Uddeholm
Sverker® 21

UDDEHOLM
a voestalpine company

Uddeholm Sverker® 21

THE BACKBONE OF COLD WORK TOOLING

The steel grade was developed around 1930 and is still going strong. Ledeburitic 12 % Cr-steel are still the most commonly used tool steel for cold work tooling all over the world.

PROPERTIES PROFILE

Uddeholm Sverker 21 is a tool steel with very good abrasive wear resistance but with rather limited cracking resistance. Being the bulk grade for cold work applications there are many advantages such as well established know-how concerning all types of treatments and tool processing. The risk with the popularity is, however, that the grade by routine is used in applications where the properties profile not is entirely appropriate. In such cases normally there are better alternatives like Uddeholm Sleipner, Uddeholm Caldie or Uddeholm Vanadis 4 Extra.

APPLICATIONS

The properties profile of Uddeholm Sverker 21 combine to give a steel suitable for the manufacture of medium run tooling for applications where abrasive wear is dominant and the risk of chipping or cracking is not so high, e.g. for blanking and forming of thinner, harder work materials.

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

Edition 13, 04.2019

CERTIFIED
ISO 9001 · OHSAS 18001
ISO 14001 · ISO 50001

GENERAL

Uddeholm Sverker 21 is a high-carbon, high-chromium tool steel alloyed with molybdenum and vanadium characterized by:

- High wear resistance
- High compressive strength
- Good through-hardening properties
- High stability in hardening
- Good resistance to tempering-back

Typical analysis	C 1.55	Si 0.3	Mn 0.4	Cr 11.3	Mo 0.8	V 0.8
Standard specification	AISI D2, W.-Nr. 1.2379					
Delivery condition	Soft annealed to approx. 210 HB					
Colour code	Yellow/white					

APPLICATIONS

Uddeholm Sverker 21 is recommended for tools requiring very high wear resistance, combined with moderate toughness (shock-resistance). In addition to the applications listed in the product information brochure for Uddeholm Sverker 3, it is used when cutting thicker, harder materials; when forming with tools subjected to bending stresses and where high impact loads are involved.

Uddeholm Sverker 21 can be supplied in various finishes, including the hot-rolled, pre-machined and fine machined condition. It is also available in the form of hollow bar and rings.

Cutting	Material thickness	Material Hardness (HB) <180 HRC	Material Hardness (HB) >180 HRC
Tools for: Blanking, fine-blanking, punching, cropping, shearing, trimming, clipping	<3 mm (1/8”) 3–6 mm (1/8–1/4”)	60–62 58–60	58–60 54–56
Short, cold shears. Shredding knives for waste plastics. Granulator knives			56–60
Circular shears			58–60
Clipping, trimming tools for forgings		Hot Cold	58–60 56–58
Wood milling cutters, reamers, broaches			58–60

Forming	HRC
Tools for: Bending, forming, deep-drawing, rim-rolling, spinning and flow-forming	56–62
Coining dies	56–60
Cold extrusion dies	58–60
Punches	56–60
Tube- and section forming rolls; plain rolls	58–62
Tools for powder compaction	58–62
Dies for moulding of: Ceramics, bricks, tiles, grinding wheels, tablets, abrasive plastics	58–62
Thread-rolling dies	58–62
Cold-heading tools	56–60
Crushing hammers	56–60
Swaging tools	56–60
Mandrels for cold drawing of tubes	54–60
Gauges, measuring tools, guide rails, bushes, sleeves, knurling tools, sandblast nozzles	58–62

PROPERTIES

PHYSICAL DATA

Hardened and tempered to 62 HRC. Data at ambient temperature and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density, kg/m³ lbs/in³	7 700 0,277	7 650 0,276	7 600 0,275
Coefficient of thermal expansion – at low temperature tempering per °C from 20°C per °F from 68°F	– –	12.3×10^{-6} 6.8×10^{-6}	– –
– at high temperature tempering per °C from 20°C per °F from 68°F	– –	11.2×10^{-6} 6.2×10^{-6}	12×10^{-6} 6.7×10^{-6}
Thermal conductivity W/m °C Btu in/ft² h °F	20,0 139	21,0 146	23,0 159
Modulus of elasticity MPa ksi	210 000 30 450	200 000 29 000	180 000 26 100
Specific heat J/kg °C Btu/lb°F	460 0.110	– –	– –

COMPRESSIVE STRENGTH

The figures are to be considered as approximate.

Hardness HRC	Compressive yield strength, Rc0,2 MPa	Compressive yield strength, Rc0,2 ksi
62	2200	319
60	2150	312
55	1900	276
50	1650	239

HEAT TREATMENT

SOFT ANNEALING

Protect the steel and heat through to 850°C (1560°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

Preheating temperature: 650–750°C (1110–1290°F).

Austenitizing temperature: 990–1080°C (1810–1980°F) but usually 1000–1040°C (1830–1905°F).

Temperature °C	°F	Soaking* time minutes	Hardness before tempering
990	1815	60	approx. 63 HRC
1010	1850	45	approx. 64 HRC
1030	1885	30	approx. 65 HRC
1080	1975	30	approx. 64 HRC

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

Protect the part against decarburization and oxidation during hardening.

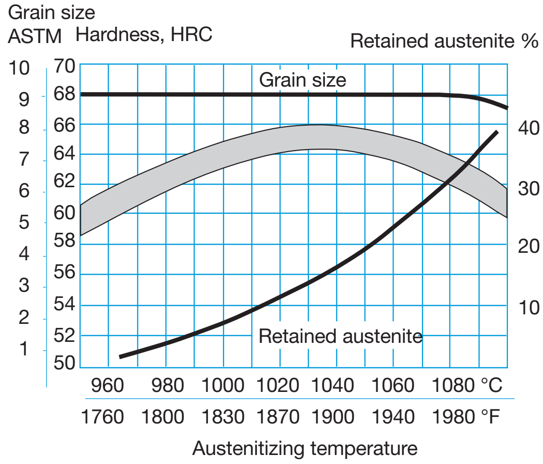
QUENCHING MEDIA

- Oil (Only very simple geometries)
- Vacuum (high speed gas)
- Forced air/gas
- Martempering bath or fluidized bed at 180–500°C (360–930°F), then cooling in air

Note: Temper the tool as soon as its temzperature reaches 50–70°C (120–160°F). Uddeholm Sverker 21 hardens through in all standard sizes.

The tempering curves are obtained after heat treatment ▶ of samples with a size of 15 x 15 x 40 mm, cooling in forced air. Lower hardness can be expected after heat treatment of tools and dies due to factors like actual tool size and heat treatment parameters.

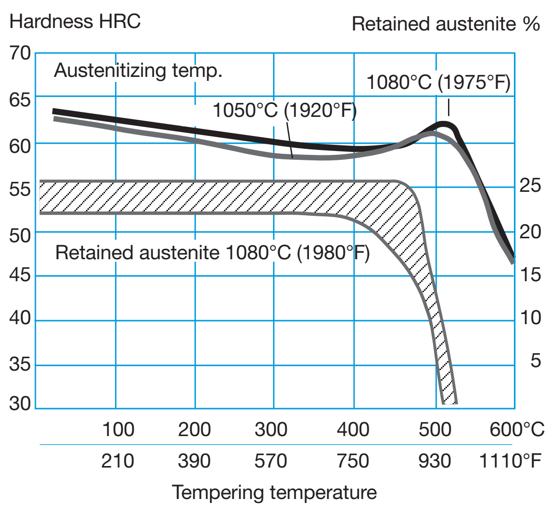
HARDNESS AS A FUNCTION OF AUSTENITIZING TEMPERATURE

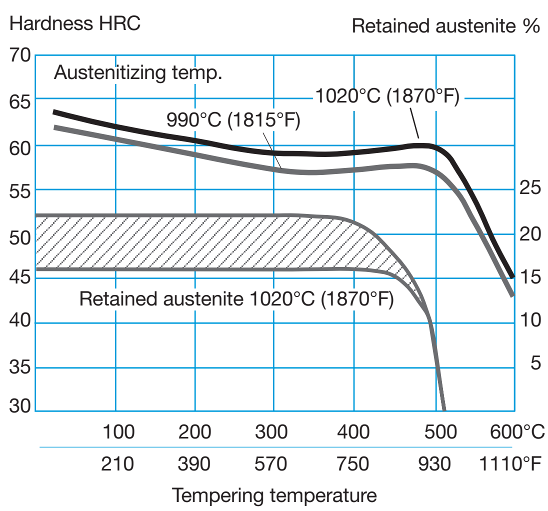


TEMPERING

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

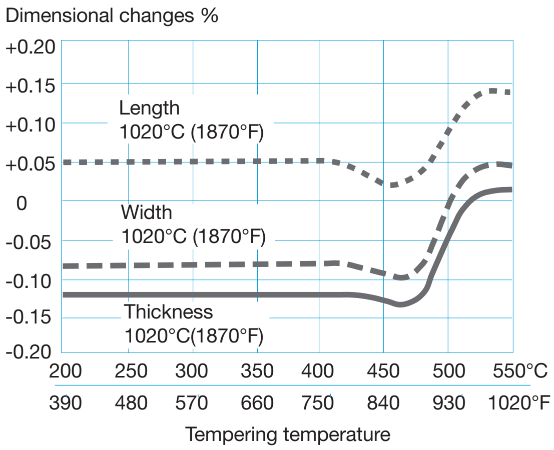




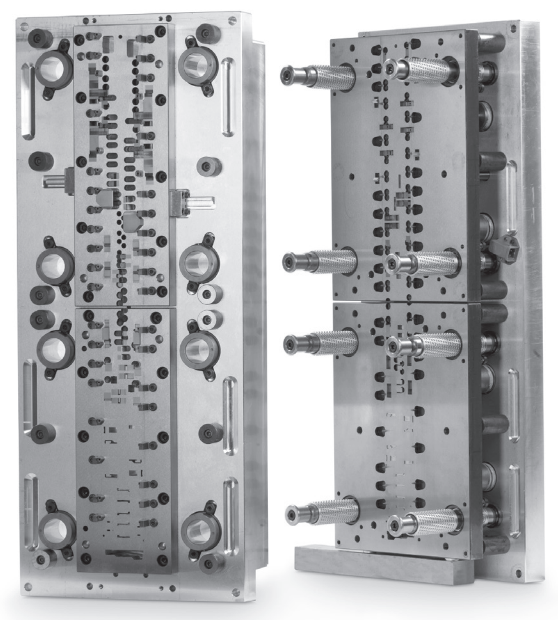
DIMENSIONAL CHANGES AFTER HARDENING AND TEMPERING

Heat treatment: Austenitizing temperature 1020°C (1870°F), 30 minutes, cooling in vacuum equipment with 2 bar overpressure. Tempering at various temperatures 2 x 2 h.

Sample, 80 x 80 x 80 mm.



Note: Recommended machining allowance 0.15%.



Progressive tool.

SUB-ZERO TREATMENT

Pieces requiring maximum dimensional stability should be sub-zero treated, as volume changes may occur in the course of time. This applies, for example, to measuring tools like gauges and certain structural components.

Immediately after quenching the piece should be sub-zero treated to between -70 and -80°C (-95 to -110°F), soaking time 3–4 hours followed by tempering. Sub-zero treatment will give a hardness increase of 1–3 HRC. Avoid intricate shapes as there will be risk of cracking.

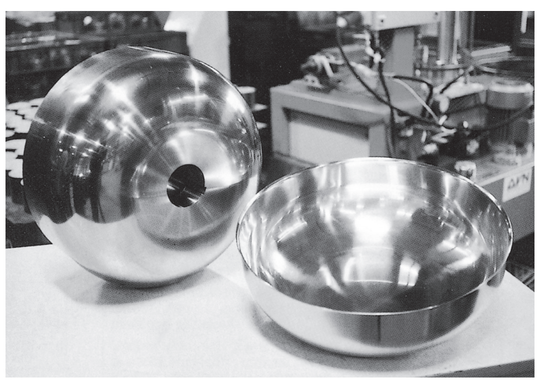
Aging occurs at 110–140°C during 25–100 hours.

NITRIDING AND NITROCARBURIZING

Nitriding will give a hard surface layer which is very resistant to wear and erosion, and also increases corrosion resistance. A temperature of 525°C (975°F) gives a surface hardness of approx. 1250 HV_1.

Nitriding temperature		Nitriding time	Depth of case approx.	
°C	°F	hours	mm	in
525	980	20	0.25	0.010
525	980	30	0.30	0.012
525	980	60	0.35	0.014

2 hours Nitrocarburizing at 570°C (1060°F) gives a surface hardness of approx. 950 HV_1. The casedepth having this hardness will be 10–20 µm (0.0004”–0.0008”). The figures refers to hardened and tempered material.



MACHINING RECOMMENDATION

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

TURNING

Cutting data parameters	Turning with carbide		Turning with high speed steel
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min. f.p.m.	 100–150 328–492	 150–200 492–656	 12–15 40–50
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	 2–6 0.08–0.20	 –2 –0.08	 –2 –0.08
Carbide designation ISO	K15–K20*	K15–K20*	–

* Use a wear resistant Al_2O_3 coated carbide grade

DRILLING

HIGH SPEED STEEL TWIST DRILLS

Drill diameter		Cutting speed (v_c)		Feed (f)	
mm	inch	m/min	f.p.m.	mm/r	i.p.r.
–5	–3/16	10–12*	30–40*	0.05–0.15	0.002–0.006
5–10	3/16–3/8	10–12*	30–40*	0.15–0.20	0.006–0.008
10–15	3/8 –5/8	10–12*	30–40*	0.20–0.25	0.008–0.010
15–20	5/8 –3/4	10–12*	30–40*	0.25–0.35	0.010–0.014

* For coated HSS drill v_c = 18–20 m/min. (59–66 f.p.m.)

CARBIDE DRILLS

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed (v_c) m/min. f.p.m.	 130–150 426–495	 70–90 230–295	 35–45 115–148
Feed (f) mm/r i.p.r.	 0.05–0.25[2] 0.002–0.010[2]	 0.10–0.25[3] 0.004–0.010[3]	 0.15–0.25[4] 0.006–0.010[4]

[1] Drill with replaceable or brazed carbide tip
[2] Feed rate for drill diameter 20–40 mm (0.8"–1.6")
[3] Feed rate for drill diameter 5–20 mm (0.2"–0.8")
[4] Feed rate for drill diameter 10–20 mm (0.4"–0.8")

MILLING

FACE AND SQUARE SHOULDER FACE MILLING

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed, (v_c) m/min. f.p.m.	 90–130 295–426	 130–180 426–590
Feed, (f_z) mm/tooth in/tooth	 0.2–0.4 0.008–0.016	 0.1–0.2 0.004–0.008
Depth of cut. (a_p) mm inch	 2–4 0.08–0.16	 –2 –0.08
Carbide designation, ISO	K20, P20*	K20, P20*

* Use a wear resistant Al_2O_3 coated carbide grade

END MILLING

Cutting data parameters	Type of milling		
	Solid carbide	Carbide indexable insert	High speed steel
Cutting speed (v_c) m/min. f.p.m.	 70–100 230–328	 80–110 262–360	 12–17[1] 40–56[1]
Feed (f_z) mm/tooth in/tooth	 0.03–0.2[2] 0.001–0.008[2]	 0.08–0.2[2] 0.003–0.008[2]	 0.05–0.35[2] 0.002–0.014[2]
Carbide designation ISO	–	K15–K20[3]	–

[1] For coated HSS end mill v_c =25–30 m/min. (82–98 f.p.m.)
[2] Depending on radial depth of cut and cutter diameter
[3] Use a Al_2O_3 coated carbide grade

GRINDING

General grinding wheel recommendations are given below. More information can be found in the Uddeholm publication "Grinding of Tool Steel".

Type of grinding	Wheel recommendation	
	Soft annealed condition	Hardened condition
Face grinding straight wheel	A 46 HV	B151 R75 B3[1] A 46 GV[2]
Face grinding segments	A 24 GV	3SG 36 HVS[2] A 36 GV
Cylindrical grinding	A 46 KV	B126 R75 B3[1] A 60 KV[2]
Internal grinding	A 46 JV	B126 R75 B3[1] A 60 HV
Profile grinding	A 100 LV	B126 R100 B6[1] A 120 JV[2]

[1] If possible use CBN wheels for this application
[2] Preferable a wheel type containing sintered Al_2O_3

WELDING

Good results when welding tool steel can be achieved if proper precautions are taken during welding (elevated working temperature, joint preparation, choice of consumables and welding procedure). If the tool is to be polished or photo-etched, it is necessary to work with an electrode type of matching composition.

Welding method	Working temperature	Consumables	Hardness after welding
MMA (SMAW)	200–250°C	Inconel 625-type UTP 67S Castolin EutecTrode 2 Castolin EutecTrode 6	280 HB 55–58 HRC 56–60 HRC 59–61 HRC
TIG	200–250°C	Inconel 625-type UTPA 73G2 UTPA 67S UTPA 696 CastoTig 45303W	280 HB 53–56 HRC 55–58 HRC 60–64 HRC 60–64 HRC

ELECTRICAL DISCHARGE MACHINING – EDM

If spark-erosion, EDM, is performed in the hardened and tempered condition, the tool should then be given an additional temper at approx. 25°C (50°F) below the previous tempering temperature.

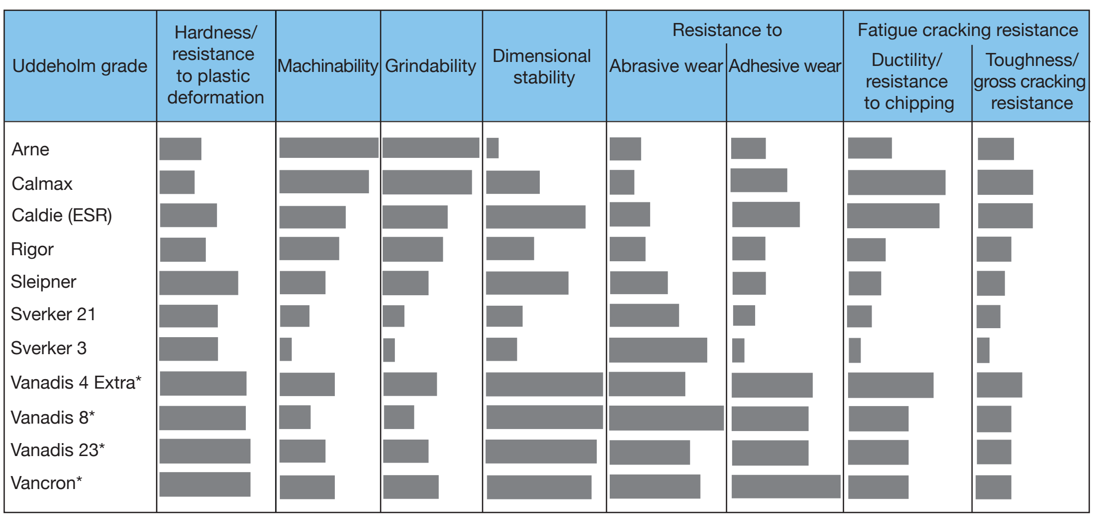
Further information can be obtained from the Uddeholm brochure “EDM of tool steel”.

FURTHER INFORMATION

Contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels, including the publication “Uddeholm tool steels for Cold Work Tooling”.

RELATIVE COMPARISON OF UDDEHOLM COLD WORK TOOL STEEL

MATERIAL PROPERTIES AND RESISTANCE TO FAILURE MECHANISMS



* Uddeholm PM SuperClean steel

THE CONVENTIONAL TOOL STEEL PROCESS

The starting material for our tool steel is carefully selected from high quality recyclable steel. Together with ferroalloys and slag formers, the recyclable steel is melted in an electric arc furnace. The molten steel is then tapped into a ladle.

The de-slagging unit removes oxygen-rich slag and after the de-oxidation, alloying and heating of the steel bath are carried out in the ladle furnace. Vacuum degassing removes elements such as hydrogen, nitrogen and sulphur.

In uphill casting the prepared moulds are filled with a controlled flow of molten steel from the ladle. From this, the steel goes directly to our rolling mill or to the forging press to be formed into round or flat bars.

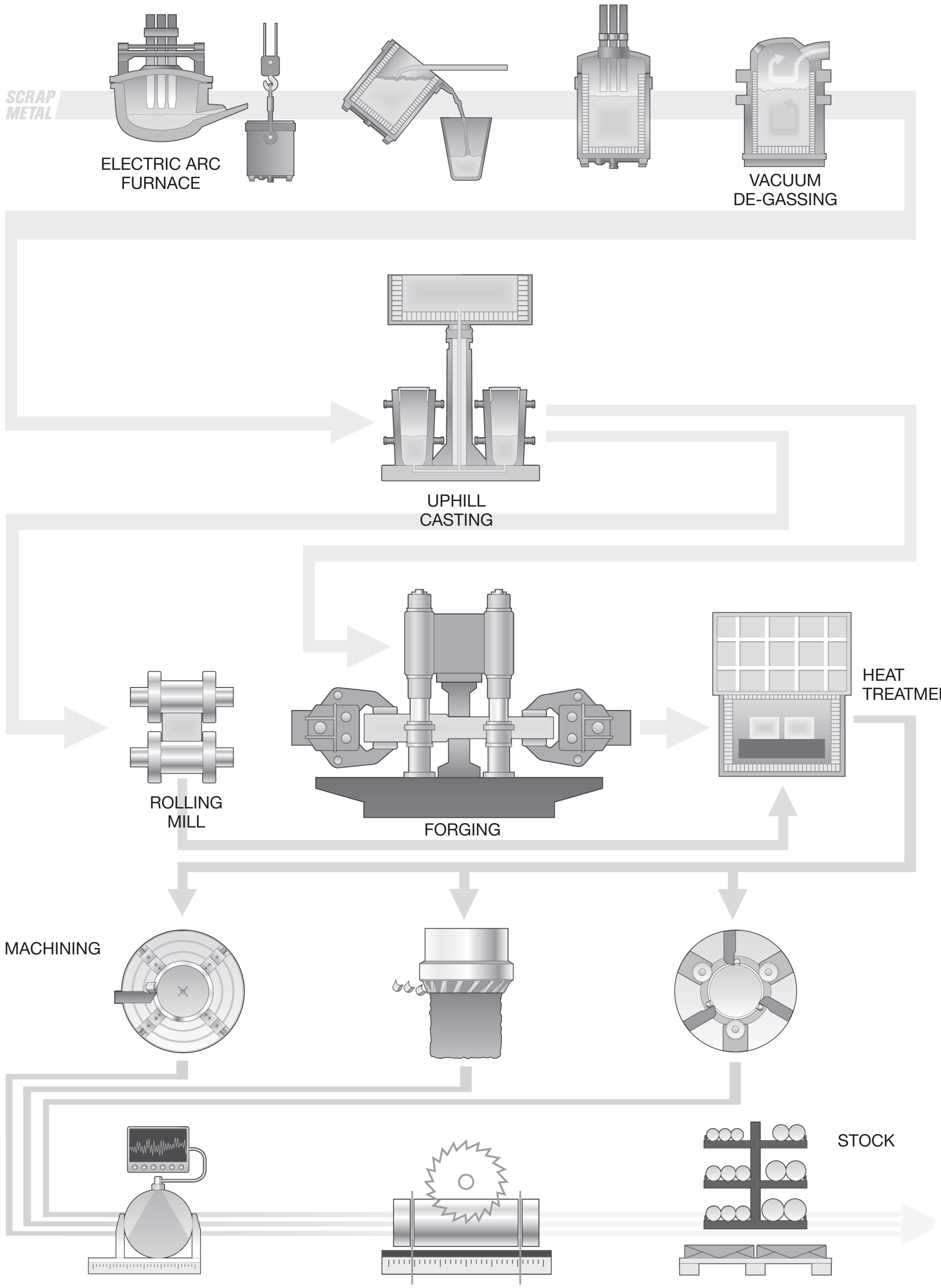
HEAT TREATMENT

Prior to delivery all of the different bar materials are subjected to a heat treatment operation, either as soft annealing or hardening and tempering. These operations provide the steel with the right balance between hardness and toughness.

MACHINING

Before the material is finished and put into stock, we also rough machine the bar profiles to required size and exact tolerances. In the lathe machining of large dimensions, the steel bar rotates against a stationary cutting tool. In peeling of smaller dimensions, the cutting tools revolve around the bar.

To safeguard our quality and guarantee the integrity of the tool steel we perform both surface- and ultrasonic inspections on all bars. We then remove the bar ends and any defects found during the inspection.


SCRAP METAL
ELECTRIC ARC FURNACE
VACUUM DE-GASSING
UPHILL CASTING
ROLLING MILL
FORGING
HEAT TREATMENT
MACHINING
STOCK

Manufacturing solutions for generations to come

SHAPING THE WORLD®

We are shaping the world together with the global manufacturing industry. Uddeholm manufactures steel that shapes products used in our every day life. We do it sustainably, fair to people and the environment. Enabling us to continue shaping the world – today and for generations to come.

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