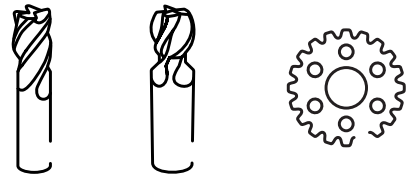
CPM® Rex 76 Data Sheet
Tooling Alloys

Zapp is Certified to ISO 9001



Chemical Composition	
Carbon	1.5 %
Chromium	3.8 %
Vanadium	3.1 %
Molybdenum	5.3 %
Tungsten	9,7 %
Cobalt	8.5 %

CPM® REX 76

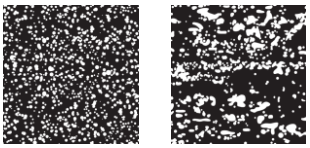
is a developed high-speed steel produced by the special Crucible Particle Metallurgy process. Its high carbon, vanadium and cobalt content provide the same wear resistance compared to CPM® Rex 15 in conjunction with outstanding elevated temperature hardness. CPM® Rex 76 achieves maximum attainable hardness values up to 70 HRC. The high degree of hardness, the fine austenite grain size and the finely dispersed carbides facilitate economical use of CPM® Rex 76 for special tools used for the purpose of machining difficult materials.

Typical Applications

_ cylindrical milling cutters
_ end milling
_ broaches
_ reamers
_ thread taps
_ gear cutting tools
_ profile turning tools and furthermore

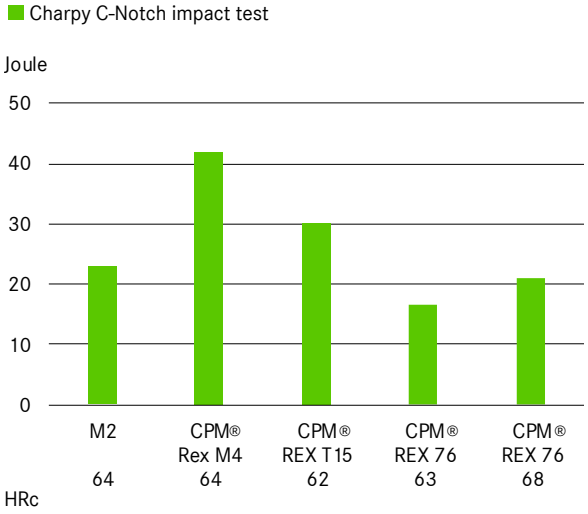
Physical Properties	
Modulus of elasticity E [kN/mm²]	218
Specific weight [kg/dm³]	8.26
Thermal conductivity [W/mk]	24.2
Coefficient of thermal expansion over temperature range of 40 - 540 °C [mm/mm °C]	10.9 x 10^{-6}

Powder metallurgical and conventional microstructure



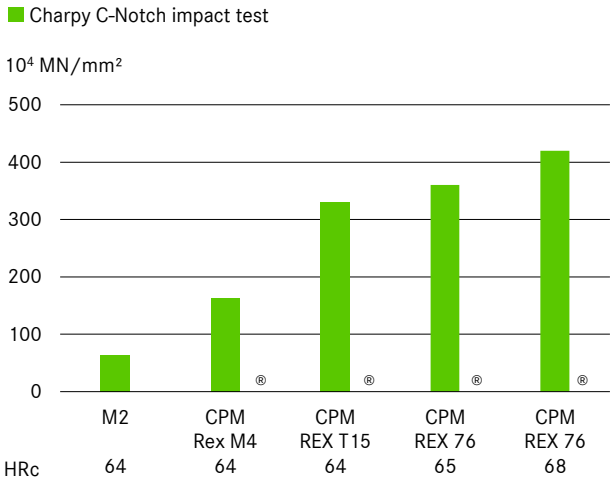
The uniform distribution of carbides in the powder- metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

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.

Heat Treatment Annealing

Soft Annealing
CPM® Rex 76 is heated uniformly to a temperature of 860 - 870 °C; maintained at this temperature for 2 hours and allowed to cool to 550°C in the furnace at a cooling rate of 10 °C per hour. This is followed by cooling in still air. The strength values achieved by soft annealing are HB 285/ 310.

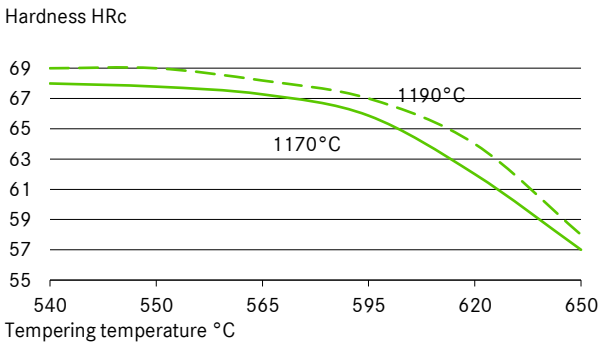
Stress Relieving
Stress relieving follows rough machining by heating to a temperature of 600 – 700 °C. After complete heat penetration has been reached, the material is allowed to cool in the furnace to approx. 500 °C, followed by cooling in air.

Hardening
Hardening of CPM® Rex 76 usually involves the use of 2 - 3 pre heating stages (450 – 500 °C / 850 – 900 °C / 1050 °C). The material is then rapidly heated from the preheating temperature to the austenitizing temperature of 1150 – 1205 °C. High austentizing temperature results in high elevated temperature hardness while a low austenitizing temperature provides improved toughness. The austenitizing temperature is normally 1180 °C to 1195 °C. We recommend hardening in salt bath. Standard guidelines for conventional high speed steels can be applied.

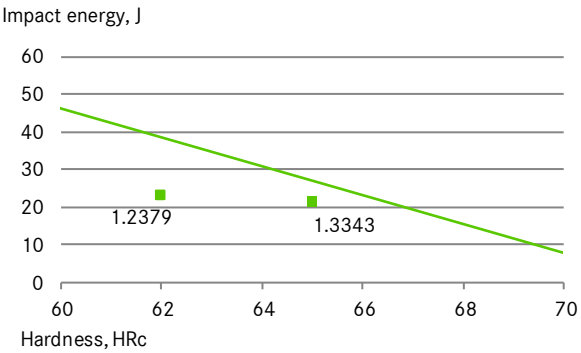
Quenching
Quenching can take place in oil, air or pressurized gas. Hot bath quenching at approx. 550°C is recommended. This provides flaw-free surfaces and avoids the risk of abnormal deformation. Material diameters up to max. 20 mm can be quenched with compressed air or compressed gas (in vacuum furnace, depending on type of furnace). This quenching method is too slow for larger cross-sections and results in the hardness values being too low. Quenching in oil ensures the correct hardness level even for large cross-sections, however, there is a risk of excessive distortion. Quenching large-volume tools in the hot bath generally results in slightly lower hardness than oil quenching. Irrespective of which quenching method is used, in all cases, the tools should be quenched to a temperature below 40 °C. The material must be tempered immediately after hardening.

Tempering
Tempering should be carried out immediately after the material has cooled down to below 50 °C or when the tool can be held with two hands. Triple tempering with a holding time of 2 hours in each stage at the tempering temperature is necessary. It is important to ensure that the tools are cooled down to room temperature between the individual tempering stages.

Tempering Diagram



Toughness Values



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 min.*	Tempering temperature[°C]
63	1150	10	590
65	1170	5	590
67	1150	10	550
66	1150**	10	565
66	1190	5	590
68	1170	5	540
67	1170	5	565
69	1190	5	540
68	1190***	5	565
70	1200	3	540

* 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 1200 °C must not be exceeded. Holding time in sec./mm thickness.

** Best toughness

***Best combination wear resistance/ toughness/ hot hardness

Machining Data

Turning

Cutting parameter	Turning with cemented carbide medium turning	finish turning	HSS
Cutting speed (V_C) m/min.	80-110	110-140	8-10
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 10*	–

* 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.	60-80	80-110	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

Cutting parameter	Solid carbide	Milling cutter w. indexable tips	Coated HSS
Cutting speed (V_C) m/min.	45-55	50-70	12*
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	12-16*	0.05–0.15
5 –10	12-16*	0.15–0.25
10 –15	12-16*	0.25–0.35
15 –20	12-16*	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.	70-90	40-60	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* 3SG 46 GVS** A 46 GV
Surface grinding	A 24 GV	3SG 36 HVS**
Cylindrical grinding	A 60JV	B126 R75 B3* 3SG 60 KVS** A 60 IV
Internal grinding	A 46 JV	B126 R75 B3* 3SG 80 KVS** A 60 HV
Profile grinding	A 100 LV	B126 R100 B6* 5SG 80 KVS** A 120 JV

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

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