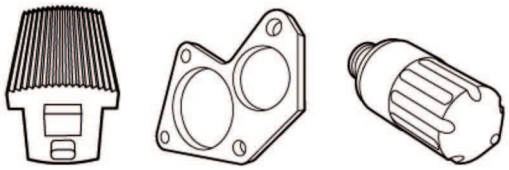
TOOL ALLOYS
DATA SHEET CPM® 1 V

CERTIFIED TO ISO 9001



CHEMICAL COMPOSITION

Carbon	0.55 %
Chromium	4.55 %
Vanadium	1.00 %
Molybdenum	2.75 %
Tungsten	2.15 %
Manganese	0.50 %

CPM® 1 V
is a medium carbon, high alloy tool steel which provides high toughness combined with high heat resistance. It is suited for hot or cold applications demanding high impact toughness which also require moderate wear resistance. CPM® 1 V is produced by the special Crucible Particle Metallurgy Process. The microstructure gives CPM® 1 V high impact toughness. The vanadium content imparts CPM® 1 V a wear resistance slightly better than H11 or S7. Because of its high alloy composition, CPM® 1 V has temper resistance similar to high speed steel (M2) and much better than most typical hot work tool steels.

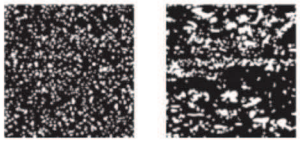
TYPICAL APPLICATIONS

_ Blanking and punching, even for thicker sheet metals
_ Hot heading dies
_ Dies and forging tools
_ Thread rolling tools
_ Plastic injection dies and inserts
_ Extrusion moulding

PHYSICAL PROPERTIES

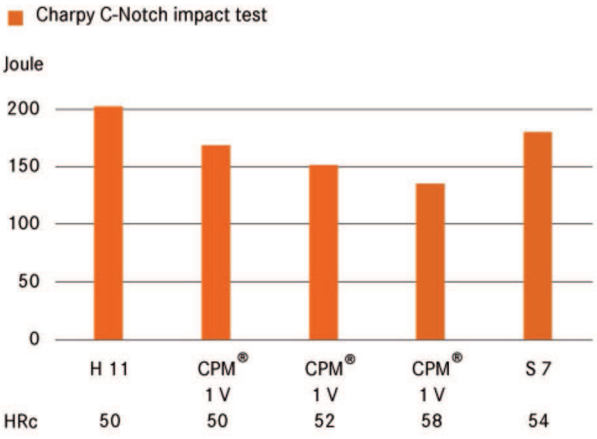
Modulus of elasticity E [kN/mm²]	207
Specific weight [kg/dm³]	7.92
Coefficient of thermal expansion over temperature range of 20 - 400 °C [mm/mm °C]	12.1 x 10^{-6}

POWDER METALLURGICAL AND CONVENTIONAL MICROSTRUCTURE



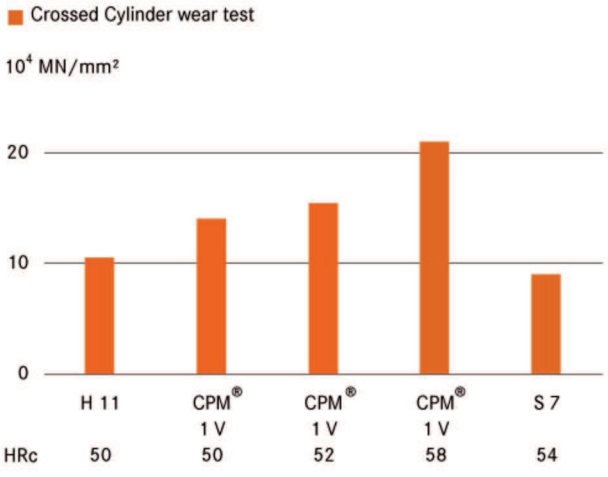
The uniform distribution of carbides in the powder-metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

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.

RS Alloys
Steel & Copper

HEAT TREATMENT

ANNEALING

CPM® 1 V is heated slowly and uniform to a temperature of 900 °C, maintain the temperature for 2 hours and allow to cool 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 approx. HB190.

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® 1 V usually involves the use of 2 pre-heating stages (450 – 500 °C/ 850 – 900 °C). Immediately following this it is heated to the required austenitizing temperature of 1065 – 1120 °C. Maximum toughness is attained at a temperature of 1065 °C, whilst maximum wear resistance is attained at the temperature of 1120 °C. In order to achieve a corresponding degree of dissolution of the alloy elements, a minimum heat penetration time of 20 minutes for hardening at 1065 °C is recommended, or 15 minutes for hardening at 1120 °C. These holding times should be correspondingly adapted for thick or thin walled material cross-sections.

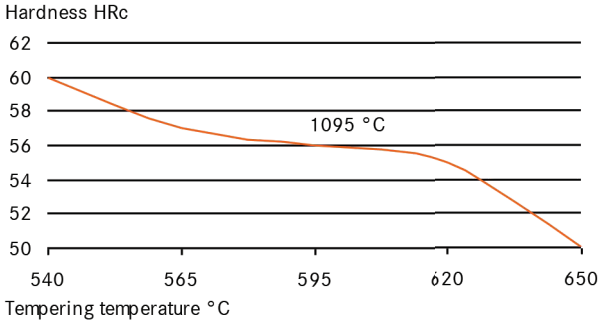
QUENCHING

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 in each stage at the tempering temperature is necessary. Normally CPM® 1 V is tempered with a temperature range of 540 – 550 °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 minutes*	Tempering temperature[°C]
50	1095	20	650
55	1095	20	620
57	1095	20	600
58	1095	20	560
58	1065**	30	540
60	1095	20	540
61	1120	15	540

* Previous preheating at 870 °C. The data preferred 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 1120 °C must not be exceeded.

**Best combination of wear resistance/ toughness.

MACHINING DATA

TURNING

Cutting parameter	Turning with cemented carbide medium turning	finish turning	HSS
Cutting speed (V_C) m/min.	100-150	150-200	12-15
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.	90-120	120-150	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	90-110	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	5 - 8*	0.05–0.15
5 –10	5 - 8*	0.15–0.25
10 –15	5 - 8*	0.25–0.35
15 –20	8 – 8*	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.	80–110	40	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.

TOOL ALLOYS
STOCK LIST CPM® 1 V

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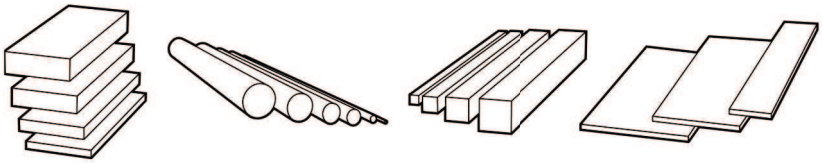

The sizes indicated below are usually available in a machined execution and can be considered as finished sizes.

ROUND BAR DIMENSIONS
25.7 mm
32.1 mm
38.4 mm
45.2 mm
51.5 mm
64.2 mm
77.0 mm
90.0 mm
94.0 mm
103.1 mm
128.5 mm
135.0 mm
153.9 mm
155.0 mm
170.0 mm
206.3 mm
244.4 mm
281.0 mm

FLAT BAR DIMENSIONS
in thicknesses
101.6 mm
155.0 mm

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

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