Uddeholm
Sverker® 3

UDDEHOLM
a voestalpine company

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

Edition 9, 04.2019

CERTIFIED
ISO 9001 · OHSAS 18001
ISO 14001 · ISO 50001

GENERAL

Uddeholm Sverker 3 is a high-carbon, high-chromium tool steel alloyed with tungsten, characterized by:

- Highest wear resistance
- High compressive strength
- High surface hardness after hardening
- Good through-hardening properties
- Good stability in hardening
- Good resistance to tempering-back

Uddeholm Sverker 3 has gained widespread acceptance as a steel with exceptional wear resistance, suitable for long-life tooling with low repair and maintenance costs, for maximum production economy.

Typical analysis %	C 2.05	Si 0.3	Mn 0.8	Cr 12.7	W 1.1
Standard specification	AISI D6, (AISI D3), (W.-Nr. 1.2436)				
Delivery condition	Soft annealed to approx. 240 HB				
Colour code	Red				

APPLICATIONS

BLANKING

Uddeholm Sverker 3 is recommended for applications demanding maximum wear-resistance, such as blanking and shearing tools for thin, hard materials; long-run press tools; forming tools; moulds for ceramics and abrasive plastics.

	Material thickness	Material hardness ≤ 180 HRC	Material hardness > 180 HRC
Tools for:			
Blanking, punching, cropping, shearing, trimming, clipping	< 3	60–62	56–58
Short, cold shears for thin materials, shredding knives for plastics waste			56–60
Circular shears for light gauge sheet, car-board etc.			58–60
Clipping, trimming tools for forgings			58–60
Wood milling cutters, reamers, broaches			56–58

FORMING

	HRC
Tools for:	
Bending, raising, deep-drawing; Rim-rolling, spinning and flow-forming	56–62
Tube- and section-forming rolls	58–62
Cold drawing/sizing dies	58–62
Compacting dies for metal powder parts	58–62
Master hobs for cold hobbing	56–60
Dies for moulding of:	
Ceramics, bricks, tiles; Grinding wheels; Tablets; Abrasive plastics	58–62
Gauges, measuring tools; Guide rails, bushes, sleeves; Knurling tools; Sandblast nozzles	58–62
Crushing hammers	56–60
Swaging blocks	56–60

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° (750°F)
Density			
kg/m³	7 700	7 650	7 600
lbs/in³	0,277	0,276	0,275
Modulus of elasticity			
N/mm²	194 000	189 000	173 000
kp/mm²	19 800	19 300	17 600
tsi	12 565	12 240	12 040
psi	28.1×10^6	27.4×10^6	25.1×10^6
Coefficient of thermal expansion			
per °C from 20°	–	11.0×10^{-6}	10.8×10^{-6}
per °F from 68°F	–	6.1×10^{-6}	6.0×10^{-6}
Thermal conductivity			
W/m °C	20,5	21,5	23,0
Btu in/ft² h °F	142	149	159
Specific heat			
J/kg °C	460	–	–
Btu/lb °F	0.110	–	–

COMPRESSIVE STRENGTH

The figures are to be considered as approximate.

Hardness	Compressive strength Rc0.2 MPa
62 HRC	2200
60 HRC	2100
55 HRC	1850
50 HRC	1600

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: 600–700°C (1110–1290°F)

Austenitizing temperature: 920–1000°C (1690–1830°F) normally 940–980°C (1725–1800°F).

Temperature °C	Temperature °F	Soaking time* minutes	Hardness before tempering
920	1690	60	approx. 65 HRC
960	1760	30	approx. 66 HRC
1000	1830	15	approx. 66 HRC

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

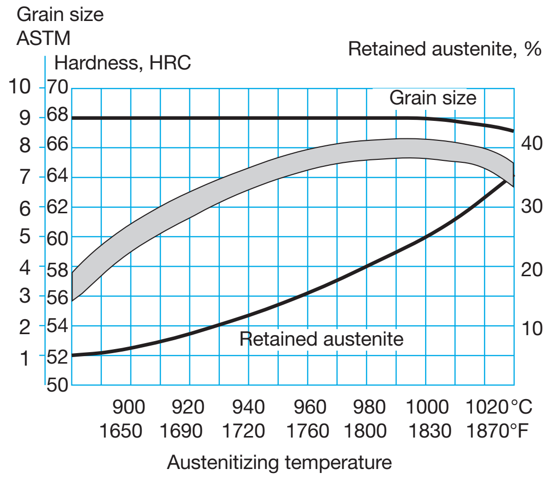
Protect the part against decarburization and oxidation during hardening.

QUENCHING MEDIA

- Oil
- 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 temperature reaches 50–70°C (120–160°F).

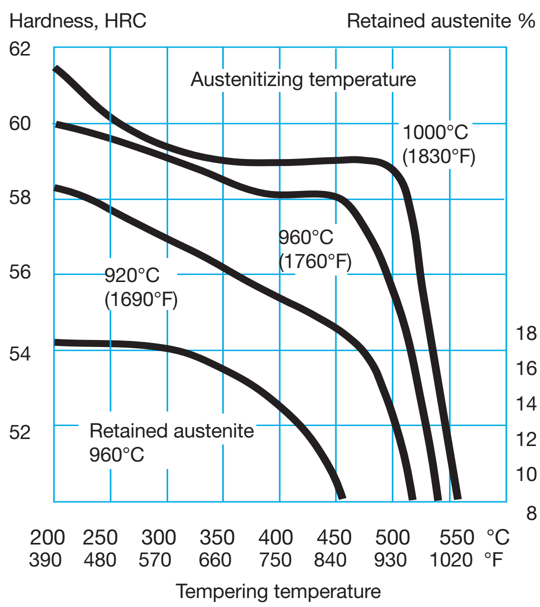
HARDNESS, GRAIN SIZE AND RETAINED AUSTENITE AS FUNCTIONS OF AUSTENITIZING TEMPERATURE



TEMPERING

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

TEMPERING GRAPH

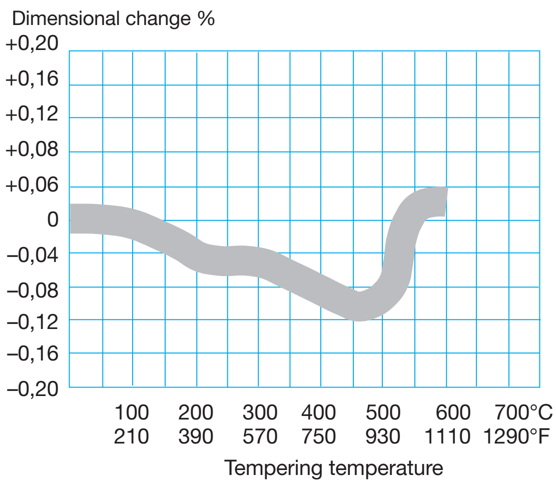


DIMENSIONAL CHANGES DURING HARDENING

Sample plate, 100 x 100 x 25 mm, 4" x 4" x 1"

	Width %	Length %	Thickness %
Oil hardening from 960°C (1760°F) min.	–0.05	+0.07	–
max.	–0.08	+0.09	–0.08
Martempering from 960°C (1760°F) min.	–0.01	+0.07	–
max.	–0.03	+0.09	–0.16
Air hardening from 960°C (1760°F) min.	+0.05	+0.09	–

DIMENSIONAL CHANGES DURING TEMPERING



Note: The dimensional changes on hardening and tempering should be added together.

SUB-ZERO TREATMENT

Pieces requiring maximum dimensional sta-bility 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 com-ponents.

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.

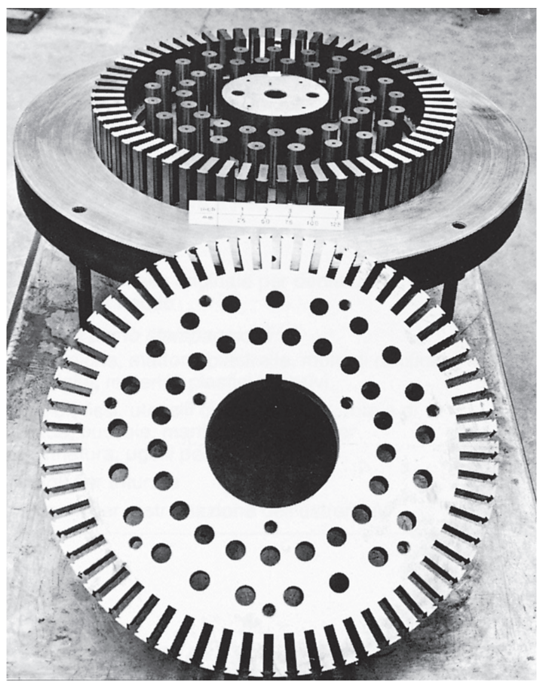
Aging occurs at 110–140°C during 25–100h.

NITRIDING

Nitriding will give a hard diffused surface layer which is very resistant to wear and ero-sion, and also increases corrosion resistance. Nitriding in ammonia gas at a temperature of 525°C (975°F) gives a surface hardness of approx. 1150 HV_1.

Nitriding temperature °C	°F	Nitriding time hours	Depth of case approx. mm	inch
525	980	20	0.20	0.008
525	980	30	0.25	0.010
525	980	60	0.30	0.012

Two hours nitrocarburizing at 570°C (1060°F) gives a surface hardness of approx. 800 HV_1. The case- depth having this hardness will be 10–20 µm (0.0004”–0.0008”). The figures refers to hardened and tempered material.



Uddeholm Sverker 3 blanking and piercing tool to produce lamination plates from abrasive high-silicon sheet.

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.	70–100 230–330	100–150 330–500	8–12 26–40
Feed (f) mm/r i.p.r.	0.3–0.6 0.012–0.023	–0.3 –0.012	–0.3 –0.012
Depth of cut (a_p) mm inch	2–6 0.08–0.16	0.5–2 0.02–0.08	0.5–3 0.02–0.12
Carbide designation ISO	K20, P10–P20 Coated carbide*	K15, P10 Coated carbide*	–

* Use a wear resistant Al_2O_3 coated carbide grade

DRILLING

HIGH SPEED STEEL TWIST DRILLS

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*	30–40*	0.05–0.10	0.002–0.004
5–10	3/16–3/8	10–12*	30–40*	0.10–0.20	0.004–0.008
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*	0.25–0.30	0.010–0.012

CARBIDE DRILLS

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1)]
Cutting speed (v_c) m/min. f.p.m.	100–130 330–430	50–70 165–230	30–40 100–130
Feed (f) mm/r i.p.r.	0.05–0.25[2)] 0.002–0.010[2)]	0.10–0.25[2)] 0.004–0.010[2)]	0.15–0.25[2)] 0.006–0.010[2)]

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

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.	90–110 300–360	110–140 360–460
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	2–4 0.08–0.16	–2 –0.08
Carbide designation ISO	K20, P10–20 Coated carbide*	K15, P10 Coated carbide*

*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.	30–70 100–230	40–80 130–260	10–15[1)] 33–50[1)]
Feed (f_z) mm/tooth inch/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, P10–P20[3)] Coated carbide	–

1) For coated HSS end mill v_c = 20–25 m/min. (65–80 f.p.m.)
2) Depending on radial depth of cut and cutter diameter
3) Use a wear resistant Al_2O_3 coated carbide grade

GRINDING

General grinding wheel recommendation is 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	B107 R75 B3[1)] A 46 HV
Face grinding segment	A 24 GV	3SG 46 FVSPF[1)] A 36 FV
Cylindrical grinding	A 46 KV	B126 R75 B3[1)] A 60 KV
Internal grinding	A 46 JV	B107 R75 B3[1)] A 60 IV
Profile grinding	A 100 LV	B107 R100 V[1)] A 100 JV

1) The first choice is a CBN grinding wheel for this operation

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	280 HB
		UTP 67S	55–58 HRC
		Castolin EutecTrode 2	56–60 HRC
		Castolin EutecTrode 6	59–61 HRC
TIG	200–250°C	Inconel 625-type	280 HB
		UTPA 73G2	53–56 HRC
		UTPA 67S	55–58 HRC
		UTPA 696	60–64 HRC
		CastoTig 45303W	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.

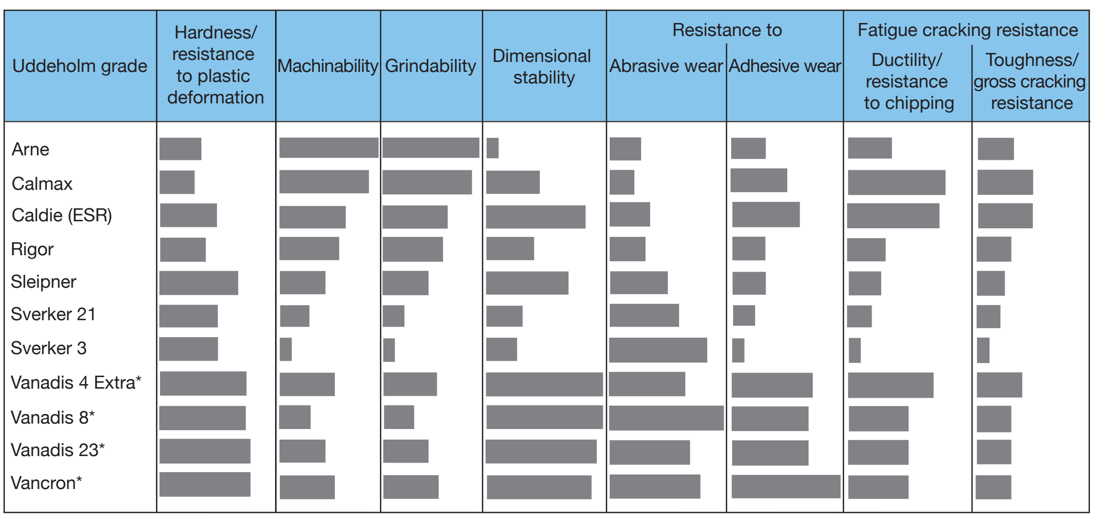
Further information can be obtained from the Uddeholm brochure “EDM of Tool Steel”.

FURTHER INFORMATION

Contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steel, including the publication “Uddeholm Steel 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.

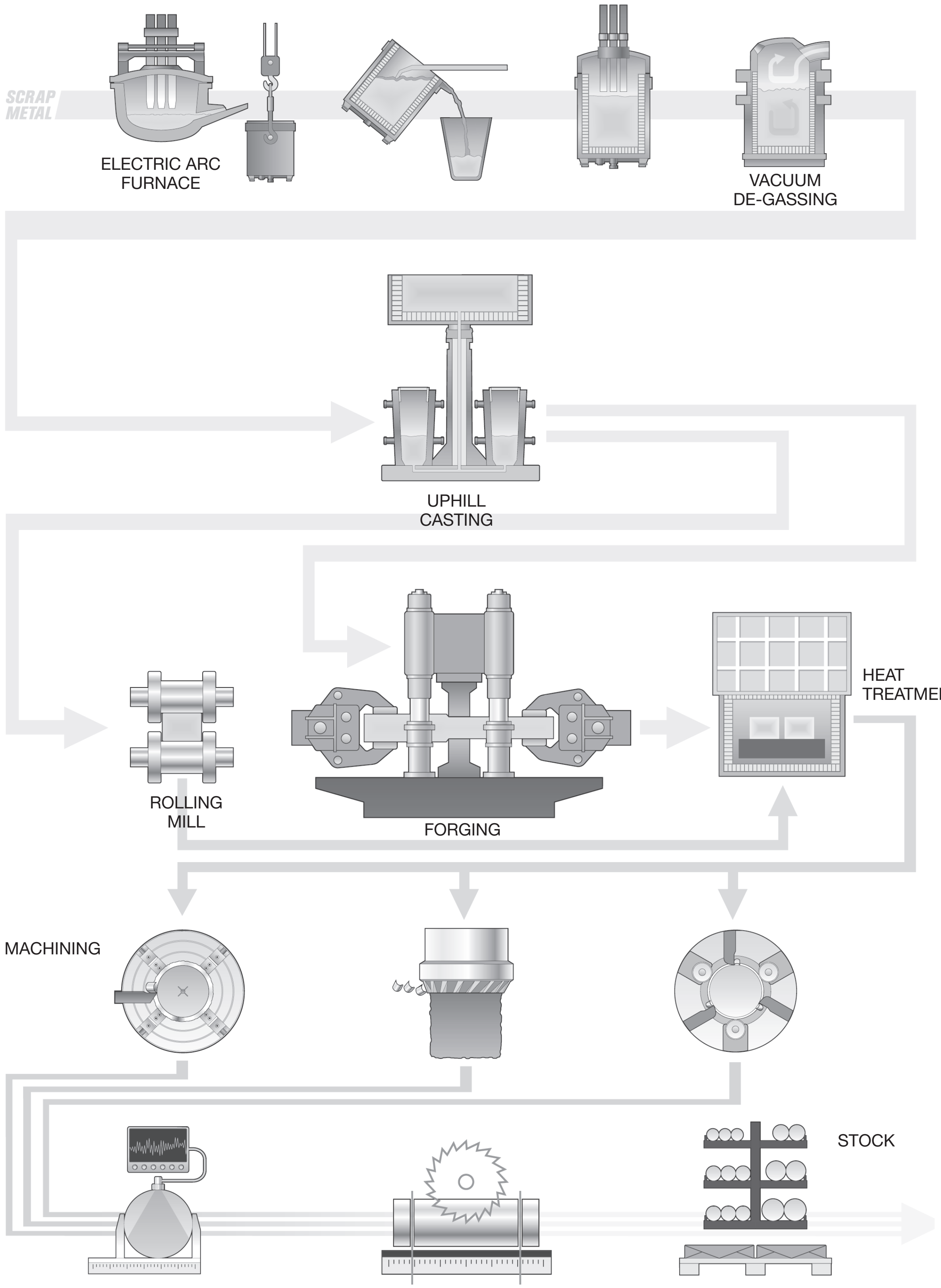
HEAT TREATMENT

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
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FORGING
HEAT
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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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