Technical Datasheet

CarTech® Micro-Melt® T15 Alloy

Type Analysis

Single figures are nominal except where noted.

Carbon	1.60 %	**Manganese**	0.30 %
Sulfur	0.070 %	**Silicon**	0.35 %
Chromium	4.25 %	**Cobalt**	5.00 %
Vanadium	5.00 %	**Tungsten**	12.25 %
Iron	Balance		

Note: In addition, the alloy can be produced with increased sulfur levels, up to 0.30%, for tools requiring improved machinability.

General Information

Description

CarTech Micro-Melt T15 alloy is a high-carbon tungsten-cobalt-vanadium high speed powder metal tool steel possessing excellent abrasion resistance and red hardness.

Many of the benefits realized in the use of CarTech Micro-Melt powder metals, such as CarTech Micro-Melt T15 alloy, are a direct result of the refined microstructure (smaller, more uniformly distributed carbide particles and a finer grain size) and the lack of segregation in the powder metallurgy product. These advantages include ease of grinding, improved response to heat treatment, greater wear resistance, and increased toughness of the finished tool.

In addition, Carpenter's unique hot rolling and rotary forging capabilities impart minimal distortion characteristics to these alloys.

Applications

CarTech Micro-Melt T15 alloy may be considered for many types of tooling applications where hot hardness, improved grindability and wear resistance are important.

Applications for this alloy have included:

Form tools
Lathe tools
Planer tools
Broaches
Milling cutters
Cold work tools
Hobs
Blanking dies
Punches
Drills
Screw machine tools

Properties

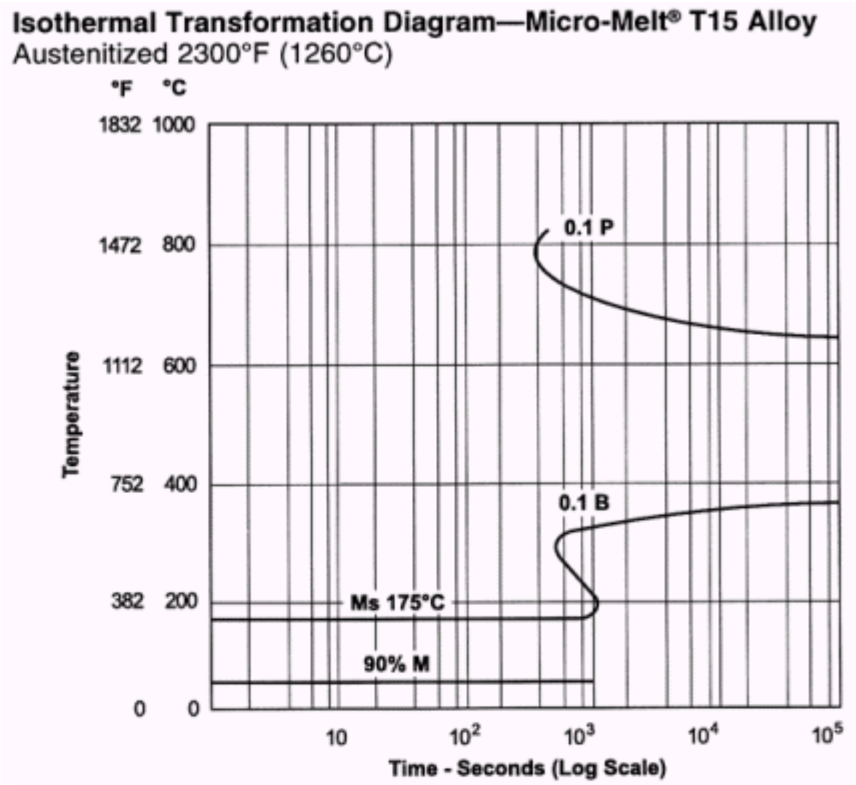
Physical Properties

Specific Gravity	8.19	
Density	0.2950	lb/in³
Mean CTE		
100 to 500°F	5.52	$\times 10^{-6}$ in/in/°F
100 to 1000°F	6.39	$\times 10^{-6}$ in/in/°F
100 to 1500°F	6.64	$\times 10^{-6}$ in/in/°F

Mean Coefficient of Thermal Expansion—Micro-Melt® T15 Alloy

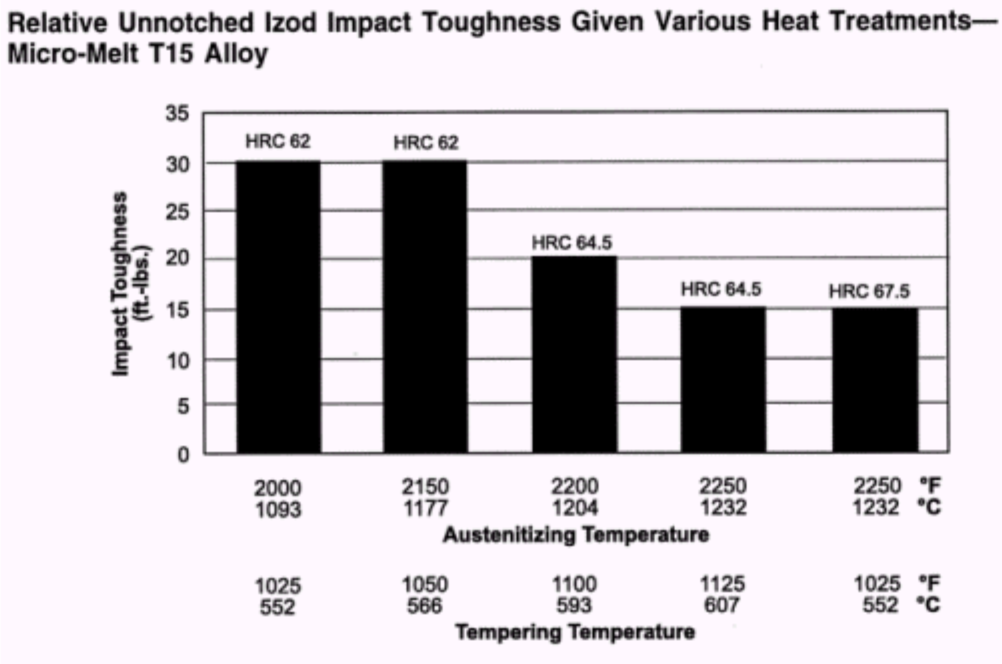
Temperature Range		Expansion Coefficient	
100°F to (°F)	38°C to (°C)	(in/in/°F) x 10^{-6}	(in/in/°C) x 10^{-6}
500	260	5.52	9.93
1000	538	6.39	11.50
1500	816	6.64	11.95

Modulus of Elasticity (E) 29.5 x 10^3 ksi



Typical Mechanical Properties

The determination of accurate mechanical properties on high-strength, notch-sensitive materials is extremely difficult. Nevertheless, the following graph gives some idea of the relative toughness resulting from different heat treating practices on Micro-Melt T15 alloy.



Heat Treatment

Decarburization

Micro-Melt T15 alloy is less susceptible to decarburization during hardening than molybdenum-type high-speed steels; however, a controlled atmosphere is required to insure that there is no decarburization during heat treatment. Use of modern furnaces such as protective atmosphere furnaces, salt pots, fluidized bed furnaces and vacuum furnaces should minimize decarburization of this alloy.

Annealing

Suitable precautions should be taken to prevent excessive carburization and decarburization.

Heat slowly to 1600/1650°F (871/899°C), hold until the entire mass is heated through, and cool slowly (do not exceed 20°F [11°C] per hour) in the furnace to about 1000°F (538°C), after which the cooling rate may be increased.

Hardening

Micro-Melt T15 alloy should be heat treated using proper precautions to prevent decarburization. First, preheat to 1500/1600°F (816/871°C), equalize, and transfer to a furnace maintained at the desired hardening temperature. Alternatively, the tool may be preheated in the vacuum furnace that will be used for the austenitizing cycle.

Austenitize at 2000/2250°F (1093/1232°C) for 5 to 45 minutes, depending on the austenitizing time to be
Used. General suggestions for the austenitizing time to be used, depending upon the austenitizing temperature chosen, are given in the heat treatment table found at the end of this section.

Quench in oil and be sure that tools are cooled below 200°F (93°C) before tempering (cool enough to hold in your hand). If a vacuum furnace is used, it should have a 4 bar minimum quench capability.

Small sizes under about 1" (25.4mm) in diameter, or delicate sections, may be hardened by cooling in still air. It is also acceptable to quench in molten salt at temperatures of 1000/1100°F (538/593°C), equalizing for 5 minutes per inch, followed by air cooling.

Stress Relieving

To relieve the stresses of machining, heat slowly to 1150/1250°F (621/677°C), allow to equalize, then cool in still air.

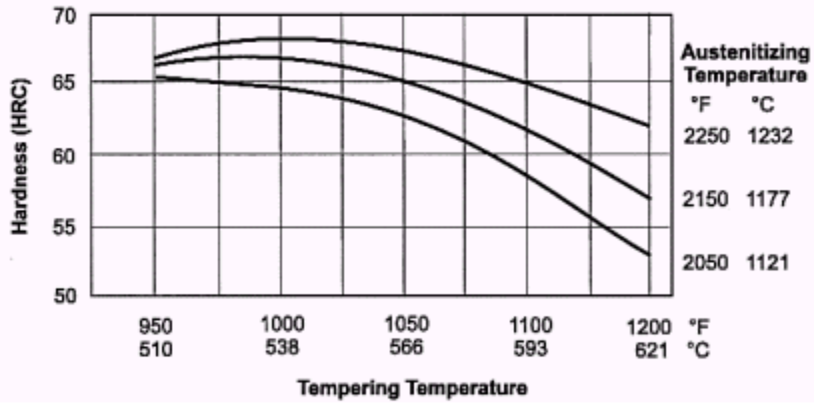
Tempering

Tools should be tempered immediately after the completion of the quench. The tempering temperature may be varied according to the desired hardness but it is usually in the range of 950/1150°F (510/621°C).

Triple tempering is always suggested.

The effects of various hardening and tempering temperatures on Rockwell hardness are shown in the following chart and figure.

Effect of Hardening and Tempering Temperatures on Hardness—Micro-Melt T15 Alloy
All samples were austenitized in salt at the temperature/time combinations shown below, oil quenched, and tempered at the indicated temperature for 2 hours + 2 hours + 2 hours.



Effect of Hardening and Tempering Temperatures on Hardness—Micro-Melt T15 Alloy
All samples were austenitized in salt for the indicated time at the indicated temperature, oil quenched, and tempered at the indicated temperature for 2 hours + 2 hours + 2 hours.

Tempering Temperature		Austenitizing Temperature					
°F	°C	2000°F (1093°C)	2050°F (1121°C)	2100°F (1149°C)	2150°F (1177°C)	2200°F (1204°C)	2250°F (1232°C)
950	510	64/65	65/66	65.5/66.5	66/67	66.5/67.5	66.5/67.5
1000	538	63.5/64.5	64/65	65.5/66.5	66.5/67.5	67/68	67.5/68.5
1025	551	62/63	63.5/64.5	64.5/65.5	65.5/66.5	66.5/67.5	67/68
1050	566	60/61	62.5/63.5	63.5/64.5	64/65	66/67	66.5/67.5
1100	593	56/57	58/59	60/61	61.5/62.5	63.5/64.5	65/66
1150	621	50/51	52.5/53.5	54.5/55.5	56.5/57.5	59/60	61.5/62.5
Austenitizing Time		45 min.	45 min.	30 min.	20 min.	10 min.	5 min.

Workability

Machinability

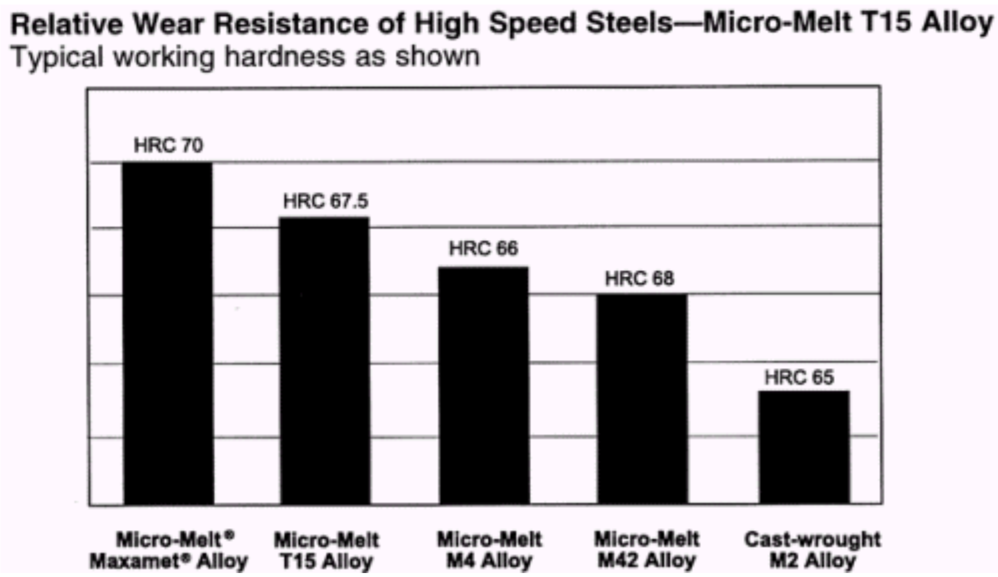
Due to the presence of the fine, uniformly distributed carbides, the grindability of Micro-Melt tool steel is relatively good. Grinding wheel suppliers' recommendations should be followed. Grinding wheels containing ceramic particles may provide improved performance.

Micro-Melt T15 tool steel can be easily cut or machined using the EDM process with proper precautions to prevent and/or remove the "white layer."

Other Information

Wear Resistance

The relative wear resistance of Micro-Melt T15 Alloy compared to other high speed steels can be viewed by clicking on Relative Wear Resistance High Speed Steels. Wear resistance was measured using a Dry Sand/Rubber Wheel abrasion test, ASTM G65. Results were normalized, with a higher value indicating better wear resistance.



Applicable Specifications

- ASTM A600
- QQ-T-590

Forms Manufactured

- Bar-Flats
- Bar-Rounds
- Bar-Squares
- Billet
- HIP'd Shapes
- Powder
- Wire

Technical Articles

- A New Guide for Selecting Ferrous Alloys, Tungsten Carbides and Ceramics for Tooling
- The ABC's of Alloy Selection, Heat Treating and Maintaining Cold Work Tooling

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