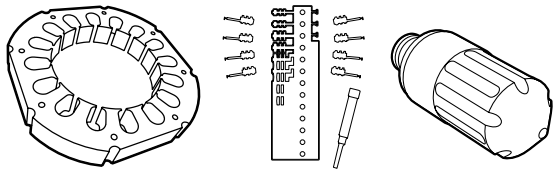
Data Sheet CPM® 15V
Tooling Alloys

Zapp is certified to ISO 9001



Chemical composition

Carbon	3.4 %
Chromium	5.3 %
Vanadium	14.5 %
Molybdenum	1.3 %

CPM® 15V

CPM® 15V is the ultimate wear resistant grade in the CPM® cold work steel family. The highest carbide amount of all PM cold work steels grant CPM® 15V an outstanding wear resistance and cutting edge stability with a reasonable toughness level.
CPM 15V is recommended as the ultimate phase in tool performance improvement or as suitable alternative to solid carbide when higher toughness is required.

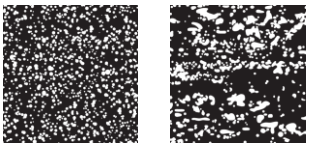
Typical applications

- Blanking and punching tools especially for thin sheets
- Knives for electric sheet steel
- Extrusion dies and hole punching tools
- Knives for cutting foil, film and paper
- Rotary cutters
- Sinter pressing tools
- Plastic forming tools where highly abrasive additives are used
- General items subject to wear

Physical properties

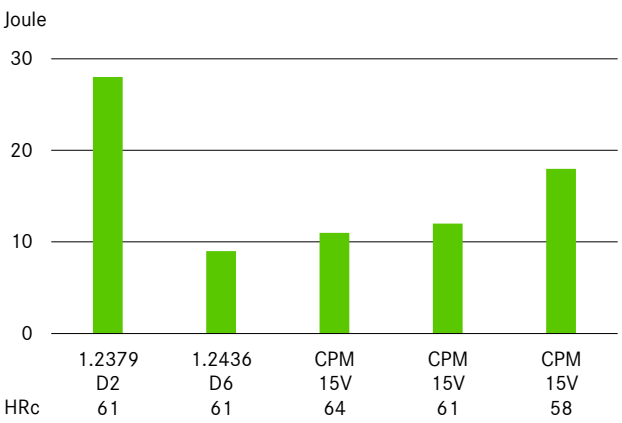
Modulus of elasticity E [GPa]	235
Density [kg/dm³]	7.25
Coefficient of thermal expansion [mm/mm/K] over temperature range of	
20 – 100 °C	10.5×10^{-6}
20 – 250 °C	11.1×10^{-6}
20 – 425 °C	11.7×10^{-6}
20 – 600 °C	12.1×10^{-6}

Powder metallurgical and conventional microstructure



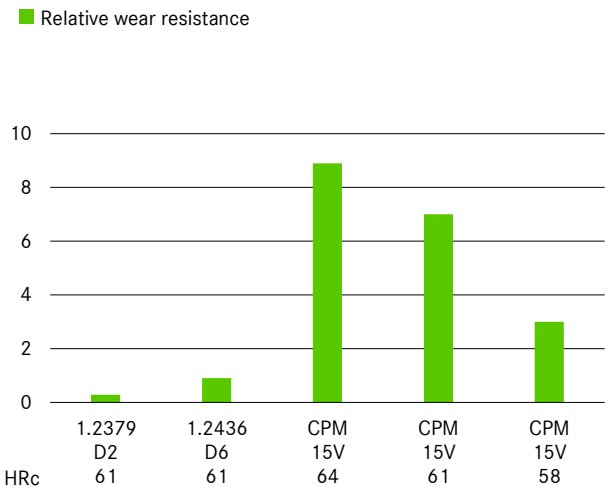
The uniform distribution of carbides in the powder-metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

Toughness



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

Wear resistance



Thermal treatments

Soft annealing
The material is heated uniformly to a temperature of 870 °C and then maintained at this temperature for 2 hours. Then, the material is cooled to 550 °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 approximately 250-280 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.

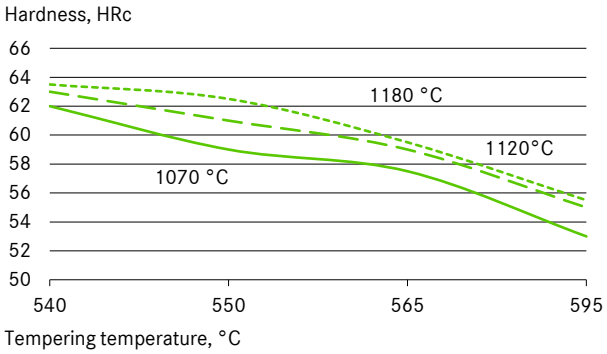
Hardening
Hardening of CPM® 15V usually involves the use of two preheating steps according to the table on the right. Depending on furnace and charging, additional preheating steps can be implemented. Maximum toughness is attained by austenitizing at 1070 °C, whilst maximum wear resistance is attained by austenitizing at 1180 °C. In order to achieve a corresponding degree of dissolution of the alloying elements, as well as an appropriate hardening, minimum heat penetration times as given in the table are 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 recommended. 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. For attaining maximum hardness after quenching, the cooling rate between 1000°C and 700°C needs to be maximized.

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 of 550 °C is necessary. It is important to ensure that the tools are cooled down to room temperature between the individual tempering stages.

Surface treatments
CPM® 15V can be nitrided and/or PVD/CVD coated.

Tempering diagram



Heat treatment instruCtions

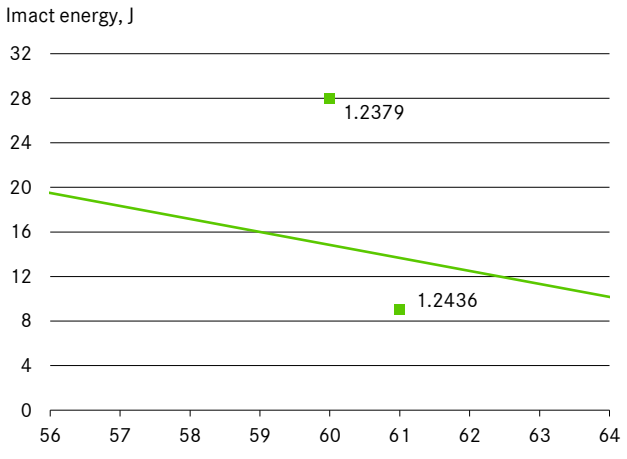
1st preheating	450–500 °C
2nd preheating	850–900 °C
(3rd preheating)	1000-1050 °C
Hardening	As specified in table
Tempering	3 x each 2 hours as specified in table

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

Required hardness HRc ± 1	**Austenitizing temperature °C**	**Holding time at austenitizing temperature minutes***	**Tempering temperature °C**
59	1070	40	550
60	1120	30	550
63	1180	15	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 1180 °C must not be exceeded.

Toughness values



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
-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* 3SG 46 GVS** A 46 GV
Surface grinding	A 24 GV	3SG 36 HVS**
Cylindrical grinding	A 60 JV	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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