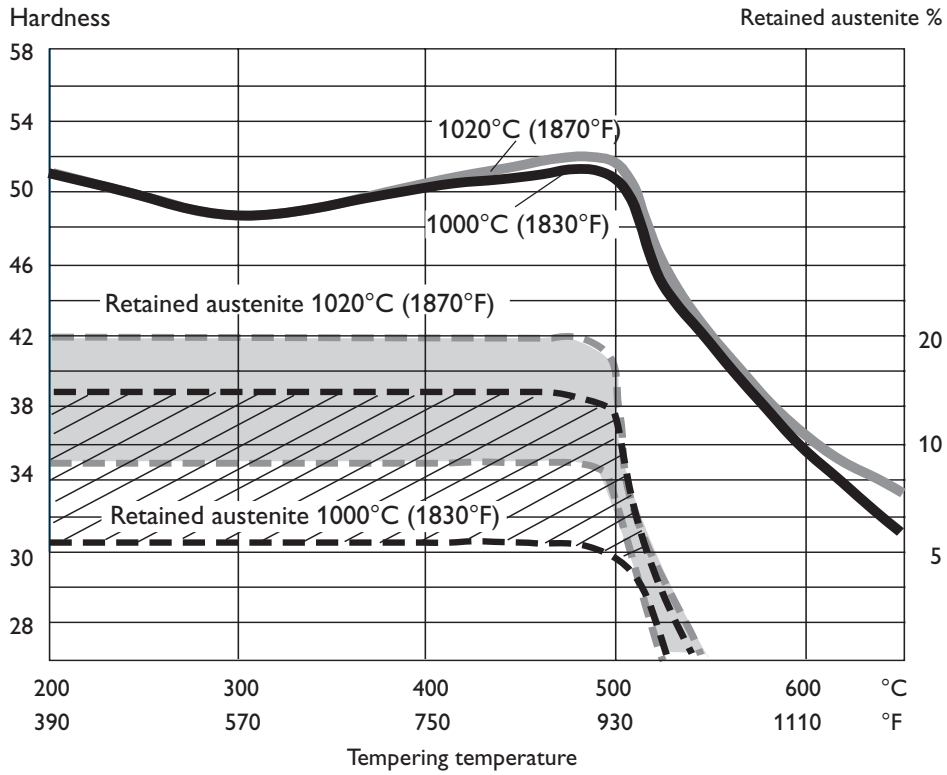
For stress temper after EDM use a temperature 20°C (40°F) lower than the highest temperature used during tempering.

Tempering at 250–300°C (480–570°F) results in the best combination of toughness, hardness and corrosion resistance. However, for very large moulds and /or complicated design, high tempering temperature is recommended to reduce the residual stresses to a minimum.

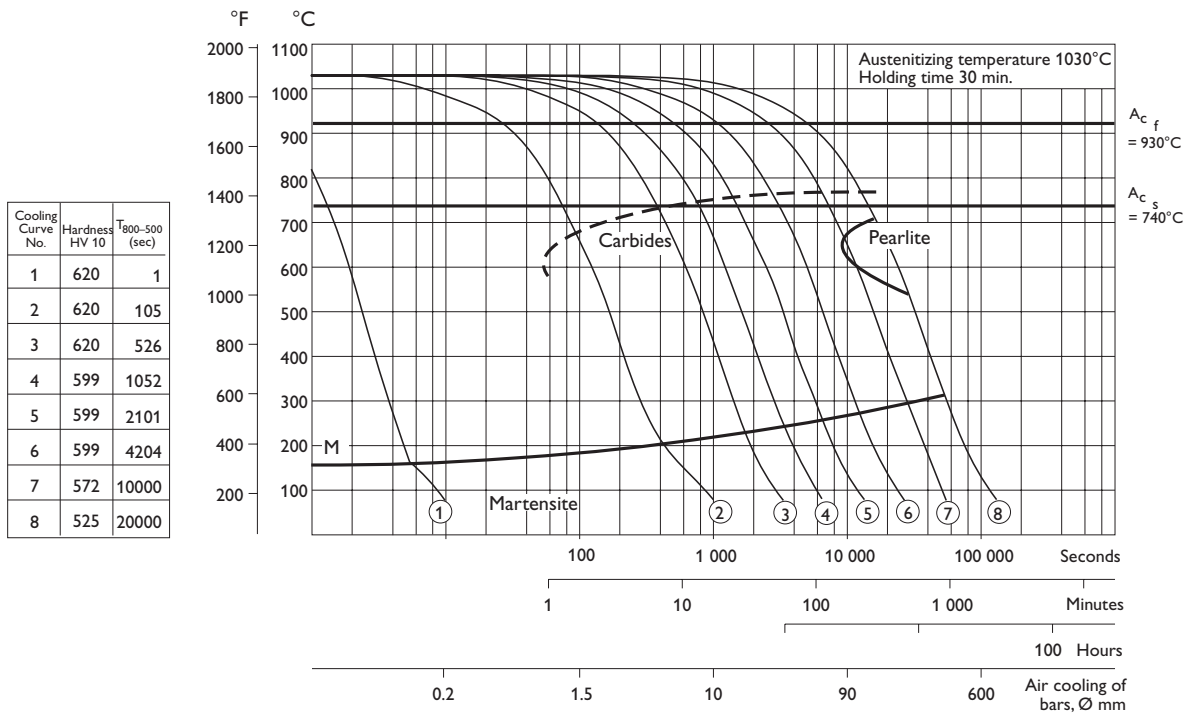
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This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose.

### Tempering graph



### CCT graph



# UDDEHOLM MIRRAX ESR

## Vacuum heat treatment—Guidelines

Dimension, mm	Shape	Furnace type	Preheat temperature	Hardening temperature	Soaking time	Quenching process	Tempering temperature Soaking time min 2 x 2h	Hardness (HRC)
≤100	Simple	Vacuum	650°C (1200°F) 850°C (1560°F)	1020°C (1870°F)	30 min	≥4–5 bar cool to 70°C (160°F)	Temper at least twice at 250–300°C (480–570°F) or at 520°C (970°F) (for low stress level)	49–51
≤100	Complex	Vacuum	650°C (1200°F) 850°C (1560°F)	1020°C (1870°F)	30 min	≥4–5 bar, step quench at 350–500°C (660–930°F), continue forced cooling, temper immediately when tool core reaches 60°C (140°F)	Temper at least twice at 250–300°C (480–570°F) or at 520°C (970°F) (for low stress level)	49–51
~100–200	All	Vacuum	650°C (1200°F) 850°C (1560°F)	1020°C (1870°F)	30 min	≥4–5 bar, step quench at 350–500°C (660–930°F), continue forced cooling, temper immediately when tool core reaches 60°C (140°F)	Temper at least twice at 250–300°C (480–570°F) or at 520°C (970°F) (for low stress level)	44–51
≥200	All	Vacuum	650°C (1200°F) 850°C (1560°F) 920°C (1690°F)	1000°C (1830°F)	30 min	≥4–5 bar, step quench at 350–500°C (660–930°F), continue forced cooling, temper immediately when tool core reaches 60°C (140°F)	Temper at high tempering temperature according to required hardness	36–50

*These shall be seen as general guidelines.  
The actual heat treatment must be tailored to the specific situation.*