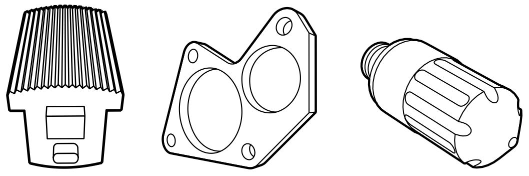
CPM® 3V Data Sheet
Tooling Alloys

Zapp is certified to ISO 9001



Chemical composition

Carbon	0.8 %
Chromium	7.5 %
Vanadium	2.8 %
Molybdenum	1.3 %

CPM® 3V

CPM® 3V is a tough and wear resistant cold work steel of the CPM® tool steel family. If offers a unique combination of high toughness and wear resistance while it also guarantees a very good machinability. CPM® 3V is often used as a “problem solver” for those cases where conventional tool steels or other PM steels do not provide any satisfactory process stability, for instance for tools with a high risk of cracking. CPM® 3V combines at a hardness of 58 to 60 HRc a high security against fracture with a very good wear resistance.

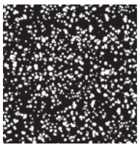
Typical Applications

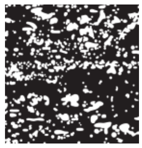
- blanking and punching, even for thicker sheet metals
- fine blanking
- dies and forging tools
- thread rolling tools
- hole punches
- guillotine blades and industrial knives and rollers
- sinter pressing tools
- tool and tool inserts in the plastic processing industry

Physical properties

Modulus of elasticity E [GPa]	207
Density [kg/dm³]	7.8
Coefficient of thermal expansion [mm/mm/K] over temperature range of 20 - 200 °C	10.6 x 10 $^{-6}$
Thermal conductivity [W/(m*K)] at 100°C	24.2

Powder metallurgical and conventional microstructure

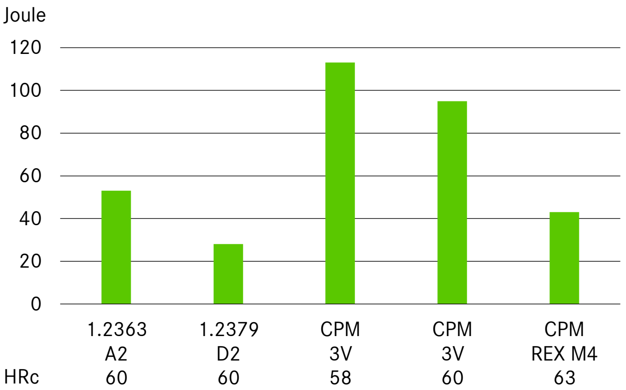




The uniform distribution of carbides in the powder- metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

Toughness

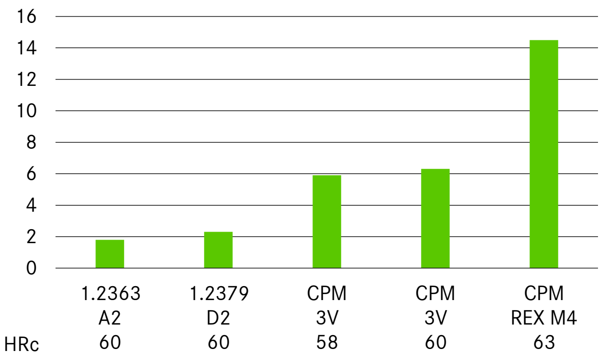
Charpy C-Notch impact test



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

Wear resistance

Relative wear resistance



Heat treatment data

Soft annealing

The material is heated uniformly to a temperature of 900 °C and then maintained at this temperature for 2 hours. Then, the material is cooled to 590 °C in a furnace at a cooling rate of maximum 15 °C per hour. It is then further cooled in still air down to room temperature. The typical hardness achieved by soft annealing is approx.-imately 240 HB.

Stress relieving

Rough machined material is stress relieved by heating to 600-700 °C. Once complete heat penetration has been reached (minimum 2 hours), the material is allowed to cool in the furnace to approximately 500 °C followed by cooling in air.
Hardened material is stress relieved at 15-30°C for 2 hours below last tempering temperature followed by cooling in air.

Straightening

Straightening should be done in the temperature range of 200-430 °C.

Hardening

Hardening of CPM® 3V usually involves the use of two preheating steps according to the table on the right. Depending on furnace and charging, additional preheating steps can be implemented. Maximum toughness is attained by austenitizing at 1030 °C, whilst maximum wear resistance is attained by austenitizing at 1120 °C. In order to achieve a corresponding degree of dissolution of the alloying elements, as well as an appropriate hardening, a minimum heat penetration time of 45 minutes for hardening at 1030 °C or 20 minutes for hardening at 1120 °C is recommended. These holding times should be correspondingly adapted for thick or thin-walled material cross sections.

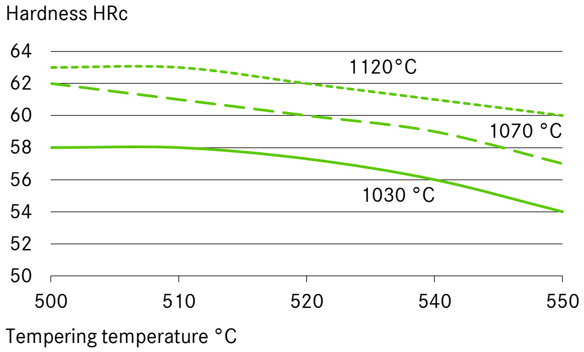
Quenching

Quenching can take place in hot bath at 540°C, oil or pressurized gas. Quenching in salt bath or oil leads to maximum hardness, whereas cooling in vacuum can lead to lower values of 1-2 HRc. By use of vacuum quenching a minimum pressure of 6 bar is recommend-ded. The appropriate pressure needs to be adjusted for complex tool shapes in order to minimize risk of cracking and tool distortion. For attaining ideal toughness properties, it is recommended to apply the hot bath quenching method.

Tempering

Tempering should be carried out immediately after the material has cooled down to below 40 °C or when the tool can be held with 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



Heat treatment instructions

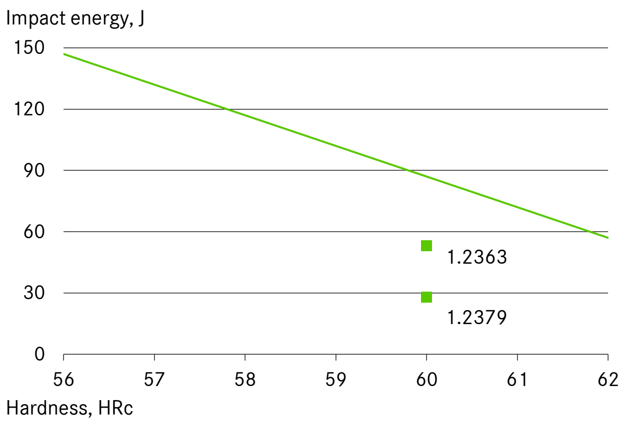
1st preheating	450–500 °C
2nd preheating	850–900 °C
3rd preheating	1000–1050 °C
Hardening	as specified in table
Tempering	3 x each 2 hours as specified in table

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

Required hardness HRc ± 1	Austenit-izing tempe-rature °C	Holding time at austenit-izing tempe-rature minutes*	Tempering tempera-ture °C
56	1030	45	540
57	1070	30	550
59	1070**	30	540
60	1120	20	550
61	1120	20	540

* In case of 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 1120 °C must not be exceeded.
** Best combination of wear resistance/ toughness

Toughness values



Surface treatments

CPM® 3V can be nitrided and/or PVD/CVD coated.

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 edge milling

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-Ø 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.

Zapp Materials Engineering GmbH
TOOLING ALLOYS
Zapp-Platz 1
40880 Ratingen
P.O. Box 10 18 62
40838 Ratingen
Germany
Phone +49 2102 710-548
Fax +49 2102 710-596
toolingalloys@zapp.com

SERVICE CENTER
Hochstraße 32
59425 Unna
Germany
Phone +49 2304 79-511
Fax +49 2304 79-7652
www.zapp.com

Further information regarding our products and locations are available in our image brochure and under www.zapp.com

Last revision: December 2019