Uddeholm
Nimax® ESR

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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GENERAL

Uddeholm Nimax ESR is a low carbon plastic mould steel delivered at a hardness of ~40 HRC. Uddeholm Nimax ESR is an ESR re-melted version of Uddeholm Nimax, keeping the features of Uddeholm Nimax, but with improved cleanliness and homogeneity as a result of the ESR process.

Uddeholm Nimax ESR is characterized by the following:

- Excellent polishing and texturing properties
- High impact and fracture toughness
- Very good welding properties
- Good resistance against indentations
- Consistent properties through large sections
- Excellent machinability

WHAT DOES ESR GIVE?

CLEANLINESS AND HOMOGENEITY

Low amount of inclusions and less segregations

- improved polishing results
- improved toughness/ductility
- improved texturing results

The excellent machinability and easy weldability, no preheating or post treatment necessary, reduce the manufacturing time and make the maintenance much easier. The high hardness in combination with a high toughness results in a mould with good resistance to indentations and a minimum risk for unexpected failures, leading to a safer mould and a prolonged tool life.

Typical analysis weight- %	C 0.1	Si 0.3	Mn 2.5	Cr 3.0	Mo 0.3	Ni 1.0
Delivery condition	360–400 HB					
Colour code	Blue					

APPLICATIONS

The material is specifically developed for big and middle sized injection moulds with high demands on surface finish.

Main applications are transparent, high gloss polished or textured moulds for use mainly within automotive, white goods, packaging and electronic industry.

Examples of applications where ESR material is often needed can be found within:

- Automotive: Head and rear lights
  Large interior parts
- White goods: Control panels
- Electronic: LED TV frames

PROPERTIES

PHYSICAL DATA

Temperature	20°C (68°F)	200°C (390°F)
Density kg/m^3 lbs/in^3	7 900 0.285	–
Modulus of elasticity N/mm^2 psi	205 000 29.7 x 10^6	–
Coefficient of thermal expansion per °C from 20°C °F from 68°F	–	12.4 x 10^{-6} 6.9 x 10^{-6}
Thermal conductivity W/m • °C Btu in/(ft^2 h °F)	–	28 194
Specific heat J/kg °C Btu/lb °F	460 0.11	–

MECHANICAL PROPERTIES

The properties are representative of samples taken from the centre of bars with dimension 596 x 296 mm unless otherwise is indicated. Values of different mechanical properties depend on dimension of original material, position and direction of samples as well as hardness and test temperature.

A highly polished mould for production of car headlights.

TENSILE STRENGTH

Hardness ~370 HB.

Yield strength, $R_{p0.2}$ MPa	785
Tensile strength, R_m MPa	1265
Elongation, %	11
Area contraction, %	47

COMPRESSIVE STRENGTH

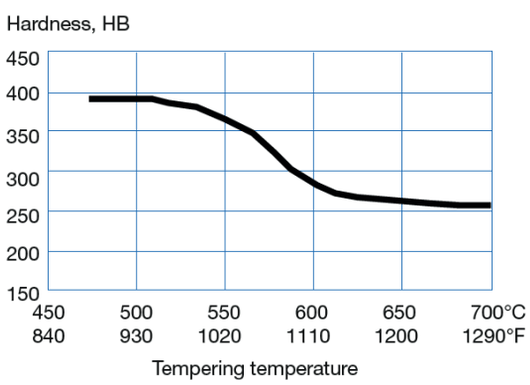
Hardness ~370 HB.

Compressive strength, $R_{c0.2}$ MPa	1000

HEAT TREATMENT

Uddeholm Nimax ESR is intended to be used in the delivery condition. The hardness cannot be increased by heat treatment, but can be decreased by tempering. **However, tempering is not recommended because it significantly decreases toughness even though that the hardness is reduced.**

The following hardness reduction can be expected after 2 h at full temperature:



If the steel has been exposed to high temperature thus reducing toughness and hardness, the following procedure can be performed in order to restore the original condition:

Heat to 850 C (1560 F), holding time 30 min. Cool in circulating air.

SURFACE TREATMENT

FLAME AND INDUCTION HARDENING

The surface hardness of Uddeholm Nimax ESR cannot be increased either by induction hardening or flame hardening.

NITRIDING

Nitriding increases the surface hardness and wear resistance. For best result the following steps should be followed:

1. Rough machining
2. Temper at a temperature between 480–525°C (896–977°F) thus reducing the amount of stresses and retained austenite content. This will minimize later dimensional changes during the nitriding operation. Heat the mould up until it is heated through and let it cool down to room temperature
3. Finish machining/grinding
4. Nitriding

The following approximate nitriding depths and surface hardnesses can be expected:

	Surface hardness MHV (200g)	Depth after nitriding 10h mm (inch)	30h mm (inch)	60h mm (inch)
Gas nitriding at 510°C (950°F)	950	**0.16[1] (0.006[1])**	**0.28[1] (0.011[1])**	**0.39[1] (0.015[1])**
Plasma nitriding at 480°C (896°F)	1000	0.13[2] (0.005[2])	**0.25[1] (0.010[1])**	**0.33[1] (0.013[1])**

1) Not recommended
2) Recommended

Nitriding at temperatures above 500°C (930°F) and times longer than 10 h is not recommended as it will reduce toughness and hardness significantly.

For more detailed information about nitriding contact your local Uddeholm office.

MACHINING RECOMMENDATIONS

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

TURNING

Cutting data parameters	Turning with carbide		Turning with HSS
	Rough turning	Fine turning	Fine turning
Cutting speed (v_c) m/min. f.p.m.	110–150 360–492	150–200 492–656	10–15 33–49
Feed (f) mm/rev. i.p.r.	0.2–0.4 0.008–0.016	–0.3 –0.012	–0.3 –0.012
Depth of cut (a_p) mm inch	2–4 0.08–0.16	–2 –0.08	–2 –0.08
Carbide designation ISO US	P20–P30 C6–C5 Coated carbide	P10 C7 Coated carbide	–

HSS = High Speed Steel

DRILLING

HIGH SPEED STEEL TWIST DRILL

Drill diameter		Cutting speed (v_c)		Feed (f)	
mm	inch	m/min	f.p.m.	mm/rev	i.p.r.
–5	–3/16	12–14*	39–46*	0.05–0.10	0.002–0.004
5–10	3/16–3/8	12–14*	39–46*	0.10–0.20	0.004–0.008
10–15	3/8 –5/8	12–14*	39–46*	0.20–0.25	0.008–0.010
15–20	5/8 –3/4	12–14*	39–46*	0.25–0.30	0.010–0.012

* For coated HSS drill v_c = 18–20 m/min. (59–66 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.	150–170 492–558	100–130 328–426	90–110 296–360
Feed (f) mm/rev. 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 MILLGING

Cutting data parameters	Milling with carbide	
	Rough milling	Fine milling
Cutting speed (v_c) m/min. f.p.m.	80–150 262–492	150–180 492–590
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	2–5 0.08–0.2	– 2 –0.08
Carbide designation ISO US	P20 C6 Coated carbide	P10–P20 C7–C6 Coated carbide or cermet

END MILLING

Cutting data parameters	Type of milling		
	Solid carbide	Carbide index-able insert	HSS
Cutting speed (v_c) m/min. f.p.m.	70–110 230–361	80–120 262–394	10–15[1] 33–49[1]
Feed (f_z) mm/tooth in/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–P30 C6–C5	– –

[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

GRINDING

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

WHEEL RECOMMENDATION

Type of grinding	Wheel recommendation
Surface grinding straight wheel	A 46 HV
Surface grinding segments	A 36 GV
Cylindrical grinding	A 60 KV
Internal grinding	A 60 IV
Profile grinding	A 120 JV

ELECTRICAL DISCHARGE MACHINING – EDM

Contrary to other steel grades, the heat affected surface layer achieved during EDM'ing will not be harder than the underlying steel. Consequently, the heat affected layer is more easily removed.

WELDING

Preheating or post heat treatment is not necessary. However if severe strain conditions could be expected a stress relieving at 450°C (840°F) for 2h is recommended after welding.

Welding method	TIG	MMA
Preheating temperature	None	None
Filler material	Impax TIG Weld Nimax TIG-Weld	Impax Weld
Max interpass temperature	300°C (570°F)	
Cooling rate	Freely in air	
Hardness as welded	Impax TIG-Weld 320–340 HB Nimax TIG-Weld 360–400 HB	330–350 HB –
Post heat treatment	None / 450°C (840°F) 2h	

LASER WELDING

For laser welding Uddeholm Nimax laser weld rods are available, they are composed to be compatible with Uddeholm Nimax ESR. For further information see Uddeholm information leaflet "Uddeholm Laser Welding Rods".

TEXTURING

Uddeholm Nimax ESR is very suitable for texturing. The very low sulphur content and homogenous structure ensures an accurate and consistent pattern reproduction.

POLISHING

Uddeholm Nimax ESR has an excellent polishability. The low amount of inclusions and the homogenous structure ensures an excellent polishing result.

FURTHER INFORMATION

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

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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