



DIMO 2311

HARDENED CrMnMo-ALLOYED STEEL IN MOLD QUALITY FOR THE CONSTRUCTION OF PLASTIC MOLDS

Material data sheet, edition February 2015¹⁾

DIMO 2311 is a hardened CrMnMo-alloyed tool steel for the construction of plastic molds with superior surface requirements on molds. It is characterized by excellent polishability, photoetchability, spark erosion behaviour and dimensional stability as well as good machinability.

Product description

Designation and range of application

DIMO 2311 is a modified version of 1.2311 according to Stahl-Eisen-Liste, respectively 40CMD8 according to NF A 35590, 40CrMnNiMo8-6-4 according to DIN EN ISO 4957 and a modified version of P20 according to ASTM A681.

DIMO 2311 is available as plate with cut edges (sheared, flame cut or water jet cut) in the following dimensions:

Thickness	$\geq 12 \leq 130$ mm	$\geq \frac{1}{2} \leq 5$ in	$> 130 \leq 170$ mm	$> 5 \leq 6\frac{6}{8}$ in
Width ^{a)}	$\geq 1000 \leq 2500$ mm	$\geq 40 \leq 98\frac{1}{4}$ in	$\geq 1000 \leq 2050$ mm	$\geq 40 \leq 80\frac{1}{2}$ in
Length	$\geq 3000 \leq 6000$ mm	$\geq 119 \leq 236$ in	$\geq 3000 \leq 6000$ mm	$\geq 119 \leq 236$ in

^{a)} Widths < 1250 mm (49 in) have to be ordered with an even number of plates
Other dimensions available upon request.

Production

The DIMO 2311 production route is designed to achieve the excellent properties of this mold steel type with superior surface requirements. DIMO 2311 is characterized by high dimensional stability. The DIMO 2311 production route provides excellent polishability, photoetchability and spark erosion properties. Therefore DIMO 2311 is particularly suitable for molds with superior surface requirements if suitable manufacturing processes are employed.

The good sulfidic and oxidic cleanliness and the modification of the few remaining inclusions by the calcium treatment lead to good machinability and minimize the tool wear. These properties can only be achieved by the combination of the following DIMO 2311-production steps:

- desulphurization to $S \leq 0.002$ % for high sulfidic cleanliness
- chemical composition analysis in dependence of plate thickness
- vacuum degassing
- argon stirring for high sulfidic and oxidic cleanliness
- calcium treatment for inclusion shape control
- special casting conditions to assure the high cleanliness and homogeneity
- High Shape Factor Rolling (high thickness reduction) to realize a closely packed structure
- appropriate heat treatment parameters according to analysis and dimensions to assure homogeneous hardness distribution over the plate and to minimize residual stresses

¹⁾ The latest edition of this material data sheet is available at <http://www.dillinger.de/>.



Chemical composition

For the ladle analysis the following limiting values in % are applicable

	C	Si	Mn	P	S	Cr	Mo	Ni	V
limiting values	0.35 - 0.45	0.20 - 0.40	1.30 - 1.60	≤ 0.025	≤ 0.002	1.80 - 2.10	0.15 - 0.25	a)	a)
auxiliary data for 100 mm plate thickness	0.40	0.30	1.55	0.015	0.001	1.90	0.20	0.12	0.05

a) alloyed depending on dimensions

Delivery condition

DIMO 2311 is supplied in the hardened (air hardened + tempered) condition.

Mechanical and physical properties in the delivery condition

Hardness

Unless otherwise agreed the hardness at the surface in the delivery condition is 280 - 325 HBW. According to EN ISO 18265, table B2, this corresponds to a tensile strength of approximately 890 - 1030 MPa (128 - 148 ksi).

Physical properties (auxiliary data)

specific heat at [kJ/(kg K)]	20 °C								
	0,46								
specific heat at [Btu/(lb °F)]	68 °F								
	0,11								
thermal conductivity at [W/(m K)]	20 °C	100 °C	200 °C	300 °C	400 °C				
	34	35	36	36	36				
thermal conductivity at [Btu/(ft h °F)]	68 °F	210 °F	390 °F	570 °F	750 °F				
	19.6	20.2	20.8	20.8	20.8				
coefficient of thermal expansion between	20 °C and	100 °C	200 °C	300 °C	400 °C	500 °C	600 °C		
10 ⁻⁶ [m/(mK)]		12.1	12.7	13.2	13.8	14.2	14.3		
coefficient of thermal expansion between	68 °F and	210 °F	390 °F	570 °F	750 °F	930 °F	1110 °F		
10 ⁻⁶ [in/(in °F)]		6.72	7.05	7.33	7.66	7.88	7.94		

Testing

- Heat analysis
- Dimension control
- Surface inspection
- Hardness
The hardness (HBW) is tested on surface of each rolled mother plate.
- Ultrasonic testing
Unless otherwise agreed, 100 % ultrasonic testing is performed on each plate in accordance with EN 10160. As admissible limit applies quality class 4 in table 5 of EN 10228-3.
Upon request, an ultrasonic testing in accordance with ASTM A 578, Level C supplementary requirements S1 and S9 is possible. In this case the desired testing standard has to be indicated on the order.



Unless otherwise agreed, the results are documented in an inspection certificate 3.1 in accordance with EN 10204.

Identification of plates

Unless otherwise agreed the marking is carried out via steel stamps with at least the following information:

- steel grade (DIMO 2311)
- heat number
- number of mother plate and individual plate
- the manufacturer's symbol
- inspector's sign

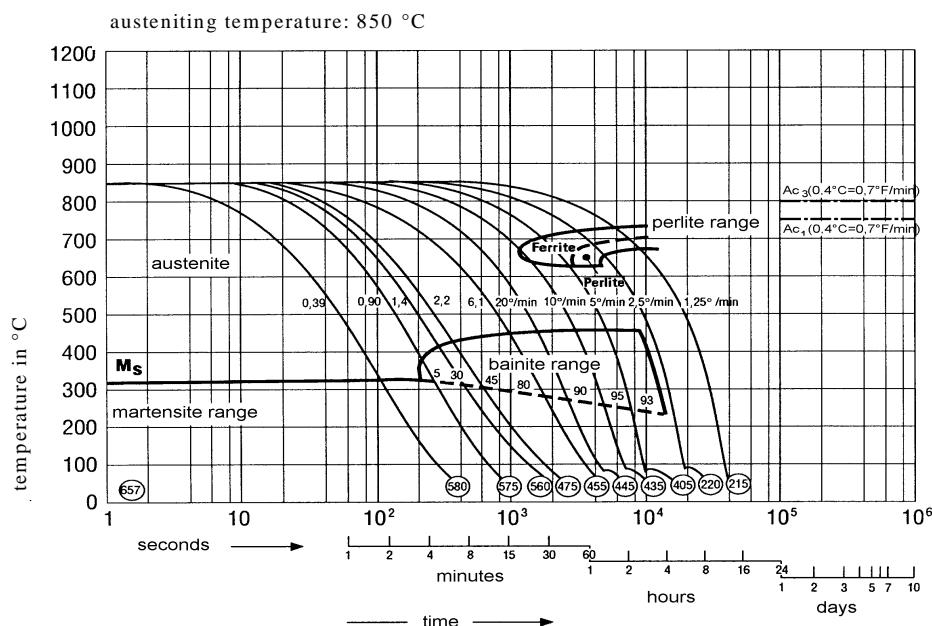
Processing

Heat treatment

DIMO 2311 is delivered in the hardened condition; therefore further heat treatment is generally not necessary. This avoids the risks and costs involved by the hardening and tempering of a mold after processing. Should a heat treatment become necessary, the following data are recommended:

soft annealing	stress relieving	hardening	tempering
720 - 740 °C (1330 - 1360 °F) 2 - 4 h, furnace cooling hardness about 230 HB	in the delivery condition max. 580 °C (1080 °F) 1 - 2 h, furnace cooling	840 - 860 °C (1540 - 1580 °F)/oil; for low wall thicknesses air cooling or warm bath hardening at 200 - 230 °C (390 - 450 °F) are possible	in accordance with tempering diagram to required hardness

Time Temperature Transformation diagram



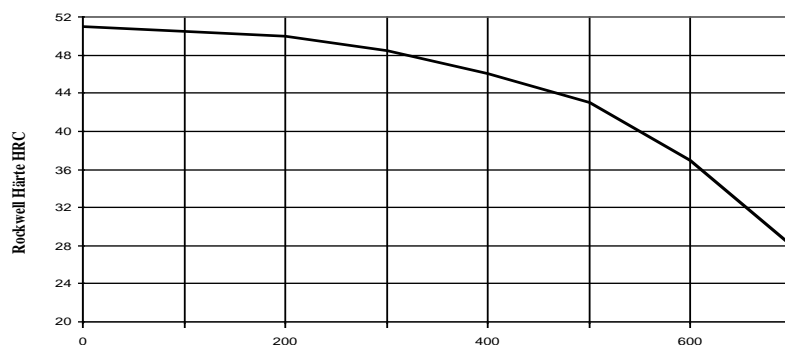
0.39 - 6.1 = cooling
parameters
($t^{8/5}$ - time in sec./100)

5 - 95 = % structure

657 = hardness in HV



Tempering diagram



Tempering temperature [°C] (valid for soaking time 1 h, air cooling)

Remark: the values in the diagram are mean values on samples, diameter 25 mm (1 in), length 50 mm (2 in), hardened at 850 °C (1560 °F) in oil

General technical delivery requirements

Unless otherwise agreed, the general technical delivery requirements in accordance with EN 10021 apply.

Tolerances

Unless otherwise agreed, tolerances are in accordance with EN 10029 with the following restrictions:

plate thickness	in accordance with EN 10029, class C			
plate width	$\geq 1000 \text{ mm} \leq 1500 \text{ mm}$	-0/+40 mm	$\geq 40 \leq 59 \text{ in}$	-0/+1,6 in
	$> 1500 \text{ mm} \leq 2050 \text{ mm}$	-0/+50 mm	$> 59 \leq 80\frac{1}{2} \text{ in}$	-0/+2 in
	$> 2050 \text{ mm}$	-0/+100 mm	$> 80\frac{1}{2} \text{ in}$	-0/+4 in
plate length		$\pm 500 \text{ mm}$		$\pm 20 \text{ in}$
flatness	$\leq 3 \text{ mm/m}, \leq 6 \text{ mm/2 m}$ ($\frac{1}{8} \text{ in/40 in}, \frac{2}{8} \text{ in/80 in}$)			

Surface quality

Unless otherwise agreed, the specifications will be in accordance with EN 10163-2 class A, subclass 3. Shot blasting of upper and lower surface of the plate and shop priming are possible on request.

General note

If special requirements, which are not listed in this specification, are to be met by the steel due to its intended use or processing, these requirements are to be agreed before placing the order. The information in this specification is a product description. This specification is updated if necessary. The latest version is available from the mill or as download at www.dillinger.de.



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