COLLINS

# QUALITY CONTROL STANDARDS

# FOR

# GENERAL ASSEMBLY PRACTICE

A PUBLICATION OF THE QUALITY CONTROL DEPT.

**COLLINS RADIO COMPANY**

CEDAR RAPIDS, IOWA

NEW YORK DALLAS BURBANK

# QUALITY CONTROL STANDARDS

# FOR

# GENERAL ASSEMBLY PRACTICE

Prepared by

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COLLINS RADIO COMPANY

Cedar Rapids, Iowa

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# SECTION I

## Soldering

1.1 Soldering is the joining of two metals by bonding them together with an alloy called solder. Soldering prevents accidental loosening or separation of the parts being connected. It also prevents oxidation, tarnish, etc. within the connection, which would be detrimental to the electrical stability of the connection. Since the prime application for soldering in electronic equipment is the joining of a wire to a terminal, these assembly standards will be based on that operation. The same general requirements apply to other solder applications.

1.2 In the soldering operation, the wire and terminal must be sufficiently heated to cause the solder to melt and flow around the wire and terminal, and to facilitate the union of the solder with the outer layers of the metals being soldered. In making a proper soldered joint, it is necessary that there be no movement of the wire until the solder is completely hardened. Movement could result in a fractured joint which would break later under strain. Prevention of this movement is one of the reasons for crimping the wire tightly to the terminal prior to soldering.

1.3 Since soldering should be an alloying of the solder with the part, a good solder joint should give indications of a "wetting" action of the molten solder on the base metal. That is, the boundary of the solder at its junction with the terminal should be concave rather than convex. See Fig. 1.

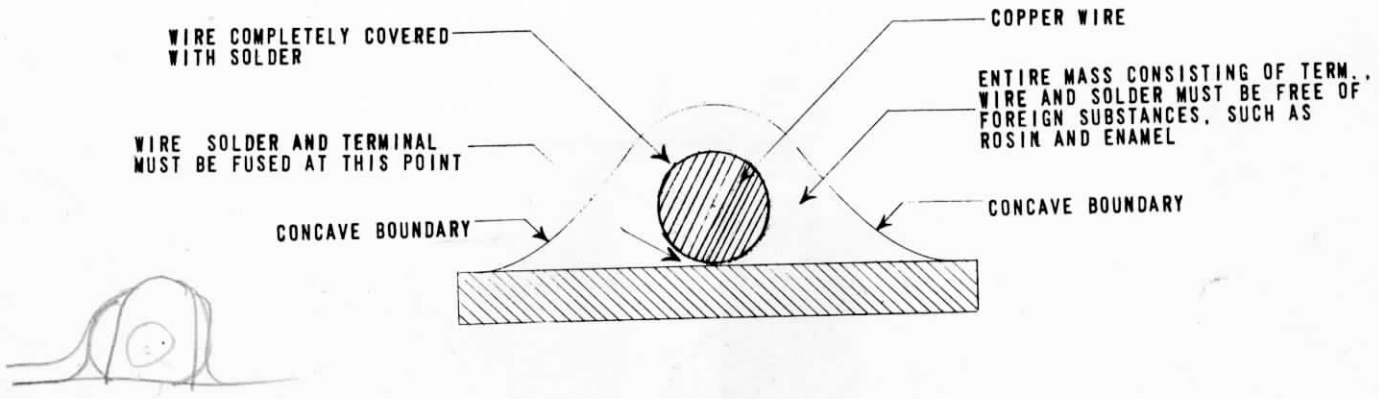



Figure 1. Solder boundary Concave rather than Convex

1.4 Indications of an acceptable connection are: the solder is neat, bright and properly covers the wire and terminal. The amount of solder used is moderate; usually leaving the outline of the wire, feathering out to a thin edge, indicating the proper "flowing and wetting" action. The joint is smooth; with no sharp points or foreign material imbedded in it. See Fig. 2.

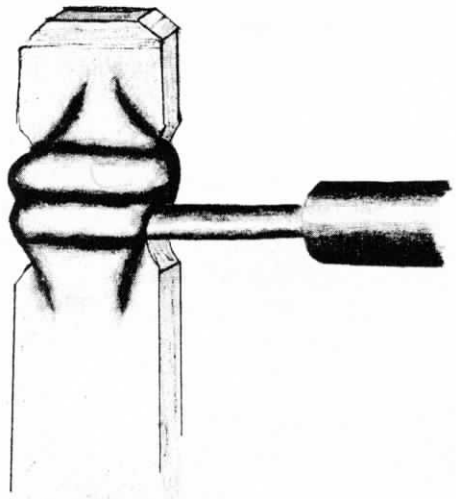


Figure 2. Acceptable solder joint

1.5 Soldering is to be considered not acceptable if any of the following points are in evidence:

1.5A Unsoldered joint - Solder is required but none has been applied.

1.5B Insufficient solder - The entire length of the wire used in the connection is not properly covered with solder, or the solder does not adhere to the terminal on both sides of the wire connection. See Fig. 3.

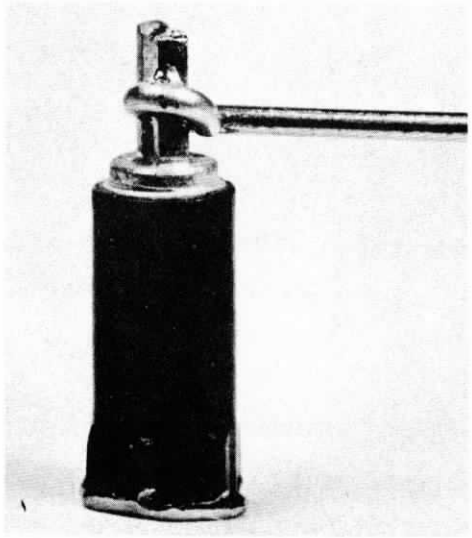
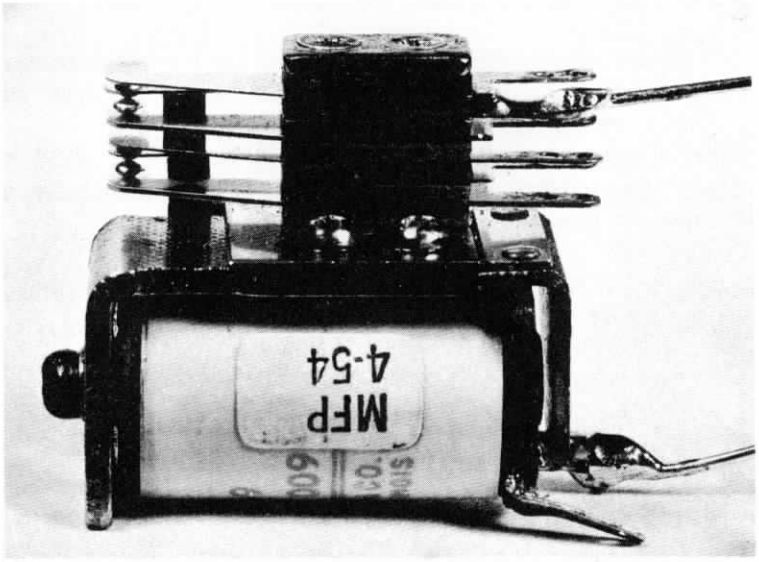


Figure 3. Insufficient Solder

1.5C Excess solder - Solder in excess of that required for a good solder joint has been used. This condition is often accompanied by solidified solder drips, tails or globules. See Fig. 4.




Excess Solder, causing short between two adjacent terminals

Excess Solder, leaving globules connection

Figure 4.

1.5D Cold solder - Improper heating has resulted in a granular, irregular, porous joint with a dull, rough surface, evidencing poor "wetting" action. A definite dividing line between the solder and the members being soldered may also be found. See Fig. 5.

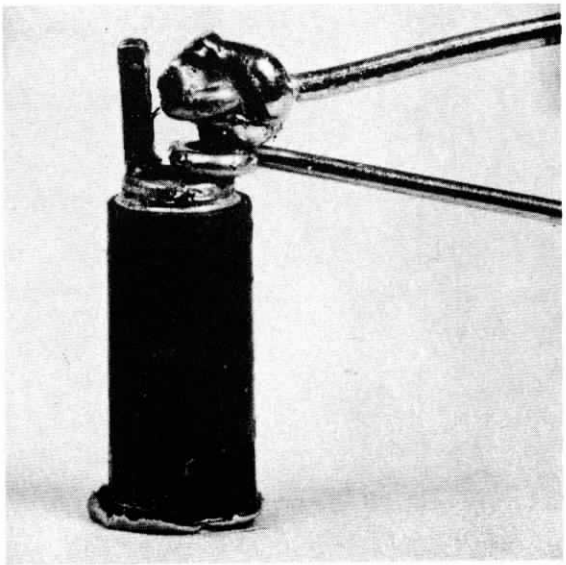


Figure 5. Cold Solder Connection

1.5E Rosin joint - A rosin joint is evidenced by the interposition of rosin between the solder and soldered members, indicating one or both of the members were not properly cleaned.

1.5F Fractured joint - Movement of one of the members being joined prior to the hardening of the solder has caused the solder to crack.

1.5G Repeated heating of a solder joint may cause the joint to appear gray or granular. New solder may have to be added to correct this condition.

1.6 When a wire is connected to a terminal provided with a hole, it will not be necessary to fill the hole with solder as long as the requirements are met for an acceptable solder connection.

## SECTION II

### Mechanical Connections

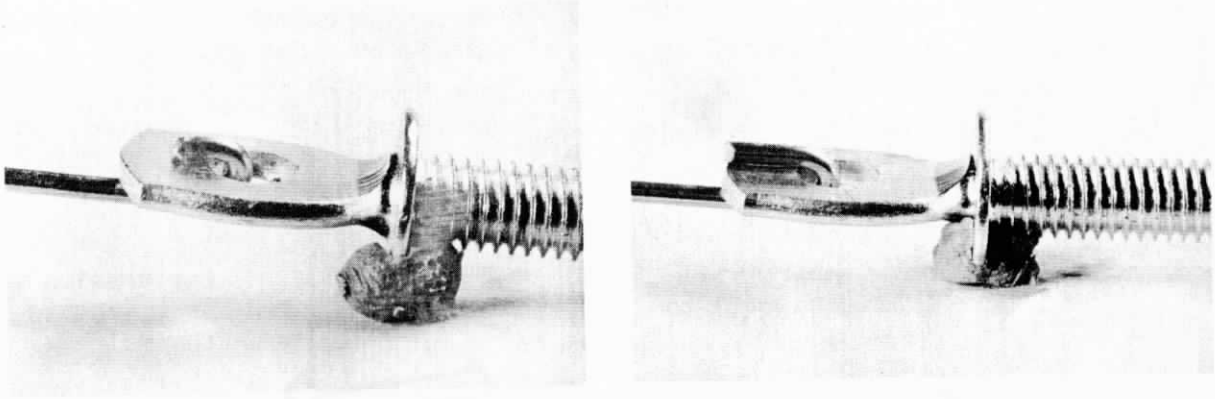
2.1 A mechanical connection is a wire connection designed to prohibit movement of the wire in relation to its connecting part prior to soldering.

2.2 Prior to the soldering process, the parts to be soldered must be connected mechanically. This is done by wrapping the wire to the terminal, inserting the wire through the hole in the terminal (where a hole is provided), and wrapping or crimping a lug to the wire.

2.3 When connecting any stranded wire, or bus wire smaller than #22, to a terminal with no hole provided, one complete turn is required.

2.4 When connecting #22 or larger bus wire, the loop must be more than 75% complete.

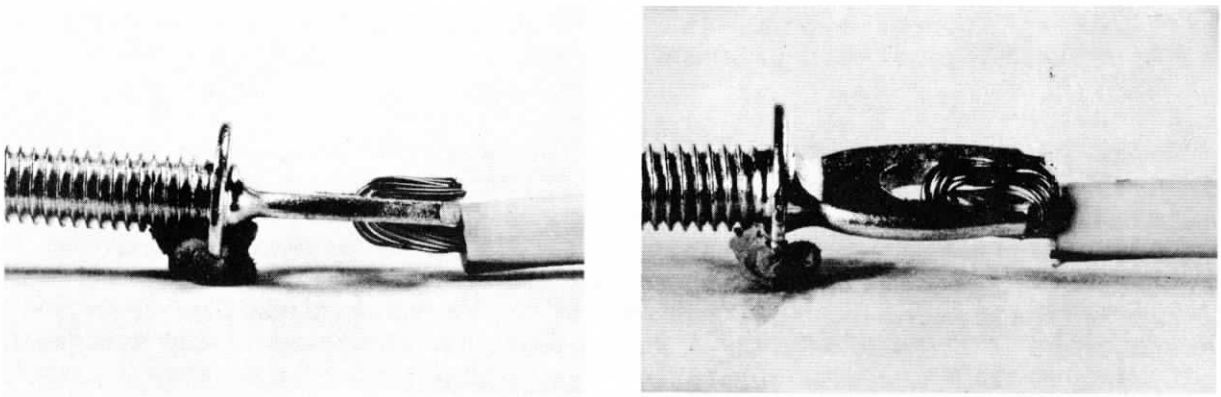
2.5 When connecting #22 bus or larger to a terminal with a hole provided, the loop may be incomplete by the thickness of the terminal, providing the loop is larger than the hole. See Fig. 6. Bus wire smaller than #22 and all stranded wire connecting to a terminal provided with a hole, the loop must be 100% complete. See Fig. 7.



Not Acceptable-Wire Loop Smaller Than Hole

Acceptable

Figure 6.



Not Acceptable-Wire Loop
Not 100% Complete

Acceptable

Figure 7.

2.6 Where a connection is made by wrapping a wire around a terminal, the end of the terminal must project above the wire loop.

2.7 Any terminal must be large enough to provide adequate contact area for every wire connected to it. The wrapping of wires upon wires with no contact with the terminal should not be necessary.

2.8 Wire should be wrapped around the terminal so that tension on the wire will be transmitted to the terminal and not to the solder. See Fig. 8.

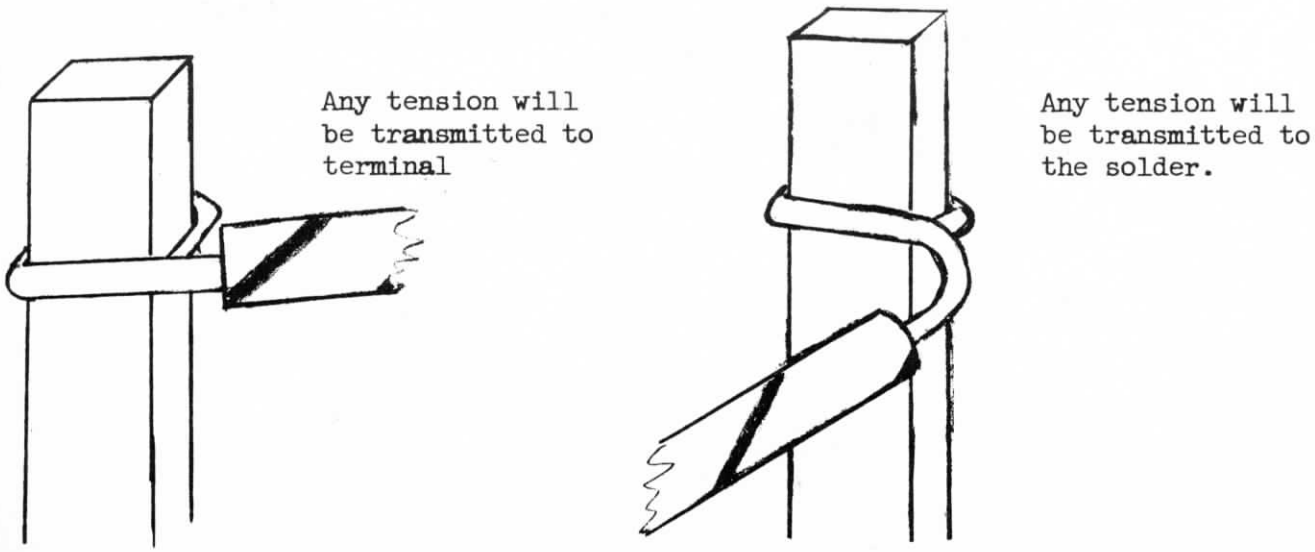



Figure 8

2.9 Where a series of three or more terminals provided with a hole are connected together, the wire should be wrapped to each terminal unless approved by Quality Control.

2.10 In certain instances where bus wire heavier than the terminal to which it is connected is used, the requirements for mechanical connections may be omitted. These cases must be approved by the Engineering and Quality Control Departments.

2.11 Where mechanical connections will cause insufficient clearance between terminals due to the design of the terminal spacing, the mechanical connection requirements may be relaxed, upon approval by the Engineering and Quality Control Departments.

*2.12 Mechanical connections between lugs and the wires to which they are assembled are obtained by crimping the "ears" of the lugs around the wire. The cut end of the wire should protrude slightly beyond the "ears". Where the lugs used have two sets of "ears", the insulation should terminate approximately halfway between them. The "ears" adjacent to the insulation should be firmly crimped around the insulated wire after the soldering operation. See Fig. 9.

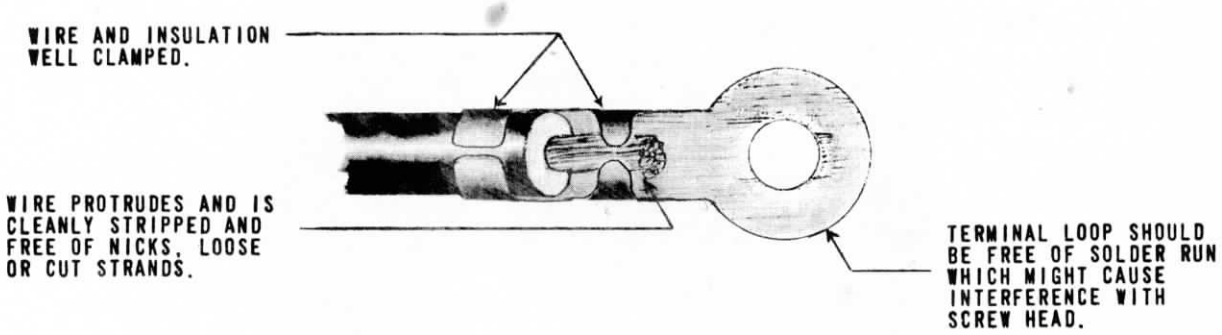



Figure 9.

## SECTION III

### Cables

3.1 Wherever practical, wires connecting various parts should be grouped together and tied or laced to form a cable.

3.2 All cables should be tight and neatly formed, with a minimum of crossing of wires. See Figs. 10 and 11.

3.3 Cables should be laced or tied at intervals of approximately 1". When the cable is tied, the Collins standard knot, locked with a square knot, should be used. The knots should be on the side which is least visible after installation of the cable.

3.4 When cables are laced, single lacing stitches may be used on cables whose diameter is 1/2" or less. Double lacing is required at each breakout and each corner. See Fig. 11. On larger diameter cables, double lacing should be used. At large breakouts and at corners, the number of laces should be increased accordingly.

3.5 Cables should follow the contour of the chassis, wherever possible.

3.6 All cables should be secured to the chassis as necessary to prevent movement from their intended position, or strain on the leads.

3.7 Wherever possible, cables should be routed in such a manner as to prevent their coming into contact with sharp metal objects, or other items which could cause damage to the wire insulation.

3.8 Where such contact cannot be eliminated, additional protection such as sleeving, tape, or like protecting material should be added to the cable.

3.9 The protective material should be positioned and secured in such a manner that it will always protect the point for which it was intended.

3.10 In no case should a cable, even so protected, be held under constant pressure against any sharp object.

3.11 Cables should be routed in such a manner that they do not come into contact with moving parts such as gears, switches, relays, slug racks, shafts, dials, tuning condensers, etc.

3.12 Where the wire insulation is susceptible to cold flow, (an illustration is Teflon insulated wire), a flat, ribbon type lacing cord should be used.

3.13 Cables should be routed far enough away from any heat generating part to prevent heat damage to the wire insulation.

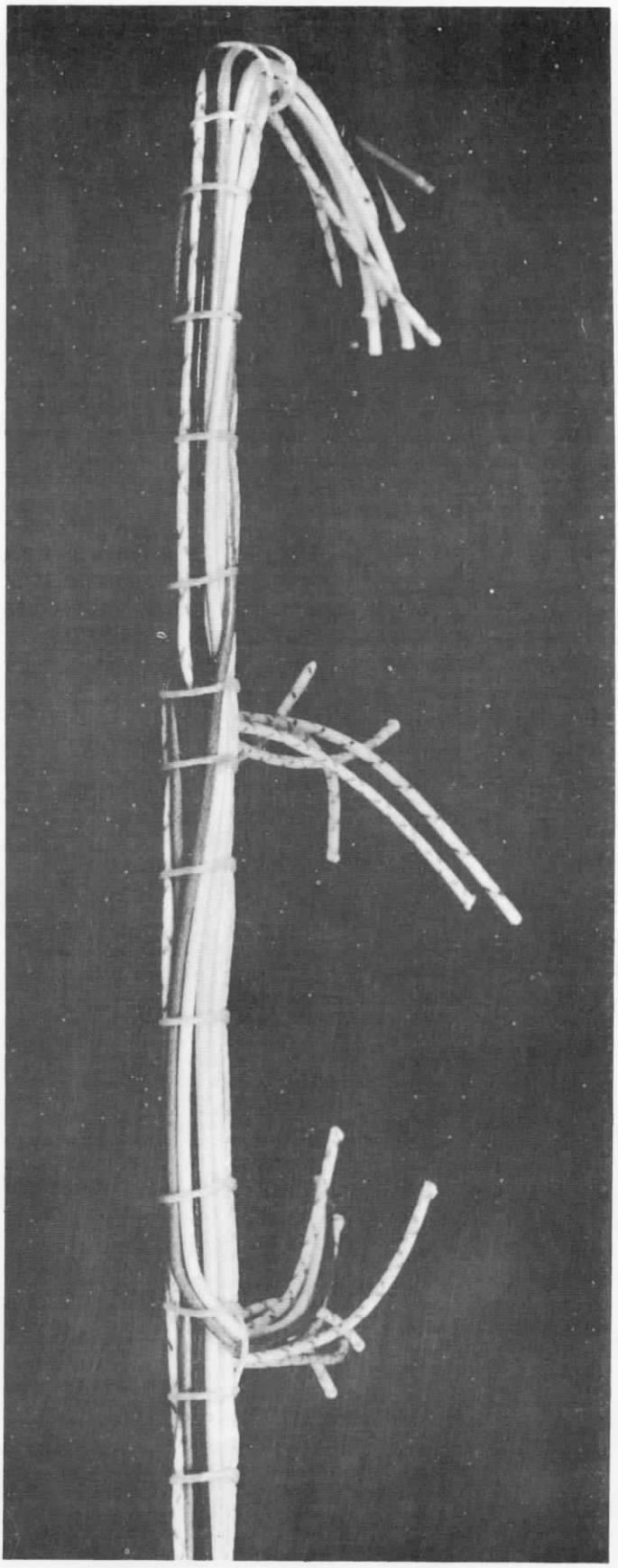


Figure 10. Cable Is Not Properly Laced or Formed

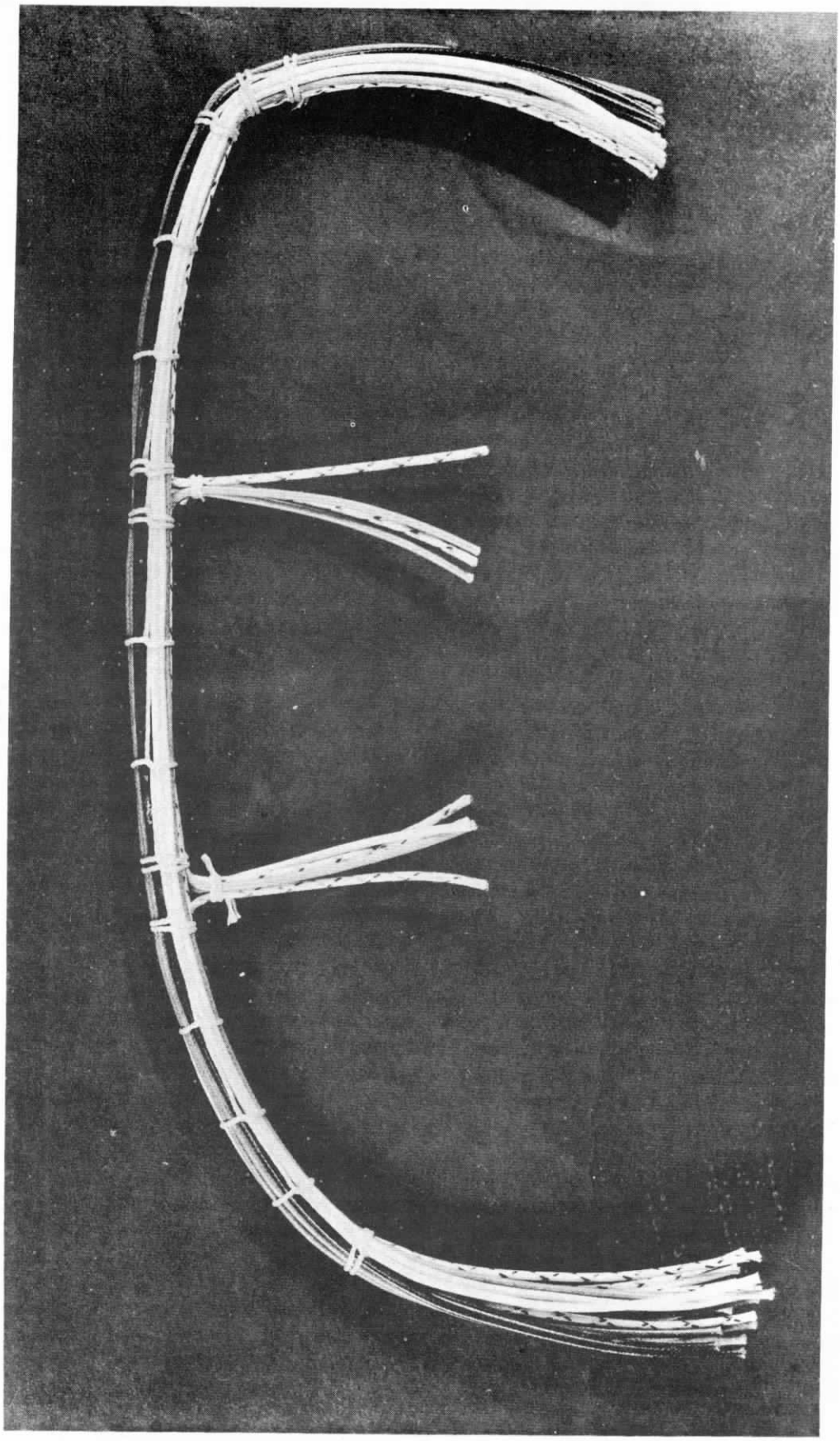


Figure 11. Cable Is Properly Laced and Formed

3.14 When shielded wires are incorporated in a cable, they should be positioned in the cable in such a way that they are insulated from adjacent terminals by unshielded cable wires.

3.15 If sufficient clearance between shielded leads and adjacent terminals cannot be obtained in this manner, the cable should be sleeved or taped to give the necessary protection.

## SECTION IV

### Bus Wire

4.1 All bus work should be neat and direct, without more bends than are necessary to give adequate clearance from adjacent parts or terminals.

4.2 A minimum of 1/16 inch clearance should be maintained between any bare bus wire and any terminal or part carrying a different potential.

4.3 In cases where this requirement cannot be met, the lead must be sleeved. Sleeving has low mechanical strength and cold flows under pressure. It therefore should not be depended upon for protection under pressure.

4.4 Collins Quality Control Department will not require sleeving of terminals where the terminal spacing requirements can be met per Par. 4.2 unless the contract requirements are otherwise specified.

4.5 The sleeving must protect the intended point when it is in its worst possible position.

4.6 When bus wire is used to connect two terminals whose relative position could change due to movement of the terminals, flexing of the chassis or board, or other like cause, sufficient slack must be left in the lead to allow this movement without causing stress on the part, terminal or lead.

4.7 When metallic braid is used as a conductor, the same requirements apply as for bus wire.

4.8 Solder leads, lugs and terminals should be tinned, silver plated, lead coated or with a protection equivalent.

4.9 For details on terminating bus wire leads, see sections concerning mechanical connections and soldering.

# SECTION 5

## Insulated Wire

5.1 When terminating cabled wires, sufficient slack should be left to afford 3 reconnections with the lead maintaining its normal routing. Usually approximately 3/4" will meet this requirement. Point to point jumper wires should be long enough to allow for flexing and vibration without any stress being applied to either terminal. Approximately 1/4" is usually sufficient. The above lead length requirement may be omitted where critical circuit applications apply and specified otherwise by Engineering.

5.2 No loop shall be so long as to interfere with moving parts.

5.3 No loop shall be excessively long.

5.4 When two or more wires are connected to the same terminal, the wires should be routed directly to the terminal, with no excess crossing. Their loops should be of approximately the same length.

5.5 All wires must be dressed so that they are not liable to be pinched when sub-assemblies, parts or covers are mounted.

5.6 Some form of protection must be provided wherever insulated wires are routed through chassis holes, across chassis edges, or adjacent to any object which could, under vibration, cause damage to the insulation. This protection may be in the form of grommets, chamfered edges, sleeving, tape, etc.

5.7 No insulated wire should be routed so close to a heat dissipating part to allow heat damage to the insulation, such as electron tubes, resistors, dynamotors, etc.

5.8 Insulated wires routed behind terminal boards should be dressed so that they do not touch terminals other than the one to which they are connected. This is to allow replacement of components on the face of the board without causing damage to the insulation.

5.9 Insulated leads, particularly nylon coated, should not be bent to such a small radius as to cause the insulation to crack.

5.10 The insulating material must be intact. In certain instances a limited amount of repaired damage is allowable. For instance, damage to the outer (nylon) jacket of nylon coated plastic wire may be repaired, provided that the damage is limited to the outer jacket of the wire and is not larger than 1/4" long and not more than 1/3 the diameter of the wire. If the damage exceeds these limits, the wire must be replaced.

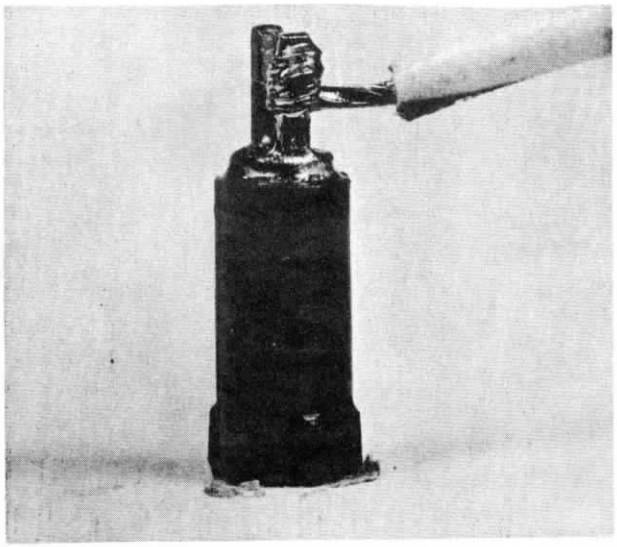
5.11 If a stranded wire consists of 5 or less strands, no strands shall be cut or broken between the insulation and the solder connection. Not more than

5.11 (Cont)

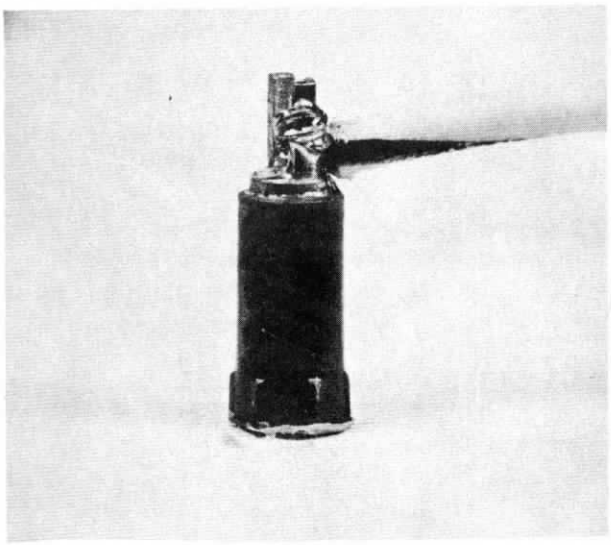
one strand may be severed in a 6 to 15 strand conductor. Not more than two strands may be severed in a 16 to 25 strand conductor. In wires consisting of more than 25 strands, not more than 10% of the strands may be broken. If the individual strands are larger than #18, none may be broken in any case.

5.12 When terminating insulated wires, the insulation should end not more than 1/16" from the terminal to which the connection is made. It should not be so close to the terminal as to interfere with the soldering of the connection. See Fig. 12.

5.13 For details on terminating insulated wire, see sections on mechanical connections and soldering.



Insulation Too Far Back from Connections



Insulation Is Properly Positioned at Connection

Figure 12.

## SECTION VI

### Shielded Wires and Coaxial Cables

6.1 Shielded wires should be routed so that a minimum clearance of 1/16" from any part or terminal carrying a different potential is maintained at all times. When this requirement cannot be met by routing of the wires, they should be insulated by the addition of sleeving or tape. Sleeving or tape have low mechanical strength and must not be depended on for protection under pressure.

6.2 Shielded wires 12 inches long or less should have the shielding grounded on at least one end. Wires longer than 12 inches should have the shielding grounded at both ends unless otherwise specified.

6.3 The shielding of shielded leads should terminate at a point between 1/4 and 1 inch from the end of the insulation unless otherwise specified.

6.4 The cut end of shielding must be terminated in such a manner as to prevent fraying.

6.5 The insulated wire should not be bent against the sharp edge of terminated shielding in such a manner that the insulation is liable to be damaged.

6.6 Where the braid is subjected to a soldering operation, there must not be sufficient heat transferred to the insulating material to cause it to be damaged.

6.7 Refer to Manual C3 furnished by Amphenol Corporation for correct assembly methods of coax cables and connectors.

## SECTION VII

Machine & Set Screws

7.1 Required screw lengths shall be as follows:

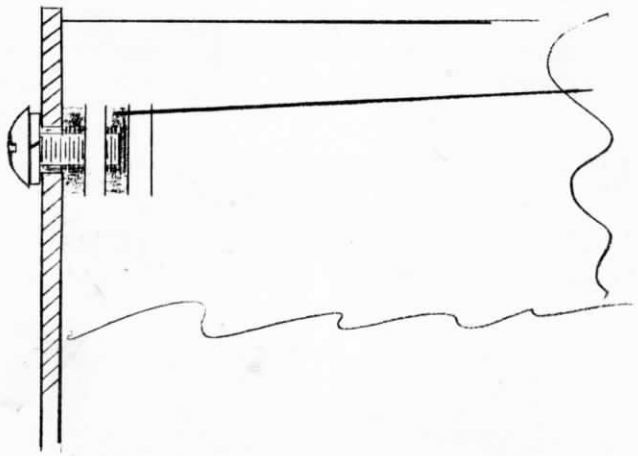
7.1A All screws used in screw and nut assemblies should be long enough to project a minimum of 1 1/2 threads above a standard nut. The maximum length should not exceed 1/8" plus 1 1/2 threads for screws whose overall length is 2" or less. It should not exceed 1/4" plus 1 1/2 threads for screws whose overall length is greater than 2".

7.1B Screws threaded into aluminum, phenolic, plastic or similar material must have a minimum engagement of 3 usable threads.

7.1C Screws threaded into steel, brass or similar material must have a minimum engagement of 2 usable threads.

7.1D Screws threaded into ceramic material must have a minimum engagement of 3/16" of usable threads.

7.1E Screws threaded into threaded lances must project at least half way through the third lance. See Fig. 13.



The screw must project at least half way through this lance.

Figure 13.

7.2 Fractured screw heads should be considered defective only when there is a definite separation at point of fracture.

7.3 Screw heads should be considered defective when the flute or slot is damaged to the extent that it does not afford good purchase to the screw driver. See Figs. 14 and 15.

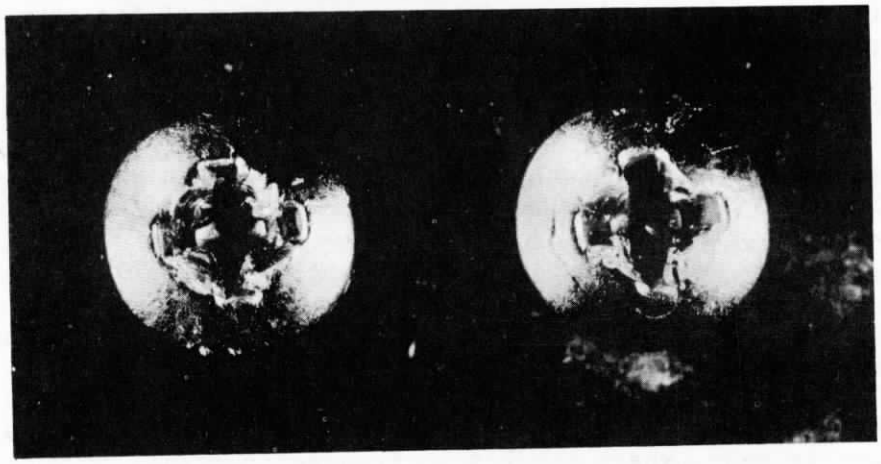


Figure 14. Not Acceptable

Figure 15. Acceptable

7.4 All hardware should be tight enough to withstand the vibration to which the equipment in which it is used may be subjected without loosening.

7.5 Hardware used in making electrical connections must be tight enough to prevent possible oxidation between the conducting parts.

7.6 The heads of all flat head screws should seat flush, or slightly below flush, with the panel through which they pass.

7.7 Whenever the chamfered head of a flat head screw passes completely through the panel and could interfere with proper seating of the next part in the sequence, this part should be countersunk to receive the head.

7.8 All hardware should seat flush against the part to which it is assembled.

7.9 All items of hardware in each sequence, (screw, flat washer, lock washer, nut), should be of the same material.

7.10 Hardware used in making an electrical connection should be brass or copper.

7.11 Hardware used for purely structural purposes should be steel or stainless steel unless otherwise specified.

7.12 Sheet metal screws should not be used in soft materials, where an electrical connection is made, where subject to frequent removal, or where a sizeable amount of structural strength is required.

7.13 Thread cutting screws must have the same minimum thread engagement as hardware threaded into tapped holes. They must not be used where an electrical connection is made. They should not be used in aluminum, brass, non-metals or other soft materials. They should not be used where subject to removal during operation or maintenance of the equipment, or where any sizeable amount of structural strength is required.

7.14 Where parts are assembled to a shaft and secured by set screws, two set screws, 90 degrees apart, should be used. If the shaft has a flatted side, one set screw will be sufficient. Whenever a flatted shaft is used, one set screw should seat on the flat.

7.15 The socket or slot in set screws must not be damaged to the extent that it does not afford good purchase to the wrench or screw driver.

7.16 Where mounting studs appear on purchased parts and the maximum protruding thread length is greater than specified in Par. 7.1A, they will be acceptable. However, if the stud length does interfere with the design of the equipment, the studs may be cut off, as long as the cut off end of the stud is protected and the minimum thread length requirements are met per Par. 7.1A.

Studs that are cut off and soldered on end after part is mounted to mating part should have nut backed off stud to correct any damage to thread during cutting or soldering operation.

## SECTION VIII

Lock Washers

8.1 Every screw assembly must incorporate some locking device. This may be in the form of "Shakeproof" washers, (internal or external tooth), split lock washers, a nylon or similar insert incorporated in the nut or screw for locking purposes, a second or locking nut, or liquid or mechanical staking. The type used shall be determined by the design requirements and/or the conditions in which the item appears.

8.2 External tooth washers must not be used adjacent to: painted surfaces, slotted holes, flat washers, or any part whose area is not of sufficient size to afford enough surface for the teeth to seat against. (For example: filister head screws, small outside dimension nuts, etc.) They should not be used adjacent to: phenolic, plastic, ceramic or other compressible or easily chipped materials, or where these materials appear in the sequence of parts being assembled. They should not be used to lock hardware which is subject to frequent removal. They must not be used adjacent to phenolic (Winchester) standoffs.

8.3 Internal tooth lock washers must not be used adjacent to: slotted holes, flat washers, internal tooth solder lugs, recessed head screws, or any material that is liable to be damaged by the teeth. They should not be used where compressible materials appear in the sequence of parts being assembled or where the hardware is subject to frequent removal. It is recommended that they not be used where the desired locking can be obtained by the use of either external tooth or split type lock washers. The internal teeth incorporated in certain types of solder lugs are not considered adequate locking devices. An additional lock washer, preferably external tooth, must be used.

8.4 Split lock washers must not be used directly adjacent to slotted holes or holes large enough that the washer does not seat properly. They should not be used where compressible materials appear in the sequence of parts being assembled. They should be used wherever heavy components are mounted to aluminum or other soft material, or where a sizeable amount of structural strength is required. They are the only type of lock washer approved for use adjacent to flat washers. They may be used adjacent to internal tooth solder lugs only when design requirements can be met in no other way.

8.5 Countersunk lock washers should be avoided wherever possible. They will be acceptable, however, where necessary to meet design requirements, providing that the requirements for seating of flat head screws are met.

8.6 Only stainless steel split lock washers will be acceptable where depended upon for structural strength, and phosphorous bronze where depended upon for electrical connection.

## SECTION IX

### Liquid Staking

9.1 Blue glyptal, or equivalent, shall be used for liquid staking.

9.2 Liquid staking must not be used where an electrical connection is involved.

9.3 All hardware which passes through or is threaded into phenolic, ceramic, plastic, or similar material, must be liquid staked or otherwise locked in such a manner that pressure against these parts is not involved in the locking process.

9.4 All set screws must be liquid staked. This is done by applying a small amount of glyptal to the exposed threads after the set screw is tightened. The socket or slot must remain accessible.

9.5 Solder may be used as a staking compound where an electrical connection is made and the locking requirements can be met in no other way.

# SECTION X

## Flat Washers

10.1 Flat washers must be used over slotted holes or holes so large that they do not present sufficient bearing surface for the hardware or part adjacent to them. Split lock washers or liquid staking should be used as the locking device in this case.

10.2 Flat washers must be used adjacent to mica, acetate or other nonmetallic washers or parts which are liable to be damaged by other items of hardware.

10.3 A series of flat washers should not be used in place of a spacer of the necessary length.

# SECTION XI

## Compressible Washers

11.1 Compressible washers must always be used when mounting ceramic to metal or ceramic to ceramic parts to absorb the stress of mounting.

11.2 When mounting heat dissipating parts, mica washers should be used.

11.3 Compressible washers are not necessary when mounting phenolic or similar parts which are compressible in themselves.

## SECTION XII

### Lead Mounted Components

12.1 Wherever possible, lead mounted components, (resistors, condensers, chokes, etc.), should be positioned parallel to two of the three major planes of the unit. See Fig. 16.

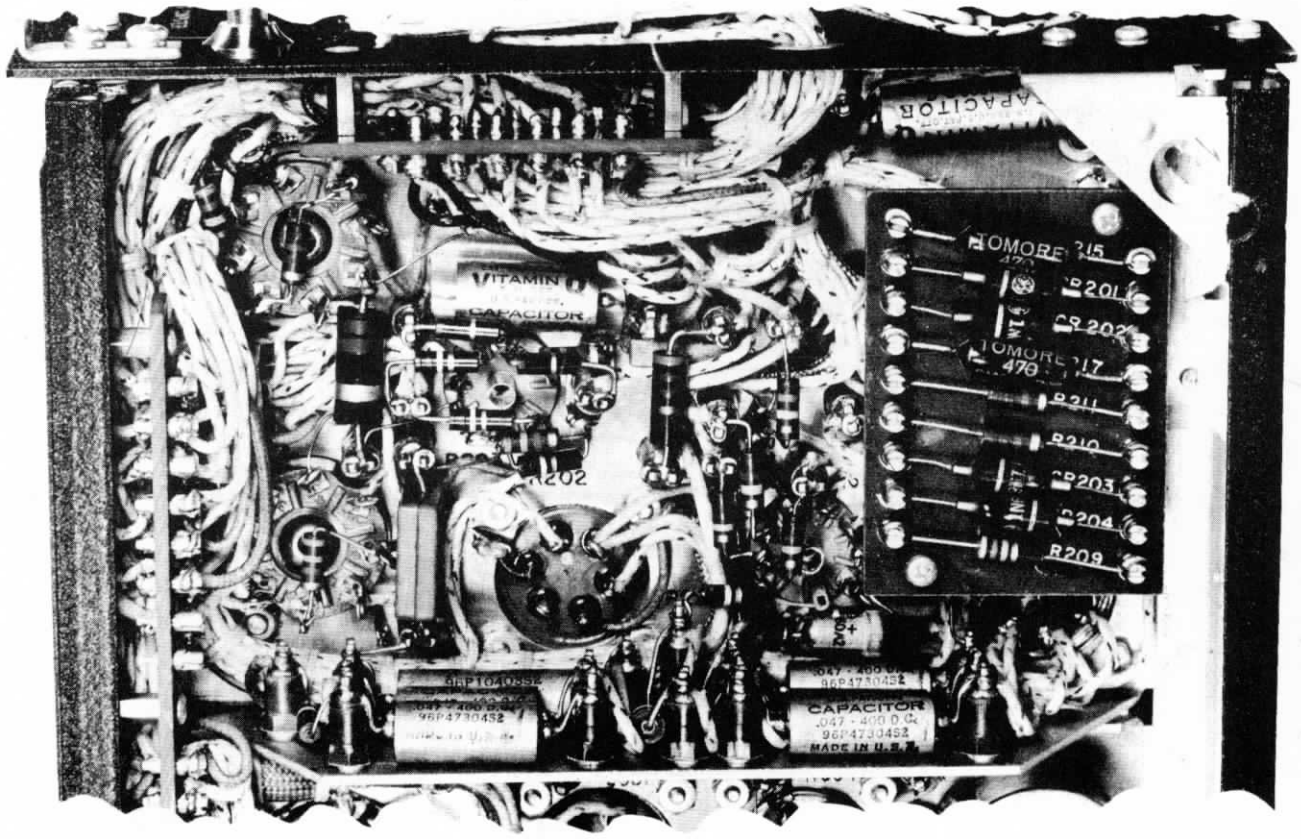



Figure 16. Lead Mounted Components Properly Positioned

12.2 Wherever possible, the crossing of component leads should be avoided. The components should be positioned so that the lead of one crosses the body of the other or so that the two bodies cross. Where this is not possible, one or both leads should be insulated if a potential short situation exists.

12.3 All components should be mounted within the boundaries of the unit to which they are assembled.

12.4 Since "Durez" or like coating compounds are considered to be a sealing, not an insulating, agent, components so coated should be positioned in such a manner that they do not touch metal parts. Where this is not possible, the body of the component should be sleeved.

12.5 The insulating or sealing material on resistors, capacitors, chokes, etc. should not be damaged or chipped to the extent that the winding is exposed to moisture.

12.6 Lead mounted components must not be used to support or position cables.

12.7 Where it is necessary to bend component leads, the bend should not be so close to the body of the component as to cause fracturing or other damage. Wherever possible, a distance of 1/8" between the body and the bend should be maintained.

12.8 To prevent internal damage to components, solder connections should not be made closer than 1/8" from the body of the component. In the case of "Vitamin Q" type condensers or other glass seal parts, this distance should be increased to 1/4".

12.9 Component parts which, due to their size or weight, are liable to move when subjected to the equipment's specified vibration requirements should not depend solely on their leads for support.

12.10 Component leads should not be drawn tight between two terminals.

12.11 Markings as to value, tolerances, voltage rating, etc. placed on the component by the manufacturer as required by the component specification should be intact and legible. The component should, wherever possible, be positioned in such a way that these markings can be read without disturbing any parts.

## SECTION XIII

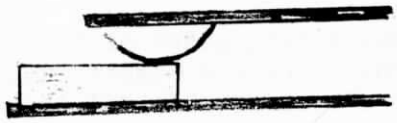
### Movable Parts

13.1 All parts which, in operation of the equipment, move from their normal position, should be free from binding or other defects which will keep them from functioning properly throughout their entire operation cycle.

13.2 Where two or more parts move in association with each other, they must be properly aligned in respect to each other throughout their entire cycle.

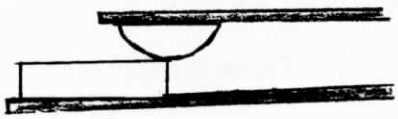
13.3 Where a detent action is involved, the detent should snap into positions with sufficient force that it leaves no doubt as to whether or not the selected position has been reached.

13.4 Switch or relay contacts should align so that the contact area of the smaller contact makes 100% contact with the larger contact at its worst position. See Fig. 17.



100% of smaller contact's contact area touches larger contact.

Acceptable



Only part of smaller contact's contact area touches larger contact.

Not Acceptable

Figure 17.

13.5 Switch or relay contacts should not be moved from their intended position due to stress from tight leads or other like factors. Contact supporting parts should not be subjected to any stress which could be detrimental to free action or alignment.

13.6 Switch or relay contacts which are burned to the extent that they have become pitted, are not acceptable. These pits can trap dirt and foreign material, causing contact failure.

13.7 Properly adjusted relay contacts will have a noticeable amount of follow through in the closed position. This is necessary to assure sufficient contact pressure.

13.8 All contacts must be free of foreign material. This includes solder.

13.9 Slug table rollers should ride on the cam throughout their entire travel. The roller should also turn freely throughout the entire travel. A minimum of 75% of the cam thickness should make contact with the roller when in the worst position. In cases where the table rides directly on the cam, with no roller, the same requirements for engagement apply.

13.10 Both ends of slug tables should start to rise at the same time and retain an equal amount of rise throughout the cycle.

13.11 Slugs should not bind inside the coil.

13.12 Slug stud retainers must have sufficient tension to prevent movement when the equipment is subjected to its specified vibration. The retainer must be installed in such a way that it will remain in place during, and yet not hinder, adjustment.

13.13 The thinner gear of two mating gears or two mating gears of the same thickness must have a minimum of 75% of the thickness meshing with the mating gear. These requirements apply to the worst position in the gears rotation.

13.14 Tooth engagement of two mating gears shall be governed by the backlash and torque requirements of the equipment.

# SECTION XIV

## General Requirements

14.1 At no time, will the splicing of wires be permissible.

14.2 Pressure against a compressible part should not be depended upon for making an electrical connection.

14.3 Riveting should not be depended upon for making an electrical connection.

14.4 In the case of ceramic tap switches or other like applications, where two or more metallic parts which form an electrical connection rely on a press fit for continuity, the parts should be soldered together to implement the press fit.

14.5 Liquid staking, fungus proofing or other similar insulating materials must not run into points of electrical contact such as tube socket and connector pins, under ground lugs, onto switch or relay contacts, etc.

14.6 Where electrical connections are made to a chassis or panel whose surface has an insulating finish (paint, anodize, etc.), the finish must be removed from the entire contact area.

14.7 Where sleeving is used over the shank of a lug which connects a lead to a threaded terminal, the sleeving should not be caught under the mounting hardware.

14.8 Parts should be free from scratches, fractures, dents, etc.

14.9 Structural parts should not be fractured to the extent that their strength is impaired.

14.10 Cracks or breaks should not appear between two terminals of a part, or between a terminal and any metallic part. They can become moisture traps, causing high resistance shorts.

14.11 Controls mounted on front panels by means of threaded bushings should have at least 1 1/2 and not more than 3 threads projecting through their mounting nuts.

14.12 The locating tabs of potentiometers, rotary switches, etc. should align in the holes provided.

14.13 All parts and assemblies should mount flush and square with the panel or chassis to which they are assembled. They should not protrude over the chassis or panel edge, and should be securely fastened.

14.14 Grounding springs, where used, should be intact and should make the intended contact.

14.15 Retainer rings should be installed in such a manner that the smooth side forms the bearing surface.

14.16 Gear trains and other moving parts should be lubricated in accordance with specifications.

14.17 Painted surfaces should be free from chips, scratches and blisters.

14.18 Plated surfaces should show no evidence of peeling or blistering. There should be no corrosion.

14.19 All markings (silk-screening, stamping, etc.) should be intact and legible, and should be capable of remaining so for the service life of the equipment.

14.20 All stamping should be coated with fungus proof varnish or similar protective material unless the stamping ink is fungus resistant.

14.21 Decals must be smooth, with no wrinkles or air bubbles. They should be parallel to the edge of the panel to which they are applied.

14.22 All equipments should be thoroughly cleaned of all loose material or material which could cause potential shorts or unsightly appearance. These include: excess hardware, solder splatters, wire strands, insulation clippings, excess flux, dust and dirt, etc.

14.23 Where a solder connection is made on the terminals of a wafer switch, the solder must not flow to the heel of the switch contact, interfering with the proper spring action of the contact.

14.24 No abrasive material should ever be used to clean switch or relay contacts. Burnishing tools made for this purpose should be used instead.

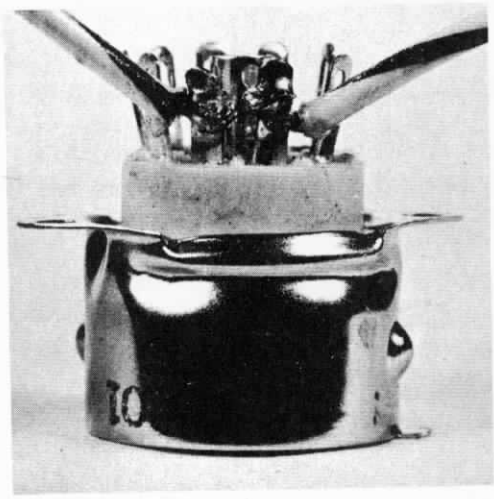
14.25 Parts and/or assemblies should be adequately protected during assembly, handling and storage to prevent damage to dimensions and finish.

14.26 Wires should not be wrapped in opposite directions on adjacent terminals whose spacing will not allow 1/16" minimum clearance after the connection is completed. See Fig. 18.

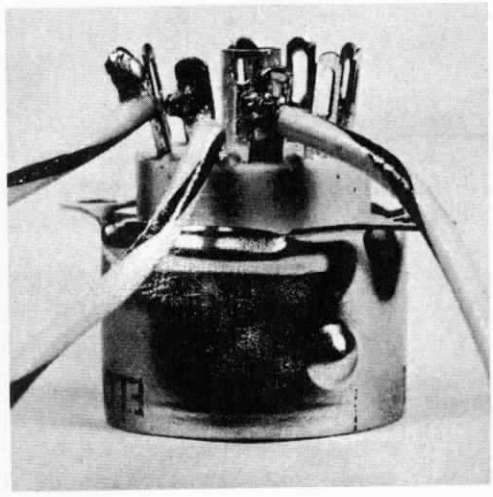
14.27 Where miniature tube sockets are assembled with a grounding shield, it will be advisable to turn the terminals adjacent to the shield approximately 45 degrees away from the shield and wrap the wire over the top or the opposite side of terminal from shield. See Fig. 19.

14.28 All parts with movable terminals such as tube sockets, connectors with floating pins, etc., should be checked for adequate clearance between terminals when adjacent terminals are in their worst possible position.

14.29 At no time, will it be permissible to use destructive methods for obtaining the proper alignment of parts without approval of both the Engineering and Quality Control Departments.

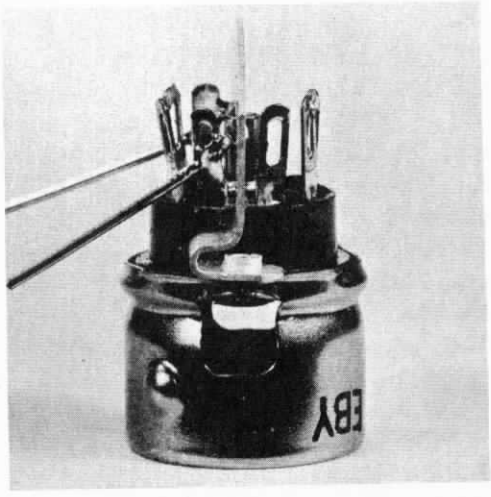


Wires Wrapped Opposite Directions Causing Direct or Potential Short

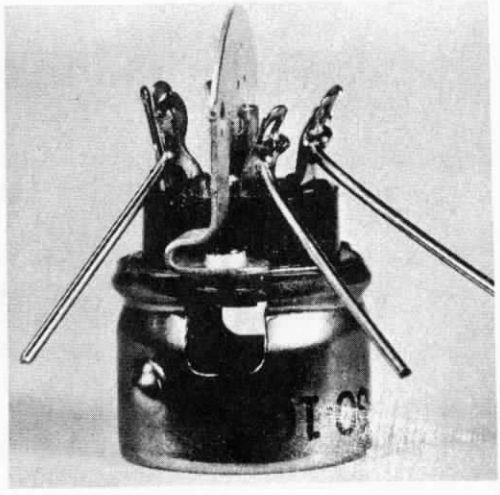


Wires Wrapped Same Direction Leaving Sufficient Clearance between Connections

Figure 18.



Wires and Terminals Adjacent to Shield Not Properly Positioned



Wires and Terminals Adjacent to Shield Properly Positioned

Figure 19.

## SECTION XV

### Mechanical Assembly

15.1 All rivets should be tight and completely rolled against the panel to which they are assembled. See Fig. 20.

Properly rolled rivet  Improperly rolled rivet

Figure 20.

15.2 The heads of flat headed rivets used in countersunk panels should not protrude above the surface of the panel through which they pass.

15.3 Pressed bearings should seat completely against the panel to which they are assembled. A slight undercut of the bearing will be acceptable providing the bearing is completely seated. See Fig. 21.

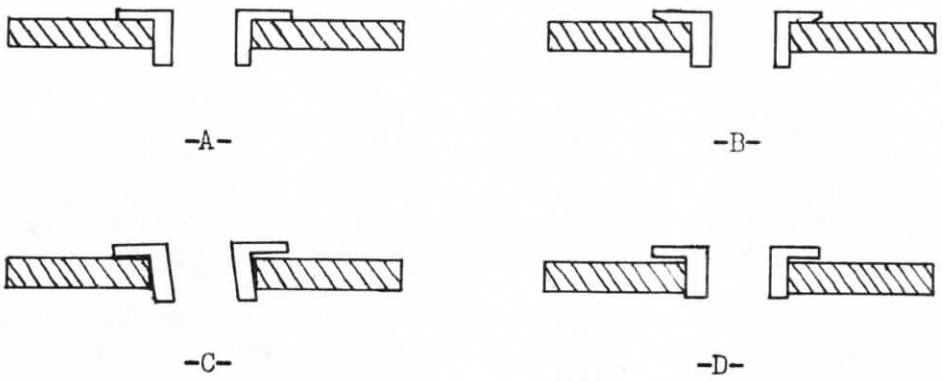



Figure 21.

| | | |
|---|---|---|
| -A- | Acceptable | The bearing is completely seated and square with the plate. |
| -B- | Acceptable | The bearing edge is undercut, but the bearing is completely seated and square with the plate. |
| -C- | Not Acceptable | The bearing is not square with the plate. |
| -D- | Not Acceptable | The bearing is not properly seated. |

15.4 Bearings should not move in the panel.

15.5 Pressed bearings will not be reamed to original specification size unless the drawing requests doing so.

15.6 When hubs are assembled to gears, cams, etc., the hub should seat against the mating part throughout its entire circumference. Run out should be checked when called for on the assembly drawing.

15.7 Where parts are assembled using taper or groove pins, the pin should engage at least 50% of the second side of the hub. If the hub has a wall thickness of 1/16" or less, the engagement should be at least 75%. See Fig. 22.

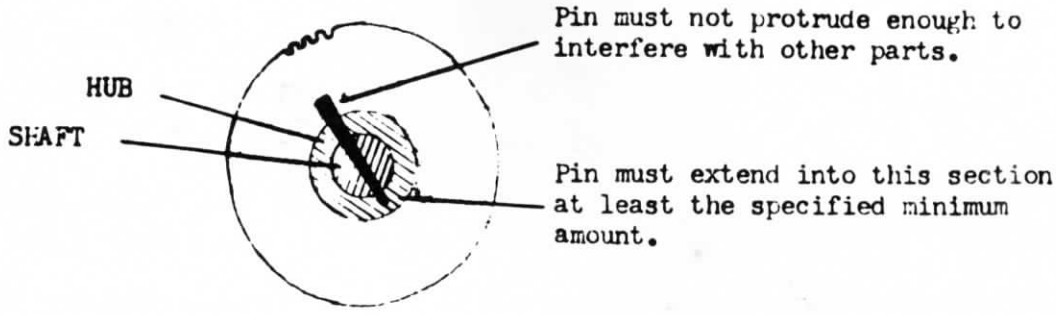



Figure 22.

15.8 Pins should not extend on either side of parts through which they pass sufficiently, to interfere with other parts.

15.9 Taper pins should, when finger tight in their assembly position, stand a minimum of 1/32" above the surface of the part through which they pass. With groove pins, this minimum should be 1/16". The requirements for projection into and extension above their associated parts, (Paragraphs 15.7 and 15.8 above), should be met after they are pressed into place.

15.10 Where eyelets are used only for structural purposes, an occasional split will be acceptable if it does not appreciably weaken the part.

15.11 Where eyelets will have wires passing through them, splits should not appear where they can chafe the wire insulation.

15.12 An occasional split rivet will be acceptable so long as the structural strength is not appreciably lessened.

15.13 Excessive splitting should be investigated immediately.

15.14 Where plating has been removed from rivets, eyelets, etc. by a spinning operation, the part will be acceptable providing the plating was not defective.

15.15 Where threaded parts, bearings and other similar parts are subjected to a staking operation, the stake must not project into or distort the inner surface.

15.16 Any threaded parts which have been subjected to a riveting staking or like operation should be checked with a thread gauge after the operation.

15.17 The threads of aluminum rivet nuts should be checked with a machine screw rather than a thread gauge to prevent thread damage.

15.18 Parts which have been subjected to a mechanical assembly operation should not be distorted to the extent that alighment or future assembly operations will be affected.