

**Heat Treatment
Recommendations for
Uddeholm Mirrax™ ESR**

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:

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

2nd Same procedure as first tempering

3rd Same procedure as first tempering

High temperature tempering cycle:

1st Tempering at 520°C (970°F)

2nd According to required hardness

3rd Tempering at 520°C (970°F)

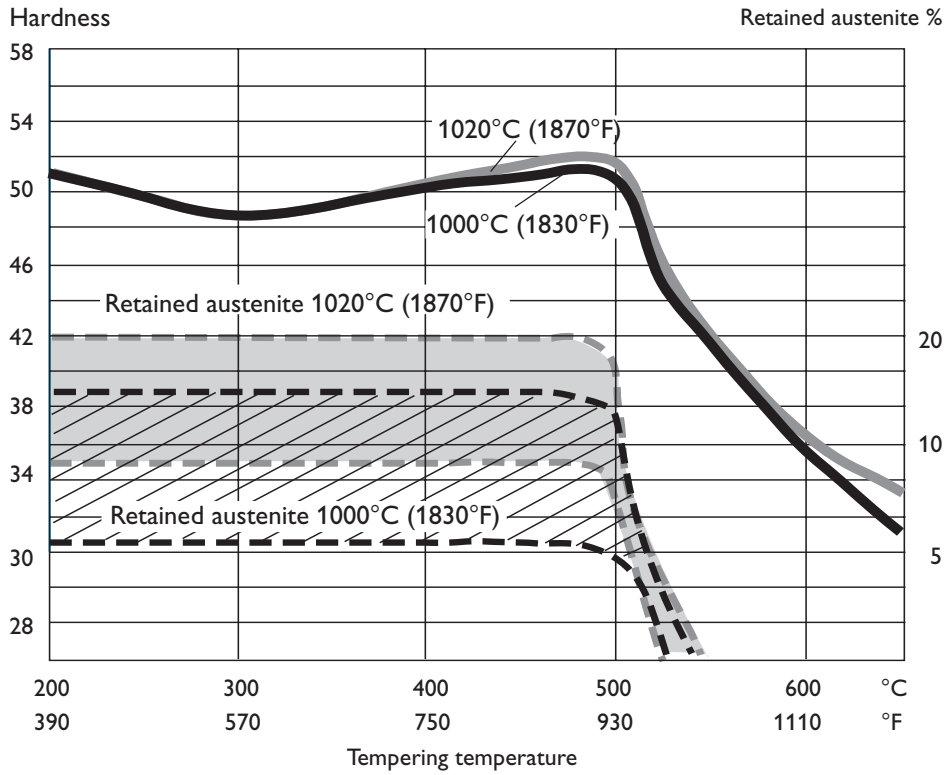
Holding time at temperature minimum 2 hours.

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

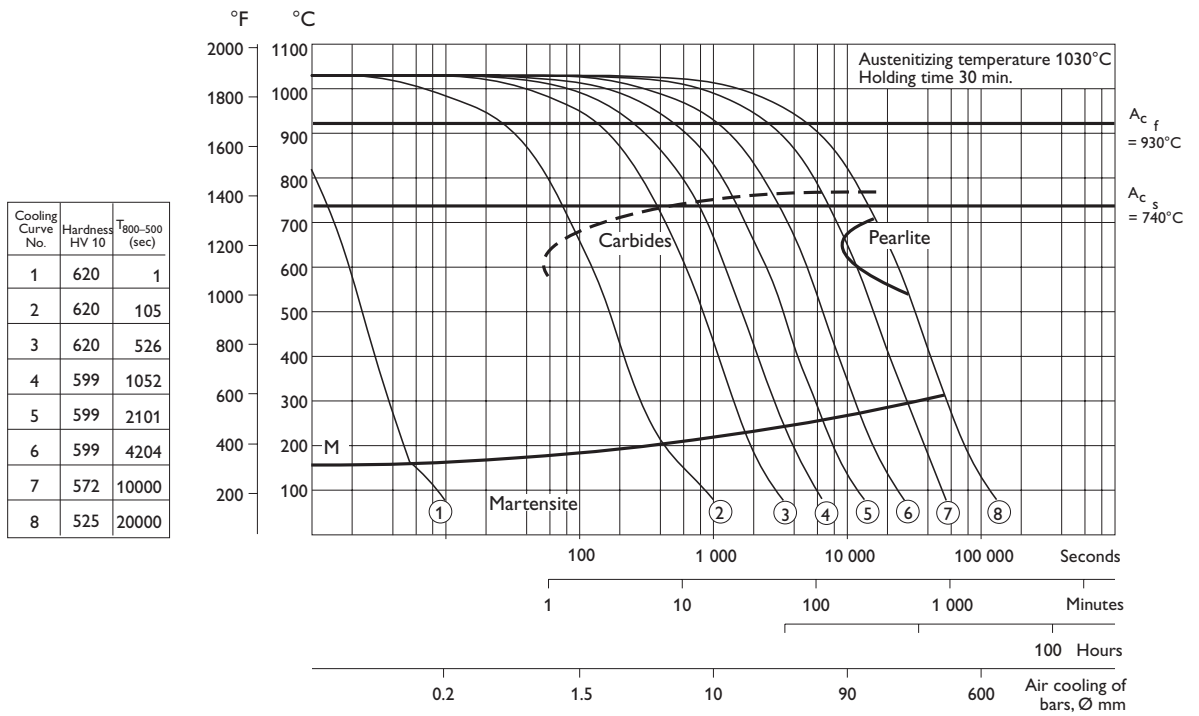
Tempering at 250–300°C (480–570°F) results in the best combination of toughness, hardness and corrosion resistance. However, for very large moulds and /or complicated design, high tempering temperature is recommended to reduce the residual stresses to a minimum.

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.*