Designation: A 686 – 92 (Reapproved 2004)

Standard Specification for Tool Steel, Carbon[1]

This standard is issued under the fixed designation A 686; 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 Department of Defense.

1. Scope

1.1 This specification covers the chemical, mechanical, and physical requirements for available wrought carbon tool steel products.

1.2 These products, which include hot- or cold-finished bar, plate, sheet, rod, wire, or forgings, are normally fabricated into tools, dies, or fixtures. The selection of a material for a particular application will depend upon design, service conditions, and desired properties.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are provided for information only.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products

A 388/A 388M Practice for Ultrasonic Examination of Heavy Steel Forgings

A 561 Practice for Macroetch Testing of Tool Steel Bars

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment

E 3 Methods of Preparation of Metallographic Specimens

E 30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron

E 45 Test Methods for Determining the Inclusion Content of Steel

E 59 Practice for Sampling Steel and Iron for Determination of Chemical Composition

2.2 *Military Standard:*

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage[3]

2.3 *Federal Standards:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[3]

Fed. Std. No. 183 Continuous Identification Marking of Iron and Steel Products[3]

3. Classification

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

3.1.1 *Carbon Tool Steels, Identification W*—Types W1, W2, and W5 are often referred to as water hardening tool steels since they require rapid quenching rates to attain the necessary hardness. Except in very small sizes they will harden with a hard case and a soft core.

3.1.1.1 Type W1 is an unalloyed carbon steel available in several carbon ranges.

3.1.1.2 Type W2 is characterized by a nominal vanadium content of 0.25 % and is also available in several carbon ranges.

3.1.1.3 Type W5 is characterized by a nominal chromium content of 0.50 %.

3.1.1.4 A suffix following the type designation is added to denote the minimum carbon content of the carbon range to be specified.

3.1.2 Types W1 and W2 are further classified by quality levels, namely, Grade A and Grade C.

3.1.2.1 Grade A is sometimes referred to as *Extra* or *Special.* It is controlled for hardenability; the chemical composition is held to closest limits; and it is subject to rigid tests to ensure uniformity. Grade A is available with three degrees of hardenability, namely, shallow hardening, regular hardening, and deep hardening.

3.1.2.2 Grade C is sometimes referred to as *Regular* or *Standard*. It is intended for applications that do not require controlled hardenability and where some latitude in uniformity is permissible.

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 Class of material (carbon tool steel),

[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.

Current edition approved Sept. 1, 2004. Published January 2005. Originally approved in 1973. Last previous edition approved in 1999 as A 686 – 92 (1999).

[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.

[3] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005

4.1.2 Type (W1, W2, W5),

4.1.3 Suffix denoting carbon range (where applicable, such as W1–9, W2–10, etc.),

4.1.4 Grade and hardenability (where applicable, for example, Grade A deep hardening, and so forth),

4.1.5 Shape (sheet, plate, flat bar, round bar, square bar, hexagon bar, octagon, special shapes),

4.1.6 Dimensions (thickness, width, diameter, length),

4.1.7 Finish (hot rolled, forged, blasted or pickled, cold drawn, machined, ground, precision ground and polished),

4.1.8 Condition (annealed, unannealed, hardened and tempered, and so forth),

4.1.9 ASTM specification number and date of issue, and

4.1.10 Special requirements.

5. Materials and Manufacture

5.1 Unless otherwise specified, material covered by this specification shall be made by an electric melting process. It shall be made from ingots that have been reduced in cross section in such a manner and to such a degree as to ensure proper refinement of the ingot structure.

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 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 Method E 59. The chemical analysis of the drilling chips shall be made in accordance with the latest issue of Methods E 30. The chemical composition thus determined shall not vary from the limits specified in Table 1.

7. Hardness Properties

7.1 Annealed hardness values shall be obtained in accordance with the latest issue of Test Methods and Definitions A 370, and 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 ¼-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 material form or size does not lend itself to accurate hardness determination on ¼-in. (6.4-mm) 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 or sheet. 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 as prescribed in Table 3.

7.2.1 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 A 370, 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.

7.2.2 Hardness penetration and fracture grain size for Grade A shall be determined on test pieces of ¾ in. (19.1 mm) diameter and 3 in. (76.2 mm) length. Two pieces for each test shall be given a preliminary treatment by heating uniformly to 1600 ± 10°F (871 ± 5°C) and holding at temperature for 40

TABLE 1 Chemical Composition, %[A]

UNS Designation	Type	Grade	Carbon		Manganese		Silicon		Phosphorus, max	Sulfur, max	Chromium		Vanadium		Tungsten, max	Molybdenum, max	Copper, max	Nickel, max
			min	max	min	max	min	max			min	max	min	max				
T72301	W1	A	[B]	[B]	0.10	0.40	0.10	0.40	0.030	0.030	. . .	0.15	. . .	0.10	0.15	0.10	0.20	0.20
T72301	W1	C	[B]	[B]	0.10	0.40	0.10	0.40	0.030	0.030	. . .	0.30	. . .	0.10	0.15	0.10	0.20	0.20
T72302	W2	A	[C]	[C]	0.10	0.40	0.10	0.40	0.030	0.030	. . .	0.15	0.15	0.35	0.15	0.10	0.20	0.20
T72302	W2	C	[C]	[C]	0.10	0.40	0.10	0.40	0.030	0.030	. . .	0.30	0.15	0.35	0.15	0.10	0.20	0.20
T72305	W5	...	1.05	1.15	0.10	0.40	0.10	0.40	0.030	0.030	0.40	0.60	. . .	0.10	0.15	0.10	0.20	0.20

[A] Chemistry limits include product analysis tolerances.

[B] The carbon ranges for W1 and their respective suffix identification, sometimes referred to as tempers, are as follows:

Suffix	Carbon Range, %	Suffix	Carbon Range, %
8	0.80–0.90	10	1.00–1.10
8½	0.85–0.95	10½	1.05–1.15
9	0.90–1.00	11	1.10–1.20
9½	0.95–1.05	11½	1.15–1.25

[C] The carbon ranges for W2 and their respective suffix identification are as follows:

Suffix	Carbon Range, %
8½	0.85–0.95
9	0.90–1.00
9½	0.95–1.10
13	1.30–1.50

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

TABLE 2 Maximum Brinell Hardness in Annealed or Cold Drawn Condition

Type	Annealed BHN	Cold Drawn BHN
W1	202	241
W2	202	241
W5	202	241
Drill Rod (W1, W2, or W5)		
Ordered Diameter, in. (mm)	Brinell	Rockwell
To ⅛ (3.2)	HB 341	HRC 37
Over ⅛ to ¼ (3.2 to 6.4), incl	HB 275	HRC 28
Over ¼ to ½ (6.4 to 12.7), incl	HB 241	HRC 23
Over ½ (12.7)	HB 207	HRB 96

min, then quenching in oil. One piece shall be reheated to 1450 ± 10°F (788 ± 5°C) and the other to 1550± 10°F (843 ± 5°C). Each piece shall be held in the furnace at the respective temperature for 30 min and then quenched in brine (5 to 10 % sodium chloride solution). The pieces shall be nicked with an abrasive wheel in the center of the length and fractured. The fracture face of one portion of each broken test piece shall be ground smooth and etched in 1 + 1 muriatic acid at 165°F (74°C) for measurement of the depth of penetration to be expressed in 64ths of an inch. The fracture grain size shall be determined on the remaining portion of each broken test piece by comparison of the fracture surface of the hardened case with the Shepherd Fracture Grain Size Standards.[4] These standards consist of ten pieces of steel with fracture faces representing graduated grain sizes from the coarsest (No. 1) to the finest (No. 10). The fracture grain size is estimated to the nearest quarter number. The hardness penetration and fracture grain size for Grade A shall meet the requirements shown in Table 3.

8. Macrostructure

8.1 The macrostructure of a specimen representing the entire cross-sectional area in the annealed condition shall be prepared in accordance with the latest issue of Practice A 561. It shall exhibit a structure free of excessive porosity, segregation, 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 A 561, shall not exceed the ratings specification in Table 4 for the appropriate material size and composition. More stringent requirements are available by agreement between seller and purchaser.

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 Methods E 3. When examined at 20× or greater magnification it shall not exceed the values given in Tables 5-9 for the appropriate size and shape of material. Lower limits of decarburization may be specified by agreement between the seller and purchaser.

9.2 Material ordered as ground and polished or ground finished or machine finished shall be free of scale and decarburization.

[4] The Shepherd Fracture Grain Size Standards may be purchased from Metallurgical Services, Inc., Box 1075, 925 Main St., Niagara Falls, NY 14302.

10. Permissible Variations for Dimensions

10.1 Permissible variations for dimensions shall not exceed the applicable limits stated in Table 6, and Tables 10-22 and Note 1.

NOTE 1—Unmachined tool steel forgings are furnished to size and surface allowances for machining and tolerances over allowances. Experience indicates that the allowances and tolerances in the tabulation below are satisfactory for many applications. When width and thickness differ, each dimension carries its individual allowance and tolerance in accordance with the tabulation: also, the ID and OD take their respective allowances and tolerances. When forgings are ordered, the purchaser should state whether the sizes are the forged or the finished sizes. The minimum sizes ordered for forgings should be the finished sizes plus allowances for machining; and the ordered forged sizes are subject to applicable tolerances

10.2 Out-of-round tolerances for round bars shall be one half the permissible dimensional variations stated in Table 6, Table 10, Table 12, Table 14, Table 15, and Table 17.

11. Workmanship, Finish, and Appearance

11.1 All carbon tool steels shall be free of heavy scale, deep pitting, laps, porosity, injurious segregations, excessive nonmetallic 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.

12. Sampling

12.1 Each particular shipment of a heat of steel by type, size, and shape shall be considered a lot and must conform to the provisions of this specification.

13. Inspection

13.1 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 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 and mechanical property tests made in accordance with this specification.

14. Rejection and Rehearing

14.1 Unless otherwise specified, any rejections based on tests made in accordance with this specification shall be reported to the seller within 30 days from the date of receipt of the material.

14.2 Material that shows injurious defects subsequent to its acceptance by the purchaser shall be rejected and the seller notified.

14.3 Samples tested in accordance with this specification that represent rejected material shall be preserved for 30 days from the date of the test report. In case of dissatisfaction with the results of the test, the seller may make claim for a rehearing within that time.

15. Packaging, Loading, and Package Marking

15.1 *Packaging and Loading*:

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

TABLE 3 Heat-Treating Requirements

Type	Carbon Range, %	Austenitizing Temperature, °F (°C)	Quench Medium	Minimum Hardness, HRC
W1	0.70–0.85	1475 (802)	brine	64
	0.85–0.95	1475 (802)	brine	65
	0.95–1.50	1450 (788)	brine	65
W2	0.85–0.95	1475 (802)	brine	65
	0.95–1.50	1450 (788)	brine	65
W5	1.05–1.15	1475 (802)	brine	65

Hardness Penetration and Fracture Grain Size for Grade A

Specified Depth of Hardening	Quench Temperature, ° F (°C)	W1 (0.70 to 0.95 C)	W2 (0.85 to 0.95 C)[A]	W1 (0.95 to 1.10 C) W2 (0.95 to 1.10 C)[A]	W1 (1.10 to 1.30 C)[A]
		Penetration 64th in.	Grain Size (Shepherd) Not Coarser Than	Penetration 64th in.	Grain Size (Shepherd) Not Coarser Than
Shallow	1450 (788)	10 max	8	8 max	8½
	1550 (843)	not more than 5/64 deeper than at 1450	6½	not more than 5/64 deeper than at 1450	6½
Regular	1450 (788)	9 to 13	8	7 to 11	8½
	1550 (843)	not more than 8/64 deeper than at 1450	6½	not more than 8/64 deeper than at 1450	6½
Deep	1450 (788)	12 min	8	10 to 16	8
	1550 (843)	not more than 10/64 deeper than at 1450	6½	not more than 10/64 deeper than at 1450	6½

[A] Applicable to shallow and regular hardening material only.

TABLE 4 Macroetch Standards Maximum Allowable Rating[A]

Size Round, in. (mm)	Carbon Tool Steels	
	Porosity	Ingot Pattern
Up to 2 (50.8), incl	4	6
Over 2 to 3 (50.8 to 76.2), incl	4½	6
Over 3 to 4 (76.2 to 101.6), incl	4½	6
Over 4 to 5 (101.6 to 127.0), incl	5	6
Over 5 to 6 (122.0 to 152.4), incl	5	6
Over 6 (152.4)	as negotiated between seller and purchaser.	

[A] Refer to macroetch photographs in Practice A 561.

TABLE 5 Maximum Decarburization Limits Rounds, Hexagons and Octagons Maximum Limit Per Side

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

Ordered Size, in. (mm)	Hot Rolled	Forged	Cold Drawn
Up to ½ (12.7), incl	0.013 (0.33)	...	0.013 (0.33)
Over ½ to 1 (12.7 to 25.4), incl	0.025 (0.64)	...	0.025 (0.64)
Over 1 to 2 (25.4 to 50.8), incl	0.038 (0.97)	0.058 (1.47)	0.038 (0.96)
Over 2 to 3 (50.8 to 76), incl	0.050 (1.27)	0.075 (1.91)	0.050 (1.27)
Over 3 to 4 (76 to 102), incl	0.070 (1.78)	0.096 (2.44)	0.070 (1.78)
Over 4 to 5 (102 to 127), incl	0.090 (2.29)	0.116 (2.95)	...
Over 5 to 6 (127 to 152),incl	0.120 (3.05)	0.136 (3.45)	...
Over 6 to 8 (152 to 203),incl	...	0.160 (4.06)	...
Over 8 to 10 (203 to 254), incl	...	0.160 (4.06)	...

15.1.1 Unless otherwise specified, shipments shall be packaged and loaded in accordance with Practices A 700.

15.1.2 When specified in the contract or order, and for direct procurement by or direct shipment to the government, when Level A is specified, preservation, packaging, and loading shall be in accordance with the Level A requirements of MIL-STD-163.

15.2 *Marking*:

15.2.1 Shipments shall be properly marked with the name or brand of manufacturer, purchaser's name and order number, specification number (ASTM A 686), heat number, grade or type, and where appropriate, the size, length, and weight. Unless otherwise specified, method of marking is at the option of the manufacturer.

15.2.2 When specified in the contract or order, and for direct procurement by or direct shipment to the government, marking for shipment, in addition to any requirements specified in the contract or order, shall be in accordance with MIL-STD-163 for military agencies, and in accordance with Fed. Std. No. 123 for civil agencies.

15.2.3 For government procurement by the Defense Supply Agency, steel shall be continuously marked for identification in accordance with Fed. Std. No. 183.

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

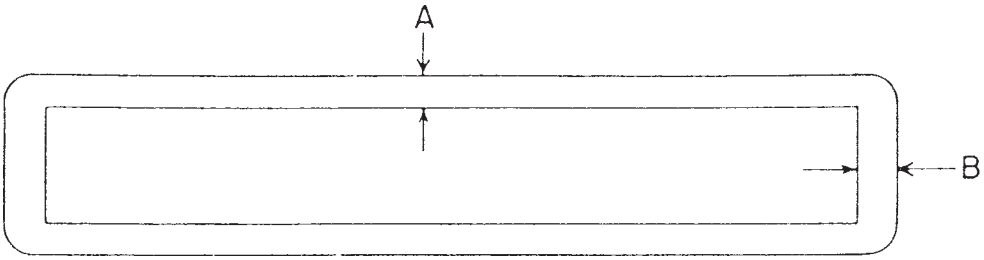
TABLE 6 Rough-Turned Round Bars Size Tolerance[A]

Specified Sizes,[B] in. (mm)	Size Tolerance, in. (mm)	
	Under	Over
Over ¾ to 1½ (19.0 to 38.1), incl	0.00	010 (0.254)
Over 1½ to 3 1/16 (38.1 to 77.8), incl	0.00	015 (0.38)
Over 3 1/16 to 4 1/16 (77.8 to 103.2), incl	0.00	031 (0.79)
Over 4 1/16 to 6 1/16 (103.2 to 154), incl	0.00	062 (1.6)
Over 6 1/16 to 10 1/16 (154 to 255.6), incl	0.00	094 (2.4)
Over 10 1/16 Please consult producer		

[A] Out-of-round tolerances to be one half of the total tolerance.
[B] Consult producer for oversize allowance and decarburization limits for all sizes.

TABLE 7 Maximum Decarburization Limits Hot Rolled Square and Flat Bars Maximum Limit Per Side

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

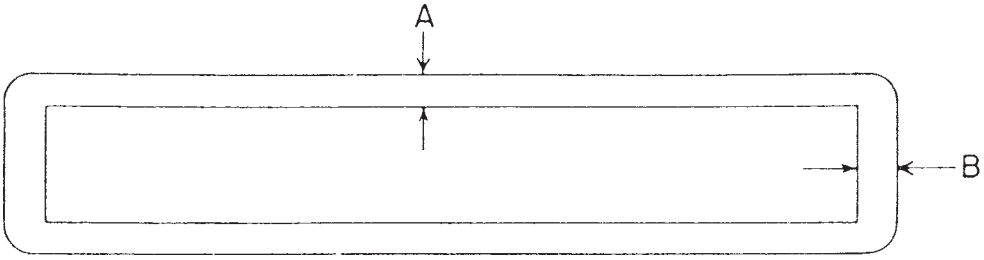


Specified Thickness, in. (mm)		Specified Widths, in. (mm)										
		0 to ½ (0 to 12.7) incl.	Over ½ to 1 (12.7 to 25.4), incl	Over 1 to 2 (25.4 to 50.8), incl	Over 2 to 3 (50.8 to 76), incl	Over 3 to 4 (76 to 102), incl	Over 4 to 5 (102 to 127), incl	Over 5 to 6 (127 to 152), incl	Over 6 to 7 (152 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 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)	0.040 (1.02)	0.044 (1.12)	0.048 (1.22)	0.048 (1.22)	0.048 (1.22)
	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 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)	0.052 (1.32)	0.056 (1.42)	0.060 (1.52)	0.060 (1.52)	0.060 (1.52)
	B	...	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 1 to 2 (25.4 to 50.8), incl	A	...	...	0.052 (1.32)	0.052 (1.32)	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)
	B	...	...	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 2 to 3 (50.8 to 76), incl	A	...	...	...	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)
	B	...	...	...	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 3 to 4 (76 to 102), incl	A	...	...	...	...	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)
	B	...	...	...	...	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)

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

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

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

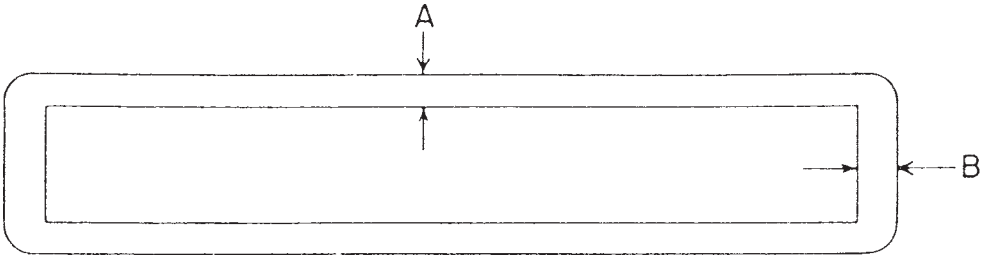


Specified Thickness, in. (mm)		Specified Width, in. (mm)					
		0 to ½ (0 to 12.7), incl	Over ½ to 1 (12.7 to 25.4), incl	Over 1 to 2 (25.4 to 50.8), incl	Over 2 to 3 (50.8 to 76), incl	Over 3 to 4 (76 to 102), incl	Over 4 to 5 (102 to 127), incl
0 to ½ (0 to 12.7), incl	A	0.020 (0.51)	0.020 (0.51)	0.024 (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)	...

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

TABLE 9 Maximum Decarburization Limits
Forged Square and Flat Bars
Maximum Limit Per Side

NOTE—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)								
		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)
Over 4 to 5 (102 to 127), incl	A	...	...	...	0.126 (3.20)	0.130 (3.30)	0.138 (3.51)	0.146 (3.71)	0.156 (3.96)	0.170 (4.32)
	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 10 Hot Rolled Bars
Rounds, Squares, Octagons, Quarter Octagons, Hexagons
Size Tolerances[A]

Specified Sizes, in. (mm)	Size Tolerances, in. (mm)	
	Under	Over
To ½ (12.7), incl	0.005 (0.13)	0.012 (0.30)
Over ½ to 1 (12.7 to 25.4), incl	0.005 (0.13)	0.016 (0.41)
Over 1 to 1½ (25.4 to 38.1), incl	0.006 (0.15)	0.020 (0.51)
Over 1½ to 2 (38.1 to 50.8), incl	0.008 (0.20)	0.025 (0.64)
Over 2 to 2½ (50.8 to 63.5), incl	0.010 (0.25)	0.030 (0.76)
Over 2½ to 3 (63.5 to 76.2), incl	0.010 (0.25)	0.040 (1.02)
Over 3 to 4 (76.2 to 101.6), incl	0.012 (0.30)	0.050 (1.27)
Over 4 to 5½ (101.6 to 139.7), incl	0.015 (0.38)	0.060 (1.52)
Over 5½ to 6½ (139.7 to 165.1), incl	0.018 (0.46)	0.100 (2.54)
Over 6½ to 8 (165.1 to 203.2), incl	0.020 (0.51)	0.150 (3.81)

[A] Out of section tolerance to be [nl]P of total tolerance max.

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

TABLE 11 Hot Rolled Flat Bars
Width and Thickness Tolerances
Width Tolerances[A]

Specified Widths, in. (mm)	Width Tolerances, in. (mm)	
	Under	Over
To 1 (25.4), incl	0.016 (0.41)	0.031 (0.79)
Over 1 to 3 (25.4 to 76), incl	0.031 (0.79)	0.047 (1.19)
Over 3 to 5 (76 to 127), incl	0.047 (1.19)	0.063 (1.60)
Over 5 to 7 (127 to 178), incl	0.063 (1.60)	0.094 (2.39)
Over 7 to 10 (178-254), incl	0.078 (1.98)	0.125 (3.18)
Over 10 to 12 (254-305), incl	0.094 (2.39)	0.156 (3.96)

Thickness Tolerances

Specified Widths, in. (mm)	Thickness Tolerances for Specified Thicknesses, in. (mm)											
	To ¼ (6.4), incl		Over ¼ to ½ (6.4 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	
	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over
To 1 (25.4), incl	0.006 (0.15)	0.010 (0.25)	0.008 (0.20)	0.012 (0.30)	0.010 (0.25)	0.016 (0.41)	...	...	...	...	...	...
Over 1 to 2 (25.4 to 50.8), incl	0.006 (0.15)	0.014 (0.36)	0.008 (0.20)	0.016 (0.41)	0.010 (0.25)	0.020 (0.51)	0.020 (0.51)	0.024 (0.61)	...	...	...	...
Over 2 to 3 (50.8 to 76), incl	0.006 (0.15)	0.018 (0.46)	0.008 (0.20)	0.020 (0.51)	0.010 (0.25)	0.024 (0.61)	0.020 (0.51)	0.027 (0.69)	0.026 (0.66)	0.034 (0.86)	...	...
Over 3 to 4 (76 to 102), incl	0.008 (0.20)	0.020 (0.51)	0.010 (0.25)	0.022 (0.56)	0.013 (0.33)	0.024 (0.61)	0.024 (0.61)	0.030 (0.76)	0.032 (0.81)	0.042 (1.07)	0.040 (1.02)	0.048 (1.22)
Over 4 to 5 (102 to 127), incl	0.010 (0.25)	0.020 (0.51)	0.012 (0.30)	0.024 (0.61)	0.015 (0.38)	0.030 (0.76)	0.027 (0.69)	0.035 (0.89)	0.032 (0.81)	0.042 (1.07)	0.042 (1.07)	0.050 (1.27)
Over 5 to 6 (127 to 152), incl	0.012 (0.30)	0.020 (0.51)	0.014 (0.36)	0.030 (0.76)	0.018 (0.46)	0.030 (0.76)	0.035 (0.89)	0.036 (0.91)	0.036 (0.91)	0.046 (1.17)	0.044 (1.12)	0.054 (1.37)
Over 6 to 7 (152 to 178), incl	0.014 (0.36)	0.027 (0.69)	0.016 (0.41)	0.032 (0.81)	0.018 (0.46)	0.035 (0.89)	0.030 (0.76)	0.040 (1.02)	0.036 (0.91)	0.048 (1.22)	0.046 (1.17)	0.056 (1.42)
Over 7 to 10 (178 to 254), incl	0.018 (0.46)	0.030 (0.76)	0.020 (0.51)	0.035 (0.89)	0.024 (0.61)	0.040 (1.02)	0.035 (0.89)	0.045 (1.14)	0.040 (1.02)	0.054 (1.37)	0.052 (1.32)	0.064 (1.62)
Over 10 to 12 (254 to 305), incl	0.020 (0.51)	0.035 (0.89)	0.025 (0.64)	0.040 (1.02)	0.030 (0.76)	0.045 (1.14)	0.040 (1.02)	0.050 (1.27)	0.046 (1.17)	0.060 (1.52)	0.056 (1.42)	0.072 (1.83)

[A] Out of square tolerance to be [nl]P of total width tolerance max.

TABLE 12 Cold Drawn Bars
Rounds, Octagons, Quarter Octagons and Hexagons
Size Tolerances[A]

Size Range, in. (mm)	Tolerance, in. (mm) Plus and Minus
¼ to ½ (6.4 to 12.7), excl	0.002 (0.05)
½ to 1 (12.7 to 25.4), excl	0.0025 (0.06)
1 to 2¾ (25.4 to 69.8), incl	0.003 (0.08)

[A] Out of section tolerance to be ½ the total tolerance max.

TABLE 13 Cold Drawn Square and Flat Bars
Size Tolerances[A]

Size Range, in. (mm)	Tolerance, in. (mm) ±
¼ to ¾ (6.4 to 19.1), incl	0.002 (0.05)
Over ¾ to 1½ (19.1 to 38.1), incl	0.003 (0.08)
Over 1½ (38.1)	0.004 (0.10)

[A] Out of square tolerance to be ½ total tolerance max.

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

TABLE 14 Centerless Ground Bars
Rounds Diameter Tolerances[A]

Diameter Range, in. (mm)	Tolerance, in. (mm)	
	Under	Over
¼ to ½ (6.4 to 12.7), excl	0.0015 (0.038)	0.0015 (0.038)
½ to 3 1/16 (12.7 to 77.8), excl	0.002 (0.05)	0.002 (0.05)
3 1/16 to 4 1/16 (77.8 to 103.2), incl	0.003 (0.08)	0.003 (0.08)

[A] Out of round tolerance to be ½ of the total tolerance, max.

TABLE 15 Forged Bars
Rounds, Squares, Octagons, Hexagons
Size Tolerances[A]

Specified Sizes, in. (mm)	Size Tolerances, in. (mm)	
	Under	Over
Over 1 to 2 (25.4 to 50.8), incl	0.030 (0.76)	0.060 (1.52)
Over 2 to 3 (50.8 to 76), incl	0.030 (0.76)	0.080 (2.03)
Over 3 to 5 (76 to 127), incl	0.060 (1.52)	0.125 (3.18)
Over 5 to 7 (127 to 177.8), incl	0.125 (3.18)	0.187 (4.75)
Over 7 to 9 (178 to 229), incl	0.187 (4.75)	0.312 (7.92)

[A] Out of section tolerance to be [nl]P
of total tolerance max.

TABLE 16 Forged Flat Bars
Width Tolerances[A]

Specified Widths, in. (mm)	Width Tolerances, in. (mm)	
	Under	Over
Over 1 to 3 (25.4 to 76), incl	0.031 (0.79)	0.078 (1.98)
Over 3 to 5 (76 to 127), incl	0.062 (1.57)	0.125 (3.18)
Over 5 to 7 (127 to 178), incl	0.125 (3.18)	0.187 (4.75)
Over 7 to 9 (178 to 229), incl	0.187 (4.75)	0.312 (7.92)

Thickness Tolerances

Specified Widths, in. (mm)	Thickness Tolerances for Specified Thicknesses, in. (mm)									
	To 1 (25.4), incl		Over 1 to 3 (25.4 to 76), incl		Over 3 to 5 (76 to 127), incl		Over 5 to 7 (127 to 178), incl		Over 7 to 9 (178 to 229), incl	
	Under	Over	Under	Over	Under	Over	Under	Over	Under	Over
1 to 3 (25.4 to 76), incl	0.016 (0.41)	0.031 (0.79)	0.031 (0.79)	0.078 (1.98)	...	...	...	...	...	...
Over 3 to 5 (76 to 127), incl	0.031 (0.79)	0.062 (1.57)	0.047 (1.19)	0.094 (2.39)	0.062 (1.57)	0.125 (3.18)	...	...	...	...
Over 5 to 7 (127 to 178), incl	0.047 (1.19)	0.094 (2.39)	0.062 (1.57)	0.125 (3.18)	0.078 (1.98)	0.156 (3.96)	0.125 (3.18)	0.187 (4.75)	...	...
Over 7 to 9 (178 to 229), incl	0.062 (1.57)	0.125 (3.18)	0.078 (1.98)	0.156 (3.96)	0.094 (2.39)	0.187 (4.75)	0.156 (3.96)	0.219 (5.56)	0.187 (4.75)	0.312 (7.92)

[A] Out of square tolerance to be [nl]P
of total width tolerance max.

TABLE 17 Drill Rod
Rounds, Polished or Ground
Size Tolerances[A]

Size Range, in. (mm)	Standard Manufacturing Tolerance, in. (mm), ±	Precision Tolerance, in. (mm), ±
Up to 0.124 (3.15), incl	0.0003 (0.008)	0.0002 (0.005)
0.125 to 0.499 (3.18 to 12.7), incl	0.0005 (0.013)	0.00025 (0.006)
0.500 to 1.500 (12.7 to 38.1), incl	0.001 (0.03)	0.0005 (0.013)

[A] Out of round tolerance to be ½ the total tolerance.

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Not for Resale
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005

TABLE 18 Drill Rod
Shapes Other Than Rounds, Cold Drawn
Size Tolerances[A]

Size Range, in. (mm)	Tolerance, in. (mm), ±
Up to ¼ (6.4), excl	0.0005 (0.013)
¼ to ¾ (6.4 to 19.1), excl	0.001 (0.03)
¾ to 1 (19.1 to 25.4), incl	0.0015 (0.04)

[A] Out of section tolerance to be ½ the total tolerance.

TABLE 19 Hot Rolled or Forged Bars and Billets
Tolerances for Machine Cut Lengths

Specified Sizes Apply to Rounds, Squares, Hexagons, Octagons, and Width of Flats. in. (mm)	Tolerances for Specified Lengths, 14 ft (4.27 m) max, in. (mm)	
	Over	Under
To 9 (229), incl	⅜ (9.5)	0
Over 9 to 12 (229 to 305), incl	½ (12.7)	0
Over 12 to 18 (305 to 457), incl	¾ (19.1)	0
Over 18 (457)	1 (25.4)	0

TABLE 20 Straightened Hot Rolled Annealed Bars or Cold Finished Bars
Straightness Tolerances

This table does not apply to flat bars having a width to thickness ratio of 6 to 1 or greater.

Measurement is taken on the concave side of the bar with a straight edge. Bars are furnished to the following straightness tolerances:

Hot rolled bars:

$1/8$ in. in any 5 ft, but may not exceed $1/8$ in. × (no. of ft in length/5)

The foregoing formula applies also to bars under 5 ft in length. (3.2 mm in any 1.54 m), but may not exceed 3.2 mm × (no. of m in length/1.54). The foregoing formula applies also to bars under 1.54 m in length.)

Cold finished bars:

$1/16$ in. in any 5 ft, but may not exceed $1/16$ in. × (no. of ft in length/5)

The foregoing formula applies also to bars under 5 ft in length. (1.6 mm in any 1.54 m, but may not exceed 1.6 mm × (no. of m in length/1.54). The foregoing formula applies also to bars under 1.54 m in length.)

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale

TABLE 21 Forgings, Disks, Rings and Rectangular Blocks
Allowances for Machining; Tolerances Over Allowances

NOTE 1—Unmachined tool steel forgings are furnished to size and surface allowances for machining and tolerances over allowances. Experience indicates that the allowances and tolerances in the tabulation below are satisfactory for many applications. When width and thickness differ, each dimension carries its individual allowance and tolerance in accordance with the tabulation: also, the ID and OD take their respective allowances and tolerances.

NOTE 2—When forgings are ordered, the purchaser should state whether the sizes are the forged or the finished sizes. The minimum sizes ordered for forgings should be the finished sizes plus allowances for machining; and the ordered forged sizes are subject to applicable tolerances.

Diameters of Disks and Rings and Dimension of Blocks

Finished Size Diameters or Dimensions of Blocks, in. (mm)	Allowance for Machining Over Finished Size, in. (mm)	Tolerance Over the Allowance, in. (mm)	
		+	–
Up to 3 (76), incl	1/8 (3.2)	1/8 (3.2)	0
Over 3 to 5 (76 to 127), incl	3/16 (4.8)	3/16 (4.8)	0
Over 5 to 7 (127 to 178), incl	1/4 (6.4)	1/4 (6.4)	0
Over 7 to 10 (178 to 254), incl	5/16 (7.9)	5/16 (7.9)	0
Over 10 to 12 (254 to 305), incl	3/8 (9.5)	3/8 (9.5)	0
Over 12 to 15 (305 to 381), incl	7/16 (11.1)	7/16 (11.1)	0
Over 15 to 18 (381 to 457), incl	1/2 (12.7)	1/2 (12.7)	0
Over 18 to 24 (457 to 610), incl	5/8 (15.9)	1/2 (12.7)	0
Over 24 to 32 (610 to 813), incl	3/4 (19.1)	1/2 (12.7)	0
Over 32 to 40 (813 to 1016), incl	7/8 (22.2)	1/2 (12.7)	0

Ring forgings for the OD, use the same allowances and tolerances shown in the above tabulation; for the ID, double the tolerances shown in the above tabulation.

Thickness of Disks and Ring Forgings

Finished Diameter, in. (mm)	Finished Thickness, in. (mm)																	
	Up to 3 (76), incl			Over 3 to 5 (76 to 127), incl			Over 5 to 7 (127 to 178), incl			Over 7 to 10 (178 to 254), incl			Over 10 to 12 (254 to 305), incl		
	Allowance	Tolerance		Allowance	Tolerance		Allowance	Tolerance		Allowance	Tolerance		Allowance	Tolerance	
		+	–		+	–		+	–		+	–		+	–
Up to 3 (76), incl	1/8 (3.2)	1/8 (3.2)	0	1/8 (3.2)	1/8 (3.2)	0									
Over 3 to 5 (76 to 127), incl	1/8 (3.2)	1/8 (3.2)	0	1/8 (3.2)	1/8 (3.2)	0									
Over 5 to 7 (127 to 178), incl	3/16 (4.8)	3/16 (4.8)	0	3/16 (4.8)	3/16 (4.8)	0	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0			
Over 7 to 10 (178 to 254), incl	3/16 (4.8)	3/16 (4.8)	0	1/4 (6.4)	1/4 (6.4)	0	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0			
Over 10 to 12 (254 to 305), incl	3/16 (4.8)	3/16 (4.8)	0	1/4 (6.4)	1/4 (6.4)	0	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0	3/8 (9.5)	3/8 (9.5)	0
Over 12 to 15 (305 to 381), incl	1/4 (6.4)	1/4 (6.4)	0	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0	3/8 (9.5)	3/8 (9.5)	0	7/16 (11.1)	7/16 (11.1)	0
Over 15 to 18 (381 to 457), incl	1/4 (6.4)	1/4 (6.4)	0	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0	7/16 (11.1)	7/16 (11.1)	0	7/16 (11.1)	7/16 (11.1)	0
Over 18 to 24 (457 to 610), incl	1/4 (6.4)	1/4 (6.4)	0	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0	7/16 (11.1)	7/16 (11.1)	0	7/16 (11.1)	7/16 (11.1)	0
Over 24 to 32 (610 to 813), incl	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0	7/16 (11.1)	7/16 (11.1)	0	1/2 (12.7)	1/2 (12.7)	0	1/2 (12.7)	1/2 (12.7)	0
Over 32 to 40 (813 to 1016), incl	5/16 (7.9)	5/16 (7.9)	0	3/8 (9.5)	3/8 (9.5)	0	7/16 (11.1)	7/16 (11.1)	0	1/2 (12.7)	1/2 (12.7)	0	1/2 (12.7)	1/2 (12.7)	0

Finished Diameter, in. (mm)	Finished Thickness, in. (mm)[A]																	
	Over 12 to 15 (304 to 381), incl			Over 15 to 18 (381 to 457), incl			Over 18 to 24 (457 to 610), incl			Over 24 to 32 (610 to 813), incl			Over 320 to 40 (813 to 1016), incl		
	Allowance	Tolerance		Allowance	Tolerance		Allowance	Tolerance		Allowance	Tolerance		Allowance	Tolerance	
		+	–		+	–		+	–		+	–		+	–
Up to 3 (76), incl															
Over 3 to 5 (76 to 127), incl															
Over 5 to 7 (127 to 178), incl															
Over 7 to 10 (178 to 254), incl															
Over 10 to 12 (254 to 305), incl	7/16 (11.1)	7/16 (11.1)	0												
Over 12 to 15 (305 to 381), incl	1/2 (12.7)	1/2 (12.7)	0												
Over 15 to 18 (381 to 457), incl	1/2 (12.7)	1/2 (12.7)	0	1/2 (12.7)	1/2 (12.7)	0	5/8 (15.9)	5/8 (15.9)	0						
Over 18 to 24 (457 to 610), incl	1/2 (12.7)	1/2 (12.7)	0	1/2 (12.7)	1/2 (12.7)	0	5/8 (15.9)	5/8 (15.9)	0						
Over 24 to 32 (610 to 813), incl	9/16 (14.3)	9/16 (14.3)	0	5/8 (15.9)	5/8 (15.9)	0	3/4 (19.1)	3/4 (19.1)	0	3/4 (19.1)	3/4 (19.1)	0	3/4 (19.1)	3/4 (19.1)	0
Over 32 to 40 (813 to 1016), incl	9/16 (14.3)	9/16 (14.3)	0	5/8 (15.9)	5/8 (15.9)	0	3/4 (19.1)	3/4 (19.1)	0	3/4 (19.1)	3/4 (19.1)	0	7/8 (22.2)	7/8 (22.2)	0

[A] Forgings processed to the above allowances are free of decarburization and surface defects when machined or ground to the finished size by removal of equal amounts from opposite surfaces.

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Not for Resale
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005

TABLE 22 Hot Rolled Plates and Sheets
Tolerances for Width and Thickness

Thickness, in. (mm)	Width, in. (mm)			
	Up to 15 (381)		Over 15 (381)	
	All tolerances over specified width and specified thickness, in. (mm)			
	Width	Thickness	Width	Thickness
Up to 0.025, (0.64), incl	⅛ (3.2)	0.006 (0.15)	3⁄16 (4.8)	0.006 (0.15)
Over 0.025 to 0.065, (0.64 to 1.65), incl	⅛ (3.2)	0.008 (0.20)	3⁄16 (4.8)	0.008 (0.20)
Over 0.065 to 0.120, (1.65 to 3.05), incl	⅛ (3.2)	0.010 (0.25)	3⁄16 (4.8)	0.010 (0.25)
Over 0.120 to 0.1875, (3.05 to 4.76), incl	3⁄16 (4.8)	0.016 (0.41)	¼ (6.4)	0.016 (0.41)
Over 0.1875 to 0.250, (4.76 to 6.35), incl	3⁄16 (4.8)	0.018 (0.46)	¼ (6.4)	0.018 (0.46)

Thickness, in. (mm)	Width, in. (mm)	
	Over 12 (305)	
	All tolerances over specified width and specified thickness, in. (mm)	
	Width	Thickness
¼ to ½ (6.4 to 12.7), incl	¼ (6.4)	1⁄16 (1.6)
Over ½ to 2 (12.7 to 50.8), incl	¼ (6.4)	⅛ (3.2)
Over 2 (50.8)	¼ (6.4)	¼ (6.4)

SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply only when specified by the purchaser in the inquiry, contract, and order. Details of these supplementary requirements shall be agreed upon by the seller and purchaser.

S1. Ultrasonic Quality

S1.1 Material shall be ultrasonically tested at appropriate stages of the manufacture to ensure the quality, when and as agreed upon between seller and purchaser. When required, it shall be performed in accordance with the latest issue of Practice A 388/A 388M.

S2. Cleanliness

S2.1 In special situations, such as where the surface finish of the part requires optimum polishing characteristics, the cleanliness of the steel shall be ascertained in accordance with the latest issue of Practice E 45. The permissible limits shall be agreed upon between seller and purchaser.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).

Copyright ASTM International
Reproduced by IHS under license with ASTM
No reproduction or networking permitted without license from IHS
Copyright by ASTM Int'l (all rights reserved);
Reproduction authorized per License Agreement with Kathe Hooper (ASTMIHS Account); Mon Jan 24 15:24:42 EST 2005
Not for Resale