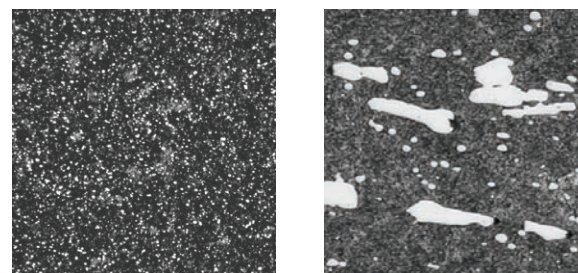


Z-SERIES PM TOOL STEEL SELECTION

PROPER TOOL STEEL SELECTION is a critical component in maximizing productivity and, thus, maximizing profits. With today's more highly alloyed and engineered work materials, the demands on tooling have increased significantly, pushing the limits for key performance properties including wear resistance, impact resistance, compressive strength and coating technology.

Zapp Tooling Alloys' Z-Series PM family of tool steels is produced through a particle metallurgy process that offers a better solution for the most demanding tooling applications. In applications requiring extreme toughness, high wear resistance, and/or compressive strength, Zapp offers *Engineered Solutions*.



Z-WEAR PM

AISI D2

BENEFITS OF ZAPP Z-SERIES PM STEELS

The Particle Metallurgy process was developed to address key weaknesses of tool steel. Traditional ingot casting of highly alloyed tool steels has severe toughness challenges, caused by an undesirable microstructure. PM steels achieve a uniform microstructure, which dramatically increases toughness and allows for greater wear resistance.

Z-TUFF PM®

Designed specifically for high toughness applications in combination with good compressive strength.

- Typical application hardness of Rc 60-62. Attainable hardness of Rc 62 max.
- Impact resistance levels of traditional shock resistant tool steels (AISI S7).

Z-WEAR PM®

Optimizes the combination of impact toughness, wear resistance and enhanced compressive strength.

- Enhanced compressive strength with working hardness capability to Rc 64 max.
- Higher impact resistance than AISI A2, D2, M2 and PM M4.

Z-M4 PM®

The standard traditional workhorse PM grade for cold work applications offering a good combination of impact and wear resistance with good compressive strength.

- Good compressive strength with working hardness of Rc 64 max.
- Higher impact resistance than A2, D2 and M2 but lower toughness than Z-Wear PM.

Z-A11 PM®

Designed for applications requiring high wear resistance with reasonable toughness capabilities.

- Good compressive strength with working hardness of Rc 63 max. Typically used at Rc 60-62.
- Excellent wear resistance with a carbide volume of 17.5%.
- Expected wear improvement of approximately two times the performance of PM M4.
- Toughness/impact resistance in the range of conventionally produced D2 and M2 at similar hardnesses.

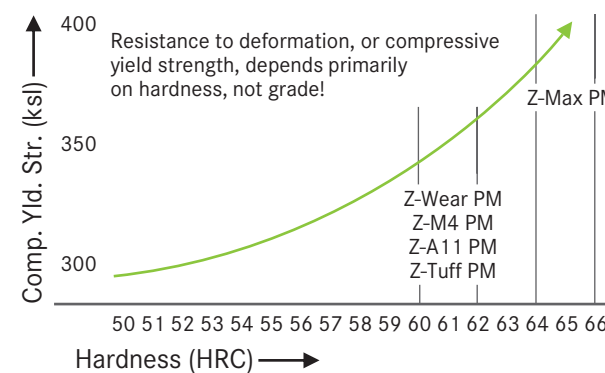
Z-MAX PM®

A Cobalt bearing PM grade designed for cold work applications requiring high wear resistance in combination with excellent compressive strength.

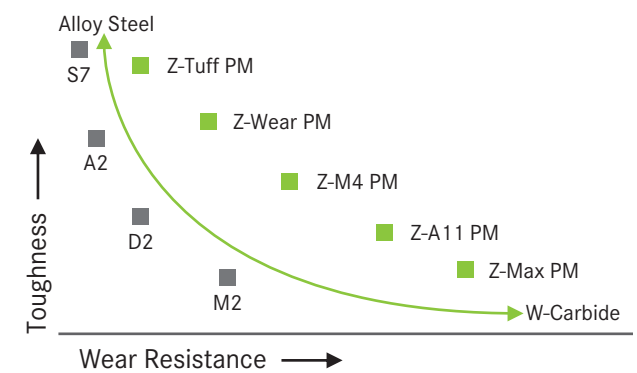
- Superior compressive strength with a standard cold work application hardness of Rc 64-66.
- Excellent wear resistance with a carbide volume of 19.5%.
- Wear resistance exceeds that of A11 due to higher carbide volume and attainable working hardness.
- Cobalt content (9%) to enhance and strengthen material matrix.

ENGINEERED SOLUTIONS

HARDNESS vs. COMPRESSIVE YIELD



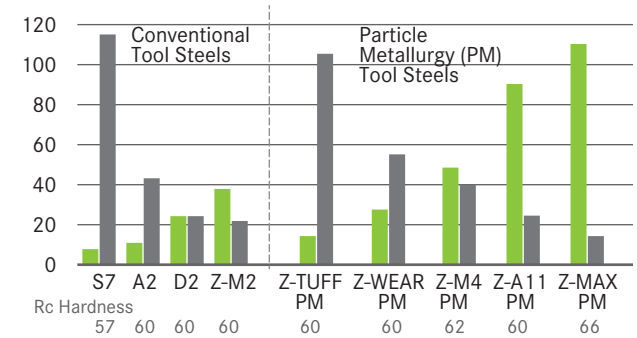
WEAR RESISTANCE /TOUGHNESS COMPROMISE



CHEMISTRY/CARBIDE VOLUME

	Z-Tuff PM	Z-Wear PM	Z-M4 PM	Z-A11 PM	Z-Max PM
Carbon	.65	1.15	1.42	2.45	2.00
Chromium	7.50	7.50	4.00	5.25	4.00
Vanadium	1.00	2.40	4.00	9.75	5.00
Molybdenum	2.00	1.60	5.25	1.30	5.00
Tungsten	-	1.00	5.50	-	10.00
Cobalt	-	-	-	-	9.00
Carbide Volume	3.50%	6.50%	12.50%	17.50%	19.50%

WEAR RESISTANCE /TOUGHNESS



TOOL STEEL UPGRADE GUIDE

IF YOU ARE USING...	S7	A2	D2	DC53	3V	PM M4	10V/A11
AND YOU NEED TO IMPROVE:							
Wear Resistance	Z-Tuff PM	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-A11 PM	Z-15V PM
Impact Resistance	N/A	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-Tuff PM	Z-Wear PM	Z-M4 PM
Compressive Strength	Z-Tuff PM	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-Max PM	Z-Max PM
Compressive Strength & Wear Resistance	Z-Tuff PM	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-Wear PM	Z-Max PM	Z-Max PM
AND YOU NEED SIGNIFICANTLY IMPROVED							
Wear Resistance	Z-Wear PM	Z-M4 PM	Z-A11 PM	Z-A11 PM	Z-M4 PM	Z-15V PM	W-Carbide
Impact Resistance	N/A	Z-Tuff PM	Z-Tuff PM	Z-Tuff PM	Z-Tuff PM	Z-Tuff PM	Z-Wear PM
Compressive Strength	Z-Wear PM	Z-M4 PM	Z-M4 PM	Z-M4 PM	Z-M4 PM	Z-Max PM	W-Carbide
Compressive Strength & Wear Resistance	Z-Wear PM	Z-M4 PM	Z-M4 PM	Z-M4 PM	Z-M4 PM	Z-Max PM	W-Carbide