UDDEHOLM FORMAX™

UDDEHOLM

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.

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

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The latest revised edition of this brochure is the English version,
which is always published on our web site www.uddeholm.com

SS-EN ISO 9001
SS-EN ISO 14001

General

Uddeholm Formax is a low carbon steel which can be supplied in as-hot-rolled or fine-machined condition.

Uddeholm Formax is characterized by:

- good machinability
- easy to flame-cut
- good mechanical strength
- can be case hardened
- good weldability

Typical analysis %	C 0,18	Si 0,3	Mn 1,4
Standard specification	(W.-Nr. 10050, SS 2172)		
Delivery condition	Hot rolled. Hardness approx. 170 HB		
Colour code	Black		

Applications

- Bolsters
- Punch holders
- Die holders
- Backing plates
- Guide plates
- Support plates
- Jigs
- Fixtures
- Constructional parts.

Properties

Tensile strength

Approximate values at room temperature. Hardness 170 HB.

Tensile strength R_m	N/mm^2 ksi	560 80
Yield strength $R_{p0,2}$	N/mm^2 ksi	320 45
Reduction of area Z	%	40
Elongation A_5	%	20

Heat treatment recommendations

Uddeholm Formax is intended for use in the as-delivered condition, i.e. not heat treated.

For applications where the material must be hardened to a higher hardness, the following instructions should be followed;

Stress relieving

Temperature approx. 550–650°C (1020–1200°F).

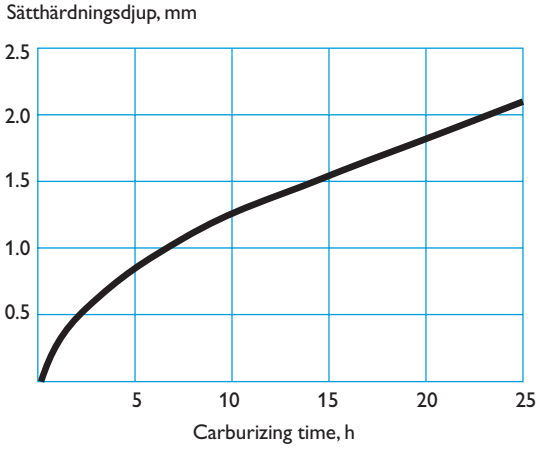
After rough machining with chip-cutting tools, stress relieving may be advisable to minimize distortion if the tool is to be hardened. Holding time: 2 hours after the entire piece has attained a temperature of approx. 650°C (1200°F). Cool in furnace to approx. 500°C (930°F), followed by cooling in air.

Case hardening

The composition of Uddeholm Formax makes it highly suitable for case hardening. Case hardening can be carried out as follows:
Carburizing temperature 850–920°C (1560–1690°F).

The time and temperature must be adapted to the required depth of hardening. Quench in salt water from 800–820°C (1470–1510°F).

THE FOLLOWING CHART SHOWS THE ROUGH RELATIONSHIP BETWEEN THE CARBURIZING TIME AND THE DEPTH OF CASE AT 900°C (1650°F)



Tempering

Tempering at 200°C (390°F) gives a surface hardness of approx. 60 HRC.

Flame hardening

Formax can be flame/induction hardened to 40 ±3 HRC. Cooling in water. Case depth 1–2 mm. Temper immediately after hardening.

Cutting data recommendations

The cutting data below for Uddeholm Formax in hot rolled condition (170 HB) are to be considered as guiding values which must be adapted to existing local condition. Further information can be found in the Uddeholm technical report "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.	210–260 690–850	260–320 850–1050	28–32 90–105
Feed (f) mm/r i.p.r.	0.3–0.6 0.01–0.024	–0.3 –0.01	–0.3 –0.01
Depth of cut (a_p) mm inch	2–4 0.08–0.16	0.5–2 0.2–0.08	0.5–3 0.2–0.1
Carbide designation ISO	P20–P30 Coated carbide	P10 Coated carbide or cermet	–

Milling

FACE- AND SQUARE SHOULDER MILLING

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_c) m/min f.p.m.	220–320 720–1050	320–370 1050–1210
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	0.5–2 –0.08
Carbide designation ISO	P20–P40 Coated carbide	P10–P20 Coated carbide or cermet

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.	160–200 525–660	210–250 690–820	40–45[1] 130–150[1]
Feed (f_z) mm/tooth inch/tooth	0.03–0.20[2] 0.001–0.008[2]	0.08–0.20[2] 0.003–0.008[2]	0.05–0.35[2] 0.002–0.014[2]
Carbide designation ISO	–	P20–P40	–

[1] For coated high speed steel end mill v_c = 60–65 m/min. (200–215 f.p.m.)
[2] Depending on radial depth of cut and cutter diameter

Drilling

HIGH SPEED STEEL TWIST DRILL

Drill diameter mm	Drill diameter inch	Cutting speed m/min	Cutting speed f.p.m.	Feed (f) mm/r	Feed (f) i.p.r.
– 5	–3/16	22–25*	70–100*	0.08–0.20	0.003–0.008
5–10	3/16–3/8	22–25*	70–100*	0.20–0.30	0.008–0.012
10–15	3/8–5/8	22–25*	70–100*	0.30–0.35	0.012–0.014
15–20	5/8–3/4	22–25*	70–100*	0.35–0.40	0.014–0.016

* For coated high speed steel drill v_c = 38–40 m/min. (125–130 f.p.m.)

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tip[1]
Cutting speed (v_c) m/min f.p.m.	250–270 820–885	130–160 425–525	130–160 425–525
Feed (f) mm/r i.p.r.	0.05–0.15[2] 0.002–0.006[2]	0.08–0.20[3] 0.003–0.008[3]	0.15–0.25[4] 0.006–0.01[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")

Grinding

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

Type of grinding	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 JV
Profile grinding	A 100 KV	A 120 JV

Welding

Uddeholm Formax has extremely good weldability and normally it needs no heat treatment in connection with the welding operation. However, if there is a risk of an abnormally high cooling rate, holding at 100–200°C (210–390°F) is recommended. Stress relieving, if any, is carried out at 550–600°C (1020–1200°F).

The low carbon content reduces hardness variations in the material after welding to a minimum.

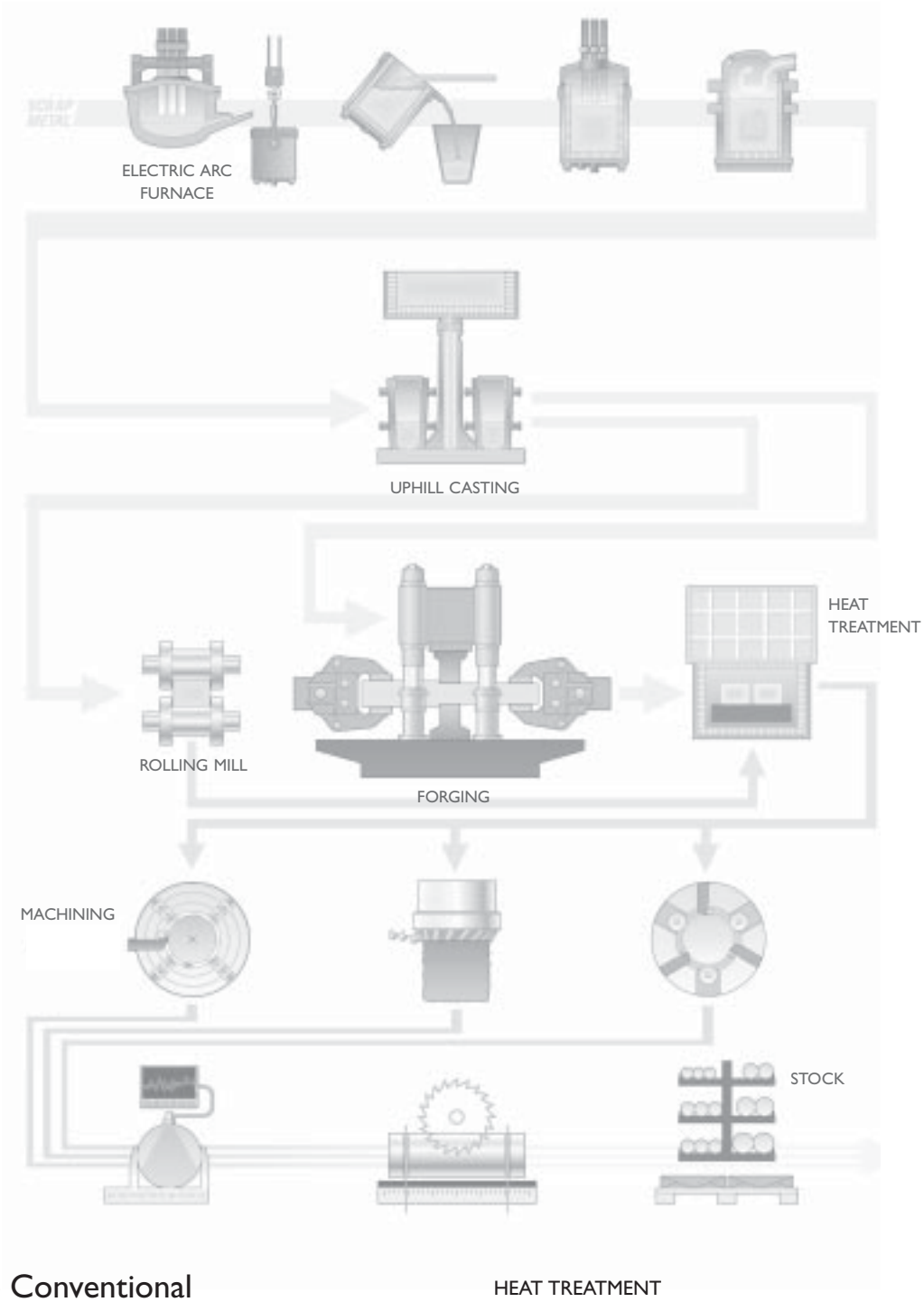
Flame-cutting

Uddeholm Formax is suitable for flame-cutting. Normally, no tempering of the cutting edge is needed before machining, since the machinability is not affected.

Gas cutting of Uddeholm Formax.

Further information

Please, contact your local Uddeholm office for further information on the selection, heat treatment, application and availability of Uddeholm tool steels.



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.

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UDDEHOLM is the world's leading supplier of tooling materials. This is a position we have reached by improving our customers' everyday business. Long tradition combined with research and product development equips Uddeholm to solve any tooling problem that may arise. It is a challenging process, but the goal is clear – to be your number one partner and tool steel provider.

Our presence on every continent guarantees you the same high quality wherever you are. ASSAB is our wholly-owned subsidiary and exclusive sales channel, representing Uddeholm in the Asia Pacific areas. Together we secure our position as the world's leading supplier of tooling materials. We act worldwide, so there is always an Uddeholm or ASSAB representative close at hand to give local advice and support. For us it is all a matter of trust – in long-term partnerships as well as in developing new products. Trust is something you earn, every day.

For more information, please visit www.uddeholm.com, www.assab.com or your local website.

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