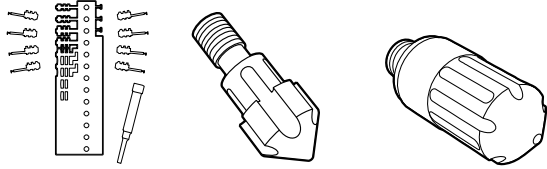


TOOLING ALLOYS

DATA SHEET Z-WEAR PM™



CERTIFIED TO ISO 9001



CHEMICAL COMPOSITION

| | |
|------------|--------|
| Carbon | 1.15 % |
| Chromium | 7.50 % |
| Vanadium | 2.40% |
| Tungsten | 1.00% |
| Molybdenum | 1.60% |

DESCRIPTION

Z-Wear PM™ is a powder metallurgy tool steel intended to provide high value and exceptional versatility. It offers wear resistance superior to standard A2 and D2 grades along with high toughness and resistance to chipping. This unique combination of properties allows consistent and reliable tool performance in a broad range of cold work applications. Z-Wear is designed to be “user friendly” and exhibits excellent machinability, heat treat response (up to HRc 64), and grindability. It maintains a high degree of dimensional stability and can serve as an ideal substrate for a variety of common tool coatings and surface treatments.

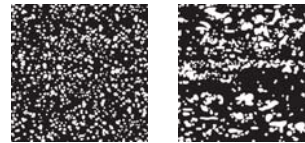
TYPICAL APPLICATIONS

- _ general tool and die
- _ stamping and forming tools
- _ punches
- _ thread rolling tools
- _ fine blanking tools
- _ shear blades
- _ tooling for plastic processing

PHYSICAL PROPERTIES

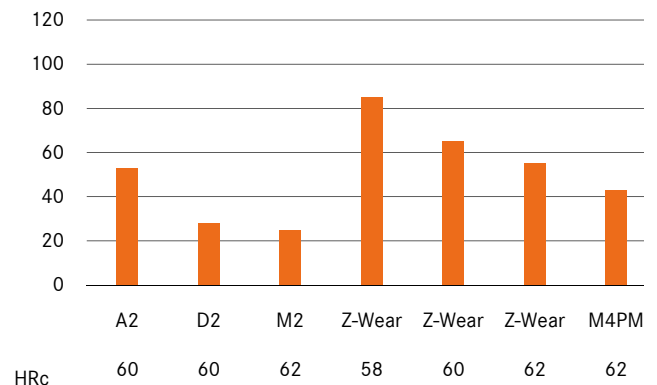
| | |
|--|-------------------------|
| Modulus of elasticity E [psi x 10 ⁶] | 30 |
| Density [lb/in ³] | 0.277 |
| Thermal conductivity at 72 °F [BTU/hr-ft-°F] | 13.5 |
| Coefficient of thermal expansion over temperature range of 100 - 1000 °F [in/in/ °F] | 6.25 x 10 ⁻⁶ |

POWDER METALLURGICAL AND CONVENTIONAL MICROSTRUCTURE

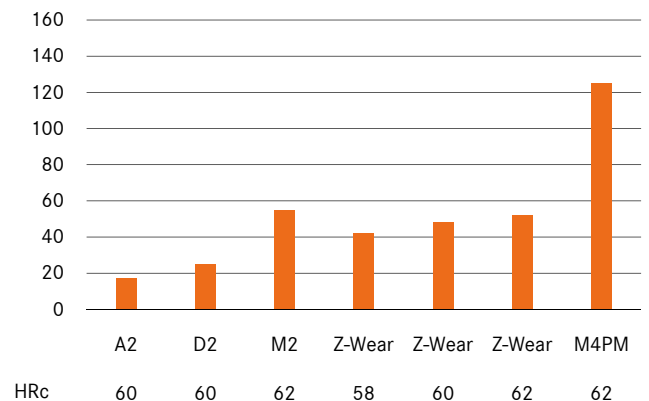


The uniform distribution of carbides in the powder-metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

RELATIVE TOUGHNESS



RELATIVE WEAR RESISTANCE



THERMAL PROCESSING

ANNEALING

Heat uniformly in a protective atmosphere (or vacuum) to 1600°F (870°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 is BHN 225-248.

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 1500-1550°F (810-845°C) until temperature is equalized. Additional preheat steps including 1200-1250°F (620-650°C) and at 1700-1750°F (930-955°C) are suggested when using programmed control during vacuum processing.

Austenitizing: Temperatures in the range of 1850°F (1010°C) to 2050°F (1120°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 4 bar preferred), salt bath, or oil. Quench rate from the hardening temperature range down to 1300°F (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

Tempering should be performed immediately after quenching. Temperatures in the range of 1000°F (540°C) to 1050°F (595°C) are generally used depending on the hardness required. Heat uniformly to the selected temperature and soak for 2 hours. Double tempering is absolutely necessary while triple tempering is recommended when hardening at 1950°F (1093°C) and over. Tempering temperatures of less than 1000°F (540°C) should not be used, and care must be taken to cool parts fully to room temperature between each temper.

STRESS RELIEVING (HARD)

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

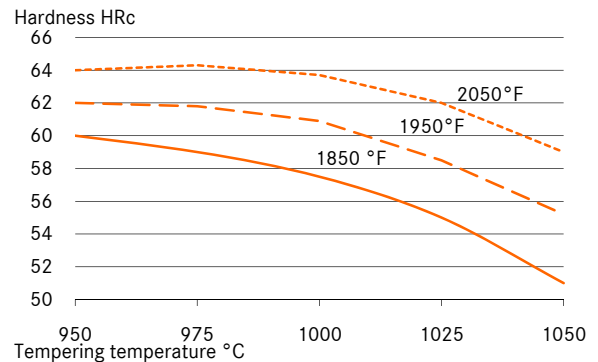
CRITICAL TEMPERATURE

1545°F (840°C)

SIZE CHANGE DURING HARDENING

+0.0005 in/in (at HRC 60)

TEMPERING DIAGRAM



HEAT TREATMENT INSTRUCTIONS

| | |
|----------------|--|
| 1st preheating | 1200-1250°F |
| 2nd preheating | 1500-1550 °F |
| Hardening | as specified in table |
| Tempering | 2 x each 2 hours as specified in table |

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

| Required hardness HRC | Austenitizing soak temp [°F] | Austenitizing soak time [Min]* | Tempering temperature[°F]** |
|-----------------------|------------------------------|--------------------------------|-----------------------------|
| 57-59 | 1900 | 45 | 1000 |
| 58-60 | 1950 | 30 | 1015 |
| 59-61 | 1950 | 30 | 1000 |
| 60-62 | 1975 | 25 | 1000 |
| 61-63 | 2000 | 20 | 1000 |
| 62-64 | 2050 | 15 | 1000 |

* 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.

** An increase in tempering temperature by 15°F can be used to reduce hardness 1 to 2 points HRC. Tempering temperatures less than 1000°F should not be used.

STRAIGHTENING

Should be done warm (or during quench) using temperatures in the range of 400°F (200°C) to 800°F (430°C).

SURFACE TREATMENT

This grade is an excellent substrate material for use with the various commercially available PVD coating processes. Conventional nitriding (.001” maximum depth) and steam tempering can also be used. Coating vendors should be consulted to select the optimum process for a given application.

Care must be exercised during CVD and other surface treatment processes that can alter the original heat treatment of the tool.

MACHINING DATA

TURNING

| Cutting parameter | Turning with cemented carbide | | HSS |
|--|-------------------------------|----------------|----------|
| | medium turning | finish turning | |
| 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 EDGEMILLING

| Cutting parameter | Milling with cemented carbide | | HSS |
|--|-------------------------------|----------------|-----|
| | medium turning | finish turning | |
| 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-φ 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 | B 126 R75 B3* 3SG 60 KVS** A 60 IV |
| Internal grinding | A 46 JV | B 126 R75 B3* 3SG 80 KVS** A 60 HV |
| Profile grinding | A 100 LV | B 126 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

Zapp Tooling Alloys, Inc.

475 International Circle

Summerville, South Carolina 29483

USA

Phone +1 843 871-2157

Fax +1 843 873-6649

Toll-free +1 888-9 BUY-ZAPP

ztasales@zapp.com

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