Technical Datasheet

CarTech® M7 Tool Steel

Identification

UNS Number

• T11307

AISI Number

• Type M7

Type Analysis

Single figures are nominal except where noted.

Carbon	1.00 %	**Manganese**	0.25 %
Silicon	0.25 %	**Chromium**	4.00 %
Molybdenum	8.75 %	**Vanadium**	2.00 %
Tungsten	1.75 %	**Iron**	Balance

General Information

Description

CarTech M7 tool steel is an electroslag remelted (ESR) molybdenum-bearing high-speed tool steel with a content of tungsten, chromium and molybdenum similar to that of CarTech M1 tool steel (AISI Type M1).

The increased carbon and vanadium content of this tool steel results in improved cutting efficiency without materially reducing toughness.

Applications

Applications for CarTech M7 tool steel have included:

Blanking dies
Chasers
Drills
End mills
Form cutters
Hobs
Lathe tools
Milling cutters
Planer tools
Punches
Reamers
Shearing blades
Slitting saws
Taps
Thread rolling dies
Trimming dies

Heat Treatment

Decarburization

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

Normalizing

Normalizing is not recommended.

Annealing

Pack in a suitable container with clean cast iron borings. Heat uniformly to 1525/1575°F (830/857°C) and cool slowly in the furnace to 1100°F (593°C) at a rate of 20/40°F (11/22°C) per hour. Average Brinell hardness is 240.

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

Hardening

Seven Star 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 a high-heat furnace when using controlled atmosphere.

First, preheat to 1400/1500°F (760/816°C), then transfer to a superheating furnace with a temperature maintained at 2150/2225°F (1177/1218°C). When neutral salt baths are used for hardening, the temperature should be dropped 25°F (14°C) as compared to other furnace temperatures.

If the usual controls over temperature and atmosphere are employed, there should be no difficulty with decarburization.

Quench in oil, ensuring that the tools are cooled below 200°F (93°C) before tempering (cool enough to hold in your hand).

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 5 minutes per inch followed by air cooling.

Deformation (Size Change) in Hardening

Seven Star tool steel changes size only slightly in hardening. A 1" (25.4 mm) cube will expand about 0.0005" (.0127 mm) in hardening at 2200°F (1204°C) and will expand a like amount when tempered at 1000°F (538°C).

Cutter and form tools will open up slightly in the hole and expand slightly on the OD.

Tempering

Be sure to allow sufficient time for the tools to reach the proper temperature and then start timing 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 suitable. For cutting tools, double or triple temper at 1000/1050°F (538/566°C) where maximum wear resistance is desired.

The Approximate hardness of Seven Star tool steel as tempered between 1000/1050°F (538/566°C) is Rockwell C 66.

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

Effect of Tempering Temperature on Hardness—Seven Star Tool Steel
Hardening temperature 2225°F (1218°C) 5 minutes in salt and oil quenched

Tempering Temperature		Average Values — Rockwell C Scale
°F	°C	
As Hardened		64/65
800	427	59/60
900	482	61/62
1000	538	66
1050	566	66
1100	593	65/66
1200	649	59/61

Workability

Forging

Preheat very slowly to 1500/1600°F (816/871°C), then increase 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.

Forgings should be cooled slowly in lime or ashes. Cool to at least 400°F (204°C) before reheating to anneal.

Machinability

Seven Star tool steel is carefully annealed to produce the highest degree of machinability possible for this type of steel. It machines somewhat better than the 18-4-1 type. For further comparison, its machinability rating is about 60% of a 1% carbon tool steel.

Following are typical feeds and speeds for Seven Star high speed steel.

Turning—Single Point and Box Tools

Depth of Cut, In.	High-Speed Tools			Carbide Tools			
	Speed, fpm	Feed, ipr	Tool Material	Speed, fpm		Feed, ipr	Tool Material
				Brazed	Throw Away		
.150	60	.015	M-42	220	250	.015	C-6
.025	65	.007	M-47	250	300	.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	
55	.001	.001	.0015	.0015	.001	.0007	.0007	M-2
190	.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	
35	.001	.002	.003	.005	.007	.008	.011	.013	M-1;M-10

Reaming

High-Speed Tools								Carbide Tools	
Speed, fpm	Feed, Inches per Rev						Tool Material	Speed, fpm	Tool Material
	Reamer Diameter, Inches								
	1/8	1/4	1/2	1	1-1/2	2			
30	.003	.005	.008	.012	.015	.018	M-7	100	C-2

Tapping

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

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, Cutter Diameter, Inches				Tool Material	Speed, fpm	Feed—Inches per Tooth, Cutter Diameter, Inches				Tool Material
		1/4	1/2	3/4	1-2			1/4	1/2	3/4	1-2	
.050	60	.001	.002	.003	.004	M-42	225	.0015	.0025	.004	.005	C-6
	55	.001	.002	.003	.004		220	.0015	.0025	.004	.005	

Broaching

Speed, fpm	Chip Load, Inches per Tooth	Tool Material
5	.002	M-42

Sawing—Power Hack Saw

Pitch—Teeth per Inch, Material Thickness, Inches				Speed	Feed
Under 1/4	1/4-3/4	3/4-2	Over 2	Strokes/Minute	Inches/Stroke
10	10	6	4	60	.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 and 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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