Industeel

ArcelorMittal

W 1.2711

W 1.2711: a HRC 40 prehardened tool steel

W1.2711 is a 40HRC pre - hardened grade for the plastic mould industry, which is characterized by:

> Higher hardness than P20 or W1.2311

> High resistance to wear

> High toughness

> Good polishing properties

The grade is delivered heat treated 360/400 HB. The steel is melted in an electric arc furnace and refined under high vacuum process (VOD) for efficient deoxidation and desulfurization. This process ensures

> A precise and consistent chemical analysis

> A very low level of oxygen

The steel is then bottom poured in ingots designed to improve chemical homogeneity during solidification, and cross rolled. Segregates concentrated in the upper part of the ingot are systematically cropped.

PROPERTIES

STANDARD

> Euronorm 54 Ni Cr Mo V6

> Werkstoff W1.2711

CHEMICAL ANALYSIS - WEIGHT%

		C	Si	Mn	P	S	Cr	Mo	Ni	V	W
1.2711	Min	0.50	0.15	0.50	-	0.80	0.60	0.25	1.50	0.07	-
	Typical	0.55	0.30	0.70	0.02	0.007	0.70	0.30	1.70	0.07	-
	Max	0.60	0.35	0.80	< 0.025	< 0.025	0.80	0.35	1.80	0.12	-

MECHANICAL PROPERTIES

Hardness (HRC)	Hardness (HB)	Rp 0.2 Yield Strength		Rm ultimate strength		Elongation %
		Mpa	Ksi	MPa	ksi	
40	376	1045	151	1270	184	10

Specimen are taken in the rolling direction hardened in oil from 870°C (1600°F) and double tempered to the required hardness.

PHYSICAL PROPERTIES

Thermal conductivity	Specific heat	Density	Thermal expansion Coefficient (10^{-6} °C^{-1})			
W.m-1.K-1	J/Kg°C		20-100°C 68 - 212°F	20-200°C 68 - 392°F	20-300°C 68 - 572°F	20-400°C 68 - 752°F
29	460	7.8	11.9	12	12.7	13.4

METALLURGICAL PROPERTIES

Internal soundness

All plates are ultrasonically tested, according to ASTM A578 - S9 specification.

Grain size

Uniform 7/8 grain size according to ASTM E 112 method.

Cleanliness

Due to the above mentioned steelmaking process, 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 measured in accordance with ASTM E45A method («worst field»).

B (alumina)		C (silicate)		D (Globular oxides)	
Thin	Heavy	Thin	Heavy	Thin	Heavy
2	1.5	1.0	1.0	2	1.5

Guaranteed levels

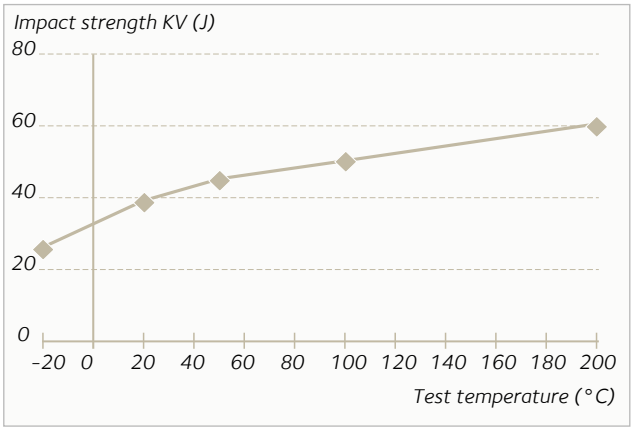
Metallurgical transformation points

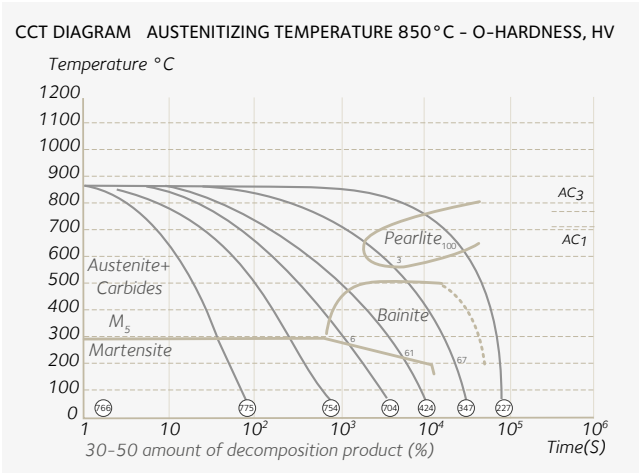
AC_1 (°C)	AC_3 (°C)	M_S (°C)
715	770	235

Heating conditions: 150C/h - 875°C (1607°F)-10 min

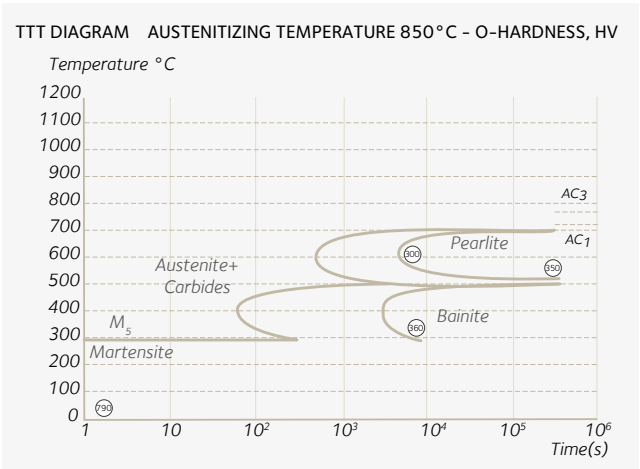
TOUGHNESS

KCV impact strength in the longitudinal direction for a prehardened 400 HB, 100 mm thick (4")





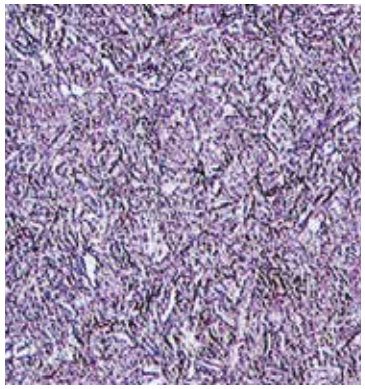
The Continuous Cooling Transformation diagram reveals the identity and quantity of microstructural constituents obtained at different cooling rates.



The Transformation Time Temperature diagram reveals the decomposition of austenite in isothermal conditions.

Homogeneity

W1.2711 has an excellent hardenability due to the Nickel addition resulting in good uniformity of hardness and microstructure. Hardness scatter is less than 30 HB all through thickness.



HEAT TREATMENT

For particular applications requiring higher resistance, hardening can be performed in the following way:

- **> Heating around 870°C (1600°F) with holding time 1 hour/inch**
- **> If necessary, protect the tool against decarburization and oxidation during hardening**
- **> Quenching media: Oil or air depending on thickness (see CCT diagram hereafter). High speed gas or circulating atmosphere**
- **> Tempering temperature depends on the required mechanical characteristics (see tempering curve hereafter)**
- **> Immediate tempering is advised after the tool has reached 50 - 80°C (120/180°F)**

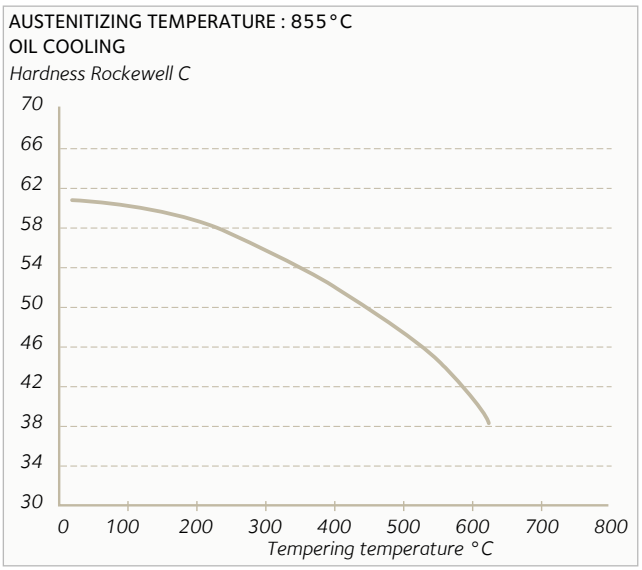
Following instructions should be followed to obtain an efficient tempering:

- **> Holding time one hour per inch of total thickness**
- **> Double tempering with cooling to room temperature between them is recommended**

Note that complicated shapes require accurate control of steel temperature and holding times.

Tempering curve

Selection of tempering conditions in terms of required mechanical properties



CHEMICAL ETCHING

W1.2711 is well adapted for texturing. Its composition, uniform microstructure and hardness ensure accurate and consistent pattern reproduction.

E.D.M.

Electrical Discharge Machining: This method of machining can be used on W1.2711 grade. It is advisable to remove completely the rehardened white layer by grinding and polishing.

SURFACE TREATMENT

Quality of surface treatment is largely dependent on the surface roughness after polishing. Homogeneity of hardness, microstructure and good cleanliness ensure a good behavior for chromium plating, nickel plating or nitriding. After hard - chromium plating, the steel should be tempered for about 4 hours at 180°C (356°F) in order to avoid hydrogen embrittlement.

POLISHING

W1.2711 has a good polishability in the quenched and tempered condition. After grinding, polishing should proceed with aluminium oxide or diamond paste. A typical polishing sequence might be: 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

Avoid overpolishing (high pressure or polishing time) which can lead to defects on the polished surface (orange peel, waves...).

DIMENSIONAL PROGRAM

Thickness	Width
120 - 350 mm	2 000 mm

APPLICATIONS

W1.2711 is generally used in the plastic industry. Also, its good mechanical characteristics (hot and cold), make the grade advisable as a tool steel:

> Plastic injection molds for thermoplastics
> Extrusion dies for thermoplastics
> Compression moulds
> Forge drop hammer dies

YOUR CONTACTS

Perrine Lavalley
Tel. +33 3 85 80 52 56
perrine.lavalley@arcelormittal.com

https://industeel.arcelormittal.com

Industeel France
Le Creusot Plant
56 rue Clemenceau
F - 71 201 Le Creusot Cedex