

## Cutting tool classification I - Material

### I-M2 High Speed ToolSteel

High speed steel (HSS or HS) is a subset of tool steels, Commonly used in tool bits and cutting tools. It is often used in power saw blades and drill bits. It is superior to the older high carbon steel tools used extensively through the 1940s in that it can withstand higher temperatures without losing its temper (hardness). This property allows HSS to cut faster than high carbon steel, Hence the name high speed steel.

At room temperature, In their generally recommended heat treatment, HSS grades generally display high hardness (above HRC 60) and a high abrasion resistance compared to common carbon and tool steels.

M2 is a high speed steel in tungsten-molybdenum series. The carbides in it are small and evenly distributed. It has high wear resistance. After heat treatment, Its hardness is the same as T1, But its bending strength can reach 4700 MPa, and its toughness and thermoplasticity are higher than T1 by 50%. It is usually used to manufacture a variety of tools, Such as drill bits, taps and reamers. Its decarbonization sensitivity is a little bit high.

#### Coatings-

To increase the life of high speed steel, Tools are sometimes coated. One such coating is TiN (titanium nitride). Most coatings generally increase a tool's hardness and/or lubricity. A coating allows the cutting edge of a tool to cleanly pass through the material without having the material gall (stick) to it. The coating also helps to decrease the temperature associated with the cutting process and increase the life of the tool.

#### Applications-

The main use of high speed steels continues to be in the manufacture of various cutting tools: drills, Taps, milling cutters, tool bits, gear cutters, Saw blades, etc., Although usage for punches and dies is increasing.

High speed steels also found a market in fine hand tools where their relatively good toughness at high hardness, Coupled with high abrasion resistance, made them suitable for low speed applications requiring a durable keen (sharp) edge, Such as files, chisels, hand plane blades, And high quality kitchen, pocket knives, And swords.

#### Metallurgical Content-

Grade	C	Cr	Mo	W	V	Co	Mn	Si
T1	0.65-0.80	3.75-4.00	-	17.25-18.75	0.9-1.3	-	0.1-0.4	0.2-0.4
M2	0.95	4.2	5.0	6.0	2.0	-	-	-
M7	1.00	3.8	8.7	1.6	2.0	-	-	-
M35	0.94	4.1	5.0	6.0	2.0	5.0	-	-
M42	1.10	3.8	9.5	1.5	1.2	8.0	-	-

Note that impurity limits are not included

### II-D2 High Carbon Tool Steel

## Steel Properties-

Dimensionally stable, High carbon, high-chromium (11%) steel, Particularly suitable for air hardening. D2 steel provides superior hardness, High wear-resistance, Good toughness, sufficient machinability, And excellent compressive and impact strength.

## Application-

High-duty cutting tools, blanking and punching tools, Wood working tools, Shear blades for cutting light-gauge material, Thread rolling tools, tools for drawing, Deep drawing and cold extrusion, pressing tools for the ceramics and pharmaceutical industries, Cold rolls (working rolls) for multiple-roll stands, Measuring instruments and gauges, Small moulds for the plastics industry where excellent wear resistance is required.

Chemical composition (average %) of AISI D2 Cold Work Tool Steel (DIN 1.2379)

Carbon (C)	1.55
Silicon (Si)	0.30
Manganese (Mn)	0.30
Chromium (Ch)	11.00
Molybdenum (Mo)	0.75
Vanadium (V)	0.75

Obtainable hardness: 58 - 60 HRC

## III-52100 Cr Steel

52100 is a high-carbon chromium alloy steel, Which, because of its versatility, Is used in a variety of mechanical applications. In the annealed condition this steel is comparatively easy to machine, yet very high hardness and abrasion resistance can be developed by heat treatment to make the steel particularly suitable for applications requiring extreme wear resistance. In addition, 52100 alloy steel can be heat treated to high levels of tensile strength and fatigue strength.

Tool Steels. Compared with tool steels in general, 52100 is less expensive and is much easier to handle. It is easier to form and machine than most tool steels yet can, After simple heat treatment, Develop many of the properties of tool steels.

Carburizing Grades. Compared with the carburizing grades of alloy steels, 52100 sacrifices some machinability but in return the user has a material with a much more simple and inexpensive heat treatment that minimizes distortion. Three compositions of 52100 have been developed with a wide range of hardenabilities which are suitable for nearly any application requiring high hardness throughout medium to heavy sections.

## Basic Characteristics of 52100 Alloy Steel-

Three compositions of 52100 have been developed with a wide range of hardenabilities which are suitable for nearly any application requiring high hardness throughout medium to heavy sections. These analyses are as follows in order of increasing hardenability:

	52100	MOD #1	MOD #2
Carbon	.93-1.05	.92-1.02	.87-.97
Manganese	.25-.45	.95-1.25	1.40-1.70
Phosphorus	.025 max	.025 max	.025 max
Sulphur	.025 max	.025 max	.025 max
Silicon	.20-.35	.50-.70	.60-.80
Chromium	1.30-1.60	.90-1.15	1.40-1.70

### Applications-

Some of the typical applications of 52100 steel tubing are:

Sleeves	Pins
Guides	Collars
Slitting Rolls and Knives	Spacers
Spindles	Machine Tool parts
Precision Instrument Parts	Pump Parts
Bushings	Tools
Collets	Thrust Collars
Stamping Tools	Anti-Friction Bearings
Gears	Engine Parts
Seals	Rollers
Dies	Cylinder Liners
Gages	Hydraulic Parts
Molds	Clutch Faces
Forming Rolls	Disintegrater Rolls

### Steel Quality-

The steel from which 52100 tubing is produced is made in electric furnaces using special refining techniques, Which insure maximum cleanliness and freedom from objectionable microscopic slag type inclusions. This steel is made to conform to the stringent chemical and cleanliness requirements of ASTM, A295, And AMS 6440. The modified grades meet ASTM A485.