Z-T15 PM Data Sheet
Tooling Alloys

ACFI and ZAPP are certified
according to ISO 9001 standard

AÇO FERRAMENTA

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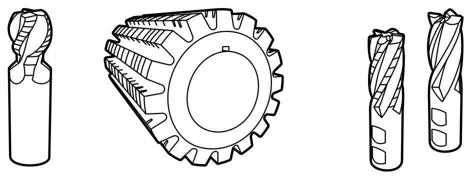


Chemical composition

Carbon	1.60 %
Chromium	4.00 %
Vanadium	4.90 %
Tungsten	12.00 %
Cobalt	5.00 %
Manganese	0.30 %
Silicon	0.30 %

Description

Z-T15 PM is a tungsten-vanadium-cobalt high speed steel produced by powder metallurgy methods that can be heat treated to a maximum attainable hardness of HRc 66-68.
It offers high levels of both wear resistance and red hardness which make it suitable for use in various heavy duty cutting tool applications involving difficult to machine materials. It can be effective in select cold work applications when under- hardened to optimize toughness. The particle metallurgy processing also provides improved machinability, grindability, heat treat response, and dimensional stability when compared to similar grades produced by conventional methods.

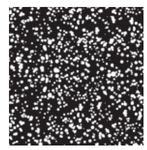
Typical Applications

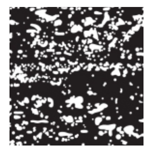
- form tools
- broaches
- gear tools
- milling cutters
- end mills
- taps
- spade blades
- roll forming tools
- punches and dies

Physical properties

Modulus of elasticity E [psix 10^6]	30
Density [lb/in^5]	0.296
Thermal conductivity at 72° F [BTU/hr-ft-°F]	10.94
Coefficient of thermal expansion over temperature range of 100 - 1000 °F [in/in °F]	6.4 x 10^{-6}

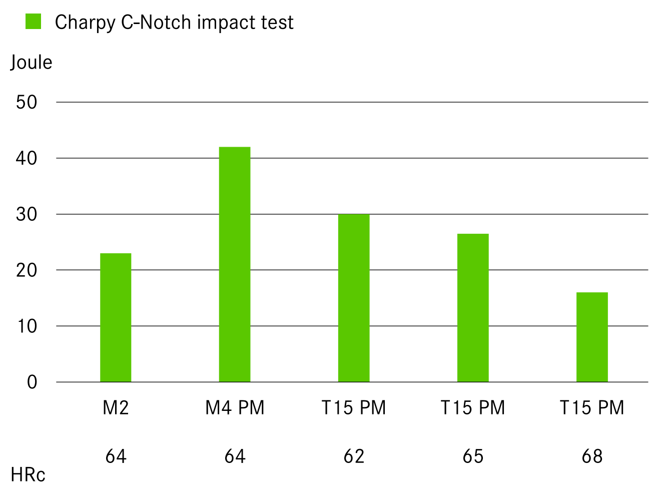
Powder metallurgical and conventional microstructure





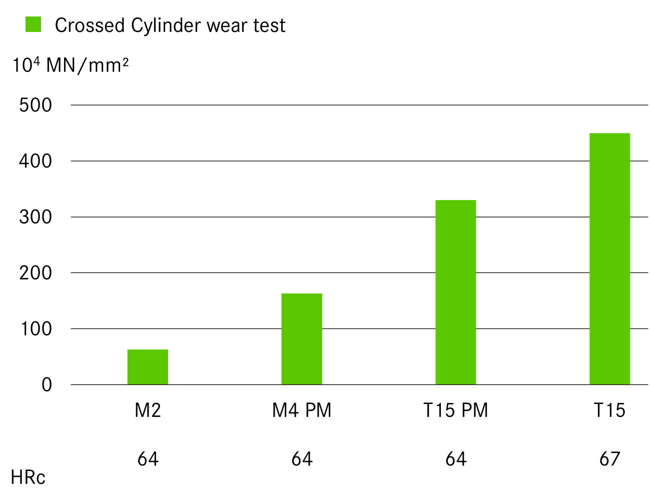
The uniform distribution of carbides in the powder-metallurgical structure compared to conventional tool steels with big carbides and carbide clusters.

Toughness



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

Wear resistance



Reciprocal of wear rate in wear test with non lubricated crossed cylinder in contact with a rotation tungsten carbide cylinder.

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 245-275.

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 2100°F (1180°C) to 2250°F (1235°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°F (1040°C) 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.

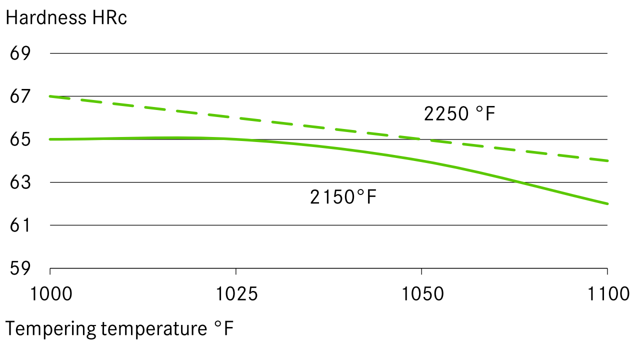
Tempering
Tempering should be performed immediately after quenching. Temperatures in the range of 1000°F (540°C) to 1100°F (595°C) are generally used depending on the hardness required. Heat uniformly to the selected temperature and soak for 2 hours. Triple tempering is required. Tempering temperatures 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
1550 °F (845 °C)

Size change during hardening
+.0020 in/in (at HRc 66)

Tempering diagram



Heat treatment instructions

1st preheating	1250–1300 °F
2nd preheating	1550–1600 °F
Hardening	as specified in table
Tempering	2+2+2 hours at 1000 °F minimum

Required hardness HRc ± 1	Austenitizing soak temp. [°F]	Austenitizing soak time [min]*	Tempering temperature[°F]**
60-62	2100	10	1075
62-64	2100	10	1050
63-65	2150	10	1050
64-66	2200	5	1050
65-67	2225	5	1025
66-68	2250	5	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 temperatures by 25 °F can be used to reduce hardness 1 to 2 points HRc. Tempering temperatures less than 1000 °F should not be used.

Critical temperature
1550 °F (845 °C)

Size change during hardening
+.0020 in/in (at HRc 66)

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

Surface Treatments
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.