V2316MOD®
Plastic Mold 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.

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SIMILAR STANDARDS

V2316MOD® is a modified version of the following grades: DIN X38CrMo16 and X36CrMo17, W.Nr. 1.2316, UNS S42010.

GENERAL INFORMATION

V2316MOD® is a martensitic stainless steel with high chromium and molybdenum. The main application for this steel is manufacturing of plastic molds that work in corrosive environments.

MAIN CHARACTERISTICS

V2316MOD® presents the following properties:

- Excellent corrosion resistance,
- Excellent polishability,
- Good wear resistance,
- Good machinability.

V2316MOD® has special chemical composition and homogeneity, which prevents delta ferrite formation.

CHEMICAL COMPOSITION

Typical Analysis (Weight Percent)

C	Si	Mn	Cr	Mo	Ni	N	Fe
0.25	0.35	0.9	14.0	0.90	0.50	+	Bal.

STANDARD PRODUCTION RANGE

Production Route	Production Range	Finishing
Rolled Products	Thickness between 8 to 152 mm with width between 38.10 to 320mm Rd. 12.70-152.40mm	Centerless ground Peeled Turned
Forged Products	Rd. 152.40 – 570 mm Thickness up to 300mm with width up to 760mm	Turned Peeled Milled

*Other dimensions and conditions are available upon inquiry.

DELIVERY CONDITION

V2316MOD® is usually available pre-hardened to 337 – 373 HBW (36 – 40 HRC). Other hardness ranges or annealed condition can also be supplied upon request.

HEAT TREATMENTS

Soft Annealing

Soft annealing should be carried out by slow heating to 780 and 840°C for 1 hour for each inch of thickness, followed by slow cooling at 30°C per hour until 600°C and, then, by air cooling. In this treatment, the use of protective atmosphere is important to avoid surface oxidation and decarburization.

Stress Relief

In case of high removal during machining, a stress relief heat treatment shall be applied in order to avoid distortions during quenching and tempering heat treatments. The indicated procedure is slow heating to 650°C or 50°C lower than the tempering temperature in case of hardened tool, holding until complete homogenization, and cooling inside the furnace at least down to 200°C.

Hardening

Preheat the part to 600-750°C in two steps, until the temperature from center to surface is equal in each step. The austenitizing temperature should be between 1000 and 1040°C holding the temperature until complete homogenization of the part,

Surface decarburization cause decrease in hardness and may cause polishing problems named “overpolishing”. Therefore, the use of protective atmosphere (or vacuum) is important during heating to hardening.

After austenitization, the quenching can be performed in different quench media as:

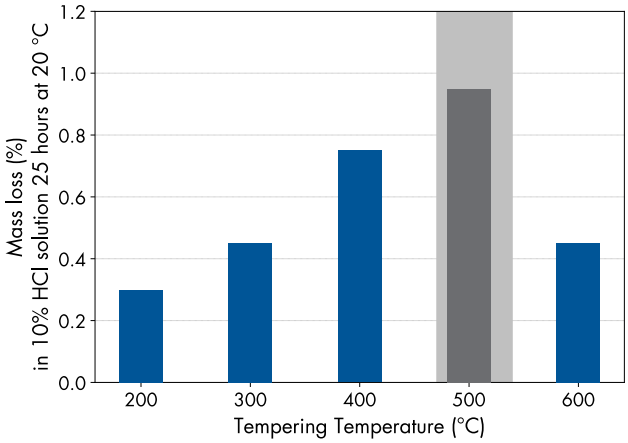
- Pressurized vacuum furnace with pressure higher than 5 bar,
- Warm oil, 40 - 70°C,
- Salt or fluidized bed between 400 - 450°C.

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. After each tempering, parts shall be slowly cooled to room temperature.

Tempering temperatures between 470 – 540°C cause excessive loss on corrosion resistance and toughness (figure below) and must be avoided.

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.

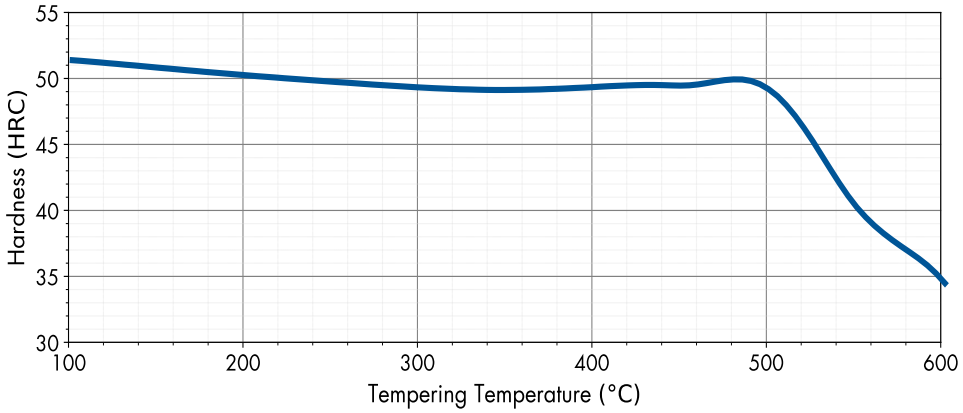


Effect of tempering temperature on corrosion resistance

Surface Treatments

Nitriding or nitrocarburizing might be applied when higher levels of surface hardness or wear resistance are required. V2316MOD® has a good nitriding response in terms of hardness, but it is important to highlight that nitriding impairs corrosion resistance.

PVD (especially DLC) and CVD coatings are also suitable to be applied if desired. Same precautions in terms of tempering temperature must be observed for all coating processes in order to avoid excessive loss of corrosion resistance.



Tempering curve of V2316MOD® after hardening at 1020°C. Tempering time: 2 hours
Curve obtained from specimens with 20 mm x 20 mm x 20 mm

MAIN APPLICATIONS

V2316MOD® is applied in molds that work in corrosion conditions or need to be stainless for other reasons. Typical applications are:

- Molds for Injection or extrusion of chlorinated thermoplastic polymers, such as PVC,
- Molds that work or are storage in corrosion environments or wet conditions,
- Molds for glass industry,
- Other applications were high mechanical strength and high corrosion resistance are necessary.

MACHINABILITY

Due to its refined structured V2316MOD® presents good behavior in grinding operations. This contributes to reduce the risk to surface overheating and cracking. Care need to be taken in the selection of the tool and the speed in order to allow a good machinability. 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 not higher than 500°C.

WELDING

In exceptional cases and always considering that welding would be a temporary solution V2316MOD® might be welded using special procedures to minimize the HAZ.
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 temper 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.

PHYSICAL PROPERTIES

Density:

Temperature	g/cm³	lb/in³
20°C (68°F)	7.70	0.278

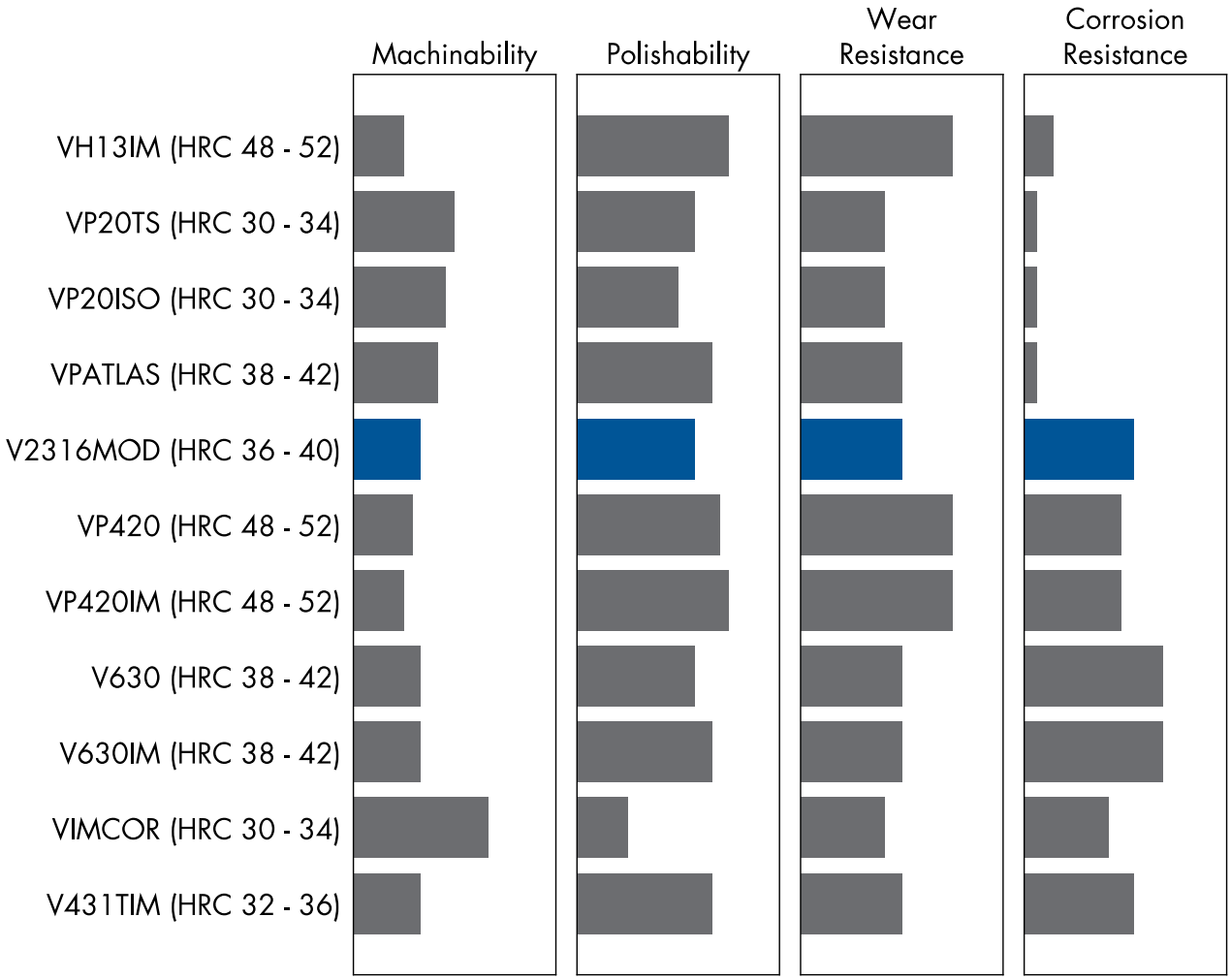
Thermal Conductivity:

Temperature	W/(m.K)	Btu.in/(h.ft².°F)
100°C (212°F)	23.5	163

Specific Heat:

Temperature 20 °C to (68°F to)	J/kg.K	Btu/lb.°F
200°C (392°F)	460	0.110

COMPARISON WITH VILLARES METALS PLASTIC MOLD STEELS



Headquarters | Sales Office – Worldwide

Villares Metals S.A.
Rua Alfredo Dumont Villares, 155
Jardim Santa Carolina | CEP 13178.902
Sumaré - SP
+55 19 3303 8000
tooling@villaresmetals.com

Services & Solutions Centers – Brazil

Sumaré
Rua Alfredo Dumont Villares, 155
Jardim Santa Carolina | CEP 13178.902
Sumaré - SP
0800 707 0577
cac@villaresmetals.com

Flores da Cunha
Rod VRS 814, KM 1
Lagoa Bela | CEP 95270.000
Flores da Cunha - RS
0800 707 0577
cac@villaresmetals.com

Joinville
Perini Business Park
Rua Dona Francisca, 8.300, bloco C7
Distrito Industrial | CEP 89219.600
Joinville - SC
0800 707 0577
cac@villaresmetals.com

Vespasiano
Parque Norte Business Center
Avenida Três, 105
Morro Alto | CEP 33200.000
Vespasiano - MG
0800 707 0577
cac@villaresmetals.com

Sales Office – Europe

Villares Metals International B.V.
Delftse Poort - units 17.10-17.11
Weena 505
3013 AL - Rotterdam
The Netherlands
+31 6 15 95 14 51
info@villaresmetals.com

ISO 9001:2015
ISO 14001:2004 (ANAB and UKAS)
ISO 17025
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AS 9100 D
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