

## SM - 2738 Mod E

■ Typical analysis	C	Mo	Ni	Si	Mn	Cr	S (max)	P (max)
	0,4	0,2	0,4 - 0,6	0,3	1,5	1,9	0,005	0,012

Figures in % by mass.

■ Standards	
EN	≈40 CrMnMo 7+Ni
WERKSTOFF Number	≈2738 Mod E
AISI	≈P20
AFNOR	≈40 CMND8

### ■ Characteristics

SM-2738 Mod E, prehardened 280 - 325 HB, grade specially designed for plastic mold industry. Chromium, Molybdenum, Manganese and Nickel additions are optimized to have a fully martensite-bainite microstructure after quenching. The steel is melted in an electrical furnace and refined with VOD or DH device.

The cleanliness of the steel is guaranteed as well as the soundness. This makes the steel particularly well adapted for mold steel even when polishing or chemical etching are required for surface finish quality.

### ■ Applications

Typical applications for 2738 Mod E grade are:

- Plastic injection molds for thermoplastics.
- Extrusion dies for thermoplastics
- Compression molds.

■ Physical properties (reference values)				
Thermal conductivity $W m^{-1} K^{-1}$	Thermal expansion coefficient $10^{-6} °C^{-1} / 10^{-6} °K^{-1}$			
20°C	20 - 100°C	20 - 200°C	20 - 300°C	20 - 400°C
68°F	68 - 212°F	68 - 392°F	68 - 572°F	68 - 752°F
34	11,5	11,57	12,47	12,81

### ■ Metallurgical properties

- Internal soundness: all plates are ultrasonically tested. The acceptance standards of EN 10228.3 c/4 are guaranteed.
- Grain size: uniform 7/8 grain according to ASTM E1 1 2.
- Cleanliness: SM-2738 Mod E is melted in an electric arc furnace and refined through a VOD or DH process-consequently, the content of non metallic inclusions is reduced to an extremely low level. This ensures a good polishability and chemical etching ability.

Non metallic inclusions content is assessed in accordance with ASTM E45 Method A ("worst field").

### ■ Homogeneity

SM-2738 Mod E has a good hardenability resulting in good uniformity of hardness and microstructure.

■ Metallurgical transformation points				
$AC_1$ °C (°F)	$AC_3$ °C (°F)	$M_s$ °C (°F)	$V_1$ °C/h (°F/h)	$V_2$ °C/h (°F/h)
733 (1351)	780 (1436)	320 (608)	1000 (1830)	300 (540)

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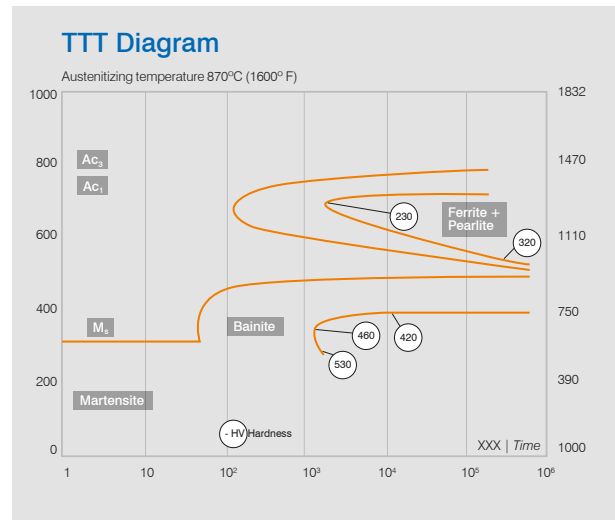
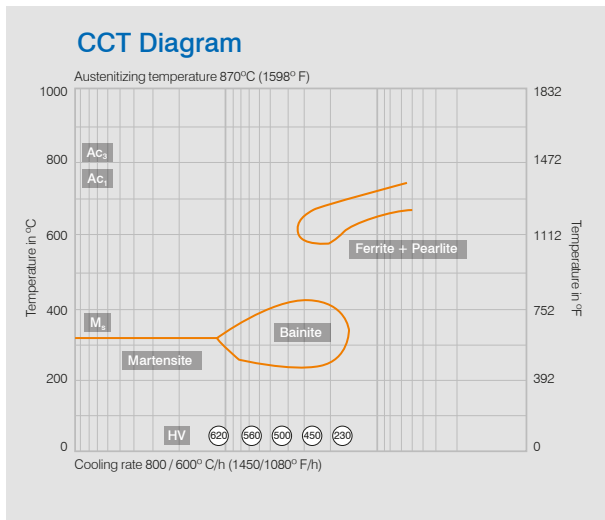
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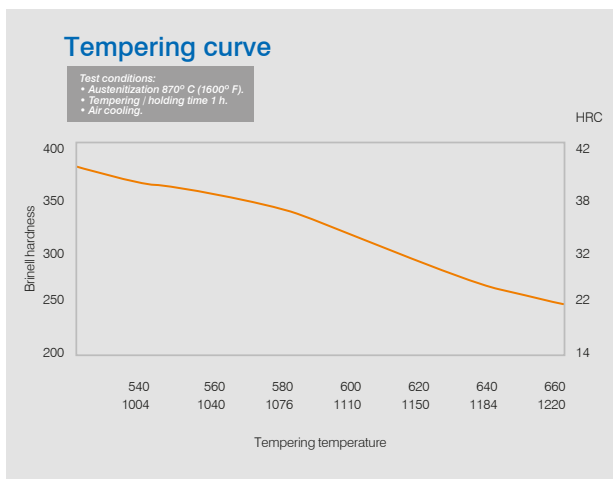
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### Heat Treatment

For specific applications where mechanical properties higher than 280 - 325 HB are required, hardening can be performed in the following way:

- Heating about 850°C - (1560°F) with a sufficient holding time 1 hour/25mm (1hour/inch).
- Water, oil or air quenching depending on thickness ( see C.C.T diagram)
- The tempering temperature controls the mechanical characteristics. Generally, instructions given here after must be followed to obtain an efficient tempering:
  - Uniform heating at the selected tempering temperature (see tempering curve)
  - Holding time of one hour per inch of total thickness.
  - Double tempering with complete cooling to room temperature for 1 hour/50mm of thick each treatment.



- Note that complicated shapes require accurate control of steel temperature uniformity and sufficient holding times to limit stresses and prevent cracking.

### Surface treatment

The quality of surface treatments is largely dependent on the surface roughness and characteristics after polishing. Homogeneity of hardness, microstructure and good cleanliness ensure a good behaviour for chromium plating, nickel plating or nitriding. Nevertheless, after hard-chromium plating, the steel should be tempered for about 4 hours at 180°C (356°F) to avoid any hydrogen embrittlement.

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### ■ Machining

SM-2738 Mod E grade performs very well in drilling and in milling using high speed steel or carbide tools. Cutting conditions ( cutting speed, feed rate, etc...) depend on the tool, but SM-2738 Mod E is a well known grade for which any tool maker can provide cutting conditions adapted to its tools.

### ■ Electrical discharge Machining (EDM)

This method of machining can be used on SM-2738 Mod E grade. Precaution should be taken to avoid the presence, after machining, of a rehardened surface layer ("white layer") on the steel. It is advisable to remove completely this layer by grinding and polishing.

### ■ Polishing

2738 Mod E has a good polishability in the quenched and tempered condition. After grinding, polishing shall be made with aluminium oxide or diamond paste. A typical polishing sequence could be:

Grinding	→	Emery polishing paper or stones FEPA 120 → 240 → 320 → 600 → 1000 GRIT 120 → 220 → 280 → 360 → 500	→	Diamond paste 10µm → 6µm → 3µm → 1µm
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### ■ Texturing

SM-2738 Mod E is particularly adapted for texturing. Steel making process and heat treatment of plate leads to uniform structure and homogeneous hardness which ensure accurate and consistent pattern reproduction.

### ■ Welding

Carefully degrease, clean and dry the surface before welding; grind surface defects is necessary. A V-type bevel without sharp angle is recommended. Pre and postheating treatment must be achieved to ensure crack free welds. GTAW is the recommended process to ensure a clean weld without sulphides, porosites or oxides wich affect properties of the weld such as chemical etching ability, polishability...