VCMAIM®

Hot Work Tool Steel

VILLARES METALS
a voestalpine company

The presented information in this datasheet is only for technical guidance and represents our present state of knowledge of this product. This information shall not be considered as warranty of specific properties or fitness for a particular application of this product..

Edition 1, 01.2021

SIMILAR STANDARDS

VCMAIM® is a modified AISI H10 grade. This steel is similar to UNS T20810, DIN X32CrMoCoV3-3-3 and W.Nr. 1.2885.

GENERAL INFORMATION

VCMAIM® is a hot work tool steel, which combines high hot resistance and high thermal conductivity. This steel is intended for applications in molds for low-pressure die casting wheels and hot forging dies.

MAIN CHARACTERISTICS

VCMAIM® is a martensitic hot work tool steel intended to deliver high hot resistance associated with high thermal conductivity. This steel is produced by ISOMAX process that includes ESR (Electro-Slag Remelting) process to assure high isotropy of mechanical properties. Indications for VCMAIM® are applications where the resistance to initiation and propagation of mechanical and thermal cracks are essential. In these situations, high thermal conductivity and high temperature strength are the most important properties and determine the tool life.

CHEMICAL COMPOSITION

Typical Analysis (Weight Percent)

C	Si	Mn	P	S	Co	Cr	Mo	V	Fe
0,30	0,25	0,30	0.03 max	0.003 max	3,00	3,00	2,9	0,5	Bal.

STANDARD PRODUCTION RANGE

Production Route	Standard	Production Range	Finishing
Rolled Products	ASTM A681	Thickness between 8 to 152 mm with width between 25 to 320mm Rd. 5.50-152mm	Centerless ground Peeled Turned Milled
Forged Products		Rd. 152 – 760 mm Thickness up to 550mm with width up to 1000mm	Turned Milled

*Other dimensions and conditions are available upon inquiry.

DELIVERY CONDITION

VCMAIM® is supplied in annealed condition with maximum hardness of 230HB. It can also be supplied in hardened condition in accordance to customer's needs.
Identification Colors: white, yellow, white

HEAT TREATMENTS

Stress Relief

Stress relief heat treatment aims to reduce the residual stress of the part and it shall be employed after machining and before hardening. It shall be applied in dies with draws and profiles, in which the machining removal has been higher than 30%, in other to minimize distortions during and after hardening.

Stress relief heat treatment consists in a slowly heating to 650°C followed by furnace cooling until 200°C. In hardened parts, the stress relief must employ a temperature 50°C lower than the last tempering temperature.

Hardening

The austenitizing temperature should be between 1010-1040°C.

For better toughness performance, it is indicated 1010°C and for better heat resistance response 1040°C can be applied. The choice of the ideal temperature should also consider aspects of design and finishing details of the parts. After austenitization, the quenching can be performed in different quench media as:

- Pressurized vacuum furnace with pressure higher than 5 bar.
- Oil between 40-70°C.
- Salt bath between 500-550°C.

Tempering

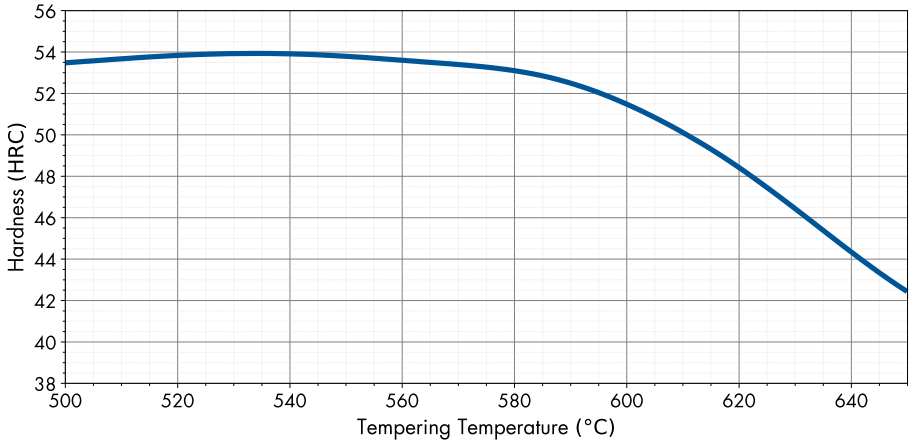
Temper immediately after quenching, i.e. as soon as parts reaches 60°C. Double tempering, at least is recommended and after each tempering cycle, parts shall be slowly cooled to room temperature.

Tempering temperatures are generally between 550-650°C, depending upon the desired hardness. The soaking 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

Nitriding or nitrocarburizing are recommended when higher levels of surface hardness or wear resistance are required. VCMAIM® has a good nitriding response. PVD or CVD coatings are also suitable to be applied. Surface treatments shall be employed after hardening and tempering, since their temperatures is at least 50°C lower than the last tempering heat treatments.



Tempering curve of VCMAIM® after hardening at 1020°C. Tempering time: 2 hours
Curve obtained from specimens with 20 mm x 20 mm x 20 mm

MAIN APPLICATIONS

VCMAIM® is mainly used on:

- LPDC automotive alloy wheel molds
- Die casting,
- Hot forging dies and punches
- Hot forming,
- Extrusion tools and components,

MACHINABILITY

VCMAIM® 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. In order to avoid distortions on the part during hardening and tempering, it is recommended to perform a stress relief heat treatment before hardening, if more than 30% of part weight was removed in machining operations. Electro-erosion process can be employed in heat treated dies or molds. 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.

WELDING

It is not recommended to perform welding operations on VCMAIM® steel. Welding operations will produce Heat Affected Zones (HAZ), which will reduce the performance of the steel in the application. HAZ produced during arc welding operation are harder and brittle, with risk of cracking unless great care is exercised. In exceptional cases and always considering that, the welding would be a temporary solution VCMAIM® might be welded using special procedures to minimize the HAZ. The sequence of operations for repair welding VCMAIM® depends upon its prior heat treatment. As a general guideline, it is recommended to: (a) preheat, (b) weld with appropriate filler metal, (c) perform a stress relief heat treatment, (d) machine, (e) quench and temper if in the annealed condition or stress relief if already hardened and (f) grind to final dimensions. The qualification of a specific welding procedure for repair is the key point to obtain the desired quality. The skill and experience of the welder is also a vital factor in obtaining satisfactory results.

IMPROVEMENT OF TOOL LIFE

Before starting operation, pre-heat slowly between 200-300°C, to obtain thermal homogenization of core and surface. Apply periodic stress relieving during the use of tools is recommended to improve the tool life.

PHYSICAL PROPERTIES

Density:

Temperature	g/cm³	lb/in³
20°C (68°F)	7.80	0.281

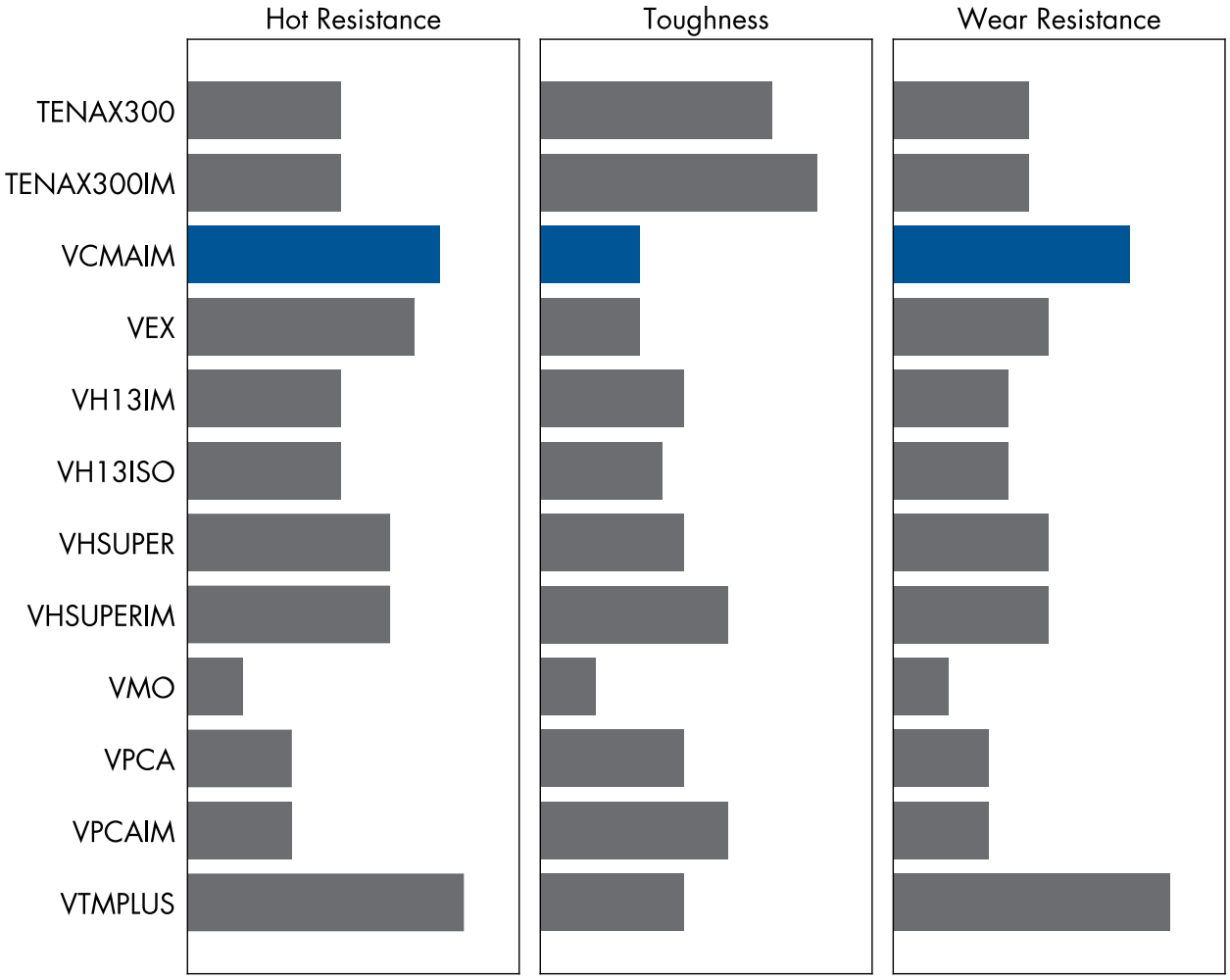
Thermal Conductivity:

Temperature	W/(m.K)	Btu.in/(h.ft².°F)
20°C (68°F)	28.7	198
350°C (662°F)	30.0	208
700°C (1292°F)	32.4	224

Thermal Expansion Coefficient:

Temperature 20 °C to (68°F to)	10^{-6}m/m.K	10^{-6}in/in.°F
100°C (212°F)	10.5	5.8
200°C (392°F)	10.7	5.9
300°C (572°F)	11.0	6.1
400°C (752°F)	11.3	6.3
500°C (932°F)	11.7	6.5
600°C (1112°F)	12.1	6.7

COMPARISON BETWEEN VILLARES METALS HOT WORK STEELS



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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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