

## CHEMICAL COMPOSITION

C	Cr	Mo	W	V
1.40	4.2	5.0	5.8	4.1

SAFETY DATA SHEET SDS: A

## STANDARDS

- Europe: HS 6-5-4
- Germany: 1.3361

## DELIVERY HARDNESS

- Typical soft annealed hardness is 265 HB
- Cold drawn material is typically 10-40 HB harder

## DESCRIPTION

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

## APPLICATIONS

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

## FORM SUPPLIED

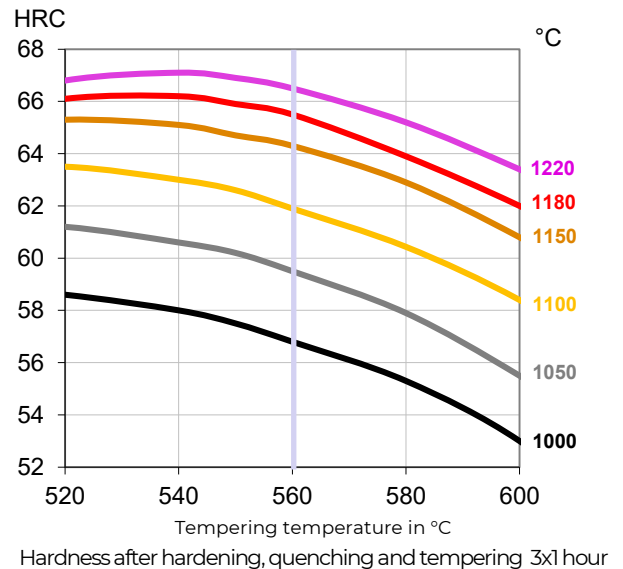
- Coils
- Flat & square bars
- Forged blanks
- Round bars

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 preheating in 2 steps at 450-500°C and 850-900°C and austenitising 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.

## GUIDELINES FOR HARDENING



## PROCESSING

ASP<sup>®</sup>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).

## 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.

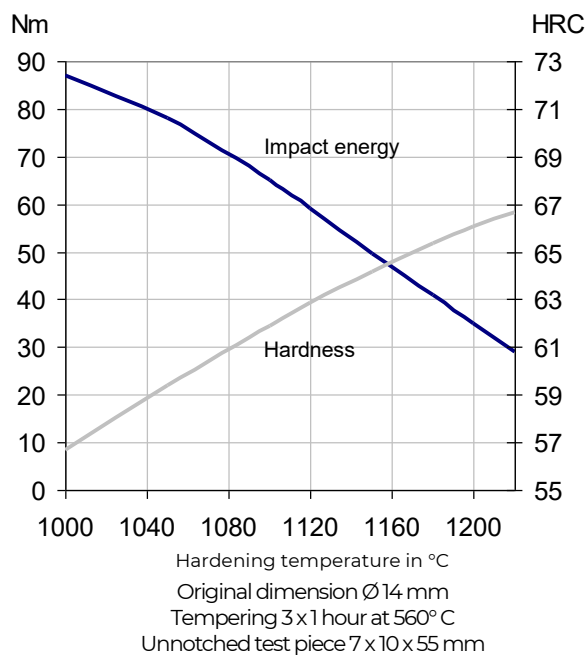
**PROPERTIES**

**PHYSICAL PROPERTIES**

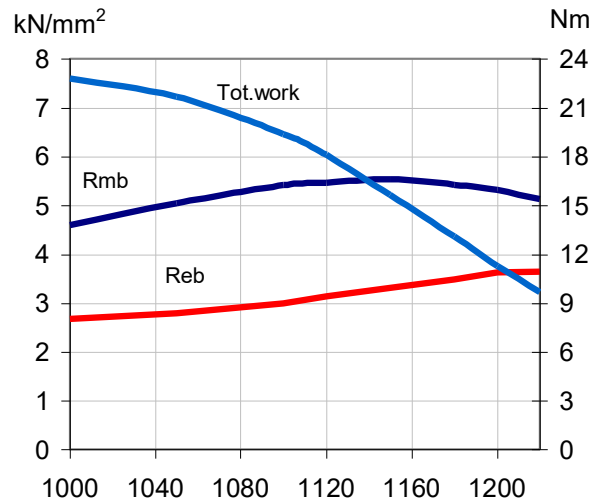
Temperature	20°C	400°C	600°C
Density g /cm <sup>3</sup> (1)	8.0	7.9	7.8
Modulus of elasticity kN/mm <sup>2</sup> (2)	240	214	192
Thermal expansion ratio per °C (2)	-	12.1x10 <sup>-6</sup>	12.7x10 <sup>-6</sup>
Thermal conductivity W/m°C (2)	24	28	27
Specific heat J/kg °C (2)	420	510	600

(1)=Soft annealed  
 (2)=Hardened 1180°C and tempered 560°C, 3x1 hour

**IMPACT TOUGHNESS**

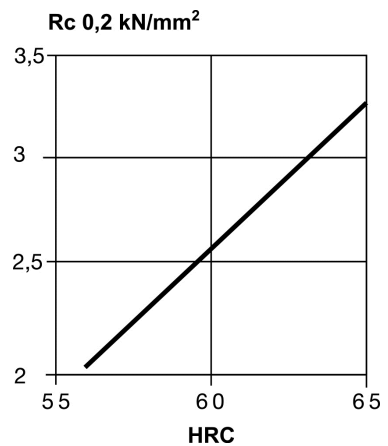


**4-POINT BEND STRENGTH**



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**

