ASP®2023

Powder metallurgy HSS

zapp
Zapp Materials Engineering GmbH
TOOLING ALLOYS
Zapp-Platz 1
40880 Ratingen
Germany
Phone +49 2102 710-548
Fax + 49 2102 710-596
www.zapp.com

CHEMICAL COMPOSITION

C	Cr	Mo	W	V
1.28	4.00	5.00	6.40	3.10

STANDARDS

- Europe: HS 6-5-3
- Germany: 1.3395

DELIVERY HARDNESS

Soft annealed	max. 260 HB
Cold drawn	max. 300 HB

DESCRIPTION

ASP®2023 is a non cobalt grade for high performance cutting tools, cold work tools and rolls for cold rolling.

APPLICATIONS

- Gear cutting tools
- Broaches
- Taps
- Cold work
- Rolls
- Knives
- Plastic injection

FORM SUPPLIED

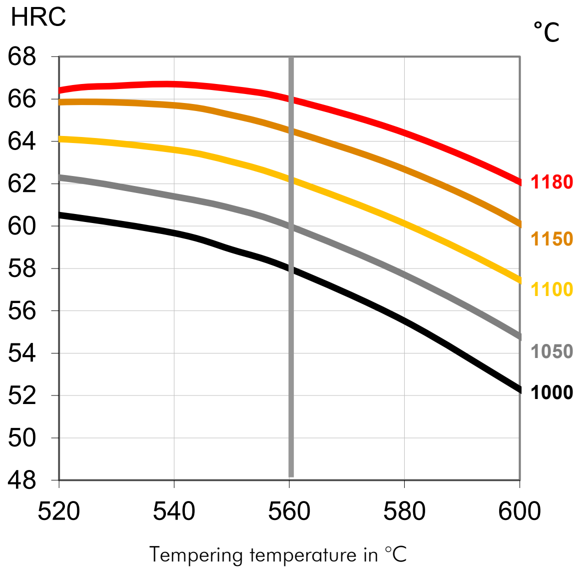
- Coils
- Round bars
- Flat & square bars
- Strips
- Sheets
- Discs

Available surface conditions: drawn, ground, 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 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®2023 can be worked as follows:

- Machining (grinding, turning, milling)
- Polishing
- Plastic forming
- Plectrical 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

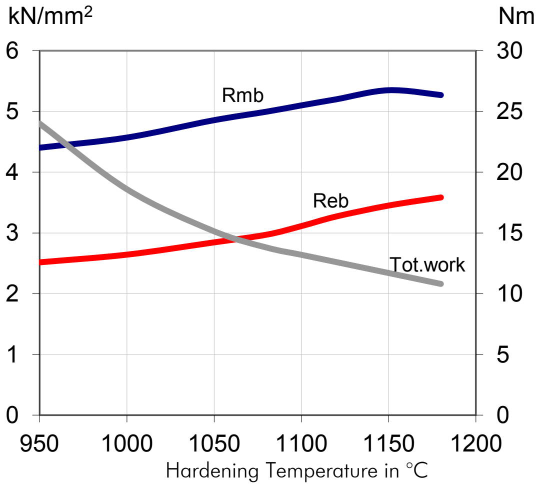
The steel grade is a good substrate material for PVD and CVD coating. If nitriding is requested a small zone of 2-15 μm is recommended. The steel grade can also be steam-tempered if so desired.

PHYSICAL PROPERTIES

Temperature	20°C	400°C	600°C
Density g /cm³ *(1)*	8.0	7.9	7.9
Modulus of elasticity kN/mm² *(2)*	230	205	184
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

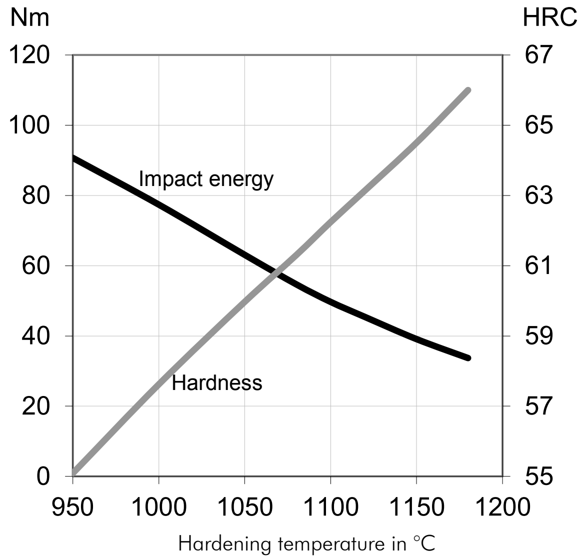
4-POINT BEND STRENGTH



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

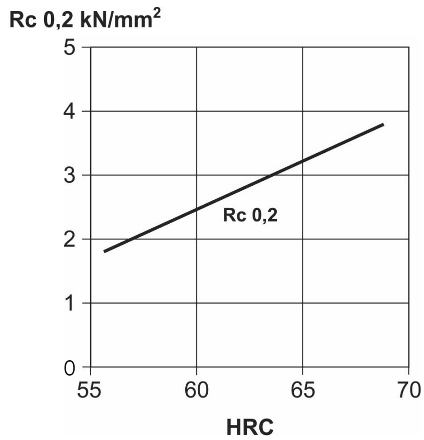
Rmb = Ultimate bend strength in kN/mm²
Reb = Bend yield strength in kN/mm²
Tot. work = Total work in Nm

IMPACT ENERGY



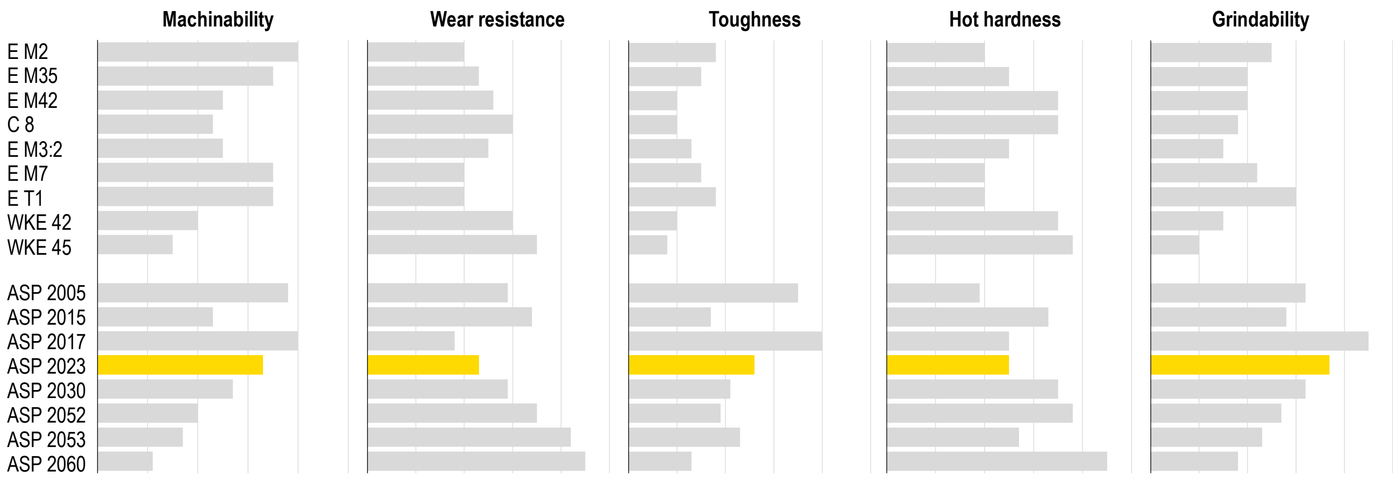
Original dimensions 9 x 12 mm
Tempering 3 x 1 hour at 560° C
Unnotched test piece 7 x 10 x 55 mm

COMPRESSION YIELD STRESS

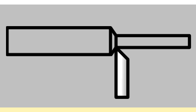


Test piece with 10 mm waist diameter

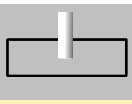
COMPARATIVE PROPERTIES



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

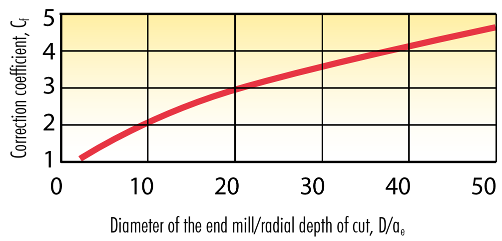
TURNING 	CEMENTED CARBIDE		HSS
	Medium turning	Finishing turning	
Cutting speed, v_c (m/min)	110-160	160-210	12-20
Feed, f (mm/rev)	0.2–0.4	0.05-0.2	0.05-0.3
Cutting depth, a_p(mm)	2–4	0.5-2	0.5-3
Tools according to ISO	coated carbide P10-P20	coated carbide P10	coated

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)				
		1-5	5-10	10-20	20-30	30-40
Coated HSS	Cutting speed, v_c (m/min) Feed, f_z (mm/tooth)	16-18 0.015-0.030	16-18 0.03-0.04	16-18 0.04-0.05	16-18 0.05-0.06	16-18 0.07-0.08
Coated solid cemented carbide	Cutting speed, v_c (m/min) Feed, f_z (mm/tooth)	40-45 0.006-0.01	40-45 0.01-0.02	40-45 0.02-0.04	- -	- -
Indexable carbide tips	Cutting speed, v_c (m/min) Feed, f_z (mm/tooth)	-	-	90-120 0.06-0.10	90-120 0.10-0.12	90-120 0.15-0.20
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=2.8x0.20=0.56mm/tooth
Cutting speed	v_c=100m/min

FACE MILLING	CEMENTED CARBIDE TOOL Rough machining	Finishing machining
Cutting speed, v_c (m/min)	110-120	130-140
Feed, f_z (mm/tooth)	0.2–0.3	0.1-0.2
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)	120-150	110-140	100-130
Feed, f_z (mm/tooth)	0.25	0.15	0.10
Tools according to ISO	coated cemented carbide K15, P25		

Use a wear resistant coated cemented carbide e.g Coromant 3150 or Seco T15M.

DRILLING		DRILL DIAMETER (mm) 3-5	5-10	10-20	20-30	30-40
HSS	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	12-14 0.05-0.15	12-14 0.15-0.25	12-14 0.25-0.35	12-14 0.35-0.40	12-14 0.40-0.45
Coated HSS	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	15-20 0.05-0.15	15-20 0.15-0.25	15-20 0.25-0.35	15-20 0.35-0.40	15-20 0.40-0.45
Short hole drill indexable (cemented carbide)	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	-	-	-	120-150 0.08-0.12	120-150 0.10-0.14
Solid cemented carbide	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	-	-	45-50 0.1-0.15	45-50 0.1-0.15	45-50 0.1-0.15
Brazed cemented carbide	Cutting speed, v_c (m/min) Feed, f_z (mm/rev)	-	-	35-40 0.1-0.2	35-40 0.1-0.2	35-40 0.2-0.3

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

Machining in hardened condition

ASP®2023 has been machined in hardened condition up to 66 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.