UDDEHOLM ALVAR

UDDEHOLM

Classified according to EU Directive 1999/45/EC
For further information see our “Material Safety Data Sheets”.

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The latest revised edition of this brochure is the English version, which is always published on our web site www.uddeholm.com

SS-EN ISO 9001
SS-EN ISO 14001

General

Uddeholm Alvar is a chromium-nickel-molybdenum-vanadium alloyed steel which is characterized by:

- Good toughness
- Good resistance to high thermal stresses
- Good stability in hardening
- Good through-hardening properties

Typical analysis %	C	Si	Mn	Cr	Ni	Mo	V
	0.45	0.7	0.8	1.8	0.5	0.3	0.2
Standard specification	W.-Nr. 1.2329, DIN 46 CrSiMoV7						
Delivery condition	Soft annealed to max. 250 HB.						
Colour code	Red/black						

Applications

Uddeholm Alvar is ideally suited for support parts for extrusion tooling, e.g. wedge blocks and bolsters.

Properties

Physical data

Hardened and tempered to hardness 40 HRC. Data at room and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density kg/m³ lbs/in³	 7 780 0.281	 7 730 0.279	 7 670 0.277
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	 – –	 12.9 x 10^{-6} 7.1 x 10^{-6}	 13.6 x 10^{-6} 7.5 x 10^{-6}
Modulus of elasticity N/mm² psi	 205 000 29.7 x 10^{6}	 195 000 28.3 x 10^{6}	 180 000 26.1 x 10^{6}
Thermal conductivity* W/m°C Btu in(ft²h°F)	 30 211	 31 218	 30 211

* Measured by the Laser Flash method

Heat treatment

Soft annealing

Protect the steel and heat through to 780°C (1435°F). Then cool in the furnace at 15°C (25°F) per hour to 650°C (1200°F), then freely in air.

Stress relieving

After rough machining the tool should be heated through to 650°C (1200°F), holding time 2 hours. Cool slowly to 500°C (930°F), then freely in air.

Hardening

Pre-heating temperature: 600–700°C (1110–1290°F).
Austenitizing temperature: 880–920°C (1615–1690°F) normally 900°C (1650°F).
Soaking time 30 minutes. Soaking time = time at hardening temperature after the tool is fully heated through.

Protect the part against decarburization and oxidation during hardening.

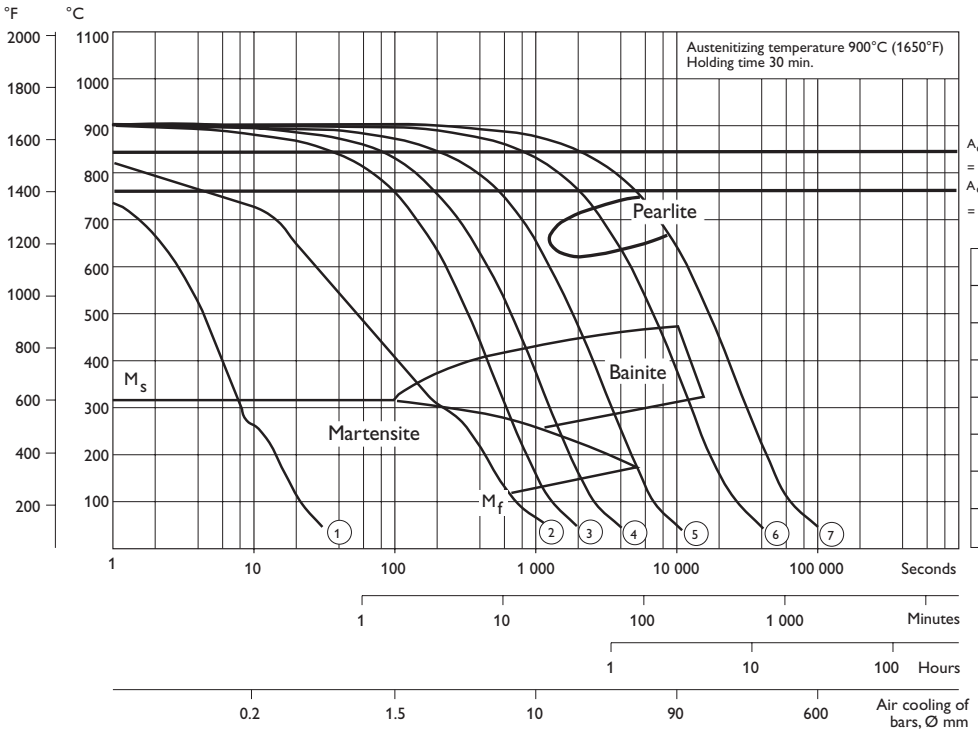
Quenching media

- Air blast/vacuum
- Martempering bath. Temperature 200–250°C (390–480°F) for max. 15 minutes, then cooling in air
- Warm oil

Note: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

CCT GRAPH

Austenitizing temperature 900°C (1650°F). Holding time 30 minutes.

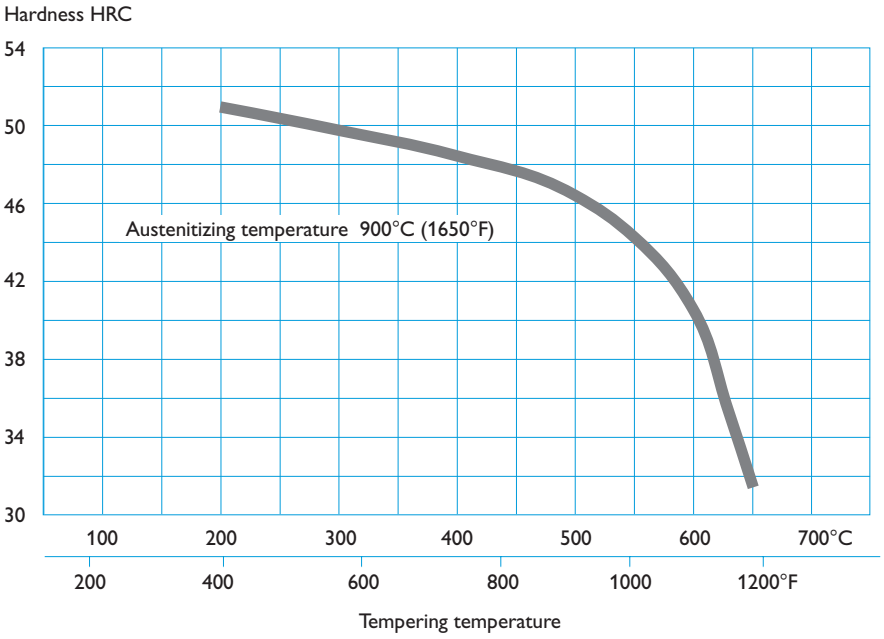


Cooling Curve No.	Hardness HV 10	$T_{800-500}$ (sec)
1	698	4
2	649	80
3	649	290
4	483	580
5	405	1390
6	357	5220
7	243	13900

Tempering

Choose the tempering temperature according to the hardness required by reference to the tempering graph below. Temper twice with intermediate cooling to room temperature. Lowest tempering temperature 180°C (360°F). Holding time at temperature minimum 2 hours.

TEMPERING GRAPH



Quenching speed $T_{800-500}$ °C/min.	Quenching speed $T_{800-500}$ °F/min.	Hardness HV10
4500	8100	698
225	405	649
62	112	649
31	56	483
13	23.5	405
3.5	6.3	357
1.3	2.3	243

The curve represents a quenching speed of 60°/min. (140°F/min.) Tempering 2+2h.

Machining recommendations

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions. More information can be found in the Uddeholm publication "Cutting data recommendation".

Condition: Soft annealed to max. 250 HB

Turning

Cutting data parameter	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min.	160–210	210–260	20–25
f.p.m.	525–690	690–855	66–82
Feed (f), mm/r	0.2–0.4	0.05–0.2	0.05–0.3
i.p.r.	0.008–0.016	0.002–0.008	0.002–0.01
Depth of cut (a_p) mm	2–4	0.5–2	0.5–3
inch	0.08–0.16	0.02–0.08	0.02–0.12
Carbide designation, ISO	P20–P30	P10	–
US	C6–C5	C7	
	Coated carbide	Coated carbide or cermet	

Milling

FACE AND SQUARE SHOULDER MILLING

Cutting data parameter	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_c) m/min.	170–250	250–290
f.p.m.	560–820	820–950
Feed (f_z) mm/tooth	0.2–0.4	0.1–0.2
inch/tooth	0.008–0.016	0.004–0.008
Depth of cut (a_p) mm	2–5	–2
inch	0.08–0.20	–0.08
Carbide designation ISO	P20–P40	P10–P20
US	C6–C5	C6–C7
	Coated carbide	Coated carbide or cermet

END MILLING

Cutting data parameter	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_c) m/min.	150–190	160–220	25–30[1]
f.p.m.	490–625	525–720	82–98[1]
Feed (f_z) mm/tooth	0.006–0.20[2]	0.06–0.20[2]	0.01–0.35[2]
inch/tooth	0.0002–0.008[2]	0.002–0.008[2]	0.0004–0.014[2]
Carbide designation ISO	K10, P40	P15–P40	–
US	C3, C5	C6–C5	

[1]For coated HSS end mill v_c = 45–50 m/min. (148– 164 f.p.m)
[2]Depending on radial depth of cut and cutter diameter

Drilling

HIGH SPEED STEEL TWIST DRILL

Drill diameter Ø		Cutting speed (v_c)		Feed (f)	
mm	inch	m/min.	f.p.m.	mm/r	i.p.r.
–5	–3/16	15–17*	49–56*	0.05–0.10	0.002–0.004
5–10	3/16–3/8	15–17*	49–56*	0.10–0.20	0.004–0.008
10–15	3/8–5/8	15–17*	49–56*	0.20–0.25	0.008–0.010
15–20	5/8–3/4	15–17*	49–56*	0.25–0.30	0.010–0.012

* For coated HSS drill v_c = 26–28 m/min. (85–92 f.p.m.)

CARBIDE DRILL

Cutting data parameter	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed (v_c) m/min.	200–220	110–140	70–90
f.p.m.	656–722	360–460	230–295
Feed (f) mm/r	0.05–0.10[2]	0.10–0.35[2]	0.15–0.40[2]
i.p.r.	0.002–0.004[2]	0.004–0.014[2]	0.006–0.016[2]

[1]Drill with replaceable or brazed carbide tip
[2]Depending on drill diameter

Grinding

A general grinding wheel recommendation is given below. More detailed information can be found in the Uddeholm publication "Grinding of Tool Steel".

Type of grinding	Soft annealed condition	Hardened condition
Face grinding straight wheel	A 46 HV	A 46 HV
Face grinding segments	A 24 GV	A 36 GV
Cylindrical grinding	A 60 KV	A 60 KV
Internal grinding	A 46 JV	A 60 JV
Profile grinding	A 100 KV	A 120 JV

Electrical-discharge machining

If spark-erosion is performed in the hardened and tempered condition, the white re-cast layer should be removed mechanically e.g. by grinding or stoning. The tool should then be given an additional temper at approx. 25°C (50°F) below the previous tempering temperature.

More information is given in the Uddeholm brochure "EDM of Tool Steel".

Nitriding

Nitriding will give a hard surface layer which is very resistant to wear and erosion.

Welding

Welding of tool steel can be performed with good results if proper precautions are taken regarding elevated temperature, joint preparation, choice of consumables and welding procedure.

Welding method	TIG	MMA
Working temperature	225–275°C 430–520°F	225–275°C 430–520°F
Filler metals	UTP A 73 G4 ESAB OK TIG ROD 13.22	UTP 73 G4 ESAB OK 83.28
Hardness after welding	340–390 HB	340–390 HB

Stress relieve large repairs.

More detailed information can be found in the Uddeholm brochure "Welding of Tool Steel".

Further information

Please contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steel.

Network of excellence

UDDEHOLM is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. ASSAB is our wholly-owned subsidiary and exclusive sales channel, representing Uddeholm in various parts of the world. Together we secure our position as the world's leading supplier of tooling materials.

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For more information, please visit www.uddeholm.com, www.assab.com or your local website.

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