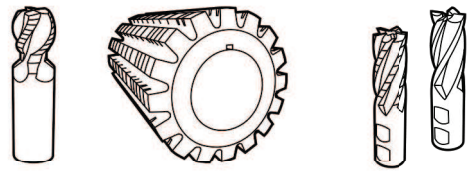
# TOOL ALLOYS
# DATA SHEET CPM® REX 121

CERTIFIED TO ISO 9001



## CHEMICAL COMPOSITION

| | |
|---|---|
| Carbon | 3.40 % |
| Chromium | 4.00 % |
| Vanadium | 9.50 % |
| Tungsten | 10.00 % |
| Cobalt | 9.00 % |
| Molybdenum | 5.00 % |

**CPM® REX 121**
is a new high vanadium cobalt bearing tool steel designed to offer a combination of the highest wear resistance, attainable hardness, and red hardness available in a high speed steel. Its superior red hardness permits higher cutting speeds compared to other high speed steels. Its superior wear resistance (due to the high vanadium content) helps maintain a sharp cutting edge at increased cutting speeds.
CPM® Rex 121 also bridges the performance gap between high alloy tool steels and carbide materials. It may be used in cutting tools, where high cutting speeds demand higher heat resistance, but carbide is too brittle, or in high wear tooling applications (punches and dies) where carbide tools are too fragile. Because of the extremely fine and uniform CPM microstructure, sulphur may be added if desired, to improve the machinability. The higher sulphur content benefits the toolmaker by allowing ease of manufacture and the tool user by allowing easier re-sharpening.

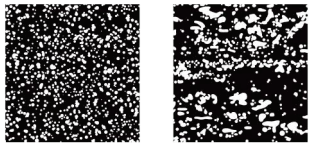
## TYPICAL APLICATIONS

_ End mills
_ Form tools
_ Milling cutters
_ Shaper cutters
_ Broaching tools
_ Tool bits
_ Wear parts

## PHYSICAL PROPERTIES

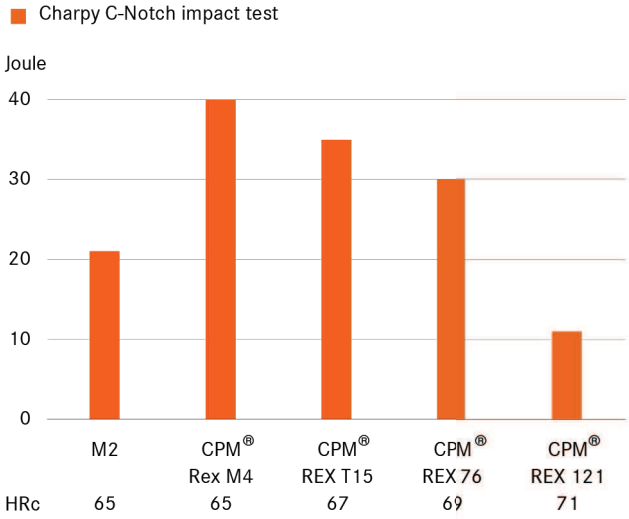
| | |
|---|---|
| Modulus of elasticity E [kN/mm² ] | 214 |
| Specific weight [kg/dm³] | 8.25 |

## POWDER METALLURGICAL AND CONVENTIONAL MICROSTRUCTURE



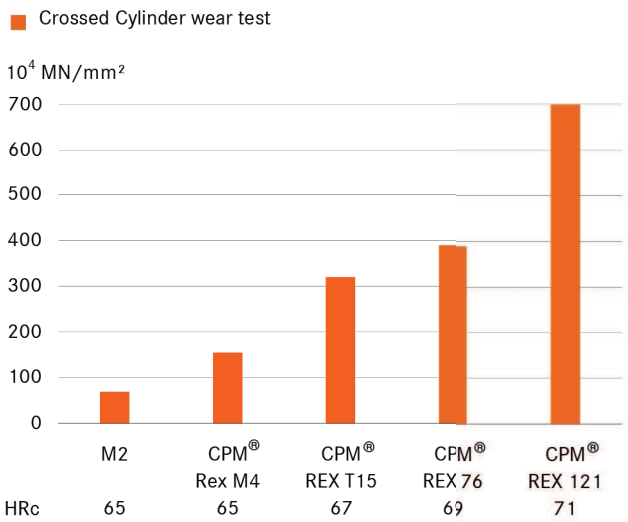
The uniform distribution of carbides in the powder-metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

## TOUGHNESS




Standard size of the Charpy-test-piece with a 12.7 mm notch radius.

## WEAR RESISTANCE




Reciprocal of wear rate in wear test with non lubricated crossed cylinder in contact with a rotation tungsten carbide cylinder.

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## HEAT TREATMENT

### ANNEALING

CPM® Rex 121 is heated slowly and uniform to a temperature of 900 °C, maintains the temperature for 2 hours and allows to cooling to 590 °C in the furnace at a cooling rate no faster than 15 °C. It is then further cooled in still air down to room temperature. The typical annealed hardness achieved by a soft annealing is approximately HB360/410.

### STRESS RELIEVING

Stress relieving follows rough machining by heating to 600 - 700 °C. Once complete heat penetration has been reached, the material is allowed to cool in the furnace to approx. 500 °C followed by cooling in air.

### HARDENING

Hardening CPM® Rex 121 usually involves the use of 2 - 3 preheating stages (450 – 500 °C / 850 – 900 °C / 1010-1065°C). Immediately following this it is heated to the required austenitizing temperature of 1025 – 1225 °C.

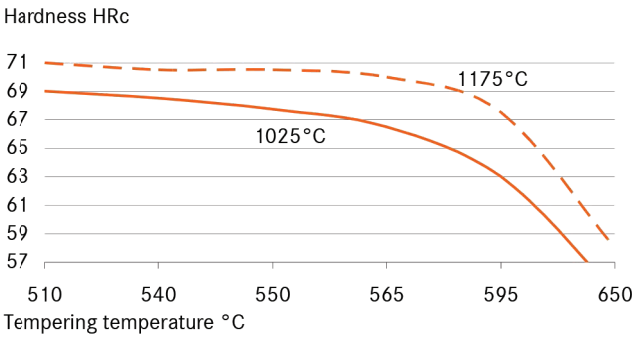
### QUENCHING

Air, hot bath or interrupted oil quenching can be used. In case of vacuum heat treatment, due regard is to be given to applying an appropriate quenching rate (at least at 5 bar pressure). For attaining ideal toughness properties it is recommended to apply the bath quenching method.

### TEMPERING

Immediately temper after the material has cooled down below 40°C. Triple tempering with a holding time of 2 hours is each stage at the tempering temperature is necessary. Normally CPM® Rex 121 is tempered with a temperature range of 550 – 595 °C.

### TEMPERING DIAGRAM




### HEAT TREATMENT INSTRUCTIONS

| | |
|---|---|
| 1st preheating | 450–500 °C |
| 2nd preheating | 850–900 °C |
| Hardening | As specified in table |
| Tempering | 3 x each 2 hours as specified in table |

Quenching after hardening in hot bath at approx. 550°C or in vacuum at least at 5 bar overpressure.

| Required hardness HRc ± 1 | Austenitizing temperature °C | * Holding time at austenitizing temperature, sec. | Tempering temperature °C |
|---|---|---|---|
| 55 | 1025 | 30 | 650 |
| 60 | 1225 | 5 | 650 |
| 63 | 1025 | 30 | 595 |
| 67 | 1025 | 30 | 565 |
| 68 | 1025 | 30 | 550 |
| 68 | 1205 | 10 | 595 |
| 69 | 1120 | 20 | 550 |
| 70 | 1175 | 15 | 550 |
| 71 | 1205 | 10 | 550 |

* Previous preheating at 870 °C.
The data referred to 13 mm round bar samples. The holding times at austenitizing temperature should be correspondingly adapted for large and very thin profile dimensions. The maximum permissible austenitizing temperature of 1205 °C must not be exceeded.
Holding time sec./mm

## MACHINING DATA

### TURNING

| Cutting parameter | Turning with cemented carbide medium turning | finish turning | HSS |
|---|---|---|---|
| Cutting speed ($V_C$) m/min. | 80-110 | 110-150 | 15-20 |
| Feed (f) mm/U | 0.2–0.4 | 0.05–0.2 | 0.05–0.3 |
| Cutting depth ($a_p$) mm | 2–4 | 0.05–2 | 0.5–3 |
| Tools according ISO | P 10–P 20* | P 20* | – |

* Use wear resistant coated cemented carbide, e. g. Coromant 4015 or Seco TP 100.

### MILLING

FACE- AND EDGEMILLING

| Cutting parameter | Milling with cemented carbide medium turning | finish turning | HSS |
|---|---|---|---|
| Cutting speed ($V_C$) m/min. | 80-130 | 130-160 | 15 |
| Feed (f) mm/U | 0.2–0.3 | 0.1–0.2 | 0.1 |
| Cutting depth ($a_p$) mm | 2–4 | 1–2 | 1–2 |
| Tools according ISO | K 15* | K 15* | – |

* Use wear resistant coated cemented carbide, e. g. Coromant 4015 or Seco TP 100.

END MILLING

| | Solid carbide | Milling cutter w. indexable tips | Coated HSS |
|---|---|---|---|
| Cutting speed ($V_C$) m/min. | 45-50 | 90-110 | 5-8 |
| Feed (f) mm/U | 0.01–0.20** | 0.06–0.20** | 0.01–0.30** |
| Tools according ISO | K 20 | P 25*** | – |

* for TiCN-coated end mills made of HSS $V_C$ ~ 25-30 m/min.
** depends on radial depth of cut and on milling cutter - diameter
*** Use wear resistant coated cemented carbide, e. g. Coromant 3015 or SECO T15M.

### DRILLING

SPIRAL DRILL MADE OF HSS

| Driller-⌀ mm | Cutting speed ($V_C$) m/min. | Feed (f) mm/U |
|---|---|---|
| 0 – 5 | 10-12* | 0.05–0.15 |
| 5 – 10 | 10-12* | 0.15–0.25 |
| 10 – 15 | 10-12* | 0.25–0.35 |
| 15 – 20 | 10-12* | 0.35–0.40 |

* for TiCN-coated end mills made of HSS $V_C$ ~ 25-30 m/min.

CARBIDE METAL DRILLER

| Cutting parameter | Drill type insert drill | Solid carbide tip | Coolant bore driller with carbide tip* |
|---|---|---|---|
| Cutting speed ($V_C$) m/min. | 120-150 | 60-80 | 35 |
| Feed (f) mm/U | 0.08–0.14** | 0.10–0.15** | 0.10–0.20** |

* driller with coolant bores and a soldered on carbide tip
** depends on driller-diameter

### GRINDING

| Grinding method | soft annealed | hardened |
|---|---|---|
| Surface grinding, straight grinding wheels | A 13 HV | B 107 R75 B3*<br>3SG 46 GVS**<br>A 46 GV |
| Surface grinding | A 24 GV | 3SG 36 HVS** |
| Cylindrical grinding | A 60JV | B126 R75 B3*<br>3SG 60 KVS**<br>A 60 IV |
| Internal grinding | A 46 JV | B126 R75 B3*<br>3SG 80 KVS**<br>A 60 HV |
| Profile grinding | A 100 LV | B126 R100 B6*<br>5SG 80 KVS**<br>A 120 JV |

* for these applications we recommend CBN-wheels
** frinding wheel from the company Norton Co.

# TOOL ALLOYS
# STOCK LIST CPM® REX 121

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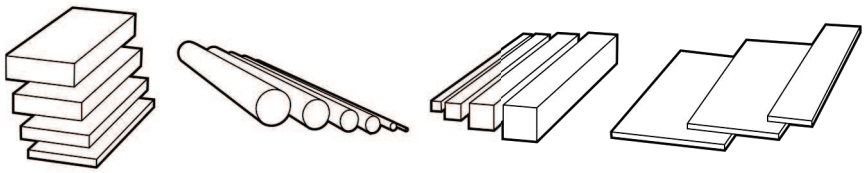

The sizes indicated below are usually available in a machined execution and can be considered as finished sizes.

| ROUND BAR DIMENSIONS |
|---|
| 65.0 mm |
| 90.4 mm |
| 128.6 mm |

Further dimensions are available within 3-4 weeks after request.

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