钢铁之家

www.steels.org.cn

全球钢号百科！

Global Steel Grade Encyclopedia

涵盖的行业或国家与地区类别

ASTM	国材料与试验协会
GJB	国家军用标准
SAE	动力机械工程师协会
EU	前欧洲标准化
AISI	美国钢铁学会
DIN	德国工业标准
AMS	[空航天材料规范
ISO	国际标准
JASO	日本汽车标准组织
EN	欧洲标准
JB	1国机械行业标准
UNS	统一编号系统
UNI	意大利标准
ASME	美国机械工程师协会
SS	瑞典标准
GB	国家标准
JIS	日本工业标准

General

Uddeholm Viking is a oil-air-vacuum-hardening steel which is characterized by:

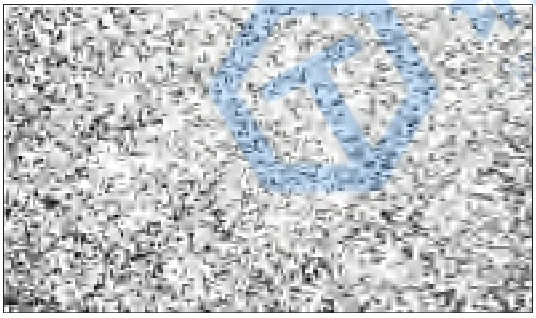
- Good dimensional stability during heat treatment
- Good machinability and grindability
- Excellent combination of toughness and wear resistance
- Normal hardness in the range 52–58 HRC
- Ideal for surface coating (CVD, PVD)

Typical analysis %	C 0,5	Si 1,0	Mn 0,5	Cr 8,0	Mo 1,5	V 0,5
Delivery condition	Soft annealed to max. 225 HB.					
Colour code	Red/white					

STRUCTURE

The structure of Uddeholm Viking, hardened from 1010°C (1850°F) and tempered twice at 540°C (1000°F), consists of carbides, tempered martensite, and approx. 1% retained austenite.

The photomicrograph below shows the typical heat treated microstructure through the cross section of a bar.



Magnification 800X

Applications

Uddeholm Viking is a versatile, high alloyed tool steel characterized by the right combination of toughness and wear resistance required for heavy duty blanking and forming.

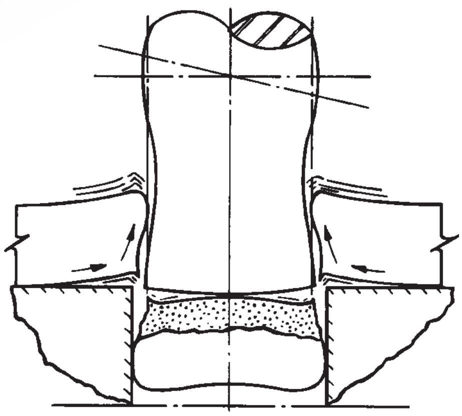
- Blanking and piercing of thick materials up to 25 mm.

Other applications:

- Fine blanking
- Shear blades
- Deep drawing
- Cold forging
- Swaging dies
- Rolls
- Cold extrusion dies with complicated geometry
- Tools for tube drawing

Tool operating conditions

The tool behaviour is influenced by a number of factors such as lubrication and cooling, rigidity of the tool set, characteristics of the working material (abrasive and adhesive wear), thickness of the working material, tool and part design, length of production runs and so on.



Exaggerated sketch of a typical punch and die in action.

The chemical composition of Uddeholm Viking gives a hardness potential of 58 HRC with compressive strength and wear resistance accordingly. The small amount of primary carbides means a high chipping resistance and with 8 % chromium follows a very good hardenability and also a fairly good resistance to corrosion.

Properties

PHYSICAL DATA

Hardened and tempered to 58 HRC. Data at room temperature and elevated temperatures.

Temperature	20°C (68°F)	200°C (390°F)	400°C (750°F)
Density kg/m³ lbs/in³	 7 750 0,279	 7 700 0,27 7	 7 650 0,275
Coefficient of thermal expansion per °C from 20°C per °F from 68°F	 – –	 $11,6 \times 10^{-6}$ $6,5 \times 10^{-6}$	 $11,3 \times 10^{-6}$ $6,3 \times 10^{-6}$
Modulus of elasticity N/mm² psi tsi	 190 000 $27,5 \times 10^{6}$ 12 300	 185 000 $26,9 \times 10^{6}$ 12 000	 170 000 $24,6 \times 10^{6}$ 11 000
Thermal conductivity W/m°C Btu in(ft²h°F)	 26,1 181	 27,1 188	 28,6 199
Specific heat J/kg °C Btu/lb °F	 460 0,110	 – –	 – –

TENSILE STRENGTH

The tensile strength figures are to be considered as typical values only. All samples were taken in the rolling direction from a round bar 35 mm (13/8") diam. The samples have been hardened in oil from 1010 ±10°C (1850 ±20°F) and tempered twice to the hardness indicated.

	Hardness HRC		
	58	55	50
Tensile strength Rm N/mm² tsi psi 1000 X	 1 960 125 300	 1 860 120 270	 1 620 105 230
Yield point Rp0.2 N/mm² tsi psi 1000 X	 1 715 110 250	 1 620 105 230	 1 470 95 210
Reduction of area, Z %	15	28	35
Elongation, A5 %	6	7	8

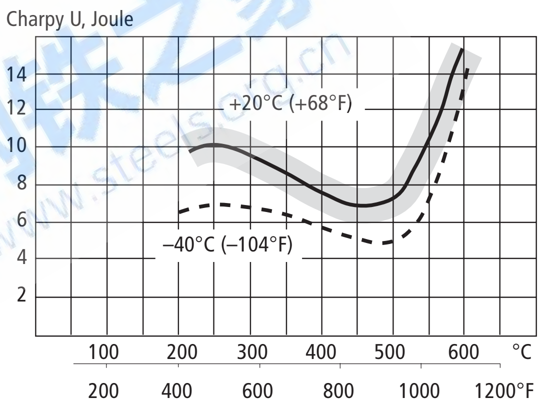
COMPRESSIVE STRENGTH

The sample have been taken out and heat treated in the same way as the samples when testing the tensile strength.

	Hardness HRC		
	58	55	50
Compressive strength Rm N/mm² tsi psi 1000 X	 2 745 175 395	 2 450 155 355	 2 060 130 300
Compressive strength Rp0,2 N/mm² tsi psi 1000 X	 2 110 135 305	 2 060 130 300	 1715 110 250

Impact strength

Approx. values. The samples have been taken out and heat-treated in the same way as the samples when testing the tensile strength.



Cold cropping tool made from Uddeholm Viking.

Heat treatment

SOFT ANNEALING

Protect the steel and heat through to 880°C (1620°F). Then cool in the furnace at approx. 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

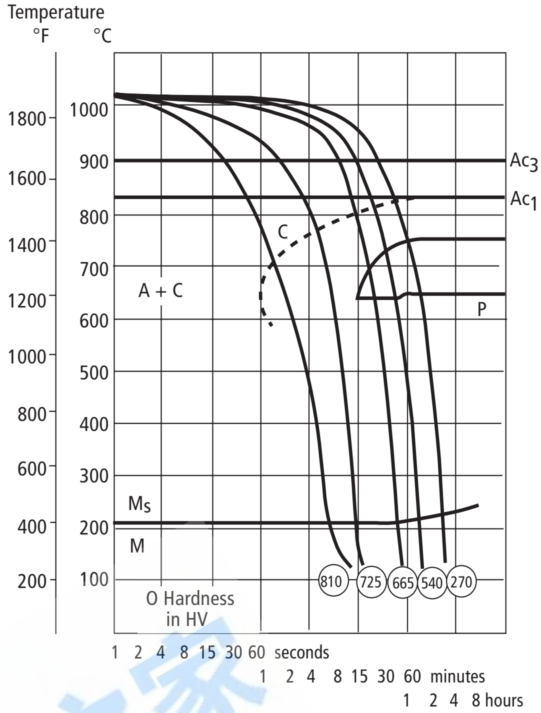
Pre-heating temperature: 600–700°C (1110–1290°F).
Austenitizing temperature: 980–1050°C (1800–1920°F) normally 1010°C (1850°F).

Temperature °C	°F	Holding time* minutes	Hardness before tempering (approx.)
980	1800	40	57 HRC
1010	1850	30	60 HRC
1050	1920	20	60 HRC

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

CCT-graph

Austenitizing temperature 1010°C (1850°F).



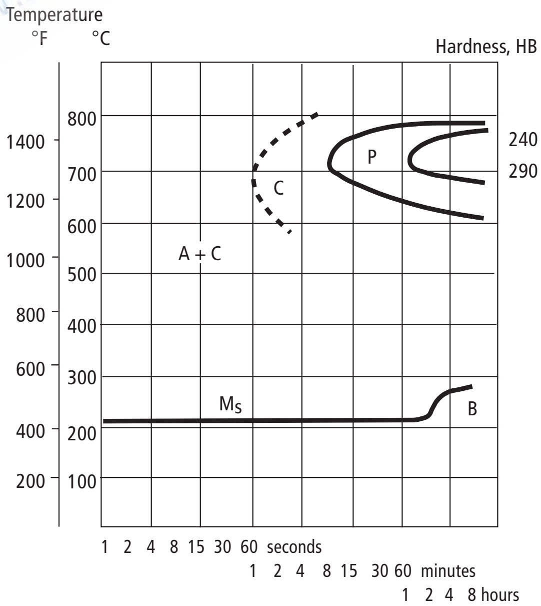
Protection against decarburization

Protection against decarburization and oxidation, while heating for hardening, is obtained by:

- Heating in neutral saltbath
- Packing in spent cast-iron chips, spent coke or paper
- Protective atmosphere—endothermic gas
- Vacuum.

TTT-graph

Austenitizing temperature 1010°C (1850°F).



QUENCHING MEDIA

- Circulating air or atmosphere
- Air blast
- Martempering bath 200–550°C (390–1020°F) 1–120 minutes, then cool in air
- Oil

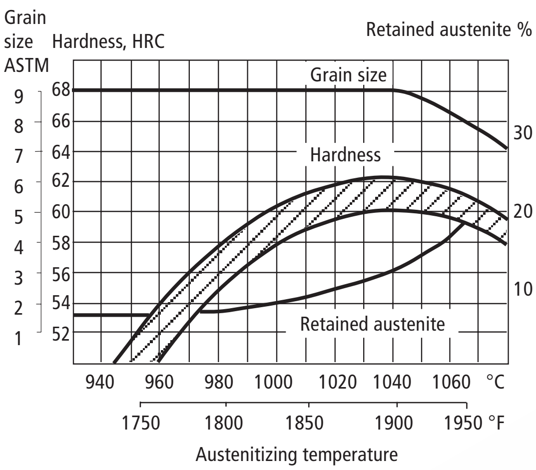
Note: Temper the tool as soon as its temperature reaches 50–70°C (120–160°F).

Transformation temperature

When heating 100°C (180°F) per hour, austenite (A1) starts forming at approx. 800°C (1470°F) and ends at approx. 850°C (1560°F).

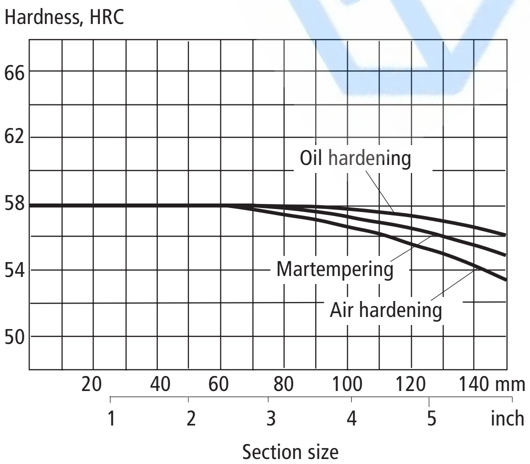
When cooling 100°C (180°F) per hours, austenite (A1) starts transforming at approx. 820°C (1510°F) and ends at approx. 750°C (1380°F).

Hardness, grain size and retained austenite as functions of austenitizing temperature



Hardenability

Hardness as a function of section thickness. Tempering temperature 180°C (360°F).

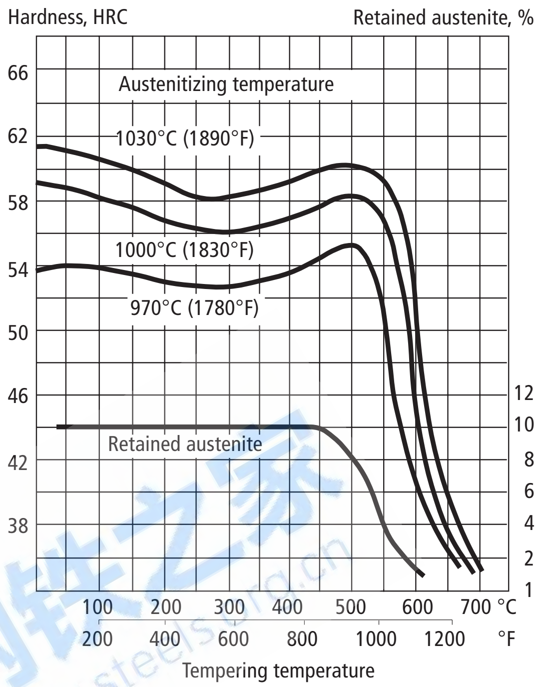


Uddeholm Viking hardens through in all common sizes.

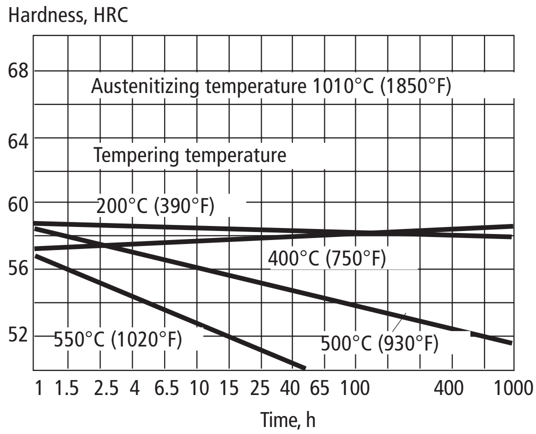
TEMPERING

Heating to tempering temperature should be carried out slowly and uniformly. Tempering should be carried out twice. Lowest temperature 180°C (360°F). Holding time at temperature minimum 2 hours.

Tempering graph



Effect of time at tempering temperature



A support arm produced in a blanking tool made from Uddeholm Viking.

FLAME AND INDUCTION HARDENING

Both flame and induction hardening methods can be applied to Uddeholm Viking.

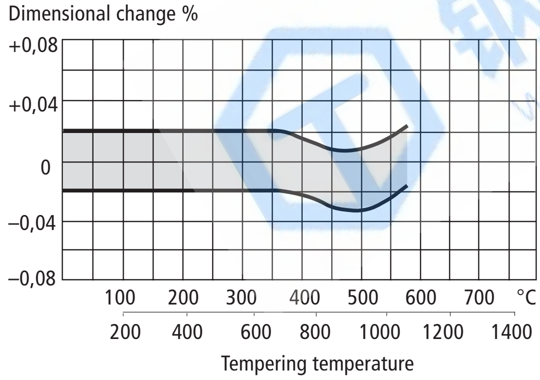
In order to get a very uniform hardness after flame or induction hardening the steel can first be prehardened to approx. 35 ±2 HRC. After flame or induction hardening the steel should be tempered at at least 180°C (360°F).

DIMENSIONAL CHANGES AFTER COOLING IN AIR

Sample plate, 100 x 100 x 25 mm, (4" x 4" x 1").

Austenitizing temperature		Width %	Length %	Thickness %
970°C (1780°F)	Min. Max.	–0.01 +0.03	–0.02 +0.04	+0.04 +0.08
1000°C (1830°F)	Min. Max.	+0.02 +0.08	+0.02 +0.09	+0.04 +0.12
1030°C (1890°F	Min. Max.	+0.01 +0.12	+0.01 +0.10	+0.04 +0.12

DIMENSIONAL CHANGES AFTER TEMPERING



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

NITRIDING

Nitriding and nitrocarburizing result in hard surface layer which is very resistant to wear and galling.

The surface hardness after nitriding is approximately 1000–1200 $HV_{0,2\ kg}$. The thickness of the layer should be chosen to suit the application in question. For cold work applications a thickness of 10–50 μm is recommended and for hot work applications an increased case depth (up to 0,3 mm) might be appropriate.

PVD AND CVD

The good tempering resistance and dimensional stability at heat treatment means possibilities for CVD and PVD of Uddeholm Viking, if 58 HRC is enough for the application.

Physical Vapour Deposition, PVD, is a method for applying wear-resistant surface coating at temperatures between 200–500°C (390-930°F).

Chemical vapour deposition, CVD, is a method for applying wear resistant surface coating a a temperature of around 1000°C (1830°F)

General machining recommendations

The cutting data below are to be considered as guiding values which must be adapted to existing local conditions.

TURNING

Cutting data parameter	Turning with carbide Rough turning	 Fine turning	Turning with high speed steel Fine turning
Cutting speed (v_c) m/min. f.p.m.	 160–210 525–690	 210–260 690–850	 20–25 65–80
Feed (f) mm/rev 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	 0,5–2 0,02–0,08	 0,5–3 0,02–0,12
Carbide designation, ISO	P20–P30 Coated carbide	P10 Coated carbide or cermet	–

DRILLING

High speed steel twist drill

Drill diameter Ø mm	inch	Cutting speed (v_c) m/min.	f.p.m.	Feed (f) mm/rev	i.p.r.
– 5	–3/16	15–17*	50–55*	0,08–0,20	0,003–0,008
5–10	3/16–3/8	15–17*	50–55*	0,20–0,30	0,008–0,012
10–15	3/8–5/8	15–17*	50–55*	0,30–0,35	0,012–0,024
15–20	5/8–3/4	15–17*	50–55*	0,35–0,40	0,014–0,016

** For coated HSS drills 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.	200–220 655–730	110–140 360–465	70–90 260–295
Feed (f) mm/rev i.p.r.	0,05–0,25[2] 0,002–0,01[2]	0,10–0,25[2] 0,004–0,01[2]	0,15–0,25[2] 0,006–0,01[2]

[1] *Drills with internal cooling channels and a brazed carbide tip.*
[2] *Depending on drill diameter.*

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.	140–230 460–755	230–270 755–885
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	P20–P40 Coated carbide	P10–P20 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.	110–140 360–460	130–180 425–590	20–25[1] 65–80[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	–	P20–P40 Coated carbide	–

[1] *For coated HSS end mill v_c =40–45 m/min (130 –148 f.p.m.).*
[2] *Depending on the type of milling (side or slot) and cutter diameter.*

GRINDING

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

Type of grinding	Wheel recommendation	
	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 46 LV	A 60 KV
Internal grinding	A 46 JV	A 60 IV
Profile grinding	A 100 KV	A 120 JV

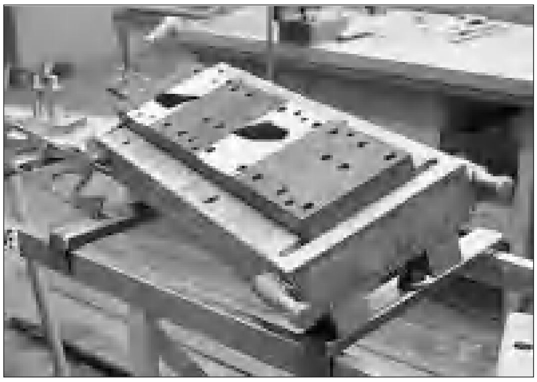
Electrical-discharge machining

If spark-erosion 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.

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.
Uddeholm Viking can be welded. It is essential, however, to pre-heat the part concerned prior to welding to avoid cracking. An outline on how to proceed is given below:

1. Welding of soft annealed Uddeholm Viking
- Pre-heat to 300–400°C (570–750°F)
- Weld at 300–400°C (570–750°F)
- Immediately soft anneal after slowly cooling to approx. 80°C (175°F)
- Harden and temper.



Blanking tool set for producing a plate part.

2. Repair welding of Uddeholm Viking in hardened and tempered condition

- Pre-heat to the previously used tempering temperature, min. 250°C (480°F), max. 300°C (570°F)
- Weld at this temperature. Do not weld below 200°C (390°F)
- Cool in air to approx. 80°C (175°F)
- Temper immediately at a temperature 25°C (45°F) below the previous tempering temperature.

Note: When welding soft annealed Uddeholm Viking always use an electrode with the same analysis as the base material.

When welding Uddeholm Viking in the hardened condition use OK Selectrode 84.52 or UTP 67S for MMA-welding. For TIG welding use UTP A67S or Castolin CastoTig 45303W.

The weld material will have approximately the same hardness as the base material