

ALVAR 14

Hot work tool steel

COLD WORK

PLASTIC MOULDING

HOT WORK

HIGH PERFORMANCE STEEL



This information is based on our present state of knowledge and is intended to provide general notes on our products and their uses. It should not therefore be construed as a warranty of specific properties of the products described or a warranty for fitness for a particular purpose.

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

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

Protect the part against decarburization and oxidation during hardening.

QUENCHING MEDIA

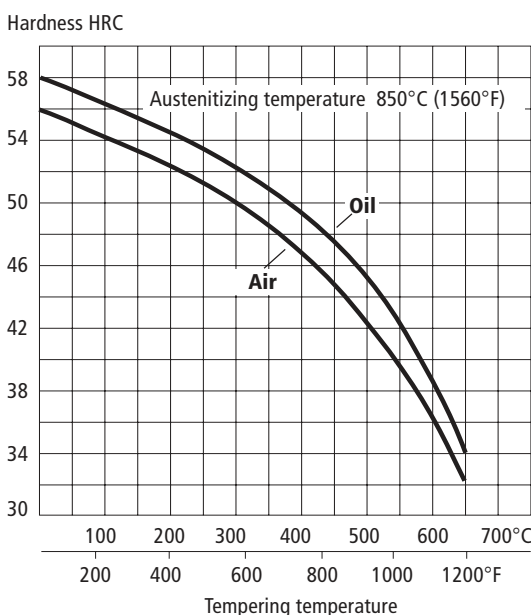
- Air blast/vacuum
- Martempering bath. Temperature 250°C (480°F) for max. 15 minutes, then cooling in air
- Warm oil.

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 Fine turning |
|---|------------------------------------|---------------------------------------|---|
| | Rough turning | Fine turning | |
| Cutting speed (v_c) m/min. f.p.m. | 160–210 525–690 | 210–260 690–855 | 20–25 66–82 |
| Feed (f), mm/r i.p.r. | 0,2–0,4 0,008–0,016 | 0,05–0,2 0,002–0,008 | 0,05–0,3 0,002–0,01 |
| Depth of cut (a_p) mm inch | 2–4 0,08–0,16 | 0,5–2 0,02–0,08 | 0,5–3 0,02–0,12 |
| Carbide designation, ISO US | P20–P30 C6–C5 Coated carbide | P10 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. f.p.m. | 170–250 560–820 | 250–290 820–950 |
| Feed (f_z) mm/tooth inch/tooth | 0,2–0,4 0,008–0,016 | 0,1–0,2 0,004–0,008 |
| Depth of cut (a_p) mm inch | 2–5 0,08–0,20 | –2 –0,08 |
| Carbide designation ISO US | P20–P40 C6–C5 Coated carbide | P10–P20 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. f.p.m. | 150–190 490–625 | 160–220 525–720 | 25–30 ¹⁾ 82–98 ¹⁾ |
| Feed (f_z) mm/tooth inch/tooth | 0,006–0,20 ²⁾ 0,0002–0,008 ²⁾ | 0,06–0,20 ²⁾ 0,002–0,008 ²⁾ | 0,01–0,35 ²⁾ 0,0004–0,014 ²⁾ |
| Carbide designation ISO US | K10, P40 C3, C5 | P15–P40 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 \emptyset mm inch | Cutting speed (v_c) m/min. f.p.m. | | Feed (f) mm/r i.p.r. | | |
|--|---|---|--------------------------------------|--------------------------------------|--|
| | –5 5–10 10–15 15–20 | –3/16 3/16–3/8 3/8–5/8 5/8–3/4 | 15–17* 15–17* 15–17* 15–17* | 49–56* 49–56* 49–56* 49–56* | 0,05–0,10 0,10–0,20 0,20–0,25 0,25–0,30 |

* 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. f.p.m. | 200–220 656–722 | 110–140 360–460 | 70–90 230–295 |
| Feed (f) mm/r i.p.r. | 0,05–0,10 ²⁾ 0,002–0,004 ²⁾ | 0,10–0,35 ²⁾ 0,004–0,014 ²⁾ | 0,15–0,40 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 Fine turning |
|---|------------------------------------|---------------------------------------|---|
| | Rough turning | Fine turning | |
| Cutting speed (v_c) m/min. f.p.m. | 90–130 295–426 | 130–180 426–590 | 8–13 26–43 |
| Feed (f) mm/r i.p.r. | 0,2–0,4 0,008–0,016 | 0,05–0,2 0,002–0,008 | 0,05–0,3 0,002–0,012 |
| Depth of cut (a_p) mm inch | 2–4 0,08–0,16 | –2 –0,08 | –2 –0,12 |
| Carbide designation, ISO US | P20–P30 C6–C5 Coated carbide | P10 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. f.p.m. | 70–140 230–460 | 140–170 460–560 |
| Feed (f_z), mm/tooth inch/tooth | 0,2–0,4 0,008–0,016 | 0,1–0,2 0,004–0,008 |
| Depth of cut (a_p) mm inch | 2–5 0,08–0,2 | –2 –0,08 |
| Carbide designation ISO US | P20–P40 C6–C5 Coated carbide | P10–P20 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. f.p.m. | 60–100 200–330 | 60–100 200–330 | 8–12 ¹⁾ 26–40 ¹⁾ |
| Feed (f_z) mm/tooth inch/tooth | 0,006–0,20 ²⁾ 0,0002–0,008 ²⁾ | 0,06–0,20 ²⁾ 0,002–0,008 ²⁾ | 0,01–0,35 ²⁾ 0,0004–0,014 ²⁾ |
| Carbide designation ISO US | K10, P40 C3, C5 | P15–P40 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) | | Feed (f) | |
|------------------------|----------|-------------------------|--------|-----------|-------------|
| | | m/min. | f.p.m. | 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. f.p.m. | 150–170 492–558 | 100–130 328–426 | 50–70 164–230 |
| Feed (f) mm/r i.p.r. | 0,05–0,10 ²⁾ 0,002–0,004 ²⁾ | 0,10–0,35 ²⁾ 0,004–0,014 ²⁾ | 0,15–0,40 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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