Z-1 PM^{cold}, PM Tooling Steel

Data Sheet - Tooling Alloys

Zapp is certified to ISO 9001

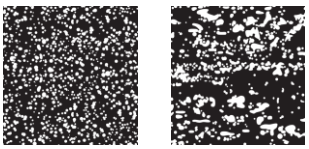
Key Features of Zapp's Powder Metallurgical Tooling Steel Z-1 PM^{cold}

- Produced using powder metallurgical processes
- Matrix-PM-High-Speed Steel
- Highest toughness at very high strength & hardness values
- Very good wear resistance compared to typical hot-work tool steels (1.2343/H11)
- High crack, fracture and heat resistance
- Case hardness up to 62 HRC possible

Typical Areas of Application

- Thick sheet and fine blanking tools
- Pressing and forming tools
- Cold and warm forming tools
- Bulk metal forming tools

Powder metallurgical vs. conventional microstructure



The homogeneous microstructure which is obtained by using powder metallurgical processes vs. the coarse carbide structure of conventionally produced steel

Physical properties

Modulus of elasticity E [GPa]	207
Density [kg/dm³]	7.8
Thermal expansion coefficient [mm/(mm/K)] in a temperature range up to 20 °C – 200 °C	11.5 x 10^{-6}
Thermal conductivity [W/(m*K)]	23.8

Delivery conditio

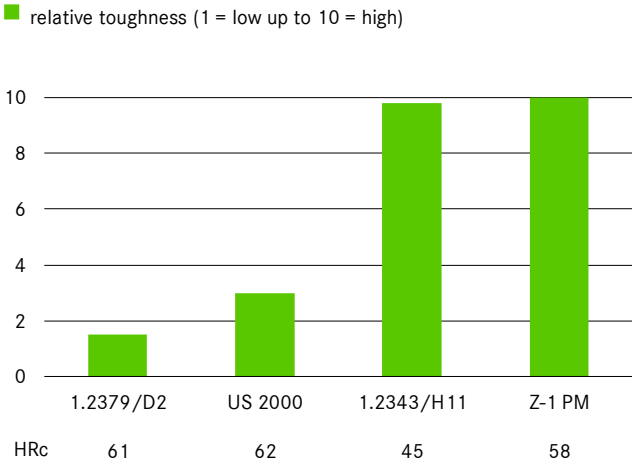
As-delivered condition	Soft-annealed, approx. 190 HB
Product form	Round bars, flat bars
Surface finish	Mechanically machined

Typical chemical composition (weight %)

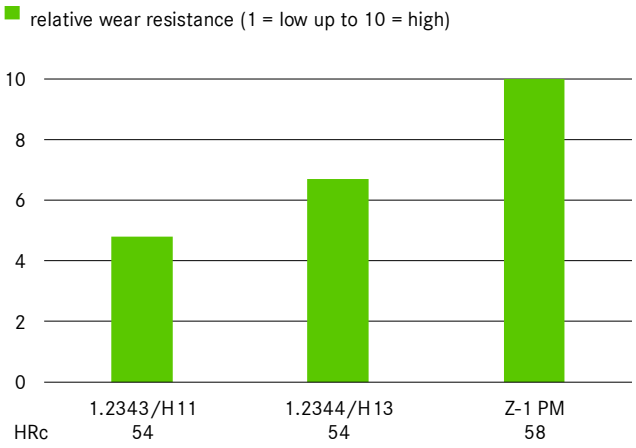
C	Cr	Mo	W	V
0.55	4.2	2.4	2.2	1.2

Qualitative comparison of the most important properties

Toughness



Wear resistance via alloy index



Heat Treatment

Soft Annealing

- In neutral atmosphere at ~ 880 °C and ~ 4 h exposure time (after through-heating)
- Followed by furnace cooling (optimum cooling rate max. 10 °C/h up to 540 °C)
- Soft annealing hardness ~ 190 HB

Stress Relief Annealing

~ 650 °C/ ~ 2 h exposure time (after through-heating) followed by furnace cooling

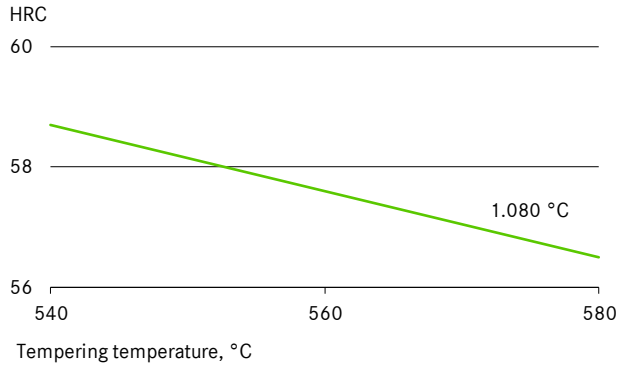
Surface Treatments

Tempering temperatures of ≥ 540 °C provide the prerequisite for subsequent nitriding or PVD coating.

You can find more materials at:
www.zapp.com/en-uk/materials/powder-metallurgical-tool-steel

Zapp Precision Metals GmbH ensures professional execution of all heat treatment steps as well as their preparation and post-processing (e.g., charging, hardness testing, straightening processes, etc.) – always with the aim of obtaining the optimum component properties!
We are happy to assist you with constructive advice!

Tempering diagram (Hardness and Tempering)



Vacuum heat treatment instructions

Pre-heating	professional heating, 3 pre-heating stages recommended
Vacuum heating	from 1,050 to 1,120 °C, see table
Exposure time	from 20 to 30 minutes after through-heating, see table
Cooling	in vacuum, a quenching pressure of at least 6 bar is required
Tempering	at least 3 times for 2 hours each according to table, fourth tempering recommended, allow to equilibrate to room temperature in between

Desired hardness HRc ± 1	Hardening temperature °C	Exposure time at hardening temperature minutes	Tempering °C
54	1,050	30	550
56	1,050	30	560
58*	1,080*	30*	550*
61	1,120	20	550

The maximum specified hardening temperature of 1,120 °C should not be exceeded. * Recommended range of use and hardness
Hardening with further heat treatment processes is possible, but should be discussed in advance!

TOOLING ALLOYS

Zapp Precision Metals GmbH
Balcke-Dürr-Allee 1
40882 Ratingen
Phone +49 2304 79-566
Sales.TA@zapp.com
www.zapp.com

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

Last revision: April 2025