

## CHEMICAL COMPOSITION

C	Cr	Mo	W	Co	V
2.45	5.25	1.3	-	-	9.75

SAFETY DATA SHEET SDS: A

## STANDARDS

- USA: AISI A11
- AMS6559

## DELIVERY HARDNESS

- Typical soft annealed hardness is 280 HB
- Cold drawn and cold rolled material is typically 10-40 HB harder

## DESCRIPTION

ASP®2011 is a high vanadium grade for wear applications.

## APPLICATIONS

- Knives
- Wear parts
- Cold work

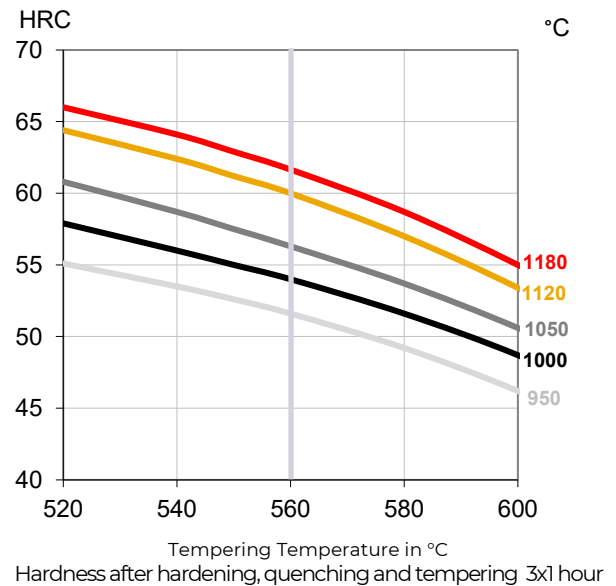
## FORM SUPPLIED

- Coils
  - Coarse Round bars
  - Flat and square bars
  - Sheets
  - Discs
  - Pieces cut from sheets
- Available surface conditions: peeled, rough machined, cold rolled, 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 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®2011 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

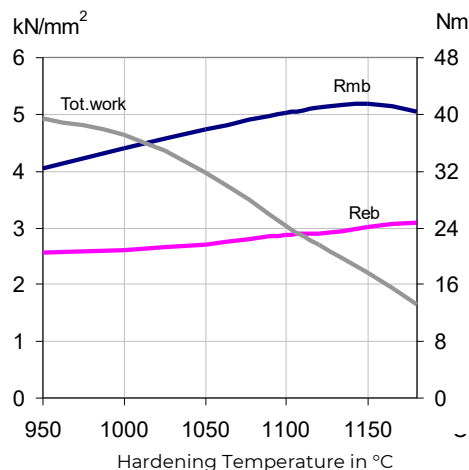
### PHYSICAL PROPERTIES

Temperature	20°C	400°C	600°C
Density g/cm <sup>3</sup> (1)	7.4	7.3	7.3
Modulus of elasticity kN/mm <sup>2</sup> (2)	220	197	177
Thermal expansion ratio per °C (2)	-	11.8x10 <sup>-6</sup>	12.3x10 <sup>-6</sup>
Thermal conductivity W/m°C (2)	20	25	26
Specific heat J/kg °C (2)	420	510	600

(1)=Soft annealed

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

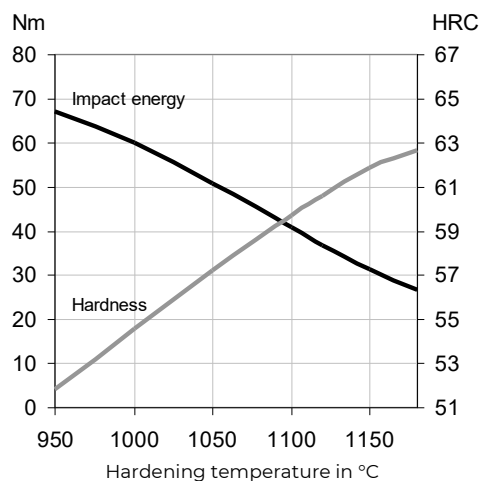
### 4-POINT BEND STRENGTH



Original dimension Ø 7.5 mm  
Tempering 3 x 1 hour at 560°C  
Dimension of test piece Ø 4.7 mm

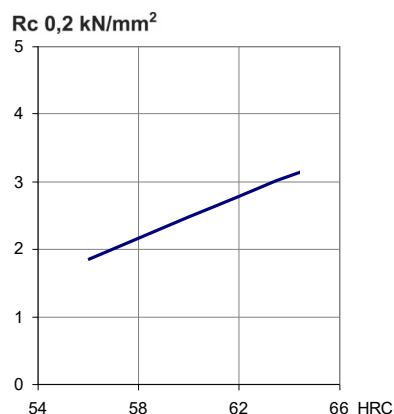
NB: High quality surface  
Rmb = Ultimate bend strength in kN/mm<sup>2</sup>  
Reb = Bend yield strength in kN/mm<sup>2</sup>  
Tot. work = Total work in Nm

### IMPACT TOUGHNESS



Original dimension 9 x 12 mm  
Tempering 3 x 1 hour at 560°C  
Unnotched test piece 7 x 10 x 55 mm

### COMPRESSION YIELD STRESS



### COMPARATIVE PROPERTIES

