VP420®
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.

Edition 1, 01.2021

SIMILAR STANDARDS

VP420® is similar to the following grades: AISI 420, DIN X42Cr13, W.Nr. 1.2083. This steel is produced in accord with ASTM A276.

GENERAL INFORMATION

VP420® is a martensitic stainless steel indicated for manufacturing of plastic molds.

MAIN CHARACTERISTICS

When applied in plastic molds, VP420® presents the following properties:

- High corrosion resistance,
- Excellent polishability,
- Good wear resistance,
- Good machinability,
- High mechanical strength, leading to hardness up to 52 HRC.

CHEMICAL COMPOSITION

Typical Analysis (Weight Percent)

C	Si	Mn	Cr	V	Fe
0.40	0.8	0.5	13.5	0.25	Bal.

STANDARD PRODUCTION RANGE

Production Route	Standard	Production Range	Finishing
Rolled Products	ASTM A276	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

VP420® is usually available annealed condition in round, square or flat bars with maximum hardness of 230 HB. This steel can also be supplied in the final heat treatment condition in accord with ASTM A276.

Identification color: yellow, gold.

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 100°C.

Hardening

The austenitizing temperature should be between 980-1040°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 warm oil and it is recommended that parts to be carried to another furnace at 100/150 °C in order to equalize temperature keeping in this furnace 1h for each 100 mm.

Tempering

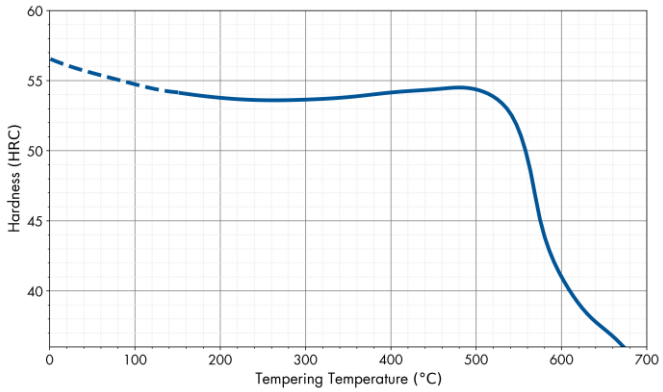
The parts shall be tempered immediately after quenching, i.e. as soon as they reach 60°C. It is necessary, at least, double tempering. After each tempering, parts shall be slowly cooled to room temperature.

Tempering temperatures are generally between 200-300°C, depending upon the desired hardness. The time of each tempering cycle shall be at least 2 hours in temperature. The temperature range between 450 and 540°C shall be avoided because it can promote an excessive loss in toughness.

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

Case hardening and nitriding impair corrosion resistance and are not normally applied.



Tempering curve of VP420® after hardening at 1000°C. Tempering time: 2 hours
Curve obtained from specimens with 20 mm x 20 mm x 20 mm

MAIN APPLICATIONS

VP420® 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

VP420® can be conventionally machined in the annealed condition. Due to its refined structured, VP420® 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. 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.

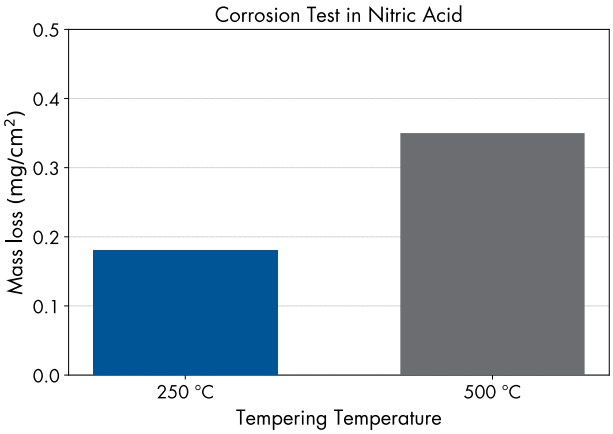
WELDING

It is not recommended to perform welding operations on VP420® 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 the welding would be a temporary solution VP420® might be welded using special procedures to minimize the HAZ.

The sequence of operations for repair welding VP420® depends upon its prior heat treatment. As a general guideline, it is recommended to: (a) preheat, (b) weld with appropriate filler metal, (c) machine, (d) quench and temper if in the annealed condition or stress temper if already hardened, and (e) 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.

CORROSION RESISTANCE

VP420® steel when adequately heat treated presents good corrosion resistance to atmosphere, mild acids and alkalis and fresh water.



Corrosion resistance of VP420® steel after hardening and tempering heat treatment.

PHYSICAL PROPERTIES

Density:

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

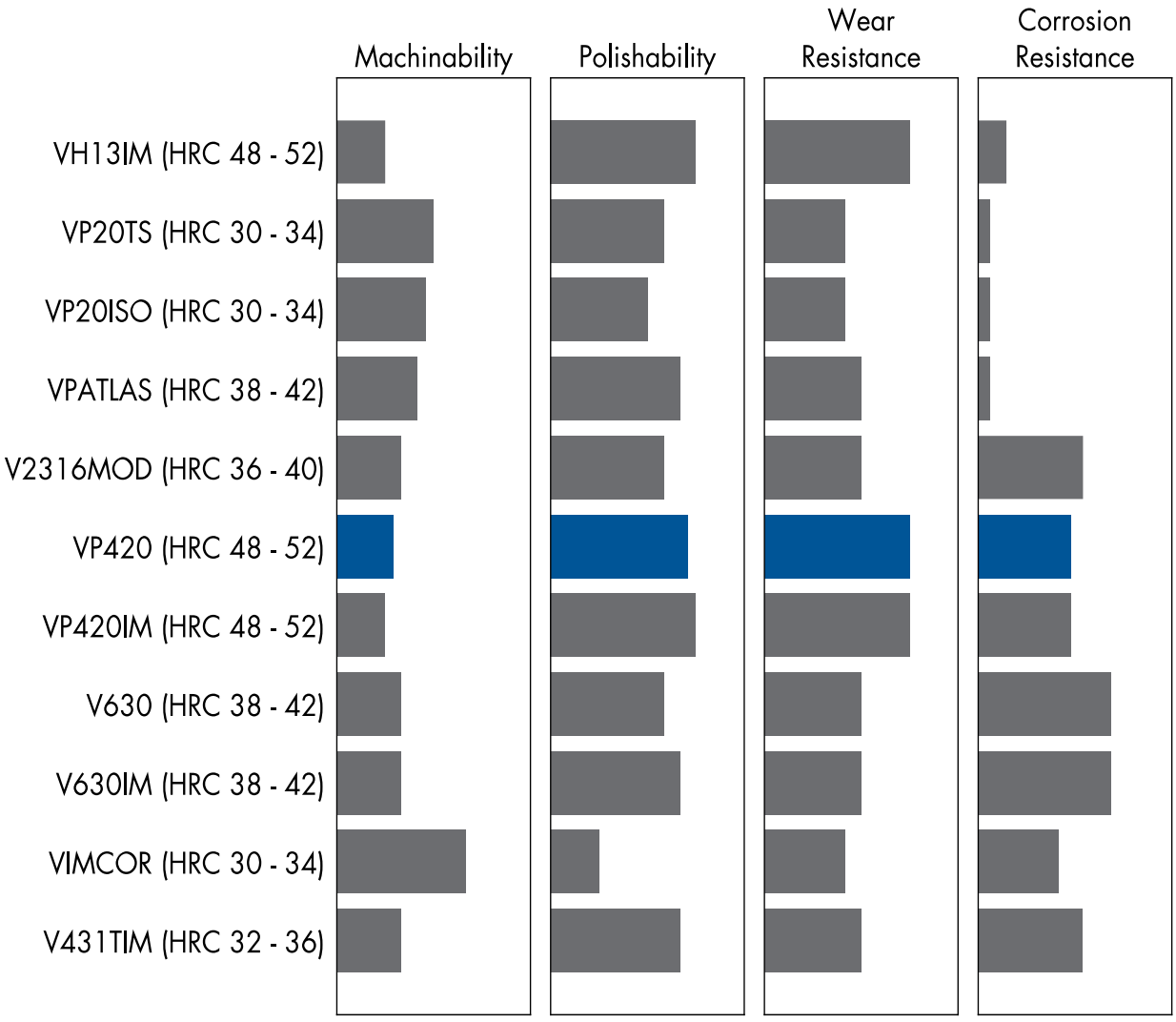
Specific Heat:

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

Thermal Conductivity:

Temperature	W/(m.K)	Btu.in/(h.ft².°F)
100°C (212°F)	24.8	171

COMPARISON WITH VILLARES METALS PLASTIC MOLD STEELS



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