

VWM2®

High Speed Steel

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SIMILAR STANDARDS

VWM2® is similar to the following grades: AISI/SAE M2, UNS T11302, BS BM 2, JIS SKH51, AFNOR Z85WDCV06-05-04-02, W.Nr. 1.3343, EN HS 6-5-2C. This steel is produced in accord with EN ISO 4957 grade HS6-5-2-C.

GENERAL INFORMATION

VWM2® is a standardized molybdenum-tungsten high speed steel with excellent properties of toughness, wear resistance and machinability. The alloy design of this steel results in an unique arrange of properties, which, leads VWM2® to be the most versatile

high speed steel, and employed in several distinct applications.

MAIN CHARACTERISTICS

VWM2® is characterized by a well-balanced chemical composition, where vanadium is responsible for the formation of MC type primary carbides with outstanding abrasive wear resistance, while molybdenum and tungsten are intended to promote the precipitation of M₂C and M₆C type carbides which promote adhesive wear resistance. Control of the carbide size results in improved toughness, promoting an excellent balance between toughness and wear resistance.

CHEMICAL COMPOSITION

Typical Analysis (Weight Percent)

C	Si	Mn	Cr	Mo	V	W	Fe
0.90	0.40	0.30	4.00	4.80	1.80	6.10	Bal.

STANDARD PRODUCTION RANGE

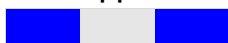
Production Route	Standard	Production Range	Finishing
Rolled Products	EN ISO 4957	Flats with thickness between 8 to 100 mm and width up to 305 mm Hot rolled coils up to 13,50 mm Drawn coils up to 12,70 mm Round bars from 0,90 to 152.40mm	As rolled Drawn Centerless ground Peeled
Forged Products		Round bars from 152.40 to 360 mm Flats with thickness up to 150mm and width up to 410mm	Peeled Turned Milled

*Other dimensions and conditions are available upon inquiry.

DELIVERY CONDITION

VWM2® is supplied in the annealed condition with a maximum hardness of 260 HB, Except for round bars up to 12 mm and drawn coils, which are supplied with a maximum hardness of 290 HB.

Identification Colors: blue, silver, blue.



HEAT TREATMENTS

Soft Annealing

Soft annealing should be carried out by heating between 850 and 880°C for 2 hours followed by cooling with cooling rate between 10 and 20°C per hour until 650°C and, then, by air cooling. The use of protective atmosphere is important to avoid surface oxidation and decarburization.

Stress Relief

Stress relief heat treatment consists in heating to 600-700°C for 2 hours minimum followed by furnace cooling until 500°C.

Hardening

Preheat the part to 400-500°C and then heat to 860-880°C until the temperature from center to surface is equal in each step. For large parts, it is also recommended an additional preheating step at 1050°C. Austenitizing temperature should be between 1180 and 1220°C for cutting tools and between 1080 and 1160°C for cold work dies. After austenitization, the quenching can be performed in different quench media as:

- Pressurized vacuum furnace with pressure higher than 5 bar,
- Salt or fluidized bed between 450 - 550°C,
- Air cooling.

Tempering

The parts shall be tempered immediately after quenching, i.e. as soon as they reach 60°C. It is necessary, at least, double tempering.

Tempering temperatures are generally between 540-600°C depending upon the desired hardness. The time of each tempering cycle shall be at least 2 hours in temperature. For parts with thickness larger than 70 mm, the time at temperature should be calculated according to their size, being a reference for calculation about one hour for each inch of thickness.

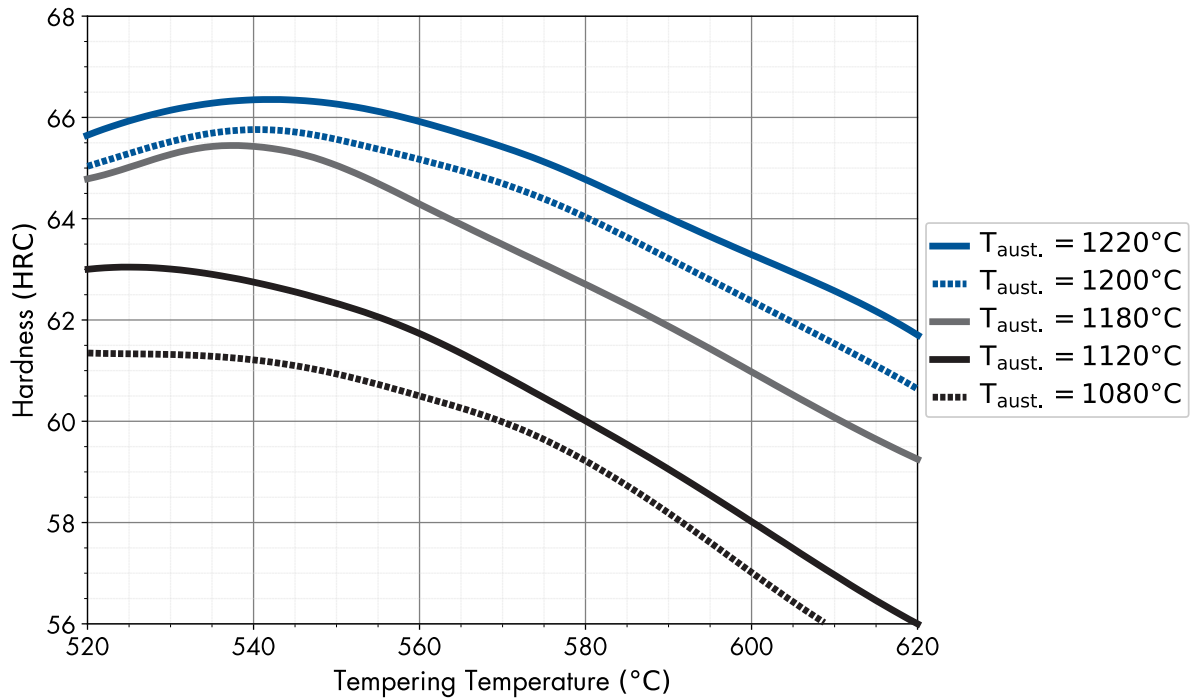
Surface treatments

Surface treatments as PVD and CVD are recommended when both abrasive and adhesive wear resistance are required. Nitriding can also be applied in order to improve abrasive wear resistance. Surface treatments shall be carried out after hardening and tempering.

MAIN APPLICATIONS

VWM2® is a general-purpose high speed steel which can be used in applications such as, but not limited to:

- General purpose drills,
- Broaches, milling cutters,
- Reamers,
- Knives and saws,
- Taps,
- Dies or inserts for cold work tooling, where high wear resistance is required.

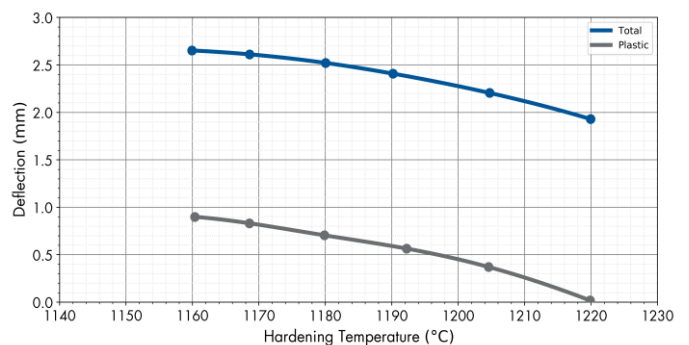
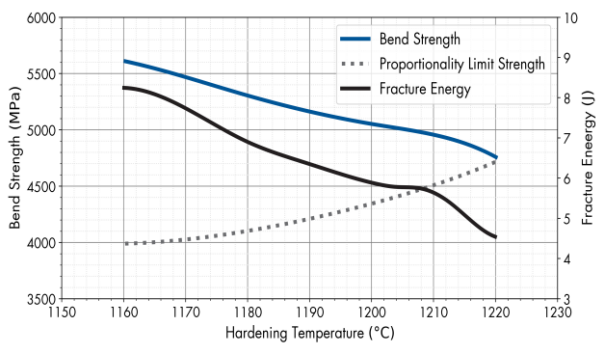


Tempering curve of VWM2® after hardening at different temperatures. Tempering time: 2 hours
Curves obtained from specimens with 20 mm x 20 mm x 20 mm

MECHANICAL PROPERTIES

As toughness decreases with higher austenitizing temperatures, the range between 1080 and 1160°C are indicated for cold work tooling, whereas the range of 1180 to

1220°C is indicated to improve hardness and wear resistance in cutting applications. Temperatures higher than 1220°C cause a considerable loss in toughness and must be avoided



Bend test results for round samples of a 5.5 mm diameter bar. Fixed double tempering at 560°C

MACHINABILITY

VWM2® can be conventionally machined in the annealed condition. Care need to be taken in the selection of the tool and the speed in order to allow a good machinability and reduce the risk to surface overheating and cracking. When machining removal is greater than 30%, a stress relief is recommended as to avoid distortions on the part during the hardening and tempering, Electro-erosion process can be employed in heat treated parts. After electro-erosion machining it is recommended to remove the superficial layer thru fine grinding wheel and perform a tempering heat treatment in temperatures around 50°C lower than that of the last tempering.

PHYSICAL PROPERTIES

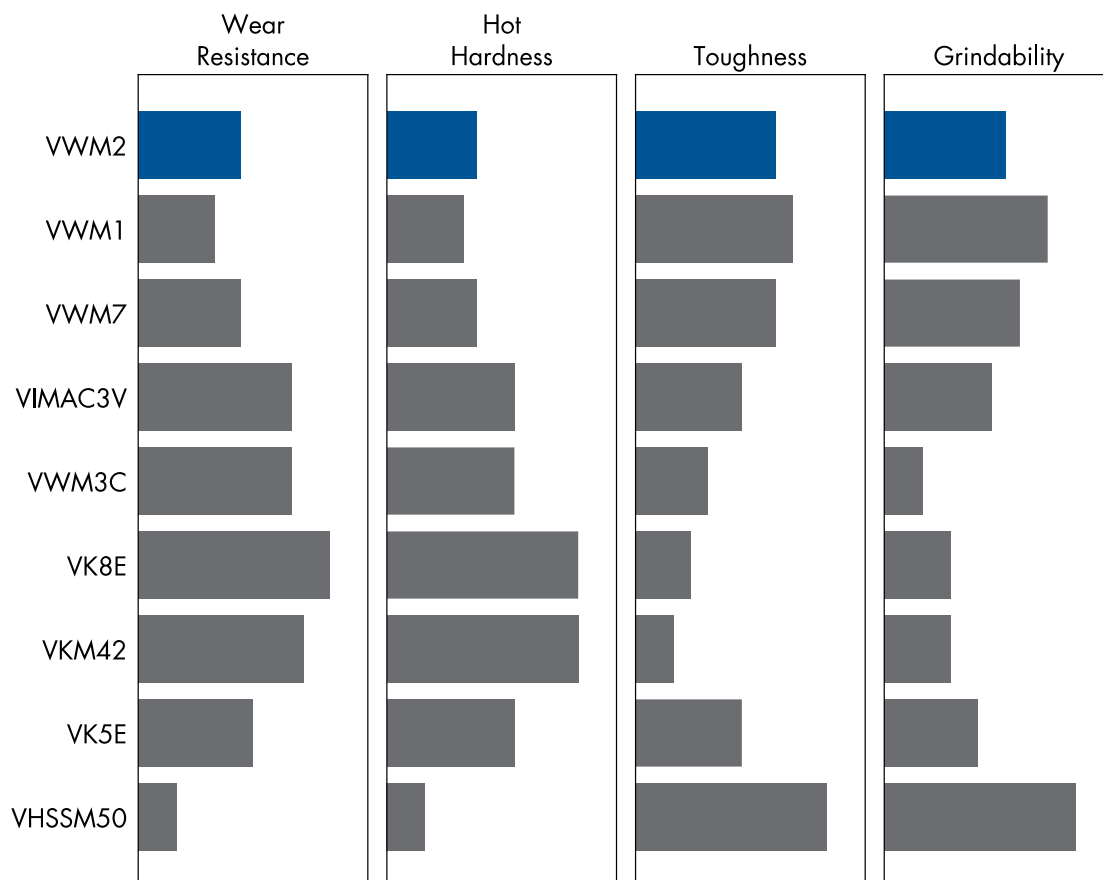
Density:

Temperature	g/cm ³	lb/in ³
20°C (68°F)	8.10	0.292

Thermal Expansion Coefficient:

Temperature 20 °C to (68°F to)	10 ⁻⁶ m/m.K	10 ⁻⁶ in/in.°F
100°C (212°F)	10.1	5.6
200°C (392°F)	11.1	6.2
300°C (572°F)	11.6	6.4
400°C (752°F)	11.9	6.6
500°C (932°F)	12.2	6.8
600°C (1112°F)	12.3	6.8

COMPARISON BETWEEN VILLARES METALS HIGH SPEED STEELS



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ISO 9001:2015
ISO 14001:2004 (ANAB and UKAS)
ISO 17025
ISO 50001

OHSAS 18001:2007
IATF 16949:2016
AS 9100 D
NORSOK M-650
NADCAP – Heat Treating and Non Destructive Testing

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