

**Uddeholm**

**RoyAlloy™**

*Uddeholm RoyAlloy is produced by Edro Specialty Steels, Inc., a division of the voestalpine Group. RoyAlloy is covered by Edro Patents #6,045,633 and #6,358,344.*

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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".

Edition 2, 08.2017



## GENERAL

Uddeholm RoyAlloy is a patented free machining stainless holder steel, which is supplied in the prehardened condition.

Uddeholm RoyAlloy is characterised by:

- Excellent machinability
- Good dimensional stability
- Excellent weldability
- Good corrosion resistance
- Good ductility
- Uniform hardness in all dimensions
- Smooth as-rolled surfaces
- Good indentation resistance

Note: Uddeholm RoyAlloy is ultrasonic tested.

|                        |                                      |           |           |            |           |         |        |
|------------------------|--------------------------------------|-----------|-----------|------------|-----------|---------|--------|
| Typical analysis %     | C<br>0.05                            | Si<br>0.4 | Mn<br>1.2 | Cr<br>12.6 | S<br>0.12 | Cu<br>+ | N<br>+ |
| Standard specification | None (patented)                      |           |           |            |           |         |        |
| Delivery condition     | Hardened and tempered to ~310 HB     |           |           |            |           |         |        |
| Colour code            | Yellow/blue with a black line across |           |           |            |           |         |        |

## APPLICATIONS

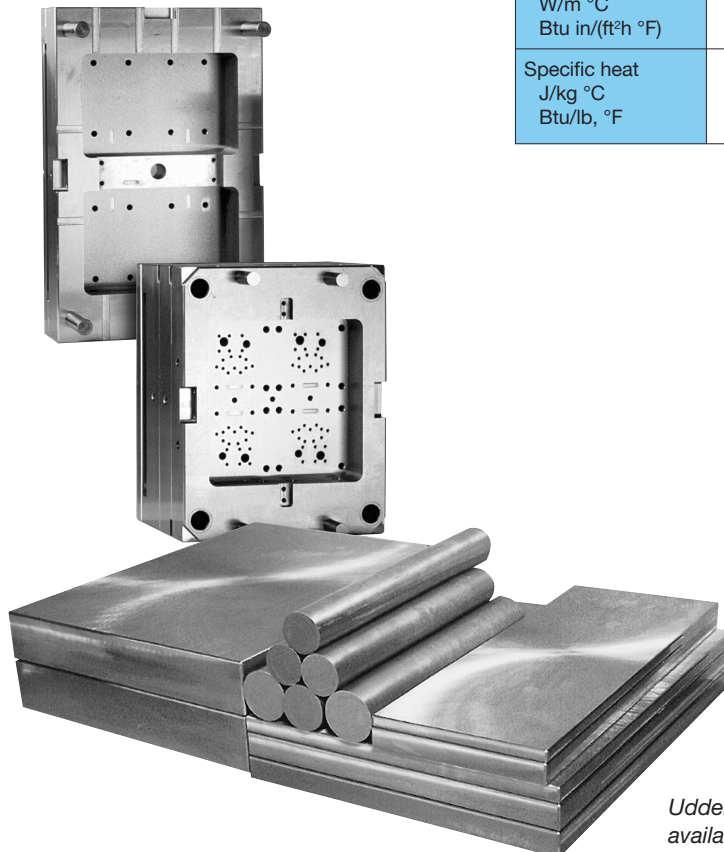
- Mould bases (holders/bolsters, cavity plates, support/backing plates, ejector plates)
- Plastic and rubber moulds with low demands on surface finish
- Dies for plastic extrusion
- Constructional parts

## PROPERTIES

### PHYSICAL DATA

Prehardened to 320 HB.

| Temperature  | 20°C<br>(68°F)                  | 100°C<br>(212°F) | 200°C<br>(392°F)                                  |
|--|---------------------------------|------------------|---|
| Density<br>kg/m <sup>3</sup><br>lbs/in <sup>3</sup>                | 7 800<br>0.284                  | –                | 7 750<br>0.282                                    |
| Modulus of elasticity<br>MPa<br>psi                                | 200 000<br>29 x 10 <sup>6</sup> | –                | 190 000<br>27.6 x 10 <sup>6</sup>                 |
| Coefficient of thermal expansion<br>/°C from 20°C<br>/°F from 68°F | –                               | –                | 11.0 x 10 <sup>-6</sup><br>6.1 x 10 <sup>-6</sup> |
| Thermal conductivity<br>W/m °C<br>Btu in/(ft <sup>2</sup> h °F)    | –                               | 27.5<br>191      | 28<br>194   |
| Specific heat<br>J/kg °C<br>Btu/lb, °F                             | –                               | 500<br>0.120     | 540<br>0.129                                      |



*Uddeholm RoyAlloy is available in both flats and rounds.*

## MECHANICAL PROPERTIES

### IMPACT STRENGTH

The energy absorption at impact testing depends on the test material (bar size and delivered hardness), test temperature and specimen (type, location, and orientation in the bar).

Charpy-V-notch impact toughness at room temperature tested in the LT-direction. Plate thickness 76 mm (3").

|                                |          |
|--------------------------------|----------|
| Hardness                       | 320 HB   |
| Impact energy<br>J<br>ft • lbs | 22<br>16 |

### COMPRESSIVE STRENGTH

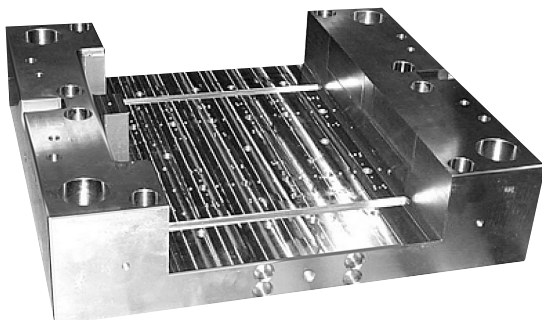
Approximate values.

|   |                |
|---|----------------|
| Hardness                                  | 320 HB         |
| Compressive strength, Rc0.2<br>MPa<br>psi | 760<br>110 100 |

### TENSILE STRENGTH

Approximate values. Longitudinal specimens tested at room temperature.

|                                     |                  |
|-------------------------------------|------------------|
| Hardness                            | 320 HB           |
| Yield strength, Rp0.2<br>MPa<br>psi | 890<br>129 000   |
| Tensile strength, Rm<br>MPa<br>psi  | 1 070<br>155 100 |
| Elongation, A5<br>%                 | 12               |
| Reduction of area, Z<br>%           | 34               |



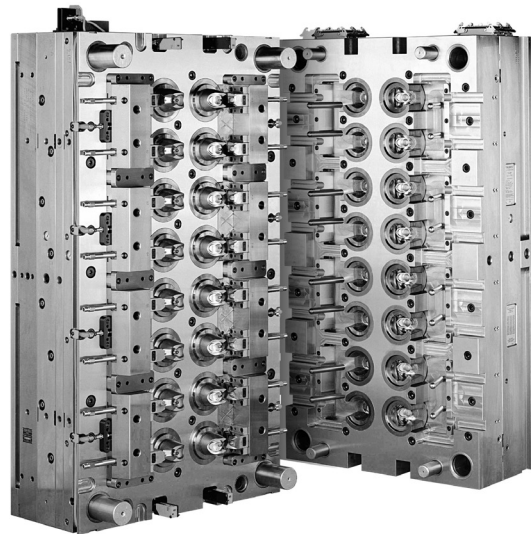
## CORROSION RESISTANCE

Uddeholm RoyAlloy was developed with a chemical composition adjusted to sufficiently provide good corrosion resistance during tool operation and storage. Tools made from Uddeholm RoyAlloy will have good resistance to corrosion caused by humid working and storage condition, and when moulding corrosive plastics under normal production conditions.

## HEAT TREATMENT

Uddeholm RoyAlloy is supplied in the prehardened condition with through-hardness of 290–330 HB. Each plate is carefully hardness-tested to ensure consistency.

Uddeholm RoyAlloy is intended for use in prehardened condition (i.e. delivery condition), no further heat treatment is generally required.



*Uddeholm RoyAlloy is the preferred steel of choice of many mould makers and end users. The steel provides enhanced machinability, improved dimensional stability and superior surface finishes compared with AISI 420F/W.-Nr. 1.2085 type of steel.*

*Uddeholm RoyAlloy remains dimensionally stable even after extensive machining of 152 x 711 x 813 mm. 0.15 mm distorsion, corner to corner.*

# MACHINING RECOMMENDATIONS

The cutting data below are to be considered as guidelines and may require adjustments based on equipment, selection of cutting tools, etc.

Condition: prehardened approx. 320 HB

## TURNING

| Cutting data parameter                     | Turning with carbide               |  | Turning with HSS*<br>Fine turning |
|--|------------------------------------|--|-----------------------------------|
|  | Rough turning                      | Fine turning                                 |                                   |
| Cutting speed ( $v_c$ )<br>m/min<br>f.p.m. | 130–190<br>430–620                 | 190–250<br>620–820                           | 25–28<br>80–90                    |
| Feed (f)<br>mm/r<br>i.p.r.                 | 0.2–0.4<br>0.008–0.016             | 0.05–0.2<br>0.002–0.008                      | 0.05–0.3<br>0.002–0.01            |
| Depth of cut ( $a_p$ )<br>mm<br>inch       | 2–4<br>0.08–0.16                   | 0.5–2<br>0.02–0.08                           | 0.5–3<br>0.02–0.1                 |
| Carbide designation ISO<br>US              | P20–P30<br>C6–C5<br>Coated carbide | P10–P20<br>C7–C6<br>Coated carbide or cermet | –<br>–                            |

\*HSS = High Speed Steel

## MILLING

### FACE AND SQUARE SHOULDER MILLING

| Cutting data parameter                     | Milling with carbide               |  |
|--|------------------------------------|--|
|  | Rough milling                      | Fine milling                                 |
| Cutting speed ( $v_c$ )<br>m/min<br>f.p.m. | 130–190<br>430–620                 | 190–250<br>620–820                           |
| Feed ( $f_z$ )<br>mm/tooth<br>in/tooth     | 0.2–0.4<br>0.008–0.016             | 0.1–0.2<br>0.004–0.008                       |
| Depth of cut ( $a_p$ )<br>mm<br>inch       | 2–5<br>0.08–0.2                    | ≤2<br>≤0.08                                  |
| Carbide designation ISO<br>US              | P20–P40<br>C6–C5<br>Coated carbide | P10–P20<br>C7–C6<br>Coated carbide or cermet |

## END MILLING

| Cutting data parameter                     | Type of end mill                                       |  |   |
|--|--|--|---|
|  | Solid carbide  | Carbide indexable insert                             | HSS   |
| Cutting speed ( $v_c$ )<br>m/min<br>f.p.m. | 80–120<br>260–390                                      | 120–170<br>390–560                                   | 35–40 <sup>1)</sup><br>115–130                        |
| Feed ( $f_z$ )<br>mm/tooth<br>in/tooth     | 0.006–0.20 <sup>2)</sup><br>0.0002–0.008 <sup>2)</sup> | 0.06–0.20 <sup>2)</sup><br>0.002–0.008 <sup>2)</sup> | 0.01–0.35 <sup>2)</sup><br>0.0004–0.014 <sup>2)</sup> |
| Carbide designation ISO<br>US              | –  | P15–P40<br>C6–C5                                     | –   |

<sup>1)</sup> For coated HSS end mill  $v_c = 60–66$  m/min (197–217 f.p.m.)

<sup>2)</sup> Depending on radial depth of cut and cutter diameter

## DRILLING

### HIGH SPEED STEEL TWIST DRILLS

| Drill diameter |          | Cutting speed ( $v_c$ ) |        | Feed (f)  |             |
|----------------|----------|-------------------------|--------|-----------|-------------|
| mm             | inch     | m/min                   | f.p.m. | mm/r      | i.p.r.      |
| –5             | –3/16    | 17–19*                  | 56–62* | 0.05–0.10 | 0.002–0.004 |
| 5–10           | 3/16–3/8 | 17–19*                  | 56–62* | 0.10–0.20 | 0.004–0.008 |
| 10–15          | 3/8–5/8  | 17–19*                  | 56–62* | 0.20–0.25 | 0.008–0.010 |
| 15–20          | 5/8–3/4  | 17–19*                  | 56–62* | 0.25–0.30 | 0.010–0.014 |

\* For coated HSS drill  $v_c = 29–31$  m/min (95–102 f.p.m.)

## CARBIDE DRILL

| Cutting data parameter                     | Type of drill  |  |  |
|--|--|--|--|
|  | Indexable insert                                     | Solid carbide  | Carbide tip <sup>1)</sup>                            |
| Cutting speed ( $v_c$ )<br>m/min<br>f.p.m. | 215–240<br>715–790                                   | 110–130<br>360–427                                   | 70–110<br>230–360                                    |
| Feed, (f)<br>mm/r<br>i.p.r.                | 0.05–0.15 <sup>2)</sup><br>0.002–0.006 <sup>2)</sup> | 0.10–0.25 <sup>3)</sup><br>0.004–0.010 <sup>3)</sup> | 0.15–0.25 <sup>4)</sup><br>0.006–0.010 <sup>3)</sup> |

<sup>1)</sup> Drill with replaceable or brazed carbide tip

<sup>2)</sup> Feed rate for drill diameter 20–40 mm (0.8”–1.6”)

<sup>3)</sup> Feed rate for drill diameter 5–20 mm (0.2”–0.8”)

<sup>4)</sup> 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             | Delivery condition |
|------------------------------|--------------------|
| Face grinding straight wheel | A 46 HV            |
| Face grinding segments       | A 36 GV            |
| Cylindrical grinding         | A 60 KV            |
| Internal grinding            | A 60 JV            |
| Profile grinding             | A 120 JV           |

## WELDING

Uddeholm RoyAlloy is readily weldable with RoyAlloy filler metal or several standard stainless filler metals, using TIG (GTAW) and MMA (SMAW) processes.

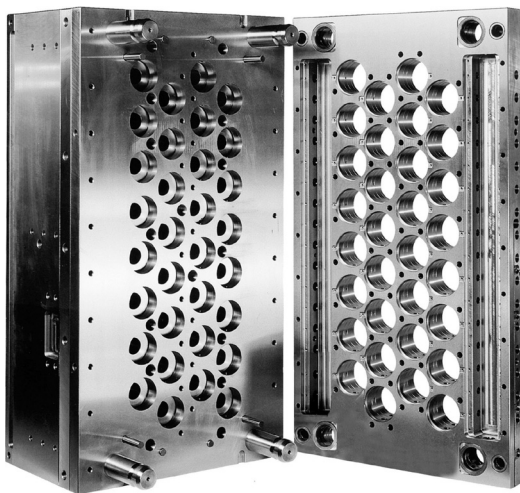
For best results, use Uddeholm RoyAlloy welding electrodes. To provide an optimal match with the base metal in terms of chemical composition and mechanical properties Uddeholm RoyAlloy filler material is recommended. The weld metal hardness after welding will become 34–38 HRC. The welding consumable, as TIG filler rod, is available in  $\varnothing$  0,9 mm and  $\varnothing$  1,8 mm.

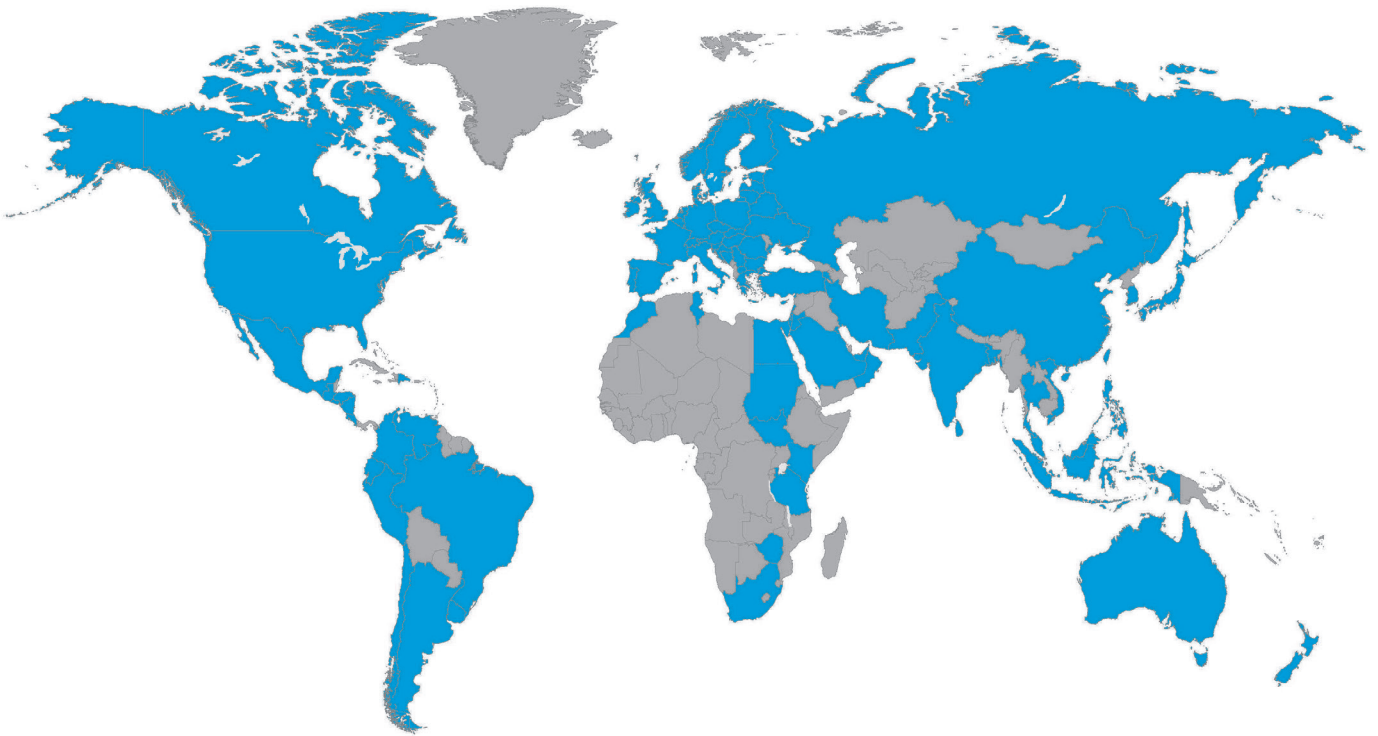
Neither preheating nor postheating is necessary. Uddeholm RoyAlloy does not develop an overhardened heat-affected zone (HAZ) around the weld deposit. This eliminates the concern of weld-induced cracking during repair or, subsequently, during service.

Stress relieving is recommended for large weld repairs to reduce residual stresses. Max. stress relieving temperature 485°C.

## FURTHER INFORMATION

Please contact your local Uddeholm office for further information on the selection, heat treatment and application of Uddeholm tool steel, including the publication “Uddeholm tool steels for Moulds”.





## **NETWORK OF EXCELLENCE**

Uddeholm is present on every continent. This ensures you high-quality Swedish tool steel and local support wherever you are. Our goal is clear – to be your number one partner and tool steel provider.

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 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](http://www.uddeholm.com)