ASP®2012

Powder metallurgy HSS

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CHEMICAL COMPOSITION

C	Si	Mn	Cr	Mo	W	V
0.60	1.00	0.30	4.00	2.00	2.10	1.50

STANDARDS

- Europe: HS 2-2-2
- Germany: 1.3397

DELIVERY HARDNESS

Soft annealed max. 230 HB
Cold drawn max. 300 HB

DESCRIPTION

ASP®2012 is the best in class for high toughness up to 58 HRC in cold-, warm- and hot applications.

APPLICATIONS

- Cold work tools: Powder compacting tools, cold extrusion tools, cold-heading dies, fine blanking tools
- Plastic injection moulders, broaches and injector pins
- Machine components and rolls
- Warm- and hot-work applications: extrusion dies, forging dies and punches, hot forming dies

FORM SUPPLIED

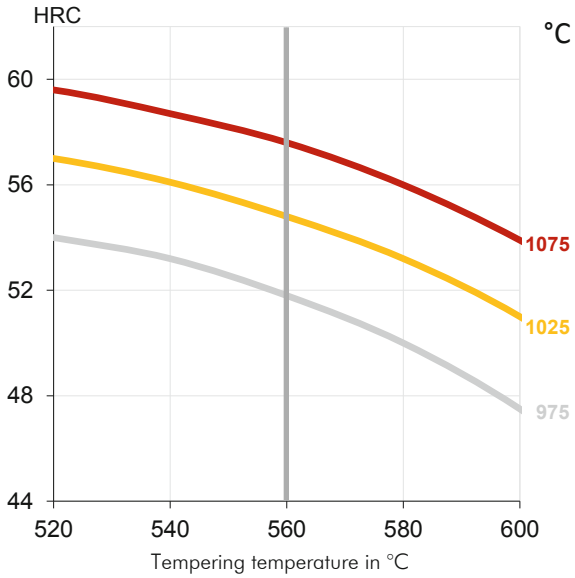
- Round bars
- Flat bars

Available surface conditions: Drawn, peeled, rough machined.

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 at a temperature suitable for chosen working hardness. Pre-heating in 2 or 3 steps depending on tool dimension-design and austenetising temperature, last step 50°C below chosen austenitising temperature. 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



Hardness after hardening, quenching and tempering 3x1 hour

PROCESSING

ASP®2012 can be worked as follows:

- Machining (grinding, turning, milling)
- Polishing
- Plastic 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 furnish advice on the choice of grinding wheels.

SURFACE TREATMENT

The steel grade is a good substrate material for PVD and CVD coating. If nitriding is requested a small zone of 2-15 µm is recommended. The steel grade can also be steam-tempered if so desired.

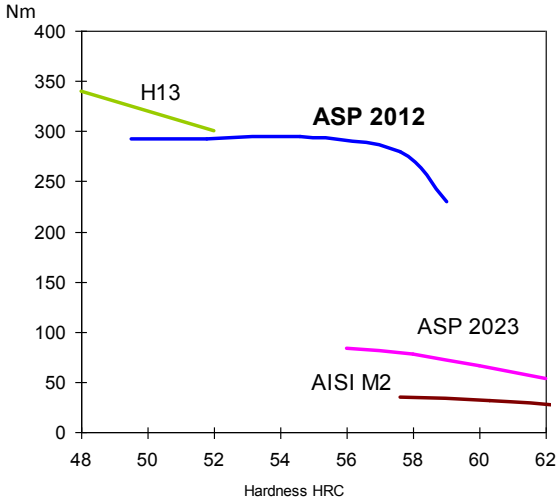
PROPERTIES

PHYSICAL PROPERTIES

Temperature	20°C	400°C	600°C
Density g /cm³ *(1)*	7.8	7.7	7.6
Modulus of elasticity kN/mm² *(2)*	220	195	175
Thermal expansion coefficient from 20°C, per °C *(2)*	-	12,1x10⁻⁶	12,7x10⁻⁶
Thermal conductivity W/m°C *(2)*	24	28	27
Specific heat J/kg °C *(2)*	420	510	600

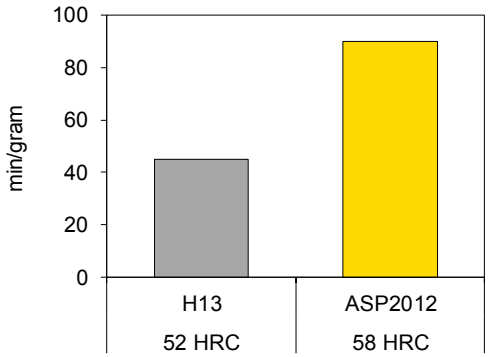
(1)=Soft annealed
(2)=Hardened 1180°C and tempered 560°C, 3x1 hour

IMPACT ENERGY



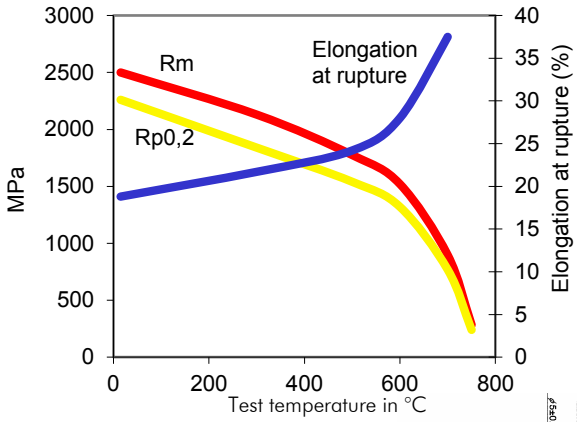
Original dimensions Ø 118 mm
Tempering 3 x 1 hour at 560° C
Unnotched test piece 7 x 10 x 55 mm

WEAR RESISTANCE

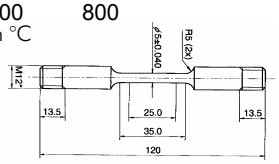


Wear resistance is measured as the time needed for removal of one-gram material from a test piece.
Technique: Pin-on-cylinder, dry SiO2-paper of grade 00, sliding rate 0,3m/s, load 9N and size of specimen 2 x 5 x 30mm.

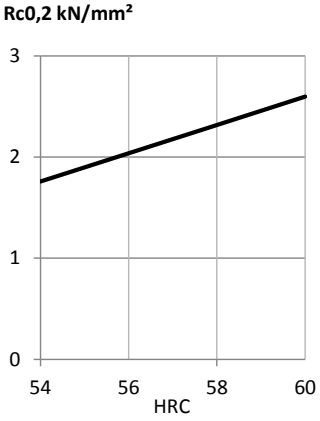
TENSILE STRENGTH



Size of blank Ø15mm
Test piece dimensions are given beside.
Hardness 58 HRC

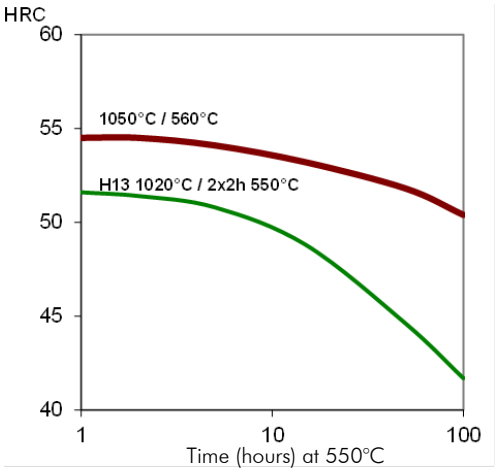


COMPRESSION YIELD STRESS

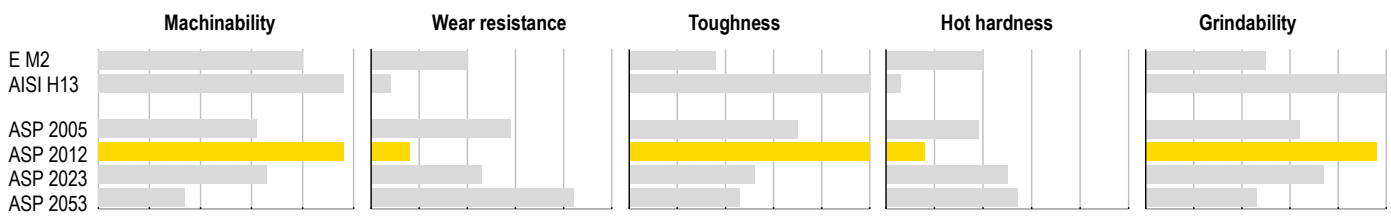


Test piece with 10 mm waist diameter

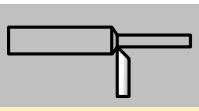
TEMPERING RESISTANCE



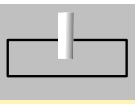
COMPARATIVE PROPERTIES



Recommendations for machining in soft annealed condition, 260-300 HB

TURNING 	CEMENTED CARBIDE		HSS
	Medium turning	Finishing turning	
Cutting speed, v_c (m/min)	190-220	220-250	21-26
Feed, f (mm/rev)	0.2–0.5	0.05-0.3	0.05-0.4
Cutting depth, a_p(mm)	2–4	0.5-2	0.5-3
Tools according to ISO	coated carbide P10-P20	coated carbide P10	coated

Use a wear resistant coated cemented carbide e.g Coromant 4015 or Seco TP 100.
Black ceramics are usually the best tools at finish turning, e.g. Coromant 650 or Feldmühle SH20.

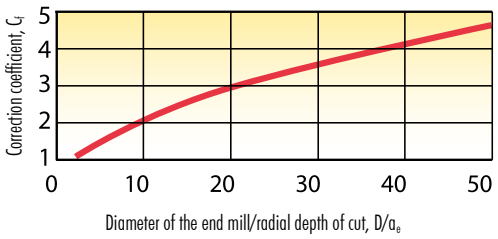
END MILLING SLOT MILLING 		DIAMETER (mm)				
		3-5	5-10	10-20	20-30	30-40
Coated HSS	Cutting speed, v_c (m/min) Feed, f_z (mm/tooth)	35-45 0.008-0.02	35-45 0.02-0.04	35-45 0.03-0.05	35-45 0.05-0.07	35-45 0.05-0.09
Coated solid cemented carbide	Cutting speed, v_c (m/min) Feed, f_z (mm/tooth)	100-120 0.006-0.02	100-120 0.01-0.03	100-120 0.02-0.05	- -	- -
Indexable carbide tips	Cutting speed, v_c (m/min) Feed, f_z (mm/tooth)	-	-	170-200 0.06-0.12	170-200 0.10-0.15	170-200 0.15-0.25
Suitable tools	-	coated carbide, K15, P25				

SIDE MILLING

The same cutting speed can be used in side milling as in slot milling. However, the feed has to be adjusted to produce an adequate chip thickness.
The diameter of the mill (D) over the radial depth of cut (a_e) is used as a parameter. Read the correction coefficient (C_f) from the diagram and multiply by the feed for slot milling from the table above.

Comments (slot and side milling)

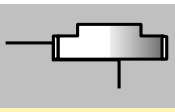
1. Coated tools are always recommended for end milling both with HSS tools and cemented carbide tools.TiCN, TiAlN or multilayer (Futura) is preferred.
2. The cutting speed must be decreased considerably if uncoated tools are used.



Example

Tool	End mill with indexable tips
Diameter of the end mill	D=40 mm
Radial depth or cut	a_e=2mm
D/a_e	40/2=20
Correction coefficient	c_f=2.8
Feed	f_z=2.8x0.17=0.48mm/tooth
Cutting speed	v_c=180m/min

FACE MILLING 	CEMENTED CARBIDE TOOL	
	Rough machining	Finishing machining
Cutting speed, v_c (m/min)	170-200	220-250
Feed, f_z (mm/tooth)	0.2–0.4	0.1-0.4
Cutting depth, a_p(mm)	2–4	1-2
Tools according to ISO	coated cemented carbide K15, P25	

SQUARE SHOULDER MILLING 	RADIAL DEPTH OF CUT, a_e		
	a_e=0.1 x D	a_e=0.5 x D	a_e=1 x D
Cutting speed, v_c (m/min)	230-250	210-240	170-220
Feed, f_z (mm/tooth)	0.3	0.2	0.15
Tools according to ISO	coated cemented carbide K15, P25		

Use a wear resistant coated cemented carbide e.g Coromant 3020 or Seco TP10.

DRILLING 		DRILL DIAMETER (mm)				
		1-5	5-10	10-20	20-30	30-40
HSS	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	12-18 0.05-0.12	12-18 0.15-0.23	12-18 0.25-0.34	12-18 0.35-0.40	12-18 0.40-0.45
Coated HSS	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	35-40 0.05-0.12	35-40 0.15-0.3	35-40 0.25-0.4	35-40 0.35-0.5	35-40 0.40-0.5
Short hole drill indexable (cemented carbide)	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	-	-	-	150-170 0.08-0.12	150-170 0.10-0.15
Solid cemented carbide	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	-	-	60 0.1-0.12	60 0.1-0.12	60 0.1-0.12
Brazed cemented carbide	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	-	-	50 0.1-0.3	50 0.1-0.3	50 0.1-0.3

TiCN or TiAlN multi layer are recommended coatings for HSS drilling.

MACHINING IN HARDENED CONDITION

ASP®2012 has been machined in hardened condition up to 58 HRC. CBN tools are recommended. Whisker reinforced ceramics (Coromant 670 or Kennametal 4300) can be used in turning, but the tool life is shorter and more difficult to predict.

