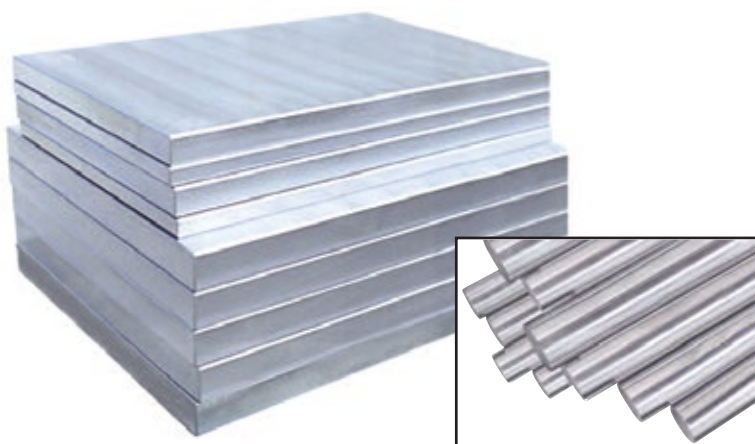


PRECIPITATION HARDENING STAINLESS MOLD STEEL



APPLICATIONS

- Ultimate mold base
- Cavities for plastics & rubber molds
- Stainless mold with corrosion resistance
- Plastic extrusion dies

UltraChem® is a chromium-nickel precipitation-hardening stainless steel, a modified PH alloy grade, which is characterized by:

- Exceptional corrosion resistance
- Uniform hardness in all dimensions
- Excellent compressive strength
- Simple low temperature hardening treatment with minimal dimensional change
- Good weldability

UltraChem is normally supplied in a fully heat treated condition, age hardened to 38 to 42 HRC. Age-hardening has a number of advantages:

- Distortion is virtually eliminated - only a small, predictable shrinkage is experienced (approx. 0.0005 in. per in.)
- Uniform hardness throughout thick sections, with minimum risk of cracking.
- No scaling or decarburization of the part.

UltraChem's excellent corrosion resistance reduces both mold maintenance costs and production costs. Consistently high molding productivity is assured since cooling channels are not subjected to corrosion and loss of cooling efficiency.

UltraChem is recommended for use in long life molds and dies subjected to severe working conditions, including corrosive materials and atmospheres, high stressed and indentation experienced in today's fast cycling molding operations.

| | | | | |
|--------------------|------------------------------------------------|-------------------------|------------------------|-------------------------------|
| Typical Analysis % | C .05 | Mn .70 Ni 4.50 | S .08 Cu 3.20 | Cr 14.75 Nb + Ta .30 |
| Delivery condition | Prehardened to 38-42 RC Hardness is Uniform | | | |
| Color code | White | | | |

PROPERTIES

PHYSICAL DATA

Age-hardened to 42 HRC. Data at room elevated temperatures.

| Temperature | 68°F (20°C) | 390°F (200°C) | 750°F (400°C) |
|--------------------------------------------------------------------|-----------------------------------|---------------------------------------------------|---------------------------------------------------|
| Density kg/m ³ lbs/in ³ | 7,800 0.284 | 7,750 0.282 | 7,700 0.280 |
| Modules of Elasticity N/mm ² psi | 196,000 28.5 x 10 ⁶ | 185,000 27.0 x 10 ⁶ | 174,400 25.4 x 10 ⁶ |
| Coefficient of Thermal Expansion /°C from 20°C /°F from 68°F | - - | 10.8 x 10 ⁻⁶ 6.0 x 10 ⁻⁶ | 11.7 x 10 ⁻⁶ 6.5 x 10 ⁻⁶ |
| Thermal Conductivity W/m °C Btu in (ft ² h°F) | 0.161 112 | 0.186 129 | 0.215 149 |
| Specific heat J/kg °C Btu/lb°F | 460 0.110 | - - | - - |

TENSILE STRENGTH

Typical values. Age hardened condition at 42 HRC.

| Testing Temperature 68°F (20°C) | psi | N/mm ² |
|------------------------------------|---------|-------------------|
| Tensile Strength | 190,000 | 1310 |
| Yield Strength | 175,000 | 1208 |
| Reduction of Area | 50% | |
| Elongation in 2" | 14% | |

IMPACT STRENGTH

Typical values. Age hardened condition at 42 HRC.

| Testing Temperature 68°F (20°C) | ft/lbs. | joules |
|------------------------------------|---------|--------|
| Impact Strength | 25 | 30 |

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. 375 HB

Coolant Recommended

TURNING

| Cutting data parameter | Turning with carbide | | Turning with HSS* Fine turning |
|--------------------------------------------|----------------------|----------------|-----------------------------------|
| | Rough turning | Fine turning | |
| Cutting speed (v_c) m/min f.p.m. | 130-190 | 190-250 | 25-28 |
| | 430-620 | 620-820 | 80-90 |
| Feed (f) mm/r i.p.r. | 0.15-0.3 | 0.0375-0.15 | 0.0375-0.225 |
| | 0.006-0.012 | 0.0015-0.006 | 0.0015-0.0075 |
| Depth of cut (a_p) mm inch | 2-4 | 0.5-2 | 0.5-3 |
| | 0.08-0.16 | 0.02-0.08 | 0.02-0.1 |
| Carbide designation | ISO | P20-P30 | P10-P20 |
| | US | C6-C5 | C7-C6 |
| | | Coated carbide | Coated carbide or cermet |
| | | | |

*HSS = High Speed Steel

MILLING

FACE AND SQUARE SHOULDER MILLING

| Cutting data parameter | Milling with carbide | |
|--------------------------------------------|----------------------|--------------------------|
| | Rough milling | Fine milling |
| Cutting speed (v_c) m/min f.p.m. | 130-190 | 190-250 |
| | 430-620 | 620-820 |
| Feed (f_z) mm/tooth in/tooth | 0.15-0.3 | 0.075-0.15 |
| | 0.006-0.012 | 0.003-0.006 |
| Depth of cut (a_p) mm inch | 2-5 | ≤2 |
| | 0.08-0.2 | ≤0.08 |
| Carbide designation | ISO | P20-P40 |
| | US | C6-C5 |
| | | Coated carbide |
| | | Coated carbide or cermet |

END MILLING

| Cutting data parameter | Type of end mill | | |
|--------------------------------------------|----------------------------|---------------------------|----------------------------|
| | Solid carbide | Carbide indexable insert | HSS |
| Cutting speed (v_c) m/min f.p.m. | 80-120 | 120-170 | 35-40 ¹⁾ |
| | 260-390 | 390-560 | 115-130 |
| Feed (f_z) mm/tooth in/tooth | 0.0045-0.15 ²⁾ | 0.045-0.15 ²⁾ | 0.0075-0.26 ²⁾ |
| | .00015-0.006 ²⁾ | .0015-0.006 ²⁾ | .0003-0.0105 ²⁾ |
| Carbide designation | - | P15-P40 | - |
| | | C6-C5 | |

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

²⁾ 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* | 0.03-0.057 | 0.0015-0.003 |
| 5-10 | 3/16-3/8 | 17-19* | 56-62* | 0.057-0.11 | 0.003-0.006 |
| 10-15 | 3/8-5/8 | 17-19* | 56-62* | 0.11-0.14 | 0.006-0.0075 |
| 15-20 | 5/8-3/4 | 17-19* | 56-62* | 0.14-0.17 | 0.0075-0.01 |

*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 ¹⁾ |
| Cutting speed (v_c) m/min f.p.m. | 215-240 | 110-130 | 70-110 |
| | 715-790 | 360-427 | 230-360 |
| Feed (f_z) mm/r i.p.r. | 0.04-0.11 ²⁾ | 0.11-0.19 ³⁾ | 0.11-0.19 ⁴⁾ |
| | 0.015-0.045 ²⁾ | 0.003-0.075 ³⁾ | 0.0045-0.0075 ³⁾ |

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.

| 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

Weld overlays of worn areas and repair welds up to 1" deep can be made on Ultrachem in the aged condition using shielded metal arc welding with W17-4 PH electrodes. In contrast to other die holder block steels no preheating is required to produce sound welds in Ultrachem regardless of its pre-weld condition.

However, welds should be stressed relieved at 900°F for 1 hour per inch of thickness after welding.

SERVICES

Saw cutting, Blanchard grinding up to 120" diameter and Surface grinding up to 40" x 192".

CORROSION RESISTANCE

The corrosion resistance of Ultrachem makes it highly resistant to rusting from water and humidity. Cooling channels will remain clean indefinitely for maximum cooling efficiency. It can be safely stored without surface deterioration. It better resists corrosion from the more highly corrosive plastics than AISI 420 stainless steels.

STOCK

Sizes up to 8" thick are available from warehouse stock, saw cut to customer's width and length. Sizes above 8" can be produced to customer's exact requirements as individual forgings from billet stock.

ULTRACHEM GRADES COMPARISON CHART

EDRO ULTRACHEM®

| Application Edro Grade | Non-Critical Surface Ultrachem | | | | High Quality Surfaces Ultrachem-ESR | | | | Critical/Reflective Surfaces Ultrachem-ESR XTRA | | | | | | |
|-------------------------------|-----------------------------------|-----|-----|-----|----------------------------------------|-------|-----|-----|----------------------------------------------------|-----|-------|-----|-----|-----|-----|
| | Type | A | B | C | D | Type | A | B | C | D | Type | A | B | C | D |
| Cleanliness - ASTM E45 | Thin | 2.0 | 1.5 | 1.0 | 1.5 | Thin | 0.5 | 1.0 | 1.0 | 1.0 | Thin | 0.5 | 0.5 | 0.5 | 0.5 |
| | Heavy | 1.0 | 1.0 | 0.5 | 1.0 | Heavy | 0 | 0.5 | 0.5 | 0.5 | Heavy | 0 | 0 | 0 | 0 |
| Hardness | 38 - 42 HRC | | | | 38 - 42 HRC | | | | 38 - 42 HRC | | | | | | |
| Microstructure | Tempered Martensite | | | | Tempered Martensite | | | | Tempered Martensite | | | | | | |
| Grain Size - ASTM E112 | 5 or Finer | | | | 5 or Finer | | | | 6 or Finer | | | | | | |
| Hot Work Ratio | 3:1 minimum | | | | 3:1 minimum | | | | 4:1 minimum | | | | | | |
| Certification | On Request | | | | On Request | | | | On Request | | | | | | |
| Ultrasonic Rejection Criteria | 8/64" Diameter FBH | | | | 5/64" Diameter FBH | | | | 3/64" Diameter FBH | | | | | | |

Chemical Analysis of Ultrachem Series

| Element | C | Mn | P | ³² S | Si | Cr | Ni | Cu | Nb + Ta |
|---------|-----|-----|------|-----------------|-----|-------|------|------|---------|
| Aim | .05 | .70 | LAP | .08 | .30 | 14.75 | 4.50 | 3.50 | .30 |
| Min. | .04 | .55 | - | .06 | .20 | 14.25 | 4.25 | 3.30 | .25 |
| Max. | .06 | .85 | .030 | .10 | .40 | 15.25 | 4.75 | 3.70 | .45 |

³²Sulfur for Ultrachem ESR will be .015 max. Sulfur for Ultrachem ESR XTRA will be .003 max.