# NIMAX ESR

## UDDEHOLM NIMAX ESR

ASSAB
a voestalpine company

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NIMAX ESR- 20260903-7

# GENERAL

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

Nimax ESR is characterised 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 % | C 0.1 | Si 0.3 | Mn 2.5 | Cr 3.0 | Mo 0.3 | Ni 1.0 |
|---|---|---|---|---|---|---|
| Delivery condition | 360 - 400 HB | | | | | |

# 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

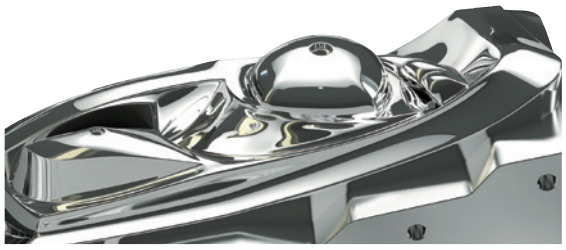
# PROPERTIES

## Physical data

| Temperature | 20 °C | 200 °C |
|---|---|---|
| Density kg/m$^3$ | 7 900 | - |
| Modulus of elasticity MPa | 205 000 | - |
| Coefficient of thermal expansion /°C from 20 °C | - | 12.4 x 10$^{-6}$ |
| Thermal conductivity W/m°C | - | 28 |
| Specific heat J/kg°C | 460 | - |

# 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 | 1 265 |
| Elongation, % | 11 |
| Area contraction, % | 47 |

## Compressive strength

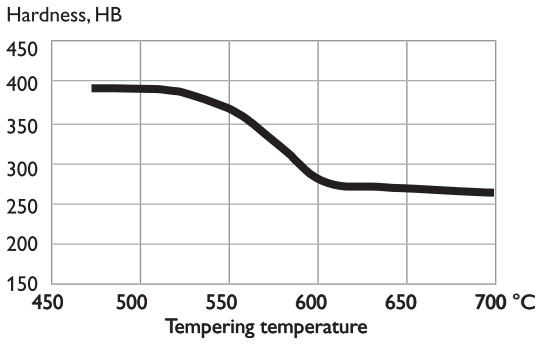
Hardness ~370 HB

| | |
|---|---|
| Compressive strength, $R_{c0.2}$ MPa | 1 000 |

# HEAT TREATMENT

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 hours 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, holding time 30 min. Cool in circulating air.

# SURFACE TREATMENT

## Flame and induction hardening

The surface hardness of Nimax ESR cannot be increased 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 thus reducing the amount of stresses and retained austenite content. This will minimise 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 | | |
|---|---|---|---|---|
| | | 10 h mm | 30 h mm | 60 h mm |
| Gas nitriding at 510 °C | 950 | **0.16** [1] | **0.28** [1] | **0.39** [1] |
| Plasma nitriding at 480 °C | 1 000 | 0.13 [2] | **0.25** [1] | **0.33** [1] |

[1] **Not recommended**
[2] Recommended

Nitriding at temperatures above 500 °C and longer than 10 hours is not recommended as it will reduce toughness and hardness significantly.

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

# 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 | | Turning with high speed steel |
|---|---|---|---|
| | Rough turning | Fine turning | Fine turning |
| Cutting speed ($V_c$) m/min | 110 – 150 | 150 – 200 | 10 – 15 |
| Feed (f) mm/rev | 0.2 – 0.4 | ≤ 0.3 | ≤ 0.3 |
| Depth of cut ($a_p$) mm | 2 – 4 | ≤ 2 | ≤ 2 |
| Carbide designation ISO | P20 – P30 Coated carbide | P10 Coated carbide | - |

## Drilling

### HIGH SPEED STEEL TWIST DRILL

| Drill diameter mm | Cutting speed (Vc) m/min | Feed (f) mm/rev |
|---|---|---|
| ≤ 5 | 12 – 14 * | 0.05 – 0.10 |
| 5–10 | 12 – 14 * | 0.10 – 0.20 |
| 10–15 | 12 – 14 * | 0.20 – 0.25 |
| 15–20 | 12 – 14 * | 0.25 – 0.30 |

* For coated HSS drill $v_c$ = 18 – 20 m/min.

### CARBIDE DRILL

| Cutting data parameter | Type of drill | | |
|---|---|---|---|
| | Indexable insert | Solid carbide | Carbide tipped [1] |
| Cutting speed ($V_c$) m/min | 150 – 170 | 100 – 130 | 90 – 110 |
| Feed. (f) mm/rev | 0.05 – 0.25 [2] | 0.10 – 0.25 [3] | 0.15 – 0.25 [4] |

[1] Drill with replaceable or brazed carbide tip
[2] Feed rate for drill diameter 20 – 40 mm
[3] Feed rate for drill diameter 5 – 20 mm
[4] Feed rate for drill diameter 10 – 20 mm

## Milling

### FACE AND SQUARE SHOULDER MILLING

| Cutting data parameter | Milling with carbide | |
|---|---|---|
| | Rough milling | Fine milling |
| Cutting speed ($V_c$) m/min | 80 – 150 | 150 – 180 |
| Feed ($f_z$) mm/tooth | 0.2 – 0.4 | 0.1 – 0.2 |
| Depth of cut ($a_p$) mm | 2 – 5 | ≤ 2 |
| Carbide designation ISO | P20 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 | 70 – 110 | 80 – 120 | 10 – 15 [1] |
| Feed. ($f_z$) mm/tooth | 0.03 – 0.20 [2] | 0.08 – 0.20 [2] | 0.05 – 0.35 [2] |
| Carbide designation ISO | – | P20 – P30 | – |

[1] For coated HSS end mill $v_c$ = 25 – 30 m/min.
[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 "Grinding of tool steel" brochure.

### 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 for 2 hours is recommended after welding.

| Welding method | TIG | MMA |
|---|---|---|
| Preheating temperature | None | None |
| Filler material | ASSAB 718 TIG Weld<br>Nimax TIG Weld | ASSAB 718 Weld |
| Max interpass temperature | 300 °C | |
| Cooling rate | Freely in air | |
| Hardness as welded | ASSAB 718 TIG Weld<br>320 - 340 HB<br>Nimax TIG Weld<br>360 - 400 HB | 330 - 350 HB |
| Post heat treatment | None / 450°C 2 h | |

## Laser welding

For laser welding Nimax laser weld rods are available, they are composed to be compatible with Nimax ESR.

# TEXTURING

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

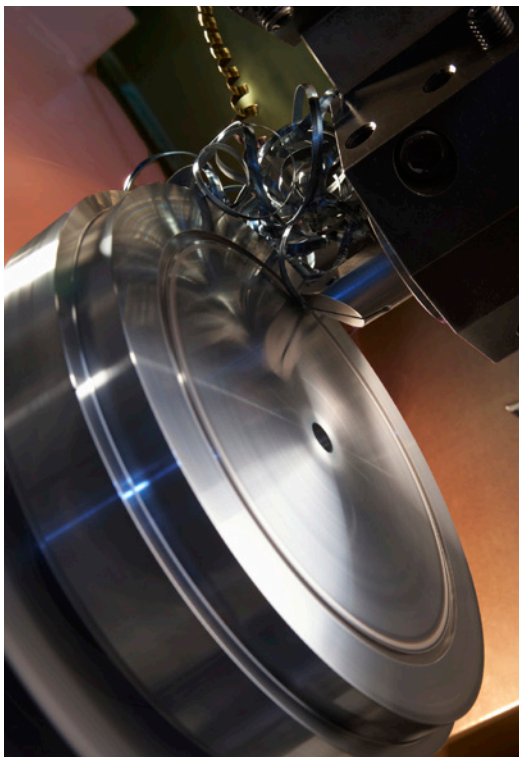
# POLISHING

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

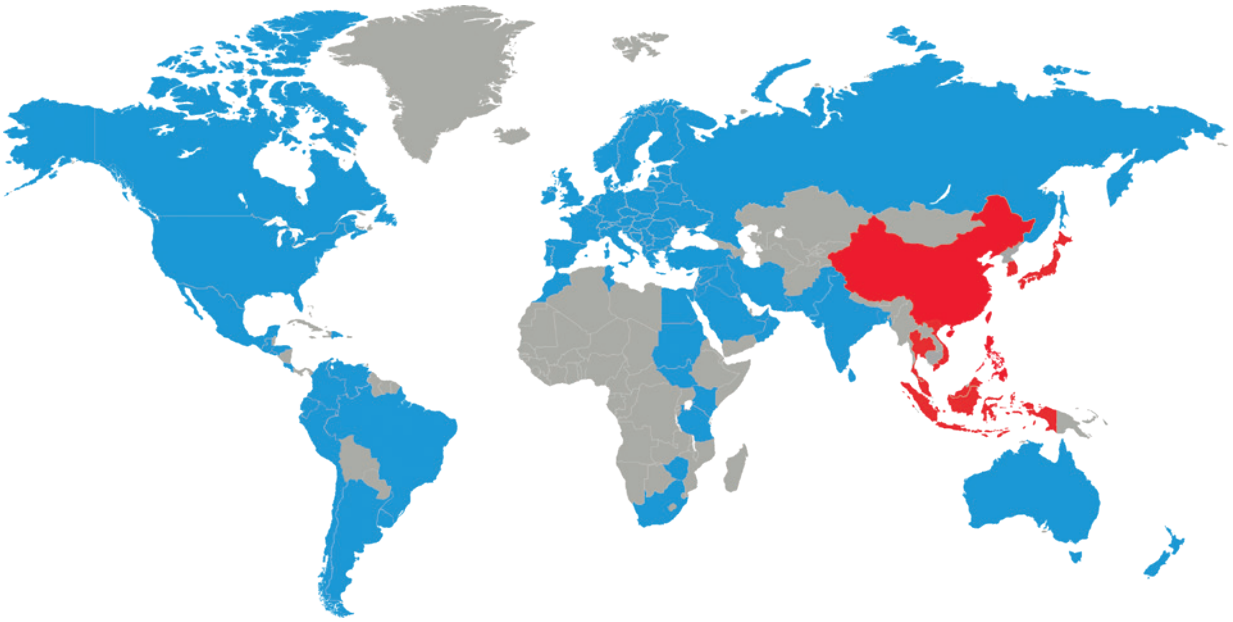
# FURTHER INFORMATION

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

# ASSAB
## SUPERIOR TOOLING SOLUTIONS
# A ONE-STOP SHOP



ASSAB is a one-stop product and service provider that offers superior tooling solutions. In addition to the supply of tool steel and other special steel, our range of comprehensive value-added services, such as machining, heat treatment and coating services, span the entire supply chain to ensure convenience, accountability and optimal usage of steel for customers. We are committed to achieving solutions for our customers, with a constant eye on time-to-market and total tooling economy.



Choosing the right steel is of vital importance. ASSAB engineers and metallurgists are always ready to assist you in your choice of the optimum steel grade and the most suitable treatment for each application. ASSAB not only supplies steel products of superior quality, but we also offer state-of-the-art machining, heat treatment, surface treatment services and additive manufacturing (3D printing) to enhance your tooling performance while meeting your requirements in the shortest lead time. Using a holistic approach as a one-stop solution provider, we are more than just another tool steel supplier.

In Asia Pacific, ASSAB anchors the distribution network for Uddeholm, a Swedish tool steel manufacturer with more than 350 years of experience in the tool steel industry. Both are integral parts of voestalpine AG, a prominent Austrian-based company listed on the Vienna Stock Exchange since 1995. Together, we establish ourselves as a key player in the steel and technology sector, with a diverse range of products and services.

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