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FEDERAL STANDARD

TOLERANCES FOR COPPER AND COPPER BASE ALLOY MILL PRODUCTS

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FSC MISC

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New and revised pages will be issued under Change Notices which will be numbered consecutively and will bear the date of issuance. Change Notices should be retained and filed in front of the Standard until such time as they are superseded by a reissue of the entire Standard.

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FEDERAL STANDARD

TOLERANCES FOR COPPER AND COPPER BASE ALLOY MILL PRODUCTS

This standard was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

SCOPE

This standard contains dimensional tolerances for copper and copper base alloy mill products. Tolerances for copper bus bar, and rod, pipe, or tube conductors are not included. The tolerances conform to industry standard tolerances in effect at the time the standard was prepared. Tolerances differing from those specified or for sizes and shapes not covered by this standard, shall be outlined in the product specification or shall be agreed upon between the procuring agency and contractor. Unless otherwise indicated, all tolerances given in this standard are plus and minus. If all plus or all minus tolerances are required, double the values given.

PURPOSE

The purpose of this standard is to provide uniform dimension and weight tolerances for copper and copper base alloy mill products for use throughout the Government.

IDENTIFICATION

Throughout this standard, all paragraphs and tables are identified by the following system:

Products (e.g., Bar, Cold Drawn or Cold Rolled; Bar, as Extruded; Flat Wire; Plate, Cold Rolled) are designated by the numbers 1 to 24.

Product categories (Nonrefractory Alloys, Refractory Alloys, and Copper) are designated by the letters a, b, and c.

The applicable dimensions (e.g., width, length, thickness) are designated by numbers in parentheses.

Any further subdivisions are designated by decimal numbers.

To illustrate: Paragraph 1a(2.2) covers Flat Products, with Unfinished Edges, Cold Rolled; Nonrefractory Alloys; Width Tolerances; Slit Metal, and Slit Metal with Rolled Edges.

REFERENCING THIS STANDARD

The following example is suggested as a suitable method of making reference to this standard in product specifications, to provide conciseness and uniformity and to minimize controversies that may arise from variously worded texts.

REFERENCING THIS STANDARD (con.)

Dimensional tolerances. The following paragraphs of Federal Standard No. 146 shall apply.

Dimension	Paragraph
Length	15a(2)
Straightness	15a(3)

DEFINITIONS

Bar. A solid rectangular (including square) section, or one with two plane parallel surfaces and round or other simple regularly shaped edges, up to and including 12 inches in width and over 0.188 inch in thickness.

Copper. For purposes of this standard, copper is defined as material containing not less than 99.88 percent copper, small amounts of silver being counted as copper.

End. The end piece resulting from cutting according to established length schedules.

Flat Product, with unfinished edges. A product with a rectangular (including square) solid section, relatively great length in proportion to thickness, and longitudinal edges resulting from the final rolling to thickness or from bringing to final width by shearing, slitting, sawing, machining, or rolling. The corners or edges may be square or of other contours. Included are Bar, Plate, Sheet and Strip.

Flat Product, with finished edges. A product with a rectangular (including square) solid section, relatively great length in proportion to thickness, and smooth longitudinal edges resulting from rolling (without previous slitting) or drawing to final dimensions. The corners or edges may be square, or of other contours. Included are Bar, Flat Wire, and Strip.

Flat Wire. A flat product (rectangular, including square) up to and including 0.188 inch thickness and up to and including 1-1/4 inch in width with all surfaces rolled or drawn without previous slitting, shearing, or sawing. It may be furnished in straight lengths or on spools, reels, or bucks.

Lengths.

Specific Length. Indicated uniform length, subject to established length tolerances; for example: 12 feet-0 inch, 9 feet-7 inches, or 0 feet-4-1/2 inches is a specific length.

Stock Length. Normally certain uniform lengths subject to established tolerances (including Standard Lengths) actually carried in mill and warehouse stocks. The nominal length actually carried will vary considerably with the product, alloy, size, mill source, and warehouse location.

Pipe. Seamless tube conforming to the particular dimensions commercially known as "Standard Pipe Sizes".

Plate. A flat rolled product over 0.188 inch in thickness and over 12 inches in width.

Refractoriness. The specific alloy and tolerance schedule applicable to the particular refractoriness classification will be defined in the individual product specification.

DEFINITIONS (con.)

Nonrefractory Alloys. Those copper-base alloys which, because of lack of abrasiveness or hardness, present relatively little difficulty in maintaining standard dimensional tolerances.

Refractory Alloys. Those copper-base alloys which, because of abrasiveness or hardness, require dimensional tolerances greater than those established for nonrefractory alloys.

Rod. A round, hexagonal, or octagonal solid section furnished in straight lengths.

Shape. A solid section other than rectangular, square, or standard rod and wire sections, furnished in straight lengths.

Sheet. A flat rolled product up to and including 0.188 inch in thickness and over 20 inches in width.

Strip. A flat product, other than Flat Wire, up to and including 0.188 inch in thickness and generally furnished as follows:

(1) With slit, sheared or slit and edge rolled edges in widths up to 20 inches, inclusive.

(2) With finished drawn or rolled edges in widths over 1-1/4 inches to 12 inches, inclusive.

Tube. A hollow product of round or any other cross-section, having a continuous periphery.

Wire. A solid section, other than strip, furnished in coils or on spools, reels, or bucks. (Square and rectangular flat wire, however, may also be furnished in straight lengths. See Flat Wire above.)

1. FLAT PRODUCTS, WITH UNFINISHED EDGES, COLD ROLLED

These products include Bar, Plate, Sheet, and Strip with slit, slit and edge rolled, sheared, sawed, or machined edges.

1a. Nonrefractory Alloys

1a(1). Thickness Tolerances.

Thickness, inches	Tolerances, inch							
	Width, inches							
	Up to 8 incl.	Over 8 to 12 incl.	Over 12 to 14 incl.	Over 14 to 20 incl.	Over 20 to 28 incl.	Over 28 to 36 incl.	Over 36 to 48 incl.	Over 48 to 60 incl.
	STRIP				SHEET			
Up to 0.004 incl.	0.0003	0.0006	0.0006	—	—	—	—	—
Over 0.004 to 0.006 incl.	.0004	.0008	.0008	0.0013	—	—	—	—
Over .006 to .009 incl.	.0006	.0010	.0010	.0015	—	—	—	—
Over .009 to .013 incl.	.0008	.0013	.0013	.0018	0.0025	0.003	0.0035	0.004
Over .013 to 0.17 incl.	.0010	.0015	.0015	.002	.0025	.003	.0035	.0045
Over .017 to .021 incl.	.0013	.0018	.0018	.002	.003	.0035	.004	.005
Over .021 to .026 incl.	.0015	.002	.002	.0025	.003	.0035	.004	.005
Over .026 to .037 incl.	.002	.002	.002	.0025	.0035	.004	.005	.006
Over .037 to .050 incl.	.002	.0025	.0025	.003	.004	.005	.006	.007
Over .050 to .073 incl.	.0025	.003	.003	.0035	.005	.006	.007	.008
Over .073 to .130 incl.	.003	.0035	.0035	.004	.006	.007	.008	.010
Over .130 to .188 incl.	.0035	.004	.004	.0045	.007	.008	.010	.012
	BAR		PLATE					
Over .188 to .205 incl.	0.0035	0.004	0.004	0.0045	0.007	0.008	0.010	0.012
Over .205 to .300 incl.	.004	.0045	.0045	.005	.009	.010	.012	.014
Over .300 to .500 incl.	.0045	.005	.005	.006	.012	.013	.015	.018
Over .500 to .750 incl.	.0055	.007	.007	.009	.015	.017	.019	.023
Over .750 to 1.00 incl.	.007	.009	.009	.011	.018	.021	.024	.029
Over 1.00 to 1.50 incl.	.022	.022	.022	.022	.022	.025	.029	.036
Over 1.50 to 2.00 incl.	.026	.026	.026	.026	.026	.030	.036	.044

1. FLAT PRODUCTS, WITH UNFINISHED EDGES, COLD ROLLED (con.)

1a(2). Width Tolerances.

1a(2.1). Width Tolerances; General Purpose. These tolerances are applicable unless otherwise specified by method of finishing (e.g., slit, sheared, sawed).

Width, inches	Tolerances, inch			
	For length up to 10 feet, incl.			For lengths over 10 ft.
	Up to 1/16 in. thick, incl.	Over 1/16 in. to 1/8 in. thick, incl.	Over 1/8 in. thick	All thicknesses
Up to 12, incl.	1/32	3/64	1/16	1/16
Over 12 to 120, incl.	1/16	1/16	1/16	1/16

1a(2.2). Width Tolerances; Slit Metal, and Slit Metal with Rolled Edges.

Width, inches	Tolerances, inch			
	0.004 to 0.032 inch thick, incl.	Over 0.032 to 0.125 inch thick, incl.	Over 0.125 to 0.188 inch thick, incl.	Over 0.188 to 0.500 inch thick, incl.
Up to 2, incl.	0.005	0.010	0.012	0.015
Over 2 to 8, incl.	.008	.013	.015	.015
Over 8 to 20, incl.	1/64	1/64	1/64	1/32

1a(2.3). Width Tolerances; Square Sheared Metal.

Width, inches	Tolerances, inch		
	Up to 1/16 inch thick, incl.	Over 1/16 to 1/8 inch thick, incl.	Over 1/8 inch thick
Up to 20, incl.	1/32	3/64	1/16
Over 20 to 36, incl.	3/64	3/64	1/16
Over 36 to 120, incl.	1/16	1/16	1/16

1. FLAT PRODUCTS, WITH UNFINISHED EDGES, COLD ROLLED (con.)

1a(2.4). Width Tolerances; Sawed Metal.

Width, inches	Tolerances, inch		
	Lengths up to 10 feet, incl.		Lengths over 10 feet
	Up to 1-1/2 inch thick, incl.	Over 1-1/2 inch, thick	All thicknesses
Up to 12, incl.	1/32	1/16	1/16
Over 12 to 120, incl.	1/16	1/16	1/16

1a(3). Length Tolerances.

1a(3.1). Length Tolerances; General Purpose. These tolerances are applicable unless otherwise specified by method of finishing.

Lengths	Applicable only to full length pieces, inch[a]
Specific lengths,	
up to 10 ft, incl.	1/4
over 10 ft. to 20 ft., incl.	1/2
Specific lengths with ends	1[b]
Stock lengths with or without ends	1[b]

[a]Tolerances are all plus; if all minus tolerances are desired, use the same values: if tolerances plus and minus are desired, halve the values given.

[b]In the case of specific or stock lengths with ends, applicable to full length pieces only.

1a(3.2). Length Tolerances; Square Sheared Metal.

Length, inches	Tolerances, inch		
	Up to 1/16 inch thick, incl.	Over 1/16 to 1/8 inch thick, incl.	Over 1/8 inch thick
Up to 20, incl.	1/32	3/64	1/16
Over 20 to 36, incl.	3/64	3/64	1/16
Over 36 to 120, incl.	1/16	1/16	1/16

1. FLAT PRODUCTS, WITH UNFINISHED EDGES, COLD ROLLED (con.)

1a(3.3). Length Tolerances; Sawed Metal.

Width, inches	Length tolerance, inch
Up to 120, incl.	1/4[a]

[a]Tolerance is all plus; if all minus tolerance is desired, use the same value. If plus and minus tolerance is desired, halve the value given.

1a(4). Schedule of Lengths. This schedule covers specific and stock lengths with ends. It is not applicable to sheet or plate over 24 inches wide.

Nominal Length, feet	Thickness, inch					
	Up to 0.050		Over 0.050 to 0.125 incl.		Over 0.125 to 0.250 incl.	
	A	B	A	B	A	B
Incl. 6 to 8, excl.	4	20	4	25	3	30
Incl. 8 to 10, excl.	6	25	5	30	4	35
Incl. 10 to 14, excl.	7	30	6	35	5	40

A - Minimum length of shortest piece, feet.
B - Maximum permissible weigth of ends, percent of lot weight.

1a(5). Straightness Tolerances. Straightness tolerance is the maximum edgewise curvature (depth of arc) in any 6-foot portion of the total length.

1a(5.1). Straightness Tolerances, General Purpose. These tolerances are applicable unless otherwise specified by method of finishing (e.g.; sheared, sawed).

Width, inches	Tolerances, inches		
	Slit only		Slit, and straightened or edge rolled rolls, flat, or on bucks
	Rolls	Flat	
Over 1/4 to 3/8, incl.	2	1-1/2	1/2
Over 3/8 to 1/2, incl.	1-1/2	1	1/2
Over 1/2 to 1, incl.	1	3/4	1/2
Over 1 to 2, incl.	5/8	5/8	3/8
Over 2 to 4, incl.	1/2	1/2	3/8
Over 4	3/8	3/8	3/8

1. FLAT PRODUCTS, WITH UNFINISHED EDGES, COLD ROLLED (con.)

1a(5.2). Straightness Tolerances; Slit Metal, and Slit Metal with Rolled Edges. Same as 1a(5.1).

1a(5.3). Straightness Tolerances; Square Sheared Metal.

Thickness, inches	Tolerances, inch	
	Up to 10 inches wide, incl.	Over 10 inches wide
Up to 1/8 incl.	1/16	1/32
Over 1/8 to 3/16 incl.	1/8	3/64
Over 3/16	1/8	1/16

1a(5.4). Straightness Tolerance; Sawed Metal.

Tolerance, inch	
Up to 3 inches wide, incl.	Over 3 inches wide
1/16	3/64

1. FLAT PRODUCTS, WITH UNFINISHED EDGES, COLD ROLLED (con.)

1b. Refractory Alloys

1b(1). Thickness Tolerances.

Thickness, inches	Tolerances, inch							
	Width, inches							
	Up to 8 incl.	Over 8 to 12 incl.	Over 12 to 14 incl.	Over 14 to 20 incl.	Over 20 to 28 incl.	Over 28 to 36 incl.	Over 36 to 48 incl.	Over 48 to 60 incl.
	STRIP				SHEET			
Up to 0.004 incl.	0.0004	0.0008	0.0008	–	–	–	–	–
Over 0.004 to 0.006 incl.	.0006	.0010	.0010	0.0015	–	–	–	–
Over .006 to .009 incl.	.0008	.0013	.0013	.002	–	–	–	–
Over .009 to .013 incl.	.0010	.0015	.0015	.0025	–	–	–	–
Over .013 to .017 incl.	.0013	.002	.002	.0025	–	–	–	–
Over .017 to .021 incl.	.0015	.0025	.0025	.003	–	–	–	–
Over .021 to .026 incl.	.002	.0025	.0025	.003	0.004	0.005	0.006	0.007
Over .026 to .037 incl.	.0025	.003	.003	.0035	.005	.006	.007	.008
Over .037 to .050 incl.	.003	.0035	.0035	.004	.006	.007	.008	.010
Over .050 to .073 incl.	.0035	.004	.004	.0045	.007	.008	.010	.012
Over .073 to .130 incl.	.004	.0045	.0045	.005	.008	.010	.012	.014
Over .130 to .188 incl.	.0045	.005	.005	.006	.010	.012	.014	.016
	BAR		PLATE					
Over .188 to .205 incl.	0.0045	0.005	0.005	0.006	0.010	0.012	0.014	0.016
Over .205 to .300 incl.	.005	.006	.006	.007	.012	.014	.016	.018
Over .300 to .500 incl.	.006	.007	.007	.008	.015	.017	.019	.023
Over .500 to .750 incl.	.008	.010	.010	.012	.019	.021	.024	.029
Over .750 to 1.00 incl.	.010	.012	.012	.015	.023	.026	.030	.037
Over 1.00 to 1.50 incl.	.028	.028	.028	.028	.028	.032	.037	.045
Over 1.50 to 2.00 incl.	.033	.033	.033	.033	.033	.038	.045	.055

1b(2). Width Tolerances. Same as 1a(2).

1b(3). Length Tolerances. Same as 1a(3).

1b(4). Schedule of Lengths. Same as 1a(4).

1b(5). Straightness Tolerances. Same as 1a(5).

1c. Copper

Same as 1a.

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED

The products include Bar, Flat Wire, and Strip with rolled (not previously slit) or drawn edges.

2a. Nonrefractory Alloys

2a(1). Thickness Tolerances.

Thickness, inches	Tolerances, inch					
	Width, inches					
	Up to 1/2 incl.	Over 1/2 to 1-1/4 incl.	Over 1-1/4 to 2.00 incl.	Over 2.00 to 4.00 incl.	Over 4.00 to 8.00 incl.	Over 8.00 to 12.00 incl.
	FLAT WIRE		STRIP			
Up to 0.013 incl.	0.001	0.0013	–	–	–	–
Over 0.013 to 0.050 incl.	.0013	.0015	0.002	–	–	–
Over .050 to .090 incl.	.0015	.002	.003	0.0035	–	–
Over .090 to .130 incl.	.002	.0025	.0035	.004	–	–
Over .130 to .188 incl.	.003	.0035	.004	.0045	0.006	0.008
	BAR					
Over .188 to .500 incl.	0.0035	0.004	0.0045	0.0045	0.006	0.008
Over .500 to 1.00 incl.	–	.0045	.005	.005	.007	.009
Over 1.00 to 2.00 incl.	–	.005	.005	.006	.008	–
Over 2.00 to 4.00 incl.	–	–	–	.30[a]	–	–

[a]Expressed to the nearest 0.001 inch.

2a(2). Width Tolerances. These tolerances apply to all rectangular cross sections except squares. For squares, use 2a(1).

Width, inches	Tolerances, inch
Up to 0.050 incl.	0.0013
Over 0.050 to 0.090 incl.	.0015
Over .090 to .130 incl.	.002
Over .130 to .188 incl.	.003
Over .188 to .500 incl.	.0035
Over .500 to 1.25 incl.	.005
Over 1.25 to 2.00 incl.	.008
Over 2.00 to 4.00 incl.	.012
Over 4.00 to 12.00 incl.	.30[a]

[a]Percent. Expressed to the nearest 0.001 inch.

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED (con.)

2a(3). Length Tolerances. Straight Lengths.

Lengths	Applicable Only to Full Length Pieces, inch[a]
Specific lengths	3/8
Specific lengths with ends	1[b]
Stock lengths with or without ends	1[b]

[a]Tolerances are all plus; if all minus tolerances are desired, use the same values: if tolerances plus and minus are desired, halve the values given.

[b]In the case of specific or stock lengths with ends, applicable to full length pieces only.

2a(4). Schedule of Lengths. This schedule covers specific and stock lengths with ends.

Square, side in inches	Rectangles, Area[a], square inches	Nominal Length, feet	Shortest Permissible length[b] in percent of nominal length	Max. Permissible weight of ends in percent of lot weight
Up to 1/2 incl.	Up to 0.250 incl.	6 to 14 incl.	65	30
Over 1/2 to 1 incl.	Over 0.250 to 1 incl.	6 to 14 incl.	60	40
Over 1 to 1-1/2 incl.	Over 1 to 2.25 incl.	6 to 12 incl.	50	50
Over 1-1/2 to 2 incl.	Over 2.25 to 4 incl.	6 to 12 incl.	40	60
Over 2 to 3, incl.	Over 4 to 9 incl.	6 to 10 incl.	40	60

[a]Width times thickness, disregarding any rounded corners or edges.

[b]Expressed to the nearest 1/2 foot.

2a(5). Straightness Tolerances. Applicable to any longitudinal edge of material supplied in nominally flat straight lengths and in rolls or on bucks.

Flat Wire, Strip, and Bar including Square	Tolerances
For material having a cross-sectional area 0.010 square inch and over, and a thickness 0.010 inch and over, furnished in straight lengths, in rolls, or on bucks.	1/2-inch maximum edgewise curvature (depth of arc) in any 6-foot portion of the total length.
For material having a cross-sectional area less than 0.010 square inch, and a thickness less than 0.010 inch, and all material furnished on reels or on stagger wound rolls.	No straightness tolerances established.

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED (con.)

2a(6). Standard Edge Contours. Compliance with the corner and edge radii shall normally be determined by estimation with standard radius gages or direct comparison with radius gages of the particular minimum and maximum permissible radii. If agreement cannot be reached, then final determination shall be made by projection at a suitable magnification of an image or silhouette of the specimen onto a screen in an instrument such as a contour projector. Here, direct comparison shall be made with an accurately drawn outline of the maximum and minimum contours.

Products with edge or corner contours other than shown here are classified as shapes.

2a(6.1). Standard Edge Contours, Square Corners. Unless otherwise specified in the contract or order, the product shall be finished with commercially square corners as shown in Figure 1. Maximum permissible radius of corners is shown below.

Form	Specified thickness, inch	Maximum radius of corners, inch
Flat Wire and strip	1/32 to 1/16 incl.	1/100
	Over 1/16 to 3/16 (0.188) incl.	1/64
Bar	Over 3/16 (0.188) to 1 incl.	1/32
	Over 1	1/16

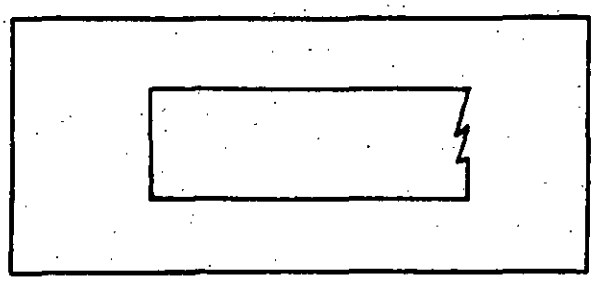

Figure 1

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED (con.)

2a(6.2). Standard Edge Contours; Rounded Corners. When specified, the product may be finished with rounded corners, as shown in Figure 2, to a quarter circle of a radius given in the table that follows. The tolerance on the radius shall be plus and minus 25 percent. The arc of the rounded corner shall not necessarily be tangent at points "A", but the product shall be commercially free from sharp, rough, or projecting edges.

Form	Specified thickness, inch	Nominal radius of corners, inch	
		For widths up to and including 2 x thickness	For widths more than 2 x thickness
Flat wire and strip	Up to 0.072 incl.	0.012	Full rounded edges only[a]
	Over 0.072 to 1/8 incl.	1/64	Full rounded edges only[a]
	Over 1/8 to 3/16 (0.188) incl.	1/32	1/32
Bar	Over 3/16 (0.188) to 1 incl.	1/16	1/16
	Over 1	1/8	1/8

[a]See 2a(6.4).

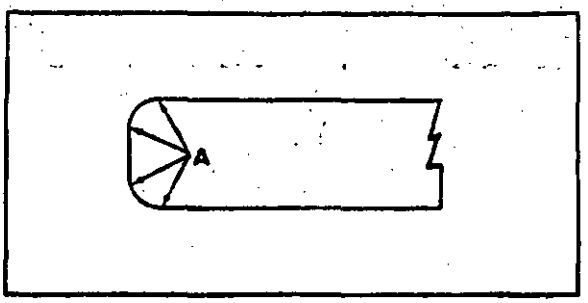

Figure 2

2a(6.3). Standard Edge Contours; Rounded Edge. When specified, the product may be finished with edges rounded as shown in Figure 3, the radius of curvature being as shown in the table below. The arc of the rounded edge shall be substantially symmetrical with the axis of the product. The corners "A" will usually be sharp, but shall not have rough or projecting edges.

Forms	Specified thickness, inch	Nominal radius of rounded edge	Tolerances on radius
Flat wire and strip	Up to 3/16 (0.188) incl.	1-1/4 x thickness	1/2 x thickness
Bar	Over 3/16 (0.188)	1-1/4 x thickness	1/4 x thickness

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED (con.)

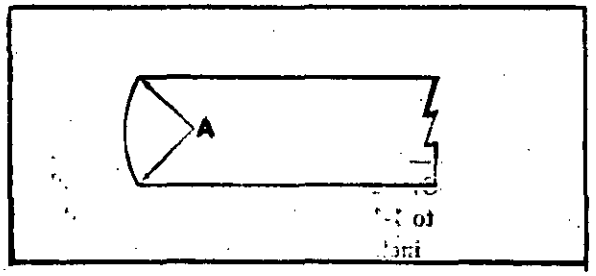

Figure 3

2a(6.4). Standard Edge Contours; Full Rounded Edge. When specified, the product may be finished with substantially uniform round edges, the radius of curvature being approximately one-half the thickness of the product as shown in Figure 4 but in no case to exceed one-half the thickness of the product by more than 25 percent. The arc of the rounded edge shall not necessarily be tangent at points "A", but shall be substantially symmetrical with the axis of the product, and the product shall be commercially free from sharp, rough or projecting edges.

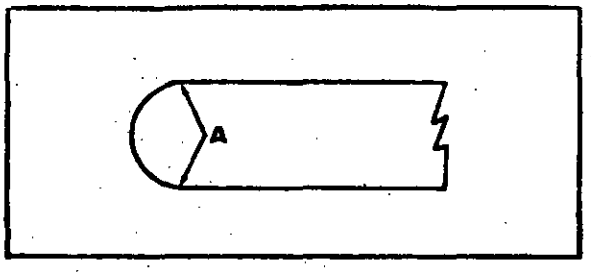

Figure 4

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED (con.)

2b. Refractory Alloys

2b(1). Thickness Tolerances.

Thickness, inches	Tolerance, inch					
	Width, inches					
	Up to 1/2 incl.	Over 1/2 to 1-1/4 incl.	Over 1-1/4 to 2.00 incl.	Over 2.00 to 4.00 incl.	Over 4.00 to 8.00 incl.	Over 8.00 to 12.00 incl.
	FLAT WIRE		STRIP			
Up to 0.050 incl.	0.0015	0.002	–	–	–	–
Over 0.050 to 0.090 incl.	.002	.003	0.004	0.005	–	–
Over .090 to .130 incl.	.003	.004	.0045	.006	–	–
Over .130 to .188 incl.	.004	.0045	.005	.007	0.009	0.012
	BAR					
Over .188 to 0.500 incl.	0.005	0.005	0.006	0.007	0.009	0.012
Over .500 to 1.00 incl.	–	.006	.007	.008	.010	.013
Over 1.00 to 2.00 incl.	–	.006	.007	.009	.011	–
Over 2.00 to 4.00 incl.	–	–	–	.50[a]	–	–

[a]Percent. Expressed to the nearest 0.001 inch.

2b(2). Width Tolerances. These tolerances apply to all rectangular products not including squares. (For squares, use table 2b(1).)

Width, inches	Tolerances, inch
Up to 0.050 incl.	0.0015
Over 0.050 to 0.090 incl.	.002
Over .090 to .130 incl.	.003
Over .130 to .188 incl.	.004
Over .188 to .500 incl.	.005
Over .500 to 1.25 incl.	.007
Over 1.25 to 2.00 incl.	.010
Over 2.00 to 4.00 incl.	.015
Over 4.00 to 12.00 incl.	.50[a]

[a]Percent. Expressed to the nearest 0.001 inch.

2. FLAT PRODUCTS, WITH FINISHED EDGES, COLD DRAWN OR COLD ROLLED (con.)

2b(3). Length Tolerances. Same as 2a(3).

2b(4). Schedule of Lengths. Same as 2a(4).

2b(5). Straightness Tolerances. Same as 2a(5).

2b(6). Standard Edge Contours. Same as 2a(6).

2c. Copper

2c(1). Thickness Tolerances.

Thickness, inches	Tolerances, inch					
	Width, inches					
	Up to 1/2 incl.	Over 1/2 to 1-1/4 incl.	Over 1-1/4 to 2.00 incl.	Over 2.00 to 4.00 incl.	Over 4.00 to 8.00 incl.	Over 8.00 to 12.00 incl.
	FLAT WIRE		STRIP			
Up to 0.013 incl.	0.001	0.001	–	–	–	–
Over 0.013 to 0.050 incl.	.0013	.0013	0.0015	–	–	–
Over .050 to .090 incl.	.0015	.0015	.002	0.0025	–	–
Over .090 to .130 incl.	.002	.002	.0025	.003	0.0035	–
Over .130 to .188 incl.	.0025	.0025	.003	.0035	.004	0.005
	BAR					
Over .188 to .500 incl.	0.003	0.003	0.0035	0.004	0.0045	0.0055
Over .500 to 1.00 incl.	–	.004	.004	.0045	.005	.006
Over 1.00 to 2.00 incl.	–	.0045	.0045	.005	.006	–
Over 2.00 to 4.00 incl.	–	–	–	.30[a]	–	–

[a] Percent. Expressed to the nearest 0.001 inch.

2c(2). Width Tolerances. Same as 2a(2).

2c(3). Length Tolerances. Same as 2a(3).

2c(4). Schedule of Lengths. Same as 2a(4).

2c(5). Straightness Tolerances. Same as 2a(5).

2c(6). Standard Edge Contours. Same as 2a(6).

3. FLAT PRODUCTS, HOT ROLLED (PLATE AND SHEET)

3a. Nonrefractory Alloys

3a(1). Thickness Tolerances. No thickness tolerances have been established for hot rolled products. These products should be ordered according to weight tolerances (3a(7)).

3a(2). Width Tolerances. Same as 1a(2).

3a(3). Length Tolerances. Same as 1a(3).

3a(4). Schedule of Lengths. Same as 1a(4).

3a(5). Straightness Tolerances. Same as 1a(5).

3a(6). Standard Edge Contours. Not applicable.

3a(7). Lot Weight Tolerances. These tolerances are expressed as percentages of the theoretical weight of the lot (five or more plate or sheet) of the same specified dimensions, when ordered to thickness. The tolerances of lots of less than five plate or sheet shall be governed by the tolerances of individual plate or sheet. The weight of any individual plate or sheet may vary from the nominal by not more than one-third (1/3) in excess of the tolerances given below. The nominal weight for the various alloys are given in the succeeding table.

Thickness, inches	Weight tolerances, percent (plus and minus)				
	Width, inches				
	Up to 48 incl.	Over 48 to 60 incl.	Over 60 to 72 incl.	Over 72 to 90 incl.	Over 90 to 110 incl.
Up to 1/8 incl.	8	9-1/2	11	12-1/2	14
Over 1/8 to 3/16 incl.	6-1/2	8	9-1/2	11	12-1/2
Over 3/16 to 1/4 incl.	6	7-1/2	8-1/2	9	10
Over 1/4 to 5/16 incl.	5-1/2	7	8	8-1/2	9
Over 5/16 to 3/8 incl.	5	6	7	7-1/2	8
Over 3/8 to 7/16 incl.	4-1/2	5	6	7	7-1/2
Over 7/16 to 1/2 incl.	4	4-1/2	5-1/2	6	6-1/2
Over 1/2 to 5/8 incl.	3-1/2	4-1/2	5	5-1/2	6
Over 5/8 to 3/4 incl.	3	4	4-1/2	5	5-1/2
Over 3/4 to 1 incl.	2-3/4	3-1/2	4	4-1/2	5
Over 1 to 1-1/2 incl.	2-1/2	3	3-1/2	4	4-1/2
Over 1-1/2 to 2 incl.	2-1/4	2-3/4	3-1/4	3-3/4	4-1/4

3. FLAT PRODUCTS, HOT ROLLED (PLATE AND SHEET) (con.)

Nominal Unit Weights		
Copper or Copper Alloy	Previous Trade Name	Weight
Number	Percent	Pounds per cubic in.
100 to 150 incl.	Copper	0.323
280	Muntz Metal	.303
464	Naval Brass	.304
510	Phosphor Bronze, 5(A)	.320
606	Aluminum Bronze, 5	.295
612	Aluminum Bronze, 8	.281
618	Aluminum Bronze, 10	.274
655	High-Silicon Bronze, (A)	.308
675	Manganese Bronze, (A)	.302
715	Copper Nickel, 30	.323

3b. Refractory Alloys

3b(1). Thickness Tolerances. Same as 3a(1).

3b(2). Width Tolerances. Same as 1a(2).

3b(3). Length Tolerances. Same as 1a(3).

3b(4). Schedule of Lengths. Same as 1a(4).

3b(5). Straightness Tolerances. Same as 1a(5).

3b(6). Standard Edge Contours. Not applicable.

3b(7). Lot Weight Tolerances. Same as 3a(7).

3c. Copper

Same as 3a.

4. BAR, COLD DRAWN OR COLD ROLLED

Same as Sections 1 and 2, FLAT PRODUCTS.

5. BAR, AS EXTRUDED

5a. Nonrefractory Alloys

5a(1). Tolerances on Diameter or Distance Between Parallel Surfaces. These tolerances cover round, square, rectangular, hexagonal, and octagonal rod and bar.

Diameter or distance between parallel surfaces, inches	Tolerances, inch
Up to 1.00 incl.	0.010
Over 1.00 to 2.00 incl.	.015
Over 2.00 to 3.00 incl.	.025
Over 3.00 to 3.50 incl.	.035
Over 3.50 to 4.00 incl.	.060

5a(2). Length and Straightness Tolerances. No commercial tolerances have been established but shall be as agreed upon between the purchaser and supplier at the time of purchase.

5b. Refractory Alloys

5b(1). Tolerances on Diameter or Distance Between Parallel Surfaces. These tolerances cover round, square, rectangular, hexagonal, and octagonal rod and bar.

Diameter or distance between parallel surfaces, inches	Tolerances, inch
Up to 1.00 incl.	0.020
Over 1.00 to 2.00 incl.	.030
Over 2.00 to 3.00 incl.	.050
Over 3.00 to 3.50 incl.	.070
Over 3.50 to 4.00 incl.	.120

5b(2). Length and Straightness Tolerances. Same as 5a(2).

5c. Copper

5c(1). Tolerances on Diameter or Distance Between Parallel Surfaces. Same as 5b(1).

5c(2). Length and Straightness Tolerances. Same as 5a(2).

6. FLAT WIRE

Same as Section 2, Flat Products.

7. PIPE

7a. Nonrefractory Alloys

7a(1). Dimensions, Weights, and Tolerances, Standard Pipe Sizes (SPS).

7a(1.1). Regular Pipe (R). All tolerances plus and minus except as otherwise indicated.

Standard Pipe Size, inches	Nominal Outside Diameter, inches	Average Outside Diameter Tolerances[a], inch (all minus)	Nominal Wall Thickness & Tolerance, inch				Nominal Weight, Copper Alloy Nos. 230 & 651, lbs. per ft.	
			Regular (R)		Extra Strong (XS)			
			Wall Thickness	Tolerance[b]	Wall Thickness	Tolerance[b]	Regular (R)	Extra Strong (XS)
1/8	0.405	0.004	0.062	0.004	0.100	0.006	0.253	0.363
1/4	.540	.004	.083	.005	.123	.007	.447	.611
3/8	.675	.005	.090	.005	.127	.008	.627	.829
1/2	.840	.005	.107	.006	.149	.008	.934	1.23
3/4	1.050	.006	.114	.006	.157	.009	1.27	1.67
1	1.315	.006	.126	.007	.182	.010	1.78	2.46
1-1/4	1.660	.006	.146	.008	.194	.010	2.63	3.39
1-1/2	1.900	.006	.150	.008	.203	.011	3.13	4.10
2	2.375	.008	.156	.009	.221	.012	4.12	5.67
2-1/2	2.875	.008	.187	.010	.280	.015	5.99	8.66
3	3.500	.010	.219	.012	.304	.016	8.56	11.6
3-1/2	4.000	.010	.250	.013	.321	.017	11.2	14.1
4	4.500	.012	.250	.014	.341	.018	12.7	16.9
5	5.562	.014	.250	.014	.375	.019	15.8	23.2
6	6.625	.016	.250	.014	.437	.027	19.0	32.2
8	8.625	.020	.312	.022	.500	.035	30.9	48.4
10	10.750	.022	.365	.030	.500	.040	45.2	61.1
12	12.750	.024	.375	.030	----	----	55.3	----

[a] The average of the maximum and minimum outside diameters, as determined at any one cross-section of the pipe.

[b] Maximum deviation at any one point.

7a(1.2). Extra Strong Pipe (XS) - See 7a(1.1).

7a(2). Weight and Wall Thickness Tolerances. Weight tolerances no longer applicable. For wall thickness tolerances, see 7a(1.1).

7a(3). Length Tolerances. Standard length: 12 feet; tolerance: plus 1/2 inch, minus 1/2 inch.

7a(4). Squareness of Cut. The departure from squareness of the end of any pipe shall not exceed the following:

Up to 5/8 inch O.D., incl.	0.010 inch
Over 5/8 inch O.D.	0.016 inch per inch of diameter

7. PIPE **(con.)**

7a(5). Roundness Tolerances. These tolerances are applicable for pipe in any drawn temper in straight lengths. The deviation from roundness is measured as the difference between major and minor outside diameters, as determined in any one cross-section of the pipe. Compliance with the roundness tolerances shall be determined by taking measurements on the outside diameter only, irrespective of the manner in which the dimensions are specified; whether outside diameter and wall thickness, outside diameter and inside diameter, or inside diameter and wall thickness.

T/D (Ratio of nominal wall thickness to nominal outside diameter)	Roundness tolerances, percent of nominal outside diameter (Expressed to the nearest 0.001 inch)
	Percent
0.01 to 0.03, incl.	1.5
Over 0.03 to 0.05, incl.	1.0
Over 0.05 to 0.10, incl.	0.8 or 0.002 in., whichever value is greater
Over 0.10	0.7 or 0.002 in., whichever value is greater

7b. Refractory Alloys

7b(1). Dimensions, Weights, and Tolerances, Standard Pipe Sizes (SPS).

7b(1.1). Regular Pipe (R). Same as 7a(1.1) except for nominal weight. Applies to copper alloy numbers 655 and 658.

Standard Pipe Size, inches	Nominal Weight, pounds per foot	
	Regular (R)	Extra Strong (XS)
1/8	0.247	0.354
1/4	.438	.596
3/8	.614	.808
1/2	.914	1.19
3/4	1.24	1.63
1	1.75	2.39
1-1/4	2.57	3.30
1-1/2	3.05	4.00
2	4.03	5.53
2-1/2	5.85	8.44
3	8.34	11.3
3-1/2	10.9	13.7
4	12.3	16.5
5	15.4	22.6
6	18.5	31.4
8	30.2	47.2
10	44.1	59.5
12	53.9	----

7b(1.2). Extra Strong Pipe (XS). Same as 7a(1.1) except for nominal weight. For nominal weight, see 7b(1.1).

7b(2). Weight and Wall Thickness Tolerances. Weight tolerances no longer applicable. For wall thickness tolerances, see 7a(1.1).

7b(3). Length Tolerances. Same as 7a(3).

7b(4). Squareness of Cut. Same as 7a(4).

7b(5). Roundness Tolerances. Same as 7a(5).

7c. Copper

7c(1). Dimensions, Weights, and Tolerances, Standard Pipe Sizes (SPS).

7c(1.1). Regular Pipe (R). Same as 7a(1.1), except for nominal weight

Standard Pipe Size, inches	Nominal Weight, pounds per foot	
	Regular (R)	Extra Strong (XS)
1/8	0.259	0.371
1/4	.457	.625
3/8	.641	.847
1/2	.955	1.25
3/4	1.30	1.71
1	1.82	2.51
1-1/4	2.69	3.46
1-1/2	3.20	4.19
2	4.22	5.80
2-1/2	6.12	8.85
3	8.75	11.8
3-1/2	11.4	14.4
4	12.9	17.3
5	16.2	23.7
6	19.4	32.9
8	31.6	49.5
10	46.2	62.4
12	56.5	----

7c(1.2). Extra Strong Pipe (XS). Same as 7a(1.1), except for nominal weight. For nominal weight, see 7c(1.1).

7c(2). Dimensions, Weights, and Tolerances, Threadless Copper Pipe (TP) Sizes.

Standard Pipe Size, inches	Nominal Dimensions, inches			Cross Sectional Area of Bore, Sq. in.	Nominal Weight, Pounds Per Foot	Tolerances, inches	
	Outside Diameter	Inside Diameter	Wall Thickness			Average Outside Diameter[a] Tolerances, All Minus	Wall Thickness Tolerances[b], Plus and Minus
1/4	0.540	0.410	0.065	0.132	0.376	0.004	0.0035
3/8	.675	.545	.065	.233	.483	.004	.004
1/2	.840	.710	.065	.396	.613	.005	.004
3/4	1.050	.920	.065	.665	.780	.005	.004
1	1.315	1.185	.065	1.10	.989	.005	.004
1-1/4	1.660	1.530	.065	1.84	1.26	.006	.004
1-1/2	1.900	1.770	.065	2.46	1.45	.006	.004
2	2.375	2.245	.065	3.96	1.83	.007	.006
2-1/2	2.875	2.745	.065	5.92	2.22	.007	.006
3	3.500	3.334	.083	8.73	3.45	.008	.007
3-1/2	4.000	3.810	.095	11.4	4.52	.008	.007
4	4.500	4.286	.107	14.4	5.72	.010	.009
5	5.562	5.298	.132	22.0	8.73	.012	.010
6	6.625	6.309	.158	31.3	12.4	.014	.010
8	8.625	8.215	.205	53.0	21.0	.018	.014
10	10.750	10.238	.256	82.3	32.7	.018	.016
12	12.750	12.124	.313	115.	47.4	.018	.020

[a]The average of the maximum and minimum outside diameters, as determined at ony one cross section of the tube.
[b]Maximum deviation at any one point.

7c(3). Weight and Wall Thickness Tolerances. Weight tolerances no longer applicable. For wall thickness tolerances, see 7a(1.1).

7c(4). Length Tolerances.

Pipe	Standard length, feet	Length tolerances, inch
SPS	12	±1/2
TP, up to 10 inch, incl.	20	+1, −0
TP, 12 inch	15	+1, −0

7c(5). Squareness of Cut. Same as 7a(4).

7c(6). Roundness Tolerances. Same as 7a(5).

8. PLATE, COLD ROLLED

Same as Section 1, Flat Products.

9. PLATE, HOT ROLLED

Same as Section 3, Flat Products.

10. PLATE, CONDENSER TUBE

10a. Nonrefractory Alloys

10a(1). Thickness Tolerances. These tolerances apply only for a distance of 7 inches inward from the edges of the plate as ordered.

Thickness, inches	Tolerances, inch						
	Diameter or width, inches						
	Up to 36 incl.	Over 36 to 60 incl.	Over 60 to 96 incl.	Over 96 to 132 incl.	Over 132 to 168 incl.	Over 168 to 204 incl.	Over 204 to 240 incl.
Over 0.300 to 0.500, incl.	0.025	0.027	0.029	0.031	0.034	0.037	0.040
Over 0.500 to 0.750, incl.	.028	.030	.032	.035	.038	.041	.045
Over 0.750 to 1.000, incl.	.033	.035	.037	.040	.043	.046	.050
Over 1.000 to 1.500, incl.	.038	.040	.042	.045	.048	.051	.055
Over 1.500 to 1.750, incl.	.043	.045	.047	.050	.053	.056	.060
Over 1.750 to 2.000, incl.	.050	.055	.062	.065	.067	.070	.080
Over 2.000 to 5.000, incl.	.058	.062	.065	—	—	—	—

10a(2). Diameter, Length or Width Tolerances. These tolerances are all plus. If all minus tolerances are desired, use the same values. If plus and minus tolerances are desired, halve the values.

Diameter, length or width, inches	Tolerances, inch (all plus)
Up to 36, incl.	3/64
Over 36 to 60, incl.	1/16
Over 60 to 96, incl.	3/32
Over 96 to 132, incl.	7/64
Over 132 to 168, incl.	1/8
Over 168 to 204, incl.	9/64
Over 204 to 240, incl.	5/32

10. PLATE, CONDENSER TUBE (con.)

10a(3). Flatness Tolerances. These tolerances are applicable to one side of plate only, but do not apply to a marginal area 7 inches wide around the edge of the plate for which no tolerances are established. They represent the greatest permissible depth of arc between a straight edge and the plate when measured by applying a 72-inch straight edge when the size permits or a shorter one equal to the dimension to be inspected.

Copper Alloy Numbers	Previous Trade Name	Thickness, inch	Tolerances, inch		
			Diameter, length, or width, inches		
			Up to 36, incl.	Over 36 to 60 incl.	Over 60 to 240, incl.
365 to 368 incl.	Leaded Muntz Metal	Over 0.300	0.050	0.055	0.060
442 to 445, incl.	Admiralty Metal	Over 0.300	.050	.065	.075
464 to 467, incl.	Naval Brass	Over .300	.050	.055	.060

10b. Refractory Alloys

10b(1). Thickness Tolerances. Add 25 percent to the tolerances listed in 10a(1).

10b(2). Diameter, Length, or Width Tolerances. Same as 10a(2).

10b(3). Flatness Tolerances. These tolerances are applicable to one side of plate only, but do not apply to a marginal area 7 inches wide around the edge of the plate for which no tolerances are established. They represent the greatest permissible depth of arc between a straight edge and the plate when measured by applying a 72-inch straight edge when the size permits or a shorter one equal to the dimension to be inspected.

Copper Alloy Numbers	Previous Trade Name	Thickness, inch	Tolerances, inch		
			Diameter, length, or width, inches		
			Up to 36, incl.	Over 36 to 60, incl.	Over 60 to 240, incl.
614	Aluminum Bronze, (D)	Over 0.300 to 0.499 incl.	0.250	0.312	0.437
		0.500 and over	.125	.187	.250
628	Aluminum Bronze with Machined Surface	Over 0.300	.060	—	—
706 and 715	Copper Nickel	Over 0.300	.060	0.075	0.090

10c. Copper

None produced.

11. ROD, COLD DRAWN

11a. Nonrefractory Alloys

11a(1). Diameter Tolerances.

Diameter or distance between parallel surfaces, inches	Tolerance, inch	
	Rounds	Hexagons, Octagons
Up to 0.150, incl.	0.0013	0.0025
Over 0.150 to 0.500, incl.	.0015	.003
Over .500 to 1.00, incl.	.002	.004
Over 1.00 to 2.00, incl.	.0025	.005
Over 2.00	.15[a]	.30[a]

[a]Percent. Expressed to the nearest 0.001 inch

11a(2). Length Tolerances. These tolerances are all plus. If all minus tolerances are desired, use the same values. If plus and minus tolerances are desired, halve the values given.

Lengths	Tolerances, inch,[a] all plus
Specific lengths	3/8
Specific lengths with ends	1
Stock lengths with or without ends	1[b]

[a]Applicable to full length pieces only.

[b]As stock lengths are cut in advance of orders, departure from this tolerance is not practicable.

11a(3). *Schedule of Lengths.* This schedule covers specific and stock lengths with ends.

Diameter or distance between parallel surfaces, inches	Nominal length, feet	A	B
Up to 1/2 incl.	6 to 14 incl.	65	30
Over 1/2 to 1 incl.	6 to 14 incl.	60	40
Over 1 to 1-1/2 incl.	6 to 12 incl.	50	50
Over 1-1/2 to 2 incl.	6 to 12 incl.	40	60

A – Shortest permissible length, expressed to the nearest 1/2 foot, in percent of nominal length.

B – Maximum permissible weight of ends, percent of lot weight.

11. ROD, COLD DRAWN (con.)

11a(4). Straightness Tolerances.

Length, feet	Maximum curvature (depth of arc), inch
Up to 2, excl.	1/32
Incl. 2 to 5, excl.	1/32 in any 2-foot portion of the total length
Incl. 5 to 10, excl.	1/8 in any 5-foot portion of the total length
10 and over	1/2 in any 10-foot portion of the total length

11a(5). Corner radius and radius tolerances, rounded corner hexagonal rod. These tolerances are applicable only to free cutting brass rod which has been extruded and cold drawn.

Distance between parallel surfaces, Inches	Nominal corner radius, Inch	Distance across corners, Inches	Tolerances on distance across corners, Inch
3/8	0.041	0.420	0.008
7/16	.048	.490	.008
1/2	.055	.560	.008
9/16	.062	.630	.008
5/8	.069	.701	.008
11/16	.076	.769	.008
3/4	.082	.841	.010
13/16	.089	.911	.010
7/8	.096	.980	.010
15/16	.103	1.051	.010
1	.110	1.120	.010
1-1/8	.124	1.261	.010
1-3/16	.130	1.330	.010
1-1/4	.138	1.402	.010
1-3/8	.151	1.541	.010
1-1/2	.165	1.680	.010
1-5/8	.179	1.821	.010
1-3/4	.192	1.962	.010
1-7/8	.206	2.101	.010
2	.220	2.242	.010

11. ROD, COLD DRAWN (Cont'd.)

Distance between parallel surfaces, Inches	Nominal corner radius, Inch	Distance across corners, Inches	Tolerances on distance across corners, Inch
2-1/4	0.248	2.522	0.012
2-1/2	.275	2.802	.016
2-3/4	.302	3.083	.016
3	.330	3.363	.018
3-1/4	.358	3.643	.018
3-1/2	.385	3.923	.020
4	.440	4.482	.020
4-1/4	.468	4.763	.020

11b. Refractory Alloys

11b(1). Diameter Tolerances.

Diameter or distance between parallel surfaces, inches	Tolerances, inch	
	Rounds	Hexagons, Octagons
Up to 0.150, incl.	0.002	–
Over 0.150 to 0.500, incl.	.002	0.004
Over .500 to 1.00, incl.	.003	.005
Over 1.00 to 2.00, incl.	.004	.006
Over 2.00	.20[a]	.40[a]

[a] Percent. Expressed to the nearest 0.001 inch.

11b(2). Length Tolerances. Same as 11a(2).

11b(3). Schedule of Lengths. Same as 11a(3).

11b(4). Straightness Tolerances. Same as 11a(4).

11c. Copper

Same as 11a.

12. ROD, AS EXTRUDED

Same as Section 5, Bar, As Extruded.

13. ROD, HOT ROLLED, ROUND

13a. Nonrefractory Alloys

13a(1). Diameter Tolerances.

Diameter, inches	Tolerances, inch
1/4 only	+0.020, –0.010
Over 1/4 to 3/4, incl.	0.015
Over 3/4 to 1-1/4, incl.	.020
Over 1-1/4 to 1-1/2, incl.	.030
Over 1-1/2 to 3, incl.	1/16
Over 3	1/8

13a(2). Length and Straightness Tolerances. No commercial tolerances have been established but shall be as agreed upon between the purchaser and supplier at the time of purchase.

13b. Refractory Alloys

13b(1). Diameter Tolerances. Same as 13a(1).

13b(2). Length and Straightness Tolerances. No commercial tolerances have been established but shall be as agreed upon between the purchaser and supplier at the time of purchase.

13c. Copper

13c(1). Diameter Tolerances. Same as 13a(1).

13c(2). Length and Straightness Tolerances. No commercial tolerances have been established but shall be as agreed upon between the purchaser and supplier at the time of purchase.

14. ROD, SPECIAL PRODUCTS

14a. Piston Finish Rod

14a(1). Diameter Tolerances. Piston finish rod shall be supplied with the diameter tolerances shown below.

Diameter, inches	Tolerances, inches
Over 1/2 to 1.00 incl.	0.0013
Over 1.00 to 2.00 incl.	.0015
Over 2.00	.10[a]

[a] Percent. Expressed to the nearest 0.0005 inch.

14. ROD, SPECIAL PRODUCTS (Cont'd.)

14a(2). Length Tolerances. Same as 11a(2).

14a(3). Straightness Tolerances. No commercial tolerances have been established but shall be as agreed upon between the purchaser and supplier at the time of purchase.

14b. Shafting Rod

14b(1). Diameter Tolerances. Same as 14a(1).

14b(2). Length Tolerances. Same as 11a(1).

14b(3). Straightness Tolerances.

Length of shaft, feet	Maximum permissible departure from straightness for either center or end portion, inch	Minimum diameter applicable for lengths indicated, inches
To 6 incl.	0.005	1/2
7	.007	1/2
8	.009	1/2
9	.012	1/2
10	.014	1/2
11	.017	1/2
12	.020	1/2
14	.028	5/8
16	.036	3/4
18	.045	1
20	.055	1-1/4
22	.068	1-1/2
24	.078	1-3/4
26	.094	2

These tolerances are applicable only when the following procedure for measurement is used:

Support the shaft at two points on freely rotating supports with the distance between supports one-half the length of the piece to be measured. Each unsupported end will have a length of one-quarter of the total rod length, and the portion between supports one-half of that length. Departure from straightness shall be measured at each end and at the center by means of a dial gage mounted on a suitable movable block. Set the gage successively at the three points to be measured and rotate the rod slowly and carefully to avoid vibration. The total range of dial reading at a given point divided by two is the departure from straightness at that point. The maximum permissible departure from straightness of the center or of either end portion is given in the schedule.

15. SHAPES, COLD DRAWN OR COLD ROLLED

15a. Nonrefractory Alloys

15a(1). Dimensional Tolerances Other Than Length. None established. Tolerances shall be as agreed upon by approval of drawing at time of purchase by the purchaser and supplier.

15a(2). Length Tolerances. Same as 11a(2).

15a(3). Straightness Tolerances. 1/2 inch maximum curvature (depth of arc) in any 6-foot portion of the total length.

15b. Refractory Alloys

15b(1). Dimensional Tolerances Other Than Length. Same as 15a(1).

15b(2). Length Tolerances. Same as 11a(2).

15b(3). Straightness Tolerances. Same as 15a(3).

15c. Copper

15c(1). Dimensional Tolerances Other Than Length. Same as 15a(1).

15c(2). Length Tolerances. Same as 11a(2).

15c(3). Straightness Tolerances. Same as 15a(3).

16. SHAPES, AS EXTRUDED, HOT ROLLED, OR FORGED

None established. Tolerances shall be as agreed upon by approval of drawing at time of purchase by the purchaser and supplier.

17. SHEET, COLD ROLLED

Same as Section 1, Flat Products.

18. SHEET, HOT ROLLED

Same as Section 3, Flat Products.

19. STRIP, COLD DRAWN OR COLD ROLLED

Same as Sections 1 and 2, Flat Products.

20. TUBE, SEAMLESS, ROUND

20a. Nonrefractory Alloys

20a(1). Average Diameter Tolerances. The average outisde or inside diameter of a tube is the average of the maximum and minimum outside diameters, or of the maximum and minimum inside diameters, as determined at one cross-section of the tube.

Specified diameter, inches	Tolerances for inside or outside diameter, inch
Up to 1/8, incl.	0.002
Over 1/8 to 5/8, incl.	.002
Over 5/8 to 1, incl.	.0025
Over 1 to 2, incl.	.003
Over 2 to 3, incl.	.004
Over 3 to 4, incl.	.005
Over 4 to 5, incl.	.006
Over 5 to 6, incl.	.007
Over 6 to 8, incl.	.008
Over 8 to 10, incl.	.010

20a(2). Wall Thickness Tolerances. Maximum deviation at any point. The following tolerances are plus and minus. If tolerances all plus or all minus are desired, double the values given.

Wall thickness, inch	Tolerances, inch						
	Outside diameter, inches						
	1/32 to 1/8 incl.	Over 1/8 to 5/8 incl.	Over 5/8 to 1 incl.	Over 1 to 2 incl.	Over 2 to 4 incl.	Over 4 to 7 incl.	Over 7 to 10 incl.
Up to 0.018	0.002	0.001	0.0015	0.002	–	–	–
Incl. 0.018 to 0.025	.003	.002	.002	.0025	–	–	–
Incl. .025 to .035	.003	.0025	.0025	.003	0.004	–	–
Incl. .035 to .058	.003	.003	.0035	.0035	.005	0.007	–
Incl. .058 to .083	–	.0035	.004	.004	.006	.008	0.010
Incl. .083 to .120	–	.004	.005	.005	.007	.009	.011
Incl. .120 to .165	–	.005	.006	.006	.008	.010	.012
Incl. .165 to .220	–	.007	.0075	.008	.010	.012	.014
Incl. .220 to .284	–	–	.009	.010	.012	.014	.016
Incl. .284 to .380	–	–	.011	.012	.014	.016	.018
Incl. .380 and over	–	–	–	5[a]	5[a]	6[a]	6[a]

[a] Percent. Expressed to the nearest 0.001 inch.

20. TUBE, SEAMLESS, ROUND (con.)

The tolerances on a given tube may be specified with respect to any two, but not all three, of the following:

a. Outside dimension

b. Inside dimension

c. Wall thickness

When tube is ordered by O.D. and I.D., the maximum plus and minus deviation of the wall thickness from the mean at any point shall not exceed by more than 50% the values shown above.

20a(3). Length Tolerances For Straight Lengths. These tolerances are all plus; if all minus tolerances are desired, use the same values; if plus and minus tolerances are desired, halve the values given. These tolerances are applicable to full length pieces only.

Length	Tolerances, inch (All plus)		
	Outside diameter, inches		
	Up to 1, incl.	Over 1 to 4 incl.	Over 4
Specific lengths:			
Up to 6 in., incl.	1/32	1/16	—
Over 6 in. to 2 ft., incl.	1/16	3/32	1/8
Over 2 to 6 ft., incl.	3/32	1/8	1/4
Over 6 to 14 ft., incl.	1/4	1/4	1/4
Over 14 ft.	1/2	1/2	1/2
Specific lengths with ends	1[a]	1[a]	1[a]
Stock lengths with or without ends	1[a]	1[a]	1[a]

[a]In the case of specific or stock lengths with ends, applicable to full length pieces only. As stock lengths are cut and placed in stock in advance of orders, departure from these tolerances is not practicable.

20. TUBE, SEAMLESS, ROUND (con.)

20a(4). Schedule of Lengths. *This schedule covers specific and stock lengths with ends.*

Outside diameter, inches	Nominal length, feet	A	B
Up to 1, incl.	6 to 20, incl.	70	20
Over 1 to 2, incl.	6 to 20, incl.	60	25
Over 2 to 3, incl.	6 to 20, incl.	55	30
Over 3 to 4, incl.	6 to 20, incl.	50	40

A – Shortest permissible length, percent of nominal length (expressed to the nearest 1/2 foot).

B – Maximum permissible weight of ends, percent of lot weight.

20a(5). Straightness Tolerances.

Length, feet[a]	Maximum curvature (depth of arc), inch
Over 3 to 6, incl.	3/16
Over 6 to 8, incl.	5/16
Over 8 to 10, incl.	1/2

[a]For lengths greater than 10 feet, the maximum curvature shall not exceed 1/2 inch in any 10 foot portion of the total length.

These tolerances apply to round tube in any drawn temper from 1/4 to 12 inches in outside diameter, inclusive. They are not applicable to copper water tube, redraw tube, as-extruded tube, or any annealed tube.

20a(6). Squareness of Cut. Not applicable to as-extruded tube, redraw tube, or any tube furnished in coils.

Outside diameter, inches	Maximum departure from squareness of end of tube, inch
Up to 5/8, incl.	0.010
Over 5/8	.016 per inch of diameter

20. TUBE, SEAMLESS, ROUND (con.)

20a(7). Roundness Tolerances.

T/D (Ratio of nominal wall thickness to nominal outside diameter)	Roundness tolerance, percent of nominal outside diameter (expressed to the nearest 0.001 inch)
	Percent
0.01 to 0.03, incl.	1.5
Over 0.03 to 0.05, incl.	1.0
Over 0.05 to 0.10, incl.	0.8 or 0.002 inch (whichever value is greater)
Over 0.10	0.7 or 0.002 inch (whichever value is greater)

These tolerances are applicable for tube in any drawn temper in straight lengths. They are not applicable to as-extruded, redrawn, annealed tubes, or any tube furnished in coils, or drawn tube whose wall thickness is under 0.016 inch.

Deviation from roundness is measured as the difference between major and minor outside diameters, as determined at any one cross-section of the tube.

Compliance with the roundness tolerance shall be determined by taking measurements on the outside diameter only, irrespective of the manner in which the tube dimensions are specified; whether outside diameter and wall thickness, outside diameter and inside diameter, or inside diameter and wall thickness.

20b. Refractory Alloys

20b(1). Average Diameter Tolerances. The average outside or inside diameter of a tube is the average of the maximum and minimum outside diameters, or of the maximum and minimum inside diameters, as determined at any one cross-section of the tube.

Specified diameter, inches	Diameter to which tolerance applies	Tolerances, inch
Up to 1/8, incl.	Inside	0.003
Up to 1/8, incl.	Outside	.0025
Over 1/8 to 5/8, incl.	Inside or outside	.0025
Over 5/8 to 1, incl.		.003
Over 1 to 2, incl.		.004
Over 2 to 3, incl.		.005
Over 3 to 4, incl.		.006
Over 4 to 5, incl.		.008
Over 5 to 6, incl.		.009
Over 6 to 8, incl.		.010
Over 8 to 10, incl.		.013

20. TUBE, SEAMLESS, ROUND (Cont'd.)

20b(2). Wall Thickness Tolerances. Maximum deviation at any point. The following tolerances are plus and minus. If tolerances all plus or all minus are desired, double the values given.

Wall thickness, inch	Tolerances, inch						
	Outside Diameter, inches						
	1/32 to 1/8 incl.	Over 1/8 to 5/8 incl.	Over 5/8 to 1 incl.	Over 1 to 2 incl.	Over 2 to 4 incl.	Over 4 to 7 incl.	Over 7 to 10 incl.
Up to 0.018	0.0025	0.0015	0.002	0.0025	–	–	–
Incl. 0.018 to 0.025	.004	.0025	.0025	.003	–	–	–
Incl. .025 to .035	.004	.003	.003	.004	0.005	–	–
Incl. .035 to .058	.004	.004	.0045	.0045	.0065	0.009	–
Incl. .058 to .083	–	.0045	.005	.005	.0075	.010	0.013
Incl. .083 to .120	–	.005	.0065	.0065	.009	.011	.014
Incl. .120 to .165	–	.007	.007	.0075	.010	.013	.015
Incl. .165 to .220	–	–	.009	.010	.013	.015	.018
Incl. .220 to .284	–	–	.012	.013	.015	.018	.020
Incl. .284 to .380	–	–	–	.015	.018	.020	.023
Incl. .380 and over	–	–	–	6[a]	6[a]	8[a]	8[a]

[a]Expressed to the nearest 0.001 inch.

The tolerances on a given tube may be specified with respect to any two, but not all three, of the following:

a. Outside dimension

b. Inside dimension

c. Wall thickness

When tube is ordered by O.D. and I.D., the maximum plus and minus deviation of the wall thickness from the mean at any point shall not exceed by more than 50 percent the values shown above.

20b(3). Length Tolerances. Same as 20a(3).

20b(4). Schedule of Lengths. Same as 20a(4).

20b(5). Straightness Tolerances. Same as 20a(5).

20b(6). Squareness of Cut. Same as 20a(6).

20b(7). Roundness Tolerances. Same as 20a(7).

20. TUBE, SEAMLESS, ROUND (Cont'd.)

20c. Copper

20c(1). Average Diameter Tolerances. Same as 20a(1).

20c(2). Wall Thickness Tolerances. Same as 20a(2).

20c(3). Length Tolerances. Same as 20a(3).

20c(4). Schedule of Lengths. Same as 20a(4).

20c(5). Straightness Tolerances. Same as 20a(5).

20c(6). Squareness of Cut. Same as 20a(6).

20c(7). Roundness Tolerances. Same as 20a(7).

20c(8). Coil Length Tolerances.

20c(8.1). Specific Lengths.

Outside diameter, inches	For nominal lengths, feet	
	Up to 50 incl.	Over 50 to 100 incl.
Up to 2, incl.	Plus 12 inches	Plus 24 inches

20c(8.2). Mill Lengths.

Outside diameter, inches	Tolerances[a], percent of nominal lengths, all plus	
	To 100 feet incl.	Over 100 feet to 2000 feet incl.
Up to 1, incl.	5[b] or 2 feet, whichever is greater	10[b]
Over 1 to 2, incl.	5[b] or 2 feet, whichever is greater	No tolerances established

[a]Applicable to full length pieces only.

[b]Expressed to the nearest foot.

20. TUBE, SEAMLESS, ROUND (con.)

20c(9). Coil Schedule of Mill Lengths With Ends.

Outside diameter, inches	Nominal length, feet	Shortest permissible length	A
Up to 1, incl.	Up to 100, incl.	70%[a] of nominal length	10
Over 1 to 2, incl.	Up to 100, incl.	60%[a] of nominal length	20
Up to 1, incl.	Over 100 to 2000, incl.	50 feet	50[b]

A - Maximum permissible weight of ends, percent of lot weight.

[a]Percent. Expressed to the nearest foot.

[b]Short pieces may be included as follows:
Up to 10 percent of lot weight between 50 feet and one-quarter of full length; and up to 40 percent between one-quarter and full length.

21. TUBE, WATER

21a. Nonrefractory Alloys

Not produced.

21b. Refractory Alloys

Not produced.

21c. Copper

Three types of copper water tube are produced:

Type K. Typical uses are applications such as underground water services, plumbing, heating, steam, gas, oil, oxygen and industrial piping where codes, installation, and service conditions necessitate the use of a heavy wall tube. Commonly used with solder type, flared, and compression fittings.

Type L. Typical uses are applications such as interior plumbing, heating, air-conditioning, steam, gas, and oil piping, and for underground drainage lines. Commonly used with solder type, flared, and compression fittings.

Type M. Typical uses are applications such as interior heating and pressure lines where engineering design indicates its suitability. Commonly used with solder type fittings.

21. TUBE, WATER (con.)

21c(1). Standard Dimensions and Tolerances of Diameter and Wall Thickness.

All dimensions, inches

Standard Size	Outside Diameter	Average Outside Diameter Tolerances[a]		Type K		Type L		Type M	
		Annealed (Soft) Temper	Drawn (Hard) Temper	Nominal wall thickness	Tolerances[b]	Nominal wall thickness	Tolerances[b]	Nominal wall thickness	Tolerances[b]
1/4	0.375	0.002	0.001	0.035	0.004	0.030	0.0035	–	–
3/8	.500	.0025	.001	.049	.004	.035	.0035	0.025	0.0025
1/2	.625	.0025	.001	.049	.004	.040	.0035	.028	.0025
5/8	.750	.0025	.001	.049	.004	.042	.0035	–	–
3/4	.875	.003	.001	.065	.0045	.045	.004	.032	.0035
1	1.125	.0035	.0015	.065	.0045	.050	.004	.035	.0035
1-1/4	1.375	.004	.0015	.065	.0045	.055	.0045	.042	.0035
1-1/2	1.625	.0045	.002	.072	.005	.060	.0045	.049	.004
2	2.125	.005	.002	.083	.007	.070	.006	.058	.006
2-1/2	2.625	.005	.002	.095	.007	.080	.006	.065	.006
3	3.125	.005	.002	.109	.007	.090	.007	.072	.006
3-1/2	3.625	.005	.002	.120	.008	.100	.007	.083	.007
4	4.125	.005	.002	.134	.010	.110	.009	.095	.009
5	5.125	.005	.002	.160	.010	.125	.010	.109	.009
6	6.125	.005	.002	.192	.012	.140	.011	.122	.010
			+ –						
8	8.125	.006	0.002 0.004	.271	.016	.200	.014	.170	.014
10	10.125	.008	.002 .006	.338	.018	.250	.016	.212	.015
12	12.125	.008	.002 .006	.405	.020	.280	.018	.254	.016

[a]The average outside diameter of a tube is the average of the maximum and minimum outside diameters, as determined at any one cross-section of the tube.

[b]Maximum deviation at any one point.

21. TUBE, WATER (con.)

21c(2). Theoretical Weight.

Standard Size, inches	Theoretical Weight, Pounds per foot		
	Type K	Type L	Type M
1/4	0.145	0.126	–
3/8	.269	.198	0.145
1/2	.344	.285	.204
5/8	.418	.362	–
3/4	.641	.455	.328
1	.839	.655	.465
1-1/4	1.04	.884	.682
1-1/2	1.36	1.14	.940
2	2.06	1.75	1.46
2-1/2	2.93	2.48	2.03
3	4.00	3.33	2.68
3-1/2	5.12	4.29	3.58
4	6.51	5.38	4.66
5	9.67	7.61	6.66
6	13.9	10.2	8.92
8	25.9	19.3	16.5
10	40.3	30.1	25.6
12	57.8	40.4	36.7

21c(3). Weight Tolerances. No tube shall vary by more than 7 percent from the theoretical weight given in 21c(2).

21c(4). Length Tolerances.

Straight Lengths (Annealed (soft) or drawn (hard) temper)				Coiled Lengths (Annealed (soft) temper only)			
Standard size, inches	Type	Standard length, feet	Tolerance, inch	Standard size, inches	Type	Standard length, feet	Tolerance, feet
Up to 8 incl.	K, L, M	20	+1, -0	Up to 1, incl.	K, L	60 & 100	+2, –0
10 only	L, M	20	+1, -0	1-1/4 & 1-1/2	K, L	60	+2, –0
10 only	K	18	+1, -0				
12 only	M	20	+1, -0				
12 only	L	18	+1, -0				
12 only	K	12	+1, -0				

21. TUBE, WATER (con.)

21c(5). Squareness of Cut. Same as 20a(6).

21c(6). Roundness Tolerances. Same as 20a(7).

22. TUBE, CONDENSER

22a. Nonrefractory Alloys

22a(1). Outside Diameter Tolerances. The outside diameter of the tube shall not vary from that specified by more than the following amounts as measured by "go" and "no-go" ring gages:

Outside Diameter, inches	Tolerances, inch			
	Wall thickness, inch			
	0.032	0.035	0.042	0.049 and over
Up to 0.500, incl.	0.0025	0.0025	0.0025	0.0025
Over 0.500 to 0.740, incl.	.004	.004	.0035	.003
Over .740 to 1.000, incl.	.006	.005	.0045	.004
Over 1.000 to 1.250, incl.	.009	.008	.006	.0045
Over 1.250 to 1.375, incl.	.011	.010	.008	.005
Over 1.375 to 2.000, incl.	–	.015	.013	.006

22a(2). Lot Weight Tolerances. Not used for condenser tube.

22a(3). Wall Thickness Tolerances. For tube ordered to minimum wall, no tube wall at its thinnest point shall be less than the specified wall thickness. For tube ordered to nominal wall, the maximum plus and minus deviation from the nominal wall at any point shall not exceed the values shown.

Wall Thickness, inch	Tolerances, inch (plus and minus)		
	Outside Diameter, inches		
	Over 1/8 to 5/8, incl.	Over 5/8 to 1, incl.	Over 1 to 2, incl.
0.032 to 0.035, incl.	0.003	0.003	0.004
Over 0.035 to 0.058, incl.	.004	.0045	.0045
Over .058 to .083, incl.	.0045	.005	.005
Over .083 to .120, incl.	.005	.0065	.0065
Over .120 to .134, incl.	.007	.007	.0075

22. TUBE, CONDENSER (con.)

22a(4). Length Tolerances.

Specified length, feet	Tolerances, inch (all plus)
Up to 15, incl.	3/32
Over 15 to 20, incl.	1/8
Over 20 to 30, incl.	5/32
Over 30 to 60, incl.	1/4
Over 60 to 100, incl.	1/2

These tolerances apply only to straight lengths and only when the length is measured at a temperature of 20 deg. C. (68 deg. F.).

22a(5). Squareness of Cut. Same as 20a(6).

22b. Refractory Alloys

22b(1). Outside Diameter Tolerances. Same as 22a(1).

22b(2). Lot Weight Tolerances. Not used for condenser tube.

22b(3). Wall Thickness Tolerances. Same as 22a(3).

22b(4). Length Tolerances. Same as 22a(4).

22b(5). Squareness of Cut. Same as 20a(6).

22c. Copper

22c(1). Outside Diameter Tolerances. Same as 22a(1).

22c(2). Lot Weight Tolerances. Not used for condenser tube.

22c(3). Wall Thickness Tolerances. Same as 22a(3).

22c(4). Length Tolerances. Same as 22a(4).

22c(5). Squareness of Cut. Same as 20a(6).

23. TUBE, DRAINAGE

23a. Nonrefractory Alloys

Not produced.

23. TUBE, DRAINAGE (con.)

23b. Refractory Alloys

Not produced.

23c. Copper

23c(1). Standard Dimensions and Weights, and Tolerances of Diameter and Wall Thickness.

Standard size, inches	Nominal O.D., inches	Average O.D.[a] Tolerances, inch	Wall thickness, inch		Theoretical weight, pounds per foot
			Nominal	Tolerances[b]	
1-1/4	1.375	0.0015	0.040	0.003	0.650
1-1/2	1.625	.002	.042	.003	.809
2	2.125	.002	.042	.004	1.07
3	3.125	.002	.045	.004	1.69
4	4.125	.002	.058	.007	2.87
5	5.125	.002	.072	.008	4.43
6	6.125	.002	.083	.008	6.10
8	8.125	+0.002 −0.004	.109	.011	10.6

[a]The average outside diameter is the average of the maximum and minimum outside diameters as determined at any one cross-section of the tube.

[b]Maximum deviation at any point.

23c(2). Lot Weight Tolerances. Theoretical weight for the nominal dimensions in 23c(1) are for information only. Actual weights will vary in accordance with the dimensional tolerances.

23c(3). Standard Length. Standard length for copper drainage tube is 20 feet.

23c(4). Length Tolerance. Length Tolerance for copper drainage tube is plus one inch, minus zero.

23c(5). Squareness of Cut. The angle of cut of the end of any length may depart from the square by not more than 0.016 inch per inch of diameter of the tube.

23c(6). Roundness tolerances. Same as 20a(7).

24. WIRE (OTHER THAN FLAT WIRE)

24a. Nonrefractory alloys.

24a(1). Diameter tolerances.

Diameter or distance between parallel surfaces, inch	Tolerances, inch	
	Round	Hexagons, octagons
Up to 0.010, incl.	0.0001	–
Over 0.010 to 0.020, incl.	.0002	–
Over .020 to .030, incl.	.0003	–
Over .030 to .040, incl.	.0004	0.0008
Over .040 to .050, incl.	.0005	.0010
Over .050 to .060, incl.	.0006	.0012
Over .060 to .080, incl.	.0008	.0016
Over .080 to .150, incl.	.0010	.002
Over .150 to .500, incl.	.0015	.003
Over .500 to .750, incl.	.002	.004

24b. Refractory alloys.

24b(1). Diameter tolerances.

Diameter or distance between parallel surfaces, inch	Tolerances, inch	
	Round	Hexagons, octagons
Up to 0.010, incl.	0.0002	–
Over 0.010 to 0.020, incl.	.0003	–
Over .020 to .030, incl.	.0005	–
Over .030 to .040, incl.	.0007	0.002
Over .040 to .050, incl.	.0008	.003
Over .050 to .060, incl.	.0010	.003
Over .060 to .080, incl.	.0015	.004
Over .080 to .150, incl.	.002	.004
Over .150 to .500, incl.	.002	.004
Over .500 to .750, incl.	.003	.005

24c. Copper.

24c(1). Diameter tolerances. Same as 24a(1).

25. BAR, HOT ROLLED

25a. Nonrefractory alloys.

25a(1). Thickness tolerances. No thickness tolerances have been established.

25b. Refractory alloys.

25b(1). Thickness tolerances. Applicable to copper beryllium alloys only.

Thickness, inches	Tolerances, inch
0.420 to 0.750	0.015
Over 0.750 to 1.250, incl.	.020
Over 1.250 to 1.500, incl.	.030
Over 1.500 to 2.00, incl.	1/16
Over 2.000 to 4.500, incl.	1/8

25c. Copper.

25c(1). Thickness tolerances. No thickness tolerances have been established.

Changes. When a Federal agency considers that this standard does not provide for its essential needs, written request for changing or adding to the standard, supported by adequate justification, shall be sent to the Administration. This justification shall explain wherein the standard does not provide for essential needs. The request shall be sent in duplicate to the General Services Administration, Federal Supply Service, Standardization Division, Washington, D. C., 20406. The Administration will determine the appropriate action to be taken and will notify the agency.

(Activities outside the Federal Government may obtain copies of Federal Specifications, Standards, and Handbooks as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

(Single copies of this specification and other Federal Specifications required by activities outside the Federal Government for bidding purposes are available without charge from Business Service Centers at the General Services Administration Regional Offices in Boston, New York, Washington, DC, Atlanta, Chicago, Kansas City, MO, Fort Worth, Denver, San Francisco, Los Angeles, and Seattle, WA.

(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from established distribution points in their agencies.)

CUSTODIANS:

Army - MR
Navy - SH
Air Force - 84

Review activities:

Army - MR, WC, MI, MD
Navy - SH, AS
Air Force - None
DSA - IS

User Activities:

Army - EL, AT, AV
Navy - YD
Air Force - None

Civil Agency Coordinating Activities:

COM-NBS
HUD-TCS
NASA-JFK
NASA-MSF
USDA-ARS

Preparing activity:

Army - MR