



Designation: A600 – 92a (Reapproved 2024)

Standard Specification for Tool Steel High Speed¹

This standard is issued under the fixed designation A600; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers tungsten-type and molybdenum-type high-speed steels available as annealed, hot-rolled bars, forgings, plate, sheet, or strip, and annealed, cold-finished bars or forgings used primarily in the fabrication of tools.

1.2 Seven types of tungsten high-speed tool steels designated T1, T2, etc., seventeen types of molybdenum high-speed tool steels designated M1, M2, etc., and two intermediate high-speed steels designated as M50 and M52 are covered. Selection will depend upon design, service conditions, and mechanical properties.

1.3 The term “high-speed steel” is described and its minimum requirements are covered in the Annex.

1.4 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A388/A388M Practice for Ultrasonic Examination of Steel Forgings](#)

¹ This specification is under the jurisdiction of ASTM Committee [A01](#) on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee [A01.29](#) on Tool Steels.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[A561 Practice for Macroetch Testing of Tool Steel Bars](#)

[A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment](#)

[E3 Guide for Preparation of Metallographic Specimens](#)

[E30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron \(Withdrawn 1995\)³](#)

[E45 Test Methods for Determining the Inclusion Content of Steel](#)

[E59 Practice for Sampling Steel and Iron for Determination of Chemical Composition \(Withdrawn 1996\)³](#)

2.2 Military Standard:

[MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage⁴](#)

2.3 Federal Standards:

[Fed. Std. No. 123 Marking for Shipment \(Civil Agencies\)⁴](#)

[Fed. Std. No. 183 Continuous Identification Marking of Iron and Steel Products⁴](#)

3. Classification

3.1 Material in accordance with this specification is classified by chemical composition. Types correspond to respective AISI designations.

3.1.1 Types T1, T2, T4, T5, T6, T8, and T15 are characterized by a controlled high tungsten content along with other alloying elements.

3.1.2 Types M1, M2, M3, M4, M6, M7, M10, M30, M33, M34, M36, M41, M42, M43, M44, M46, M47, M48, and M62 are characterized by a controlled high molybdenum content along with other alloying elements.

3.1.3 Types M2, M3, and M10 are further classified according to carbon range. Type M3 is further classified according to vanadium range.

3.1.4 Types M50 and M52 are considered intermediate high-speed steels in view of their lower total alloy content than the standard types. These leaner alloy grades normally are limited to less severe service conditions.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

4. Ordering Information

4.1 Orders for material under this specification shall include the following information, as required to describe adequately the desired material:

- 4.1.1 Name of material (high-speed tool steel),
- 4.1.2 Type,
- 4.1.3 Shape (sheet, strip, plate, flat bar, round bar, square bar, hexagon bar, octagon, special shapes),
- 4.1.4 Dimensions (thickness, width, diameter, length) (For coils, include the minimum inside diameter or inside diameter range, the maximum outside diameter, and maximum or minimum coil weight if required. (Minimum coil weights are subject to negotiation.)),
- 4.1.5 Finish (hot rolled, forged, blasted or pickled, cold drawn, rough machined, ground, precision ground and polished),
- 4.1.6 Condition (annealed),
- 4.1.7 ASTM designation and date of issue, and
- 4.1.8 Special or supplementary requirements.

5. Materials and Manufacture

5.1 Unless otherwise specified, material covered by this specification shall be made by an electric melting process.

6. Chemical Composition

6.1 An analysis of each heat of steel shall be made by the manufacturer to determine the percentage of the elements specified and these values shall conform to the requirements as to chemical composition specified in **Table 1**. If requested or required, the chemical composition shall be reported to the purchaser or his representative.

6.2 Analysis may be made by the purchaser from finished bars and forgings by machining off the entire cross section and drilling parallel to the axis of the bar or forging at any point midway between the center and surface in accordance with the latest issue of Practice **E59**. The chemical analysis of the drilling chips shall be made in accordance with the latest issue of Test Methods **E30**. The chemical composition thus determined shall not vary from the limits specified in **Table 1**.

7. Hardness Requirements

7.1 Annealed hardness values when obtained in accordance with the latest issue of Test Methods and Definitions **A370** shall not exceed the Brinell hardness values (or equivalent Rockwell hardness values) specified in **Table 2**.

TABLE 1 Chemical Requirements, %^A

UNS Designation ^B	Type	Carbon		Manganese		Phos-phorus	Sulfur ^C	Silicon	Chromium		Vanadium		Tungsten		Molybdenum		Cobalt		
		min	max	min	max	max	max	min	max	min	max	min	max	min	max	min	max	min	max
Tungsten-Type High-Speed Steels																			
T12001	T1	0.65	0.80	0.10	0.40	0.03	0.03	0.20	0.40	3.75	4.50	0.90	1.30	17.25	18.75	...	...	...	...
T12002	T2	0.80	0.90	0.20	0.40	0.03	0.03	0.20	0.40	3.75	4.50	1.80	2.40	17.50	19.00	...	1.00	...	...
T12004	T4	0.70	0.80	0.10	0.40	0.03	0.03	0.20	0.40	3.75	4.50	0.80	1.20	17.50	19.00	0.40	1.00	4.25	5.75
T12005	T5	0.75	0.85	0.20	0.40	0.03	0.03	0.20	0.40	3.75	5.00	1.80	2.40	17.50	19.00	0.50	1.25	7.00	9.50
T12006	T6	0.75	0.85	0.20	0.40	0.03	0.03	0.20	0.40	4.00	4.75	1.50	2.10	18.50	21.00	0.40	1.00	11.00	13.00
T12008	T8	0.75	0.85	0.20	0.40	0.03	0.03	0.20	0.40	3.75	4.50	1.80	2.40	13.25	14.75	0.40	1.00	4.25	5.75
T12015	T15	1.50	1.60	0.15	0.40	0.03	0.03	0.15	0.40	3.75	5.00	4.50	5.25	11.75	13.00	...	1.00	4.75	5.25
Molybdenum-Type High-Speed Steels																			
T11301	M1	0.78	0.88	0.15	0.40	0.03	0.03	0.20	0.50	3.50	4.00	1.00	1.35	1.40	2.10	8.20	9.20	...	...
T11302	M2 regular C high C	0.78	0.88	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.50	1.75	2.20	5.50	6.75	4.50	5.50	...	...
		0.95	1.05	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.50	1.75	2.20	5.50	6.75	4.50	5.50	...	...
T11313	M3 Class 1	1.00	1.10	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.50	2.25	2.75	5.00	6.75	4.75	6.50	...	...
T11323	Class 2	1.15	1.25	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.50	2.75	3.25	5.00	6.75	4.75	6.50	...	...
T11304	M4	1.25	1.40	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.75	3.75	4.50	5.25	6.50	4.25	5.50	...	...
T11306	M6	0.75	0.85	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.50	1.30	1.70	3.75	4.75	4.50	5.50	11.00	13.00
T11307	M7	0.97	1.05	0.15	0.40	0.03	0.03	0.20	0.55	3.50	4.00	1.75	2.25	1.40	2.10	8.20	9.20	...	...
T11310	M10 regular C high C	0.84	0.94	0.10	0.40	0.03	0.03	0.20	0.45	3.75	4.50	1.80	2.20	...	...	7.75	8.50	...	...
		0.95	1.05	0.10	0.40	0.03	0.03	0.20	0.45	3.75	4.50	1.80	2.20	...	...	7.75	8.50	...	...
T11330	M30	0.75	0.85	0.15	0.40	0.03	0.03	0.20	0.45	3.50	4.25	1.00	1.40	1.30	2.30	7.75	9.00	4.50	5.50
T11333	M33	0.85	0.92	0.15	0.40	0.03	0.03	0.15	0.50	3.50	4.00	1.00	1.35	1.30	2.10	9.00	10.00	7.75	8.75
T11334	M34	0.85	0.92	0.15	0.40	0.03	0.03	0.20	0.45	3.50	4.00	1.90	2.30	1.40	2.10	7.75	9.20	7.75	8.75
T11336	M36	0.80	0.90	0.15	0.40	0.03	0.03	0.20	0.45	3.75	4.50	1.75	2.25	5.50	6.50	4.50	5.50	7.75	8.75
T11341	M41	1.05	1.15	0.20	0.60	0.03	0.03	0.15	0.50	3.75	4.50	1.75	2.25	6.25	7.00	3.25	4.25	4.75	5.75
T11342	M42	1.05	1.15	0.15	0.40	0.03	0.03	0.15	0.65	3.50	4.25	0.95	1.35	1.15	1.85	9.00	10.00	7.75	8.75
T11343	M43	1.15	1.25	0.20	0.40	0.03	0.03	0.15	0.65	3.50	4.25	1.50	1.75	2.25	3.00	7.50	8.50	7.75	8.75
T11344	M44	1.10	1.20	0.20	0.40	0.03	0.03	0.30	0.55	4.00	4.75	1.85	2.20	5.00	5.75	6.00	7.00	11.00	12.25
T11346	M46	1.22	1.30	0.20	0.40	0.03	0.03	0.40	0.65	3.70	4.20	3.00	3.30	1.90	2.20	8.00	8.50	7.80	8.80
T11347	M47	1.05	1.15	0.15	0.40	0.03	0.03	0.20	0.45	3.50	4.00	1.15	1.35	1.30	1.80	9.25	10.00	4.75	5.25
...	M48	1.42	1.52	0.15	0.40	0.03	0.07	0.15	0.40	3.50	4.00	2.75	3.25	9.50	10.50	4.75	5.50	8.00	10.00
...	M62	1.25	1.35	0.15	0.40	0.03	0.07	0.15	0.40	3.50	4.00	1.80	2.10	5.75	6.50	10.00	11.00	...	...
Intermediate High Speed Steels																			
T11350	M50	0.78	0.88	0.15	0.45	0.03	0.03	0.20	0.60	3.75	4.50	0.80	1.25	...	...	3.90	4.75	...	...
T11352	M52	0.85	0.95	0.15	0.45	0.03	0.03	0.20	0.60	3.50	4.30	1.65	2.25	0.75	1.50	4.00	4.90	...	...

^A Chemistry limits include product analysis tolerances. Unless otherwise specified, nickel plus copper equals 0.75 % max for all types.

^B New designation established in accordance with Practice E527 and SAE J 1086.

^C Where specified, sulfur may be 0.06 % to 0.15 % to improve machinability.