MILITARY STANDARD

STANDARD GENERAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT

TO ALL HOLDERS OF MIL-STD-454K:

1. THE FOLLOWING PAGES OF MIL-STD-454K HAVE BEEN REVISED AND SUPERSEDE THE PAGES LISTED:

NEW PAGES	DATE	SUPERSEDED PAGES	DATE
2-1	26 Feb 87	2-1	30 Aug 83
3-1	26 Feb 87	3-1	10 Jan 83
5-1 thru 5-24	26 Feb 87	5-1 thru 5-24	15 Mar 80
14-1 thru 14-2	26 Feb 87	14-1 thru 14-2	29 Aug 86
17-1 thru 17-2	26 Feb 87	17-1 thru 17-2	30 Jun 85
18-1	26 Feb 87	18-1	1 Mar 85
22-1	26 Feb 87	22-1	30 Jul 82
46-1 thru 46-2	26 Feb 87	46-1 thru 46-2	15 Aug 81
50-1	26 Feb 87	50-1 thru 50-2	29 Aug 80
53-1 thru 53-2	26 Feb 87	53-1 thru 53-2	1 Sep 82
57-1	26 Feb 87	57-1	15 Aug 81
60-1	26 Feb 87	60-1	10 Sep 79
64-1 thru 64-3	26 Feb 87	64-1 thru 64-3	14 Feb 86
I1-1 thru I1-6	26 Feb 87	I1-1 thru I1-6	29 Aug 86

2. MAKE THE FOLLOWING PEN AND INK CHANGE:

Requirement 19, paragraph 2 - Delete the title of MIL-T-15659 and substitute "Terminal, Lug, Solder, Copper and Phosphor Bronze".

3. RETAIN THIS NOTICE AND INSERT BEFORE TABLE OF CONTENTS.

4. Holders of MIL-STD-454K will verify that page changes and additions indicated above have been entered. This notice page will be retained as a check sheet. This issuance, together with appended pages, is a separate publication. Each notice is to be retained by stocking points until the Military Standard is completely revised or cancelled.

Custodians:
Army - ER
Navy - AS
Air Force - 11

Review activities:
Army - AR, AV, CR, ME, MI
Navy - EC, OS, SH
Air Force - 17, 19, 85
DLA - ES, IS
FAA

Preparing activity:
Air Force - 10

Agent:
Air Force - 11

Project GDRQ-0048

FSC GDRQ

REQUIREMENT 2

CAPACITORS

1. Purpose. This requirement establishes criteria for the selection and application of capacitors.

2. Documents applicable to Requirement 2:

MIL-C-39006/22	Capacitors, Fixed, Electrolytic (Nonsolid Electrolyte), Tantalum, (Polarized, Sintered Slug), 85°C (Voltage Derated to 125°C), Established Reliability, Style CLR79
MIL-C-39018	Capacitor, Fixed, Electrolytic (Aluminum Oxide), Established Reliability and Non-Established Reliability, General Specification for
MIL-STD-198	Capacitors, Selection and Use of

3. Selection. Capacitors shall be selected and applied in accordance with MIL-STD-198.

3.1 Variable, compression type. Compression (spring plate) type variable capacitors shall not be used.

3.2 Fixed, paper dielectric. Paper, paper-plastic, and metallized paper capacitors in molded cases shall not be used.

3.3 Fixed, tantalum electrolytic. The use of wet slug tantalum capacitors (except tantalum cased units in accordance with MIL-C-39006/22) requires the approval of the procuring activity. For Naval Air Systems Command, silver cased tantalum capacitors shall not be used and tantalum cased capacitors require approval.

* 3.4 Fixed, aluminum electrolytic. Fixed electrolytic (aluminum oxide) capacitors shall conform to MIL-C-39018 and shall be selected from MIL-STD-198.

REQUIREMENT 3

FLAMMABILITY

* 1. Purpose. This requirement establishes criteria for the determination of flammability of materials.

2. Documents applicable to Requirement 3:

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
ASTM D568-77	Rate of Burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position, Test Method for
ASTM D635-81	Rate of burning and/or Extent and Time of Burning of Self-supporting Plastics in a Horizontal Position, Test Method for
ASTM D1000-82	Pressure-Sensitive Adhesive Coated Tapes Used for Electrical Insulation, Methods of Testing
UL 94	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

3. General. Flammability is a complex characteristic which combines ease of ignition, surface flammability, heat contribution, smoke production, fire gasses, and fire endurance. Flammability is a function of chemical composition, physical configuration, temperature, availability of oxygen, and retardants or additives.

* 4. Tests. Materials used in military equipment shall be nonburning or self extinguishing. The test used to determine the flammability of material shall be the test specified in the material specification. Since some materials may change state or characteristics relative to flammability during application, tests may be performed on the end item materials mixed/blended/saturated/impregnated/layered and processed to simulate the final configuration in the end equipment usage.

* 4.1 If the specification does not have such a test, testing shall be in accordance with ASTM D568, ASTM D635, ASTM D1000, or MIL-STD-202, Method 111, as applicable.

* 4.2 Materials not covered by the above tests shall be tested in accordance with a procedure approved by the procuring activity. UL94 is a useful guide to develop test methods and offers a comparative scale to define degree of flammability.

5. Additives. Fire retardant additives may be used provided they do not adversely affect the specified performance requirements of the basic materials. Fire retardance shall not be achieved by use of nonpermanent additives to the basic material.

REQUIREMENT 5

SOLDERING

1. Purpose. This requirement establishes procedures for making soldered electrical and electronic connections.

* 1.1 Applicability. Requirement 5 shall not be used during the manufacture of hardware for the US Navy. The latest revision of WS-6536 shall be used as the soldering requirements for Navy contracts. In the event of conflict between the requirements of this paragraph and other contractual requirements, differences shall be referred to the Government Contracting Officer prior to proceeding.

* 2. Documents applicable to Requirement 5:

O-E-760	Ethyl Alcohol (Ethanol), Denatured Alcohol, and Proprietary Solvents
O-T-236	Tetrachloroethylene (Perchloroethylene) Technical Grade
QQ-S-571	Solder; Tin Alloy; Tin-Lead Alloy; and Lead Alloys
TT-I-735	Isopropyl Alcohol
MIL-F-14256	Flux, Soldering, Liquid (Rosin Base)
MIL-P-28809	Printed Wiring Assemblies
MIL-P-50884	Printed Wiring, Flexible, General Specification for
MIL-T-81533	Trichloroethane 1, 1, 1(Methyl Chloroform) Inhibited, Vapor Degreasing
MIL-P-81728	Plating, Tin-Lead (Electrodeposited)
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-750	Test Methods for Semiconductor Devices
MIL-STD-883	Test Methods and Procedures for Microelectronics
WS-6536	Procedures and Requirements for Preparation and Soldering of Electrical Connections

3. Materials

* 3.1 Flux. Rosin fluxes conforming to types R or RMA of MIL-F-14256 shall be used for making electrical and electronic connections except that type RA flux of MIL-F-14256 may be used on assemblies which will subsequently be tested for and conform to the cleanliness requirements of MIL-P-28809. However, solid wires with sleeve type insulation or stranded or braided wires shall not be soldered utilizing type RA flux. For the Army Laboratory Command, Communications-Electronics Command, and Aviation Systems Command, the use of RA flux requires approval. For fluxing purposes, a soldered joint which functions as both a mechanical and an electrical connection (for example, in grounding applications through a chassis) shall be considered an electrical connection.

3.2 Solder. Unless otherwise specified by the procuring activity, the solder alloy shall conform to composition Sn60, Sn62, or Sn63 of QQ-S-571. The flux of flux-cored solder shall be type R or RMA of QQ-S-571, except that the core may be type RA flux in solder used only on assemblies and connections which will subsequently be tested for and conform to the cleanliness requirements of MIL-P-28809. However, stranded or braided wires or solid wires with sleeve type insulation shall not be soldered utilizing type RA flux. For the Army Commands listed in 3.1, the use of RA flux requires approval.

4. Preparation of conductors and terminals

4.1 Stripping insulation. Sufficient insulation shall be stripped from the wire or leads to provide for insulation clearances as specified in 5.1.4. In stripping insulation, care should be taken to avoid nicking or otherwise damaging the wire or the remaining insulation. The number of damaged or severed strands in a single lead shall not exceed the limits given in table 5-I. Leads used at a potential of 6kV or greater shall have no broken strands. Insulation discoloration resulting from thermal stripping is permissible.

TABLE 5-I. Limits.

Number of strands	Maximum allowable nicked or broken strands
Less than 7	0
7-15	1
16-18	2
19-25	3
26-36	4
37-40	5
41 or more	6

4.2 Cleaning of conductors and terminals. Conductor surfaces to be soldered shall be clean prior to soldering. Cleaning may be as follows:

a. Grease and oil shall be removed from conductors and terminals by applying a noncorrosive solvent such as: 1, 1, 1-trichloroethane conforming to MIL-T-81533; ethyl alcohol conforming to O-E-760, type III or isopropyl alcohol conforming to TT-I-735; or tetrachloroethylene conforming to O-T-236.

b. Oxides and varnishes shall be removed by methods which do not damage leads or parts, and which do not cause contamination or hinder solder wetting.

c. Sand blasting shall not be used.

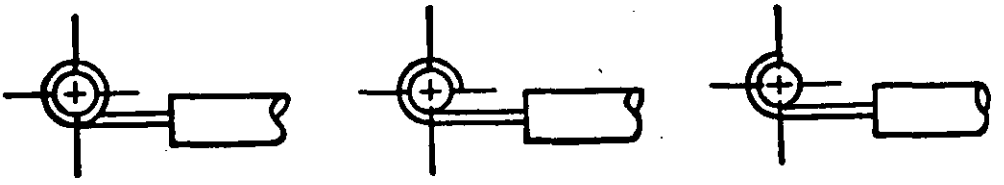
d. Dust or other loose matter shall be removed.

4.3 Pretinning (presolder coating) conductors and terminals. Wire and part leads, with or without attached terminals, shall meet the solderability requirements of Method 2026.3 of MIL-STD-750 for semiconductors, Method 2003.2 of MIL-STD-883 for microelectronics, and Method 208 of MIL-STD-202 for other electrical and electronic component parts. Pretinning (presolder coating) of electroplated tin-lead in accordance with MIL-P-81728, or hot dip solder which is 0.0003 inch minimum thickness may be used on parts which will subsequently be soldered. Tinning of a stranded wire shall not obscure the wire contour at the termination end of the insulation to permit inspection of the wire for damage. Heat sinks shall be applied to leads of heat sensitive parts during the tinning operation. The preconditioning/pretinning solder pot shall be maintained in accordance with 7.4.2. Wicking, the capillary flow of solder along the wire, is permitted; however, solder shall not obscure the contour of the conductor at the termination of the insulation. The leads of all devices to be planar mounted shall be pretinned prior to installation.

5. Attachment of wires and leads

5.1 Attachment of wires and leads to terminals

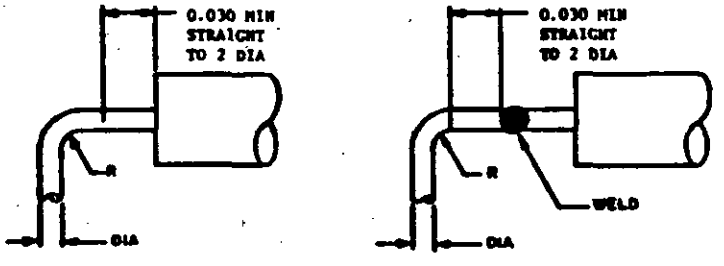
5.1.1 Wire and lead wrap-around. Leads and wires shall be mechanically secured to their terminals before soldering. Such mechanical securing shall prevent motion between the parts of a joint during the soldering operation. Leads and wires shall be wrapped around terminals for a minimum of one-half and not more than one full turn in a single layer only (see figure 5-1). For AWG 30 or smaller wire, a maximum of 3 turns may be used. Exception is made in the case of those small parts used for terminating conductors and to which such mechanical securing would be impracticable, such as connector solder cups, slotted terminal posts, heat shrinkable solder devices, etc. Lead extension shall be restricted to the limits required by design to prevent equipment malfunction. In no case shall wires be wrapped on each other.



a. Full Turn b. 3/4 Turn c. 1/2 Turn

FIGURE 5-1. Wire and lead wrap around.

5.1.2 Lead bends. The distance between the body of the part or weld and the bent section of a lead shall be at least twice the diameter of the lead but not less than 0.030 inch. Radii of bends shall conform to figure 5-2.

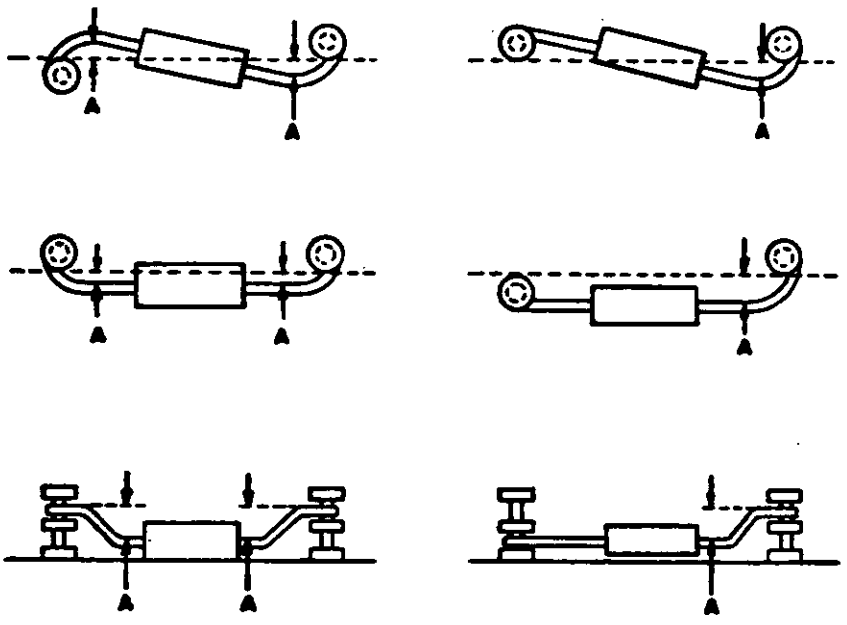


a. Standard Bend b. Welded Bend

LEAD DIA (inch)	MINIMUM RADIUS (R)
up to 0.027	1.0 D
from 0.028 to 0.047	1.5 D
0.048 and larger	2.0 D

FIGURE 5-2. Lead bend.

5.1.3 Stress relief. Axial or opposed lead devices with leads terminating at a connection point shall have a minimum lead-connection-to-body offset of at least 2 lead diameters or thicknesses (but not less than 0.030 inch) as an allowance for stress relief to minimize tensile or shear stress to the soldered connection or part during thermal expansion. Where the component body will not be secured to the mounting surface by bonding, coating or other means, the lead(s) on only one of the opposing sides of the component need be so configured. Typical examples of stress relief are included in figure 5-3.



A ≥ 2 times lead diameter or thickness but not less than 0.030 inch

FIGURE 5-3. Typical stress relief bends.

5.1.4 Insulation clearance. Clearance between the end of the insulation and the solder of the connection shall be as follows:

a. Minimum clearance: The insulation shall not be imbedded in the solder joint. The contour of the conductor shall not be obscured at the termination end of the insulation.

b. Maximum clearance: Clearance shall be less than two wire diameters (including insulation) or 0.060 inch, whichever is larger, but shall not permit shorting between adjacent conductors.

5.2 Attachment of wires and leads directly to printed terminal areas. Direct attachment of wires and leads to printed terminal areas shall conform to MIL-STD-275 or MIL-P-50884, as applicable. Wire insulation clearance shall conform to 5.1.4.

6. Manual soldering

6.1 Precleaning. Cleanliness of part leads and printed wiring surfaces shall be sufficient to insure solderability.

6.2 Applying flux. When used, liquid flux shall be applied in a thin, even coat to those surfaces being joined prior to application of heat. Cored solder wire shall be placed in such a position that the flux can flow and cover the joint as the solder melts. Flux shall be so applied that no damage will occur to surrounding parts and materials.

6.3 Applying heat. The areas to be joined shall be heated to cause melting of the solder and wetting of the surfaces. Excessive time (slow heating) and excessive temperature shall be avoided to prevent unreliable joints and damage to parts. Heat sinks shall be used for the protection of parts, as required. Parts, wire insulation, or printed wiring boards which have been charred, melted, or burned shall be replaced. When heat has caused part materials to discolor, further evaluation shall be performed to ascertain whether the essential properties have been adversely affected; if so, the item shall be replaced.

6.4 Applying solder. The areas to be joined shall be at the correct temperature, then the solder shall be applied to the joint and not to the soldering iron; however, a very small quantity of solder may be applied at the place where the iron tip touches the joint to improve heat transfer. When the solder-preform method is used, the solder may be applied to the joint prior to heating.

6.5 Cooling. No liquid shall be used to cool a soldered connection. The connection shall be cooled in air at room temperature only. Heat sinks may be used to expedite cooling. The connection shall not be subjected to movement or stress at any time during the cooling and solidification of the solder.

6.6 Resoldering. Care should be taken to avoid the need for resoldering. When resoldering is required, the quality standards for the resoldered connection shall be the same as for the original connection. A cold solder or disturbed joint will require only reheating and reflowing of the solder.

6.7 Flux residue removal. Flux residues shall be removed within one hour after soldering by applying appropriate noncorrosive solvents as specified in 4.2.a and drying. Mechanical means such as agitation, brushing, etc, may be used in conjunction with the solvents. The cleaning solvents and methods used shall have no deleterious effect on the parts, connections, and materials being cleaned. Ultrasonic cleaning may damage certain parts, particularly transistors, and should generally be avoided.

7. Automatic soldering for printed wiring assemblies

7.1 Precleaning. Cleanliness of the part leads and printed wiring surfaces shall be sufficient to insure solderability.

7.2 Flux application. Liquid flux shall be applied by the dip, spray, brush, roll, wave, or foam method and shall form a thin coating on the surface. The flux may be thinned as necessary to meet the requirements on flux application; however, the flux shall still meet the requirements of 3.1. Drying the flux to a tacky consistency before wave soldering will prevent solder splatter.

7.3 Preheating. Preheating the printed wiring assembly before soldering is advisable and will improve solder flow and reduce the required dwell time. The preheat temperature shall not exceed the maximum temperature rating of parts.

7.4 Solder bath. The solder bath shall be maintained at a temperature of 232° to 288°C (450° to 550°F). The temperature and the time of contact between the assembly and the solder shall be dependent upon such factors as preheating, thickness of board, number of contacts or conductors, and the type of parts. The period of exposure of any printed wiring board to a solder bath shall be limited to a duration which will not cause damage to the board or parts mounted thereon. In no case shall the temperature or length of time be such as to cause damage to heat-sensitive parts. Periodic inspections of the solder bath shall be made to insure that contamination levels meet the requirements of 7.4.1b.

7.4.1 Maintenance of solder purity. To maintain the proper purity of solder, the following procedures shall be adhered to in wave soldering of printed wiring assemblies.

a. Before soldering a printed wiring board, all dross appearing on the surface shall be removed. To prevent contamination of the solder, stainless steel or polytetrafluoroethylene (TFE) shall be used for stirring solder and removing dross. Dross blankets may be used provided the blankets do not contaminate the solder.

b. If the amount of any individual contaminant or the total of contaminants listed exceeds the percentages specified in table 5-II, the solder shall be replaced or altered to be brought within specifications.

7.4.2 Inspection for solder purity. Solder in solder baths shall be chemically or spectrographically analyzed or renewed at the testing frequency levels shown in table 5-II, column B. These intervals may be lengthened to the eight-hour operating days shown in column C when the results of analyses provide definite indications that such action will not adversely affect the purity of the solder bath. If contamination exceeds the limits of table 5-II, intervals between analyses shall be shortened to those eight-hour operating days shown in column A or less until continued purity has been assured by analyses. Records containing the results of all analyses and solder bath usage shall be available to the procuring activity.

7.4.2.1 Guidelines. The information provided in the right column of Table 5-II is presented to assist in the monitoring of the soldering operation and may be used to indicate a need for increased frequency of testing, other than that shown in columns A, B, and C, to insure proper purity levels.

7.5 Flux residue removal. Flux residues shall be removed in accordance with 6.7.

7.6 Resoldering. The automatic soldering operation may be repeated once, provided that the reheating and resoldering does not introduce degradation of parts or printed wiring boards.

7.7 Touchup. Manual soldering as specified herein is permitted, if necessary, to remove solder projections, icicles, and bridges of solder, or to add solder to the part connection area. The quality standards for touchup shall be the same as for the original work.

8. Additional soldering procedures. It is not the intention of Requirement 5 to exclude other acceptable procedures for applying flux and solder in making soldered electrical connections. However, the methods used must produce completed solder joints equivalent to the acceptable joints described in this requirement. The following requirements apply: (See para 3, 4, 5, 6, 7, and appropriate subparagraphs.)

a. Preparation and cleanliness of parts and wires

b. Proper attachment of wires and leads

c. Materials - fluxes, solders, and cleaning solvents

d. Application of fluxes and solders

e. Temperature control

f. Postsoldering cleaning. Terminations made with devices having premeasured amounts of solder and type R or RMA flux encapsulated in a preformed, transparent, heat shrinkable, self-sealing insulating material do not require flux removal.

8.1 Typical procedures. The following are typical additional acceptable soldering procedures:

a. Dip (solder bath)

b. Hot-plate

c. Induction

d. Radiation

e. Hot-gas-blanket.

Table 5-II. Contamination Limits

Contaminant[1]	Solder Operation: Preconditioning (Lead/Wire Tinning)	Solder Operation: Assembly Soldering[2] (Pot, Wave, Etc.)	Testing Frequency 8 Hr Operating Day[3]: A	B	C	Solder Joint Characteristic Guidelines (If Solder is Contaminated)[4]
Copper Sluggish solder	.75 flow, solder hard and	.30 brittle	15	30	30	Sluggish solder flow, solder hard and brittle
Gold	.50	.20	15	30	30	Solder grainy and brittle
Cadmium	.01	.005	15	30	60	Porous and brittle solder joint, sluggish solder flow
Zinc	.008	.005	15	30	60	Solder rough and grainy, frosty and porous High dendritic structure
Aluminum	.008	.006	15	30	60	Solder sluggish, frosty and porous
Antimony	.20 → .50	.20 → .50	15	60	120	Not enough: Solder crumbles into white powder after low temperature aging Too much: Solder brittle
Iron	.02	.02	15	60	120	Iron tin compound FeSn2 is not solderable - Compound on surface presents resoldering problems
Arsenic	.03	.03	15	60	120	Small blister-like spots
Bismuth	.25	.25	15	60	120	Reduction in working temperature
Silver[5]	.75	.10	15	60	120	Dull appearance - retards natural solvent action
Nickel	.025	.01	15	60	120	Blisters, formation of hard insoluble compounds

Notes:
1. The tin content of the solder bath shall be from 59.5% to 63.5% tin and tested at the same frequency as testing for copper/gold contamination. The balance of the bath shall be lead and/or the items listed above.
2. The total of copper, gold, cadmium, zinc, and aluminum contaminants shall not exceed .4% for assembly soldering.
3. An operating day constitutes any 8-hour period, or any portion thereof, during which the solder is liquefied and used.
4. See paragraph 7.4.2.1.
5. Not applicable for Sn62 solder - limits to be 1.75 → 2.25 (both operations)

8.2 Soldering guns. Soldering guns shall not be used.

8.3 Steel wool. Steel wool shall not be used.

9. Definitions

9.1 Soldered connection. A soldered connection is an electrical connection which employs solder for bonding two or more metals with an alloy (solder).

9.2 Solder. Solder is a metallic alloy, usually of lead and tin, used to mechanically and electrically join metallic surfaces by solidification following the wetting action of the melted alloy.

9.3 Soldering. Soldering is a process in which metallic surfaces in close physical proximity are joined by the wetting and subsequent coalescence of liquid solder having a much lower melting point (generally below 204°C) than any of the metals being joined.

9.4 Terminals. A terminal is a tie-point device used for the purpose of making electrical connections. Solder type terminals in common use include: turret, bifurcated (slotted), hook, eye, tab, and solder cups.

9.5 Part lead. A part lead is a solid or stranded wire that serves as a connection and, in some cases, as mechanical support for small electronic parts or assemblies.

9.6 Lead extension. A lead extension is that part of a lead or wire that extends beyond the soldered connection.

9.7 Flux. Flux is a chemically active compound that is capable of promoting the wetting of metals with solder.

9.8 Wetting. Wetting is the free flow and spreading of solder on a metallic surface to form an adherent bond.

9.9 Cold solder joint. A cold solder joint is an unacceptable solder joint due to poor wetting and insufficient heat.

9.10 Rosin solder connection. A rosin solder connection is an unsatisfactory connection which contains entrapped flux.

9.11 Disturbed solder joint. A disturbed solder joint is an unsatisfactory connection resulting from relative motion between lead/wire and the terminal area during solidification of the solder.

9.12 Reflow soldering. Reflow soldering is a process for joining parts by tinning the surfaces, placing them together, heating until the solder fuses, and allowing to cool in the jointed position.

9.13 Dewetting. Dewetting is a condition which results when the molten solder has coated the surface and then receded leaving irregularly shaped mounds of solder separated by areas covered with a thin solder film; basis metal not exposed.

9.14 Nonwetting. Nonwetting is a condition wherein a surface has contacted molten solder but the solder has not adhered to all of the surface.

9.15 Excessive solder. Excessive solder is a condition resulting in an unsatisfactory connection because the contour of the elements of the connection are completely obscured or the solder has overflowed beyond the confines of the connection area.

9.16 Solder projection. A solder projection is an undesirable protrusion from a solidified solder joint or coating.

9.17 Planar mounted devices. Terms that apply to flat or round leads of planar mounted devices are defined in figure 5-4.

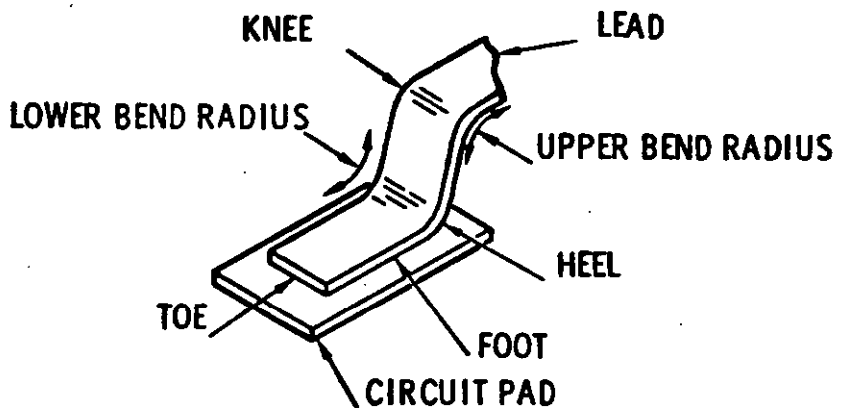
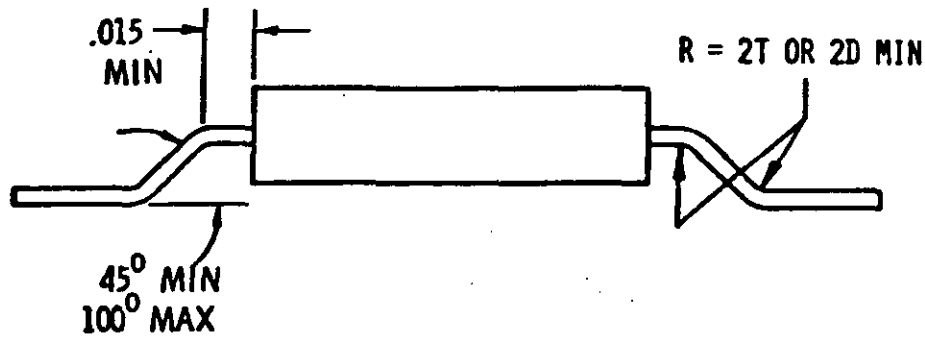


FIGURE 5-4. Planar mounted devices - definitions.

10. Workmanship. Workmanship shall be of a level of quality adequate to assure that the processed products meet the performance requirements of the applicable drawings and criteria delineated herein. The soldered connections shall have a smooth bright appearance with metallic luster and shall not have a chalky, gritty or irregular surface, nor exhibit protrusions, pits, or voids which expose basis metal or where the bottom of the pit or void is not visible.

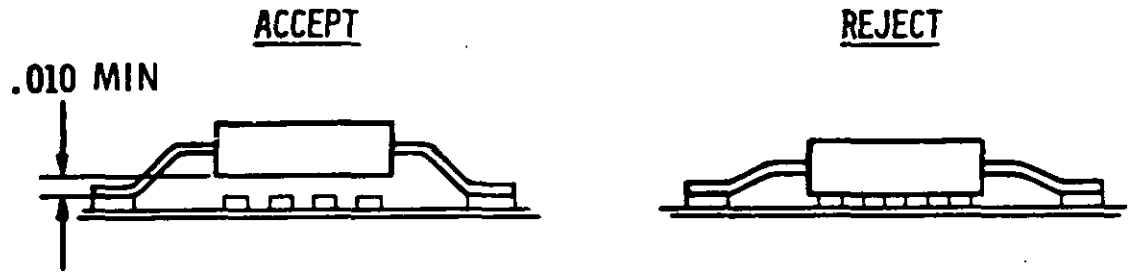
10.1 Inspection. Visual inspection of all soldered connections and assemblies shall be performed to determine conformance to the requirements specified herein.

11. Accept/reject criteria. Accept/reject criteria for soldered connections shall be in accordance with figures 5-5 through 5-35.



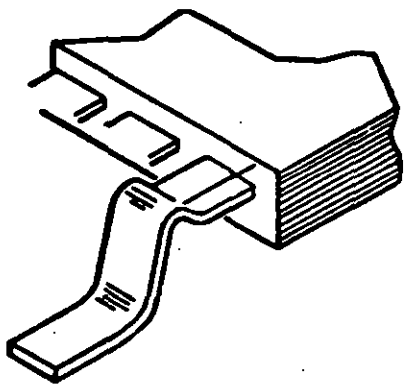
Leads shall be supported during forming to protect lead-to-body seal. Bends shall not extend into seal. Lead bend radius shall be two thicknesses or two wire diameters minimum. The angle of that part of the lead between the upper and lower bends in relation to the mounting pad shall be 45° minimum to 100° maximum.

FIGURE 5-5. Planar mounted devices - lead forming.



Parts mounted over protected surfaces, or surfaces without exposed circuitry, may be mounted flush. Parts with electrically conducting bodies over exposed circuitry shall have their leads formed to allow a minimum of .010 inch between the bottom of the component body and the exposed circuitry.

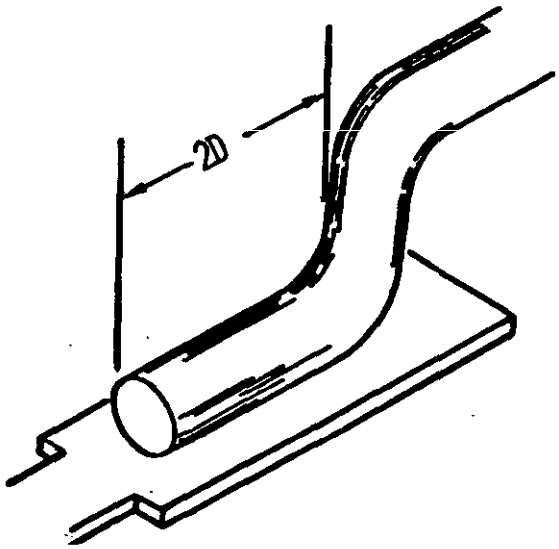
FIGURE 5-6. Planar mounted devices - lead forming.



Minor lead deformation shall be allowed, provided none of the following conditions exist:

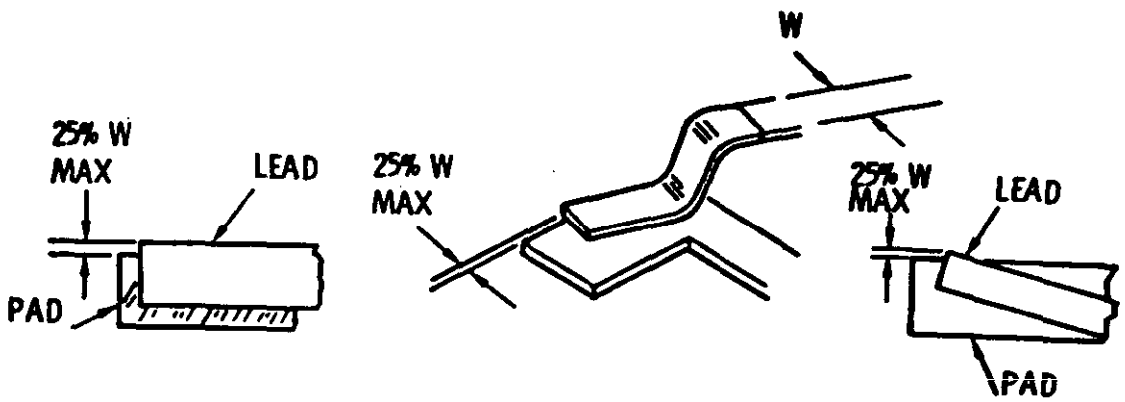
No evidence of a short or potential short deformation.
Lead or body is not damaged by the deformation.
Top of lead does not extend beyond top of body.

FIGURE 5-7. Planar mounted devices - lead forming.



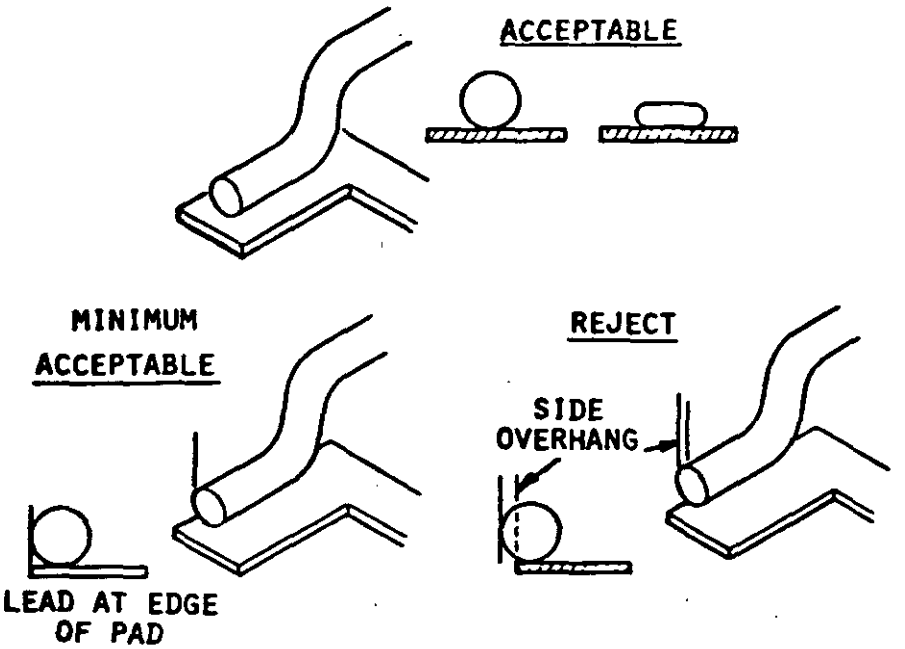
Minimum contact length shall be equal to the lead width for flat leads and two times the diameter (2D) for round leads. Heel must be completely over pad area.

FIGURE 5-8. Planar mounted devices - part placement.



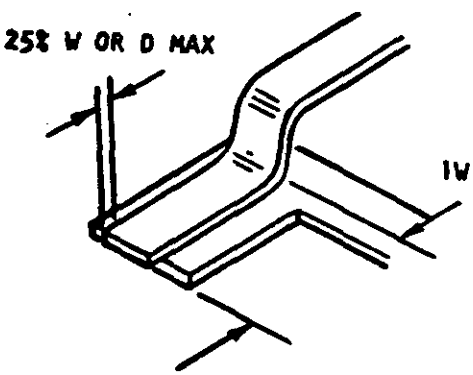
Flat leads may have side overhang, provided the overhang does not exceed 25% of the lead width and that minimum clearance is maintained.

FIGURE 5-9. Planar mounted devices - part placement.



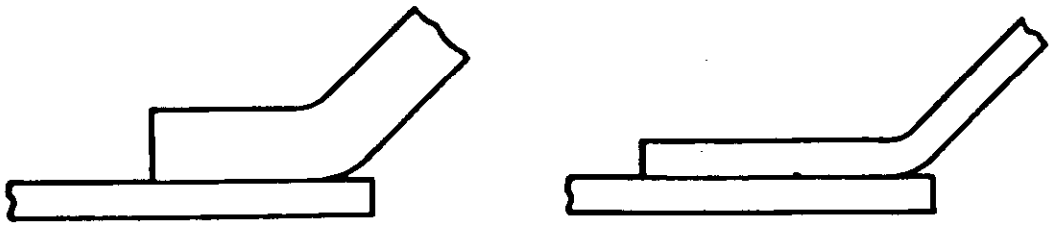
Round, flattened, or coined leads shall not exhibit any side overhang.

FIGURE 5-10. Planar mounted devices - part placement.



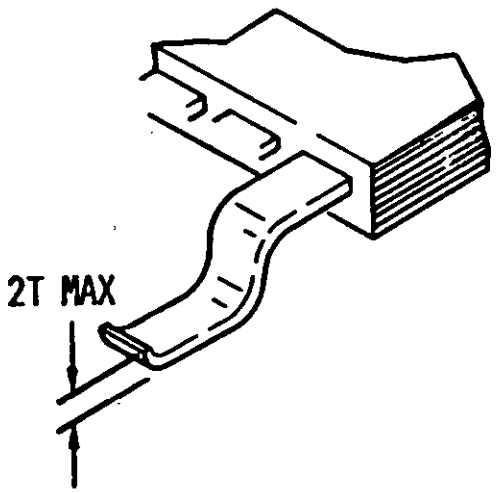
Toe end of leads may overhang the pad, provided the minimum conductor spacing is maintained, that the total overhang does not exceed 25% of the lead width or diameter (round leads), and that the minimum contact length is maintained.

FIGURE 5-11. Planar mounted devices - part placement.



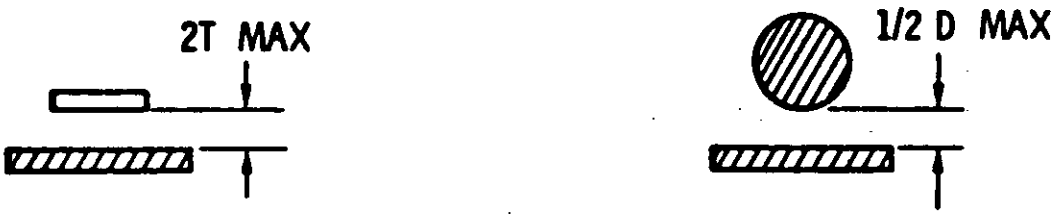
Round and flat leads shall be placed so that the heel does not extend beyond the edge of the pad.

FIGURE 5-12. Planar mounted devices - part placement.



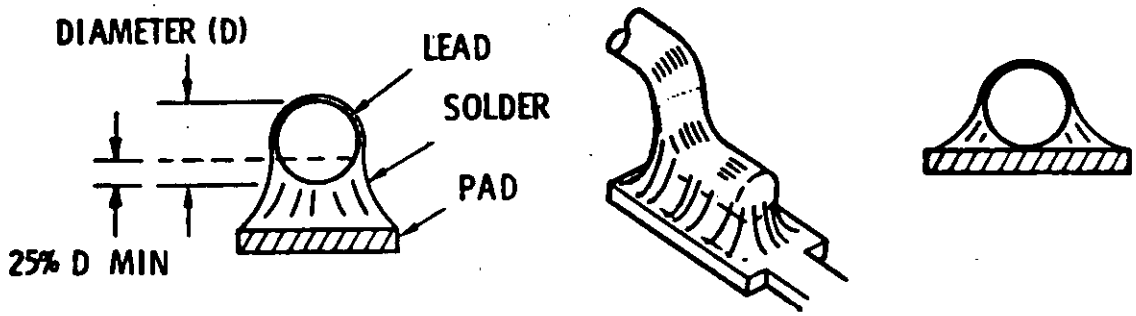
Toe curl, if present on leads, shall not exceed two times the thickness (2T).

FIGURE 5-13. Planar mounted devices - part placement.



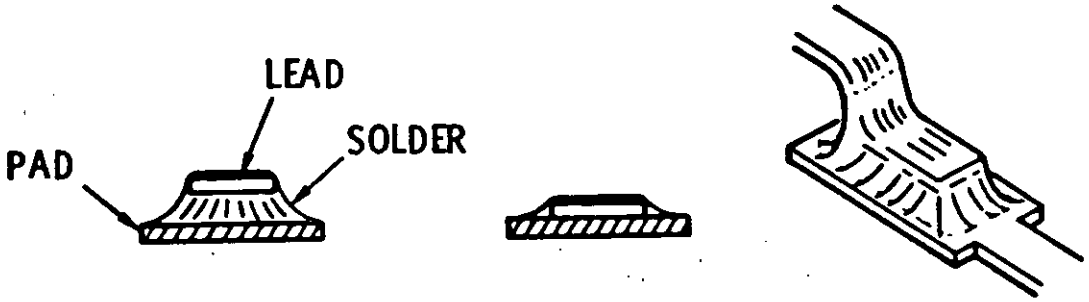
Lead may be raised off the pad surface a maximum of two lead thicknesses or 1/2 lead diameter.

Figure 5-14. Planar Mounted Devices - Part Placement



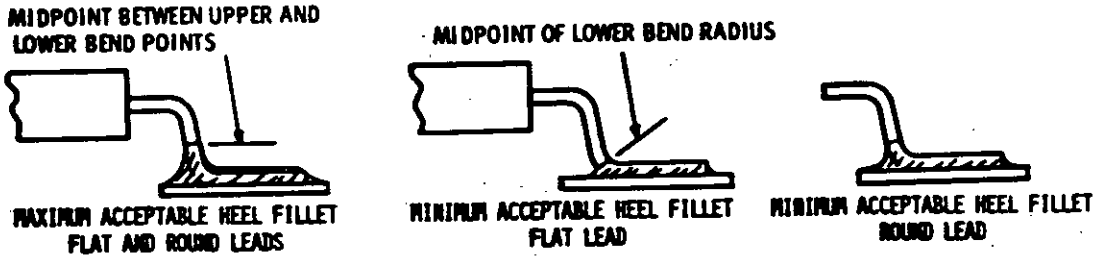
Minimum solder fillet height on round leads shall be 25% of the lead diameter. The outline of the lead must be discernible in the solder.

FIGURE 5-15. Planar mounted devices - solder fillets.



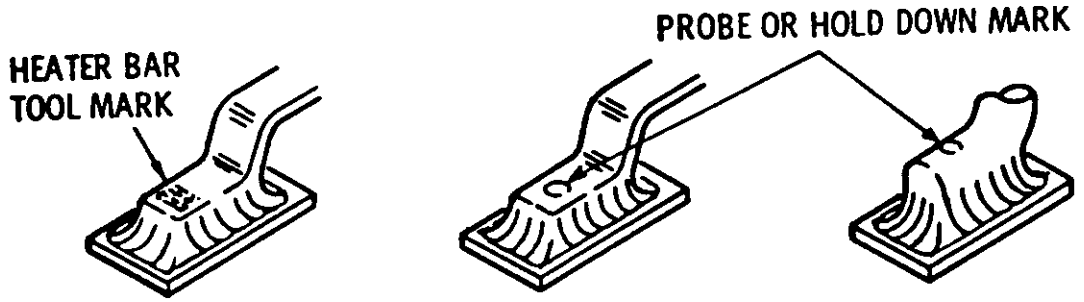
Flat leads shall exhibit a visible fillet rising from the pad to the top of the lead. The outline of the lead must be discernible in the solder.

FIGURE 5-16. Planar mounted devices - solder fillets.



The heel fillet shall be continuous between the heel of the lead and the circuit pad. The heel fillet shall extend to the midpoint of the lower bend radius for flat leads. The heel fillet shall extend beyond the full bend radius for round leads. The solder fillet for any lead shall not extend beyond the midpoint between the upper and lower bend points.

FIGURE 5-17. Planar mounted devices - solder fillets.



These tool marks shall not be cause for rejection.

FIGURE 5-18. Planar mounted devices - solder fillets.

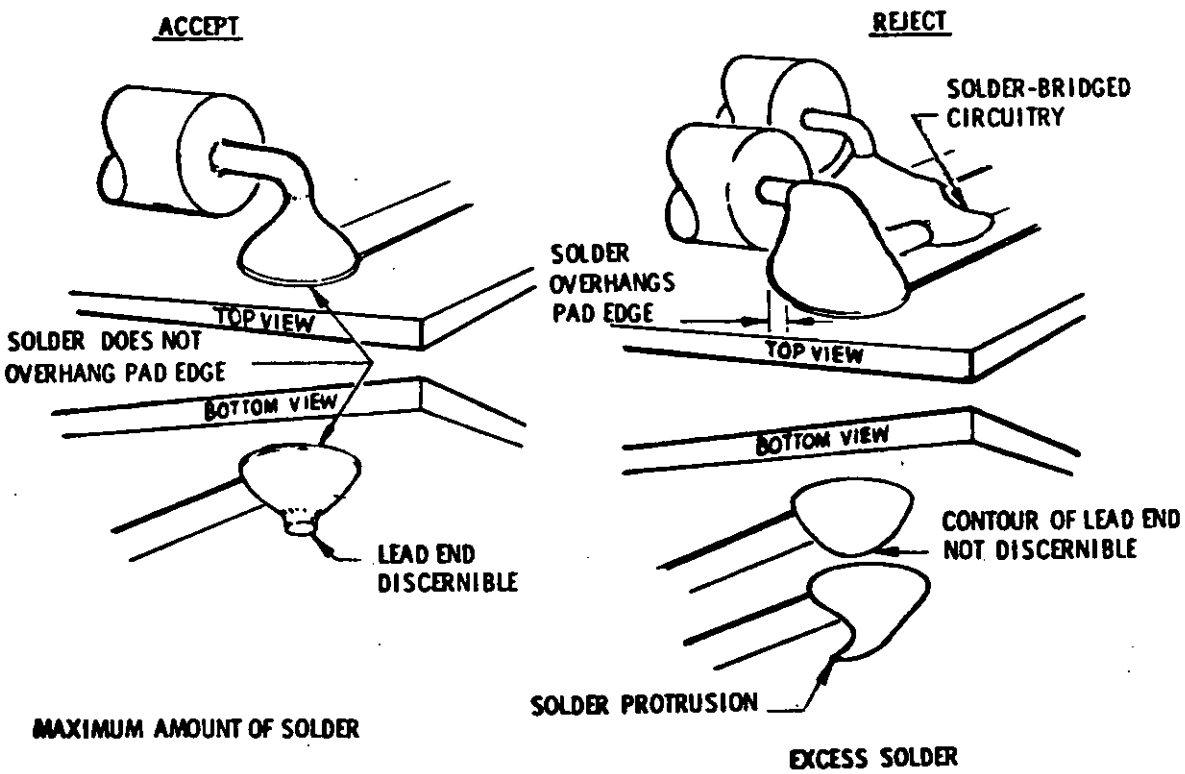


FIGURE 5-19. Plated-thru holes - amount of solder on joint.

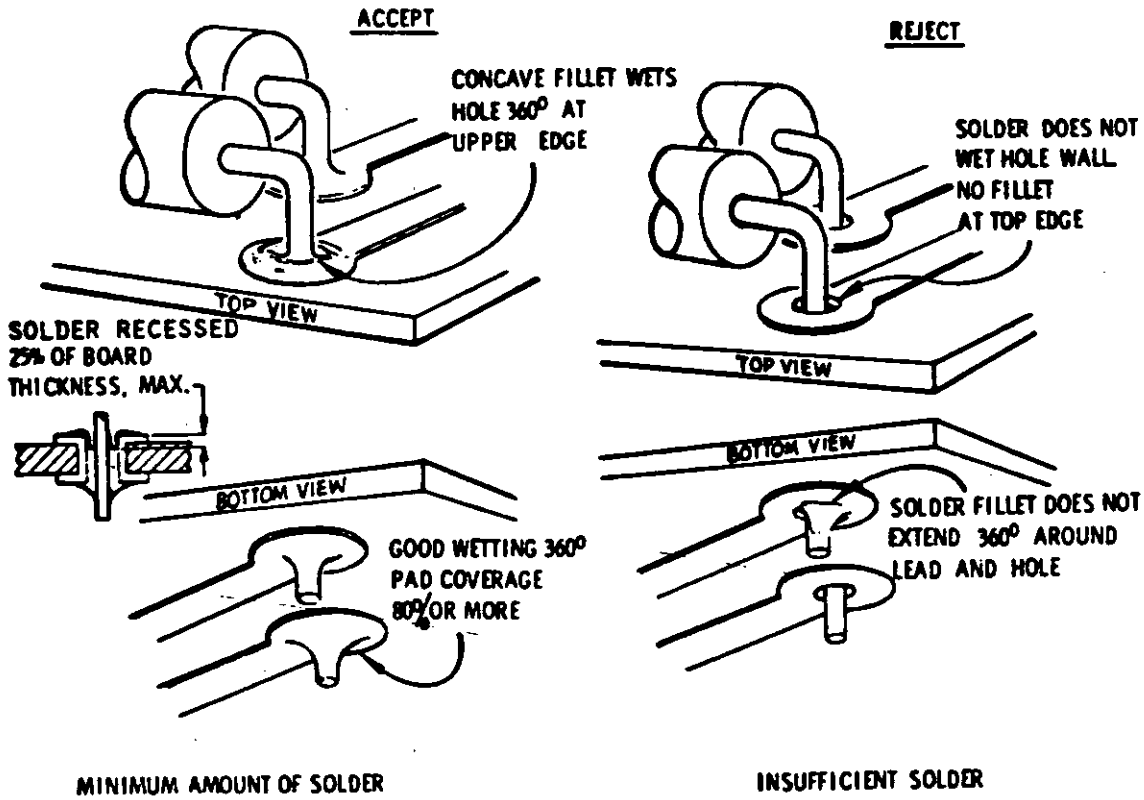


FIGURE 5-20. Plated-thru holes - amount of solder on joint.

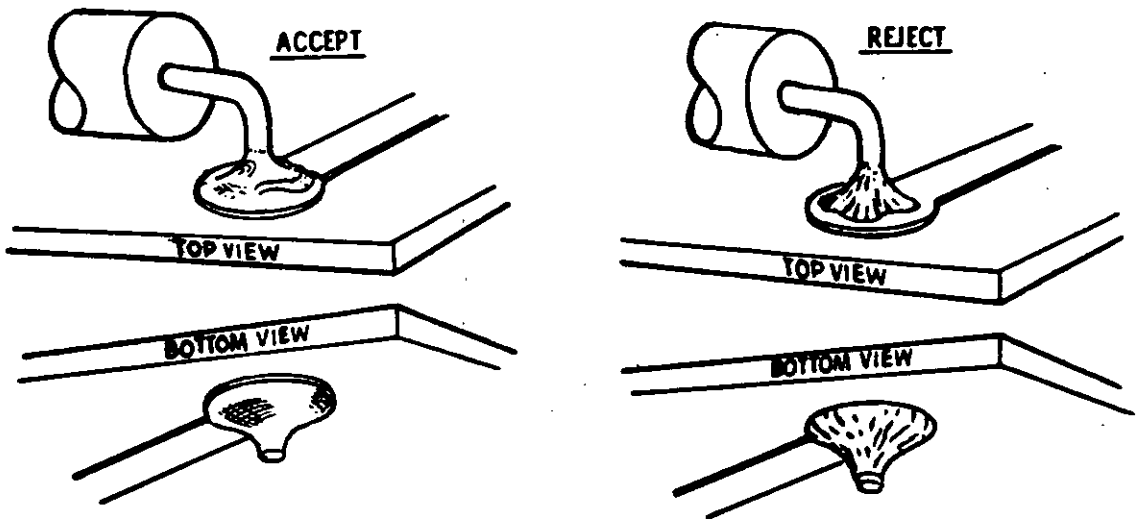


FIGURE 5-21. Plated-thru holes - solder surface characteristics.

Supersedes
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26 February 1987

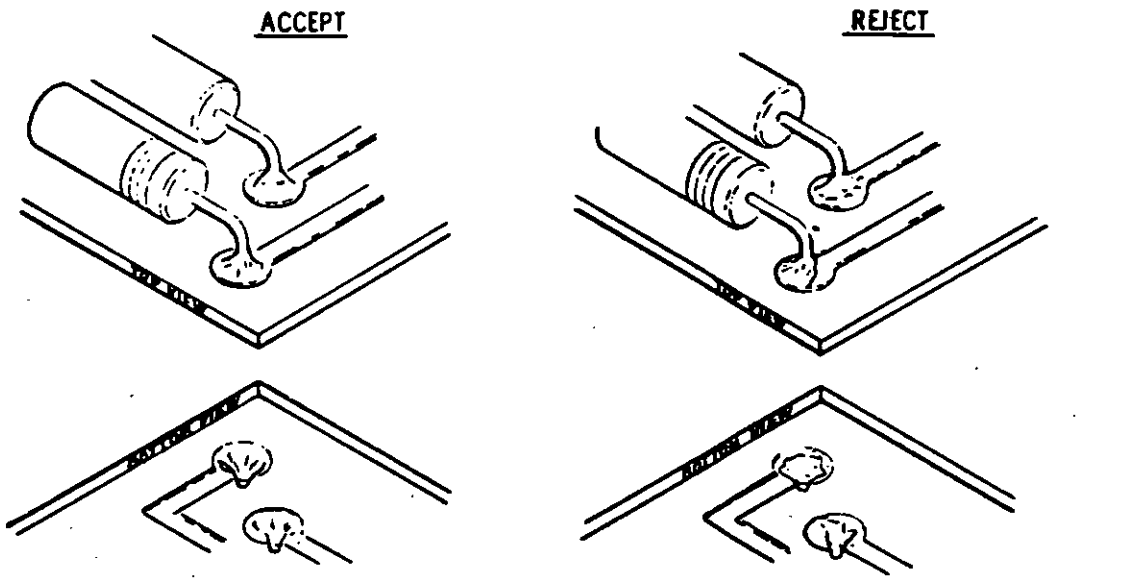


FIGURE 5-22. Plated-thru holes - solder wetting.

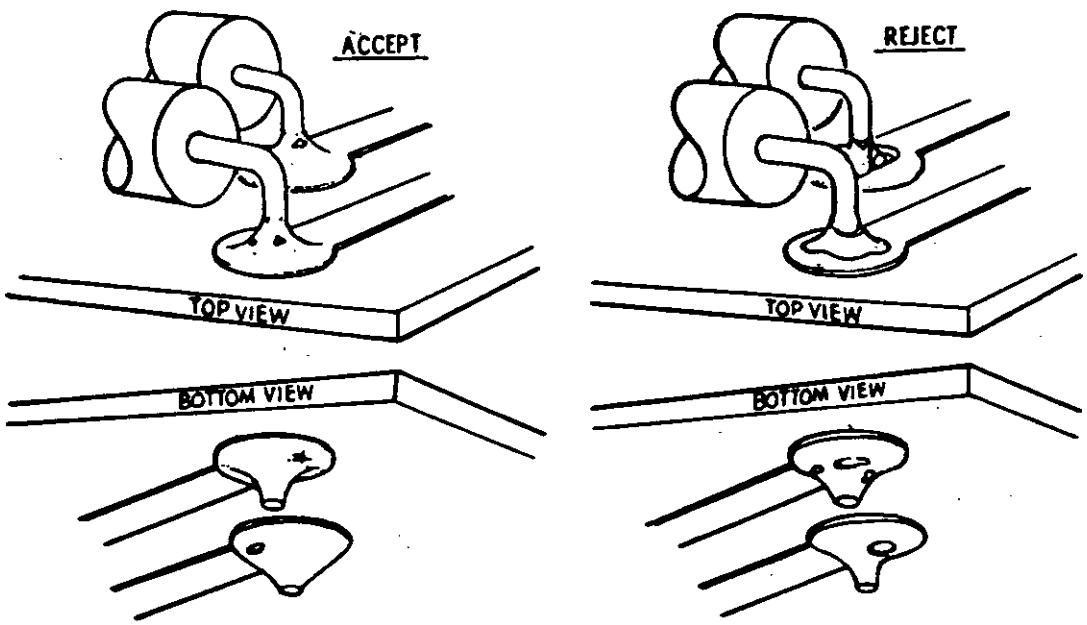
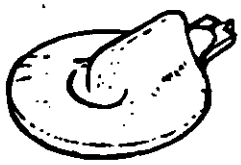


FIGURE 5-23. Plated-thru holes - voids.

MINIMUM ACCEPT

REJECT

SOLDER FILLET NOT COMPLETE.
NUMEROUS VOIDS.
EVIDENCE OF DEWETTING.



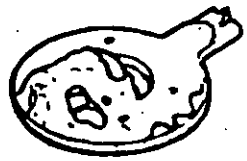
SOLDER FILLET 100% COMPLETE.
CONTOUR OF LEAD IS DISCERNIBLE.
HEEL OF LEAD IS WETTED WITH SOLDER.
SOLDER SHALL FILL HOLE 75% OF
BOARD THICKNESS MINIMUM.

EXCESS SOLDER. LEAD NOT VISIBLE.

FIGURE 5-24. Plated-thru holes - clinched leads and wires.

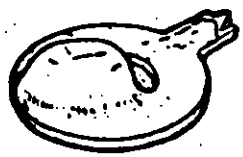
MINIMUM ACCEPT

REJECT



SOLDER FILLET NOT COMPLETE.
NUMEROUS VOIDS.
EVIDENCE OF DEWETTING.

SOLDER FILLET 100% COMPLETE.
CONTOUR OF LEAD IS DISCERNIBLE
HEEL OF LEAD IS WETTED WITH SOLDER.
NONPLATED THRU HOLE NEED
NOT BE COVERED WITH SOLDER.



EXCESS SOLDER. LEAD NOT VISIBLE.

FIGURE 5-25. Nonplated-thru holes - clinched leads and wires.

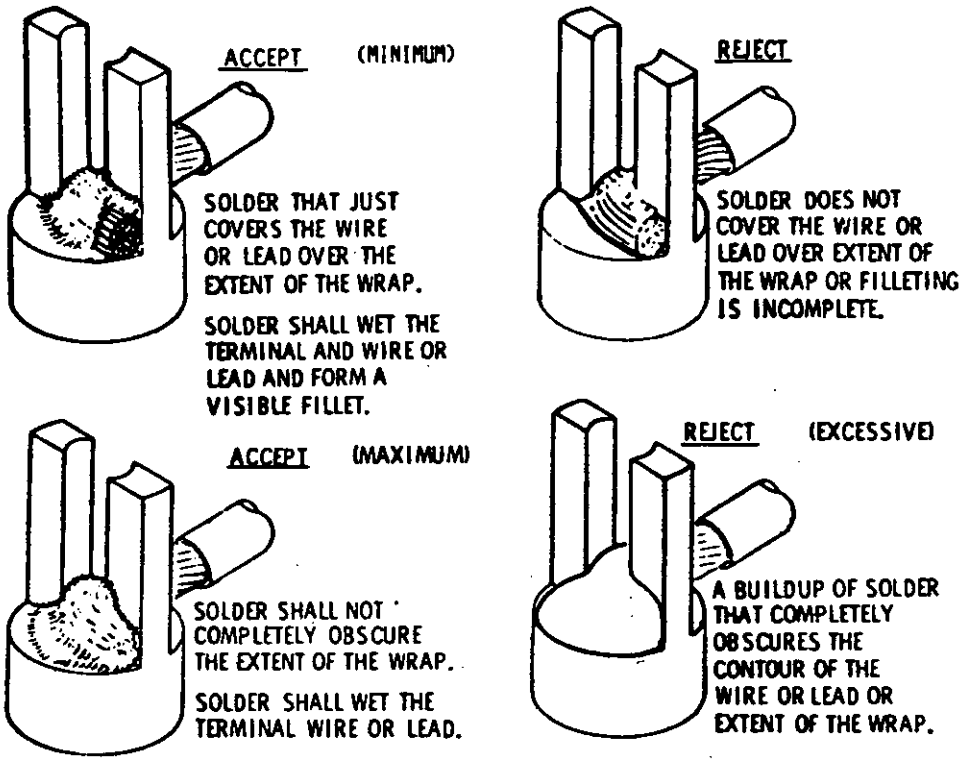


FIGURE 5-26. Wire and lead soldering to terminals - bifurcated.

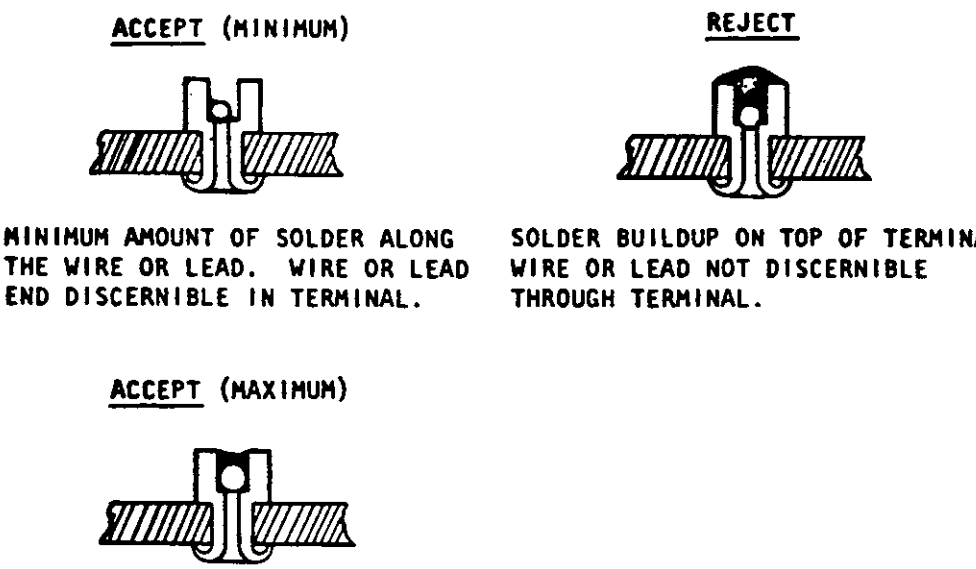


FIGURE 5-27. Wire and lead soldering to terminals - small slotted.

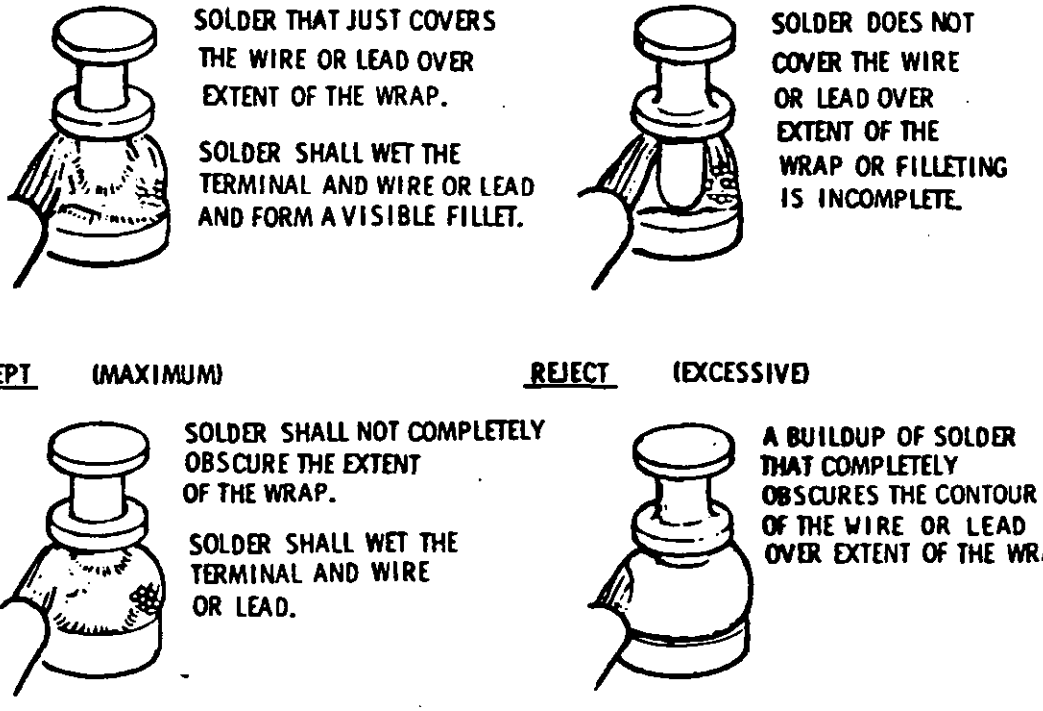


FIGURE 5-28. Wire and lead soldering to terminals - turret.

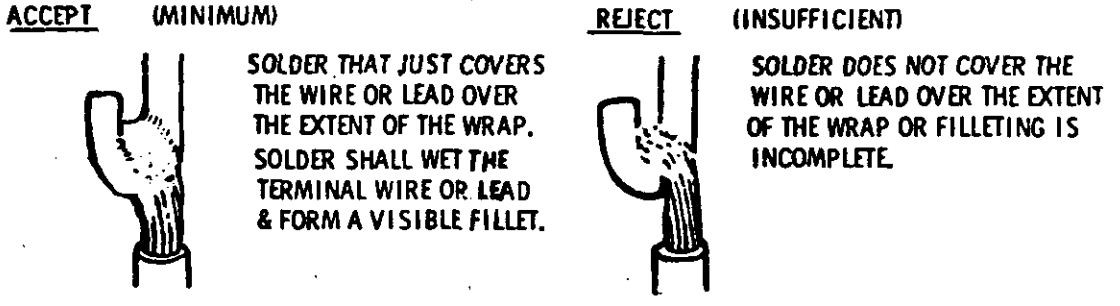


FIGURE 5-29. Wire and lead soldering to terminals - hook.

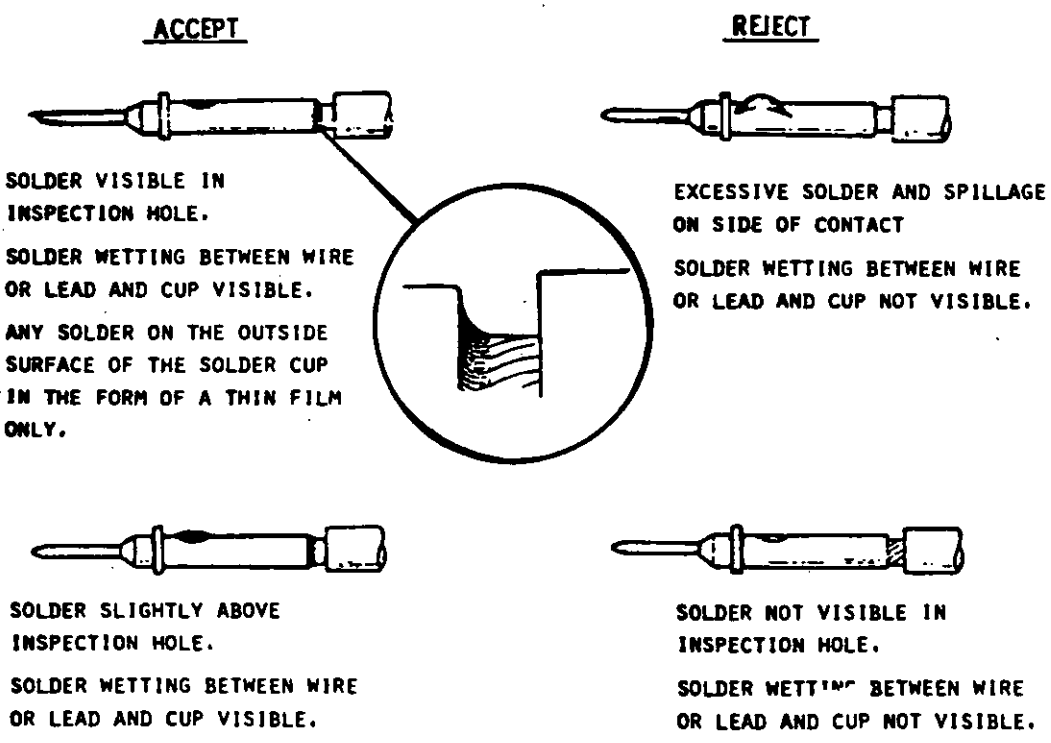


FIGURE 5-30. Wire and lead soldering to contacts.

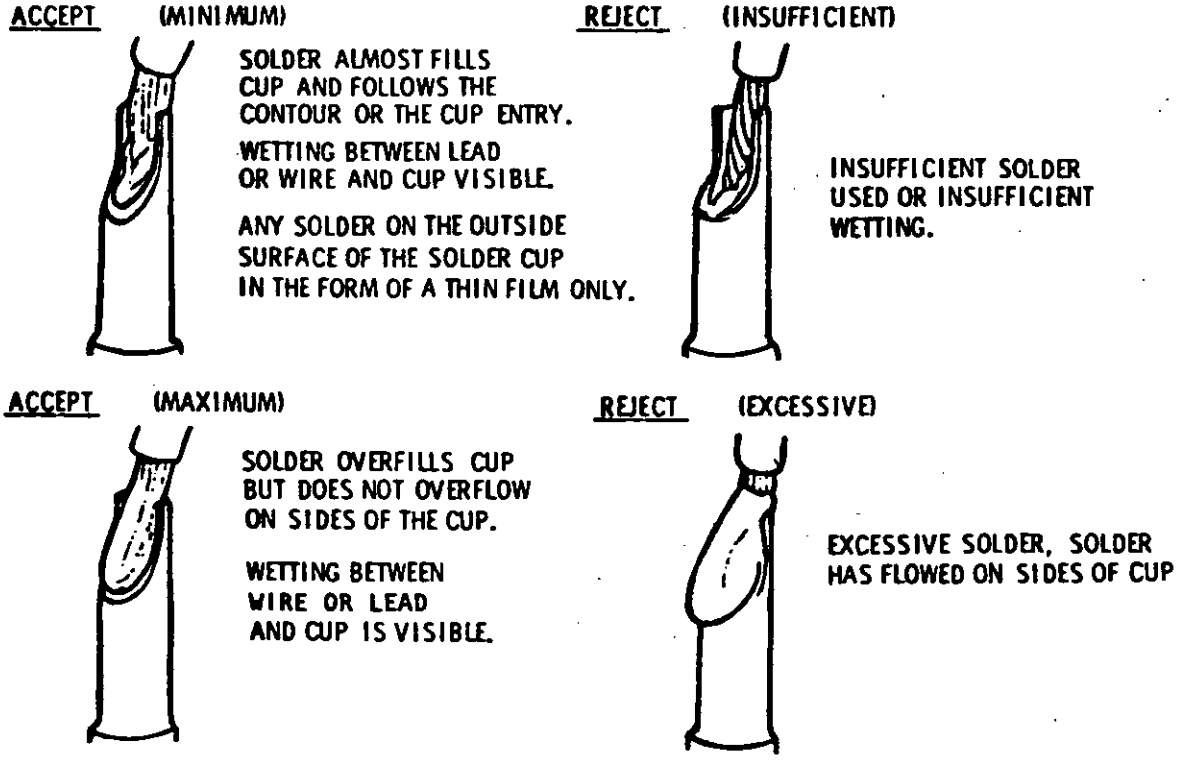
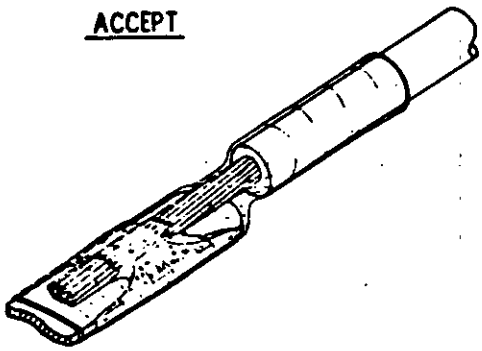


FIGURE 5-31. Wire and lead soldering to solder cups.

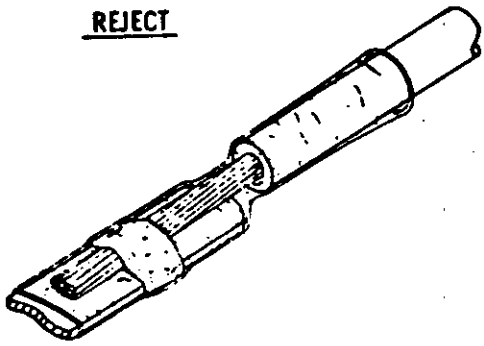
ACCEPT



MINIMUM SOLDER FLOW-- ACCEPT IF ALL OF THE FOLLOWING CONDITIONS ARE PRESENT:

- SOLDER HAS LOST ALL APPEARANCE OF RING SHAPE.
- THERE IS A DEFINITE FILLET VISIBLE ALONG THE TERMINAL AND LEAD INTERFACE.
- TERMINAL AND LEAD CONTOURS ARE VISIBLE.

REJECT

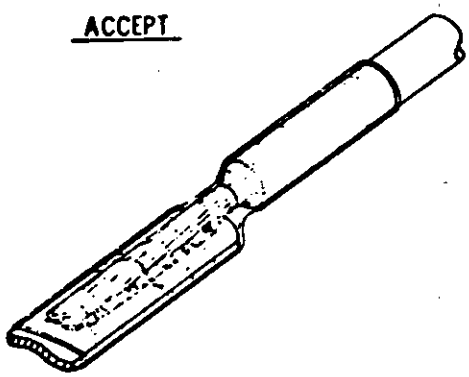


INSUFFICIENT HEAT-- REJECT IF ANY OF THE FOLLOWING CONDITIONS ARE PRESENT:

- CONTOUR OF SOLDER PREFORM IS VISIBLE.
- CONTOUR OF TERMINAL AND/OR LEAD IS OBSCURED BY SOLDER.

FIGURE 5-32. Heat shrinkable solder devices - connector terminations.

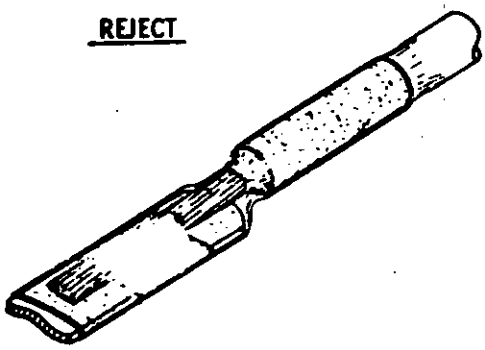
ACCEPT



MAXIMUM SOLDER FLOW-- ACCEPT IF ALL OF THE FOLLOWING CONDITIONS ARE PRESENT:

- FILLET IS CLEARLY VISIBLE BETWEEN TERMINAL AND LEAD.
- JOINT AREA IS VISIBLE DESPITE BROWNING OF SLEEVE.

REJECT

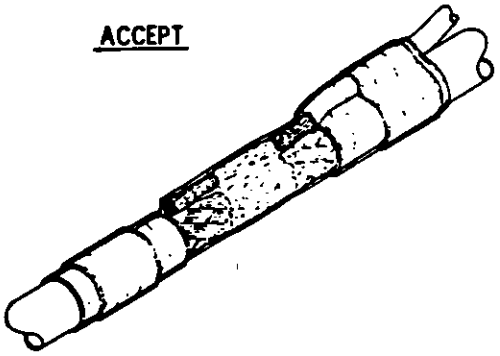


OVERHEATED-- REJECT IF ANY OF THE FOLLOWING CONDITIONS ARE PRESENT:

- JOINT AREA IS NOT VISIBLE BECAUSE OF SEVERE DARKENING OF THE OUTER SLEEVE.
- SOLDER FILLET IS NOT VISIBLE ALONG TERMINAL AND LEAD INTERFACE.
- WIRE INSULATION DAMAGED (BROWNING OKAY) OUTSIDE OF THE SLEEVE.

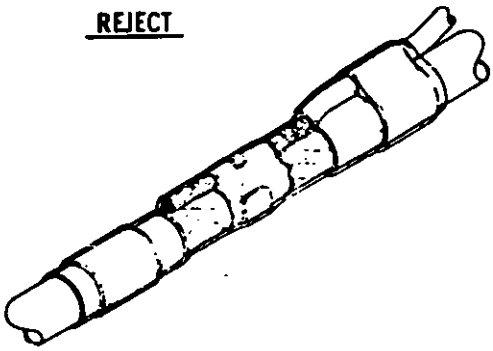
FIGURE 5-33. Heat shrinkable solder devices - connector terminations.

ACCEPT



MINIMUM SOLDER FLOW-- ACCEPT IF ALL OF THE FOLLOWING CONDITIONS ARE PRESENT:
- SOLDER HAS LOST ALL APPEARANCE OF RING SHAPE.
- INSERTS HAVE MELTED & FLOWED ALONG WIRES.
- SHIELD & LEAD CONTOURS ARE VISIBLE.
- THERE IS A DEFINITE FILLET VISIBLE ALONG THE LEAD AND SHIELD INTERFACE.

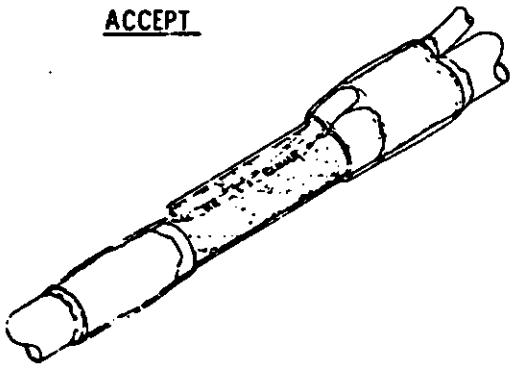
REJECT



INSUFFICIENT HEAT-- REJECT IF ANY OF THE FOLLOWING CONDITIONS ARE PRESENT:
- CONTOUR OF SOLDER PREFORM IS VISIBLE.
- MELTABLE INSERTS HAVE NOT FLOWED.
- CONTOUR OF BRAID AND/OR LEAD IS OBSCURED BY SOLDER.

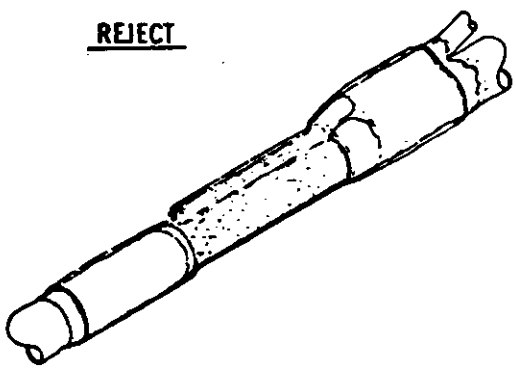
FIGURE 5-34. Heat shrinkable solder devices - shield terminations.

ACCEPT



MAXIMUM SOLDER FLOW-- ACCEPT IF ALL OF THE FOLLOWING CONDITIONS ARE PRESENT:
- FILLET IS CLEARLY VISIBLE BETWEEN LEAD AND SHIELD.
- JOINT AREA IS VISIBLE DESPITE BROWNING OF SLEEVE.

REJECT



OVERHEATED--REJECT IF ANY OF THE FOLLOWING CONDITIONS ARE PRESENT:
- JOINT AREA IS NOT VISIBLE BECAUSE OF SEVERE DARKENING OF THE OUTER SLEEVE.
- SOLDER FILLET IS NOT VISIBLE ALONG LEAD AND SHIELD INTERFACE.
- WIRE INSULATION DAMAGED (BROWNING OKAY) OUTSIDE OF SLEEVE.

FIGURE 5-35. Heat shrinkable solder devices - shield terminations.

REQUIREMENT 14

TRANSFORMERS, INDUCTORS, AND COILS

1. Purpose. This requirement establishes the requirements for transformers, inductors, and coils.

2. Documents applicable to Requirement 14:

MIL-T-27	Transformers and Inductors (Audio, Power, and High Power Pulse), General Specification for
MIL-C-15305	Coils, Fixed and Variable, Radio Frequency, General Specification for
MIL-T-21038	Transformers, Pulse, Low Power, General Specification for
MIL-C-39010	Coils, Fixed, Radio-Frequency, Molded, Established Reliability, General Specification for
MIL-T-55631	Transformers, Intermediate Frequency, Radio Frequency and Discriminator, General Specification for
MIL-C-83446	Coils, Radio Frequency, Chip, Fixed or Variable, General Specification for
MIL-T-83721	Transformer, Variable, Power, General Specification for
MIL-STD-981	Design, Manufacturing and Quality Standards for Custom Electromagnetic Devices for Space Applications
MIL-STD-1286	Transformers, Inductors, and Coils, Selection and Use of

3. Selection. Selection of transformers, inductors, and coils shall be in accordance with MIL-STD-1286 and the following paragraphs.

4. Audio, power, and high-power pulse transformers and inductors. Audio, power, and high-power pulse transformers and inductors shall conform to MIL-T-27 with grade and class as listed in table 14-I.

TABLE 14-I. Audio, power, and high power pulse transformers.

Application	Grade	Temperature class
Shipboard, transportable and ground-mobile	4 or 5	R, S, V, or T
Ground-fixed	4 or 5	Q, R, S, or V
Aircraft and missile	4 or 5	R, S, T, or U

Grade 6 transformers and inductors may be used in hermetically sealed or encapsulated assemblies only.

5. Intermediate, radio frequency and discriminator transformers. Intermediate, radio frequency and discriminator transformers shall conform to grade 1, 2, or 4 of MIL-T-55631. The use of grade 3 tranformers shall be limited to hermetically sealed or encapsulated assemblies.

6. Radio frequency coils. Radio frequency coils shall conform to grade 1, class 0, A, B, or C of MIL-C-15305, except that radio frequency coils, fixed, molded, with established failure rate levels shall conform to MIL-C-39010.

7. Low-power pulse transformers. Low-power pulse transformers shall conform to MIL-T-21038 with grade, class, and life expectancy as specified in table 14-II.

TABLE 14-II. Low-power pulse transformers.

Application	Grade	Temperature class	Life expectancy
Shipboard, transportable and ground-mobile	4 or 5	R, S, T, or U	X
Ground-fixed	4 or 5	Q, R, S, or T	X
Aircraft and missile	4, 5, 6 or 7	R, S, U, or V	X

8. Radio frequency chip coils. Radio frequency chip coils shall conform to MIL-C-83446.

9. Custom electromagnetic devices for space applications. Custom electromagnetic devices for space applications shall conform to MIL-STD-981.

10. General. Transformers and inductors, whether selected from the above or especially designed with procuring activity approval for a particular application, shall conform to the following:

a. Size and weight. The size and weight of tranformers and inductors shall be held to a minimum consistent with required performance and life. Every effort shall be made to use materials of light weight and to employ methods of design and construction which assure minimum size and weight. High temperature rise is permitted when size and weight savings can be effected, provided dependability, performance, efficiency, and required life are obtained. The best available grades of core materials shall be used to the maximum extent justifiable for the particular application.

b. Variable inductors. When a roller or slider is used in contact with the conductor of variable inductors, suitable provision shall be made to limit the travel of the roller or slider to prevent its leaving the conductor.

c. Variable transformers. Variable transformers shall conform to MIL-T-83721.

REQUIREMENT 17

PRINTED WIRING

1. Purpose. This requirement establishes criteria for the design and treatment of printed wiring boards and assemblies.

* 2. Documents applicable to Requirement 17:

MIL-P-13949	Plastic Sheet, Metal-Clad (For Printed Wiring Boards), General Specification for
MIL-P-28809	Printed Wiring Assemblies
MIL-I-46058	Insulating Compound, Electrical (For Coating Printed Circuit Assemblies)
MIL-P-46843	Printed Wiring Assemblies
MIL-P-50884	Printed Wiring, Flexible, and Rigid-Flex
MIL-P-55110	Printed Wiring Boards
MIL-STD-275	Printed Wiring for Electronic Equipment
MIL-STD-2118	Flexible and Rigid-Flex Printed Wiring for Electronic Equipment, Design Requirements for
ANSI/IPC-DW-425/11	Design and End Product Requirements for Discrete Wiring Boards/Plated-Through Hole Connection

3. Rigid printed wiring and printed wiring boards. Rigid printed wiring and printed wiring boards for single-sided, double-sided, and multilayer printed wiring shall conform to MIL-STD-275 and MIL-P-55110. The materials used for single-sided, double-sided, and multilayer printed wiring boards shall conform to MIL-P-13949.

* 3.1 Printed wiring board size. Whenever cost and technical requirements permit, preferred rigid printed wiring board sizes should be used. These board sizes will facilitate the development and use of standardized insertion and extraction tools. The preferred board sizes and thicknesses and extractor hole size and location are shown in figure 17-1.

3.2 Rigid printed wiring assemblies. Rigid printed wiring assemblies consisting of rigid printed wiring boards on which separately manufactured parts have been added shall conform to MIL-P-28809. For Army missile weapon systems, MIL-P-46843 shall apply.

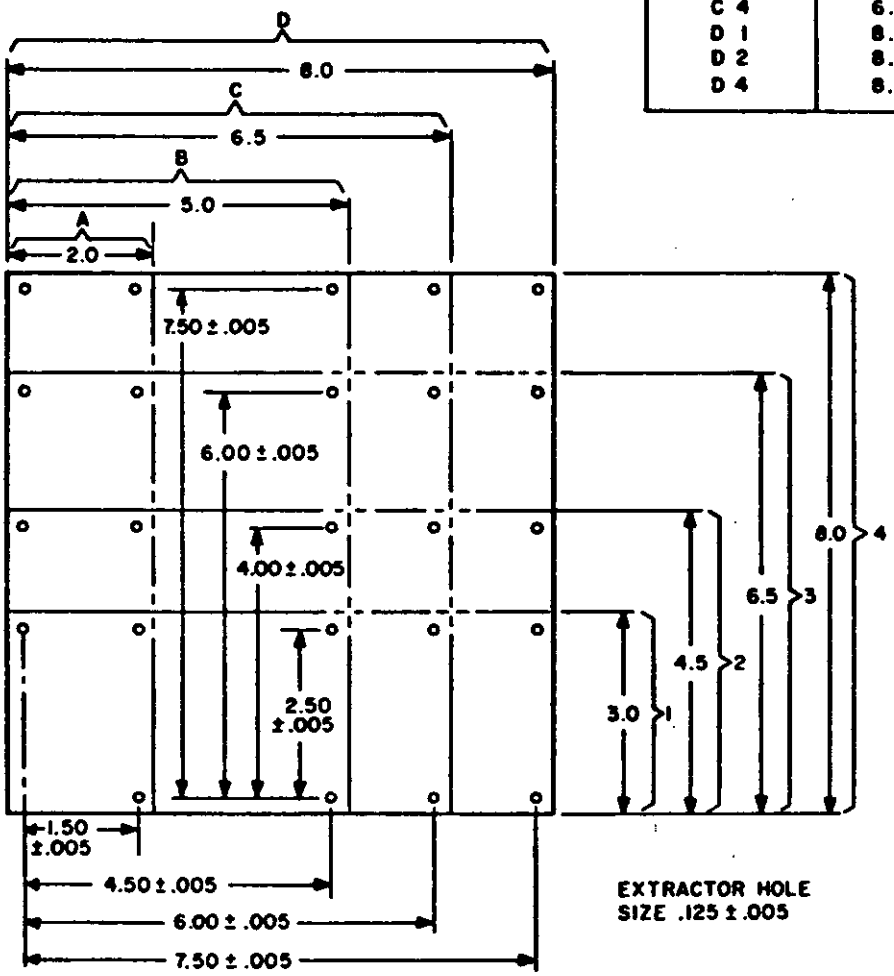
3.3 Conformal coating. When conformal coating is required, rigid printed wiring assemblies shall be conformally coated with a coating material which conforms to MIL-I-46058.

4. Flexible and rigid-flex wiring. Flexible and rigid-flex printed wiring shall conform to MIL-P-50884 and shall be designed in accordance with MIL-STD-2118.

5. Discrete wiring boards. Discrete wiring boards with plated-through holes shall be in accordance with ANSI/IPC-DW-425/11. Discrete wiring boards shall not be used for space application.

Preferred thicknesses	
Thickness (Inch)	Tolerance (Inch)
.062	±.001
.093	±.0015
.125	±.002

BOARD NO.	PRINTED WIRING BOARD SIZE IN NOMINAL ±.015
A 1	2.0 X 3.0
A 2	2.0 X 4.5
A 3	2.0 X 6.5
A 4	2.0 X 8.0
B 1	5.0 X 3.0
B 2	5.0 X 4.5
B 3	5.0 X 6.5
B 4	5.0 X 8.0
C 1	6.5 X 3.0
C 2	6.5 X 4.5
C 3	6.5 X 6.5
C 4	6.5 X 8.0
D 1	8.0 X 3.0
D 2	8.0 X 4.5
D 4	8.0 X 8.0



* FIGURE 17-1 Preferred printed wiring board sizes.

REQUIREMENT 18

DERATING OF ELECTRONIC PARTS AND MATERIALS

1. Purpose. This requirement establishes criteria for derating of electronic parts and materials.

* 2. Document applicable to Requirement 18:

MIL-STD-1547	Parts, Materials, and Processes for Space and Launch Vehicles, Technical Requirements for

3. Derating. In the application of electronic parts and materials, the parts and materials selected shall be used within their electrical ratings and environmental capabilities (e. g., any ambient or hot spot temperatures, voltage, current, or power dissipation). Derating shall be accomplished as necessary to assure the required equipment reliability within the specified operating conditions. Parts derating guidelines or requirements may be provided or requested by the procurement activity. These guidelines or requirements may be reviewed in the design review process.

* 4. Derating for launch vehicles and space systems. Electronic parts and materials used in launch vehicles or space systems shall be derated in accordance with the requirements of MIL-STD-1547.

REQUIREMENT 22

PARTS SELECTION AND CONTROL

1. Purpose. This requirement offers direction as to parts selection and control which must be considered when preparing contractual documents. IT DOES NOT ESTABLISH REQUIREMENTS AND MUST NOT BE REFERENCED IN CONTRACTUAL DOCUMENTS. Parts selection and control must be directly specified in the contract or the system/equipment specification, as appropriate.

* 2. Documents applicable to Requirement 22:

MIL-STD-965	Parts Control Program
MIL-STD-1546	Parts, Materials, and Processes Standardization Control and Management Program for Spacecraft and Launch Vehicles

3. Parts control program. MIL-STD-965, establishes two procedures covering the submission, review, and approval of Program Parts Selection Lists and changes thereto. The objective is to achieve life cycle cost savings and cost avoidances by: (1) assisting equipment or system managers and their contractors in the selection of parts commensurate with contractual requirements, (2) minimizing the variety of parts used in new design, (3) enhancing interchangeability, reliability, and maintainability of military equipments and supplies, and (4) conserving resources. MIL-STD-965 must be tailored when applied; application guidance is offered in the document.

* 4. Parts control program for spacecraft and launch vehicles. MIL-STD-1546 establishes the criteria and requirements for the preparation and implementation of a Parts, Materials, and Processes Standardization Control and Management Program for use during the design, development, fabrication, and test of spacecraft and launch vehicles. The implementation of this standard is intended to: (1) assure total, integrated, and coordinated management of the selection, application, procurement, control and standardization of parts, materials and processes (PMP), (2) reduce program costs, and (3) improve the standardization and reliability of program parts, materials, and processes.

REQUIREMENT 46

MOTORS, DYNAMOTORS, ROTARY POWER CONVERTERS
AND MOTOR-GENERATORS

1. Purpose. This requirement establishes criteria for the selection and application of motors, dynamotors, rotary power converters, and motor-generators.

* 2. Documents applicable to Requirement 46:

CC-M-1807	Motors, Alternating Current, Fractional and Integral Horsepower (500 HP and Smaller)
MIL-D-24	Dynamotors, General Specification for
MIL-G-3111	Generator, Electric, Direct Current (Naval Shipboard Use)
MIL-G-3124	Generator, Alternating Current, 60 Cycle (Naval Shipboard Use)
MIL-M-4803	Motor-Generator, 400 Cycle, Precise Output, General Requirements for
MIL-M-4818	Motor-Generator, Skid Mounted, Type MD-2
MIL-M-4819	Motor-Generator, Skid Mounted, Type MD-3
MIL-M-4820	Motor-Generator, Skid Mounted, Type MD-4
MIL-M-7969	Motor, Alternating Current, 400 Cycle, 115/200-Volt System, Aircraft, General Specification for
MIL-M-8609	Motors, Direct Current, 28 Volt System, Aircraft, General Specification for
MIL-F-9397	Frequency Converter, Mobile, Type MC-1A
MIL-M-13786	Motors, Fractional Horsepower, Direct Current and Universal (for Communication and Other Electronic and Special Military Applications)
MIL-M-13787	Motors, Alternating Current, Fractional Horsepower, Squirrel Cage (for Communication and Other Electronic and Special Military Applications)
MIL-M-17059	Motor, 60 Cycle, Alternating Current, Fractional Horsepower (Shipboard Use)
MIL-M-17060	Motors, 60 Hertz, Alternating Current, Integral Horsepower (Shipboard Use)
MIL-M-17413	Motors, Direct Current, Integral Horsepower, Naval Shipboard
MIL-M-17556	Motor, Direct Current, Fractional Horsepower, (Shipboard Use)
MIL-M-19097	Motor-Generators, DC to AC, Shipboard Service
MIL-M-19160	Motor-Generator, 60 Hertz AC to 400 Hertz AC, Shipboard Use
MIL-M-19167	Motor-Generators, AC to DC, Shipboard Service
MIL-M-19283	Motor-Generator, DC to DC, Shipboard Service
MIL-M-19633	Motor-Generator, 60 Cycle AC to 400 Cycle AC (Voltage and Frequency Regulated) Shipboard Service
MIL-B-23071	Blower, Miniature, For Cooling Electronic Equipment (10 to 500 Cfm), General Specification For

3. Electromagnetic compatibility. Motors, dynamotors, rotary power converters, and motor generators used in the equipment shall meet the electromagnetic compatibility requirement specified in the detail equipment specification.

4. Motors - alternating current. Alternating current motors shall conform to CC-M-1807, MIL-M-7969, MIL-M-13787, MIL-M-17059 or MIL-M-17060, except that any motor used with a miniature blower for cooling electronic equipment shall be in accordance with MIL-B-23071. Other motors may be used where uniquely required by the design of the equipment, provided they meet the applicable requirements of the specification covering that type of motor and the additional requirements of the detail equipment specification.

5. Motors - direct current. Direct current motors shall conform to MIL-M-8609, MIL-M-13786, MIL-M-17413 or MIL-M-17556. Other motors may be used where uniquely required by the design of the equipment, provided they meet the applicable requirements of the specification covering that type of motor and the additional requirements of the detail equipment specification.

* 6. Motor-generators. Motor-generators shall conform to one of the following or shall be as specified in the detail equipment specification.

MIL-M-4803	MIL-M-9397	MIL-M-19283
MIL-M-4818	MIL-M-19097	MIL-M-19533
MIL-M-4819	MIL-M-19150	
MIL-M-4820	MIL-M-19167	

7. Generators - alternating current. Alternating current generators shall conform to MIL-G-3124 or shall be as specified in the detail equipment specification.

8. Generators - direct current. Direct current generators shall conform to MIL-G-3111 or shall be as specified in the detail equipment specification.

9. Dynamotors. Dynamotors shall conform to MIL-D-24.

REQUIREMENT 50

INDICATOR LIGHTS

1. Purpose. This requirement establishes criteria for indicator lights and associated items.

2. Documents applicable to Requirement 50:

W-L-111	Lamps; Electric Incandescent Miniature, Tungsten-Filament
W-L-116	Lamps, Fluoroescent
MIL-L-3661	Lampholder, Indicator Lights, Indicator-Light Housings, and Indicator-Light Lenses, General Specification for
MIL-L-6363	Lamps, Incandescent, Aviation Service, General Requirements for
MIL-L-7806	Light, Panel, Plastic Plate Lighting
MIL-L-7961	Lights, Indicators, Press to Test
MIL-L-15098	Lamp, Glow
MIL-S-19500	Semiconductor Device, General Specification for
MIL-STD-1472	Human Engineering Design Criteria for Military Systems, Equipment and Facilities

3. Lights and accessories. Indicator lights, indicator light housings, lampholders, lenses, and lamps shall conform to table 50-I.

4. Visual display and legend lights. Visual display and legend lights shall comply with the requirements in MIL-STD-1472.

5. Light emitting diodes (LED's). LED's when used as indicator lights shall conform to the applicable detail specifications of MIL-S-19500.

* TABLE 50-I. Indicator lights and associated items.

	MIL-L-3661	MIL-L-7806	MIL-L-7961	MIL-L-6363	MIL-L-15098	MIL-S-19500	W-L-111	W-L-116
Indicator lights	X		X			X		
Indicator light housings	X							
Lamp holders	X	X						
Lenses	X							
Incandescent lamps				X			X	
Incandescent lamps, Aircraft				X				
Neon lamps					X			X
Fluorescent lamps								X

REQUIREMENT 53

WAVEGUIDES AND RELATED DEVICES

1. Purpose. This requirement establishes criteria for the selection of waveguides and related devices.

* 2. Documents applicable to Requirement 53:

MIL-G-24211	Gaskets, Waveguide Flange, General Specification for
MIL-S-55041	Switches, Waveguide, General Specification for
MIL-STD-1327	Flanges, Coaxial and Waveguide; and Coupling Assemblies, Selection of
MIL-STD-1328	Couplers, Directional (Coaxial Line, Waveguide and Printed Circuit), Selection of
MIL-STD-1329	Switches, RF Coaxial, Selection of
MIL-STD-1352	Attenuators, Fixed and Variable, Selection of
MIL-STD-1358	Waveguides, Rectangular, Ridge and Circular, Selection of
MIL-STD-1636	Adapters, Coaxial to Waveguide, Selection of
MIL-STD-1637	Dummy Loads, Electrical, Waveguide, Coaxial and Stripline, Selection of
MIL-STD-1638	Waveguide Assemblies, Rigid and Flexible, Selection of
MIL-STD-1639	Power Dividers, Power Combiners, and Power Divider/ Combiners, Selection of
MIL-STD-1640	Mixer Stages, Frequency, Selection of
MIL-STD-2113	Radio Frequency Circulators and Isolators, Selection of
MIL-STD-2162	Amplifiers, Radiofrequency and Microwave, Solid State, Selection of
MIL-HDBK-216	RF Transmission Lines and Fittings
MIL-HDBK-660	Fabrication of Rigid Waveguide Assemblies (Sweep Bends and Twists)

3. General. Waveguides and related devices shall be selected in accordance with table 53-I. MIL-HDBK-216 should be used as a guide wherever applicable. Waveguides and related devices shall conform to a specification listed in table 53-I, or the appropriate specification in a standard listed in table 53-I.

3.1 Materials. When selecting parts, consideration shall be given to corrosion resistance of materials and the proper protection of dissimilar metal combinations.

3.2 Fabrication of rigid assemblies. MIL-HDBK-660 shall be used as a guide in the fabrication of rigid assemblies.

* TABLE 53-I. Waveguides and related devices.

Item Description		Applicable Document
Adapters	Coaxial to Waveguide	MIL-STD-1636
Amplifiers	RF and Microwave Coaxial, Flatpack and TO Configurations	MIL-STD-2162
Attenuators, Fixed and Variable	Waveguide and Coaxial	MIL-STD-1352
Couplers, Directional	Waveguide, Coaxial, and Printed Circuit	MIL-STD-1328
Coupling Assemblies	Subminiature Quick Disconnect	MIL-STD-1327
	Waveguide, Rigid	
Flanges	Waveguide, Ridge	
	Coaxial Line, Rigid	
Dummy Loads	Waveguide, Coaxial, Stripline	MIL-STD-1637
Gaskets	Waveguide	MIL-G-24211
Isolators	Coaxial and Stripline	MIL-STD-2113
Circulators		
Switches	Waveguide	MIL-S-55041
	Coaxial	MIL-STD-1329
Waveguide Assemblies	Rigid and Flexible	MIL-STD-1638
Waveguides	Rectangular, Ridge, and Circular	MIL-STD-1358
Power Dividers and Combiners	Printed Circuit, Microstrip, Coaxial, and Stripline	MIL-STD-1639
Mixer Stages	Coaxial and Printed Circuit	MIL-STD-1640

REQUIREMENT 57

RELAYS

1. Purpose. This requirement establishes criteria for the selection and application of relays.

* 2. Documents applicable to Requirement 57:

MIL-R-83515	Relays, Reed, Dry, General Specification for
MIL-STD-1346	Relays, Selection and Application

* 3. Selection. Unless otherwise specified, the order of precedence for relay selection shall be as follows:

a. Relays listed in MIL-STD-1346. Reed relays shall conform to MIL-R-83515.

b. DESC Selected Item Drawing relays, subject to procuring activity approval.

c. Other relays, subject to procuring activity approval. The request for approval shall justify why a relay from a. or b. above is not acceptable. Sufficient detail must be presented (e.g., contact loads, coil voltages of requested relay vs the standard part) to justify the use of the nonstandard part.

* 4. Application. Relays shall be applied in accordance with MIL-STD-1346.

4.1 Load transfer relays. Relays which are not designed specifically for load transfer applications shall not be used for this purpose.

4.2 Reed relays. The use of reed relays in airborne applications requires procuring activity approval.

REQUIREMENT 60

SOCKETS AND ACCESSORIES

1. Purpose. This requirement establishes criteria for the selection and application of sockets and accessories for plug-in parts.

* 2. Documents applicable to Requirement 60:

MIL-S-12883	Socket and Accessories for Plug-In Electronic Components, General Specification for
MIL-S-24251	Shield, Retainer (Bases), and Adapters, Electron Tube, Heat Dissipating, General Specification for
MIL-M-38527	Mounting Pads, Electrical-Electronic Component, General Specification for
MIL-S-83734	Sockets, Plug-in Electronic Components, Dual-in-line (DIPs) and Single-in-line Packages (SIPs), General Specification for

3. Sockets. Sockets for plug-in electronic parts shall be of the single unit type and shall conform to MIL-S-12883 or MIL-S-83734. The use of integrated circuit sockets requires approval of the procuring activity.

* 4. Shields. Where heat dissipating tube shields are required, they shall conform to MIL-S-24251. Shield bases, used with heat dissipating shields, shall be mounted on clean and smooth metallic mating surfaces to minimize the contact resistance (thermal and electrical) between the base and the supporting chassis.

5. Clamps. Plug-in parts shall be securely retained in their sockets in their proper position under specified service conditions of shock and vibration. A positive holding device, capable of being easily released to allow replacement of the plug-in part, shall be provided where necessary to meet the foregoing environmental requirement.

* 6. Mounting pads. Where mounting pads are required for use with small electrical or electronic devices, they shall conform to MIL-M-38527.

REQUIREMENT 64

MICROELECTRONIC DEVICES

1. Purpose. This requirement establishes criteria for the selection and application of microelectronic devices. This requirement is applicable to monolithic, hybrid, microwave (hybrid/integrated circuits), and multichip microcircuits, and microcircuit modules.

2. Documents applicable to Requirement 64:

MIL-M-38510	Microcircuits, General Specification for
MIL-STD-785	Reliability Program for Systems and Equipment Development and Production
MIL-STD-883	Test Methods and Procedures for Microelectronics
MIL-STD-1562	Lists of Standard Microcircuits
MIL-HDBK-217	Reliability Prediction of Electronic Equipment

3. General. Use of microelectronic technology shall be considered in the design of all systems/equipment and maximum use shall be made of standard microelectronic devices.

* 4. Selection. Microelectronic devices shall conform to MIL-M-38510, product assurance level Class B, as a minimum. Class S is the highest product assurance level of MIL-M-38510 and is intended for space applications or other applications requiring the product assurance provisions of Class S. Unless otherwise specified, the order of precedence shall be as follows:

a. Microcircuits listed in Table I of MIL-STD-1562.

b. Other MIL-M-38510 microcircuits not listed in Tables III, IV, and V of MIL-STD-1562.

c. Other microcircuits listed in Table II of MIL-STD-1562 as preferred for new design, subject to procuring activity approval.

d. Active MIL drawing (or DESC drawing) microcircuits not listed in Tables III, IV, and V of MIL-STD-1562, subject to procuring activity approval.

e. Other microcircuits (see 4.2), subject to procuring activity approval.

* 4.1 Device selection when a QPL-38510 or MIL drawing (or DESC drawing) device exists. When the contract or purchase order for new design or redesign of military hardware specifies the use of MIL-STD-883 Class B or S microcircuits, and there is a Class B or S device on QPL-38510 of the required generic chip and package type or case outline, the qualified Class B or S microcircuit shall be the only device authorized in that design. When a qualified device does not exist and an active MIL drawing (or DESC drawing) device of the required generic chip and package type or case outline does exist, the MIL drawing (or DESC drawing) device shall be the preferred device authorized for that design.

* 4.2 Other microcircuits. For other than QPL-38510 microcircuits, the following information shall be included in the nonstandard part approval request (except where identification of a military detail specification number or MIL drawing (or DESC drawing) number satisfies this requirement):

a. Device nomenclature, marking, configuration, functional requirements, parameters and limits sufficient to insure the required form, functions and interchangeability.

b. Required environmental, endurance (life) and other design capability tests.

c. Quality assurance requirements, including screening and lot quality conformance (acceptance) tests. As a minimum, devices shall be procured to all the requirements of MIL-STD-883, paragraph 1.2.1. Hybrid and microwave microcircuits shall be procured to the requirements of MIL-M-38510, Appendix G. The applicable MIL-M-38510 detail specification, MIL drawing (or DESC drawing), or vendor/contractor document shall be specified for electrical performance, mechanical, and final electrical test requirements. Current and valid generic data may be substituted only for Groups C and D of Methods 5005, 5008, and 5010 of MIL-STD-883. Group C generic data must be on date codes no more than one year old and on a die in the same microcircuit group (see appendix E of MIL-M-38510) with the same material, design and process, and from the same wafer fabrication area as the die represented. Group D generic data must be on date codes no more than one year old and on the same package type (see 3.1.3.12 of MIL-M-38510) and from the same plant as the package represented.

4.3 Programmable read only memories (PROM). PROM devices, regardless of type, require approval of the procuring activity.

5. Fusible link devices. When fusible link devices (PROMs, PALs, FPLAs, etc) are programmed by the user, parametric and functional electrical tests in accordance with MIL-STD-883, Method 5005, Group A, Subgroups 1, 2, and 3, along with 7 and 8 at required access speeds, shall be performed after programming. This testing shall be done on a 100% basis.

6. Critical items. Custom microcircuits, hybrid or monolithic, are considered critical items and shall be treated in accordance with Task 208 of MIL-STD-785 when required by the contract.

7. Packages. Microcircuit devices used in equipment shall be hermetically sealed in glass, metal or ceramic (or combinations of these) packages. No organic or polymeric materials such as lacquers, varnishes, coatings, adhesives, or greases shall be used inside the microcircuit package,unless otherwise specified. No desiccants shall be contained in the microcircuit package, unless otherwise specified. No plastic (organic or polymeric) encapsulated or sealed devices shall be used without the approval of the procuring activity.

8. Reliability prediction. When required, microcircuit reliability predictions shall be prepared in accordance with MIL-HDBK-217.

9. Electrostatic sensitive parts. Certain types of integrated circuits are susceptible to electrostatic discharge damage. Appropriate discharge procedures shall be observed when handling, storing or testing these parts and design selections of desired devices should include a consideration of the effectiveness of the input or other protective elements included in the device design.

10. Microcircuit obsolescence. Due to rapid technology advances, many military and commercial microcircuits listed in specifications and catalogs are either obsolete or are nearing obsolescence. The use of these devices will affect the mission objectives of the using equipment. For Navy equipment current information on microcircuits that may be nearing obsolescence may be obtained from the Naval Avionics Center, Code 445, Indianapolis, Indiana 46218, telephone (317) 353-7917.

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