



Designation: A600 – 92a (Reapproved 2016)

## Standard Specification for Tool Steel High Speed<sup>1</sup>

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 ( $\epsilon$ ) 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.

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

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

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

[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[Open-Hearth Iron, and Wrought Iron \(Withdrawn 1995\)](#)<sup>3</sup>

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

[E59 Practice for Sampling Steel and Iron for Determination of Chemical Composition \(Withdrawn 1996\)](#)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

2.2 *Military Standard*:

[MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage](#)<sup>4</sup>

2.3 *Federal Standards*:

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

[Fed. Std. No. 183 Continuous Identification Marking of Iron and Steel Products](#)<sup>4</sup>

### 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.

### 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,

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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.

7.2 Specimens for determination of minimum response to hardening shall be 1/4-in. (6.4-mm) thick disks cut so as to represent either the full cross-sectional area or that midway between the center and outer surface of the material. If the

TABLE 1 Chemical Requirements, %<sup>A</sup>

UNS Designation <sup>B</sup>	Type	Carbon		Manganese		Phosphorus	Sulfur <sup>C</sup>		Silicon		Chromium		Vanadium		Tungsten		Molybdenum		Cobalt		
		min	max	min	max		min	max	min	max	min	max	min	max	min	max	min	max	min	max	min
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	...	...	...	...
T11313	M3 Class 1	0.95	1.05	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	...	...	...	...
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	...	...	...	...

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

<sup>B</sup> New designation established in accordance with Practice E527 and SAE J 1086.

<sup>C</sup> Where specified, sulfur may be 0.06 to 0.15 % to improve machinability.

**TABLE 2 Maximum Brinell Hardness in Annealed or Cold Drawn Condition**

Type	Annealed BHN	Cold Drawn Annealed BHN	Cold Drawn BHN
M1	248	255	262
M2 (regular C)	248	255	262
M2 (high C)	255	262	269
M3, Class 1 and Class 2	255	262	269
M4	255	262	269
M6	277	285	293
M7	255	262	269
M10 (regular C)	248	255	262
M10 (high C)	255	262	269
M30	269	277	285
M33	269	277	285
M34	269	277	285
M36	269	277	285
M41	269	277	285
M42	269	277	285
M43	269	297	285
M44	285	293	302
M46	269	277	285
M47	269	277	285
M48	311	321	331
M50	248	255	262
M52	248	255	262
M62	285	293	302
T1	255	262	269
T2	255	262	269
T4	269	277	285
T5	285	293	302
T6	302	311	321
T8	255	262	269
T15	277	285	293

material form or size does not lend itself to accurate hardness determination on ¼-in. thick cross-sectional disks, then longitudinal specimens may be used for hardness testing. Examples are round bars less than ½ in. (12.7 mm) in diameter; sheet; and strip. In this case, the specimen shall be a minimum of 3 in. (76.2 mm) in length, and parallel flats shall be ground on the original mill surfaces. The specimens shall be heat treated in two furnaces, one operating as a preheat furnace and the other as a high-heat furnace. The furnaces may be either controlled atmosphere or molten-salt bath. The austenitizing temperature ranges stipulated in **Table 3** cover both furnace types.

7.2.1 After being austenitized for the proper time, the samples may be oil quenched or quenched in molten salt plus air cooling. When a salt quench is employed, its temperature shall be 1050 to 1175°F (566 to 635°C) except for M3, M4, M41, M42, M43, M46, M47, M48, M62, and T15, when it shall be 1000 to 1075°F (538 to 579°C). All samples shall be double tempered at 1025°F (552°C) for 2 h each cycle except for M0 and M52 which shall be given two tempering cycles of 2 h each at 1000°F and M41, M42, M43, M44, M46, M47, M48, M62, and T15, which shall be given three tempering cycles of 2 h each at 1000°F.

7.2.2 The hardness of the specimen after the specified heat treatment shall meet the minimum hardness value for the particular type of steel shown in **Table 3**. Rockwell C tests should be used where possible but light-load tests may be necessary on thin specimens. These tests should be specified by agreement between seller and purchaser. The hardness value shall be obtained in accordance with the latest issue of Test

Methods and Definitions **A370** and shall be the average of at least five readings taken in an area midway between the center and surface of the largest dimension of the cross-sectional specimen or along the parallel surfaces of the longitudinal specimen. The surface to be tested shall be ground sufficiently to remove any surface condition, scale, carburization, or decarburization which might affect readings.

## 8. Macrostructure

8.1 The macrostructure of a specimen representing the entire cross-sectional area in the annealed condition and prepared in accordance with the latest issue of Practice **A561** shall exhibit a structure free of excessive porosity, slag, dirt, or other nonmetallic inclusions, pipes, checks, cracks and other injurious defects.

8.2 Macroetch severity levels for center porosity and ingot pattern, illustrated photographically in Practice **A561**, shall not exceed the ratings specified in **Table 4** for the appropriate material size and composition.

## 9. Decarburization

9.1 Decarburization shall be determined on a specimen representing a cross section of the material and prepared in accordance with the latest issue of Guide **E3**. When examined at 20× or greater magnification, it shall not exceed the values given in **Tables 5-8** for the appropriate size and shape of the material.

9.2 Material ordered as drill rod, ground and polished, centerless ground, ground finished, or machine finished flats and squares shall be free of scale and decarburization.

## 10. Permissible Variations in Dimensions

10.1 Permissible variations in dimensions shall not exceed the applicable limits stated in **Tables 8-22**, incl. Where out-of-round or square requirements are shown, they shall be determined as follows:

10.1.1 *Out-of-Round*—Difference between high and low readings as determined by micrometers or other suitable measuring instruments.

10.1.2 *Out-of-Square*—The amount required to be removed from each edge in order to square the edge with the face as determined with a square and suitable measuring instruments.

## 11. Workmanship, Finish, and Appearance

11.1 High-speed tool steel shall be free of heavy scale, deep pitting, laps, porosity, injurious segregations, excessive non-metallic inclusions, seams, cracks, checks, slivers, scale marks, dents, soft and hard spots, pipes, or any defects that would detrimentally affect the suitability of the material, after removal of the recommended stock allowance. (See **Tables 5-8**.)

11.2 Visual examination shall be made to ensure compliance with the requirements for workmanship, finish, dimensions and tolerances, identification marking, and packaging.

## 12. Sampling

12.1 Unless otherwise specified, a lot shall consist of all material submitted for inspection at the same time, of the same heat, type, finish, and size, and must conform to the provisions of this specification.

**TABLE 3 Heat-Treating Requirements**

NOTE 1—The austenitizing temperatures are stipulated for the response to hardening test only. Other combinations of austenitizing and tempering temperatures may be used for particular applications.

Class	Preheat Temperature °F (°C)	Austenitizing Temperature, °F (°C) <sup>A</sup>		Tempering Temperature, °F (°C) <sup>B</sup>	Minimum Hardness, Rockwell C
		Salt Bath	Controlled Atmosphere Furnace		
M1	1350–1550 (732–843)	2185 (1196)	2205 (1207)	1025 (552)	64
M2 (regular C)	1350–1550 (732–843)	2220 (1216)	2240 (1227)	1025 (552)	64
M2 (high C)	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	65
M3, Class 1	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	64
M3, Class 2	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	64
M4	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	64
M6	1350–1550 (732–843)	2170 (1188)	2190 (1199)	1025 (552)	64
M7	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	65
M10 (regular C)	1350–1550 (732–843)	2185 (1196)	2205 (1207)	1025 (552)	63
M10 (high C)	1350–1550 (732–843)	2185 (1196)	2205 (1207)	1025 (552)	64
M30	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	64
M33	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	65
M34	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	64
M36	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1025 (552)	64
M41	1350–1550 (732–843)	2175 (1190)	2195 (1202)	1000 (538)	66
M42	1350–1550 (732–843)	2150 (1177)	2170 (1188)	1000 (538)	66
M43	1350–1550 (732–843)	2150 (1177)	2170 (1188)	1000 (538)	66
M44	1350–1550 (732–843)	2170 (1188)	2190 (1199)	1000 (538)	66
M46	1350–1550 (732–843)	2200 (1204)	2220 (1216)	1000 (538)	66
M47	1350–1550 (732–843)	2175 (1190)	2195 (1202)	1000 (538)	66
M48	1350–1550 (732–843)	2175 (1190)	2195 (1202)	1000 (538)	66
M50	1350–1550 (732–843)	2020 (1104)	2040 (1116)	1000 (538)	61
M52	1350–1550 (732–843)	2125 (1163)	2145 (1174)	1000 (538)	63
M62	1350–1550 (732–843)	2175 (1190)	2195 (1202)	1000 (538)	66
T1	1500–1600 (816–871)	2330 (1277)	2350 (1288)	1025 (552)	63
T2	1500–1600 (816–871)	2330 (1277)	2350 (1288)	1025 (552)	63
T4	1500–1600 (816–871)	2330 (1277)	2350 (1288)	1025 (552)	63
T5	1500–1600 (816–871)	2330 (1277)	2350 (1288)	1025 (552)	63
T6	1500–1600 (816–871)	2330 (1277)	2350 (1288)	1025 (552)	63
T8	1500–1600 (816–871)	2330 (1277)	2350 (1288)	1025 (552)	63
T15	1500–1600 (816–871)	2240 (1227)	2260 (1238)	1000 (538)	65

<sup>A</sup> Temperature limit shall be ±10°F (±5°C). If samples are austenitized in salt, the sample shall be immersed in the austenitizing salt bath for 5 min minimum. If austenitized in a controlled atmosphere furnace, the sample shall be at the austenitizing temperature for 5 to 15 min. The time at temperature is the time after the sample reaches the austenitizing temperature. This range in time is given because of the difficulty in determining when the sample reaches the austenitizing temperature in some types of controlled atmosphere furnaces.

Quenching may be done in oil or molten salt.

<sup>B</sup> Tempering at 1025°F (552°C) are for 2 + 2 h. Tempering at 1000°F (538°C) are for 2 + 2 + 2 h.

**TABLE 4 Macroetch Standards**  
Maximum Allowable Rating<sup>A</sup>

Bar Size, in. (mm)	T Classification Steels <sup>B</sup>		M Classification Steels <sup>C</sup>	
	Porosity	Ingot Pattern	Porosity	Ingot Pattern
Up to 2 (50.8), incl	3½	5	3	5
Over 2 to 3 (50.8 to 76), incl	4	5	3½	5
Over 3 to 4 (76 to 102), incl	4½	5	4	5
Over 4 to 5 (102 to 127), incl	5	5	4	5
Over 5 to 6 (127 to 152), incl	5	5	4½	5
Over 6 (152)	As negotiated between supplier and purchaser			

<sup>A</sup> Refer to macroetch photographs in Practice A561.

<sup>B</sup> Types T1, T2, T4, T5, T6, T8, and T15.

<sup>C</sup> Types M1, M2, M3, M4, M6, M7, M10, M30, M33, M34, M36, M41, M42, M43, M44, M46, M47, M48, M50, M52, and M62.

**TABLE 5 Maximum Decarburization Limits Rounds<sup>A</sup>**

NOTE 1—The recommended minimum allowance for machining prior to heat treatment is 25 % greater than the maximum decarburization allowed.

Specified Diameter, in. (mm)	Decarburization Limits per Side, in. (mm), Drawn Finish
Up to ½ (12.7), incl	0.013 (0.33)
Over ½ to 1 (12.7 to 25.4), incl	0.025 (0.64)
Over 1 to 2 (25.4 to 50.8), incl	0.038 (0.96)
Over 2 to 3 (50.8 to 76), incl	0.050 (1.27)
Over 3 to 4 (76 to 102), incl	0.070 (1.78)

<sup>A</sup> Rounds to be free of decarburization except drawn finish. Maximum decarburization of drawn finish rounds to be in accordance with the table above.

inspection requirements as specified herein. The supplier may utilize his own facilities or any other acceptable to the purchaser.

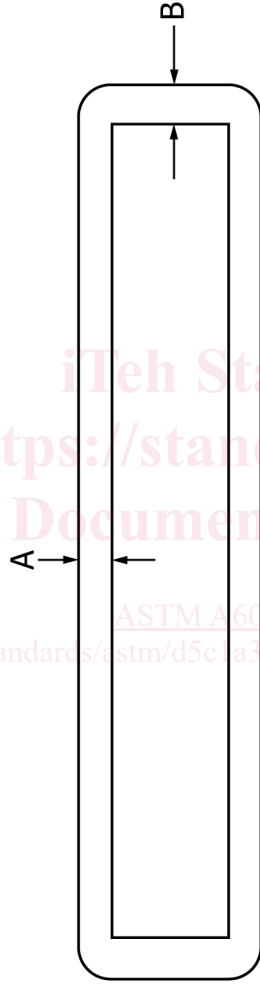
13.2 When specified in the purchase order, the inspector representing the purchaser shall have access to the material subject to inspection for the purpose of witnessing the selection of samples, preparation of test pieces, and performance of the tests. For such tests, the inspector shall have the right to

### 13. Inspection

13.1 Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all

**TABLE 6 Maximum Decarburization Limits**  
Hot Rolled Square and Flat Bars  
Maximum Limit Per Side

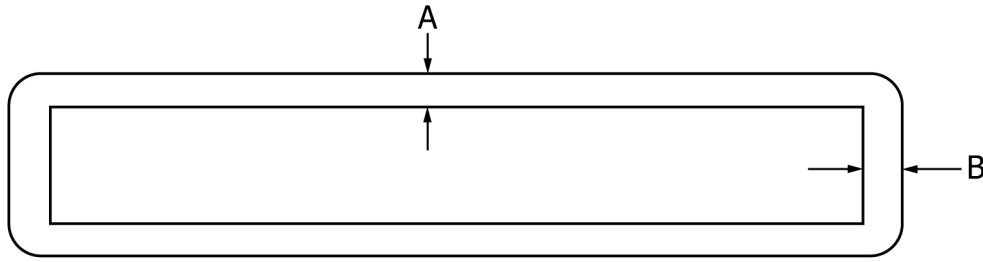
NOTE 1—The recommended minimum allowance for machining prior to heat treatment is 25 % greater than the maximum decarburization allowed.



Specified Thickness, in. (mm)	Specified Widths, in. (mm)											
	0 to 1/2 (0 to 12.7) incl.	Over 1/2 to 1 (12.7 to 25.4), incl.	Over 1 to 2 (25.4 to 50.8), incl.	Over 2 to 3 (50.8 to 76), incl.	Over 3 to 4 (76 to 102), incl.	Over 4 to 5 (102 to 127), incl.	Over 5 to 6 (127 to 152), incl.	Over 6 to 7 (152 to 178), incl.	Over 7 to 8 (178 to 203), incl.	Over 8 to 9 (203 to 229), incl.	Over 9 to 12 (229 to 304), incl.	
0 to 1/2 (0 to 12.7), incl.	A 0.020 (0.51)	0.020 (0.51)	0.024 (0.61)	0.028 (0.71)	0.032 (0.81)	0.036 (0.91)	0.040 (1.02)	0.044 (1.12)	0.048 (1.22)	0.048 (1.22)	0.048 (1.22)	
Over 1/2 to 1 (12.7 to 25.4), incl.	B 0.020 (0.51)	0.026 (0.66)	0.032 (0.81)	0.038 (0.97)	0.044 (1.12)	0.054 (1.37)	0.062 (1.57)	0.066 (1.68)	0.078 (1.98)	0.082 (2.08)	0.096 (2.44)	
Over 1 to 2 (25.4 to 50.8), incl.	...	0.036 (0.91)	0.036 (0.91)	0.036 (0.91)	0.040 (1.02)	0.044 (1.12)	0.052 (1.32)	0.056 (1.42)	0.060 (1.52)	0.060 (1.52)	0.060 (1.52)	
Over 2 to 3 (50.8 to 76), incl.	...	0.036 (0.91)	0.042 (1.07)	0.046 (1.17)	0.056 (1.42)	0.064 (1.63)	0.082 (2.08)	0.090 (2.29)	0.098 (2.49)	0.102 (2.59)	0.108 (2.74)	
Over 3 to 4 (76 to 102), incl.	...	...	0.052 (1.32)	0.056 (1.42)	0.056 (1.42)	0.056 (1.42)	0.060 (1.52)	0.060 (1.52)	0.064 (1.63)	0.068 (1.73)	0.072 (1.83)	
Over 4 to 5 (102 to 127), incl.	...	...	0.052 (1.32)	0.056 (1.42)	0.060 (1.52)	0.072 (1.83)	0.086 (2.18)	0.098 (2.49)	0.112 (2.84)	0.118 (3.00)	0.122 (3.10)	
Over 5 to 6 (127 to 152), incl.	...	...	...	0.064 (1.63)	0.064 (1.63)	0.068 (1.73)	0.068 (1.73)	0.072 (1.83)	0.072 (1.83)	0.080 (2.03)	0.080 (2.03)	
Over 6 to 7 (152 to 178), incl.	...	...	...	0.064 (1.63)	0.072 (1.83)	0.082 (2.08)	0.094 (2.39)	0.110 (2.79)	0.122 (3.10)	0.130 (3.30)	0.136 (3.45)	
Over 7 to 8 (178 to 203), incl.	...	...	...	...	0.080 (2.03)	0.080 (2.03)	0.086 (2.18)	0.092 (2.34)	0.094 (2.39)	0.100 (2.54)	0.100 (2.54)	
Over 8 to 9 (203 to 229), incl.	...	...	...	...	0.080 (2.03)	0.090 (2.29)	0.100 (2.54)	0.120 (3.05)	0.132 (3.35)	0.132 (3.35)	0.150 (3.81)	

**TABLE 7 Maximum Decarburization Limits**  
 Forged Square and Flat Bars  
 Maximum Limit Per Side

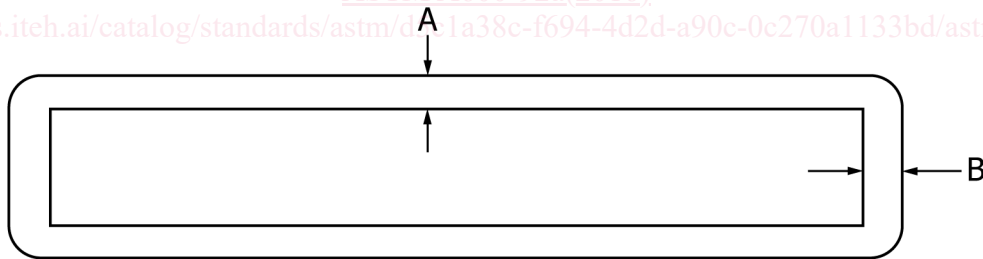
NOTE 1—The recommended minimum allowance for machining prior to heat treatment is 25 % greater than the maximum decarburization allowed.



Specified Thickness, in. (mm)	Specified Width, Inches (mm)									
	Over 1 to 2 (25.4 to 50.8), incl	Over 2 to 3 (50.8 to 76), incl	Over 3 to 4 (76 to 102), incl	Over 4 to 5 (102 to 127), incl	Over 5 to 6 (127 to 152), incl	Over 6 to 7 (152 to 178), incl	Over 7 to 8 (178 to 203), incl	Over 8 to 9 (203 to 229), incl	Over 9 to 12 (229 to 305), incl	
Over ½ to 1, (12.7 to 25.4), incl	A	0.038 (0.97)	0.042 (1.07)	0.048 (1.22)	0.052 (1.32)	0.056 (1.42)	0.062 (1.57)	0.066 (1.68)	0.072 (1.83)	0.080 (2.03)
	B	0.048 (1.22)	0.056 (1.42)	0.070 (1.78)	0.080 (2.03)	0.094 (2.39)	0.110 (2.79)	0.132 (3.35)	0.132 (3.35)	0.132 (3.35)
Over 1 to 2, (25.4 to 50.8), incl	A	0.058 (1.47)	0.062 (1.57)	0.066 (1.68)	0.070 (1.78)	0.074 (1.88)	0.080 (2.03)	0.084 (2.13)	0.094 (2.39)	0.106 (2.69)
	B	0.058 (1.47)	0.066 (1.68)	0.078 (1.98)	0.086 (2.18)	0.100 (2.54)	0.114 (2.90)	0.132 (3.35)	0.132 (3.35)	0.132 (3.35)
Over 2 to 3 (50.8 to 76), incl	A	...	0.080 (2.03)	0.084 (2.13)	0.088 (2.24)	0.092 (2.34)	0.098 (2.49)	0.106 (2.69)	0.114 (2.90)	0.126 (3.20)
	B	...	0.080 (2.03)	0.092 (2.34)	0.098 (2.49)	0.106 (2.69)	0.118 (3.00)	0.136 (3.45)	0.136 (3.45)	0.136 (3.45)
Over 3 to 4 (76 to 102), incl	A	...	...	0.102 (2.59)	0.106 (2.69)	0.112 (2.84)	0.120 (3.05)	0.132 (3.35)	0.140 (3.56)	0.158 (4.01)
	B	...	...	0.102 (2.59)	0.106 (2.69)	0.112 (2.84)	0.120 (3.05)	0.132 (3.35)	0.140 (3.56)	0.158 (4.01)
	B	...	...	...	0.126 (3.20)	0.130 (3.30)	0.138 (3.51)	0.146 (3.71)	0.156 (3.96)	0.170 (4.32)
Over 5 to 6 (127 to 152), incl	A	...	...	...	...	0.150 (3.81)	0.158 (4.01)	0.166 (4.22)	0.176 (4.47)	0.188 (4.78)
	B	...	...	...	...	0.150 (3.81)	0.158 (4.01)	0.166 (4.22)	0.176 (4.47)	0.188 (4.78)
Over 6 to 7 (152 to 178), incl	A	...	...	...	...	...	0.176 (4.47)	0.186 (4.72)	0.186 (4.72)	0.198 (5.03)
	B	...	...	...	...	...	0.176 (4.47)	0.186 (4.72)	0.186 (4.72)	0.198 (5.03)

**TABLE 8 Maximum Decarburization Limits**  
 Cold Drawn Square and Flat Bars  
 Maximum Limits Per Side

NOTE 1—The recommended minimum allowance for machining prior to heat treatment is 25 % greater than the maximum decarburization allowed.



Specified Thickness, in. (mm)	Specified Width, in. (mm)						
	0 to ½ (0 to 12.7), incl	Over ½ to 1 (12.7 to 25.4), incl	Over 1 to 2 (25.4 to 50.8), incl	Over 2 to 3 (50.8 to 76), incl	Over 3 to 4 (76 to 102), incl	Over 4 to 5 (102 to 127), incl	
0 to ½ (0 to 12.7), incl	A	0.020 (0.51)	0.020 (0.51)	0.024 (0.61)	0.028 (0.71)	0.032 (0.81)	0.036 (0.91)
	B	0.020 (0.51)	0.026 (0.66)	0.032 (0.81)	0.038 (0.97)	0.044 (1.12)	0.054 (1.37)
Over ½ to 1 (12.7 to 25.4), incl	A	...	0.036 (0.91)	0.036 (0.91)	0.036 (0.91)	0.040 (1.02)	0.044 (1.12)
	B	...	0.036 (0.91)	0.042 (1.07)	0.046 (1.17)	0.056 (1.42)	0.064 (1.63)
Over 1 to 2 (25.4 to 50.8), incl	A	...	...	0.052 (1.32)	0.052 (1.32)	0.056 (1.42)	...
	B	...	...	0.052 (1.32)	0.056 (1.42)	0.060 (1.52)	...

indicate the pieces from which samples will be selected. Otherwise the seller shall report to the purchaser, or his representative, the results of the chemical analysis and the physical property tests made in accordance with this specification.

13.3 The purchaser may perform any of the inspections set forth in the specification on the as-received material where such inspections are deemed necessary to assure that supplies and services conform to the prescribed requirements.