Technical Datasheet

CarTech® M1 Tool Steel

Identification

UNS Number

• T11301

AISI Number

• Type M1

Type Analysis

Single figures are nominal except where noted.

Carbon	0.81 %	**Manganese**	0.30 %
Silicon	0.30 %	**Chromium**	4.00 %
Molybdenum	8.50 %	**Vanadium**	1.10 %
Tungsten	1.50 %	**Iron**	Balance

General Information

Description

CarTech M1 tool steel is a general purpose high-speed steel which possesses toughness equivalent to any other material in its class.

It is produced using the electroslag remelting (ESR) process which results in higher purity, fewer inclusions, more uniform grain structure and improved properties.

CarTech M1 tool steel has been used in fire-edged tools and tools which must be ground with sharp angles where danger of edge crumbling or chipping is pronounced.

Applications

Uses of CarTech M1 tool steel in tooling applications have included:

Blanking dies
Chasers
Drills
Form cutters
Hobs
Lathe tools
Milling cutters
Planer tools
Punches
Reamers
Slitting saws
Taps
Trimming dies

Heat Treatment

Decarburization

While Star-Max tool steel is somewhat susceptible to decarburization in hardening, means of preventing this are well known. If proper control of atmosphere is maintained, Star-Max tool steel will present no difficulty with decarburization.

Normalizing

Normalizing Star-Max tool steel is not recommended.

Annealing

Pack in a suitable container with clean cast iron borings, heat uniformly to 1550/1600°F (843/871°C), then cool slowly in the furnace to 1200°F (649°C) at a rate of 20/40°F (11/22°C) per hour. Average Brinell hardness 207/248.

To relieve machining stresses for greater accuracy in hardening, first rough machine, then anneal below 1250/1300°F (677/704°C) and cool slowly. Finish machine the material after cooling.

Hardening

Star-Max tool steel should be heat treated from neutral salt baths or properly adjusted controlled atmosphere furnaces. A dew point of 10°F (-12°C) is suggested for the high heat furnace when using controlled atmosphere.

First, preheat to 1400/1500°F (760/816°C), then transfer to a superheating furnace with the temperature maintained at 2150/2200°F (1177/1204°C). When neutral salt baths are used for hardening, the temperature should be dropped 25°F (14°C) as compared to other furnace temperatures.

Quench in oil and be sure that tools are cooled below 200°F (93°C) before tempering.

Small sizes under about 1" (25.4 mm) 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 five minutes per inch followed by air cooling.

Deformation (Size Change) in Hardening

Star-Max tool steel exhibits only slight change in size when hardened. A 1" (25.4 mm) cube will expand about 0.0005" (0.013mm) in hardening at 2200°F (1204°C) and will expand a like amount when tempered at 1000°F (538°C). Cutters and form tools will open up slightly in the hole and expand somewhat on the outside diameter.

Tempering

Be sure to allow sufficient time for the tool to reach the proper temperature, then start to time the tempering operation. Tools should be tempered immediately after the completion of the quench. For best results with most tools, a range of 1000/1200°F (538/649°C) is suggested. For cutting tools, double or triple temper at 1000/1050°F (538/566°C) where maximum wear resistance is desired.

The effects of various tempering temperatures on the Rockwell hardness of Star-Max tool steel are shown in the hyperlink entitled "Effect of Tempering Temperature on Hardness."

Effect of Tempering Temperature on the Hardness of Star-Max Tool Steel
Average values — Rockwell C scale

Tempering Temperature 2 Hours at Heat		Hardening Temperature 2150°F (1177°C) 5 Minutes in Salt and Oil Quenched
°F	°C	
As hardened		66.0
700	371	61.0
900	482	62.5
1000	538	66.0
1050	566	65.5
1100	593	64.0
1200	649	58.0

Workability

Forging

Preheat very slowly to 1500/1600°F (816/871°C), then increase the furnace temperature to full heat of 1950/2050°F (1066/1121°C). Do not forge under 1700°F (927°C). Reheat as often as necessary to maintain minimum forging temperature. Forgings should be cooled very slowly in lime or ash. Always anneal after forging before hardening.

Machinability

Star-Max tool steel machines somewhat easier than the 18-4-1 type. Comparatively, it can be given a machinability rating of about 60% of a 1% carbon steel.

Following are typical feeds and speeds for Star-Max tool steel.

Turning—Single Point and Box Tools

Depth of Cut In.	High-Speed Tools			Carbide			
	Speed, fpm	Feed, ipr	Tool Material	Speed, fpm		Feed, ipr	Tool Material
				Brazed	Throw Away		
.150	60	.015	M-42	225	280	.015	C-6
.025	75	.007		280	370	.007	C-7

Turning—Cut-Off and Form Tools

Speed, fpm	Feed, ipr							Tool Material
	Cut-Off Tool Width, Inches			Form Tool Width, Inches				
	1/16	1/8	1/4	1/2	1	1-1/2	2	
60	.001	.001	.0015	.0015	.001	.0007	.0007	M-2
220	.002	.003	.0045	.003	.002	.0015	.0015	C-6

Drilling

Speed, fpm	Feed, ipr								Tool Material
	Nominal Hole Diameter, Inches								
	1/16	1/8	1/4	1/2	3/4	1	1-1/2	2	
45	.001	.002	.003	.005	.007	.009	.011	.013	M-1;M-10

Tapping

Speed, fpm	Tool Material
25	M-1; M-7; M-10

Reaming

Speed, fpm	High-Speed Tool						Carbide Tool		
	Feed, ipr						Tool Material	Speed, fpm	Tool Material
	Reamer Diameter, Inches								
	1/8	1/4	1/2	1	1-1/2	2			
45	.003	.005	.008	.012	.015	.018	M-1;M-2;M-7	150	C-2

Die Threading

Speed, fpm				Tool Material
7 or Less	8 to 15	16 to 24	25 and up, T.P.I.	
8-12	12-18	18-25	20-30	M-1;M-2;M-7;M-10

Milling—End Peripheral

Depth of Cut In.	High-Speed Tools						Carbide Tools					
	Speed, fpm	Feed—Inches per tooth				Tool Material	Speed, fpm	Feed—Inches per tooth				Tool Material
		Cutter Diameter, Inches						Cutter Diameter, Inches				
		1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2	
.050	70	.001	.002	.003	.004	M-2;M-7	275	.0015	.0025	.004	.005	C-6

Sawing—Power Hack Saw

Pitch—Teeth per Inch				Speed	Feed
Material Thickness, Inches					
Under 1/4	1/4-3/4	3/4-2	Over 2	Strokes/Minute	Inches/Stroke
10	10	6	4	70	.006

Additional Machinability Notes

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

Applicable Specifications

• ASTM A600 • QQ-T-590

Forms Manufactured

- Bar-Rounds

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