ALVAR 14

Hot work tool steel

COLD WORK | PLASTIC MOULDING | HOT WORK | HIGH PERFORMANCE STEEL

UDDEHOLM

General

Alvar 14 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 0,55	Si 0,3	Mn 0,7	Cr 1,1	Ni 1,7	Mo 0,5	V 0,1
Standard specification	W.-Nr. 1.2714, DIN 56 NiCrMoV7						
Delivery condition	1. Soft annealed to max. 250 HB. 2. Hardened and tempered to 330–400 HB (36–43 HRC; 1100–1350 N/mm^2).						
Colour code	White/black						

Applications

Alvar 14 is ideally suited for hot working tools such as:

- Support parts for extrusion tooling, e.g. backers, bolsters
- Hot forging tools
- Die for tin, lead and zinc alloys
- Tools for hot shearing.

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/m^3 lbs/in^3	 7 800 0,281	 7 740 0,279	 7 680 0,277
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	 – –	 13,1 x 10^{-6} 7,3 x 10^{-6}	 13,9 x 10^{-6} 7,7 x 10^{-6}
Modulus of elasticity N/mm^2 psi	 215 000 31,2 x 10^6	 202 000 29,3 x 10^6	 185 000 26,8 x 10^6
Thermal conductivity W/m°C Btu in(ft^{2}h°F)	 36 254	 36,5 258	 36,8 260

Heat treatment

SOFT ANNEALING

Protect the steel and heat through to 700°C (1290°F). Then cool in the furnace at 10°C (20°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: 830–870°C (1525–1600°F) in oil, 860–900°C (1580–1650°F) in air.

Temperature °C	Temperature °F	Soaking time* minutes	Hardness before tempering
850	1560	30	approx. 58 HRC (Oil)
880	1620	30	approx. 56 HRC (Air)

** Soaking time = time at hardening temperature after the tool is fully heated through.*

Protect the part against decarburization and oxidation during hardening.

QUENCHING MEDIA

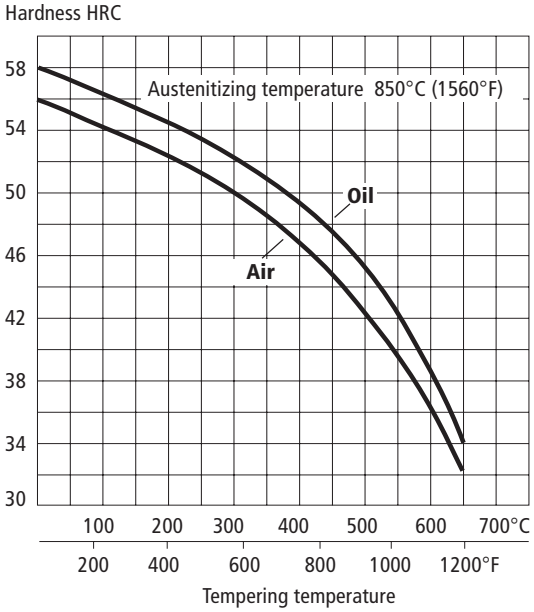
- Air blast/vacuum
- Martempering bath. Temperature 250°C (480°F) for max. 15 minutes, then cooling in air
- Warm oil.

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

TEMPERING

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

Tempering graph



NITRIDING

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

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 Coated carbide	C7 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 Coated carbide	C6–C7 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 mm	inch	Cutting speed (v_c) m/min.	f.p.m.	Feed (f) 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	Brazed carbide[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 internal cooling channels and brazed tip.
[2] Depending on drill diameter.

Condition: Prehardened to 380 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.	90–130	130–180	8–13
f.p.m.	295–426	426–590	26–43
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	0,002–0,012
Depth of cut (a_p) mm	2–4	–2	–2
inch	0,08–0,16	–0,08	–0,12
Carbide designation, ISO	P20–P30	P10	–
US	C6–C5 Coated carbide	C7 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.	70–140	140–170
f.p.m.	230–460	460–560
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	0,08–0,2	–0,08
Carbide designation ISO	P20–P40	P10–P20
US	C6–C5 Coated carbide	C6–C7 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.	60–100	60–100	8–12[1]
f.p.m.	200–330	200–330	26–40[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 = 20–25 m/min. (66–82 f.p.m).*
[2] *Depending on radial depth of cut and cutter diameter.*

DRILLING

High speed steel twist drill

Drill diameter Ø mm	inch	Cutting speed (v_c) m/min.	f.p.m.	Feed (f) mm/r	i.p.r.
–5	–3/16	10–12*	33–39*	0,05–0,10	0,002–0,004
5–10	3/16–3/8	10–12*	33–39*	0,10–0,20	0,004–0,008
10–15	3/8–5/8	10–12*	33–39*	0,20–0,25	0,008–0,010
15–20	5/8–3/4	10–12*	33–39*	0,25–0,30	0,010–0,012

** For coated HSS drill v_c =16–18 m/min. (53–59 f.p.m.).*

Carbide drill

Cutting data parameter	Type of drill		
	Indexable insert	Solid carbide	Brazed carbide[1]
Cutting speed (v_c) m/min.	150–170	100–130	50–70
f.p.m.	492–558	328–426	164–230
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 internal cooling channels and brazed 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	Wheel recommendation	
	Soft annealed condition	Prehardened 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".

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 435–525°F	225–275°C 435–525°F
Filler metals	UTPA 73G4 ESAB OK Tigrod 13.22	UTP 73G4 ESAB OK 83.28
Hardness after welding	350–400 HB	340–390 HB

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 steels.

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