M238

BÖHLER M238

VMR®/VAR®

VACUUM ARC REMELTED
HARDENED AND TEMPERED
PLASTIC LENS MOLD STEEL

Chemical Composition (average %)				AISI equivalent ~P20	
C	Si	MN	Cr	Mo	Ni
0.38	0.30	1.50	2.00	0.20	1.10

The metallurgical cleanliness of tool steel is a deciding factor in the quality and surface finish of manufactured products. One way of achieving a high cleanliness level is to use VACUUM REMELTING TECHNOLOGY.

The technology of vacuum remelting was developed for the production of high tensile strength titanium and zirconium alloys. Today, this process is also used to manufacture tool steels and nickel and cobalt-based super alloys with high cleanliness. This technology allows us to attain the properties demanded in the aircraft and aeronautics industries, the demands of the energy, medical technology and lens mold sectors as well as those of tool makers.

Properties

M238 VMR is a hardened and tempered plastic mold steel with excellent cleanliness for best polishability ideal for lens mold tooling. The hardness is consistent over the entire cross-section of the steel block, even in large sizes, due to the addition of nickel.

- Minimum gas contents
- Reduction of trace elements such as Pb, Bi, Te, As, Sn, Sb
- Minimum microsegregations at the center of ingot
- Low susceptibility to the formation of freckles (segregation)
- Highly precise chemical analysis

Applications

Lens mold tooling, mold carrier frames for plastic molds, components for general mechanical engineering and tool manufacture where highest polishability and fatigue strength are required.

Supplied Condition

Hardened and tempered to approx. 330 BHN. Generally, no heat treatment is required. If heat treatment is carried out, e.g. to obtain an increase in strength, the instructions given in this brochure should be observed.

Advantages

ONE STEEL GRADE FOR ALL REQUIREMENTS. The economic and technological advantages of M238 VMR at a glance:

Higher quality, longer service life and increased reliability

- Uniform high strength, even in larger sizes
- Optimum mechanical properties
- High toughness

More economic production and high tool quality

- Good electrical discharge machining properties
- Excellent polishability
- Good photoetching properties

Improved productivity

- Good polishability, photoetching properties and discharge machining properties help to save machining time
- The high toughness helps increase the service life of molds, i.e. more plastic components can be produced per mold

Reliability

- Good electrical discharge machining properties reducing the risk of cracking during production
- The material does not require heat treatment, reducing the risk of errors
- Optimum polishability and photoetching properties ensures the best possible surface finish
- A favorable chip shape ensures high safety during tool making in CNC machining centers
- The good toughness decreases the risk of cracking during service

Additional advantages of our hardened and tempered plastic mold steel M238 VMR:

- Minimal hardness decrease at the center even in large sizes
- Suitable for all nitriding processes to improve wear resistance
- Can be hard chromium plated. Suitable for every type of galvanic surface treatment used to optimize hardness and corrosion resistance
- Suitable for PVD coating, providing excellent adhesion conditions for the TiN-layer
- The material can be case-hardened if necessary

Heat Treatment

Annealing:

1328-1364°F (720–740°C) Slow, controlled cooling in furnace at a rate of 50-68°F/hr (10–20°C/hr) down to approx. 1112°F (600° C), further cooling in air. Hardness after annealing: max. 240 BHN.

Stress relieving:

Approx. 1112°F (600° C), In hardened and tempered condition approx. 86-122°F (30 to 50°C) below the tempering temperature. After through-heating, hold at temperature in a neutral atmosphere for 1 to 2 hours. Cool slowly in furnace.

Hardening:

1544 to 1580°F (840 to 860°C/oil),
1580 to 1616°F (860 to 880° C/air)
up to 5.9" (150 mm) thickness
After through-heating, hold for 15 – 30 minutes. Obtainable hardness: approximately 54 HRC.

Tempering

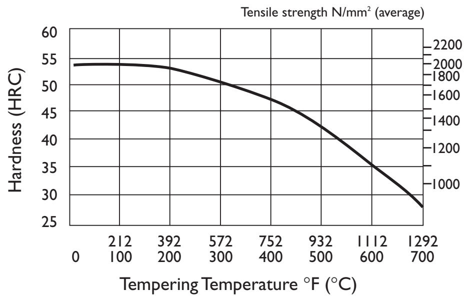
Slow heating to tempering temperature immediately after hardening.
Time in furnace: 1 hour for each .79" (20 mm) of work-piece thickness, but at least 2 hours. Cool in air.
For average hardness values after tempering please refer to the tempering chart.

Welding

Minor machining defects can be remedied and cavity modifications carried out in the hardened and tempered condition (approx. 330 BHN) under observance of the given guidelines. Buildups on large surfaces are possible only in the annealed condition and call for another hardening and tempering treatment.
In all cases we recommend either manual electric arc welding using BOHLER FOX CM2 Kb electrodes or TIG welding using BOHLER CM2-IG welding wire. The deposit is machinable.

Welding Guidelines:

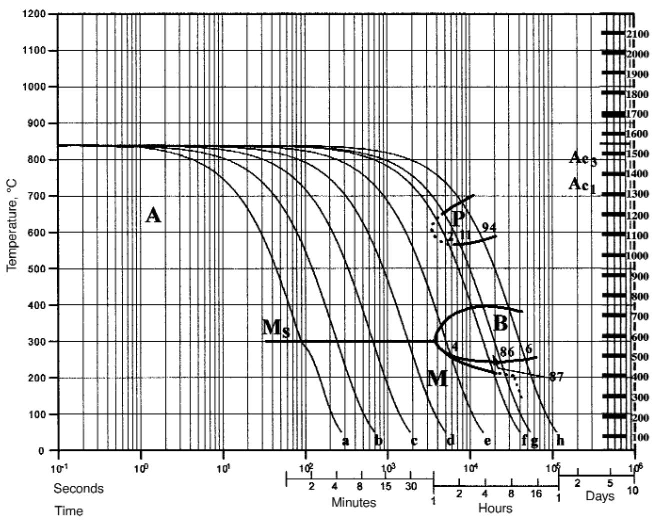
- Nitrided layers should be completely ground out as should case hardened layers and surface cracks in the weld area.
- The absence of cracks should be verified by dye penetrant testing; sharp edges and corners should be avoided in the weld area.
- Bevel radii should be at least .12" (3 mm).



Welding Cont'd.

- Prior to welding, the workpiece should be pre-heated slowly and uniformly to 572-662°F (300–350°C), if possible in a preheating furnace.
- Deep grooves resulting from crack removal should be filled using BOHLER FOX DCMS Kb electrodes or BOHLER DCMS-IG welding wire for TIG welding.
- Buildup welding should be carried out step-by-step using thin electrodes at low amperages and with low heat input depositing 0.79-1.18" (2–3 cm) long beads, with slight weaving.
- Every weld bead should be lightly peened to reduce shrinkage stresses.
- Welding should be carried out with out interruption observing the minimum preheating temperature of 572°F (300°C).
- When welding is completed, the workpiece should be cooled slowly in a furnace or covered by thermoinsulating material and then tempered at 1022-1112°F (550 to 600°C).

Austenitizing temperature (840°C)
B...Bainite, P...Perlite, M...Martensite



Sample	λ	HV10
a	0.3	634
b	1.1	632
c	3.0	620
d	8.0	599
e	23.0	572
f	65.0	455
g	90.0	433
h	180.0	254

Physical Properties

Density at	68°F (20°C)	7.85	kg/dm³)
Thermal conductivity at	68°F (20°C)	34.0	W/(m.K)
	212°F (100°C)	34.5	W/(m.K)
	392°F (200°C)	34.5	W/(m.K)
	572°F (300°C)	35.0	W/(m.K)
	752°F (400°C)	35.0	W/(m.K)
Specific heat at	68°F (20°C)	460	J/(kg.K)
Electrical resistivity at Ohm.mm²/m	68°F (20°C)	0.19	
Modulus of elasticity at	68°F (20°C)	210 x 10³	N/mm²

Thermal expansion between 68°F (20°C) and...°F (°C);
in/in x °F x 10^{-6} (m/m x °C x 10^{-6})

200°F (100°C)	400°F (200°C)	570°F (300°C)	750°F (400 °C)	930°F (500°C)	1112°F (600°C)	1292°F (700°C)
.50(12.8)	.51(13.0)	.54 (13.8)	.55(14.0)	.56 (14.2)	.56(14.2)	.57(14.5)

BD - 12/03/500

To purchase Bohler and Uddeholm products in North America please contact:

BÖHLER UDDEHOLM™ North America

Great Tooling Starts Here!™

Headquarters
4902 Tollview Drive
Rolling Meadows, IL 60008
Sales:
Tel: (800) 638-2520
Fax: (905) 812-8659
www.bucorp.com
e-mail: info@bucorp.com

USA CANADA