

## METAL WORK

### GENERAL EQUIPMENT REQUIREMENTS

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#### 1. GENERAL

##### Scope

- 1.01 This section covers the general equipment requirements applying to metal framework parts.
- 1.02 The requirements covered in this section shall be followed except as modified by applicable specifications and drawings.

1.03 Changes in requirements which have been made with this issue are explained under "Reasons for Reissue" at the end of the section. Arrows have been used to indicate changes throughout the text.

#### 2. METAL AND TYPICAL APPLICATIONS

2.01 Steel is commonly used for the framework of equipment, for supports such as auxiliary framing, brackets and braces, cable racks, guard rails, ladder tracks, and in general, for most of the ordinary metal parts associated with central office equipment. The kind of steel used is determined by the functions which the particular part must perform and by the relative importance of such characteristics as rigidity, tensile strength, resistance to wear, etc.

2.02 Hot rolled low carbon steel is the material commonly used for parts such as equipment frameworks, auxiliary framing, cable racks, switchboard frameworks and most of the smaller parts such as brackets, supports, and guard rails.

2.03 Cold rolled or cold drawn steel is used in a few instances where close limit, smooth and straight parts are required such as the stile strips of switchboards.

2.04 Steel sheet and steel strip are used principally for metal cabinets, casings, large equipment panels, frameworks partitions and small parts requiring pressed forming operations such as cable rack clamps, cable clips, and similar parts. In general, the type of steel should be omitted from Bell Telephone Laboratories piece part and detail drawings. This information, however, will be specified on W.E.Co. drawings as determined by manufacturing and supply conditions. In those cases where the type of material (sheet or strip) is essential from a design standpoint, the type of steel may be specified on Bell Telephone Laboratories drawings.

2.05 Stainless steel is used in some instances on framework structures where refinishing might become necessary because of scuffing or where resistance to corrosion is necessary.

2.06 Commercial limits for the variation of the over-all dimensions of the commonly used steel shapes may be considered as indicated in Tables 1 to 12

Cold Finished Round or Square Bar Steel	Oversize Variation All Sizes	Undersize Variation (Diameter or Thickness)						
		Up to 0.3" Incl.	Over 0.3" to 1" Incl.	1" and Under	Over 1" to 2½" Incl.	Over 1" to 2" Incl.	Over 2½" to 4" Incl.	Over 2" to 4" Incl.
Round .....	.000"			.002"		.003"		.004"
Square .....	.000"	.003"	.004"		.005"		.006"	
Rectangular or flat								
Under 1½" width.....	.000"	.003"	.004"		.005"			
1½" to 4" incl. width.....	.000"	.005"	.005"		.006"			
Over 4" to 6" incl. width.....	.000"	.008"	.009"		.010"			

Table 1 — Cold Finished Low Carbon Bar Steel  
(AISI Section 9 of 5-49)

Hot Rolled Steel Round or Square Bars Diameter or Size		Variation in Size
Over	To and Including	
	5/16"	±.005"
5/16"	7/16"	±.006"
7/16"	5/8"	±.007"
5/8"	7/8"	±.008"
7/8"	1"	±.009"
1"	1-1/8"	±.010"
1-1/8"	1-1/4"	±.011"
1-1/4"	1-3/8"	±.012"
1-3/8"	1-1/2"	±.014"
1-1/2"	2"	±1/64"
2"	2-1/2"	+1/32" -0
2-1/2"	3-1/2"	+3/64" -0

Table 2 — Hot Rolled Low Carbon Steel, Round or  
Square Bars (AISI Section 8 of 5-49)

Hot Rolled Steel Square Edge & Round Edge Flats — Width	Variation in Width	Variation in Thickness		
		1/4" to 1/2" Incl.	Over 1/2" to 1" Incl.	*Over 1" to 2" Incl.
1" or under.....	±1/64"	±.008"	±.010"	—
Over 1" to 2" incl.....	±1/32"	±.012"	±.015"	±1/32"
Over 2" to 4" incl.....	+1/16" -1/32"	±.015"	±.020"	±1/32"
Over 4" to 6" incl.....	+3/32" -1/16"	±.015"	±.020"	±1/32"

\* Larger sizes are not generally used in Bell System frameworks.

Table 3 — Hot Rolled Low Carbon Steel Bars, Square Edge  
and Round Edge Flats (AISI Section 8 of 5-49)

Hot Rolled Steel Bar Size Angles Length of Leg	Variation			
	Nominal Thickness			Variation Length of Leg
	Up to 3/16" Incl.	Over 3/16" to 3/8" Incl.	Over 3/8"	
1" or under.....	±.008"	±.010"	—	±1/32"
Over 1" to 2" incl.....	±.010"	±.010"	±.012"	±3/64"
*Over 2" to 3" excl.....	±.012"	±.015"	±.015"	±1/16"

Note: Longer leg of unequal leg angles determines size for tolerances.  
The out-of-square tolerance in either direction is 1½ degrees.  
\* For larger angles, see Table 8.

Table 4 — Hot Rolled Low Carbon Steel Bar Size Angles  
(AISI Section 8 of 5-49)

Hot Rolled Steel Bar Size Channels Specified Depth	Variation			
	Depth	Width of Flange	Thickness of Web	
			3/16" or Under	Over 3/16"
1½" or under.....	±1/32"	±1/32"	±.010"	±.015"
*Over 1½" to 3" excl.....	±1/16"	±1/16"	±.015"	±.020"

\* For 3-inch channels and larger, see Table 7 for "Structural" sizes.

Table 5 — Hot Rolled Low Carbon Steel, Bar Size Channels  
(AISI Section 8 of 5-49)

Hot Rolled Steel Bar Size Tees Specified Depth	Variation		
	Width or Depth	Thickness of Flange	Thickness of Stem
1¼" or under.....	±3/64"	±.010"	+ .005" — .020"
Over 1¼" to 2" incl....	±1/16"	±.012"	+ .001" — .020"
Over 2" to 3" excl.....	±3/32"	±.015"	+ .015" — .020"

Note: The longer member of an unequal Tee determines the size for tolerances

Table 6 — Hot Rolled Low Carbon Steel, Bar Size Tees  
(AISI Section 8 of 5-49)

Structural Shapes Beams, Tees, and Channels Specified Size	Variation	
	Depth	Width of Flanges
	3" to 7" incl.	+3/32" —1/16"

Table 7 — Structural Shapes — Larger Sizes  
of Beams, Tees, and Channels —  
(AISI Section 4 of 8-49)

Structural Shapes Angles and Zees Size, Length of Leg	Variation	
	Depth of Section	Length of Leg
	3" to 4" incl.	+1/8" —1/16"

Note: Longer leg of unequal leg angles determines size for tolerances.

Table 8 — Structural Shapes — Larger Sizes of Bulb  
Angles and Zees — (AISI Section 4 of 8-49)

Specified Widths in Inches	Variations in Inches (Plus or Minus) from Specified Thickness for Widths and Thicknesses Given													
	.1875 and thicker	.1874 1420	.1419 0972	.0971 0822	.0821 0710	.0709 0568	.0567 0509	.0508 0389	.0388 0314	.0313 0255	.0254 0195	.0194 0142	.0141 0113	.0112 and thinner
Up to 15 incl.....	.007	.006	.006	.006	.005	.005	.005	.004	.003	.003	.003	.002	—	—
Over 15 to 20 incl....	.007	.007	.007	.006	.005	.005	.005	.004	.003	.003	.003	.002	—	—
Over 20 to 24 incl....	.007	.007	.007	.006	.005	.005	.005	.004	.003	.003	.003	.002	—	—
Over 24 to 32 incl....	.008	.008	.008	.006	.006	.005	.005	.004	.003	.003	.003	.002	—	—
Over 32 to 40 incl....	.009	.009	.009	.007	.006	.005	.005	.004	.0035	.003	.003	.002	.002	.0015
Over 40 to 48 incl....	.010	.010	.009	.007	.006	.005	.005	.004	.0035	.003	.003	.002	.002	—
Over 48 to 60 incl....	.011	.010	.010	.008	.007	.006	.005	.004	.0035	.0035	.003	.002	—	—
Over 60 to 70 incl....	.012	.011	.010	.009	.007	.006	.006	.005	.004	.004	—	—	—	—
Over 70 to 80 incl....	.013	.012	.011	.009	.007	.006	.006	.005	.004	.004	—	—	—	—
Over 80 to 90 incl....	.014	.012	.012	—	—	—	—	—	—	—	—	—	—	—
Over 90 .....	.015	.012	.012	—	—	—	—	—	—	—	—	—	—	—

Note: Thickness is measured at any point on the sheet not less than 3/8 inch from an edge.

Table 9 — Cold Rolled Sheet Steel — Coils and Cut Lengths — (AISI Section 11 of 9-49)

Specified Widths in Inches	Variations in Inches (Plus or Minus) from Specified Thickness for Widths and Thicknesses Given														
	.2299 1875	.1874 1800	.1799 1420	.1419 0972	.0971 0822	.0821 0710	.0709 0568	.0567 0509	.0508 0389	.0388 0344	.0343 0314	.0313 0255	.0254 0195	.0194 0142	.0141 & thinner
To 3½ incl.....	—	—	—	—	—	—	—	—	—	—	—	—	.003	.002	.002
Over 3½ to 6 incl..	—	—	—	—	—	—	—	—	—	—	.004	.003	.003	.002	.002
Over 6 to 12 incl..	—	—	—	—	—	—	—	.005	.005	.004	.004	.003	.003	.002	.002
Over 12 to 15 incl..	.008	.007	.007	.007	.006	.006	.006	.005	.005	.004	.004	.003	.003	.002	—
Over 15 to 20 incl..	.008	.008	.008	.008	.007	.007	.006	.006	.005	.004	.004	.003	.003	.002	—
Over 20 to 32 incl..	.009	.009	.009	.008	.007	.007	.006	.006	.005	.004	.004	.003	.003	.002	—
Over 32 to 40 incl..	.009	.009	.009	.009	.008	.007	.006	.006	.005	.004	.004	.003	.003	.002	.002
Over 40 to 48 incl..	.010	.010	.010	.010	.008	.007	.006	.006	.005	.004	.004	.003	.003	.002	.002
Over 48 to 60 incl..	—	—	.010	.010	.008	.007	.007	.006	.005	.004	.004	—	—	—	—
Over 60 to 70 incl..	—	—	.011	.011	.009	.008	.007	.007	.006	.005	.005	—	—	—	—
Over 70 to 80 incl..	—	—	.012	.012	.009	.008	—	—	—	—	—	—	—	—	—
Over 80 to 90 incl..	—	—	.012	.012	.010	—	—	—	—	—	—	—	—	—	—
Over 90 .....	—	—	.012	.012	—	—	—	—	—	—	—	—	—	—	—

Note: Thickness is measured at any point on the sheet not less than 3/8 inch from an edge.

Table 10 — Hot Rolled and Hot Rolled Annealed Sheet Steel — Coils and Cut Lengths, Including Pickled Sheets — (AISI Section 11 of 9-49)

Specified Thickness		Variations from Specified Thickness							
		Widths							
Over	To and Incl.	Over 1/2" Less than 1"	1" and Less than 3"	3" to 6" Incl.	Over 6" to 9" Incl.	Over 9" to 12" Incl.	Over 12" to 16" Incl.	Over 16" to 20" Incl.	Over 20" to 23-15/16" Incl.
.160"	.2499"	±.002"	±.003"	±.0035"	±.0035"	±.0035"	±.0045"	±.005"	±.005"
.099"	.160"	±.002"	±.002"	±.003"	±.003"	±.003"	±.0035"	±.0045"	±.005"
.068"	.099"	±.002"	±.002"	±.0025"	±.003"	±.003"	±.0035"	±.0035"	±.0035"
.049"	.068"	±.002"	±.002"	±.0025"	±.0025"	±.0025"	±.003"	±.0035"	±.0035"
.039"	.049"	±.002"	±.002"	±.0025"	±.0025"	±.0025"	±.003"	±.003"	±.003"
.034"	.039"	±.002"	±.002"	±.002"	±.002"	±.002"	±.002"	±.002"	±.002"
.031"	.034"	±.0015"	±.0015"	±.002"	±.002"	±.002"	±.002"	±.002"	±.002"
.028"	.031"	±.0015"	±.0015"	±.0015"	±.002"	±.002"	±.002"	±.002"	±.002"
.025"	.028"	±.001"	±.0015"	±.0015"	±.002"	±.002"	±.002"	±.002"	±.002"
.019"	.025"	±.001"	±.001"	±.0015"	±.0015"	±.0015"	±.002"	±.002"	±.002"
.012"	.019"	±.001"	±.001"	±.001"	±.0015"	±.0015"	±.0015"	±.0015"	±.0015"
.011"	.012"	±.001"	±.001"	±.001"	±.001"	±.0015"	±.0015"	±.0015"	±.0015"
.009"	.011"	±.001"	±.001"	±.001"	±.001"	±.001"	±.001"	±.001"	±.001"
.005"	.009"	±.00075"	±.00075"	±.00075"	±.001"	±.001"	±.001"	±.001"	±.001"
—	.005"	±.0005"	±.0005"	±.0005"	—	—	—	—	—

Note: Thickness measured 3/8 inch in from edge on strip one inch or wider, and at any place when the strip is narrower than one inch.

Table 11-A

Thickness	Width		
	1" to 5" Incl.	Over 5" to 12" Incl.	Over 12" to 23-15/16" Incl.
	Additional Thickness at Center		
.005" to .010" incl.....	.00075"	.001"	.0015"
Over .010" to .025" incl.....	.001"	.0015"	.002"
Over .025" to .065" incl.....	.0015"	.002"	.0025"
Over .065" to .187" incl.....	.002"	.0025"	.003"
Over .187" to .2499" incl.....	.002"	.0025"	.003"

Note: Crown tolerance for thickness at center of strip is that of the edge measurement plus thickness shown in above.

Table 11-B

Table 11 — Cold Rolled Carbon Steel Strip (AISI Section 13 of 9-49)

Specified Widths	Variations from Specified Thickness for Widths Given					
	.2299" to .2031" Incl.	.2030" to .1875" Incl.	.1874" to .1180" Incl.	.1179" to .0568" Incl.	.0567" to .0344" Incl.	.0343" to .0255" Incl.
Up to 3½" incl.....	—	±.006"	±.005"	±.004"	±.003"	±.003"
Over 3½" to 6" incl....	—	±.006"	±.005"	±.005"	±.003"	—
Over 6" to 12" incl.....	±.006"	±.006"	±.005"	±.005"	—	—

Note: Thickness measured ⅜ inch in from edge on strip one inch or wider, and at any place when the strip is narrower than one inch. The given variations do not include crown.

Table 12-A

Specified Widths	Variations from Specified Thickness for Widths Given					
	.2299" to .2031" Incl.	.2030" to .1875" Incl.	.1874" to .1180" Incl.	.1179" to .0568" Incl.	.0567" to .0344" Incl.	.0343" to .0255" Incl.
Over 1" to 3½" incl.....	—	.001"	.002"	.002"	.002"	.002"
Over 3½" to 6" incl.....	—	.002"	.002"	.003"	.003"	—
Over 6" to 12" incl.....	.002"	.003"	.003"	.004"	—	—

Note: Crown tolerance for thickness at center of strip is that of the edge measurement plus thickness shown above.

Table 12-B

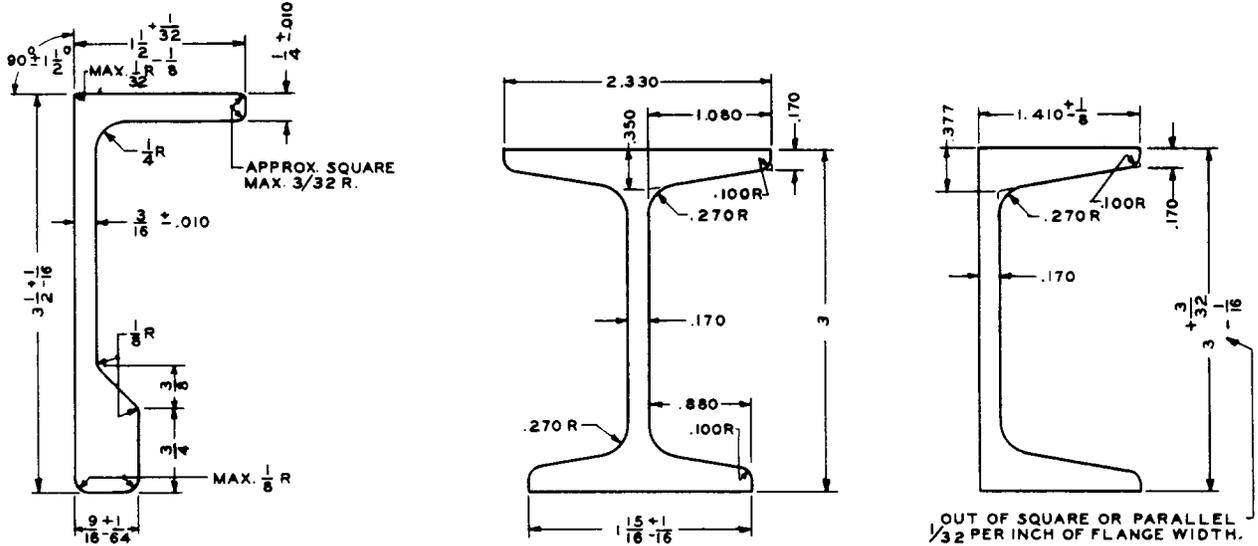
Table 12 — Hot Rolled Carbon Steel Strip — Coils and Cut Lengths — (AISI Section 12 of 8-49)

American Standard Recommended Commercial Thicknesses Preferred Nominal Thicknesses for Uncoated Metals						
.004"	.009"	.016"	.028"	.050"	.090"	.160"
.005"	.010"	.018"	.032"	.056"	.100"	.180"
.006"	.011"	.020"	.036"	.063"	.112"	.200"
.007"	.012"	.022"	.040"	.071"	.125"	.224"
.008"	.014"	.025"	.045"	.080"	.140"	

Table 13 — Flat Rolled Low Carbon Sheet and Strip Steel (ASA-B32.1—1941)

Commercial Alloy Number	Nominal Thickness Range	Thickness Tolerance	Commercial Alloy Number	Nominal Thickness Range	Thickness Tolerance
2S	From .249" to .126" incl.	±.009"	17S 52S 24S 24S (Alcad) 61S	From .249" to .126" incl.	±.009"
	From .126" to .092" incl.	±.005"		From .126" to .092" incl.	±.005"
	From .092" to .041" incl.	±.004"		From .092" to .041" incl.	±.004"
	From .041" to .033" incl.	±.003"		From .041" to .033" incl.	±.003"
3S	From .033" to .017" incl.	±.0025"		From .033" to .019" incl.	±.0025"
	From .017" to .011" incl.	±.002"		From .019" to .015" incl.	±.002"
	From .011" to .006" incl.	±.0015"		From .015" to .010" incl.	±.0015"

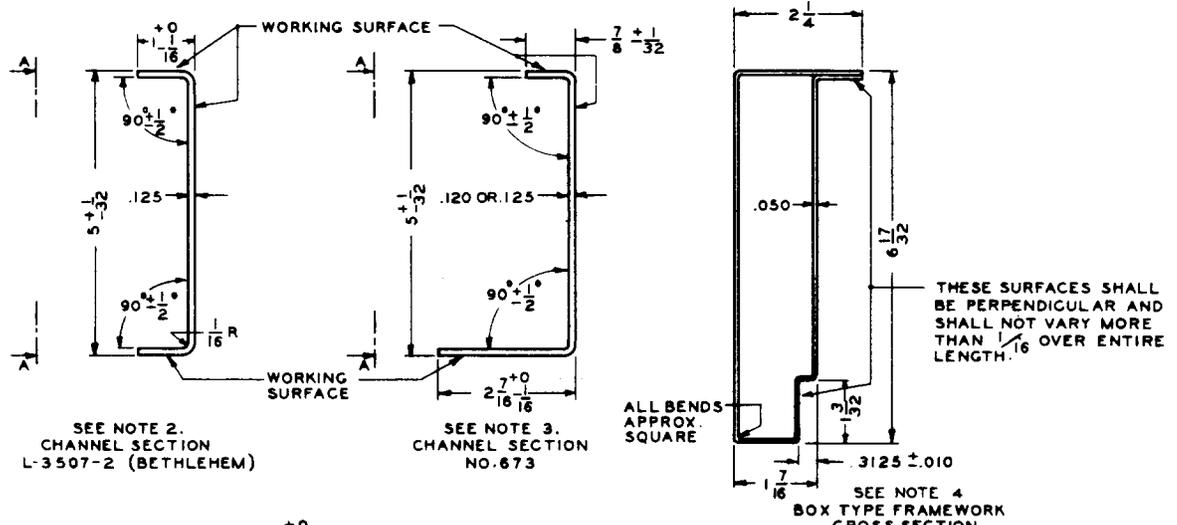
Table 14 — Aluminum and Aluminum Alloy Sheet



CROSS SECTION OF NO. 632 BULB ANGLE

SEE NOTE 1 SPECIAL I BEAM NO. 607 CROSS SECTION

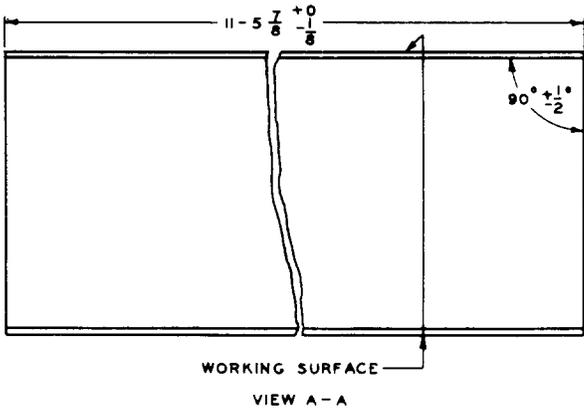
CHANNEL CROSS SECTION C-10 (CARNEGIE)



SEE NOTE 2. CHANNEL SECTION L-3507-2 (BETHLEHEM)

SEE NOTE 3. CHANNEL SECTION NO. 673

SEE NOTE 4. BOX TYPE FRAMEWORK CROSS SECTION



VIEW A-A

- NOTES:
1. ALL DIMENSIONS FOR THIS SPECIAL 3" - 5.4 LB. I<sup>16</sup> BEAM EXCEPT  $1\frac{15}{16} \pm \frac{1}{16}$  ARE STANDARD FOR 3" - 5.7 LB I<sup>16</sup> BEAM.
  2. WORKING SURFACES OF THIS CHANNEL SHALL BE STRAIGHT WITHIN .002 IN ANY INCH AND WITHIN  $\frac{1}{8}$  IN OVERALL LENGTH.
  3. WORKING SURFACES OF THIS CHANNEL SHALL BE STRAIGHT WITHIN .002 IN ANY INCH AND WITHIN  $\frac{3}{32}$  IN OVERALL LENGTH.
  4. ALL OF THE OUTER SURFACES OF THE BOX TYPE FRAMEWORK SHALL BE CONSIDERED AS WORKING SURFACES

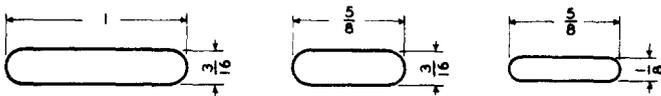
Fig. 1 - Cross Sections of Special Shapes

inclusive. These limits have been taken from AISI Steel Products manuals of 1949 as shown in the title of each table and are included here for convenient reference and are not to be a requirement.

2.07 Commercial thicknesses for uncoated metals of flat rolled low carbon sheet and strip steel should be specified in accordance with Table 13.

2.08 The dimensional tolerances for special shapes in general use for equipment structures are shown in Fig. 1.

2.09 Special shapes for parts using insulating finish, such as cable brackets, fanning rings, etc. are illustrated in Fig. 2. These special shapes are shown on A-165399. They have been used extensively in the past and are available for this or other purposes where required. Mill edge stock may be used if the edges are sufficiently broken to meet the insulating finish breakdown requirements.



NO. 641 NO. 642 NO. 643  
NOTE: ROUND EDGES MUST BE TANGENT TO FLAT SURFACES.

Fig. 2 - Special Shape Bars for Parts Using Insulating Finish

2.10 Cast iron is used to a limited extent for small castings such as foot rail brackets and distributing rings. Annealed castings are usually used to reduce the liability of breakage.

2.11 Aluminum alloy has been used extensively as a substitute for steel where strength is not a factor. Sometimes as in the case of large apparatus mounting panels, aluminum alloy is used for weight reduction purposes. Generally it should be specified per LRM 177. Commercial limits for the variation in thickness of aluminum and aluminum alloy sheet are shown in Table 14.

2.12 Other Metals: Copper, brass, bronze, nickel silver, and other metals are used to a slight extent for miscellaneous equipment parts, such as mouldings, hinges, designation plates etc. Copper is also used for battery bus bars.

**3. GENERAL REQUIREMENTS**

3.01 Material: The quality of the metals used for equipment purposes should,

unless otherwise specified, be in accordance with the best commercial practice; that is, free from scale, rust, pits, etc.

3.02 Straightening: Parts 1'-0" or less in length, made from bars, angles, channels, tees, or other shapes, may be mill-straightened stock. Parts longer than 1'-0" should be made from stock that has been checked and corrected for straightness to the following limits.

(a) Bars, angles, channels, I-beams, and similar rod stock shall be straight within .002" in any inch with a limit of 3/32" in any piece, these limits applying to the functioning surfaces or working points of the parts.

3.03 Shearing and Sawing: Sheared ends should be reasonably square and free from sharp burrs. The deformation of the sheared end should be as small as practicable considering the thickness and nature of the material. Sawed ends should be square and free from sharp burrs.

(a) Where the deformation of a sheared end of a bar, angle, channel, or similar shape affects the assembly of the part, the deformation should be corrected to the extent necessary to permit satisfactory assembly.

3.04 Machining: Surfacing operations such as planing, milling, grinding, etc., should be as free from defects such as burrs, splits, cracks and undue roughness, as practicable, considering the type of operation and the nature of the material being machined.

3.05 Drilling and Punching: Drilled holes should be clean cut and free from burrs. Punched holes should be clean cut and free from ragged edges. Slight burrs and split out edges are permitted provided they do not interfere with assembling the parts. Slight cracks in mounting plates and panels having punched holes are permissible. Holes near bends that become distorted after bending are permissible provided the distortion does not interfere with mounting of apparatus or equipment. Drilled or punched holes should not exceed the following permissible variations from their true location.

Diameter of Hole	Dimension Locating Hole	
	3'-0" or less	Over 3'-0"
7/32" or less	1/32"	1/32"
Over 7/32" to 1/2" incl.	1/32"	3/64"
Over 1/2"	3/64"	1/16"

3.06 Tapping: All tapped holes should be free of stripped or otherwise defective threads. Unless otherwise specified, blind holes should have complete

threads to the depth specified, and through holes should have complete threads for their entire length. The thread form should be the form known and specified as the Unified and American Standard Screw Thread Form.

3.07 Threading: All internal threads shall have a class 2B fit. All ferrous external threads shall have a class 2 fit making allowance for the finish. All nonferrous external threads shall have a class 2A fit. Threaded rods, such as the 5/8" hanger rod, shall have a class 2 fit over a 289 finish which should give a free spinning fit for the associated nut.

3.08 Riveting: Rivets, when driven, should draw the riveted parts into actual contact and hold them rigidly without causing undue twists or bends. Drifting and reaming of rivet holes should not be done to such an extent as to injure the material or enlarge the holes so that the rivet, when driven, will not entirely fill the hole.

3.09 Bending: Cold bends and forged bends should be accurately made to the specified dimensions. Bends without specific designation as to radius of bend may be made to the usual radii permitted by commercial shop practice. The usual radius is 1/8" except for sheet metal or other thin parts for which the radii are as follows:

<u>Thickness of Metal</u>	<u>Radius of Bend</u>
1/16" or under	Approx. 1/32"
Over 1/16"	Approx. equal to thickness of metal

Bends without specific designation as to angle of bends should be considered as 90° angle.

3.10 Welding: Where welds are specified they should be so located and of such design as will provide satisfactory strength and appearance to the welded parts. Welds should be as uniform as practicable in appearance and should be free from sharp projections and from badly pitted and excessive welding metal. Except where otherwise specified or required for the proper fitting of parts, welds need not be filed, ground, chipped or otherwise dressed. No welding material should project above a working surface. Surfaces adjoining welds, where specified to be free from welding metal should be protected therefrom with particular care. The commonly used types of welds on Bell System framework drawings are shown in Figs. 3 and 4. The method of showing these welds by weld number has been

discontinued but since many of the framework assembly and piece part drawings still show these weld numbers, the above figures are shown for reference only. All new framework assembly and piece part drawings on which welding information is to be shown should have the types of welds to be used indicated by using the standard symbols shown in the Graphical Symbols for Welding ASA Z32.2.1-J949.

3.11 Screws, nuts, and washers should be specified by commercial description only. Piece part numbers on Bell Telephone Laboratories drawings, except those for manufacturing purposes, should be omitted. Unless otherwise specified, these parts will be assumed to be steel with a 289 finish. Also the lengths of screws should not be specified unless this constitutes a specific engineering requirement. Washers should be identified by type only, omitting dimensional information. Western Electric manufacturing drawings should be specific with regard to specifying piece part numbers, types of material, finish, and size of parts.

3.12 Edges of hot and cold rolled strip steel are identified as follows:

Hot Rolled (AlSl Sect. 12 of 8-49)

Mill edge - Slightly rounded but no attempt made to control contour.

Square edge - Produced by side (hot edge) rolling.

Slit edge - Sharp corners, or even burred, as is characteristic of cutting or shearing.

Cold Rolled (AlSl Sect. 13 of 9-49)

No. 1, Prepared edge - of a specified contour.

No. 2, Natural mill edge - Slightly rounded but no attempt made to control contour.

No. 3, Square edge - Produced by slitting.

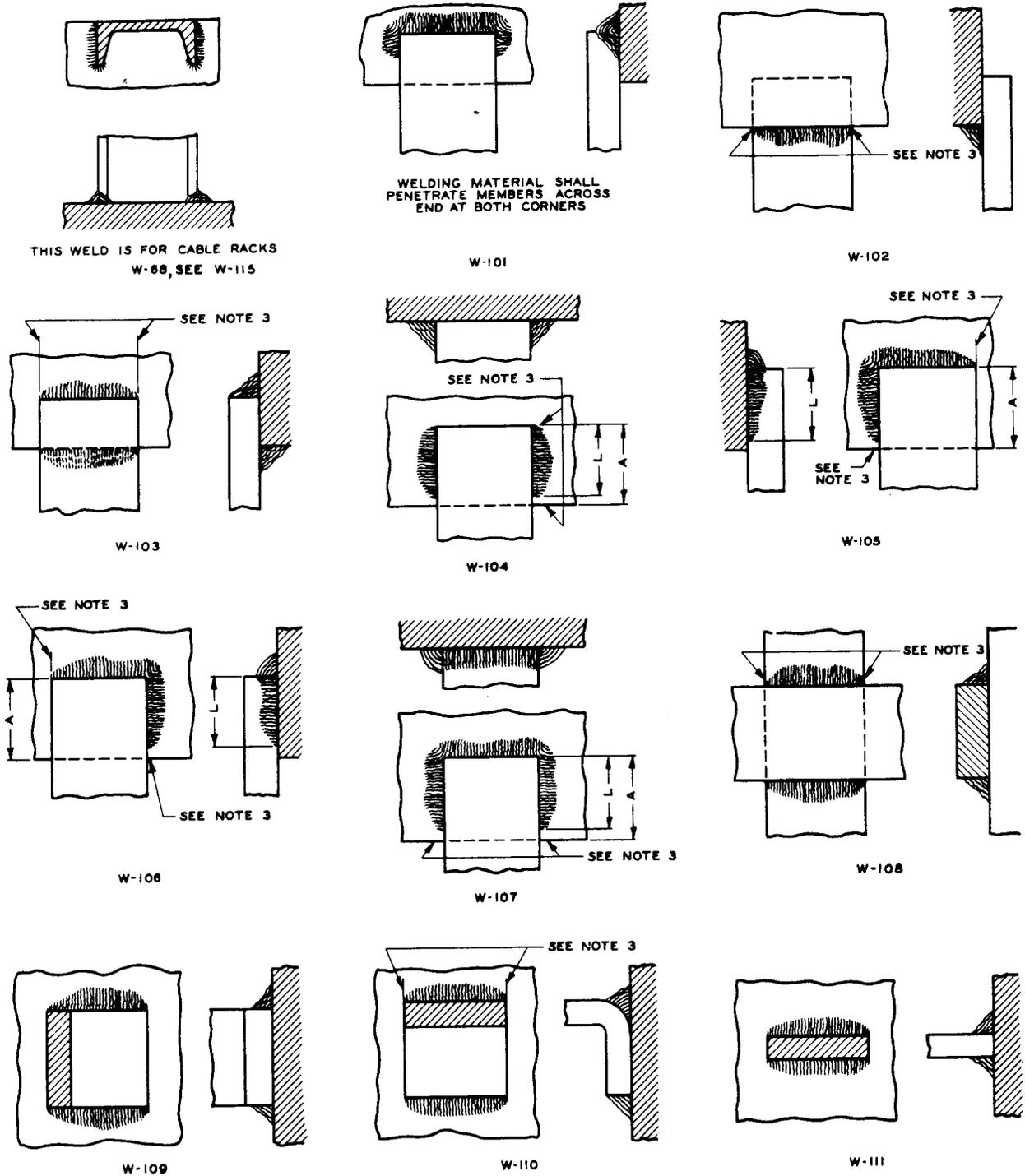
No. 4, Rounded edge - Produced by edge rolling, curved edges are cylindrical but not tangential to the flat surfaces - generally sharp lines at intersection.

No. 5, Square edge - Produced by rolling or filing of a slit edge to remove burr.

No. 6, Square edge - Produced by edge rolling the natural edge of hot rolled strip or slit edge strip.

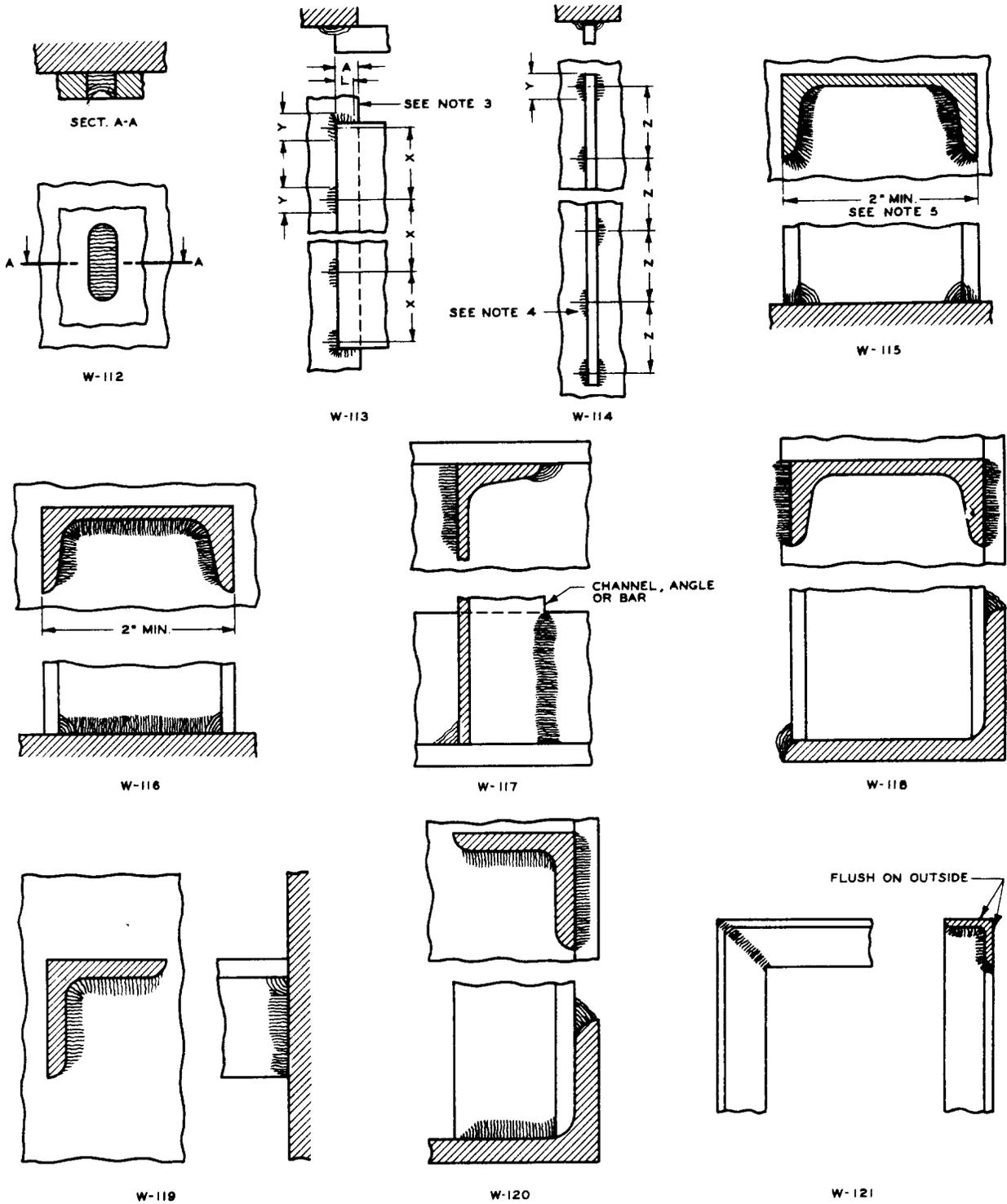
4. REQUIREMENTS FOR ASSEMBLED METAL PARTS

4.01 Metal parts should be assembled accurately to within such limits as will assure proper functioning of the assembled parts. These limits are only those essential for the basic design.



- NOTES:
1. THE NUMBER UNDER EACH FIGURE IS THE NUMBER FOR THAT PARTICULAR WELD.
  2. UNLESS OTHERWISE SPECIFIED "L" IS 3/4" WHEN "A" IS MORE THAN 3/4".
  3. THIS SIDE OF LINE TO BE FREE FROM WELDING MATERIAL.
  4. THESE FIGURES ARE SHOWN FOR REFERENCE ONLY AND ARE REPLACED BY ASA Z32.2.1-1949

Fig. 3 - Welds W-68 and W-101 to W-111 Inclusive



NOTES:

1. THE NUMBER UNDER EACH FIGURE IS THE NUMBER FOR THAT PARTICULAR WELD.
2. UNLESS OTHERWISE SPECIFIED "L" IS  $\frac{3}{4}$ " WHEN "A" IS MORE THAN  $\frac{3}{4}$ ", DIMENSION "Y" IS 1", DIMENSION "X" IS 3" MIN. AND 8" MAX. DIMENSION "Z" IS 6" MIN. AND 9" MAX. ALL DIMENSIONS APPROXIMATE ONLY.
3. THIS SIDE OF LINE TO BE FREE FROM WELDING MATERIAL.
4. WHEN MORE THAN ONE INTERMEDIATE WELD IS USED THEY SHALL BE STAGGERED ALTERNATELY ON EITHER SIDE OF BAR.
5. WHEN W-115 IS USED FOR CABLE RACK STRAPS, THE WELD SHALL BE CONTINUOUS ALONG THE INSIDE CONTOUR OF CHANNEL AND THE 2" MIN. DIMENSION DISREGARDED.
6. THESE FIGURES ARE SHOWN FOR REFERENCE ONLY AND ARE REPLACED BY ASA Z32.2.1 -1949.

Fig. 4 - Welds W-112 to W-121 Inclusive

4.02 Switchboard steel framework, after assembly, should conform to the specified over-all dimensions to within  $\pm 1/16"$ . The dimension between adjacent cold drawn stile strips should be within  $\pm 1/64"$  of the specified dimension.

4.03 Individual frames, such as shop-assembled frames, relay racks, fuse bays, etc., should conform to the specified over-all dimensions to within  $\pm 1/8"$  in height and  $\pm 1/16"$  in width. A frame upright should not be bowed more than  $1/16"$  in its entire length. Uprights of a single bay frame should touch and no upright of a multiple bay frame should be raised more than  $1/8"$  above the surface of bars when resting of its own weight in a horizontal position with the rear of the uprights on a pair of parallel bars located transversely approximately at the top and bottom equipment mounting holes.

4.04 Frameworks for unit equipments arranged for mounting on frames, racks, etc., should conform to the specified over-all dimensions to within  $\pm 1/16"$  in width and  $\pm 1/32"$  in height.

(a) Step-by-step line finder units and switch shelf frameworks should have an over-all tolerance of  $+1/16"$  to  $-3/32"$  in width and  $+0.00"$  to  $-3/32"$  in height.

4.05 Unit lengths of cable rack should conform to the specified over-all dimensions to within  $\pm 1/16"$  in width. The edgewise bow of the stringers of welded type cable rack should not exceed  $3/8"$  in a  $9'-8-1/2"$  long unit.

4.06 Keyshelf steel frames should conform to the specified over-all dimensions to within  $\pm 1/64"$ .

4.07 Steel stile strips should conform to the specified dimensions to within  $\pm 1/64"$  between drillings for adjacent jack fasteners,  $\pm 1/32"$  between drillings for the first and last jack fasteners, and  $1/64"$  on either side of the center line for all drillings.

4.08 Welded units of two or more distributing frame verticals  $11'-6"$  or more in height may have a permissible bow, due to welding, not to exceed  $5/16"$ , and those less than  $11'-6"$  high may have a permissible bow in proportion to their height.

#### REASONS FOR REISSUE

1. Paragraph 1.02 has been added to recognize the condition where other specifications and drawings modify the general requirements.

2. Paragraph 2.04 has been amplified to add a statement requiring the omission of the type of steel to be used on Bell Telephone Laboratories piece part and detail drawings.
3. Paragraph 2.05 covering stainless steel was added.
4. Paragraph 2.06 was amplified to state that limits and tolerances shown in Tables 1 to 12 were taken from AISI Steel Products manuals of 1949.
5. Paragraph 2.07 was added to cover commercial thicknesses of steel as shown in Table 13.
6. Tables 9, 10, 11, and 12 covering cold and hot rolled sheet steel and cold and hot rolled strip steel were added.
7. Table 13 replaces former Table 9.
8. Paragraph 2.09 has been amplified to state that the special shapes per Fig. 2 and shown on A-165399 are available for use for cable brackets but are not used extensively at present and that mill edge stock may be used if edges are sufficiently rounded to meet insulation breakdown requirements.
9. Paragraph 2.11 and Table 14 have been added to cover aluminum and aluminum alloy sheet.
10. In paragraph 2.12, aluminum has been omitted for use in battery bus bars.
11. Paragraph 3.01 has been changed to add that material should be free from scale, rust, pits, etc.
12. Paragraph 3.03 has been changed to add that sheared ends should also be free from sharp burrs.
13. Paragraph 3.05 has been changed to permit slight cracks in punched plates and to permit some distortion in holes near bends.
14. Paragraph 3.06 has been changed to omit the class of fit of the threads.
15. Paragraph 3.07 on threading has been added.
16. In paragraph 3.09 the radius of bend for metal  $1/16"$  or under in thickness has been changed.
17. Paragraph 3.10 on welding has been amplified to state that weld numbers, W117 etc., are discontinued and all new Bell System framework and detail drawings will show the symbols shown in Graphical Symbols for Welding

ASA Z32.2.1-1949. The paragraph also states that no welding material should project above a working surface.

18. Paragraph 3.11 on screws, nuts, and washers has been added.
19. Paragraph 3.12 has been added to define the different types of edges used with hot and cold rolled strip steel.
20. Bowing limits have been added to paragraph 4.03.
21. An exception for the over-all limits of step-by-step line finder units and switch shelf frameworks has been added to paragraph 4.04. The tolerance for the height of units was changed to  $\pm 1/32"$ .
22. In paragraph 4.06 the over-all dimension of keyshelf steel frames has been changed to  $\pm 1/64"$ .
23. Fig. 1 has been revised to add cross sections for channel C-10, box type framework and channel L-3507-2.
24. In Fig. 3 reference to W-115 weld added to W-68 weld and Notes 1 to 4 added.
25. In Fig. 4 notes 3 and 5 have been revised and Note 6 added.

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