TMC SPECIFICATION

NO. S735

REV: C D E F G

COMPILED: FRD | CHECKED: JRB | APPD: [signature] 9/27/65 | SHEET 1 OF 29

TITLE:

typed by ev 8/6/65

STANDARD DRAWING

PRINTED WIRING BOARDS

REVISION SHEET	THE TECHNICAL MATERIEL CORP. MAMARONECK NEW YORK	S-735 LIST NO.

DATE	REV.	SHEET	EMN #	DESCRIPTION	APP.
3/23/64	0	A11	----	ORIGINAL RELEASE FOR PRODUCTION	
6/30/64	A	9	11687	Revised sht. 9 per EMN	
1/22/65	B	A11	13354	Revised per EMN	
8/27/65	C	A11	14738	Revised per EMN	
5/11/66	D	→	16222	Revised per EMN 2,4,10,11,12,15,16	
10/28/66	E	-----	17155	Sheets 2,5,6,7, and 14 revised per EMN	
6/26/67	F	15	18332	Revised per EMN	
11/21/67	G	ALL	18635	REVISED PER EMN	

TMC FORM MLR-1 2-65—AINS.

typed by ev 8/6/65

I N D E X

PRECEDENCE

In the event of conflict between the contract, drawings, or any applicable specifications, the order of precedence shall be as follows:

1 Contract

2 Master Drawing and art work

3 This Specification, S735

4 MIL-STD-275

5 MIL-P-55110

6 MIL-P-13949

typed by ev 8/6/65

1. SCOPE

1.1 This specification covers printed wiring boards consisting of a conductor pattern on a rigid, insulating base. This specification does not apply to the fabfication of parts, such as resistors, inductors, capacitors, or transmission lines fabricated using these techniques; but does apply to the mounting of such parts on printed wiring boards. See Appendix I(for reference only).

2. APPLICABLE DOCUMENTS

2.1 The latest issues of the following documents form a part of this specification(See, also, para. 24.1).

MS16912	Printed Circuit Shapes, Master Drawing
MIL-F-14256	Flux, Soldering, Liquid(Resin Base)
MIL-P-13949	Plastic Sheet, Laminated, Copper Clad
MIL-P-55110	Printed Wiring Boards
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-429	Printed Circuit Terms and Definitions
MIL-STD-202	Test Methods for Electronic Equipment Component Parts
MIL-P-18177	Plastic Sheet, Laminated
MIL-T-10727	Tin Plating, Electro-deposited or Hot Dipped

2.1 (continued)

MIL-G-45204	Gold Plating
SCL-6225	Design Requirements for Auto-Sembled Army Signal Electronic Equipment
QQ-S-571	Solder
MIL-T-152	Treatment, Moisture and Fungus-resistant

3. BASE

3.1 The composite material of the base shall consist of woven-fabric glass which has been impregnated with epoxy resin(NEMA grade G-10) and overlaid with copper foil on one or both sides. The entire assembly shall be bonded together and processed to meet the applicable requirements of MIL-P-18177(GEE grade) and MIL-P-13949(Class II tolerance). Other materials may be specified for special applications in accordance with MIL-P-13949(See Appendix III - for reference only).

3.2 Overall thickness of the base plus copper, exclusive of plating or varnish, shall be 0.062 ± 0.0062 inch, unless otherwise specified as in the master drawing. Other thicknesses may be specified for special applications in accordance with MIL-P-13949.

4. CONDUCTIVE PATTERN

4.1 Nominal thickness of the copper foil shall be $0.0028^{+0.0007}_{-0.0003}$ inch(two ounces). Other thicknesses may be specified for special applications only. The copper foil shall have a minimum purity of 99.5% and a maximum resistivity of 0.15940 ohm-gram per meter squared at 20°C.

typed by ev 8/6/65

4. CONDUCTIVE PATTERN (continued)

4.2 The width of the conductors shall be determined on the basis of the current carrying capacity required and the allowable temperature rise(See Figure I). The minimum conductor width should be .025 inch, however, in special cases the width may belowered to .020 inch minimum.

4.3 The width of the conductive pattern shall be as specified in the master drawing $^{+0.006}_{-0.009}$ inch.

4.3.1 When a printed wiring board is made using a plating as the etch resist, the conductive pattern shall be as specified in the master drawing $^{+0.012}_{-0.006}$ inch.

4.3.2 The reduction of the conductor width caused by etching under the edge of the plating resist, shall not exceed 0.005 inch. (See Figure VIII)

4.4 The length of the conductors between various terminal areas shall be held to a minimum. (See Figure III)

4.5 The conductors shall contain no exterior corners having less than a 90^{o} included angle. (See Figure IV)

4.6 Conductive areas larger than 3/8 inch square shall be avoided where practicable. When such conductive areas are necessary, such as for shielding purposes, these areas shall be broken up by a design which will leave the conductive pattern electrically continuous, or other methods shall be used to prevent blistering or warpage resulting from the soldering operation.

4.6.1 Care should be taken in the design of these open areas. For frequencies above 2 Mc, holes in the foil larger than 0.25 inch allow a considerable amount of RF energy to pass through the board.

4. CONDUCTIVE PATTERN (continued)

4.7 Terminal areas shall be so designed as to have a minimum diameter of at least 0.020 inch greater than the diameter of the flange, or projection of the flange, of eyelets or standoff terminals. The mimimum diameter of the terminal area surrounding an unsupported hole shall be at least 0.040 inch greater than the diameter of the hole. The minimum diameter of a terminal area surrounding a plated-through hole shall be at least 0.020 inch greater than the diameter of the hole. Maximum size, consistent with minimum spacing requirements, shall be maintained for ease of manufacture and durability in usage. (See appendix II for reference only.)

4.8 Annular rings shall be used only on the circuitry side of a board.

4.9 The minimum spacing between conductors on coated boards shall be as indicated in chart.

Conductor spacing (conformal coated boards) (applicable to all altitudes).

Voltage between conductors DC or AC peak (volts)	Minimum spacing
0-30	0.010 inch
31-50	.015 inch
51-150	.020 inch
151-300	.030 inch
301-500	.060 inch
Greater than 500	.00012 (inch per volt)

4.10 The conductive pattern shall be formed in the metal foil preferably by etching.

4.11 The pattern edges shall be clearly defined and shall not be ragged. There shall be no tears or cracks in the conductor pattern. Nicks or pinholes exposing the base laminate shall not reduce the conductor width by more than 20%.

4.12 Repaired conductor patterns are not acceptable.

4.13 Etching shall result in complete removal of unwanted conductive material from the insulation areas. Isolated spots of conductive material no greater than 1/32 inch in diameter are acceptable provided the spacing requirements of paragraph 4.9 are not violated.

5. MASTER DRAWING (See MIL-STD-429 for definition)

5.1 All locations on the master drawing shall be dimensioned by the use of a modular grid system. The basic modular units of length shall be 0.100, 0.050, or 0.025 inch, in that order of preference. Overall board dimensions(length and width), wherever practical, shall coincide with lines of the 0.100 inch grid.

5.2 If a specific requirement for warp and twist is necessary, the allowable warp and twist shall be as specified in paragraph 23.3. (See Appendix III - for reference only)

5.3 Holes for component parts having rigid terminals, whose spacing is such that all terminal holes will not fall on an intersection of the grid, shall have at least one terminal hole located on the intersection of the grid and the remaining terminal holes dimensioned, using cartesian co-ordinates.

6. ARTWORK (See MIL- STD-429 for definition)

6.1 Artwork shall be in the form of a 1:1 or a 2:1 positive reproducible and shall be stable over a temperature range of +50° to +175°F. and should not exceed 42 inches squared(0.007 mylar film or equivalent).

6.2 In no case shall the original artwork be processed through roll duplicating equipment.

6.3 Artwork shall indicate which side is up using any suitable means, such as the words, "THIS SIDE UP."

6.4 Artwork shall, also, show the true overall dimensions when reproduced to a scale of 1:1, in both a horizontal and a vertical direction(X and Y co-ordinates).

6.5 Conductor widths on the artwork should be 0.010 inch larger than specified on the master drawing for boards using a plating as an etch resist; 0.0075 inch greater than specified for boards without plating or for boards that are plated after etching.

6. ARTWORK (continued)

6.6 When reduced to a scale of 1:1, the artwork shall have a minimum conductor spacing of:

0-30V -	0.010 inch
31-50V -	.015 "
51-150V-	.020 "
151-300V-	.030 "
301-500V-	.060 "
Greater than 500V-	.00012 (inch per volt)

7. TEMPERATURE

7.1 Printed wiring boards shall not be operated at temperatures greater than +125°C. (ambient temperature plus temperature rise caused by the current in the conductors) (See, also, Figure I).

8. TERMINAL HOLES

8.1 The diameter of unsupported holes shall not exceed by more than 0.015 inch the diameter of the lead to be inserted. The diameter of holes in which eyelets are to be inserted shall not exceed the outside diameter of the eyelet by more than 0.010 inch.

8.2 A distance of not less than twice the board thickness or 1.5 times the diameter of the smaller hole, whichever is smaller, shall be maintained between the edges of all holes or between the edges of a hole and the edge of the board.

8.3 Holes may be drilled, punched or reamed.

8.4 The hole walls may be prepared for plating-through by sensitizing with electroless copper or nickel. Silver or graphite shall not be used in any form.

8.5 The hole edges shall be clean-cut with no chipping, and the conductive pattern shall not be torn nor separated from the base.

8. TERMINAL HOLES (continued)

8.6 Hole locations shall be as specified in the master drawing.

8.6.1 The diameter of at least 90% of the holes on one board shall fall within a tolerance of ±0.005 inch and in no case shall the diameter of any hole vary by more than ±0.010 from that specified on the master drawing.

8.7 The eccentricity of the terminal areas shall be 0.0075 inch maximum(See Figure IX).

8.8 The bond strength of plated-through holes or eyeleted holes, and conductors or terminal areas around a bare hole shall be tested in accordance with the latest revision of MIL-P-55110, paragraph 4.7.4.

8.8.1 Acceptance of printed wiring boards to paragraph 8.8 shall be based upon certification by the supplier. TMC may, at its option, repeat any or all of the tests specified.

8.9 Plated-through Holes

8.9.1 The inside diameter of a plated-through hole shall be no more than 0.050 inch greater than the diameter of the lead or terminal which is to be inserted in the plated-through hole.

8,9.2 The inside diameter of plated-through holes should not be less than 60% of the base board thickness.

8.9.3 Whenever possible on single-sided boards, unsupported holes should be used rather than eyelets or plated-through holes.

8.9.4 When the number of terminal holes per board is less than 25 or less than 3 holes per inch squared, it may be more economical to use eyelets rather than plated-through holes. However, unsupported holes are preferable.

8.9 Plated-through Holes (continued)

8.9.5 Plated-through holes shall be of copper, not less than 0.001 inch thick, nor more than 0.002 inch thick. Plated-through holes shall be solder-coated per para.11, or tin-lead plated per para. 13.2.2.

8.10 Eyelets

8.10.1 The inside diameter of an eyelet shall not be more than 0.050 inch greater than the diameter of the lead or terminal which is to be inserted in the eyelet.

8.10.2 Eyelets shall be solder-coated per para. 11, or tin-lead plated per para. 13.2.2, or tinplated per para. 13.2.6.

9. BOARD MOUNTING

9.1 All boards shall be supported witnin one inch of the edge on at least three sides. For non-rectangular or irregularly shaped boards, supports shall be provided at intervals of not more than four(4) inches, around at least 75% of the periphery, within one inch of the edge.

10. EDGE BOARD CONNECTORS (FINGERS)

10.1 Edge board connectors, those connectors using a portion of the conductive pattern as the male contact, shall have copper contacts the thickness of the remaining conductive pattern. The contact shall be plated with a minimum of 0.0001 inch of gold.

10.2 When specified, edge board connectors may be plated with rhodium or gold over low stress nickel as per paragraph 13.2.

10. EDGE BOARD CONNECTORS(FINGERS) - (continued)

10.3 Unless otherwise specified, on single-sided boards, there shall be fingers only on the circuitry side of the base.

10.4 The leading edge of the contact should be tapered and shall not extend to the edge of the board. This is to prevent the female contact from lifting the foil on insertion. (See Figure V)

11. SOLDER-COATING

11.1 Solder-coating shall be a minimum of 0.0003 inch thick.

11.2 Solder used shall have a composition (by weight) of Tin 59.5-61.5%, Lead 37.6-40.3%, miscellaneous 0.2-0.9%.

12. FLUX

12.1 Flux shall be rosin per MIL-R-626 Class A, Type II, Grade WW.

12.2 Acid flux shall not be used in any form.

13. PLATING

13.1 The conductive pattern with the exception of eyelets (See paragraph 8.10.2) and plated-through holes(See paragraph 8.9.5) shall be tin-lead, electrodeposited tin or rhodium plated, or solder-coated. Rhodium plating shall not be used where soldering to the conductive pattern is required. Silver plating shall not be used. A low stress nickel plating may be used between the rhodium overplating and the copper foil.

13.2 Plating shall be as specified herein and as specified on the master drawing:

13.2.1 PARAGRAPH - DELETED - SEE PARAGRAPH 11.

13.2.2 Tin-lead plating shall be a minimum of 0.0003 inch thick and shall contain a minimum of 50% and a maximum of 70% tin.

13.2.3 Gold plating shall be a minimum of 0.00008 inch thick unless otherwise specified and shall be in accordance with Type II of Specification MIL-G-45204.

13.2.4 Rhodium plating shall be a minimum of 0.000010 inch thick and a maximum of 0.00005 inch thick.

13. PLATING (continued)

13.2.5 Low stress nickel plating shall be a minimum of 0.0005 inch thick and a maximum of 0.001 inch thick.

13.2.5.1 When used as a base for rhodium, it shall be a minimum of 0.00025 inch thick.

13.2.6 Electrodeposited tin shall be a minimum of 0.0003 inch thick and shall be in accordance with Specification MIL-T-10727.

13.3 In all cases, with the exception of contact fingers, where an electrodeposited material is used; there shall be an added coating of solder, as per paragraph 11. . , on the printed wiring side. Even though some printed wiring may be on the component side, this side shall not be solder-coated unless otherwise specified.

13.3.1 After the solder-coating operation, no solder shall be left on the contact fingers and all terminal holes shall remain continuous.

14. COMPONENT POSITIONING

14.1 In order to facilitate the proper assembly of component parts on the printed wiring board, lead identification or component positioning shall be indicated, using the same process as is used to form the component symbol numbers.

14.1.1 For voltage-polarized items, such as capacitors, a simple "+" shall suffice and shall have the dimensions specified in paragraph 16.2 or paragraph 16.2.1.

14.1.2 Diodes (Zener, Rectifier, or other) shall be located with the schematic symbol (or) placed between the diode mounting holes.

14. COMPONENT POSITIONING

14.1.3 Metallic rectifiers may be identified as in 14.1.1, if so identified on the item.

14.1.4 The locating tab on transistor cases, viz. TO-5, TO-18, TO-33, etc., shall be identified by a dot with a minimum diameter of 0.062 inch.

14.1.5 Color coded leads shall be identified by labeling the appropriate hole with the word BLK, BRN, RED, ORN, YEL, GRN, BLU, VIO, GY, or WHT as per paragraph 16.2 or paragraph 16.2.1.

14.1.6 Numbered leads shall be identified on the printed wiring board at the appropriate hole.

15. FABRICATION

15.1 All component parts shall be mounted so that the body of the part is 1/16 inch away from the printed wiring board, unless the body of the part is otherwise supported. Component parts shall not be mounted in such a way as to obscure the termination of another part. Those parts weighing more than 1/2 ounce, and all sub-miniature tubes with flexible leads, shall not rely on the strength of the solder joints alone for support, but shall have additional means of support such as brackets, clamps, etc.

15.2 All part leads shall be clinched over on the side opposite to insertion and soldered so as to contact the conductor pattern (See Figure VI). The length of the clinched end shall not be less than 1/16 nor more than 3/16 inch. In no case shall the clinched wire extend beyond the edge of the conductor pattern. The width of the conductor pattern, or terminal area to which the lead is soldered, shall be no less than the lead diameter. The solder fillet shall be at least 80% complete around the lead.

15. FABRICATION (continued)

15.3 Interfacial connections shall be made by the use of a well formed, uninsulated, solid copper lead(jumper) extending through a hole and clinched and soldered to the foil on each side of the board so as to contact the conductor or terminal area directly(See Figure VII). The length of the clinched end shall not be less than 0.030 inch nor more than 0.190 inch. Eyelets or plated-through holes may be used, if desired, provided all of the above requirements are met.

15.4 Wire jumpers may be used to facilitate top side wiring on one-side-etched boards. When jumpers are used, they shall be placed on the component part side of the board, be constructed of solid insulated wire, be designed to be as straight and as short as practicable, and shall not be applied over other component parts.

15.5 Leads of axial-leaded parts shall remain straight for at least 0.015 inch from the part extremity but not greater than 0.035 inch(See Figure VI).

16. MARKING

16.1 Printed wiring boards shall be marked in accordance with MIL-STD-130.

16.2 Unless otherwise specified, all letters and numerals printed using ink, shall be $0.062^{+0.015}_{-0.000}$ inch high, shall have a line width of $0.010^{+0.010}_{-0.000}$; and shall be Gothic in style. (See, also, paragraphs 16.5 and 16.6)

16.2.1 When letters or numerals are made using the same process as is used to make the conductor pattern, they shall be at least 0.035 inch wide by 0.125 inch high unless otherwise specified on artwork or master dwg, and at least 0.031 inch from any conductor or terminal area.

16. MARKING (continued)

16.3 When specified, printed wiring boards shall include component-identification markings in accordance with MIL-STD-16.

16.4 Whenever possible, markings should be so placed that they are visible when the components are in place.

16.5 Markings shall be produced either by the same process used in producing the conductor pattern or by using indelible ink of a contrasting color with base material(e.g., White ink on G-10 material).

16.6 All markings on printed wiring boards shall meet or exceed the applicable requirements of the latest revision of TMC Specification S727, "MARKING PROCESS FOR METAL AND PHENOLIC MATERIAL."

17. COATINGS

17.1 Completed printed wiring assemblies shall be protected with a thin epoxy-type conformal coating to protect the pattern and components against moisture, dust, and other contaminants, in accordance with MIL-T-152 and TMC Specification S113. When the nature of the components mounted on the board is such that coating them is not feasible, the coating will be applied only to the conductive pattern.

17.1.1 Hermetic sealing in a dry atmosphere is acceptable in place of the conformal coating.

17.1.2 Alternate coating material may be used, provided all other specifications are met (e.g., Silicone or Acryllic lacquer with a thickness of 0.002 to 0.005 inch.

17.2 The coating thickness shall be 0.012± 0.007 inch on the conductor side of the board and all edges.

17. COATINGS (continued)

17.3 The bare ends of wires, terminals, and surfaces of individual parts that are to be soldered and/or connected, after installation of the printed wiring board assembly, shall be protected (such as masking) against the application of the varnish coating.

17.4 No visible deterioration of the coating material shall occur as a result of temperature cycling. Evidences of deterioration include blistering, wrinkling, cracking, or peeling of coating materials.

17.5 The cured film shall be free from pinholes, bubbles, entrapped contaminants or other defects, and shall not mask or obliterate the color coding of various electronic parts.

17.6 The average insulation resistance shall not be less than 100 megohms and, in no case, shall it be less than 50 megohms.

18. PARAGRAPH - DELETED - SEE PARAGRAPH 4

19. PARAGRAPH - DELETED - SEE PARAGRAPH 8

20. PARAGRPAH - DELETED - SEE PARAGRAPH 16.5 - 16.6

21. PARAGRAPH - DELETED - SEE PARAGRAPH 17

22. WORKMANSHIP

22.1 Printed wiring boards shall be processed in such a manner as to be uniform in quality and shall be free from defects that may affect life and serviceability.

22. WORKMANSHIP (continued)

22.2 Printed wiring boards shall be clean and free from dirt, oil corrosion, corrosion products, salts, smot, grease, finger prints, and all foreign matter.

22.3 There shall be no whiskers of solder or plating left on the conductive pattern.

23. GENERAL

23.1 Printed wiring boards shall meet or exceed all applicable requirements of MIL-P-55110 and MIL-P-13949. However, Government source inspection shall not be required. (See Appendix IV for reference only)

23.2 See, also, TMC Specification S676 - "Cleaning and Inspection of Printed Circuit."

23.3 Requirement for warp and twist shall be as specified in the latest revision of MIL-P-13949, Paragraph 3.4, Class A.

24. DELETED See page 2

DATE 18 February 1964	TMC SPECIFICATION NO. S-735	6
SHEET 18 OF 29		
FRD COMPILED / CHECKED	TITLE: PRINTED WIRING BOARDS	
APPROVED		

(FOR USE IN DETERMINING CURRENT CARRYING CAPACITY AND SIZES OF ETCHED COPPER CONDUCTORS FOR VARIOUS TEMPERATURE RISES ABOVE AMBIENT.)

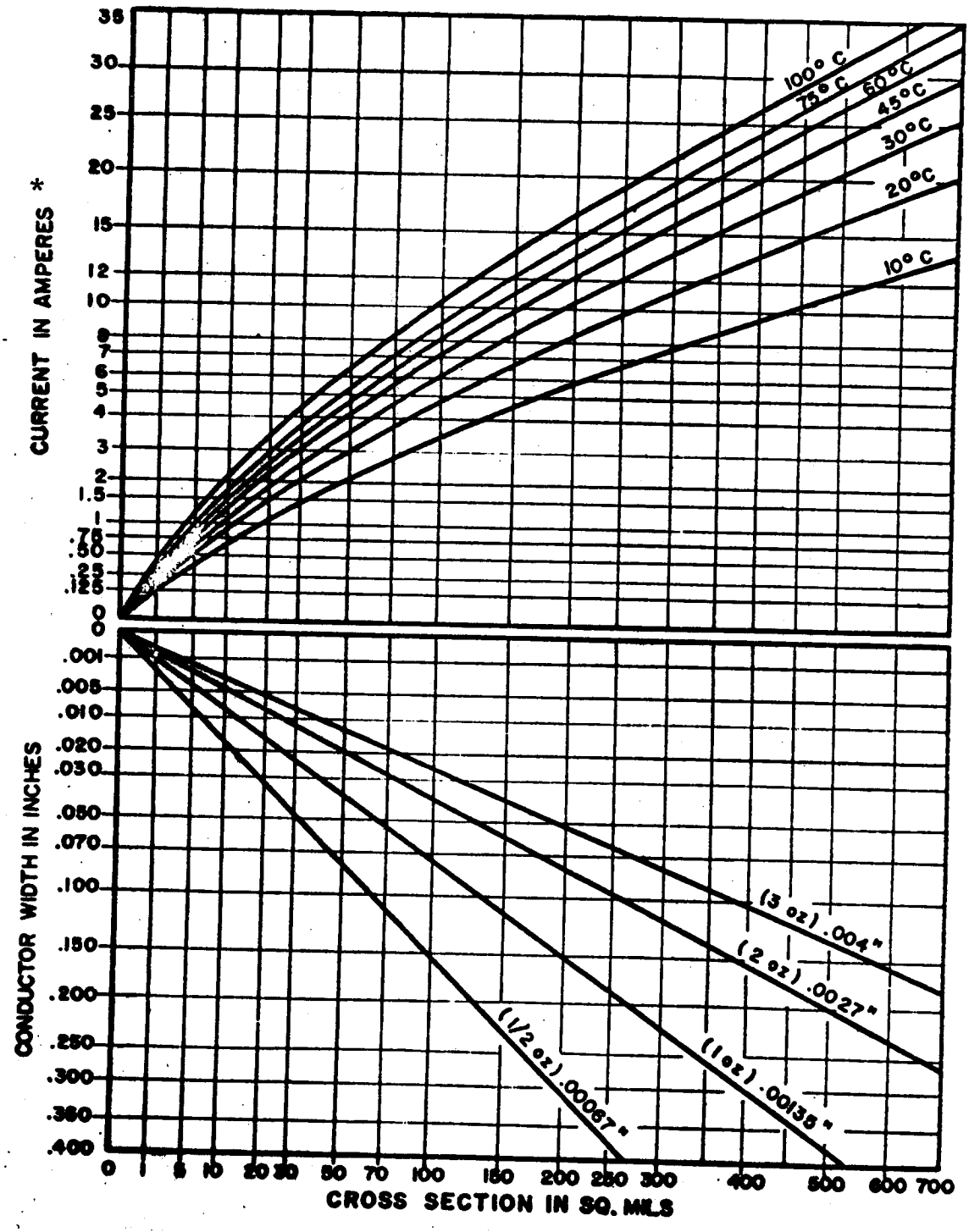


FIGURE 1. CONDUCTOR THICKNESS AND WIDTH.

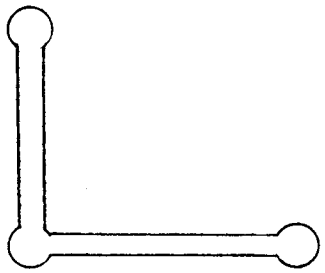
*Based on 1/16 inch boards. For thicker boards derate by 15%.

OGILVIE PRESS, INC., BROOKLYN 37, N. Y. STOCK NO. 4288M

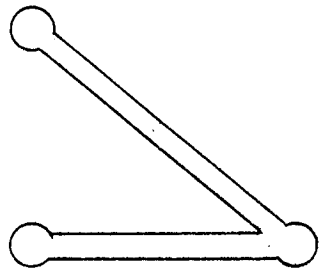
CONDUCTOR SPACING---INCHES Figure II

Sea Level to 10,000 feet Uncoated Board Normal Environment	Sea Level to 10,000 feet Uncoated Board Severe Contamination	Sea Level to 10,000 ft Coated Board	Over 10,000 feet Uncoated Board	Over 10,000 feet Coated Board	Voltage Between Conductors (DC or AC Peak)
0.020	0.080	0.020	0.026	0.022	0----50
0.026	0.080	0.022	0.062	0.030	50---100
0.026	0.080	0.022	0.125	0.060	50---150
0.062	0.125	0.030	0.125	0.060	50---170
0.062	0.125	0.030	0.250	0.125	50---250
0.062	0.125	0.030	0.500	0.250	50---300
0.125	0.300	0.060	0.500	0.250	50---500
0.0003 inch per volt	0.0006 inch per volt	0.0002 inch per volt	0.001 inch per volt	0.0005 inch per volt	Greater than--500

FIGURE III (Para. 4.4)

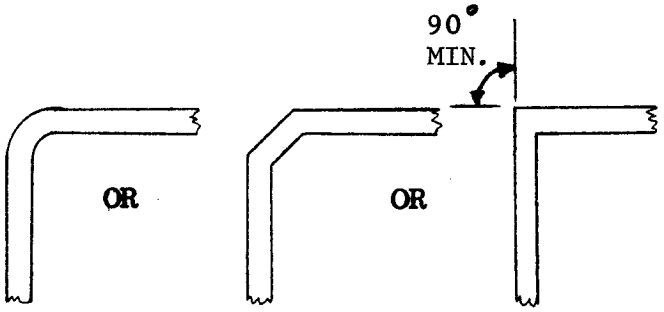


CORRECT

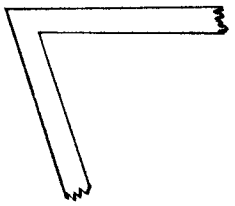


INCORRECT

FIGURE IV (Para. 4.5)



CORRECT



INCORRECT

TMC SPECIFICATION NO. S -735

G

FRD COMPILED | CHECKED

TITLE: PRINTED WIRING BOARDS

APPROVED

FIGURE V (Para. 10.4) EDGE BOARD CONNECTOR

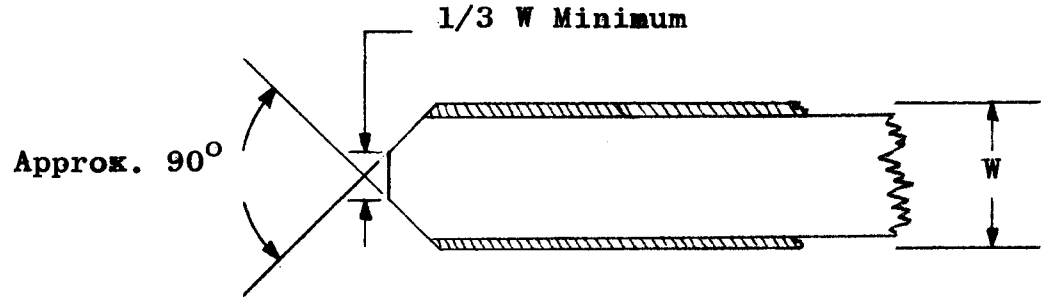


FIGURE VI (Para. 15.2 and 15.5) LEAD TERMINATION

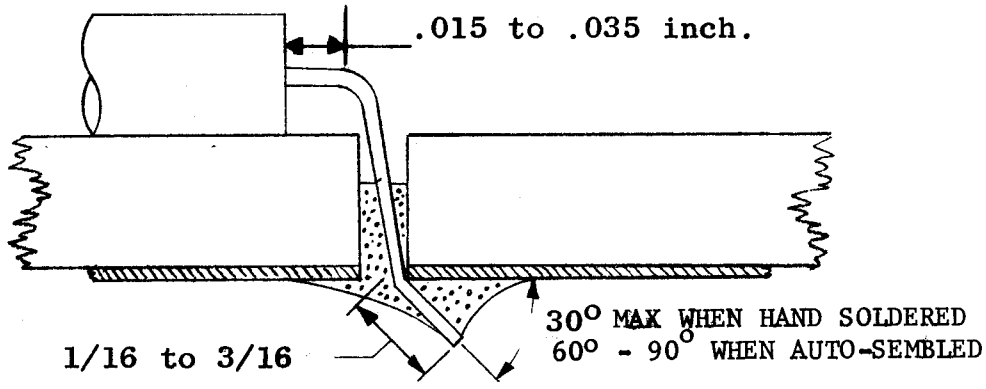


FIGURE VII (Para. 15.3) INTERFACIAL CONNECTION
(Direction of Clinch is Optional)

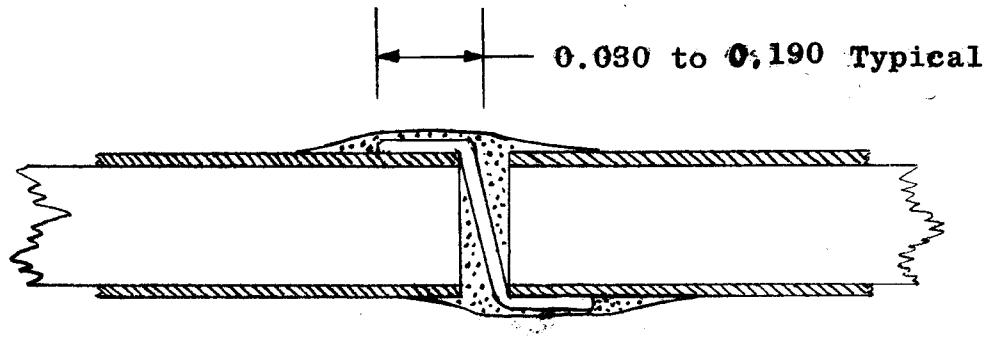


FIGURE VIII (Paragraph 4.3.2)

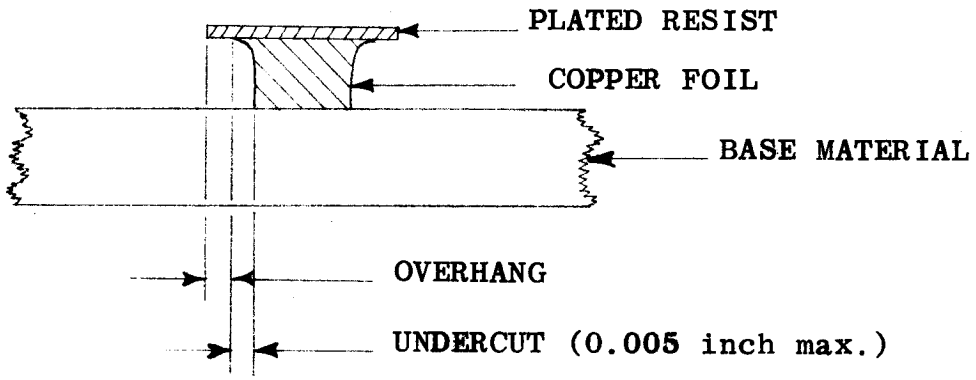
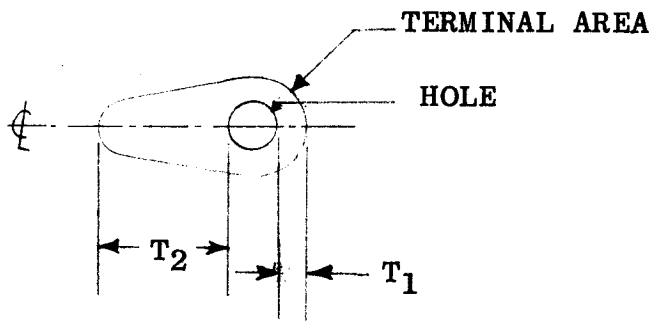


FIGURE IX (Paragraph 8.7)



$$\text{Eccentricity} = \left(\frac{T_2 - T_1}{2}\right) - R \qquad \text{For two-sided boards}$$

where R = Registration Error

$$\text{Eccentricity} = \frac{T_2 - T_1}{2} \qquad \text{For one-sided boards}$$

Approximate capacity of conductors (pfd per inch)

SPACING	MATERIAL		
	XXXP	MELAMINE	TEFLON
1/32 inch	1.05	1.25	0.33
1/16 inch	0.85	1.10	0.26
1/8 inch	0.72	0.90	0.22

Approximate resistance of conductors (ohms per inch)

$R = \frac{0.000503}{W}$ for 1 ounce copper

$R = \frac{0.000226}{W}$ for 2 ounce copper

$R = \frac{0.000135}{W}$ for 3 ounce copper

Where W = width of conductor in inches.

Based on 100% conductivity of copper at 20°C.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 430M

Characteristics of printed switches and commutator discs.

CONDUCTOR PATTERN	PLATING	BASE	(RPM) SPEED	LIFE
Raised	.001 to .003 silver	phenolic or epoxy	0 to 300	up to 1,000,000
Raised	nickel and rhodium	phenolic or epoxy	0 to 500	up to 50,000,000
Flush	nickel and rhodium	melamine or epoxy	0 to 2,000	greater than 50,000,000

BRUSH MATERIALS: Gold alloy contacts, silver-graphite contacts and plated phospher-bronze brushes, when operated with contact pressures between 2 and 20 grams, give the most satisfactory results.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 4304

TMC SPECIFICATION NO. S-735

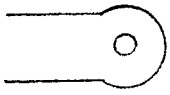
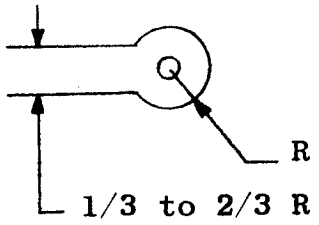
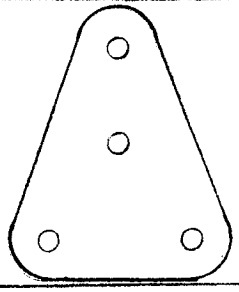
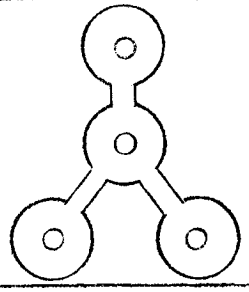
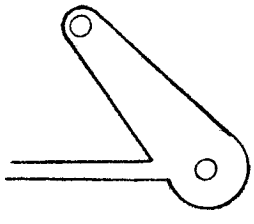
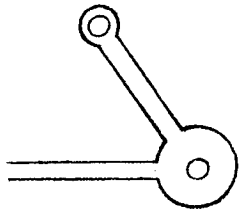
(6)

FRD COMPILED | CHECKED

TITLE: PRINTED WIRING BOARDS

APPROVED

APPENDIX II

NOT RECOMMENDED	PREFERRED
 Non-symmetrical solder fillet will result.	
 Fillet will flow solder away from conductor.	Conductor will flow solder away from fillet. 
	
 Non-symmetrical solder fillet will result.	
 Non-symmetrical solder fillet will result.	
 Conductor in center hole will pull solder from outside conductors.	
Solder will bleed towards larger terminal area.. 	

FRD

GUIDE FOR BASE MATERIAL QUALIFICATIONS

WARP (inches per inch MAX.)

THICKNESS	MATERIAL	
	PAPER BASE	GLASS BASE
1/16 single sided board	0.025	0.010
3/32 single sided board	0.020	0.008
1/8 single sided board	0.012	0.006
1/4 single sided board	0.006	0.005
All double sided boards	0.007	0.005

BOND STRENGTH (pounds MINIMUM)

BASE MATERIAL	COPPER	STRENGTH
Paper	1 oz.	6
Paper	2 oz.	8
Glass	1 oz.	7
Glass	2 oz.	9

DISSIPATION FACTOR (at 1.0Mc)

XXXP 0.035 MAX.

G-10 0.025 MAX.

DIELECTRIC CONSTANT (at 1.0Mc)

XXXP 4.80 MAX.

G-10 4.50 MAX.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 43004

UNDERWRITERS LABORATORY APPROVAL

1. Actual circuitry samples with various width conductors are subjected to dip soldering and simulated dip soldering. Bond tests are made of each sample.

2. Three samples are placed in an air oven at 128° C for 1344 consecutive hours(56 days).

3. Three samples are placed in a relative humidity of 83.5 to 86.5% at 33.5° C for 1344 hours.

4. Three remaining samples are placed first in an air oven for 168 hours(7 days), then in humidity for 168 hours, and the cycle repeated for a total of 1344 hours.

5. All samples are bond tested at room temperature.

6. Samples are subjected to arcing , dielectric strength , And fire hazard tests.

OGILVIE PRESS, INC., BROOKLYN 17, N. Y. STOCK NO. 4504M

APPENDIX V
(For Reference Only)

RELIABILITY OF FINISHED PRINTED WIRING BOARD ASSEMBLIES

From MIL-R-27070:

The mean operating time between independent failures shall not be less than that specified in the detailed equipment specification. When not specified therein, the MTBF shall not be less than that given by the following formula:

$$\text{MTBF (in hours)} = \frac{1}{(30 \times 10^{-6}N_t + 15 \times 10^{-6}N_m + 2 \times 10^{-6}N_s + 0.5 \times 10^{-6}N_c)}$$

N_t = Number of tube envelopes

N_m = Number of motors and relays

N_s = Number of semiconductor diodes and transistors

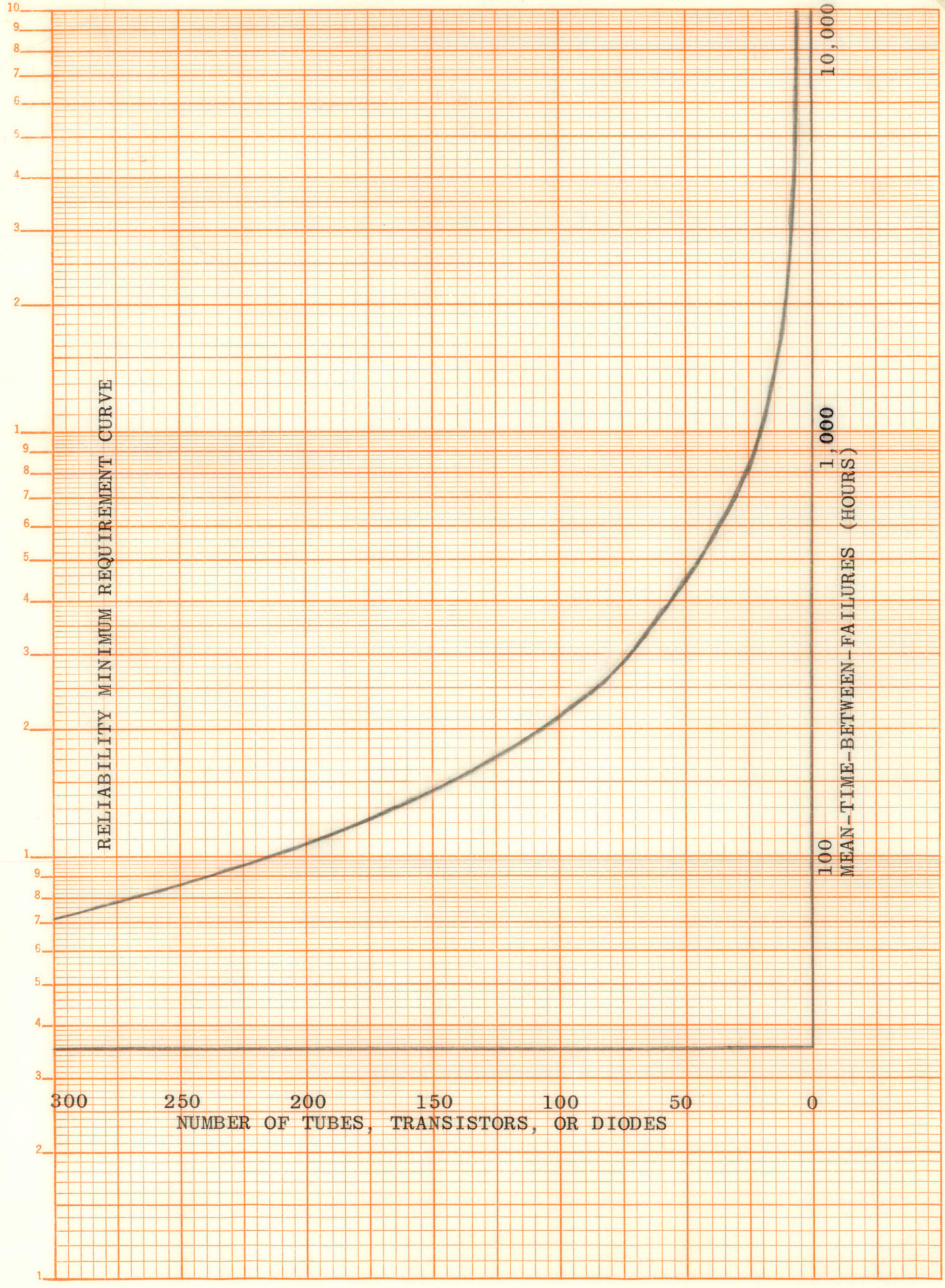
N_c = Number of remaining electrical and electrical-mechanical parts

From MIL-R-22256:

The MTBF of interdependent assemblies shall not be less than that specified in the following chart. (See Figure X)

The MTBF of nondependent assemblies shall not be less than three(3) times that specified in the following chart (See Figure X) nor less than four thousand hours for those non-dependent assemblies not containing tubes.

NOTE: For reliability of printed wiring boards without components, see MIL-HDBK-217 (Fig. 50A and 50B).



typed by ev 8/10/65

DELETED