

**ASP® 2004 is a high vanadium alloyed grade with high wear resistance and toughness suitable for cold work applications.**

## STANDARDS

- > EN 10027-1: PMHS 6-5-4
- > EN 10027-2: 1.3361
- > ASTM: AISI M4
- > JIS: SKH54

## DELIVERY HARDNESS

- > Typical soft annealed hardness is 270 HB
- > Cold-drawn material is typically 10-40 HB harder

## CHEMICAL COMPOSITION

Safety datasheet available

C	Cr	Mo	W	Co	V
1.43	4.2	5.0	5.8	-	4.1

## APPLICATIONS

- > Punches
- > Dies
- > Rolls
- > Rotating multi-edge cutting tools
- > Milling cutters
- > Taps
- > Broaches

## FORM SUPPLIED

- > Coils
- > Flat & square bars
- > Forged blanks
- > Round bars

Available surface conditions: drawn, ground, hot-worked, peeled, rough-machined, hot-rolled.

## HEAT TREATMENT

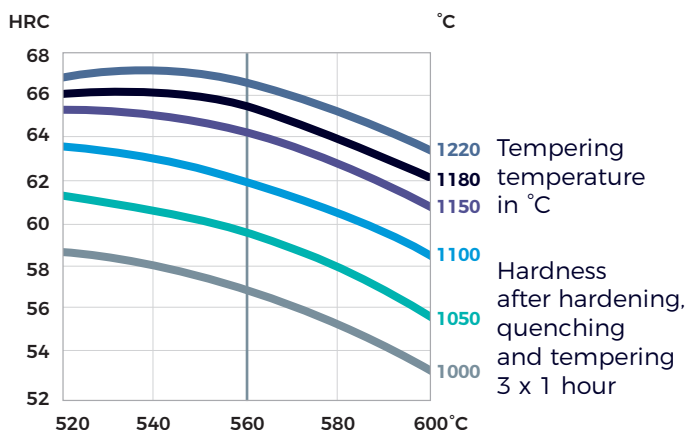
- > Soft annealing in a protective atmosphere at 850-900°C for 3 hours, followed by slow cooling at 10°C/h down to 700°C, then air cooling.
- > Stress-relieving at 600-700°C for approximately 2 hours, slow cooling down to 500°C.
- > Hardening in a protective atmosphere with pre-heating in 2 steps at 450-500°C and 850-900°C and austenitizing at a temperature suitable for chosen working hardness. Cooling down to 40-50°C.
- > Tempering at 560°C three times for at least 1 hour each time. Cooling to room temperature < 25°C between temperings.

## PROCESSING

ASP® 2004 can be worked as follows:

- > machining (grinding, turning, milling)
- > polishing
- > hot forming
- > electrical discharge machining
- > welding (special procedure including preheating and filler materials of base material composition)

## GUIDELINES FOR HARDENING



## GRINDING

During grinding, local heating of the surface, which may alter the temper, must be avoided. Grinding wheel manufacturers can provide advice on the choice of grinding wheels.

## SURFACE TREATMENT

The steel grade is a perfect substrate material for PVD coating. If nitriding is requested, a small diffusion zone is recommended but avoid compound and oxidized layers.



**PROPERTIES**

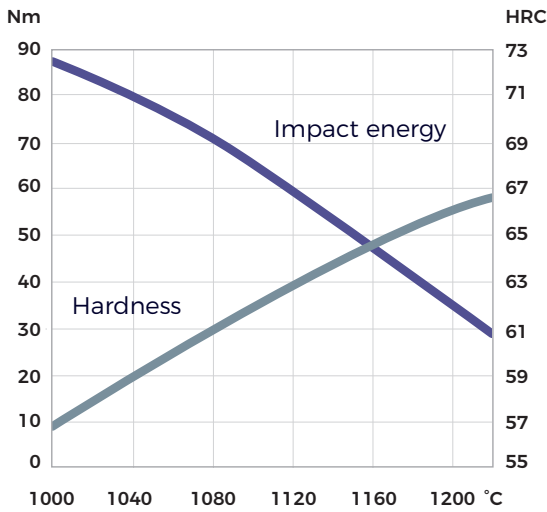
**PHYSICAL PROPERTIES**

Temperature	20 °C	400 °C	600 °C
Density g/cm <sup>3</sup> (1)	8.0	7.9	7.8
Modulus of elasticity kN/mm <sup>2</sup> (2)	240	214	192
Thermal expansion ratio per °C (2)	-	12.1x10 <sup>-6</sup>	12.7x10 <sup>-6</sup>
Thermal conductivity W/m°C (2)	24	28	27
Specific heat J/kg°C (2)	420	510	600

(1) Soft annealed

(2) Hardened 1180°C and tempered 560°C, 3 x 1 hour

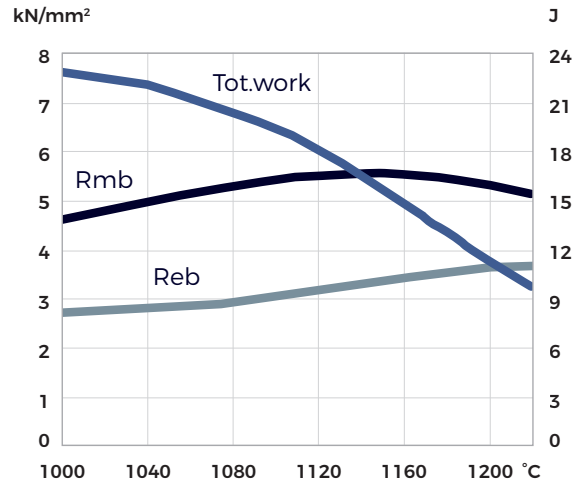
**IMPACT TOUGHNESS**



Hardening temperature in °C

Original dimension Ø 14 mm  
Tempering 3 x 1 hour at 560°C  
Unnotched test piece 7 x 10 x 55 mm

**4-POINT BEND STRENGTH**

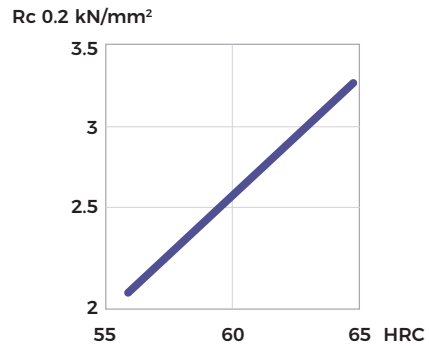


Hardening temperature in °C

Original dimension Ø 6 mm  
Tempering 3 x 1 hour at 560°C  
Dimension of test piece Ø 4.7 mm

Rmb = Ultimate bend strength in kN/mm<sup>2</sup>  
Reb = Bend yield strength in kN/mm<sup>2</sup>  
Tot. work = Total work in Nm

**COMPRESSION YIELD STRESS**



**COMPARATIVE PROPERTIES**

