Technical Datasheet CARPENTER TECHNOLOGY

CarTech® Micro-Melt® Maxamet® Alloy

Identification

U.S. Patent Number
• 6,482,354

Type Analysis

Single figures are nominal except where noted.

Carbon	2.15 %	**Manganese**	0.30 %
Sulfur	0.070 %	**Silicon**	0.25 %
Chromium	4.75 %	**Cobalt**	10.00 %
Vanadium	6.00 %	**Tungsten**	13.00 %
Iron	Balance		

NOTE: In addition, the alloy can be produced with increased sulfur levels, up to 0.23%, for tools requiring improved machinability.

General Information

Description

CarTech Micro-Melt Maxamet alloy is a high alloy content super-hard high speed powder tool steel possessing properties intermediate between conventional high speed tool steels and cemented carbide. The high room temperature and hot hardness of this alloy allow it to be considered for use in applications where conventional tool steels do not hold up, such as in dry machining.

The balanced alloying additions allow the alloy to provide excellent wear resistance due to a high carbide volume, but to maintain good toughness at high hardness levels. In addition, the combination of high hardness, hot hardness, and high temperature stability make the alloy a candidate for applications in which tools are coated prior to service.

Applications

CarTech Micro-Melt Maxamet alloy may be considered for many types of tooling applications where either conventional high speed steels or cemented carbides are currently being used. Possible applications could include those where high speed steel is currently being used and an upgrade is desired but the switch to carbide is unattractive due to cost, tooling manufacture, toughness, or machine rigidity concerns; or applications where carbide is currently being used but is not cost-effective due to limited production runs or toughness/breakage problems.

Possible applications for this alloy could include:
Hobs
Punches
Form tools
Taps
End mills
Milling cutters
Thread roll dies
Indexable inserts
Broaches

Properties

Physical Properties

Density	0.2900	lb/in^3

Typical Mechanical Properties

Hot Hardness

The hot hardness of Micro-Melt Maxamet alloy tempered at 1025°F (552°C) to a room temperature hardness of HRC 70.0 was measured as HRC 63.0 at a test temperature of 1000°F (538°C). This is significantly higher than that of Micro-Melt T15 alloy, a grade known to provide good hot hardness, which measures HRC 58.0 under similar conditions.

Toughness

The toughness of Micro-Melt Maxamet alloy is somewhat lower than that of conventional powder metal high speed steel grades hardened to HRC 65/67. However, the toughness is significantly greater than that of cemented carbide.

Heat Treatment

Decarburization

Micro-Melt Maxamet alloy is less susceptible to decarburization during hardening than molybdenum-type high speed steels. However, a controlled atmosphere is required to ensure that there is no decarburization during heat treatment. Salt bath or vacuum furnace treating is preferred for this alloy.

Annealing

Suitable precautions should be taken to prevent excessive decarburization or carburization. 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. The annealed hardness should be approximately BHN 321/331 (HRC 32/34).

Hardening

Preheat at 1500/1600°F (816/871°C) long enough to ensure a thorough soak. Austenitize at 1900/2225°F (1038/1218°C) for 3-5 minutes, then oil quench. Parts may also be salt quenched to 1000°F (538°C), and air cooled. Vacuum furnaces with positive pressure quench capability greater than 4 bars can be used, but resultant hardness may be approximately 1-2 points HRC lower than obtained with other heat treating methods. Parts should be allowed to cool to room temperature prior to tempering.

Stress Relieving

To relieve the stresses of machining, heat slowly to 1150/1250°F (621/677°C), hold 1 to 2 hours, 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 is usually in the range 1000/1100°F (538/593°C). For austenitizing temperatures of 2150°F (1177°C) or below, a minimum of a double temper is desired. For austenitizing temperatures above 2150°F (1177°C), a triple temper with an included refrigeration step of -100°F (-73°C) after the first temper is suggested. Alternatively, 3 to 4 tempers with no refrigeration may be used. Each temper should be 2 hours at temperature, with parts cooled to room temperature between tempers.

Hardness Results—Micro-Melt Maxamet Alloy

Tempering Temperature		Hardening Temperature				
		1950°F (1066°C)	2050°F (1121°C)	2150°F (1177°C)	2200°F (1204°C)	2225°F (1218°C)
1000°F	538°C	68.5	69.5	70.0	70.5	71.0
1025°F	552°C	66.0	68.5	69.5	69.5	70.0
Austenitizing Time		5 min.	4 min.	4 min.	3 min.	3 min.
Tempering Practice		2 + 2	2 + 2	2 + 2	2, refrigerate, 2 + 2	2, refrigerate, 2 + 2

All above samples were oil quenched from the austenitizing temperature. Vacuum hardening may result in slightly lower hardness values.

Workability

Typical Machining Speeds and Feeds – Maxamet Alloy

The speeds and feeds in the following charts are conservative suggestions for initial setup. Higher speeds and feeds may be attainable depending on machining environment.

Turning—Single-Point and Box Tools

Carbide Tools (Inserts)	
Speed (sfpm)	Feed (ipr)
210	.010 - .014

Turning—Cut-Off and Form Tools

Carbide Tools		
Speed (sfpm)	Cut-Off Tool Width (inches)	Feed (ipr)
87	1/16 - 1/8	.009 - .014

Drilling

Carbide Tools		
Tool Material	Speed (sfpm)	Feed (ipr)
Solid Carbide	145	.003 - .007
Brazed Carbide Tip	75	.003 - .008

Die Threading

SFPM for Carbide Tools - 110

Milling, End-Peripheral

Carbide Tools		
Tool Material	Speed (sfpm)	Feed (ipr)
Indexable	160	.010
Solid fluted	85	.001 - .004

Milling, Face

Carbide Tools	
Speed (sfpm)	Feed (ipr)
160	.009 - .014

Figures used for all metal removal operations covered are average. On certain work, the nature of the part may require adjustment of speeds and feeds. Each job has to be developed for best production results with optimum tool life. Speeds or feeds should be increased or decreased in small steps.

Other Information

Wear Resistance

The wear resistance of Micro-Melt Maxamet alloy is better than that of conventional powder metal high speed steel grades and is equivalent to AISI A11 cold work powder metal tool steel.

Forms Manufactured

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

Technical Articles

- A New Guide for Selecting Ferrous Alloys, Tungsten Carbides and Ceramics for Tooling
- A Three-Point Program for Improving the Performance of Cold Work Tooling
- New Ideas for Machining Austenitic Stainless Steels
- New Powder Metal Alloy Bridges Gap Between High Speed Steel and Tungsten Carbide

Edition Date: 5/17/06