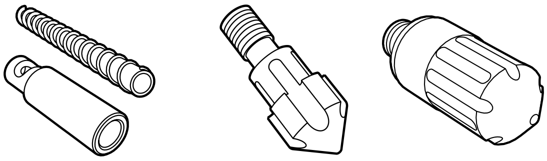
Z-420 PM® Data Sheet
Tooling Alloys

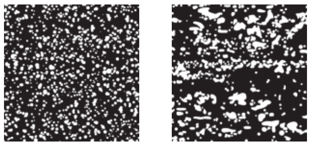
Zapp is certified to ISO 9001



Chemical composition

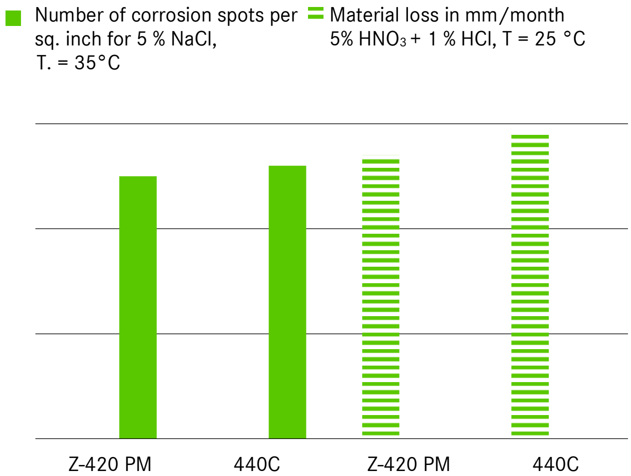
Carbon	2.30 %
Chromium	14.00 %
Vanadium	9.00 %
Molybdenum	1.00 %

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.

Corrosion resistance



Qualitative comparison

Description

Z-420 PM® is a corrosion resistant, high vanadium tooling material produced by powder metallurgy methods. It is a martensitic stainless grade designed to also provide high wear resistance (similar to Z-9 PM) while maintaining good toughness (similar to Z-10 PM). It is intended for use in applications where grades such as D2, 9V, and 10V do not have the needed corrosion resistance, and where stainless grades such as 420 and 440C do not have sufficient wear resistance.
Z- 420 PM® has been shown to provide equivalent fabricability, wear, and corrosion resistance in CPM S90V* in a broad spectrum of applications.

Typical Applications

- plastic injection and extrusion feedscrews
- non-return valve components
- palletizing equipment
- injection molds and inserts
- industrial knives, cutters and slitters
- wear parts in food and chemical processing
- gear pumps

Physical propertiesS

Modulus of elasticity E [kN/mm^2]	215
Specific weight [kg/dm^3]	7.4
Thermal conductivity at 65 °C [W/mk]	17.3
Coefficient of thermal expansion over temperature range of [mm/mm °C]	
20 - 200 °C	11.0 x 10^{-6}
20 - 315 °C	11.7 x 10^{-6}

Z-420 PM is a registered trademark of Zapp.

Thermal processing

Annealing
Heat uniformly in a protective atmosphere (or vacuum) to 1650 °F (890 °C) and soak for 2 hours. Slow cool 30 °F (15 °C) per hour until 1000 °F (540 °C). Parts can then be cooled in air or furnace as desired. Hardness expected by is BHN 277-300.

Stress relieving (soft)
Heat uniformly to 1100 – 1300 °F (595 – 700 °C) soak for 2 hours and cool in air or furnace.

Hardening
Vacuum, salt, or protective atmosphere methods are generally used. Care must be taken to prevent decarburization.

Preheat
Heat to 1550 - 1600 °F (845 - 870 °C) until temperature is equalized. Additional preheat steps including 1250 - 1300 °F (680 - 700 °C) and 1850 - 1900 °F (1010–1040 °C) are suggested when using programmed control during vacuum processing.

Austenitizing
Temperatures in the range of 1950 °F (1040 °C) to 2150 °F (1180 °C) are commonly used with the specific temperature and soak time determined by the hardness required. Higher hardening temperatures will provide maximum wear resistance and hardness while temperatures lower in the range will provide increased toughness. Refer to chart for further information.

Quenching
Methods include use of high pressure gas (minimum 5 bar preferred), salt bath, or oil. Quench rate through the temperature range of 1900 - 1300 °F (1040 - 700 °C) is critical to the development of optimum structure and properties. Part temperature can then be equalized at 1000 - 1100 °F (540 - 595 °C) after which cooling can continue to below 150°F (66 °C) or "hand warm". Step quenching in this manner will help to minimize distortion in larger section sizes.

Tempering
Immediately temper after the material has cooled down below 40 °C. CPM® 420 V® is normally tempered through two tempering stages, each of 2 hours duration at 200 °C to 400 °C. If required, cooling to sub-zero temperatures can be carried out between the first and the second tempering cycle to fully destroy any reaustenitic formation. The first tempering process should always be concluded prior to any sub-zero cooling process.

Stress relieving (hard)
Heat to 25° F (15° C) less than the temperature of the last temper and soak for 1 hour.

Size change during hardening
+.0005 in/in (at HRc 60)

Heat treatment instructions

1st preheating	1250–1300 °F
2nd preheating	1550–1600 °F
Hardening	as specified in table
Tempering	2 +2 hours each as specified in table

Prefered quench method is high pressure inert gas (minimum 4 bar) or molten salt at 1025° F.

Required hardness HRc ± 1	Austenitizing soak temp. [°F]	Austenitizing soak time [min]*	Tempering temperature[° F]
56	1950	30	550
57	2050	25	750**
58	2050	25	550
59	2150	20	550

* Process variation and part section size can Affect results. Soak times should be based on Actual part temperatures. Use of load thermocouples is highly recommended during batch processing.

** Tempering temperatures from 750 – 1000° F are not recommended.

Machining data

Turning

Cutting parameter	Turning with cemented carbide medium turning	finish turning	HSS
Cutting speed (V_C) m/min.	70-100	100-120	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.	50-70	70-100	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.	20–35	60-80	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.	70-90	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.

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