Uddeholm
Fermo

UDDEHOLM
a voestalpine company

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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SS-EN ISO 9001
SS-EN ISO 14001

GENERAL

Uddeholm Fermo is a high strength, flame- and induction hardening steel delivered pre-hardened to 250–290 HB. The surface of the steel can be flame hardened without water cooling. The hardened and tempered matrix provides good support for the flame hardened layer.

The steel can be repair welded without pre-heating.

Typical analysis %	C 0.48	Si 0.4*	Mn 0.9	Cr 1.5
Standard specification**	Approx. W.-Nr. 1.7140 (forged)			
Delivery condition	Hardened and tempered to 250–290 HB			

* Castings: 0.4–0.8% Si

** As casting equal to W.-Nr. 1.7140

PROPERTIES

MECHANICAL PROPERTIES

Nominal values at room temperature.

	Forgings 250–290 HB	Castings
Tensile strength R_m N/mm^2 ksi	 800 116	 600 87
Yield point, $R_{p0,2}$ N/mm^2 ksi	 630 91	 450 65
Elongation, A_5 %	15	10
Reduction of area, Z %	50	25

APPLICATIONS

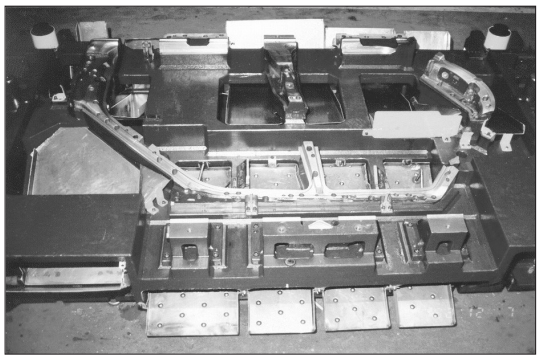
- Blanking and forming tools for car body parts
- Tool parts such as slides, pressure plates/ pads
- Shear blades and circular knives with special requirements on toughness
- Curve plates, cams
- Guides, constructional parts
- The steel is particularly suitable for tools with surfaces exposed to abrasion and which can be flame hardened

OTHER IMPORTANT PROPERTIES

Forming and blanking body sheet requires high strength in the tool so that it can stand up to the relatively high pressure during the work operation. This requirement is met by Uddeholm Fermo.

By flame or induction hardening wear resistance can be improved considerably by the simplest means.

Thanks to the fact that Uddeholm Fermo is delivered prehardened, an optimum transition zone between the flame hardened surface layer and the matrix is ensured. This is very important to avoid edge chipping and cracks in the surface layer.



Car body tool.

WELDING RECOMMENDATIONS

FILLER MATERIAL

Welding method	GTAW (TIG) Gas tungsten arc welding	SMAW (MMA) Shielded metal arc welding
Filler material	UTP A 73G2 UTP ADUR 600	UTP 73G2 UTP 67S ESAB OK 84.52
Hardness as welded	56–58 HRC (ADUR 600) 53–55 HRC (A 73G2)	56–58 HRC (67S) 53–55 HRC (73G2) 50–55 HRC (84.52)

PROCEDURE

Condition	Prehardened	Comment
Preheating temperature	200–250°C (390–485°F)	The temp. should be kept constant during the welding operation. Minor repairs can be made with the TIG-method at room temp. see Fig. 1.
Max interpass temperature	400°C (750°F)	The temp. of the tool in the vicinity of the weld. When passed, there is a risk for distortion of the tool or soft zones around the weld.
Cooling rate	20–40°C (45–70°F) the first 2 hours then freely in air <70°C (160°F)	
Post treatment	Temper 640°C* (1185°F)	Holding time when tempering 2 h. When soft annealing and harden ing see heat treatment

*For flame hardened cutting edges, temper at 200°C (400°F).

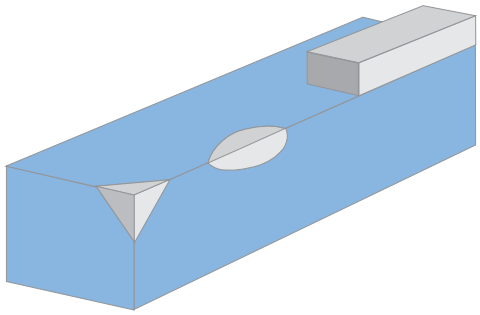


Fig. 1. Repairs that can be performed at room temperature

REPAIR WELDING OF CUTTING EDGE

Use the same welding procedure as for pre-hardened condition with the exception of the post treatment. Post treatment should be made at 175–200°C (350–400°F) to avoid lowering the hardness of the surrounding flame hardened cutting edge. Holding time 2 hours after the tool is heated through.

When there is minor damage, prepare the repair area, approx. 4 x 8 mm (0.16–0.32 inch), and deposit a hard facing filler material.

MMA	TIG
EAB OK 84.52 UTP 67 S	UTP A 73 G2 UTP ADUR 600

In case of major damage (Fig. 2) and, consequently, a larger joint, a buffering layer should be used for the primary weld.

MMA	TIG
Castolin 680 S UTP 65 D	CastoTig 45507W UTP A 651

Post treatment at 175–200°C (350–400°F).

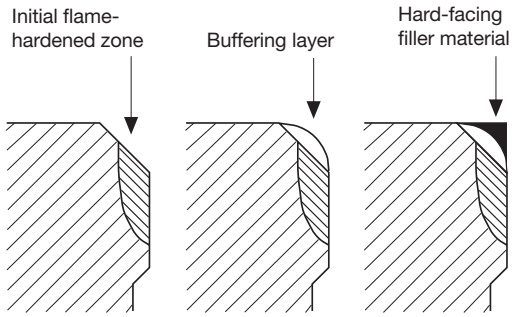


Fig. 2

FLAME- /INDUCTION HARDENING

Temperature: 850–870°C (1560–1600°F). *Cooling*: freely in air.

Surface hardness: 54–56 HRC.

Hardening depth: 41 HRC at a depth of 3.5–4 mm (0.14–0.16 inch) when flame hardening. Can be increased when induction hardening depending on the coil and the power input.

Flame or induction hardening can be done over an edge weld.

HEAT TREATMENT RECOMMENDATIONS

STRESS RELIEVING

Temperature: 550–650°C (1020–1200°F) or 25°C (50°F) below the tempering temperature used during the prehardening.

Holding time: 2 h. Cooling in furnace to 500°C (930°F), then freely in air.

HARDENING

Uddeholm Fermo is primarily intended for flame hardening. If ordinary heat treatment is required, the following directions can be followed:

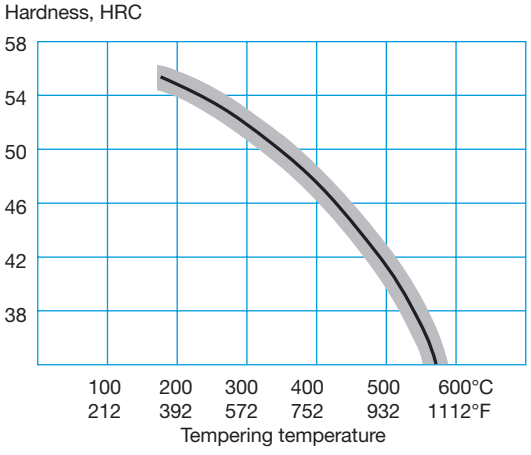
- austenitizing temperature: 840–880°C (1540–1620°F), normally 860°C (1580°F)
- holding time: 20–30 minutes
- the tool should be protected against decarburization during hardening
- quenching medium: oil
- note: temper the tool as soon as its temperature reaches 50–70°C (120–160°F)
- maximum surface hardness after hardening will be approx. 57 HRC
- the steel hardens through up to a material thickness of ~50 mm (~2 inch)

TEMPERING

The tempering temperature according to the hardness required may be determined by means of the tempering graph.

Temper twice. Lowest tempering temperature 180°C (360°F). Holding time at temperature minimum 2 hours.

SURFACE HARDNESS AFTER TEMPERING



MACHINING RECOMMENDATIONS

The cutting data below are to be considered as guiding values for forged material which must be adapted to existing local condition.

For cast material the cutting parameters must be somewhat reduced when machining the surface skin.

Further information can be found in 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	150–200 490–660	200–250 600–820	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 0.02–0.08
Carbide designation ISO US	P20–P40 C6– C5 Coated carbide	P10 C7 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.	140–230 460–750	230–270 750–880
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–P40 C7–C5 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.	 110–140 360–460	 130–180 430–590	 25–30[1] 82–98[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 US	 – –	 P20–P40 C6–C5	 – –

[1] For coated HSS end mill v_c = 45–50 m/min. (150–160 f.p.m.)
[2] Depending on radial depth of cut and cutter diameter

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter		Cutting speed (v_c)		Feed (f)	
mm	inch	m/min	f.p.m.	mm/r	i.p.r.
– 5	–3/16	15–17*	49–56*	0.05–0.10	0.002–0.004
5–10	3/16–3/8	15–17*	49–56*	0.10–0.20	0.004–0.008
10–15	3/8–5/8	15–17*	49–56*	0.20–0.25	0.008–0.010
15–20	5/8–3/4	15–17*	49–56*	0.25–0.30	0.010–0.012

* For coated HSS drill v_c 26–28 m/min. (85–92 f.p.m.)

CARBIDE DRILL

Cutting data parameters	Type of drill		
	Indexable insert	Solid carbide	Carbide tipped[1]
Cutting speed (v_c) m/min f.p.m.	 180–200 590–660	 110–140 360–460	 70–90 230–300
Feed (f) mm/r 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] Drill with replaceable or brazed carbide tip
[2] Depending on drill diameter

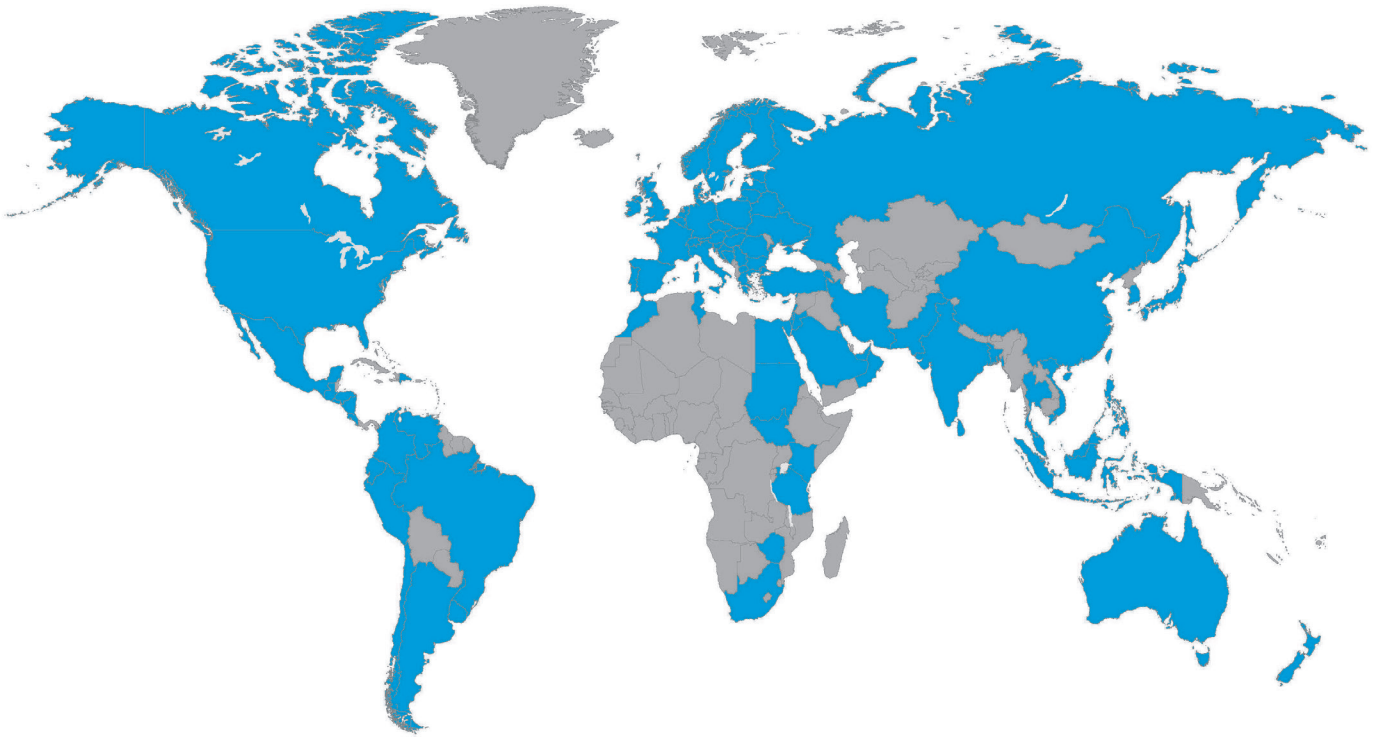
GRINDING

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

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

FURTHER INFORMATION

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



NETWORK OF EXCELLENCE

Uddeholm is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. We secure our position as the world's leading supplier of tooling materials.

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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. We secure our position as the world's leading supplier of tooling materials. We act worldwide. For us it is all a matter of trust – in long-term partnerships as well as in developing new products.

For more information, please visit www.uddeholm.com

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