

TOOL STEEL



VOJAY®

We light your way in business.

www.vojay-group.com



General description

Tool steel refers to a variety of carbon and alloy steels that are particularly well-suited to be made into tools. Their suitability comes from their distinctive hardness, resistance to abrasion, their ability to hold a cutting edge, and/or their resistance to deformation at elevated temperatures (red-hardness). Tool steels are made to a number of grades for different applications. The variety of materials ranges from unalloyed, surface-hardening steel to very highly alloyed. There are six groups of tool steels: water-hardening, cold-

work, shock-resisting, high-speed, hot-work, and special purpose. The choice of group to select depends on cost, working temperature, required surface hardness, strength, shock resistance, and toughness requirements. For every field of application, we supply individual steels characterised by the following properties, among other things:

- great wear resistance;
- very good toughness;
- high pressure resistance.

Specification

AISI	Chemical composition (%)									
	C	Mn	Si	S	P	Cr	V	W	Mo	Other
D2	1.40-1.60	0.10-0.60	0.10-0.60	≤0.030	≤0.030	11.00-13.00	0.50-1.10	-	0.70-1.20	-
D3	2.00-2.35	0.10-0.60	0.10-0.60	≤0.030	≤0.030	11.00-13.50	≤1.00	≤1.00	-	-
H10	0.35-0.45	0.20-0.70	0.80-1.25	≤0.030	≤0.030	3.00-3.75	0.25-0.75	-	2.00-3.00	-
H11	0.33-0.43	0.20-0.60	0.80-1.25	≤0.030	≤0.030	4.75-5.50	0.30-0.60	-	1.10-1.60	-
H13	0.32-0.45	0.20-0.60	0.80-1.25	≤0.030	≤0.030	4.75-5.50	0.80-1.20	-	1.10-1.75	-
M2	0.80-0.90	0.15-0.40	0.20-0.45	≤0.030	≤0.030	3.75-4.50	1.75-2.20	5.50-6.75	4.50-5.50	-
M3	1.00-1.10	0.15-0.40	0.20-0.45	≤0.030	≤0.030	3.75-4.50	2.25-2.75	5.00-6.75	4.75-6.50	-
M7	0.97-1.05	0.15-0.40	0.20-0.55	≤0.030	≤0.030	3.50-4.00	1.75-2.25	1.40-2.10	8.20-9.20	-
M35	0.88-0.96	0.20-0.40	0.25-0.45	≤0.030	≤0.030	3.80-4.50	1.70-2.00	6.00-6.70	4.70-5.20	Co=4.50-5.50
M42	1.05-1.15	0.15-0.40	0.15-0.65	≤0.030	≤0.030	4.50-4.25	0.95-1.35	1.15-1.85	9.00-10.00	Co=7.75-8.75
T1	0.65-0.80	0.10-0.40	0.20-0.40	≤0.030	≤0.030	3.75-4.50	0.90-1.30	17.25-18.75	-	-
T4	0.70-0.80	0.10-0.40	0.20-0.40	≤0.030	≤0.030	3.75-4.50	0.80-1.20	17.50-19.00	0.40-1.00	Co=4.25-5.75

*Note: Any other specification is subject to discussion and available upon request.

Heat treatment requirements

AISI	Annealing T, °C	Stress Relieving T, °C	Quenching T, °C	Quenching Media*	Tempering T, °C	Rockwell Hardness
D2	870-890	720-740	980-1050	O/A	180-230	60-64
D3	850-870	720-740	950-980	O	180-350	57-62
H10	860-890	730-760	1030-1060	O/A	560-580	55-60
H11	860-890	730-760	1020-1050	O/A	560-580	53-57
H13	860-890	730-760	1020-1050	O/A	560-580	52-56
M2	840-860	720-760	1210-1230	S/O/A	540-560	63-66
M3	840-860	720-760	1210-1230	S/O/A	540-560	63-66
M7	840-860	720-760	1210-1230	S/O/A	540-560	63-66
M35	840-860	720-760	1200-1235	S/O/A	540-560	64-67
M42	860-880	720-760	1160-1190	S/O/A	530-560	66-68
T1	840-860	720-760	1270-1285	S/O/A	550-570	63-66
T4	840-860	720-760	1270-1285	S/O/A	550-570	63-66

*Note: S - Salt bath; O - oil; A - air

Typical applications



DELIVERY PROGRAMM

PRODUCTS RANGE



COLD DRAWN WIRE

SPECIFICATION:
Diameter: 1.00 - 14.50 mm
Finish: Annealed / Bright



HOT ROLLED WIRE ROD

SPECIFICATION:
Diameter: 5.50 - 16.00 mm
Finish: Annealed / Black



HOT ROLLED ROUND BAR

SPECIFICATION:
Diameter: 8.00 - 700.00 mm
Finish: Black / Peeled / Turned



FORGED ROUND BAR

SPECIFICATION:
Diameter: 80.00 - 700.00 mm
Finish: Wheeled / Turned



FLAT BAR

SPECIFICATION:
Thickness: 1.50 - 50.00 mm
Width: 20.00 - 500.00 mm
Finish: Annealed / Black



SHEET / PLATE

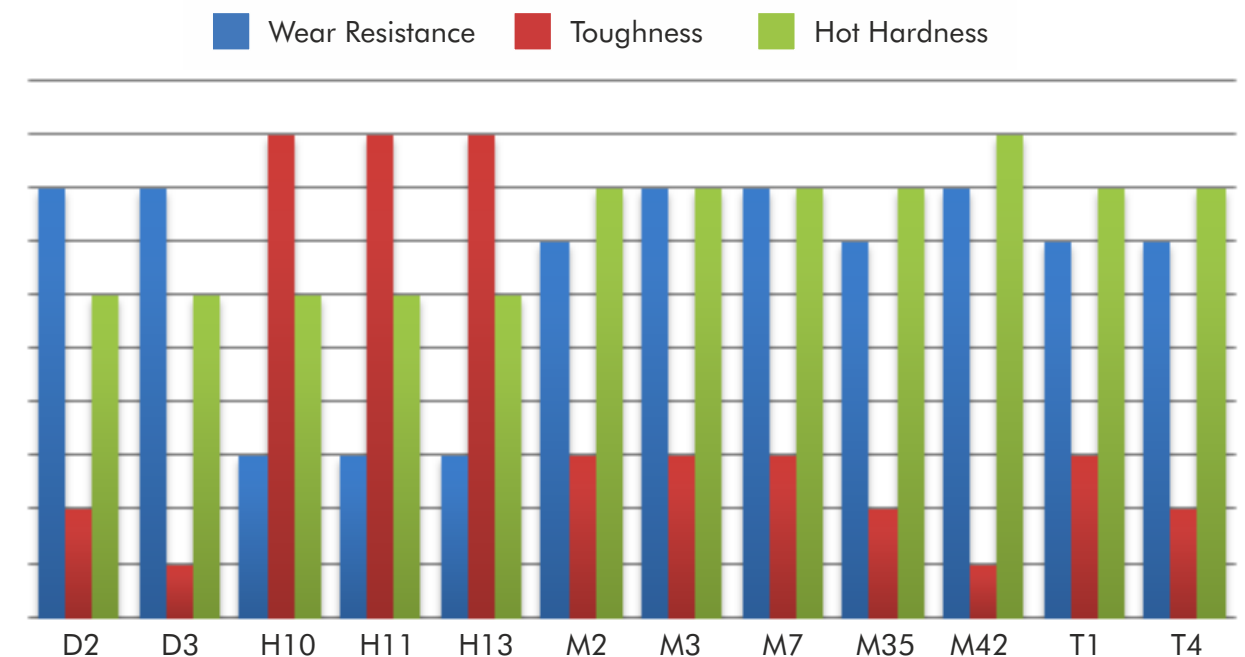
SPECIFICATION:
Thickness: 1.00 - 120.00 mm
Width: 500.00 - 810.00 mm
Finish: Annealed / Black

SPECIFICATION RANGE

Steel type	Grade	ROUND BAR / WIRE	FLAT BAR / SHEET / PLATE	
		Diameter, mm	Thickness, mm	Width, mm
Cold-Work Tool Steel	D2	12.00 - 550.00	1.00 - 100.00	40.00 - 810.00
	D3	15.00 - 400.00	1.00 - 80.00	
Hot-Work Tool Steel	H10	15.00 - 550.00	1.00 - 100.00	
	H11	15.00 - 680.00	1.00 - 120.00	
	H13	15.00 - 680.00	1.00 - 120.00	
High Speed Tool Steel	M2	1.00 - 260.00	1.50 - 65.00	15.00 - 510.00
	M3	1.00 - 260.00		
	M7	15.00 - 80.00		
	M35	2.00 - 160.00		
	M42	16.00 - 160.00		
	T1	3.00 - 160.00		
	T4	3.00 - 160.00		

* Note: All dimensions are reference values and do not constitute a basis for others. Please check with us for specifications not listed above.

GENERAL PROPERTIES



COLD-WORK TOOL STEEL

Tool steels of the cold-working category are primarily intended for die work, although their use is by no means restricted to that general field. Cold-work steels are not designed to resist softening at elevated temperatures, and are therefore restricted to applications at temperatures below ~200- 260 °C.

High Carbon & Chromium Steel - D2

An air-hardening die steel with high-carbon, high-chromium content having several desirable tool steel properties, such as abrasion resistance, high hardness, and nondeforming characteristics.

The carbon content of this type, although relatively high, is not particularly detrimental to its machining. The ease of working can be further improved by selecting the same basic type with the addition of sulfur.

The applications comprise primarily cold-working press tools for shearing (blanking and stamping dies, punches, shear blades), for forming (bending, seaming), also for thread rolling dies, solid gages, and wear resistant structural parts. Dies for hot trimming of forgings are also

made of D2 which is then heated treated to a lower hardness for the purpose of increasing toughness.

High Carbon & Chromium Steel - D3

The high carbon content of this high-chromium tool steel type results in excellent resistance to wear and abrasion and provides superior compressive strength as long as the pressure is applied gradually, without exerting sudden shocks.

In hardening, an oil quench is used, without affecting the excellent nondeforming properties of this type. Its deep-hardening properties make it particularly suitable for tools that require repeated regrinding during their service life, such as different types of dies and punches.

The more important applications comprise blanking, stamping, and trimming dies and punches for long production runs; forming, bending and drawing tools; and structural elements like plug and ring gages, and lathe centers, in applications where high wear resistance is important.

HOT-WORK TOOL STEEL

This family of special tool steels has been developed for tools that in their regular service are in contact with hot metals over a shorter or longer period of time, with or without cooling being applied. The essential property of these steels is their capability to sustain elevated temperature without seriously affecting the usefulness of the tools made from them.

Chromium Hot-Works Steel - H10

Hot work steel that exhibits excellent resistance to softening at elevated temperature. This grade is very resistant to thermal fatigue cracking (heat checking), and can be water cooled in service. H10 is recommended for difficult hot work tooling applications such as hot punches, die casting dies, forging dies, hot shear blades, hot gripper dies, and extrusion tooling.

Chromium Hot-Works Steel - H11

Hot work steel that is characterized by excellent impact toughness. It contains less vanadium than the widely-used H13 hot work tool steel. This provides for the higher toughness, with some reduction in wear resistance and temper resistance. H11 hot work tool steel is a deep-

hardening, air-hardening steel that exhibits minimal size change during heat treatment. It has good resistance to thermal fatigue cracking (heat checking) and excellent resistance to gross cracking and thermal shock when water cooled in service.

H11 hot work tool steel is recommended for hot tooling applications where maximum resistance to cracking is required. Such applications include hot punches, die casting dies, forging dies, hot shear blades, hot gripper dies, and extrusion tooling.

Chromium Hot-Works Steel - H13

This type of tool steel differs from the preceding ones particularly in properties related to the addition of about 1 per cent vanadium, which contributes to increased hot hardness, abrasion resistance, and reduced sensitivity to heat checking. Such properties are needed in die casting, particularly of aluminum, where the tools are subjected to drastic heating and cooling at high operating temperatures.

Besides die-casting dies, H13 is also widely used for extrusion dies, trimmer dies, hot gripper and header dies, and hot shear blades.

HIGH-SPEED STEEL

The primary application of high-speed steels is to tools used for the working of metals at high cutting speeds. Cutting metal at high speed generates heat, the penetration of the cutting tool edge into the work material requires great hardness and strength, and the continued frictional contact of the tool with both the parent material and the detached chips can only be sustained by an abrasion-resistant tool edge.

Molybdenum High-Speed Steel - M2

A high-speed tool steel with a well balanced composition suitable for a wide variety of applications. Worldwide, the M2 type is the most popular high speed steel having replaced T1 high speed in most applications because of its superior properties and relative economy. Typical applications for M2 high speed steel include twist drills, taps, milling cutters, reamers, broaches, saws, and knives.

Molybdenum High-Speed Steel - M3

A high-speed tool steel with increased vanadium content for improved wear resistance, yet still below the level where vanadium would interfere with the ease of grinding.

This steel is preferred for cutting tools requiring improved wear resistance, like broaches, form tools, milling cutters, chasers, and reamers.

Molybdenum High-Speed Steel - M7

A high-speed tool steel with superior abrasion resistance because of its high carbon and vanadium content. It is an excellent choice for premium grade tools which require an outstanding balance of red hardness, edge toughness, and wear resistance. Because of sensitivity to decarburization, heat treatment in a salt bath or a controlled atmosphere is advisable.

Used for blanking and trimming dies, shear blades, lathe tools, and thread rolling dies.

Molybdenum High-Speed Steel - M35

A high-speed tool steel alloyed by Cobalt with a good machinability and increased hot hardness. The composition of M35 makes for a good combination of toughness and hardness. M35 is suitable for cutting

conditions where demands for hot hardness are of importance and for cold work applications, where exacting demands are imposed on wear resistance.

By virtue of these well balanced properties M35 has come into very wide use for cutting tools such as, broaches, taps, milling, reamers, hobs, shapers cutters, saws etc.

Molybdenum High-Speed Steel - M42

In applications where high hardness both at regular and at elevated temperatures is needed, this type of high-speed steel with high cobalt content can provide excellent service.

Typical applications are tool bits, form tools, shaving tools, fly cutters, roll turning tools, and thread rolling dies.

Tungsten High-Speed Steel - T1

Is considered to be the classical type of high-speed tool steel. The chemical composition of T1 was developed in the early 1900s, and has changed very little since. T1 is still considered to be the best general-purpose high-speed tool steel because of the comparative ease of its machining and heat treatment. It combines a high degree of cutting ability with relative toughness.

T1 steel is used for all types of multipleedge cutting tools like drills, reamers, milling cutters, threading taps and dies, etc and is also used for punches, dies, and machine knives, as well as for structural parts that are subjected to elevated temperatures, like lathe centers, and certain types of antifriction bearings.

Tungsten High-Speed Steel - T4

Is high-speed tool steel similar to T1, but alloyed with Cobalt to increase heat resistance. It combines high red hardness, moderate abrasion resistance, and good toughness. Tungsten content promotes high temperature hardness and wear resistance.

Used in high speed tool and cutting applications such as drills, milling processes, reamers, etc.





UK & EUROPE & USA

VOJAY LLP
Eldon House, Regent Centre,
Newcastle upon Tyne, NE3 3PW, UK.
Tel: + 44 191 622 01 05
Fax: + 44 191 622 00 17
E-mail: info@vojay-group.com

CIS (Ukraine, Russia, Belarus, etc)

VOJAY-UKRAINE LLC
Olexadr Pol' Avenue 107-G
49069 Dnipro, Ukraine
Tel: + 38 056 790 65 00
Fax: + 38 056 786 20 09
E-mail: ua@vojay-group.com

ASIA

JIANGSU FEIYUE ALLOY CO. LTD
Houxiang Town, Danyang City, Jiangsu Province,
212300 China
Tel: + 86 523 802 18 725
Fax: + 86 523 802 18 724
E-mail: cn@vojay-group.com