5.2.3 Other Quality Requirements

A Cracks or splits in the rolled or flared portions of eyelets, tubelets, and terminals after installation shall be permissible with the following limitations:

(1) No single part may have more than one crack or split per side of the board. Intentional splitting of tubelets in accordance with a Collins specification is acceptable. No circumferential tears are permitted.

(2) No crack or split on a part may extend past the surface of the board into the hole.

Unintentional cracks or tears may indicate defective tooling or material.

B All tubelets, eyelets, split tubelets and terminals installed in a printed wiring board shall be attached firmly to the board so that they cannot be moved or rotated by finger pressure before soldering.

C The inner diameter of tubelets and eyelets after flaring or rolling shall be not less than 95% of the calculated minimum inner diameter of the part before installation.

Example:	Tubelet	542-0811-003
	Inner Dia	.058 inch ±.003 inch
	Minimum ID	.058 inch -.003 inch = .055 inch
	Minimum Acceptable ID after Installation	.055 inch x .95 = .05225 inch or .052 inch

D Eyelets, tubelets and terminals must be seated perpendicular to the board and contact the copper cladding.

5.3 COMPONENT ATTACHMENT

5.3.1 Components with Wire Leads

Electrical components with wire leads shall be prepared, inserted and clinched according to the following requirements:

a. Component lead wires shall be reasonably straight, free of kinks, and properly cleaned and tinned before installation on printed wiring boards. Strain relief bends with one wire diameter (min) radius are not kinks.

b. All wire leads which are inserted into circuit boards shall be clinched over on the side opposite to insertion, in the direction of circuit paths where applicable. The length of the clinched end shall be not less than 1/16 inch or more than 1/8 inch, measured from the center line of the hole from which the lead emerges to the cut end. In no case shall a clinched wire end on a board be closer to a nonconnected circuit path than the minimum spacing maintained between nonconnected circuit paths on that board. The clinch shall be such that it holds the component lead perpendicular to the board. The clinched

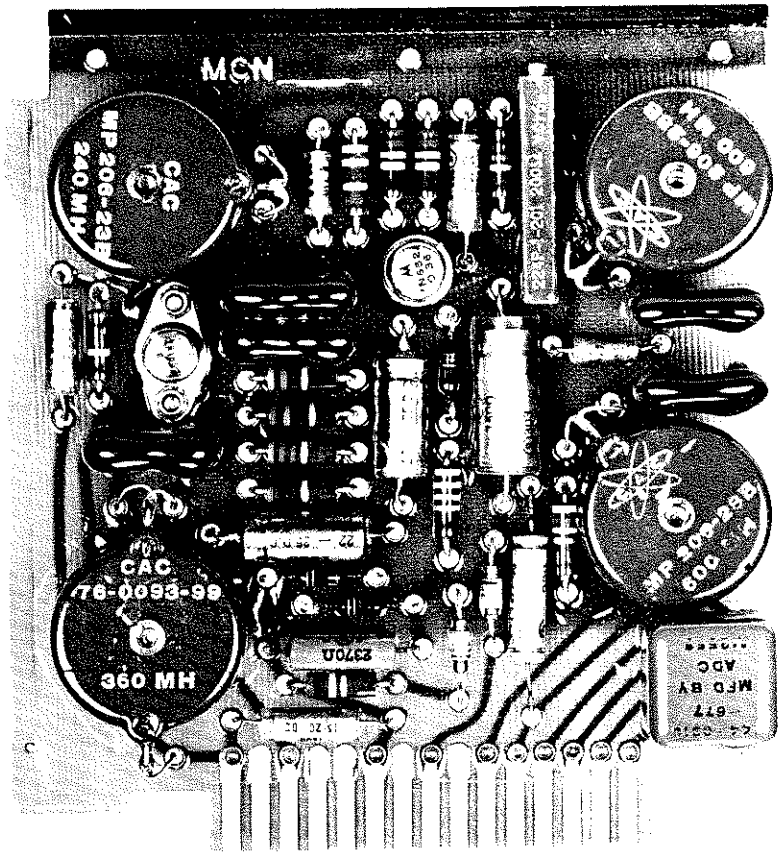


Figure 5-3. Assembled Printed Circuit Board

lead shall contact the tubelet through which the lead is projected, so that the lead is mechanically secure during the soldering operation. Component tab, pin or lead terminals not designed to be bent shall not be bent.

c. No process of straightening, cutting, bending, inserting, or clinching wire leads of electrical components shall be permitted which could result in internal damage, change of rating, or change of value of those components.

d. Markings pertaining to values, tolerance, ratings, etc., shall be intact, legible, and readable from the most visible angle.

e. Sharp bends in component leads shall be avoided. See paragraph 2.5.

f. Component lead bends shall not be positioned so close to the integral body of the component (welds, solder beads, plastic seal fillets, etc., included) that fracturing or other damage could result. (See paragraph 2.4.5.)

g. Component leads shall be free of large indentations and fractures, cuts and nicks as specified in paragraph 1.1.3.C.

h. Whenever possible, components should be centered between mounting points.

i. Component leads shall not be stressed tight between mounting points. Adequate strain relief shall be provided to prevent damage to the component and solder joint. See figures 2-4 and 2-5.

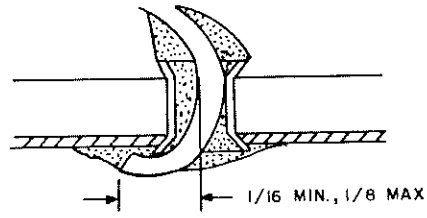


Figure 5-4. Lead Clinch and Cut-Off

5.3.2 Hardware Mounted Components

Electrical components, clamps, connectors, brackets, etc., which are to be mounted with threaded hardware shall be fastened in accordance with the requirements described in section 3 of this manual. If the fastener is covered with an approved post-coating material, no additional locking is required.

5.3.3 "Snap-In" Components

"Snap-in" components, such as tube sockets, transistor sockets, etc., shall be oriented and seated in the board properly. All metal tabs, spring leads, etc., which are intended for electrical connection to circuitry by soldering, shall be in contact with the circuit to which they are to be soldered.

5.4 QUALITY REQUIREMENTS FOR PRINTED CIRCUIT BOARD ASSEMBLIES

5.4.1 Component Bodies and Wire Leads

Failure to meet the requirements of paragraphs 5.3.1 through 5.3.3, or presence of any of the following defects shall be cause for rejection of the board assembly:

a. Chipped or cracked components per paragraph 2.3.

b. Wire leads which are fractured, broken, collapsed, or otherwise improperly inserted.

5.4.2 Printed Circuitry Separation

A lifted, separated or unbonded circuit may be identified easily by viewing the circuitry from the opposite side of the translucent laminate. An unbonded circuit will not be visible when viewed as described.

A Unbonded circuitry less than 1/2 inch in length (see figure 5-5) may be made acceptable by rebonding the circuitry to the laminate with currently approved epoxy bonding materials. Bonding material shall be applied all over and beyond the lifted area for a distance of approximately 1/16 inch all around. No one printed wiring path shall exhibit more than two such rebonded areas in its length.

B Any board on which a circuit path shows lifting exceeding 1/2 inch of continuous length shall be rejected.

C There shall be no allowable separation of the cladding from the base laminate in the contact area on printed switches. Separation detectable by the unaided eye is cause for rejection.

5.4.3 Base Laminate

A scratch in the base laminate deep enough to expose the base filler material shall be repaired if it is closer than 1/32 inch to adjacent circuits. Post-coating will accomplish this repair.

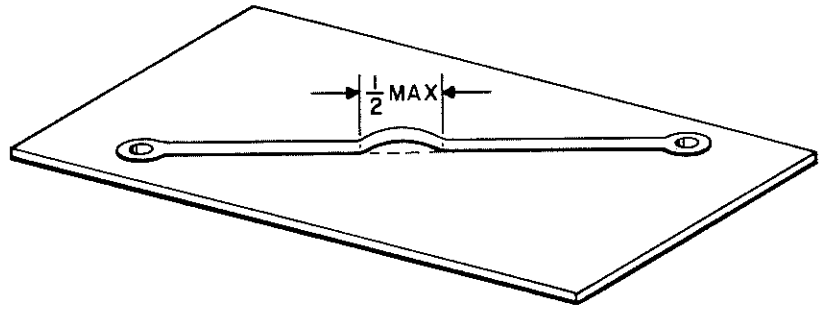


Figure 5-5. Lifted Circuitry Repairable Maximum

5.4.4 Repair of Printed Circuit

Limited damage to circuitry may be repaired by connecting wire from tubelet to tubelet.

5.5 SOLDERING ON PRINTED BOARDS

5.5.1 Preparation

A Surfaces to be soldered shall be free of grease, dirt, oxide, scale, or other foreign materials.

B All wires, component leads, and terminals which do not have an easily solderable coating shall be tinned before soldering.

C All forming and trimming of leads shall be done prior to soldering.

5.5.2 Fluxes

A Only currently approved solder fluxes shall be used.

B Corrosive (chloride) fluxes shall not be used on printed wiring boards.

C Flux may be applied to boards by spraying, dipping, or brushing. All surfaces to be soldered must be covered with flux.

5.5.3 Hand Soldering

A In making a proper solder joint, it is necessary that there be no movement of the members until the solder has hardened completely. Movement during the soldering operation could result in a fracture or weakened joint which eventually may break under strain. Prevention of movement of members is the reason for making the wire mechanically secure to the terminal prior to soldering.

B In the soldering operation, the members to be soldered must be hot enough to maintain the solder in a melted condition until the necessary "wetting" action takes place. It is important that the soldering iron or other source of heat be of adequate capacity to maintain the metal being soldered at the proper fusion temperature.

C The soldering iron tip shall be kept tight within the iron and excess oxidation shall be removed at frequent intervals to ensure maximum transfer of heat from the heating element to the tip. A bright, clean, well-tinned, smooth face shall be kept on the tip. The tinned portion should extend a minimum of 1/2 inch back from the pointed end.

D Heat sinks shall be used on the leads of all components that could be damaged by the heat of normal soldering.

E If a solder connection is to be reheated, the old solder should be removed and the new solder applied, unless the reason is insufficient solder, in which case additional solder would be applied. Removal of solder from a joint shall be accomplished by a method that minimizes heat transfer to the component, such as the use of wire braid to soak up molten solder.

F Only enough solder should be applied to allow adequate alloying action to take place but the solder shall be plainly visible. The general outline of the members should be visible. See figure 1-20.

G Insulation or foreign material shall not be imbedded in a solder joint.

H Cored solder having an approved flux or a solid wire solder used with a separate approved flux shall be used in hand-soldering. 63/37 solder is preferred (60/40 solder is also acceptable) unless otherwise specified.

5.5.4 Dip Soldering

A Circuitry other than contact areas and plated areas must be coated with solder.

B The composition of solder for dip-soldering printed circuit assemblies shall be 63% tin, 37% lead, unless otherwise specified.

C The temperature of the molten solder for dip-soldering shall be maintained so that complete fusion of the alloy to the metal to be soldered shall result. All metal to be soldered shall be covered completely after soldering and well tinned with concave fillets (radii) in evidence.

D All tubelets, eyelets, plated-thru holes, or any other surfaces which are not to be soldered during a dip solder operation shall be suitably masked, covered, or plugged.

5.5.5 Removal of Flux Residues

A All residues shall be removed from board surfaces and parts after soldering, using suitable cleaning agents or processes.

B The cleaning agents or processes must not attack or degrade the board materials, component materials, color codings or silk-screened paint markings of the assembly. They shall be noncorrosive.

5.5.6 Workmanship Standards - Dip-Soldered Boards

A The completed printed wiring board assembly shall conform to all the requirements stated. Spare parts, subassemblies, or other printed boards containing only tubelets, eyelets, and terminals also shall conform. Presence of the following defects shall be cause for rejection:

a. Incomplete coverage by solder of metal surfaces, component leads, tubelets, or terminals which are to be soldered.

b. "Cold" or fractured solder joints or nonadherence of solder to metal.

c. Excess solder globules, peaks, strings, or bridging of solder between adjacent parts or circuits.

d. Burned, scorched, or otherwise heat-damaged boards or components.

e. Corroded metal parts or circuits.

f. Flux residues, oils, greases, or foreign materials on assembly.

g. Substantial damage to color codes or nomenclature of electrical components, silk-screened paint, component materials, or board materials.

B Solder joints and solder coatings must not reduce the spacing of conductors to less than 2/3 of the nominal spacing; where greater spacing is necessary due to high voltage, etc., the minimum spacing should be specified on the drawing. Excessive solder globules, bumps, or peaks must be removed. There must be visible evidence of the lead under the solder coating, on the side of the board opposite the component.

5.6 POST-COATING

When specified on the drawing, printed wiring boards shall be given a resinous coating on completion of the component assembly and soldering operations. The coating must protect the board surface from contamination, mechanical damage, and moisture.

5.6.1 Cleaning

Immediately before applying the coating, the surface of the printed board shall be free of any moisture, grease or residue which would lower the surface resistivity of the printed board or reduce the adhesion of the coating.

5.6.2 Masking

Terminals, sockets, connectors, and portions of the metallic pattern such as switch pads which are to be used for electrical connection, shall be suitably masked so that they do not become coated.

5.6.3 Cured Coating Requirements

The cured coating shall meet the following requirements:

a. It shall be smooth and uniform, without excessive globules or bare spots.

b. It shall be substantially free from bubbles.

c. There shall be no blisters or cracks.

5.7 HANDLING AND PACKAGING

The fabricated boards shall be handled and packaged carefully to avoid scratching, chipping, or other damage during shipment, assembly, or storage.

section 6

resistance welding of circuitry

6.1 CONDUCTORS

6.1.1 Surface Conditions

All surfaces to be welded shall be free from oil, wax, dirt, grease, oxides, paint, or other foreign material which may be detrimental to the achievement of an acceptable weld. Surface coatings detrimental to the welding process shall be removed by methods that will not create the conductor imperfections described in paragraph 6.1.4. If resistance welded connections are used adjacent to soldered connections on a single terminal, the completed termination must be cleaned with a solvent which will not increase the rate of corrosion.

6.1.2 Bending of Component Leads and Nickel Wire (before welding)

Kinking of component leads (prior to assembly) or bending not required for lead forming shall not be permitted. All bends of component leads and nickel wire shall be clearly separated from the weld location. The beginning of curvature must be at least 1/2 the width of the electrode face plus .020 inch from the center of the weld, as shown in figure 6-1. Bending of component leads is to be avoided whenever possible. Nickel wire or ribbon may be bent in any direction.

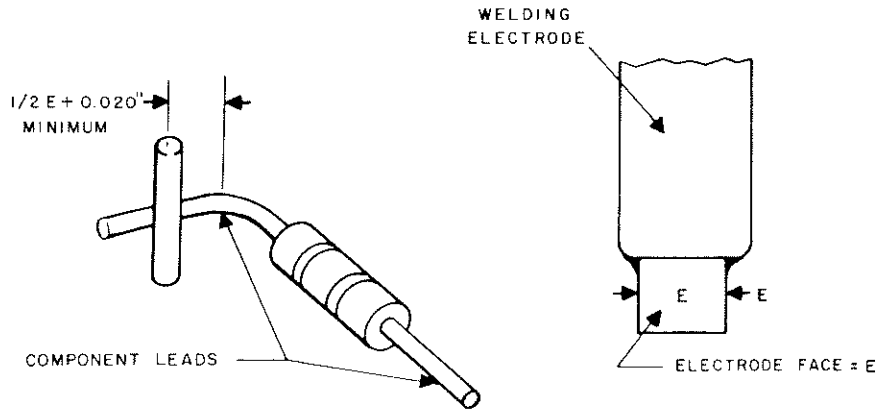


Figure 6-1. Forming of Conductor Before Welding

6.1.3 Permissible Weld Combinations

The combinations of materials or alloys to be welded shall be as indicated in an approved weld schedule.

6.1.4 Conductor Imperfections

Conductor imperfections shall be classified as follows and will be limited as described:

(1) Abrasions

An abrasion is a scraped or roughened surface finish of a conductor. It is identified by its lack of definite outline, shallowness and the fact that it may

extend for a relatively long distance along the conductor. Abrasions do not create any critical stress points and are acceptable unless extensive enough to be considered nicks or indentations, or result in exposure of the base material as defined below.

(2) Indentations

An indentation is a deformation of the surface of the conductor by a dull or blunt instrument. In either conductor, indentations with depths exceeding 1/4 the diameter of the conductor shall not be allowed.

(3) Nicks

A nick is a partial severance of the conductor by a sharp instrument. No nick in either conductor shall be allowed.

(4) Exposure of Base Material

Any single or multiple exposure of the base material shall not exceed 1/4 of the diameter of the conductor, as shown in figure 6-1A.

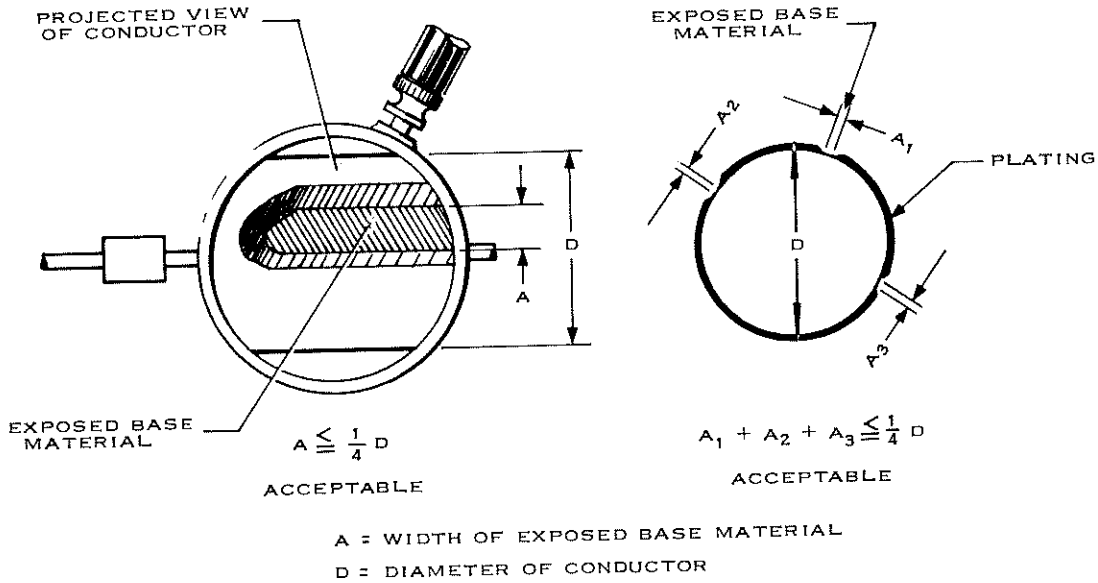


Figure 6-1A. Exposure of Base Material

6.2 STRANDED WIRE WELDING

Weld connections of stranded wire shall not be permitted without the written approval of the cognizant welding Application Engineer.

6.3 SPACING FROM COMPONENT BODY TO TERMINAL

Spacing from the component body to the terminal center line shall be measured from the point at which the component lead is weldable. The minimum spacing is 0.050 inch. The recommended spacing is one-half the welding electrode diameter, dimension D in figure 6-2, plus 0.020 inch. Spacing shall provide for centering components where possible.

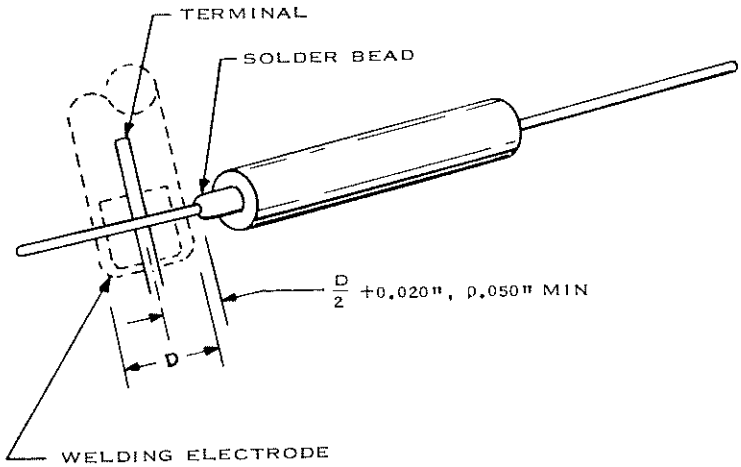


Figure 6-2. Spacing from Component to Terminal

6.4 ANGLE OF CONDUCTORS

6.4.1 Cylindrical Conductors

The angle of welded connections of cylindrical conductors shall be 90 ± 45 degrees. See Figure 6-3. This requirement does not apply to butt welds; refer to paragraph 6.16 for butt welding requirements.

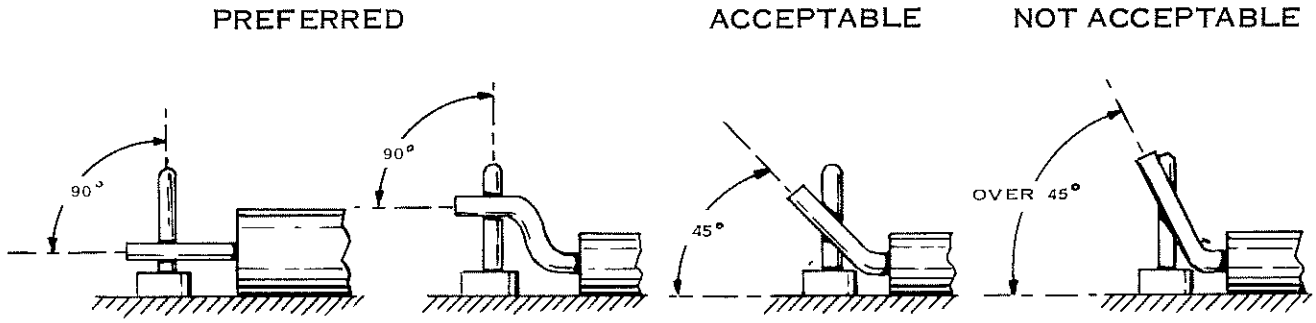


Figure 6-3. Angle Between Lead and Terminal

6.4.2 Ribbon Conductors

The angle of welded connections using ribbon conductors or ribbon and cylindrical conductors shall be 90 ± 10 degrees.

6.5 SPACING BETWEEN WELDS ON A TERMINAL

Where several conductors are welded to one terminal, the following limitations, which are illustrated in figure 6-4, shall be observed:

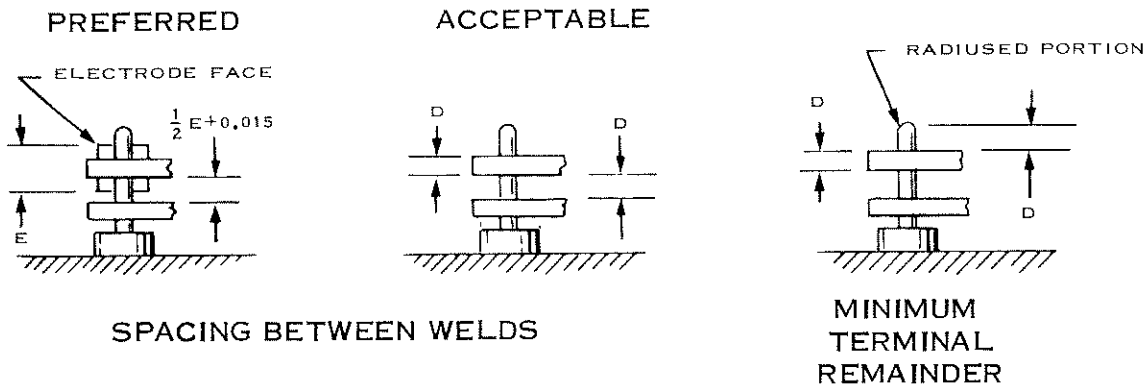


Figure 6-4. Spacing Between Welds

(1) Preferred Spacing

The preferred spacing between adjacent welded conductors on the terminal is 1/2 the electrode face dimension plus 0.015 inch.

(2) Acceptable Spacing

If closer spacing than the preferred dimension is required, the minimum acceptable spacing shall equal one diameter of the adjacent conductor.

(3) Minimum Terminal Remainder

The minimum distance remaining from the top of the upper conductor to the top of the terminal shall equal one diameter of the upper conductor below the radiused or chamfered portion of the terminal top.

6.6 STACKING OF COMPONENTS ON TERMINALS

The components must be welded in the order specified by the assembly drawings and/or approved assembly methods.

6.7 CONNECTING TRANSISTORS - Deleted

Figure 6-5. Transistor Lead Extension - Deleted

6.8 CLEARANCE

A 0.030-inch minimum clearance is required between an uninsulated lead (or ribbon) and a terminal or other conductor operating at a different voltage, unless high circuit potentials require more clearance, in which case the drawings shall specify the increased clearance. See figure 6-6.

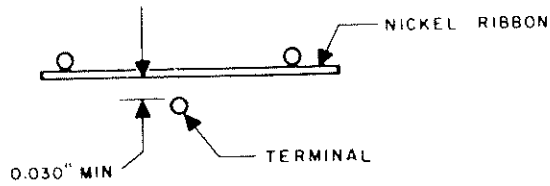


Figure 6-6. Minimum Clearance

6.9 MULTIPLE TERMINAL CONNECTIONS

When more than two terminals are to be connected by bus wire, the bus shall be bent and welded on the far side of the center terminals (concave side of bus wire) to reduce stresses on the weld, as shown in figure 6-7. If necessary, the wire can be welded on the inside of the terminal (convex side of wire) if the weld is made on a straight section of wire. (See figure 6-1.) If the wire is to be bent after the weld is made, the beginning of curvature shall be a minimum of 0.040 inch from the edge of the weld.

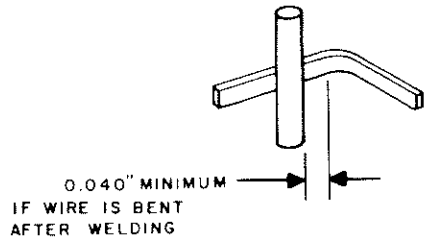


Figure 6-7. Position of Terminal

6.10 CLIPPING

A. All bus wires and component leads shall be clipped no more than 1/16 inch from the conductors to which they are welded. See figure 6-8.

B. The minimum clearance between a clipped wire or lead and an insulated lead is 0.030 inch. Clipped bus wire has sharp edges and will cut insulation. All wires should be routed and secured away from contact with a clipped wire or lead end.

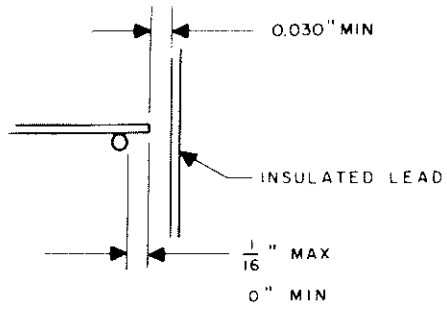


Figure 6-8. Clipped Wire Dimension and Clearance

6.11 SLEEVING

All sleeving must conform to the requirements of paragraph 1.8 of this manual. Sleeving shall be required on all component leads and on other bare conductors longer than 3/4 inch. During welding, such sleeving shall not be permitted closer than 1/16 inch from the edge of the terminal.

6.12 WELD STANDARDS

6.12.1 Acceptable Welds

A good weld is indicated by the following items:

(1) The correct quantity of melt between the two materials being welded.

(2) The proper "set-down" (indentation) of the material at the weld location.

There must be an indication that the base or core material (not just the tinning or coating) is fused.

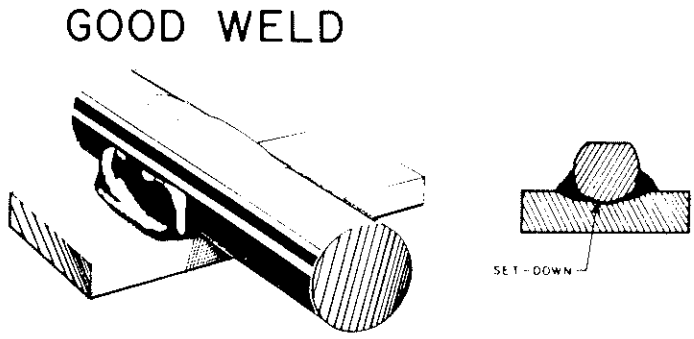


Figure 6-9. Good Weld

6.12.2 Defective Welds

Welds shall be rejected if any of the following defects are present:

a. Weld Splatter

Whiskers of metal with length over .010 inch protruding from the weld in an irregular manner. Such whiskers are the result of an improper weld and removal of the whiskers will not make the weld acceptable.

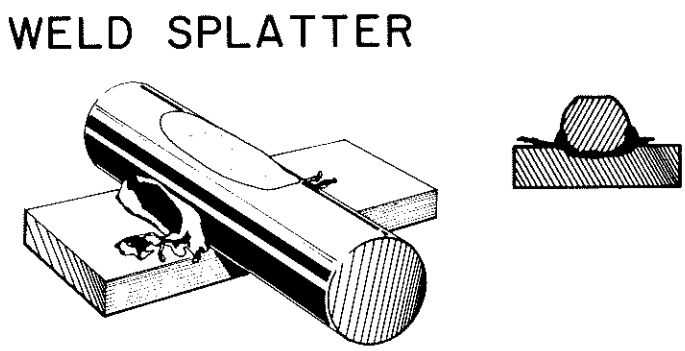


Figure 6-10. Weld Splatter

b. Crack

A crack in or adjacent to the weld area. See figure 6-11.

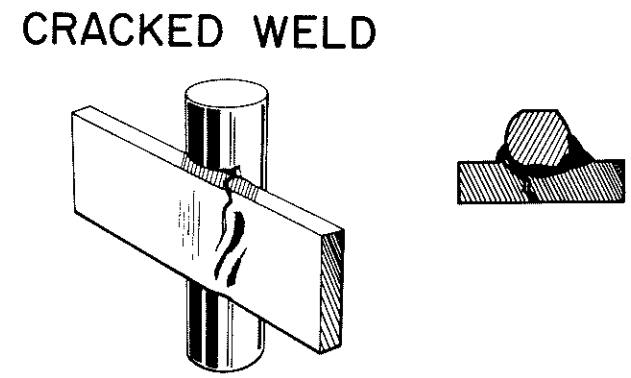


Figure 6-11. Cracked Weld

c. Blow Hole

Any hole greater than .003 inch diameter in the fused area between the welded parts.

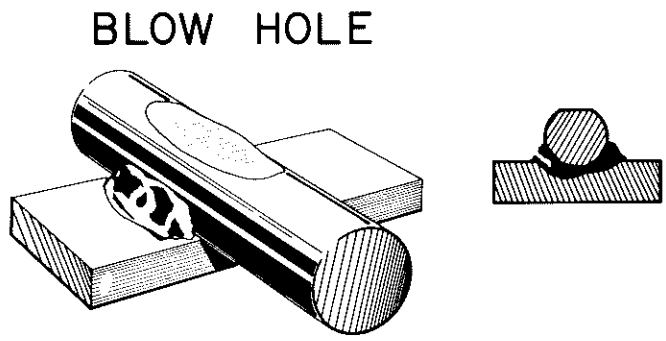


Figure 6-12. Blow Hole

d. Burned Weld

Any welded member which is reduced by heat (and pressure) more than 50 percent of its original dimension.

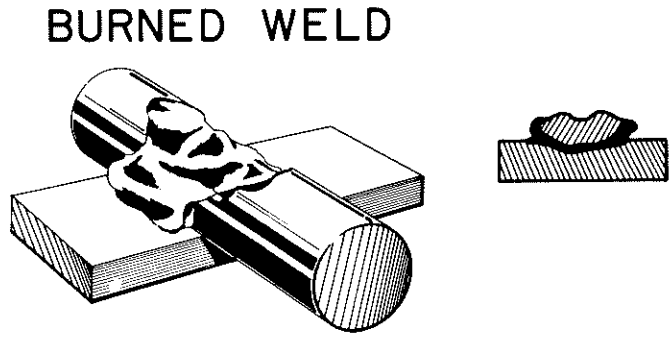


Figure 6-13. Burned Weld

e. Burned Hole

A hole of any size through either of the welded members.

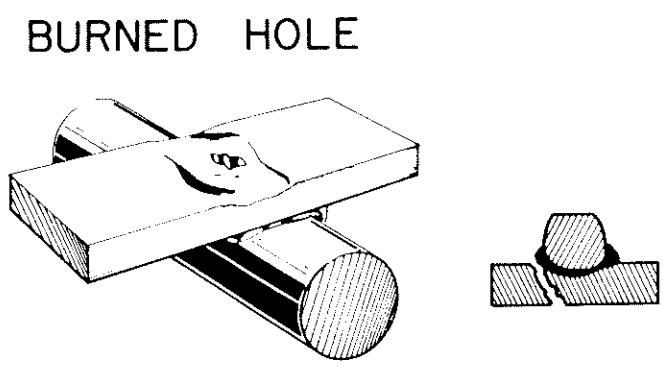


Figure 6-14. Burned Hole

f. Insufficient Weld

Absence of flow of melt around weld joint indicating lack of fusion between elements of the welded joint. If this condition is peculiar to the combination of materials and is noted on the weld schedule, it is an acceptable weld.

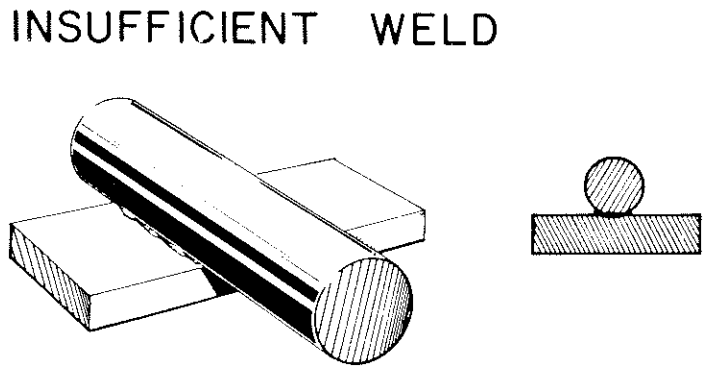


Figure 6-15. Insufficient Weld

g. Electrode Sticking

A particle of electrode material on either member of the weld joint, or evidence of lead damage due to sticking.

h. Deformation

Depression or flattening of either joint member exceeding 30 percent of the original dimension of the member at the electrode contact point. If noted on the weld schedule, deformation greater than 30 percent shall be acceptable as a condition peculiar to the combination of materials.

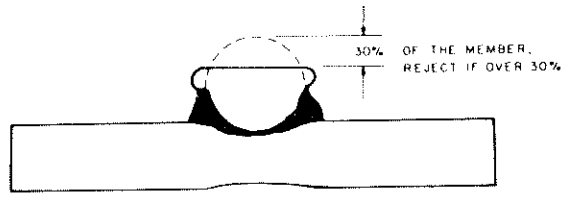


Figure 6-16. Deformation

i. Indentation by Electrode

Maximum depth of indentation (caused by the miscentering of the leads with respect to the center of the electrode face) shall not exceed 10 percent of the original cross section of the indented lead.

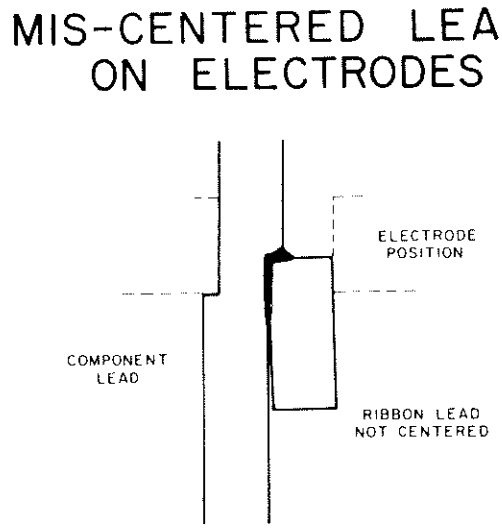


Figure 6-17. Miscentered Leads on Electrodes

6.12.3 Discoloration

The presence of discoloration at the weld joint is not a cause for rejection. However, a distinct change in characteristic color of a given combination usually means that one of the defects listed in paragraph 6.12.2 is present.

6.13 REPAIR OF REJECTED WELDING

If a weld is defective, the conductor shall be cut as close to the weld joint as possible. The bit of material left in the weld area can remain in place if it proves to be secure during a reasonable amount of probing. The following criteria shall govern the replacement of a rejected weld:

(1) Sufficient conductor length shall remain for the required weld.

(2) The weld shall be separated from the original location of the rejected weld as in paragraph 6.5. In no case shall a repair be done on the same spot as the original weld; or at a location on the same cross sectional plane.

(3) Terminal diameter shall not be reduced below the limits of paragraph 6.12.2, d or h.

6.14 SOLDER BEADS ON "TIN" DIPPED CONDUCTORS

Tinned (dipped) conductor materials, such as some resistor leads, will intermittently produce small solder beads when welded to a high resistivity terminal material. In such cases, the following steps must be taken:

(1) Probe each bead and remove it if it is loose.

(2) Remove bead if it presents an objectionable appearance to the naked eye.

(3) Remove bead if it makes a potential short.

6.15 INSPECTION

6.15.1 Inspector Qualification

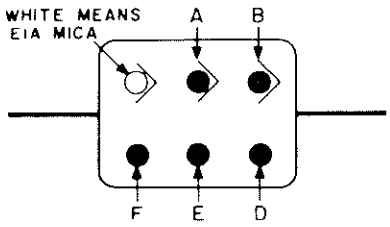
All welding inspection shall be performed by qualified inspectors who have demonstrated their ability to recognize the conditions described in this section, and their understanding of the resistance welding process.

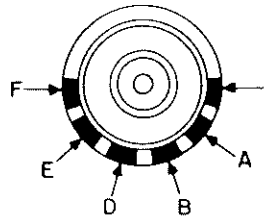
appendix A

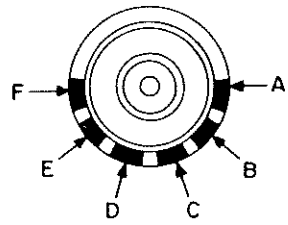
Mica Capacitor Color Code

EIA **STANDARD** RS-153

MIL-C-10950







Color	Digits of Capacitance (μμf) A	B	C	Multiplier D	Tolerance % E	Characteristic See table below F
Black	0	0	0	1	± 20	A
Brown	1	1	1	10	± 1	B
Red	2	2	2	100	± 2	C
Orange	3	3	3	1,000	± 3	D
Yellow	4	4	4	10,000*	—	E
Green	5	5	5	—	± 5	—
Blue	6	6	6	—	—	—
Violet	7	7	7	—	—	—
Gray	8	8	8	—	—	
White	9	9	9	—	—	
Gold	—	—	—	0.1	—	—
Silver	—	—	—	0.01	± 10	—

DESCRIPTION OF CHARACTERISTIC

Characteristic	*Temperature Coefficient (parts per million per °C)*	*Maximum Capacitance Drift*	*Minimum Insulation Resistance (megohms)*
A	±1000	±(5% +1 μμf)	3000
B	±500	±(3% +1 μμf)	6000
C	±200	±(0.5% +0.5 μμf)	6000
D	±100	±(0.3% +0.1 μμf)	6000
E	+100 −20	±(0.1% +0.1 μμf)	6000
I	+150 −50	±(0.3% +0.2 μμf)	6000
J	+100 −50	±(0.2% +0.2 μμf)	6000

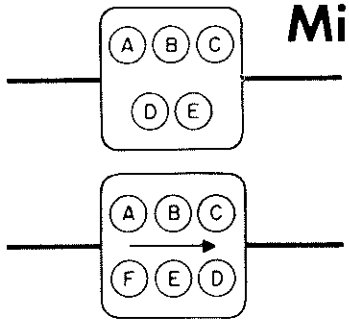
VOLTAGE RATING

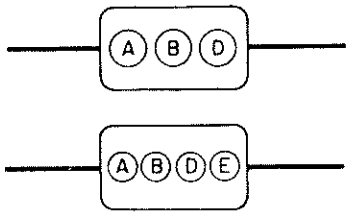
(Indicated by dimensions rather than color coding)

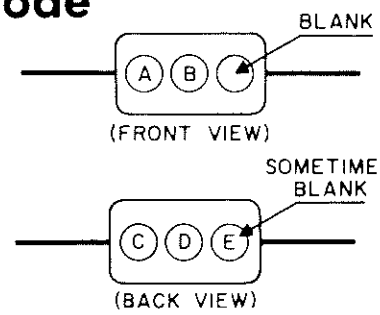
Maximum Inches Long	Wide	Thick	*Style*	*Capacitance (μμf)*	*Rating (v d-c)*
51/64	15/32	7/32	20	5–510	500
				560–1000	300
1 7/64	15/32	7/32	25	5–1000	500
				1100–1500	300
53/64	53/64	9/32	30	470–6200	500
				Over 6200	300
53/64	53/64	3/8	35	3300–6200	500
				Over 6200	300
1 1/32	41/64	11/32	40	100–2400	1000
				2700–7500	500
				Over 7500	300

Mica Capacitor Color Code

Obsolete Style



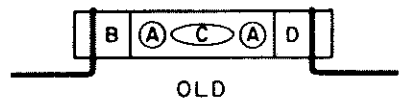




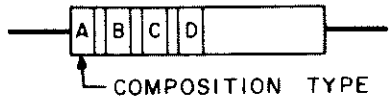
Dot Color	Digits of Capacitance (μμf) A	B	C	Multiplier D	Tolerance % E	Voltage Rating (v d-c) F
Black	0	0	0	1	± 20	—
Brown	1	1	1	10	± 1	100
Red	2	2	2	100	± 2	200
Orange	3	3	3	1,000	± 3	300
Yellow	4	4	4	10,000	± 4	400
Green	5	5	5	100,000	± 5	500
Blue	6	6	6	1,000,000	± 6	600
Violet	7	7	7	10,000,000	± 7	700
Gray	8	8	8	100,000,000	± 8	800
White	9	9	9	1,000,000,000	± 9	900
Gold	—	—	—	0.1	± 5	1,000
Silver	—	—	—	0.01	± 10	2,000
No Color	—	—	—	—	± 20	500

Resistor Color Code

RETMA STANDARD RS-172, REC-117 MILITARY STANDARD MIL-STD-221A



OLD



OLD

Color	1st Digit A	2nd Digit B	Multiplier C	Tolerance D
Black	0	0	1	—
Brown	1	1	10	—
Red	2	2	100	—
Orange	3	3	1,000	—
Yellow	4	4	10,000	—
Green	5	5	100,000	—
Blue	6	6	1,000,000	—
Violet	7	7	10,000,000	—
Gray	8	8	100,000,000	—
White	9	9	—	—
Gold	—	—	0.1	± 5%
Silver	—	—	0.01	± 10%
No Color	—	—	—	± 20%

OLD INSULATION CODING

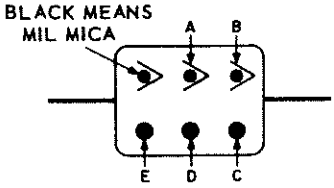
RETMA: Insulated resistors with axial leads are designated by a background of any color except black. The usual color is natural tan. Noninsulated resistors with axial leads are designated by a black background color.

MILITARY (MIL): Same as RETMA with the addition of: Noninsulated resistors with radial leads designated by a black background color or by a background the same color as the first significant figure of the resistance value.

Mica Capacitor Color Code

MILITARY STANDARD

SEE MIL-C-5A, -5B



Color	Digits of Capacitance (μμf) A	Digits of Capacitance (μμf) B	Multiplier C	Tolerance % D	Characteristic. See table below E
Black	0	0	1	± 20	—
Brown	1	1	10	—	B
Red	2	2	100	± 2	C
Orange	3	3	1,000	—	D
Yellow	4	4	—	—	E
Green	5	5	—	—	F
Blue	6	6	—	—	—
Violet	7	7	—	—	—
Gray	8	8	—	—	—
White	9	9	—	—	—
Gold	—	—	0.1	± 5	—
Silver	—	—	0.01	± 10	—

DESCRIPTION OF CHARACTERISTIC

Characteristic	*Temperature Coefficient (parts per million per °C)*	*Maximum Capacitance Drift*	*Minimum Insulation Resistance (megohms)*
B	Not specified	Not specified	7500
C	±200	±0.5%	7500
D	±100	±0.3%	7500
E	+100 −20	±(0.1% +0.1 μμf)	7500
F	+70	±(0.05% +0.1 μμf)	7500

VOLTAGE RATING

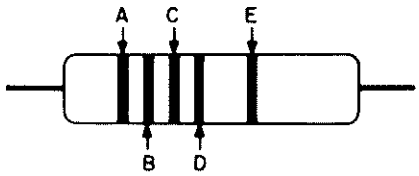
(If indicated by dimensions rather than color coding)

Maximum Inches Long	Wide	Thick	*Style CM*	*Capacitance (μμf)*	*Rating (v d-c)*
35/64	5/16	7/32	15	5–510	300/500
51/64	15/32	7/32	20	5–510 560–1000	500 300/500
1 7/64	15/32	7/32	25	51–1000	500
53/64	53/64	9/32	30	560–3300	500
53/64	53/64	11/32	35	3600–6200 6800–10,000	500 300
1 1/32	41/64	11/32	40	3300–8200 9100–10,000	500 300

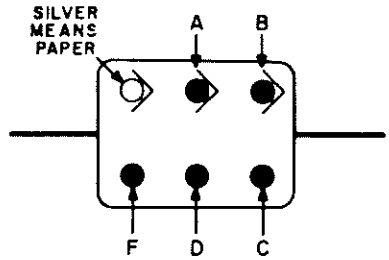
Paper Capacitor Color Code

MILITARY STANDARD MIL-C-91A

(Commercial codes are same except as noted)



Tubular Capacitors
(Commercial Only)



Rectangular Capacitors

Color	Digits of Capacitance ($\mu\mu$f) A	Digits of Capacitance ($\mu\mu$f) B	Multiplier C	Tolerance % D	Tubular Voltage Rating (v d-c) E	Temp. Rating °C and Characteristic F
Black	0	0	1	± 20	—	85-A
Brown	1	1	10	—	100	85-E
Red	2	2	100	—	200	—
Orange	3	3	1,000	± 30	300	—
Yellow	4	4	10,000	—	400	—
Green	5	5	—	—	500	—
Blue	6	6	—	—	600	—
Violet	7	7	—	—	700	—
Gray	8	8	—	—	800	—
White	9	9	—	—	900	—
Gold	—	—	—	—	1,000	—
Silver	—	—	—	± 10	—	—

VOLTAGE RATING FOR RECTANGULAR CAPACITORS

(Indicated by dimensions rather than color coding)

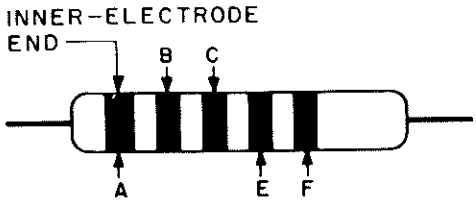
Maximum Dimensions (inches) Length	Width	Thickness	*Style CN*	*Capacitance ($\mu\mu$f)*	*Voltage Rating (v d-c)*
51/64	15/32	7/32	20	1000 2000–6000 10,000	400 200 120
57/64	37/64	17/64	22	2000–3000 6000–10,000 20,000	400 300 120
53/64	53/64	9/32	30	1000–2000 3000 6000–10,000 20,000	800 600 400 120
53/64	53/64	11/32	35	3000 6000–10,000 20,000	800 600 300
1 1/4	41/64	9/32	41	3000–6000 10,000 20,000 30,000	600 400 300 120
1 15/32	49/64	11/32	42	1000–6000 10,000–20,000 30,000 50,000 100,000	1000 600 400 300 120
1 15/32	49/64	13/32	43	10,000 20,000–30,000 50,000–100,000 200,000	1000 600 400 120

Ceramic Capacitor Color Code

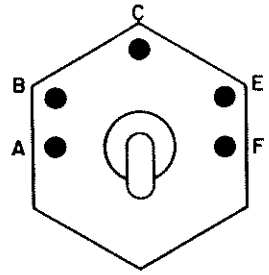
SEE EIA **STANDARD** RS-198

MILITARY STANDARD MIL-C-11015B,

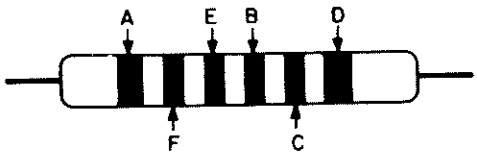
Mil-C-20C



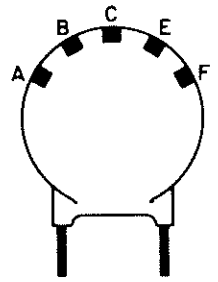
Tubular Capacitors
(Voltage rating is always 500 v.)



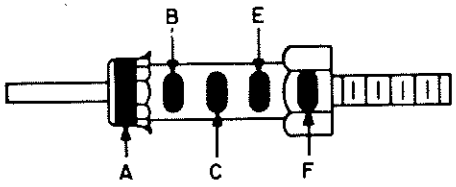
Feed Through Capacitors



Tubular Capacitors
(Old RMA)

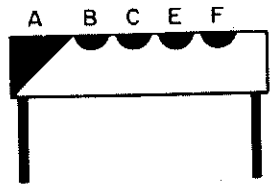


5-Dot Disc Capacitors
(EIA)
(Voltage rating is 500 v. or as marked)

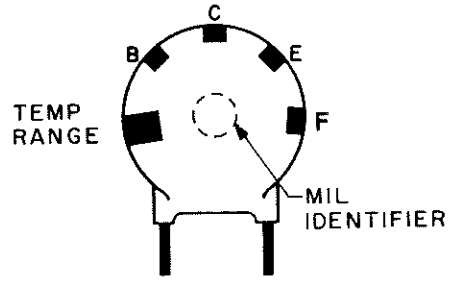


Stand-Off Capacitors
(RETMA ONLY)

5-Dot System

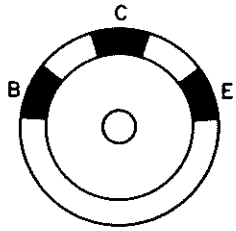


RADIAL LEAD



6 -Dot Disc Capacitors

(Voltage rating is always 500 v.,)



3-Dot Button Capacitors
RETMA ONLY

Color	Digits of Capacitance ($\mu\mu$f) B	C	D	Multiplier E	Tolerance F: 10 $\mu\mu$f or less ($\mu\mu$f)	Over 10 $\mu\mu$f (%)	Temp. Coef. A (Parts per million per °C.): EIA	MILITARY
Black	0	0	0	1	±2.0	±20*	0	0
Brown	1	1	1	10	±0.1*	±1	— 33	— 30
Red	2	2	2	100	±0.25**	±2	— 75	— 80
Orange	3	3	3	1,000	—	±3*	—150	—150
Yellow	4	4	4	10,000*	—	+100. 0*	—220	—220
Green	5	5	5	—	±0.5	±5	—330	—330
Blue	6	6	6	—	—	—	—470	—470
Violet	7	7	7	—	—	—	—750	—750
Gray	8	8	8	0.01	±0. 25*	+80 -20*	+150 to —1500	+ 30
White	9	9	9	0.1	± 1.0	±10	+100 to —750	+330*
Gold	—	—	—	—	—	—	—	+100

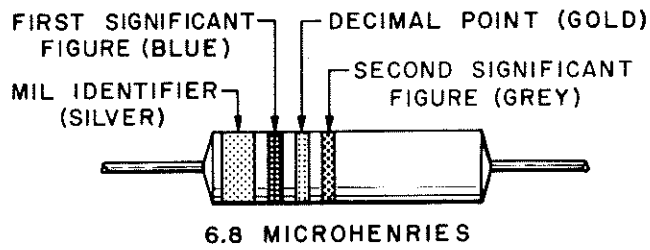
*EIA (formerly RETMA) **MIL-C-20C

COLOR CODING MOLDED CHOKE COILS
MIL-C-15305B

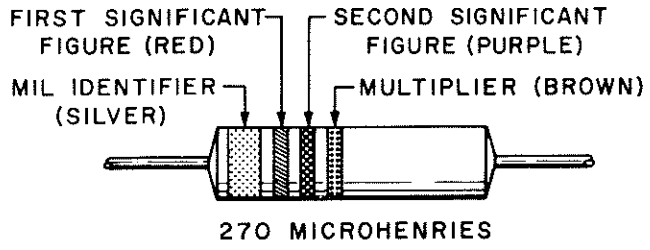
A silver band, greater in width than the other bands, near one end of the coil is the MIL identifier. The inductance value in microhenries is indicated by three additional bands. For inductance values of 10 microhenries or more, the color code is the same as for resistors. When either the first or second of the three bands is gold, the gold band represents the decimal point for inductance values less than 10. The other two colors represent the significant figures using the same digit values as for resistors.

For small chokes, dots may be used instead of bands as above.

EXAMPLES



6.8 MICROHENRIES



270 MICROHENRIES

It is significant to note that there have been isolated instances when, for no apparent reason, the manufacturer has not followed this marking code. If there is any question or doubt about the value of a choke, it should be checked by actual measurement on a suitable bridge.

1N DIODE TYPE AND POLARITY
PER EIA STANDARD RS 236, etc.

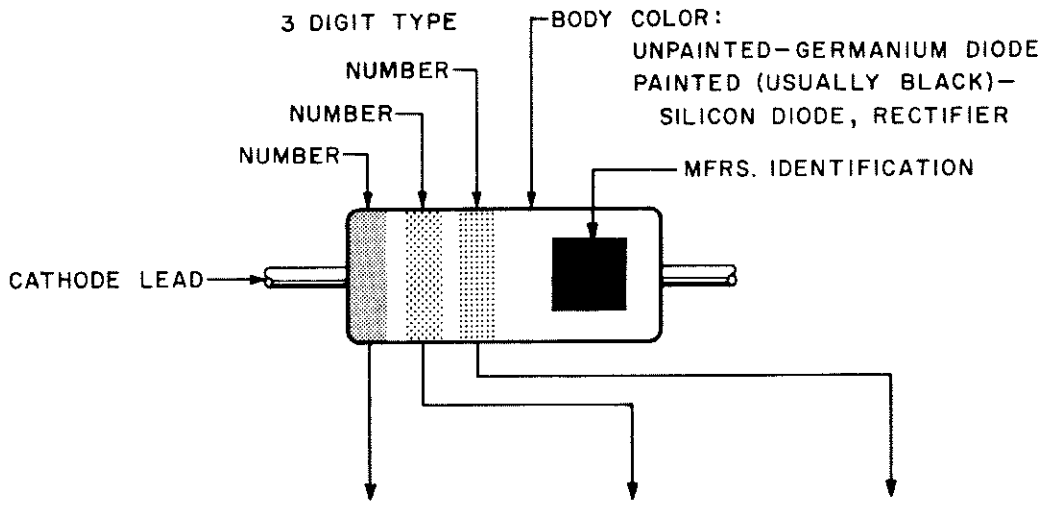
Types are identified by number or by colored bands which designate the JEDEC type number. Reading from the cathode end, the digits are represented by the same colors as in the resistor color code. If necessary to show a suffix letter, a band will follow the type number as follows:

Brown	A	Yellow	D
Red	B	Green	E
Orange	C	Blue	F

Four-digit type numbers are shown by four bands followed by a fifth, black, band. If a suffix letter is required, it will be indicated as the fifth band in place of the black band.

The cathode end is indicated by a double-width band as the first band; or bands should be grouped toward the cathode end. The cathode end may be indicated by a single band or by the bar of the diode symbol: Cathode —|◄— Anode.

Examples 2 or 3 DIGIT TYPES OF DIODES



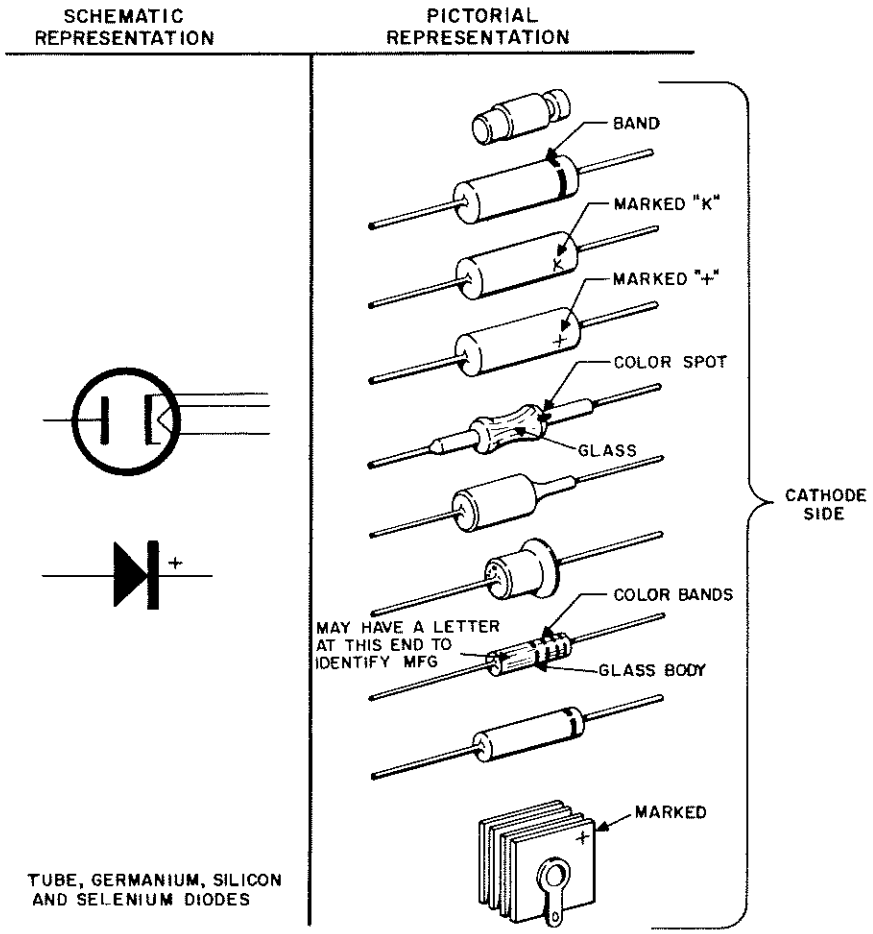
EIA Type	1st Band	2nd Band	3rd Band	4th Band
1N116	Brown - 1	Brown - 1	Blue - 6	
1N67A	Black - 0*	Blue - 6	Purple - 7	Brown - A

*Zero precedes two-digit EIA designation

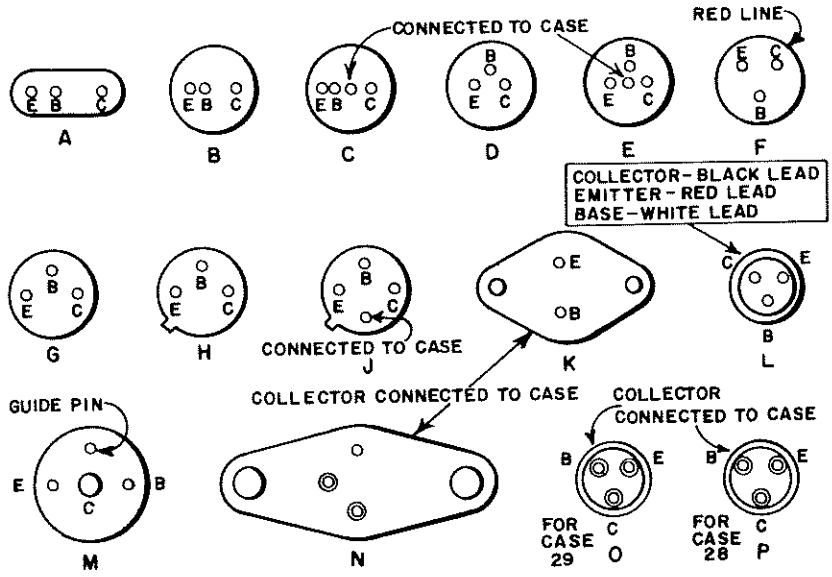
4 DIGIT TYPES OF DIODES

EIA Type	1st Band	2nd Band	3rd Band	4th Band	5th Band
1N1234A	Brown - 1	Red - 2	Orange - 3	Yellow - 4	Brown - A
1N1695	Brown - 1	Blue - 6	White - 9	Green - 5	Black - 0

TYPICAL DIODE POLARITY GUIDE



TRANSISTOR BASE DIAGRAMS



NOTE: MANY MANUFACTURERS CONNECT ONE OR ANOTHER OF THE LEADS TO THE CASE STRUCTURE, SO THE INDIVIDUAL TRANSISTOR SPECIFICATION SHEET SHOULD BE REFERRED TO BEFORE CONNECTING THE TRANSISTOR INTO A CIRCUIT, ESPECIALLY FOR BASE DIAGRAMS B, G, & H.

PART AND ASSEMBLY DESIGNATIONS

Alphabetically by Letters

General classes of parts are marked with an asterisk (*) to facilitate designation of parts not specifically included in this list. In case of doubt, a letter or letters already assigned to the class most similar in function should be used. Certain item names may apply to either a part or a subassembly. When the item is a subassembly, the letter "A" shall be used in lieu of the letters listed except in the case of wire and cable.

*A .... Assembly; subassembly.
AT .... Attenuator; pad; resistive termination.
*B .... Blower; fan; motor; prime mover; resolver; synchro.
BT .... Battery.
C ..... Capacitor, capacitance bushing, silicon diode voltage variable capacitor.
CB .... Circuit breaker.
CP .... Coupling (aperture, loop, or probe); coaxial or waveguide junction (tee or wye); adapter, connector.
CR .... Crystal detector; crystal diode; crystal unit; crystal, contact or metallic rectifier; selenium cell; varistor, asymmetrical.
D ..... Dynamotor, converter, inverter.
DC .... Directional coupler.
DL .... Delay line.
DP .... Diaphragm.
*DS ... Indicator; miscellaneous illuminating or indicating device (except meter or thermometer) such as: alarm, annunciator; audible or visual signalling device; bell; buzzer; drop; flasher; pilot, illuminating or signal lamp; telegraph sounder; telephone set ringer; vibrator (indicating) dials.
*E .... Miscellaneous electrical part such as: aerial; aluminum or electrolytic cell; antenna; armature assy, bimetallic strip; binding post; brush; carbon block; clips; cord tip; counterpoise; dipole antenna; electrical shield; electric contact; gap; individual terminal; insulator; lightning arrester; loop antenna; magnet; printed circuit boards; protector; resonator; short; slip ring; rotor; solenoid.
EQ .... Equalizer.
F ..... Fuse; fuse cutout.
FL .... Filter.
G ..... Exciter; generator; magneto; rotating amplifier; vibrator (interrupting), chopper.
*H .... Hardware; bolts; nuts; screws; etc.
HR .... Heater (element for thermostat, oven, etc.), heating lamp.
HS .... Handset.
HX .... Heat exchanger.
HT .... Headset; hearing aid; telephone receiver.
HY .... Hybrid coil; hybrid junction.
J ..... Connector, receptacle, electrical (with male, female, or male and female contacts and designed to be mounted on a bulkhead, wall, chassis or panel); jack; receptacle.
K ..... Relay (electrically operated contactor or switch).
L ..... Choke; inductor; loading coil; relay operating coil; retardation coil; solenoid; tuning coil; winding; reactor, filter; ferrite bead.
LS .... Loudspeaker; horn; howler; siren; speaker.
*M .... Meter; clock; counter (indicating device); elapsed time recorder; gauge; instrument; message register; oscillograph; oscilloscope; thermometer; timer.
MG .... Motor-generator.
MK .... Microphone; telephone transmitter.
*MP ... Miscellaneous mechanical part such as: bearing; coupling; gear; mechanical interlock; shaft; vibrator reed; gyroscope; structural part; window, observation; mounting (not in electrical circuit and not a socket); air filter.
MR .... Magnetic reactor.
MT .... Mode transducer.
N ..... Plate, identification; chart; nameplate; etc.
O ..... Knob.

P ..... Connector, plug, electrical (with male, female, or male and female contacts, constructed to be affixed to the end of a cable, conduit, coaxial line, cord or wire).
PU .... Pickup; erasing head; recording head; reproducing head.
Q ..... Transistor.
R ..... Resistor; shunt; resistor, variable; potentiometer; rheostat, dummy load.
RP .... Repeater.
RT .... Current regulating resistor; ballast tube; ballast lamp; resistance lamp; thermistor.
RV .... Symmetrical varistor.
S ..... Switch (mechanically or thermally operated); contactor; disconnecting device; dial (circuit interrupter); electrical safety interlock; governor switch; speed regulator; telegraph key; thermal cutout; thermostat.
T ..... Transformer; autotransformer; IF transformer; repeating coil (telephone usage); transformer; waveguide or coaxial taper; induction coil (telephone usage).
TB .... Terminal board; connecting block; group of individual terminals on its own mounting; terminal strip; test block.
TC .... Thermocouple.
**TP .. Test point.
*U .... Hydraulic part.
V ..... Electron tube; barrier photocell; blocking layer cell; light-sensitive cell; photoemissive cell; phototube, photoconductive cell.
VR .... Voltage regulator (except an electron tube).
*W .... Cable; coaxial cable; guided transmission path; waveguide; wire.
X ..... Socket; fuseholder (see note 2) lampholder.
Y ..... Oscillator (excluding electron tube used as an oscillator); piezoelectric crystal; magnetostriction oscillator.
Z ..... Artificial line; discontinuity; tuned cavity; tuned circuit; network; mode suppressor.

**Not a reference designation, but included in this listing to permit usage in connection with reference designations, where required.

Note 1. TERMINALS. The letter "E" shall not be used to identify terminals of such parts as sockets, terminal boards, transformers, etc., where terminal numbers are assigned and no confusion will result.

Note 2. SOCKETS. A socket or fuseholder which is always associated with a single particular part or subassembly, such as an electron tube, fuse, or printed circuit board (not containing a separate electrical connector), shall be identified by a composite reference designation which includes the class letter "X" and the letter (s) and number which identify the associated part. For example, the fuse holder for fuse F7 would be identified XF7, and the socket for electron tube 10V3 would be identified 10XV3, etc.

Note 3. CONNECTORS. When reference designations are required to identify cables and connectors, the reference designations of the movable connector and adapter shall be included in parentheses on drawings and diagrams, at the stationary connector marking. Whenever possible, the item number shall be the same for the stationary and the movable connectors.

Note 4. POTTED, EMBEDDED OR HERMETICALLY SEALED SUBASSEMBLIES. A potted, embedded, or hermetically sealed subassembly ordinarily replaced as a single item of supply shall be treated as a subassembly for reference designation marking purposes.

CONVERSION TABLES

To Convert	Into	Multiply By	Conversely Multiply By
Calories	Btu	3.97×10^{-3}	252
Calories (mean)	Watt-seconds	4.186	0.2389
Centigrade	Fahrenheit	X 9/5, add 32°	Sub. 32°, X 5/9
Chains	Feet	66	1.515×10^{-2}
Cubic feet	Gallons (U.S.)	7.481	0.1337
Cubic inches	Gallons (U.S.)	4.329×10^{-3}	231
Gallons (U.S.)	Gallons (Brit)	0.8327	1.201
Grains (for humidity)	Pounds (Avoir)	1.429×10^{-4}	7000
Grams	Grains	15.43	6.481×10^{-2}
Grams	Ounces (Avoir)	3.527×10^{-2}	28.35
Inches	Centimeters	2.540	0.3937
Kilowatt-hours	Btu	3413	3.930×10^{-4}
Knots	Miles per hour	1.1508	0.8690
Meters	Yards	1.094	0.9144
Miles per hour	Feet per minute	88	1.136×10^{-2}
Ounces (fluid)	Quarts	3.125×10^{-2}	32
Ounces (avoir)	Pounds	6.25×10^{-2}	16
Pounds of water	Gallons	0.1198	8.347
Watts	Horsepower	1.341×10^{-3}	745.7

INCANDESCENT LAMPS FOR INDICATOR LIGHTS

Size	Base Type	Commercial Number	Voltage (D.C.)	Current (Amps)
T-1	Wire Leads	680	5.0	0.060
T-1	Wire Leads	683	5.0	0.060
T-1	Wire Leads	715	5.0	0.115
T-1	Wire Leads	683AS15	5.0	0.060
T-1	Wire Leads	715AS15	5.0	0.115
T-1	Flange	682	5.0	0.060
T-1	Flange	685	5.0	0.060
T-1	Flange	718	5.0	0.115
T-1	Flange	685AS15	5.0	0.060
T-1	Flange	718AS15	5.0	0.115
T-1-3/4	Flange	338	2.7	0.060
T-1-3/4	Flange	328	6.0	0.200
T-1-3/4	Flange	330	14.0	0.080
T-1-3/4	Flange	327	28.0	0.040
T-1-3/4	Flange	328AS15	6.0	0.200
T-1-3/4	Flange	327AS15	28.0	0.040
T-2	Flange	6C	6.0	0.045
T-2	Flange	12A	12.0	0.120
T-2	Flange	24A	24.0	0.035
T-2	Flange	48C	48.0	0.042
T-3-1/4	Bayonet	48	2.0	0.060
T-3-1/4	Bayonet	47	6.3	0.150
T-3-1/4	Bayonet	1816	13.0	0.330
T-3-1/4	Bayonet	313	28.0	0.170
T-3-1/4	Bayonet	1822	36.0	0.100
T-3-1/4	Bayonet	1835	55.0	0.050
S-6	Bayonet	6S6/1DC	120	0.050
S-6	Screw	6S6/3	120	0.050

GAS FILLED GLOW LAMPS

Base Type	Commercial Number	Voltage (RMS)	External Resistance Required	Watts
Wire Leads	NE-2A	115	200,000	1/25
		230	560,000	
Wire Leads	NE-2H	115	25,000	1/4
		230	90,000	
Flange	NE-2D	115	100,000	1/25
Flange	NE-2J	115	35,000	1/4
Bayonet	NE-51	115	200,000	1/25
Bayonet	NE-51H	115	25,000	1/4

Further information may be found in Collins Component Standards.

STANDARD METAL GAUGES

Gauge No.	American or B & S[1]	U.S. Standard[2]	Birmingham or Stubs[3]
1	.2893 inch	.28125 inch	.300 inch
2	.2576	.265625	.284
3	.2294	.25	.259
4	.2043	.234375	.238
5	.1819	.21875	.220
6	.1620	.203125	.203
7	.1443	.1875	.180
8	.1285	.171875	.165
9	.1144	.15625	.148
10	.1019	.140625	.134
11	.09074	.125	.120
12	.08081	.109375	.109
13	.07196	.09375	.095
14	.06408	.078125	.083
15	.05707	.0703125	.072
16	.05082	.0625	.065
17	.04526	.05625	.058
18	.04030	.05	.049
19	.03589	.04375	.042
20	.03196	.0375	.035
21	.0284	.034375	.032
22	.02535	.03125	.028
23	.02257	.028125	.025
24	.02010	.025	.022
25	.01790	.021875	.020
26	.01594	.01875	.018
27	.01420	.0171875	.016
28	.01264	.015625	.014
29	.01126	.0140625	.013
30	.01003	.0125	.012
31	.008928	.0109375	.010
32	.007950	.01015625	.009
33	.007080	.009375	.008
34	.006350	.00859375	.007
35	.005615	.0078125	.005
36	.005000	.00703125	.004
37	.004453	.006640626	--
38	.003965	.00625	--
39	.003531	---	--
40	.003145	---	--

[1] Used for copper, brass and nonferrous alloy sheets, wire and rods.

[2] Used for iron, steel, nickel and ferrous alloy sheets, wire and rods.

[3] Used for seamless tubes; also, by some manufacturers for copper and brass.

OHM'S LAW AND ELECTRICAL POWER

1. $I\ (\text{amperes}) = \frac{E\ (\text{volts})}{R\ (\text{ohms})}$
2. $E = IR$
3. $R = \frac{E}{I}$
4. $P\ (\text{power}) = \frac{E^2}{R}$
5. $P = I^2R$

NUMBERED DRILL SIZES

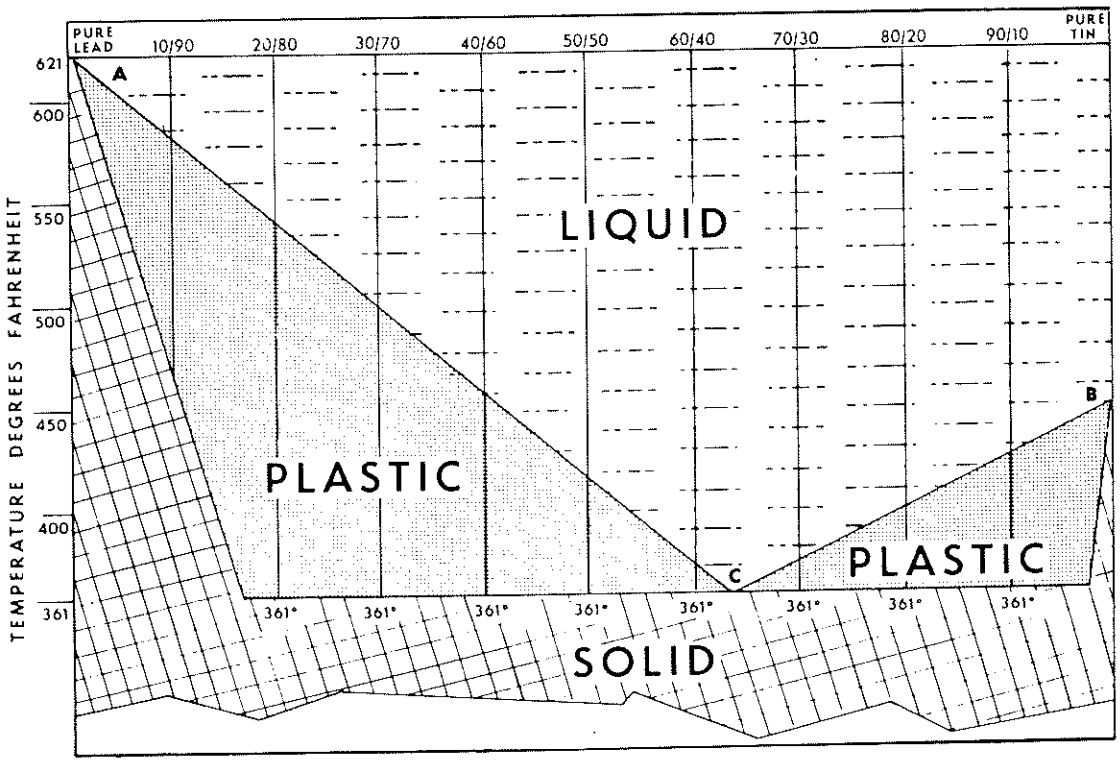
Number	Diameter (mils)	Will Clear Screw	Use for Tapping Iron, Steel, or Brass*
1	228.0	-	-
2	221.0	12-24	-
3	213.0	-	14-24
4	209.0	12-20	-
5	205.0	-	-
6	204.0	-	-
7	201.0	-	-
8	199.0	-	-
9	196.0	-	-
10	193.5	10-32	-
11	191.0	10-24	-
12	189.0	-	-
13	185.0	-	-
14	182.0	-	-
15	180.0	-	-
16	177.0	-	12-24
17	173.0	-	-
18	169.5	8-32	-
19	166.0	-	12-20
20	161.0	-	-
21	159.0	-	10-32
22	157.0	-	-
23	154.0	-	-
24	152.0	-	-
25	149.5	-	10-24
26	147.0	-	-
27	144.0	-	-
28	140.0	6-32	-
29	136.0	-	8-32
30	128.5	-	-
31	120.0	-	-
32	116.0	-	-
33	113.0	4-36, 4-40	-
34	111.0	-	-
35	110.0	-	6-32
36	106.5	-	-

* Use one size larger for tapping Bakelite and hard rubber.

NUMBERED DRILL SIZES (Cont)

Number	Diameter (mils)	Will Clear Screw	Use for Tapping Iron, Steel, or Brass*
37	104.0	-	-
38	101.5	-	-
39	099.5	3-48	-
40	098.0	-	-
41	096.0	-	-
42	093.5	-	4-36, 4-40
43	089.0	2-56	-
44	086.0	-	-
45	082.0	-	3-48
46	081.0	-	-
47	078.5	-	-
48	076.0	-	-
49	073.0	-	2-56
50	070.0	-	-
51	067.0	-	-
52	063.5	-	-
53	059.5	-	-
54	055.0	-	-

* Use one size larger for tapping Bakelite and hard rubber.



TIN-LEAD FUSION DIAGRAM

TYPICAL DIELECTRIC CONSTANTS AND BREAKDOWN VOLTAGES

Material	Dielectric Constant at 1 Mc	Puncture Voltage*
Air	1.0	
Alsimag 196	5.7	240
Bakelite	4.4-5.4	300
Bakelite (mica-filled)	4.7	325-375
Cellulose acetate	3.3-3.9	250-600
Fiber	5-7.5	150-180
Formica	4.6-4.9	450
Glass (window)	7.6-8	200-250
Glass (pyrex)	4.8	335
Lucite	2.5-3	480-500
Mica, ruby	5.4	3800-5600
Mica (clear India)	6.4-7.5	600-1500
Mycalex	7.4	250
Paper, royal gray	3.0	200
Polyethylene	2.3-2.4	1000
Polystyrene	2.4-2.9	500-700
Porcelain	5.1-5.9	40-100
Quartz, fused	3.8	1000
Rubber (hard)	2-3.5	450
Steatite (low-loss)	4.4	150-315
Wood (dry oak)	2.5-6.8	
Teflon	2.1	1000-2000

*In volts per mil (0.001 inch).

This table should be used for general reference or a comparative guide only. Specific values are determined by the applicable material specifications.

COPPER-WIRE TABLE

Wire Size AWG (B & S)	Diam in Mils	Circular Mil Area	Coil Turns per Linear Inch				Feet per Lb		Ohms per 1000 ft 25°C	Diam in mm
			Enamel (Ena)	SSC	DSC or SCC	DCC	Bare	DCC		
1	289.3	83690	-	-	-	-	3.947	-	.1264	7.348
2	257.6	66370	-	-	-	-	4.977	-	.1593	6.544
3	229.4	52640	-	-	-	-	6.276	-	.2009	5.827
4	204.3	41740	-	-	-	-	7.914	-	.2533	5.189
5	181.9	33100	-	-	-	-	9.980	-	.3195	4.621
6	162.0	26250	-	-	-	-	12.58	-	.4028	4.115
7	144.3	20820	-	-	-	-	15.87	-	.5080	3.665
8	128.5	16510	7.6	-	7.4	7.1	20.01	19.6	.6405	3.264
9	114.4	13090	8.6	-	8.2	7.8	25.23	24.6	.8077	2.906
10	101.9	10380	9.6	-	9.3	8.9	31.82	30.9	1.018	2.588
11	90.74	8234	10.7	-	10.3	9.8	40.12	38.8	1.284	2.305
12	80.81	6530	12.0	-	11.5	10.9	50.59	48.9	1.619	2.053
13	71.96	5178	13.5	-	12.8	12.0	63.80	61.5	2.042	1.828
14	64.08	4107	15.0	-	14.2	13.8	80.44	77.3	2.575	1.628
15	57.07	3257	16.8	-	15.8	14.7	101.4	97.3	3.247	1.450
16	50.82	2583	18.9	18.9	17.9	16.4	127.9	119	4.094	1.291
17	45.26	2048	21.2	21.2	19.9	18.1	161.3	150	5.163	1.150
18	40.30	1624	23.6	23.6	22.0	19.8	203.4	188	6.510	1.024
19	35.89	1288	26.4	26.4	24.4	21.8	256.5	237	8.210	.9116
20	31.96	1022	29.4	29.4	27.0	23.8	323.4	298	10.35	.8118
21	28.46	810.1	33.1	32.7	29.8	26.0	407.8	370	13.05	.7230
22	25.35	642.4	37.0	36.5	34.1	30.0	514.2	461	16.46	.6438
23	22.57	509.5	41.3	40.6	37.6	31.6	648.4	584	20.76	.5733
24	20.10	404.0	46.3	45.3	41.5	35.6	817.7	745	26.17	.5106
25	17.90	320.4	51.7	50.4	45.6	38.6	1031	903	33.00	.4547
26	15.94	254.1	58.0	55.6	50.2	41.8	1300	1118	41.62	.4049
27	14.20	201.5	64.9	61.5	55.0	45.0	1639	1422	52.48	.3606
28	12.64	159.8	72.7	68.6	60.2	48.5	2067	1759	66.17	.3211
29	11.26	126.7	81.6	74.8	65.4	51.8	2607	2207	83.44	.2859
30	10.03	100.5	90.5	83.3	71.5	55.5	3287	2534	105.2	.2546
31	8.928	79.70	101	92.0	77.5	59.2	4145	2768	132.7	.2268
32	7.950	63.21	113	101	83.6	62.6	5227	3137	167.3	.2019
33	7.080	50.13	127	110	90.3	66.3	6591	4697	211.0	.1798
34	6.305	39.75	143	120	97.0	70.0	8310	6168	266.0	.1601
35	5.615	31.52	158	132	104	73.5	10480	6737	335.0	.1426
36	5.000	25.00	175	143	111	77.0	13210	7877	423.0	.1270
37	4.453	19.83	198	154	118	80.3	16660	9309	533.4	.1131
38	3.965	15.72	224	166	126	83.6	21010	10666	672.6	.1007
39	3.531	12.47	248	181	133	86.6	26500	11907	848.1	.0897
40	3.145	9.88	282	194	140	89.7	33410	14222	1069	.0799

WEIGHTS AND MEASURES

Liquid Measure

1 (U. S.) gallon = 0. 1337 cu ft = 231 cu in. = 4 qt = 8 pints
1 quart = 2 pints = 8 gills
1 British gallon = 1. 2009 U. S. gallon

Avoirdupois Weight

1 pound = 16 ounces = 7000 grains
1 ounce = 16 drams = 437. 5 grains

Troy Weight

1 pound = 12 ounces = 5760 grains
1 ounce = 20 pennyweights = 480 grains
1 pennyweight = 24 grains
1 carat = 3. 086 grains
1 grain Troy = 1 grain Avoir = 1 grain Apothecaries

Apothecaries Weight

1 pound = 12 ounces - 5760 grains
1 ounce = 8 drams - 480 grains
1 dram = 3 scruples = 60 grains
1 scruple = 20 grains

PHYSICAL PROPERTIES OF METALS

MATERIAL	RESISTIVITY COMPARED TO COPPER	THERMAL CONDUCTIVITY	LINEAR COEFFICIENT OF EXPANSION $1/1/°C \times 10^{-6}$
Aluminum	1.70	.504 at 18°C	23.8 (20-100°C)
Alloy 42 (Nickel-Iron)	38.40	.030 at 18°C	5.3 (25-400°C)
Alloy 52 (Nickel -Iron)	25.70	.053 at 18°C	9.5 (25-500°C)
Brass	3.57	.260 at 17°C	18.9 at 20°C
Beryllium Copper	6.00	.430 at 18°C	16.8
Cadmium	5.26	.222 at 18°C	28.8 at 20°C
Chromium	1.82	.16 at 20°C	6.8 (20-100°C)
Copper (hard-drawn)	1.12	.918 at 18°C	16.8 (25-100°C)
Copper (annealed)	1.00	.918 at 18°C	16.8 (25-100°C)
Dumet	6.7	.030 at 18°C	6.5 axially (25-400°C)
Iron (pure)	5.65	.161 at 18°C	9.07 (-190 to +17°C)

PHYSICAL PROPERTIES OF METALS (Cont)

MATERIAL	RESISTIVITY COMPARED TO COPPER	THERMAL CONDUCTIVITY	LINEAR COEFFICIENT OF EXPANSION $1/1/^{\circ}C \times 10^{-6}$
Kovar	28.4	.046 at 18°C	5.71 (20-500°C)
Lead	14.3	.083 at 18°C	29.40 (18-100°C)
Nickel	6.25-833	.142 at 18°C	12.79 at 40°C
Phosphor bronze	2.78		16.8 (0-85°C)
Silver	0.94	.974 at 18°C	18.8 at 20°C
Tin	7.70	.155 at 18°C	26.92 (20-100°C)
Zinc	3.54	.265 at 18°C	26.28 (10-100°C)

Thermal conductivity is given as the heat in calories which is transmitted per second through a plate one centimeter thick across an area of one square centimeter when temperature difference is one degree centigrade.

$$\frac{\text{cm} \times \text{cal/sec}}{\text{cm}^2 \times {}^{o}\text{C}}$$

DECIMAL EQUIVALENTS OF FRACTIONS

.015625	1/64	.265625	17/64	.515625	33/64	.765625	49/64
.03125	1/32	.28125	9/32	.53125	17/32	.78125	25/32
.046875	3/64	.296875	19/64	.546875	35/64	.796875	51/64
.0625	1/16	.3125	5/16	.5625	9/16	.8125	13/16
.078125	5/64	.328125	21/64	.578125	37/64	.828125	53/64
.09375	3/32	.34375	11/32	.59375	19/32	.84375	27/32
.109375	7/64	.359375	23/64	.609375	39/64	.859375	55/64
.125	1/8	.375	3/8	.625	5/8	.875	7/8
.140625	9/64	.390625	25/64	.640625	41/64	.890625	57/64
.15625	5/32	.40625	13/32	.65625	21/32	.90625	29/32
.171875	11/64	.421875	27/64	.671875	43/64	.921875	59/64
.1875	3/16	.4375	7/16	.6875	11/16	.9375	15/16
.203125	13/64	.453125	29/64	.703125	45/64	.953125	61/64
.21875	7/32	.46875	15/32	.71875	23/32	.96875	31/32
.234375	15/64	.484375	31/64	.734375	47/64	.984375	63/64
.25	1/4	.5	1/2	.75	3/4	1.	1

FRACTIONS OF AN INCH TO MILLIMETERS

	mm		mm		mm		mm
1/64	.397	9/64	3.572	17/64	6.747	25/64	9.922
1/32	.794	5/32	3.969	9/32	7.144	13/32	10.319
3/64	1.191	11/64	4.366	19/64	7.541	27/64	10.716
1/16	1.588	3/16	4.763	5/16	7.938	7/16	11.113
5/64	1.984	13/64	5.159	21/64	8.334	29/64	11.509
3/32	2.381	7/32	5.556	11/32	8.731	15/32	11.906
7/64	2.778	15/64	5.953	23/64	9.128	31/64	12.303
1/8	3.175	1/4	6.350	3/8	9.525	1/2	12.700

SUGGESTED MAXIMUM TORQUE VALUES FOR FASTENERS OF DIFFERENT MATERIALS

Bolt Size	Low Carbon Steel	18-8 St. St.	Brass	Silicon Bronze	Aluminum 24ST-4	316 St. St.	Monel
	in.-lbs.	in.-lbs.	in.-lbs.	in.-lbs.	in.-lbs.	in.-lbs.	in.-lbs.
2-56	2.2	2.5	2.0	2.3	1.4	2.6	2.5
2-64	2.7	3.0	2.5	2.8	1.7	3.2	3.1
3-48	3.5	3.9	3.2	3.6	2.1	4.0	4.0
3-56	4.0	4.4	3.6	4.1	2.4	4.6	4.5
4-40	4.7	5.2	4.3	4.8	2.9	5.5	5.3
4-48	5.9	6.6	5.4	6.1	3.6	6.9	6.7
5-40	6.9	7.7	6.3	7.1	4.2	8.1	7.8
5-44	8.5	9.4	7.7	8.7	5.1	9.8	9.6
6-32	8.7	9.6	7.9	8.9	5.3	10.1	9.8
6-40	10.9	12.1	9.9	11.2	6.6	12.7	12.3
8-32	17.8	19.8	16.2	18.4	10.8	20.7	20.2
8-36	19.8	22.0	18.0	20.4	12.0	23.0	22.4
10-24	20.8	22.8	18.6	21.2	13.8	23.8	25.9
10-32	29.7	31.7	25.9	29.3	19.2	33.1	34.9
1/4"-20	65.0	75.2	61.5	68.8	45.6	78.8	85.3
1/4"-28	90.0	94.0	77.0	87.0	57.0	99.0	106.0
5/16"-18	129	132	107	123	80	138	149
5/16"-24	139	142	116	131	86	147	160
3/8"-16	212	236	192	219	143	247	266
3/8"-24	232	259	212	240	157	271	294
7/16"-14	338	376	317	349	228	393	427
7/16"-20	361	400	327	371	242	418	451
1/2"-13	465	517	422	480	313	542	584
1/2"-20	487	541	443	502	328	565	613
9/16"-12	613	682	558	632	413	713	774
9/16"-18	668	752	615	697	456	787	855
5/8"-11	1000	1110	907	1030	715	1160	1330
5/8"-18	1140	1244	1016	1154	798	1301	1482
3/4"-10	1259	1530	1249	1416	980	1582	1832
3/4"-16	1230	1490	1220	1382	958	1558	1790
7/8"-9	1919	2328	1905	2140	1495	2430	2775
7/8"-14	1911	2318	1895	2130	1490	2420	2755
1"-8	2832	3440	2815	3185	2205	3595	4130
1"-14	2562	3110	2545	2885	1995	3250	3730
	ft.-lbs.	ft.-lbs.	ft.-lbs.	ft.-lbs.	ft.-lbs.	ft.-lbs.	ft.-lbs.
1-1/8"-7	340	413	337	383	265	432	499
1-1/8"-12	322	390	318	361	251	408	470
1-1/4"-7	432	523	428	485	336	546	627
1-1/4"-12	396	480	394	447	308	504	575
1-1/2"-6	732	888	727	822	570	930	1064
1-1/2"-12	579	703	575	651	450	732	840

This table of torque values is reprinted by courtesy of the H. M. Harper Company. The table is intended as a guide only. Tests were conducted on dry or near dry products. Mating parts were wiped clean of chips and foreign matter.

appendix B

-A-

ADAPTER - Any device used to enable a part or wire to fit where it was not originally intended.

ADJUSTABLE RESISTOR - A resistor whose resistance can be changed mechanically, often used as an adjustable voltage divider. This is not so easily varied as a variable resistor.

AIR CAPACITOR - A capacitor whose dielectric is air.

AIR CORE - Descriptive term for coils or transformers which have no iron in their magnetic circuits, used chiefly in radio frequency circuits.

AIR GAP - A path for passage of electric current or magnetic flux through air. Examples: The air gap in a spark gap; the spaces between sections of an iron-core transformer.

AIR GAP CRYSTAL HOLDER - A device consisting of two plates for holding a piezoelectric crystal such that a small air gap exists between the top plate and the crystal.

ALTERNATING CURRENT - Electric current as usually supplied by power lines. This is usually produced by rotating machines. The usual form is sinusoidal. Current flow from zero to maximum through zero to the opposite maximum and back to zero constitutes one cycle. The number of cycles per second (cps) is the frequency. Power frequencies are of the order of 60 cps, but the term a-c is used with other frequencies, often to distinguish varying currents from d-c components.

AMBIENT TEMPERATURE - The temperature of the medium surrounding an object, e.g., the temperature of the air surrounding a transistor. The term is often used to qualify specifications given for temperature-sensitive electronic components, such as transistors, capacitors, crystals, relays, etc.

AMPLIFICATION (ELECTRONIC) - The process of increasing the current, voltage and/or power of a signal usually produced by vacuum tube or transistor circuits.

AMPLIFIER - A device used to increase power, voltage, or current of a signal.

AMPLITUDE - Term used to describe the maximum value of a periodic wave or of a component of a complex wave. It is the largest or crest value measured from zero.

AMPLITUDE MODULATION - Modulating a carrier frequency current by varying its amplitude above and below normal value in step with the audio or video frequency being transmitted. The common system of radio broadcasting. Abbreviated as AM.

ANGLE OF LAG OR LEAD - Phase angle by which quantities such as voltages or currents, may follow or precede one another in time. These relations are often shown, in the cases of voltages or currents, by plotting the sinusoidal curves along an axis of angle or time. They may also be pictured by arrows (vectors) drawn at appropriate angles and with lengths corresponding to the values of the quantities. See LAG 2.

APPROXIMATE - A term generally used to estimate a value (dimension, size, quantity, etc.), based on limited data or a gauge of limited accuracy. Close to an actual or exact value. Not to be confused with the term "nominal."

BACKLASH - A form of mechanical hysteresis in which there is a lag, lost motion or slack between the application of a driving force and the response of the driven object. For example, if the knob of a tuning mechanism must be rotated several degrees before the dial pointer begins to move, the mechanism is said to have backlash. The presence of backlash is most evident when the direction of motion is reversed. Backlash is especially serious in precision systems such as gear trains in servo mechanisms.

BAND-PASS FILTER - A filter in which a frequency band is passed and all frequencies above and below this band are attenuated.

BANDSPREAD - Any method, mechanical or electronic, of increasing space on a tuning scale between stations otherwise crowded and difficult to tune.

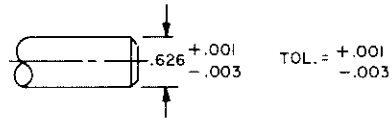
BANDWIDTH - A section of the frequency spectrum required to transmit the desired information, whether visual, aural, or both. The bandwidth of the average television channel is 6 mc; of a broadcast channel, 10 kc, which is 1/600 that of a television channel.

BASIC - A term used to define a size shown on the drawing. The tolerances, as specified, are measured from the basic size.

BATHTUB CAPACITOR - A capacitor enclosed in a metal can with rounded corners like a bathtub.

bel - Unit of relative audio power, named after Alexander Graham Bell, used to express differences in power amplitudes. Usually used is 1/10 bel, termed a decibel, and abbreviated db. See decibel.

BILATERAL TOLERANCE - Permissible variation from a desired dimension in both directions.



Plus and minus variations are not necessarily the same.

BLIND HOLE - A hole which penetrates only part way through a material.

BLOCK DIAGRAM - A simple line diagram in which functions, parts, subassemblies or equipments are represented by labeled (block or) blocks with the functional sequence indicated by means of arrow lines similar to flow charts.

BREADBOARD - Laboratory idiom for an experimental circuit setup exposed for ease of assembly, disassembly, and test.

BREAKDOWN VOLTAGE - The voltage at which the insulation between two conductors or parts will break down.

BROKEN CORNER OR EDGE - This term designates a definite bevel or rounding of corners and edges of parts. The size of break or rounding varies with the size of parts.

ASSEMBLY - A number of parts or subassemblies, or any combination thereof, joined together to perform a specific function. (Example: Audio Frequency Amplifier.)

Note: The distinction between an assembly and a subassembly is not always exact. An "assembly" may be called a "subassembly" when it forms a portion of an over-all assembly.

ATTENUATION - Reduction in strength as of an electrical impulse.

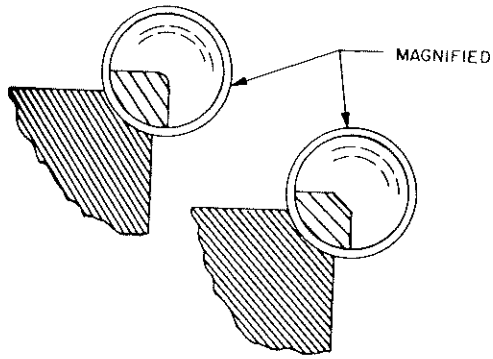
ATTENUATOR - A fixed or variable device (usually a type of potentiometer) which is used to reduce the amplitude of an input or output signal to or from an audio or radio frequency circuit. Attenuators are commonly used to control the output level of signal generators, to control the input level to oscilloscopes, and to control the audio level of broadcast programs.

AUDIO - Pertaining to currents or frequencies corresponding to normally audible sound waves.

AUDIO FREQUENCY - A frequency corresponding to the frequency of an audible sound wave. The extreme limits of audible frequencies vary with the individual and are from about 20 cycles to about 15,000 cycles per sound.

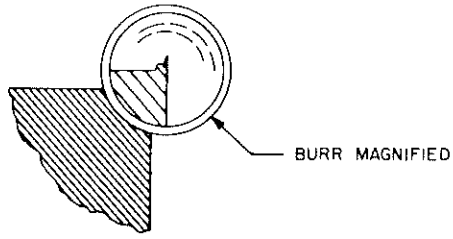
AUDIO FREQUENCY OSCILLATOR - A device which generates voltage, current or power at audio frequencies.

AUDIO TRANSFORMER - An iron-core transformer used to couple two audio circuits.



BUNCH STRANDING - A conductor of multiple strands, twisted together.

BURR - An undesired displacement of metal. It is usually a sharp uneven projection at the edges and corners of part.



BUS BAR - A rigid bar conductor mounted on suitable supports.

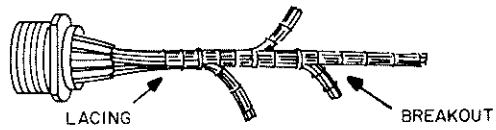
BUS (WIRE) - A short solid wire, bare or insulated.

-C-

CABLE - 1. An assembly of insulated wires protected by an outer insulating jacket. It may also have an outer braided shield. 2. A wiring harness or cable harness.

CABLE ASSEMBLY - An assembly of single or multiple insulated conductors secured together by cotton braid, shielding or other materials.

CABLE HARNESS - A cable with branches for connecting to a multiplicity of points. It may or may not be preformed but the wires are usually secured by lacing.



CALIBRATION - 1. Comparing an instrument, device, or dial with a standard to determine its accurary. 2. Devising a scale.

CAPACITANCE - The ability of a circuit element to store an electric charge. The quantity of electric charge which can be received by a system if insulated conductors from a potential source of unit value. (The term capacity was formerly used.) A capacitor does not become filled but will receive more charge with increasing potential until breakdown occurs. Theoretical unit of capacitance is the farad. A microfarad (uf) is one one-millionth 10^{-6} of a farad. A picofarad (pf) is one-one-millionth of a microfarad or 10^{-12} farads; also micromicrofarad.

CAPACITOR-INPUT FILTER - A filter in which a capacitor across the output of the rectifier precedes an inductor or a resistor. There may be several such elements. Voltage regulation with this type of filter is not as good as when using the inductor (choke) input filter. Capacitor input filters offer the advantage of about 55% greater output voltage from a given source than inductor input filters.

CAPACITOR - An electrical part consisting of two conducting surfaces separated from each other by an insulator such as air, oil, paper, glass, mica, or ceramic material. A capacitor is capable of storing electrical energy. Capacitors are used to block the flow of direct current while allowing alternating and pulsating currents to pass.

CARBON RESISTOR - A resistor made of carbon particles and a binder, usually molded into a cylindrical shape with leads attached to opposite ends.

CARRIER FREQUENCY - The frequency of an unmodulated radio wave produced by a transmitter. A broadcast station carrier frequency must be maintained within a few cycles of the frequency assigned by the Federal Communications Commission.

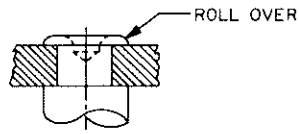
CHAMFER - This term is used to describe a definite bevel on the edge or corner of a part. Its most common use is in reference to edges on circular parts, such as a chamfer on the end of a shaft. The term BEVEL is used more commonly in reference to corners and straight edges.

CHOKE COIL - An inductor used to greatly reduce the flow of alternating current while allowing direct current to pass relatively freely. R-f choke coils have air or pulverized iron cores, while (audio frequency) a-f chokes have iron cores.

CIRCUIT - A path over which an electric current can flow when the path is complete.

CIRCUIT BREAKER - A device for opening a circuit if the current exceeds a predetermined value. It can be reset without being replaced.

CLINCHING - Term used to describe riveting with hollow point rivets (hollow point rivets and tenons are used to reduce the pressure required for single stroke riveting).



CLINCHING, (LEAD) - Bending of the lead (on the printed side of a board) to mechanically secure the part (to the board).

COAXIAL CABLE (COAX) - A solid or stranded conductor along the axis of a larger hollow conductor such as a braided shield or metal tube, with insulation between the two conductors.

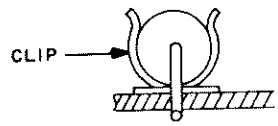
COIL - A number of turns of wire wound on an iron core, on a form made of insulating material, or by means of a mandrel so as to be self-supporting. A coil offers opposition to the passage of alternating current but little opposition to direct current.

COIL FORM - The tubing or solid object on which a coil is wound. Cardboard, fiber, or a plastic or ceramic materials are commonly used.

COILWINDER - A manually operated or power-driven mechanism for winding coils (used in radio and other electronic applications).

COLOR CODE - A system of colors used to identify the electrical value of a radio part or distinguish terminals or leads.

COMPONENT PART HOLDER - Clip, restraining wire or strap used to secure the part to a mounting surface.



CONCENTRIC-LAY CABLE - A multiple conductor cable composed of a central core surrounded by one or more layers of helically laid insulated conductors, successive layers being applied in opposite directions.

CONCENTRIC-LAY STRANDING - A stranded conductor composed of a central strand surrounded by one or more layers of helically laid strands.

CONDUCTANCE - A measure of ability to conduct electricity. In d-c circuits it is the reciprocal of resistance. In a-c circuits it is more strictly the resistance divided by the square of the impedance. Conductance is expressed in mhos. The symbol is G.

CONDUCTOR - 1. A wire or combination of wires that form a single electrical path. 2. That which offers little opposition to continuous current.

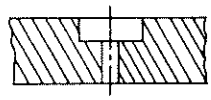
CONNECTION DIAGRAM - Wiring diagram.

CONNECTOR - A fitting used to join wires temporarily in an electrical circuit.

CORD - 1. A small flexible cable with insulation that will withstand wear. 2. A string.

CORES - Sand, plaster, or metal shapes placed in a mold to produce contours, recesses, cavities, openings, etc., in the cast or molded parts.

COUNTERBORE - A flat bottomed cylindrical enlargement from the mouth of a round hole to a given depth. Its center line coincides with that of the hole. (Should not be confused with spot-face.)



CRYSTAL - 1. A piece of natural quartz or similar piezoelectric material which has been ground to the proper size to produce natural vibrations at a desired radio frequency when set into vibration. A quartz crystal is used in radio transmitters to generate with a high degree of accuracy the assigned carrier frequency of a station and is used in crystal filters of radio receivers to improve the selectivity of the i-f amplifier. 2. The mineral used in a crystal detector.

CRYSTAL FILTER - A highly selective tuning circuit using a quartz crystal, sometimes used in the i-f amplifier of a communications receiver to improve selectivity so as to permit reception of a desired station even when there would otherwise be interference from stations of nearly the same frequency.

CURRENT - A movement of electrons through a conductor. Current is measured in amperes, in milliamperes and microamperes.

CUTOFF FREQUENCY - That frequency in a filter or other system at which most, if not all of the signal is attenuated.

-D-

db - Abbreviation for decibel.

db METER - A meter having a scale calibrated to read directly in decibel at a predetermined level and used to indicate volume levels.

DECIBEL - Unit of relative power, voltage or current. In electroacoustics, since the response of the ear is logarithmic (detectable change increases with level), the number of bels is defined as the logarithm of the ratio of the power level in question to that of the reference value. Since perhaps a tenth of this difference could be detected by the ear, a unit one-tenth as large is used: the decibel. The number of decibels is 10 log P_2/P_1 or 20 log E_2/E_1 or 20 log I_2/I_1.

DELAMINATION - Separation of layers as in the base material of a nonmetallic board.

DIELECTRIC - The insulating material between the plates of a capacitor, adjacent wires in a cable, or any two parts of an electronic circuit: generally air, mica, paper, plastics, oil, cloth, glass, or ceramic material.

DIELECTRIC CONSTANT - The relative permittivity of a dielectric material as compared to vacuum. It is measured by determining how many times greater the capacitance of a capacitor is with the dielectric between the plates than with air. Transformer oil has a dielectric constant of about 2; mica, of 5-6.

DIELECTRIC STRENGTH - Strength measured by the maximum voltage that a dielectric can withstand without breakdown (rupture). Also called insulating strength. Expressed in volts per mm, the dielectric strength of air is about 3,000, oil 16,000 and mica 50,000. May be stated in kilovolts per inch.

DIODE - A component having two electrodes, the cathode and the plate or anode, which allows more electrons to pass in one direction, from the cathode to the anode.

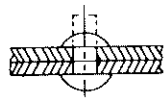
DISTORTION - Unfaithful reproduction of audio or video signals due to changes occurring in the wave form of the original signal, somewhere in the course it takes through the transmitting and receiving system. Classified as nonlinear (amplitude), frequency, and phase distortion.

DISTRIBUTED CAPACITANCE - Capacitance distributed between wires, between parts, between conducting elements themselves, or between the elements and ground, as distinguished from capacitance concentrated or lumped in a capacitor; usually applied to the capacitance between the turns of a coil.

DISTRIBUTED INDUCTANCE - The inductance that exists along the length of a conductor, as distinguished from inductance concentrated or lumped in a coil.

DRAFT - A relief slope or taper to facilitate the removal of the pattern from the mold.

DRIVING - Operation performed with solid rivets or tenons. (The tool has a hemispherical or similar depression to form the desired shape. High pressures are required for this operation.)



DUPLEX CABLE - Two insulated stranded conductors twisted together with a common insulating covering.

DUTCH BEND - A 180° bend (see illustration below).

-E-

ECCENTRICITY - The distance between centers of parts intended to be concentric.

ELECTRONICS - A broad term used to cover a field which deals with the use, characteristics, and properties of electrons, especially in vacuum or gas filled tubes or in semiconductors. For example, Radio, TV, Radar, control circuits.

EQUIPMENT GROUP - A collection of parts or assemblies which is a subdivision of a system but which is not capable of performing a complete operational function. (Example: Antenna Group, Indicator Group.)

EQUIVALENT - This term indicates mechanical as well as electrical interchangeability.

-F-

FACE RUNOUT - Deviation from squareness of face with respect to the axis of a turned part.

FARAD - Unit of capacitance. In the practical system of units the farad is too large for ordinary use, and capacity measurements are made in terms of microfarads and pico-farads. Both are commonly used in radio. See capacitance.

FIELD COIL - An insulated winding energized by direct current, and mounted on a field pole so as to magnetize it.

FILTER CAPACITOR - A capacitor used in a filter system to provide a low-reactance path for alternating currents.

FILTER CHOKE - An iron-core used in a filter system to pass steady direct current while offering high impedance to current pulsations or alternating currents.

FIXED CAPACITOR - A capacitor having a definite value that cannot be varied.

FIXED RESISTOR - A resistor having a definite value that cannot be varied.

FLASH - Excess material (metal, pressed powder or molding compound) left on the die casting or molding, at the parting line, resulting from leakage of material into vents and between mating die or mold surfaces.

FLAWS - Such defects as cracks, blowholes, checks, ridges, or scratches.

FLUX - 1. A material used to promote joining of metals in soldering or welding. Rosin is widely used as a flux in electronic soldering. 2. All the electric or magnetic lines of force in a region.

FREQUENCY - The number of complete cycles or vibrations per unit of time, usually per second. Frequency of a wave is equal to the velocity divided by the wavelength.

FREQUENCY BAND - A range of frequencies between two limiting frequencies.

FREQUENCY RESPONSE - The manner in which a circuit or device handles the different frequencies falling within its range. Thus, the frequency response of a high-fidelity amplifier may be specified as essentially flat or uniform between 20 and 20,000 cycles per second.

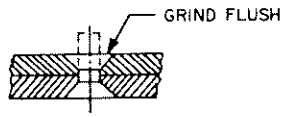
FREQUENCY-RESPONSE CURVE - A graph showing the frequency response of a radio or audio part, circuit, or system.

FUSE - A protective device containing a short piece of wire which melts and breaks when the current through it exceeds the rated value. Fuses are used to open the circuits automatically in case of serious overload, thereby preventing damage.

FUSE WIRE - Wire made from an alloy that melts at a relatively low temperature.

-G-

GRIND FLUSH - Term indicating an extra smoothing operation after riveting. This operation is performed only where a countersink is provided to nest the material at the riveted end.



GRINDING - Process of dressing, shaping or finishing surfaces by means of a rotating abrasive wheel. (This is accomplished by feeding the work against the revolving wheel or by feeding the revolving wheel against the work.)

GROUND - 1. A large conducting body such as the earth or a chassis. 2. A connection, intentional or accidental, between an electric circuit and ground. (def 1).

GROUND POTENTIAL - The potential of the chassis ground or earth. The chassis ground should be zero, as a safety measure.

GROUND WIRE - A conductor leading from electrical equipment or a part to a low resistance electrical connection with the earth or a vehicle frame.

-H-

HARMONIC - A frequency of sinusoidal wave, or alternating current that is an integral multiple of the fundamental frequency which may be called the first harmonic.

HEAT LOSS - Energy dissipated as heat.

HEAT SINK - Any device that absorbs and draws off heat from a hot object, radiating it into the surrounding atmosphere. Examples of heat sinks are metal radiators placed around tubes and semiconductors to permit them to operate at temperatures much higher than would ordinarily be possible, and metal clamps placed on the leads of components that are easily damaged by heat while being soldered into a circuit.

HERMETICALLY SEALED - Sealed so as to be airtight.

HIGH Q - Having a high ratio of reactance to effective resistance. The Q expresses coil efficiency.

HIGH-RESISTANCE VOLTMETER - A voltmeter having a resistance of 10,000 ohms per volt or higher, so that it draws little current from the circuit in which a measurement is made.

HONEYCOMB WINDING - A special type of coil winding, so designed as to keep distributed capacity at a minimum. Also called lattice winding. The winding resembles a basket-weave pattern.

HOT - Connected, alive, energized. Said of a wire, terminal, or any conductor having an appreciable voltage.

-I-

IMPEDANCE - The opposition that a circuit offers to the flow of alternating current or any other current variation at a particular frequency. Impedance, symbol Z, is a combination of resistance and reactance. The ohm is the unit of impedance.

IMPREGNATED - Having spaces filled with a dielectric such as paraffin, shellac, or varnish.

INDUCTANCE - That property of a coil or other wire which tends to prevent a change in current. Inductance is effective only on varying or alternating currents; it has no effect upon the steady flow of direct current. Inductance is measured in henrys.

INDUCTOR - A part with inductance as its important property. A coil.

IN PHASE - The condition existing when waves or current variations pass through their maximum and minimum values of like polarity simultaneously.

INPUT - 1. The current, voltage, or power that is fed into a circuit or device. 2. The terminals to which the incoming signal voltage is applied.

INPUT CAPACITANCE - The total capacitance at input terminals, as between the control grid and the cathode of a vacuum-tube circuit.

INPUT IMPEDANCE - The ratio between voltage and current at input terminals. Usually a coupling network is between the source and the load for optimum power transfer. Maximum power transfer is obtained with equal source and load or input impedances.

INSERTION LOSS - The ratio (expressed in decibels) of the power delivered before, to the power delivered after, the insertion of an apparatus in a transmission system.

INSULATED WIRE - An electric wire covered with a nonconducting material.

INSULATING STRENGTH - A measure of the ability of an insulating material to withstand electric stress without breakdown. Also called electric strength and dielectric strength.

INSULATION - A nonconductive material used to prevent shorting or leakage of electricity from or to a conductor. It may be plastic, rubber, glass, mica, ceramic, etc.

INSULATION RESISTANCE - The electric resistance of an insulating material.

INSULATOR - A device having high resistance, used for supporting or separating conductors so as to prevent undesired flow of current between conductors or to persons.

INTERCONNECTION DIAGRAM - A diagram of wire, cable or conduit connections between units of an over-all installation by means of labeled blocks which indicate separate units. Delineation of points of connection may be made at edge of the blocks.

-J-

JACK - A stationary receptacle usually providing for 1, 2 or 3 temporary connections, often associated with telephone equipment.

JUMPER - A short length of conductor used to make an electrical connection.

JUNCTION - 1. A point in a circuit where two or more wires are connected. 2. A point in an electrical network at which three or more conductors meet.

-K-

KILO - Metric prefix meaning 1000.

KILOCYCLE - One thousand cycles. Abbreviated kc. Also one thousand cycles per second.

KILOHM - Unit of resistance, equal to 1000 ohms.

KNURLS - Small protuberances in the form of ridges or beads on a cylindrical surface. (General purpose of knurling is to provide an extra grip on the surface. Also used for decorative purposes.)

-L-

LAG - 1. A delay in the recording or indicating of any device with respect to the conditions being measured or reproduced. 2. Of two alternating electrical quantities of the same frequency, the one that reaches a particular cyclic point later lags the others.

LAMINATED - A type of construction widely used for the cores of iron core transformers, choke coils, electromagnets, motors and generators. It involves building up the desired thickness and shape of core with thin strips of a magnetic materials such as soft iron or silicon steel.

LAMINATED CORE - An iron core for a coil, transformer, armature, etc., built up from laminations of iron or steel.

LAMINATION - A single sheet of material used in making a laminated object, such as a transformer core or printed circuit board.

LAY - A term used to describe the amount of advance of any point in a strand for one complete turn in a stranded conductor. (The looser the twist, the greater the strength and flexibility.)

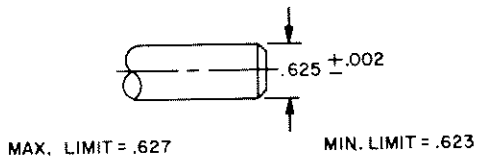
LEAD - A lead is a bare or insulated wire conductor, stranded or solid, which is a part of a component part, and used for making a connection.

LEAD-COVERED WIRE - One or more solid or stranded insulated wires with an over-all sheathing of extruded lead.

LEAKAGE RESISTANCE - The resistance of the path over which leakage current flows. It is normally a high value, as between electrodes in a vacuum tube.

LEAKY - A condition in which the resistance has dropped so much below its normal value that excessive leakage current flows. A common capacitor defect.

LIMITS - The minimum and maximum permissible dimensions of a part, considering the tolerance.



LITZ WIRE - A group of fine wires individually coated with thin insulation, braided or twisted, to reduce radio-frequency resistance; the braided or twisted conductors are covered with an over-all insulation to maintain the cross-sectional shape and furnish mechanical protection during winding.

LOSS - Energy dissipated without accomplished useful work.

LOW CAPACITANCE (COAX) CABLE - A solid or stranded inner conductor shielded cable, usually designed to a specific capacitance, with the inner conductor running through the axis of the shielding with a low dielectric insulation between the two conductors.

LUG - 1. A small strip of metal held by a screw or riveted to an insulating material to provide a convenient means for making a soldered wire connection. 2. An earlike projection.

-M-

ma - Abbreviation for milliampere.

MACHINE FINISH - Indicates a surface produced by machine tools. Does not refer to a surface produced by casting, drawing or rolling operations.

MAGNET - A body which attracts iron and steel, and if free to rotate, sets itself in a definite direction due to the influence of the earth's magnetic field.

MASKING - Protection of certain areas from finish or coating applications by means of a covering.

MEGA - Prefix denoting one million.

MEGACYCLE - One million cycles per second, abbreviated mc.

MEGGER - A high-range ohmmeter having a built-in hand-driven generator as a direct-voltage source, used for measuring insulation resistance.

MEGOHM - One million ohms. Abbreviated meg.

mfd - Older abbreviation for microfarad. Usually written uf.

mh - Abbreviation for millihenry.

MICA - A transparent flaky mineral which splits readily into thin sheets and has excellent insulating and heat-resisting qualities. It is used extensively to separate the plates of capacitors, to insulate electrode elements of vacuum tubes, and for many other insulating purposes in radio.

MICA CAPACITOR - A type of fixed capacitor with mica as the dielectric material.

MICRO - A prefix meaning one millionth of. Often designated by the Greek letter μ (mu) in abbreviations.

MICROVOLT - One millionth of a volt.

MILLI - A prefix meaning one thousandth of.

MILLING - A machine operation whereby metal is removed by a revolving cutter.

MOLDED CAPACITOR - A capacitor encased in a molded plastic material to keep out moisture and insulate.

MULTIMETER - A test instrument having a number of different ranges for measuring voltage, current, and resistance. Multitester. Volt-ohm-milliammeters are typical.

MULTIPLE CONDUCTOR CABLE - A combination of insulated conductors with or without a common insulating covering.

-N-

NEGATIVE - A term used to describe the terminal of a pair which has more electrons. Electrons flow out of the negative terminal of a voltage source.

NETWORK - 1. A system of interconnected resistors, inductors, and capacitors, or any combination thereof. Common networks are in the form of a bridge, a Δ, an O, a Y, a T, or a π. 2. A number of broadcasting stations connected by radio, telephone lines, coaxial cable or radio relay. It enables all stations to broadcast the same program simultaneously.

NOISE - Undesirable random voltages caused by an internal circuit part or from some external source. In television, this type of interference results in a multitude of black and white spots distributed over the entire picture. It is often called "snow." In radio receivers, noise appears as an audible hissing sound, especially between stations.

NOMINAL - A term used to define a value (size, dimension, etc.) for purpose of general identification.

NONCONDUCTOR - An insulating material.

"NONCORROSIVE" FLUX - Flux that is relatively free from acid and other substances which might cause corrosion in soldering.

NONLINEAR - Not directly proportional and hence producing a curve instead of a straight line when plotted on a graph.

NONMAGNETIC - Not affected by magnetic fields. Some nonmagnetic materials are glass, wood, copper, and paper.

NORTH POLE - That pole of a magnet at which magnetic lines of force are considered as leaving the magnet; the lines enter the south pole. If the magnet is free to rotate, its north pole will point south.

NULL - Zero; insignificant.

NULL INDICATOR - Any device that indicates when a quantity such as current, voltage, or power is zero or a minimum.

-O-

OHM - The practical unit of electrical resistance. It is the resistance in which one volt will maintain a current of one ampere.

OHMMETER - An instrument for measuring resistance. It consists essentially of a milliammeter in series with a d-c voltage and suitable series resistors.

OHMS-PER-VOLT - A rating for voltage-measuring instruments, obtained by dividing the resistance of the instrument in ohms at a particular range by the full-scale voltage value at that range. The higher the ohms-per-volt rating, the less the meter lowers the voltage being measured.

OPEN CIRCUIT - An incomplete circuit. Current does not flow in an open circuit.

OPEN CORE - An iron core fitting inside a coil but having no iron for the external return path, so that the magnetic circuit has a long path through air.

OPPOSITE HAND - A mirror image of the view or object shown; that is, the object is reversed from "left to right" or vice versa.

OSCILLOSCOPE - A voltmeter/ammeter which reproduces, on the screen of its cathode-ray tube, traces of the waveforms of one or more varying quantities.

OUT OF PHASE - Having waveforms that are of the same frequency but not passing through corresponding values at the same instants.

OUTPUT - 1. Useful energy/voltage delivered. 2. The terminals from which output may be taken.

-P-

PADDER - 1. In a superheterodyne receiver, the capacitor placed in series with the oscillator tuning circuit to control the receiver calibration at the low-frequency end of a tuning range. 2. Any physically small capacitor inserted in series with a main capacitor to adjust its capacity to some predetermined value.

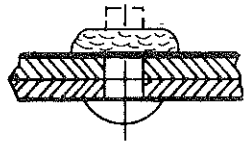
PAPER CAPACITOR - A fixed capacitor consisting of interleaved strips of metal foil separated by an oiled or waxed paper dielectric.

PART - One piece, or two or more pieces joined together which are not normally subject to disassembly without destruction of designed use. (Examples: Tubelet, Electron Tube, Composition Resistor, Mica Capacitor, Audio Transformer.)

PATCH CORD - A flexible conductor cable used for a temporary connection.

PEAK - The maximum instantaneous value of a quantity.

PEENING - Riveting operation performed with a hammer (or by multiple blow riveting with same type of tool used for "driving") to form a head without controlled shape. 2. Hammering around a hole (prohibited for signed assemblies.)



PICO - Prefix denoting a millionth of a millionth; micromicro.

PIGTAIL - A flexible metallic connection usually consisting of braided wire used between a stationary terminal and a portion of a circuit having a limited range of motion.

PLUG - Portion of a connector pair which is attached to a cable or cord.

POLARITY - 1. An electrical condition determining the direction in which current tends to flow. Applied to direct current sources; also to components when connected in d-c circuits. 2. The quality of having two opposite charges, one positive and the other negative. 3. The quality of having two opposite magnetic poles, one north and one south .

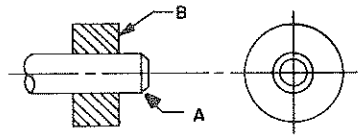
POSITIVE - A term used to describe a terminal having fewer electrons than the negative terminal, so that it attracts electrons in seeking to return to its uncharged state. Thus, electrons flow into the positive terminal of a voltage source.

POTENTIAL - Voltage between any two conductors or parts. The work per unit charge required to bring charge to the point at which the potential exists.

POTENTIAL SHORT - A defect which may contribute to an unintentional short circuit, but which is not detected by normal electrical testing.

POWER CORD - A flexible multiple conductor cable used for attaching equipment to a power supply. The cord is furnished with an attachment plug for insertion in a service outlet.

PRESS - The act of assembling tightly fitting parts with a designed interference.



NOTE:
PRESS ITEM A INTO ITEM B

PRESS FIT (Also called FORCE or INTERFERENCE fit) - Term indicates that force is required to assemble parts. The parts may be driven together, forced with a press, or shrunk together and are considered permanently assembled.

PRIMARY - 1. First in order of time, development or importance. 2. The transformer winding which receives the energy from a supply circuit. Sometimes called the input coil or winding.

PRIMARY VOLTAGE - The voltage applied to the input terminals of a transformer.

PRIMARY WINDING - The input winding of a transformer.

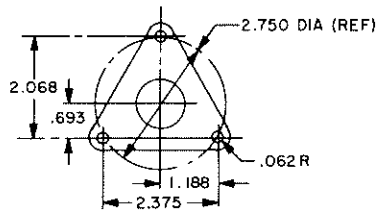
-R-

RANGE - 1. Extent of coverage or effectiveness. 2. Distance over which a radio system can operate.

REACTANCE - Opposition offered to the flow of alternating current by inductance or capacitance of a component or circuit. An inductor having an inductance L (henrys) has an inductive reactance ωL (angular velocity times inductance). The unit is ohms. The value increased with frequency. A capacitor having a capacitance C (farads) has a capacitive reactance $1/\omega C$ (reciprocal of angular velocity times capacitance). This is also in ohms. The value decreases with increasing frequency. Reactance is designated by X. Its reciprocal is susceptance, B.

RECEPTACLE - Portion of a connector pair attached to the equipment. A socket.

REFERENCE DIMENSION - A duplicated dimension or a dimension not strictly essential in fabricating or inspecting the part, but has an important reference value. Such dimensions are usually suffixed with the letters REF in parentheses.



REFERENCE LEVEL - The starting or zero point from which a scale is laid out or from which measurements are made. For example, the common reference point (level) in decibels (db) is 0.006 watt; in volume units (VU's) it is 0.001 watt.

REGISTRATION (PRINTED CIRCUIT) - Matching in position of printed wiring patterns on opposite sides of a printed board; or positioning of a pattern with respect to the details on the opposite side.

RESISTANCE (ELEC) - The nonreactive opposition which a device or material offers to the flow of direct or alternating current. The opposition results in production of heat in the material carrying the current. Resistance is measured in ohms, and may be designated by the letter R.

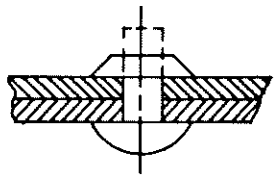
RESISTOR - A part which is intended to offer resistance to the flow of electric current. Its electrical size is specified in ohms or megohms (one megohm equals 1,000,000 ohms). A resistor also has a power-handling rating in watts, indicating the amount of power which can safely be dissipated as heat by the resistor.

RESISTOR CORE - The support on which a wire-wound resistor element is wound.

RHEOSTAT - A current-regulating resistor whose value may be changed by means of a control knob. One fixed and one movable terminal are used, or, usually in the larger sizes, only these two terminals are provided.

RIPPLE - The alternating-current component present in the output of a direct-current generator, rectifier system or other d-c power supply.

RIVETING - Assembling by use of rivets. Methods of riveting in common use: single squeeze or blow, and multiple blows.



RIVET OVER - Operation of forming the riveted or second head by means of squeezing or forming with hammer blows.

ROLL-OFF - A controlled attenuation (de-emphasis) of frequencies in a high-fidelity amplifier or preamplifier. Roll-off compensates for the emphasis of frequencies when phonograph records are made. Emphasis gives the recording a better signal-to-noise ratio, while roll-off helps restore correct tonal balance when the record is played.

ROLL OVER - Term applied to the assembly of eyelets, hollow point rivets and tenons by curling over the tubular extending section of metal by either clinching or spinning.

ROPE-LAY CABLE - An extremely flexible cable composed of groups of strands made up into a complete cable using concentric lay construction.

ROPE-LAY STRANDING - A flexible stranded conductor composed of a central core of stranded wires surrounded by one or more layers of helically laid groups of stranded wires.

ROSIN-CORE SOLDER - Solder made up in tubular form, with the inner space containing rosin flux for effective soldering.

RUNNING FIT (PRECISION) - This fit has a smaller minimum clearance than the Running Fit (Production), but allows a thin film of lubricant. It is suitable for shafts revolving under 600 rpm and at pressures less than 600 lb per sq in.

RUNNING FIT (PRODUCTION) - Term used where the minimum clearance between the hole and the shaft is such that it will permit free assembly and the tolerances are large enough to permit economical manufacturing.

RUNOUT - Two times the eccentricity. (See Eccentricity and Face Runout.)

-S-

SATURABLE REACTOR - A device consisting of a d-c winding and an a-c winding on the same core. The d-c winding is used to vary the core saturation and thus controls the reactance and impedance to current in the a-c winding.

SATURATION - 1. The condition existing in a tube when thermionic or photoelectric current is the maximum that can be obtained by increasing the anode voltage. Or, in the thermionic case, by increasing the temperature of the cathode. 2. The condition existing in a magnetic material when the flux density is the maximum that can be obtained by increasing the magnetomotive force. In color TV, freedom of a color from white. Vivid or strong colors are highly saturated while pastel shades are of low saturation.

SCHEMATIC DIAGRAM - A line diagram using graphic symbols to show the functional operation or diagramatic scheme of an electrical circuit, part, subassembly, assembly, etc.

SELECTIVE - Responding to a desired frequency to a greater degree than to other frequencies.

SELECTIVITY - The characteristic which determines the ability of a radio receiver to reject undesired untuned signals.

SELECTOR - A device, mechanical, electronic, or electrical, for making connection to any of a number of circuits at will.

SENSITIVITY - 1. Characteristic of an electronic circuit which determines the minimum input signal strength required for a given signal output value. 2. The displacement (generally measured in inches) of the luminous spot on the screen of a cathode-ray tube, per volt applied to deflecting plates or per ampere of current through a deflecting coil.

SERIES - An arrangement of parts in a circuit, connecting them end to end to provide a single path for current flow.

SERIES RESONANT CIRCUIT - A circuit in which an inductor and capacitor are connected in series, and have values such that the inductive reactance of the inductor will be equal to the capacitive reactance of the capacitor at the resonant frequency. At resonance, the current through a series resonant circuit is a maximum.

SERVICE LOOP - A length of wire in excess of that required for a single connection.

SHEARING - Cutting as with scissors rather than with a beveled cutter. One blade can be stationary. The material being cut moves in the direction of the moving blade or blades.

SHIELDED WIRE - One or more insulated wires covered with shielding (usually braided wire), with or without an outer insulating covering.

SHIELDING - Metal covering used on a cable; also a metal can, case, partition, or plates enclosing an electronic circuit or component. Shielding is used to prevent undesirable radiation or pickup of signals (magnetic induction, stray current, or a-c hum).

SHORT (CIRCUIT) - A low-resistance connection across a voltage source or between the sides of a circuit or line; usually accidental and usually resulting in excessive current flow which often causes damage.

SHORTED OUT - Made inactive by connecting a wire or other low-resistance path around a device or portion of a circuit.

SHUNT - 1. A precision low-value resistor placed across the terminals of an ammeter to increase its range by allowing a definite fraction of the circuit current to go around the meter. 2. Any part connected in parallel with some other part.

SIDEBANDS - Two bands of frequencies, one on either side of the carrier frequency of a modulated radio signal, including components whose frequencies are, respectively, the sum and difference of the carrier and the modulation frequencies.

SIGNAL GENERATOR - A test instrument that generates an unmodulated or tone-modulated radio-frequency signal at any frequency needed for aligning or servicing electronic equipment.

SIMILARITY - Quality of being nearly alike, but not alike in all respects.

SINE WAVE - Waveform corresponding to harmonic motion. If amplitude is plotted against angle (or time, which is in proportion to angle) the curve is a sine function. From 0° to 90° (one quarter period) the amplitude increases as the sine of the angle. From 90° to 180° it decreases symmetrically with the increase, completing an arch (of one half period). During the interval 180° to 360° (the other half period), the arch is inverted and repeated in a trough. The periods or cycles then repeat.

SLEEVE - 1. The cylindrical metal contacting part back of the tip/ring in a telephone or radio type plug. 2. A tubular part such as a simple bearing or insulating tubing.

SNAGGING - Rough cutting and grinding operation employed to remove gates, risers, fins, flash, etc.

SNUG FIT - This fit has zero minimum clearance between the shaft and the hole, but parts can be assembled without the use of tools. This fit is not suitable for moving parts.

SOLDER - An alloy of lead and tin which melts at a fairly low temperature (361°-496° F) and is used for making permanent electrical connections between parts and wires. Silver solder, which has a much higher melting point, is composed of silver, copper and zinc.

SOLDERING IRON - A device used to apply heat to a joint which is to be made permanent by soldering.

SOLID CONDUCTOR - A solid wire. A metallic conductor that is not composed of strands.

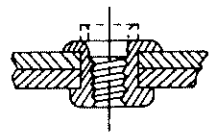
SOLID WIRE - A slender, generally flexible rod or filament of drawn metal, not stranded.

SOURCE - The supply, or the part which is supplying electrical energy or radio signals to a circuit.

SPAGHETTI - Heavily varnished cloth tubing sometimes used to provide insulation for radio circuit wiring.

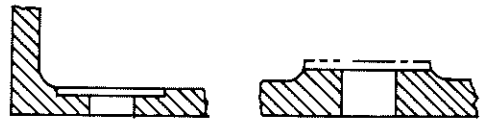
SPARKOVER - Breakdown of the air between two electrodes producing a spark.

SPINNING - Assembly accomplished by using a rotating tool (often equipped with rolls) which causes a small section of the metal ahead of the tool to flow.

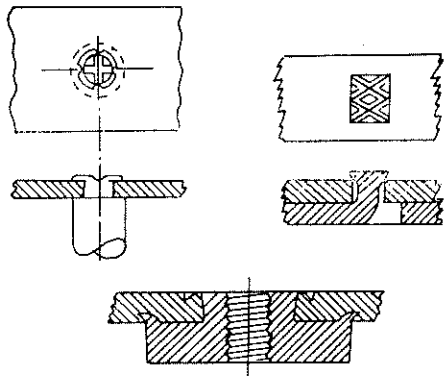


SPLICE - A connection of two or more wires not connected to a terminal or to shielding.

SPOT-FACE - A machining operation which removes irregularities and creates a smooth surface perpendicular to the axis of the hole. The area is machined sufficiently to provide a seating surface for bolts, nuts, washers and other mating parts. In all cases, the spot-facing tool should cut below the irregular surface.



STAKING - An assembly operation performed with various shapes of dull punches which cause sideward distortion of a tenon or of metal around a hole. Securing a fastener with solder is called solder staking.



STAKING, LIQUID - Securing a fastener with a friction-increasing liquid.

STATIC - Noise heard in a radio receiver due to atmospheric electrical disturbances such as lightning, or man-made causes such as electric motors, neon signs, electric shavers or other appliances which produce sparking in operation.

STEP-DOWN TRANSFORMER - A transformer in which the secondary winding has fewer turns than the primary, so that the secondary delivers a lower voltage than is applied to the primary. Current is greater in the secondary than in the primary.

STEP-UP TRANSFORMER - A transformer in which the secondary winding has more turns than the primary, so that the secondary delivers a higher voltage than is applied to the primary. Current is less in the secondary than in the primary.

STRAND - One of the wires, or group of wires, of stranded conductor.

STRANDED CONDUCTOR - A conductor composed of strands, or of any combination of strands, twisted (or braided) together.

STRANDED WIRE - A flexible conductor composed of a group of bare wires or of any combination of groups of bare wires twisted together. The entire wire is usually insulated.

STRAY CAPACITANCE - Capacitance existing between circuit wires and/or parts including the metal chassis of electronic apparatus.

SUBASSEMBLY - Two or more parts which form a portion of an assembly or a unit, replaceable as a whole (having a part or parts which are individually replaceable. (Examples: I-F Strip; Terminal Board with mounted parts).

SUPPLY - Source of voltage, current and/or power.

SURFACE ROUGHNESS - Closely spaced deviations from flatness of a surface, such as those produced in machine finished surfaces by the cutting action of tool edges or abrasive grains.

SYSTEM (Electrical & Electronic) - A combination of assemblies and parts usually physically separated in operation, necessary to perform an operational function. (Example: Fire Control System).

-T-

TERMINAL - An electrically conductive item such as is attached to the end of a wire or to terminal board for convenience in making reliable electrical connections.

TERMINAL BOARD - An insulating strip or board on which screws, solder lugs, or other electrical connecting items are fastened and used for junctions or terminations of wires and cable assemblies.

TEST LEAD - A flexible insulated lead, usually with a test prod at one end, for making tests or connecting instruments to a circuit temporarily.

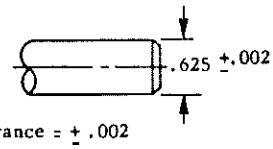
TEST OSCILLATOR - A test instrument that will generate an unmodulated or tone-modulated radio-frequency signal at any desired frequency for aligning or servicing electronic equipment. Also called a signal generator.

TINNED WIRE - Copper wire that has been coated with a layer of tin or solder to simplify soldering and prevent corrosion.

TIP - The contact at the end of a telephone-type plug.

TIP JACK - A small single-hole jack into which a single pin contact plug is inserted to make an electrical connection.

TOLERANCE - Permissible variation from the desired dimension.



TOROID - A ring. A doughnut-shaped coil such as would be formed by bringing together the ends of an ordinary coil.

TRANSDUCER - 1. Generally, a device which converts energy from one form into another, always retaining the characteristic amplitude variations of the energy being converted. Examples: A microphone, which converts acoustical energy into electrical energy; a loudspeaker, which does the reverse; a photocell, which converts light energy into electrical energy; a phonograph pickup, which converts mechanical energy into electrical energy.

TRANSFORMER - An electrical device, without moving parts, that transfers electrical energy by electromagnetic induction from one or more circuits to one or more other circuits. May be used to step up or down voltage. Does not affect frequency. All the energy is transferred except for small copper wire and core losses. Consists essentially of one coil or two or more coils inductively coupled. For power or audio transformers, iron cores are used. In r-f either air or powdered iron cores are employed.

TRANSMISSION LINE, R-F- Means of transferring r-f energy from a source to a load in an efficient manner. It may consist of parallel wires properly spaced and terminated to match the source to a load. It may consist of parallel wires properly spaced and terminated to match the source impedance. It may be an arrangement of coaxial conductors or a wave guide system similarly terminated.

TRANSIENT - A temporary current or voltage existing in a circuit due to a changed load, different source voltage, or line impulse.

TRIMMER CAPACITOR - A small semiadjustable capacitor, usually adjusted with a screwdriver, and used in the tuning circuits of radio receivers and other radio apparatus. It permits fine adjustment of capacity of the tuned circuit for accurate alignment.

TRIPLEX CABLE - Three insulated stranded conductors twisted together with a common insulating covering.

TUBE VOLTMETER - A vacuum-tube voltmeter. See vacuum-tube voltmeter.

TUBULAR - Having the form of a cylinder, as a component with leads projecting axially from one or both ends.

TUNED FILTER - An arrangement of electronic components tuned either to greatly reduce or pass signals at its resonant frequency.

TUNING - 1. Adjusting the inductance or capacitance (or both) in a coil-capacitor circuit. 2. Adjusting all circuits in electronic equipment for best performance.

TUNING COIL - A variable inductor.

TUNING CAPACITOR - A variable capacitor.

TWIN-AXIAL CABLE - Same as Coaxial Cable, except there are two parallel conductors in a common shield.

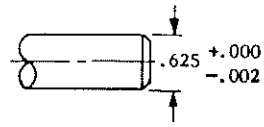
TWIN CABLE - Two insulated solid or stranded conductors laid parallel with a common insulating covering.

TWISTED PAIR - Two insulated conductors twisted together either with or without a common covering.

uf - Abbreviation for microfarad. Formerly written mfd.

UNILATERAL TOLERANCE - Permissible variation from the desired dimension in one direction only.

Tolerance is minus .002.



UNIT - An assembly or any combination of parts, subassemblies, and assemblies mounted together, normally capable of independent operations in a variety of situations (Example: Radio Receiver).

-V-

v - Abbreviation for volt.

va - Abbreviation for volt-ampere.

VACUUM-TUBE VOLTMETER - A test instrument for measuring voltages which takes advantage of the high input impedance of a vacuum tube to minimize the effect on the circuit to which the instrument is connected. Abbreviated vtvm.

VARIABLE CAPACITOR - A capacitor whose capacity may be changed either by varying the space between plates (as in a trimmer capacitor) or by varying the amount of meshing between the two sets of plates (as in a tuning capacitor).

VARIABLE RESISTANCE - A resistor having a sliding contact so that its resistance value can be readily changed.

VARIABLE TRANSFORMER - A transformer, the output voltage of which can be varied continuously.

VERNIER - An auxiliary scale of slightly smaller divisions than a main measuring scale, by means of which measurements may be made with greater precision than allowed by the main scale alone. Thus any device, control, or scale used to obtain fine adjustment or more accurate measurement.

VERNIER CAPACITOR - A small variable capacitor shunt-connected with a larger tuning capacitor to provide a finer adjustment than the larger capacitor.

VOLT - The unit of voltage, potential or electromotive force. One volt is the electromotive force which will send one ampere through a resistance of one ohm.

VOLTAGE - The electrical pressure that makes current flow through a conductor. Same as electromotive force.

VOLTAGE GAIN - Voltage amplification. A rating of an amplifier stage obtained by dividing the a-c output voltage by the a-c input voltage. It is less than the amplification factor of the tube. As the external impedance becomes larger in comparison to the plate impedance the value approaches the amplification factor.

VOLTMETER - An instrument for measuring voltage.

VOLT-OHM-MILLIAMMETER - A test instrument having provisions for measuring voltages, resistances, and small currents. It consists essentially of a single meter having the necessary number of scales and a switch which places the meter in the correct circuit for a particular measurement.

-W-

WATT - The practical unit of electrical power, and in a direct-current circuit, equal to volts multiplied by amperes. In an alternating-current circuit, true watts are equal to effective (rms) volts multiplied by effective amperes, then multiplied by the factor.

WAVE GUIDE - A system of conducting boundaries (such as a copper duct) capable of guiding electromagnetic waves.

WIRE - A rod, filament, or group of strands forming a metallic conductor having practically uniform thickness. Used in radio and electronics to provide a path for electric current between two points.

WIRE GAUGE - A system of numerical designations of wire sizes, starting with low numbers for the largest sizes. The American wire gauge, abbreviated AWG (formerly the Brown and Sharpe gauge, abbreviated B & S gauge) is in common use in the United States and starts with 0000 as the largest size, going to 000, 00, 0, 1, 2, and up to 40 and beyond for the smallest sizes.

WIRING DIAGRAM - A pictorial diagram showing physical location of parts and terminating connections for illustrating the actual wiring of the electrical parts or equipment. Usually views of the wiring sides of assemblies are preferred.

WIRING HARNESS - Insulated wires, parallel or twisted with or without shields, which connect electrical circuits and which are properly bound together with lacing tape or braid. The individual wires are usually identified by color or number code. Various components' may or may not be attached to the ends of the harness wires.

appendix C

APPENDIX C

INDEX

Other Subjects May be Found in the Following: