Chapter 6

Soldering and Magnet Wire Terminations

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Introduction

Reliability is accomplished through control of design, materials, techniques, and processes. There are many applications where reliability is supreme. Programs that demand this type of reliability are spacecraft, aircraft, missile guidance, and internal medicine. A failure in any one of these programs cannot be tolerated.

Fabrication

The fabrication of a Hi-Rel magnetic component, such as a transformer and/or an inductor, must be controlled from ordering the parts through final inspection. The documentation to fabricate any magnetic component must be exact in every detail. Nothing is left to memory or standard operating procedure.

Construction

Transformers and inductors shall be constructed according to the latest, signed engineering drawings. A complete up-to-date bill of materials will accompany, or be a part of the engineering drawings.

Materials

Only materials specified by the engineering drawing shall be used in the construction of transformers and inductors. Traceability of all materials is required, including shelflife certification for materials with limited life expectancy.

Facilities and Work Stations

Soldering Facility (Clean Room)

The general assembly and soldering area shall have a controlled environment, which limits the entry of contaminations. The temperature and humidity in the soldering area shall be monitored and maintained within the comfort zone, as shown in Figure 6-1. The enclosed soldering facility, will maintain a positive pressure, unless the soldering area is not in an air-conditioned, clean room.

Lighting

The lighting at the working surface for soldering and solder pot operations shall have a minimum illumination of 100 foot-candles.

Handling Parts

Prior to handling parts and/or materials, the operator shall thoroughly clean his/her hands; the use of any hand lotion is forbidden. Anyone working or handling parts, and/or materials must wear clean gloves and/or finger cots. Gloves must be changed when they show signs of contamination, and finger cots must be replaced when they are torn or contaminated.

Work Area

The work areas and workbenches shall be maintained in a clean and orderly manner. At the start of each workday, the work stations shall be free of visible dirt, grime, grease, flux or solder splatters, and other foreign materials.

Restrictions

There will be no smoking, eating, or drinking permitted at the workstations.

Cosmetics

Hand cream, ointments, perfumes, cosmetics, and other materials, not essential to the fabrication operation shall not be permitted at the work station.

ESD Protection Requirement

Supplier shall establish and maintain a documented program for the control of Elect-Static Discharge (ESD) during fabrication and handling of such devices. The program shall comply with the requirements of MIL-STD- 1686.

Hand Tools

Hand tools shall be checked daily for proper condition, operation, performance, and cleanliness.

Recommended Work Stations Tools and Materials

The following tools are required for lead attachment, soldering, anchoring, and cutting insulating tape.

1. Needle nose pliers (non-serrated).
2. Tweezers, (fine point).
3. Cutters, (full flush cut).
4. Scissors.
5. Orange stick.
6. Wire scrapers.
7. Gloves.
8. 3-10X magnification, (with a light is preferred).
9. Dial or vernier calipers.
10. Ruler.
11. Soldering iron (temperature-controlled).
12. Alcohol burner.

The following materials are required as an aid in lead attachment, soldering, anchoring, and cleaning. Only those materials that are "Program Approved" are allowed in the work area. All materials in the work area are required to have traceability data.

1. Solder, type S/N 60 or 63.

2. Alcohol, Isopropyl grade A.
3. Liquid flux conforming to Mil-F-14256.
4. Sandpaper (emery), 220, 280, 320 grit.
5. Kimwipes.
6. Cotton swabs.
7. Acid brushes (cleaning).

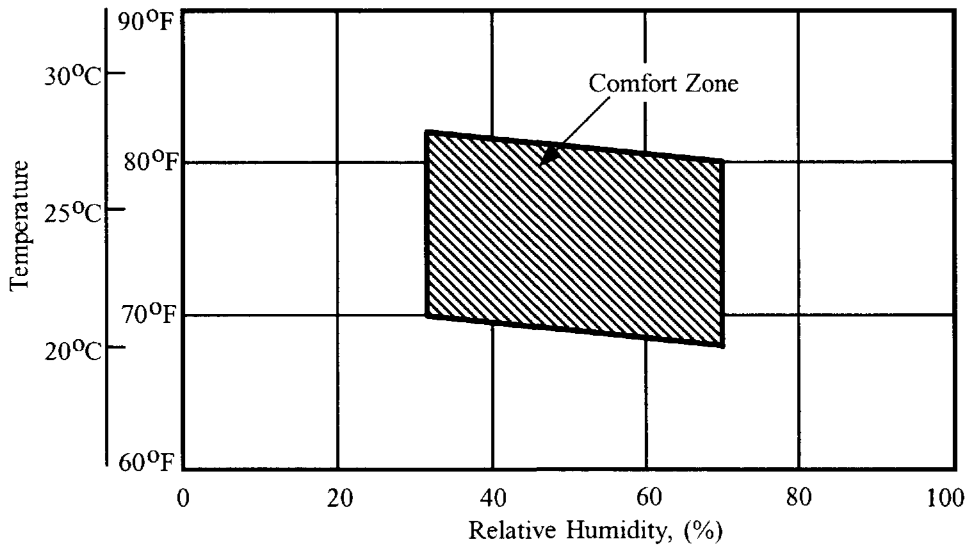

Figure 6-1. Temperature and Humidity in the Soldering Area.

Soldering Irons

Soldering Irons and Soldering Irons Tips

Only a temperature, controlled soldering iron shall be used, similar to the one shown in Figure 6-2. The tip idling temperature shall be checked with a calibrated device, at least once a day, and as often as necessary to assure that the requirements are adhered to.

Temperature

For all solder joints, except those containing "solder-through" magnet wire, the tip idling temperature shall be controlled to 315°C +/- 20°C (600 +/- 35°F). For solder joints containing "solder-through" magnet wire, the tip idling temperature shall be controlled to 370°C +/- 20°C (700 +/- 35°F).

Grounding

The soldering iron shall have a NEMA, three wire power plug. There will be less than 2 ma leakage to the local ground and 2 ohms resistance, tip-to-ground.

Melting Capacity

Select the correct soldering iron tip size, and the proper tip geometry for the soldering application. The soldering iron tip must be of a size and configuration to provide the capability to melt solder on a wire or joint, within a maximum of three seconds.

Cleaning

Plated soldering iron tips shall not be filed. The surface of plated soldering irons tips shall be polished, only if the plated tip was not tinned in the, "as received," condition, or if dewetting is evident. If the soldering iron tips need to be polished to remove the dewetting, either an emery cloth or aluminum oxide cloth, 320 grit, shall be used. If the dewetting cannot be easily removed, or there are signs that the soldering iron tip is eroding, as shown in Figure 6-3, the tips shall be replaced.

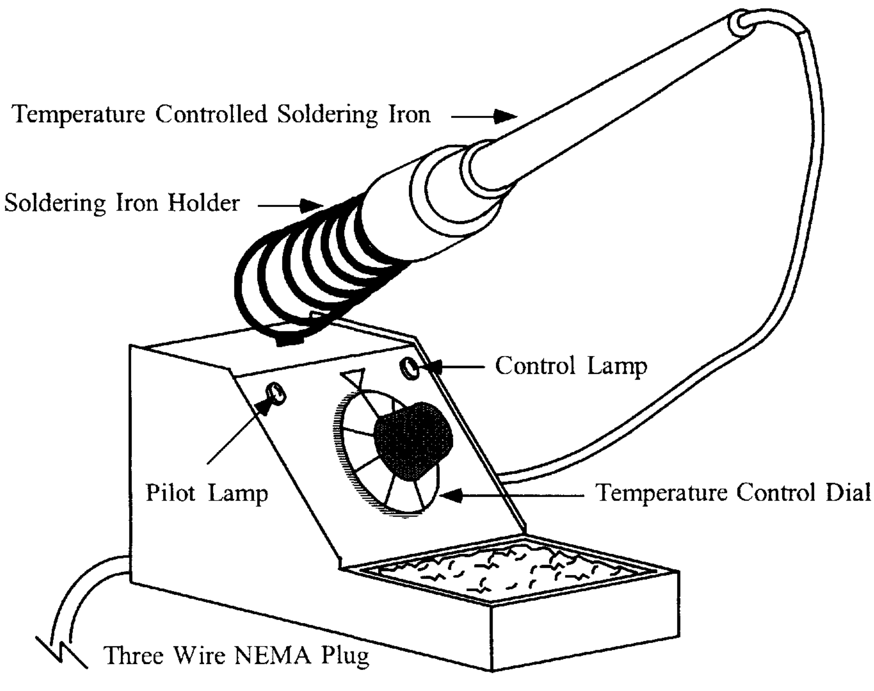

Figure 6-2. Temperature Controlled, Soldering Iron.

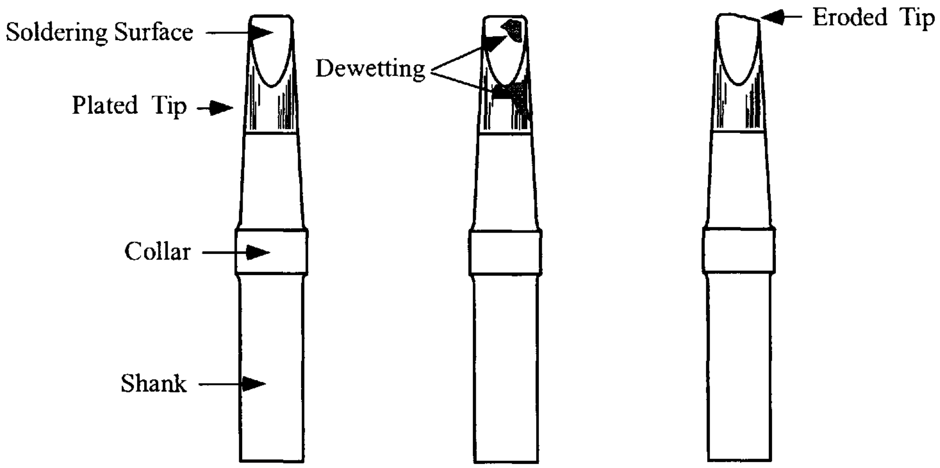

Figure 6-3. Soldering Iron Tips.

Soldering Preparation

<u>Preparing Leads for Tinning</u>

The enamel magnet wire must be stripped and made ready for tinning (See Chapter 5). Abrasive cleaning shall not be used on tinned, or plated leads.

<u>Fluxing</u>

It is recommended that liquid flux be applied to component leads and component terminals, prior to the application of heat, even when using flux cored solder.

Heat Sink or Shunt

A component lead heat sink or shunt is shown in Figure 6-4. It is used to absorb, or delay, the heat from traveling up the lead being soldered which will cause damage. The size, shape, and material of the heat sink shall be adequate to provide enough heat sink protection to heat sensitive parts or components. The heat sink shall not scratch or damage a component lead or wire.

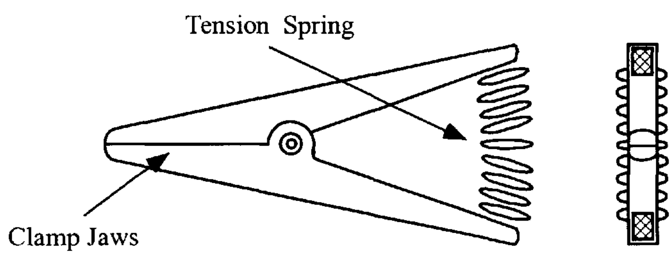

Figure 6-4. Typical, Commercially Available, Component Lead Heat Sink.

Solder Tinning

Tin the soldering iron tip by applying a rosin, cored solder. Remove excess solder by wiping the tip with either a moist sponge, or a tissue, before each soldering operation. The tinned surface shall be continuous, smooth, and without inclusions. It shall not show evidence of either non-wetting or dewetting. The strands of stranded wire shall be visible under the solder coating. There shall not be any wicking of solder under the insulation of the insulated wire. The lay of the tinned wire shall not be disturbed.

Connection

For those terminations, which require the conductor to be formed, use a smooth, or round jaw pliers to prevent damaging the conductor. Then, trim the end off to the required length using flush-cut type cutters.

Soldering

Acceptable Soldering

An acceptable solder joint shall be continuous, smooth, and without inclusions, with fillets, that are either straight or concave, feathered to a fine edge. There shall be no evidence of dewetting or non-wetting. The cut end of the wires shall be covered with solder, and the contour of the soldered conductors shall be visible after soldering. During the time the joint is heated, and until the solder has solidified, the lead shall be immobilized to prevent movement of the solder joint. Heat-sensitive leads shall be protected with suitable heat sink, during soldering.

Flux Removal After Soldering

After soldering, flux residues shall be completely removed, using an approved, flux removal solvent, and an acid brush.

Solder Joint

All solder joints should be well-formed, and positioned, and should not show any of the following characteristics, when inspected under a magnification of 3X to 10X:

1. Solder joints with sharp (tips, peaks).
2. Excessive solder, which obscures the connection configuration, except connections of a AWG 38 or smaller magnet wire.
3. Swelling of stranded leads, due to excessive wicking.
4. Loose wire, (except stress relief wraps).
5. Foreign or extraneous material, embedded in the solder.
6. Fractures, cracks, or pinholes.
7. Bare conductor or dewetting within the solder joint area.
8. Protrusion of the bare wire end, of stranded wire out of the solder joint.

9. Necking down of the magnet wire at the joint.
10. Pitting or voids in the corona free ball connections.

Excess Solder Removal

Excess solder shall be removed from a joint by the use of a vacuum or with an approved pre-flux wicking braid, as shown in Figure 6-5. Wick the solder from the lead or terminal, by placing the braid in contact with the solder joint. Apply the soldering iron tip to the wicking braid, as shown Figure 6-6. Limit the time on the joint to 5 to 6 seconds to avoid any damage. After all the solder has been removed from the solder joint, clean the area with an approved flux removal solvent.

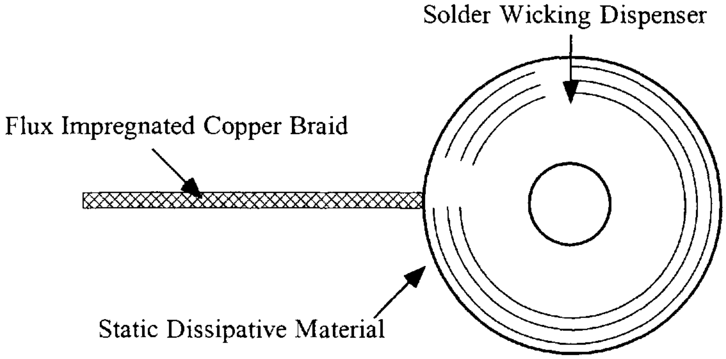

Figure 6-5. Commercially Prepared, Copper Wicking Braid.

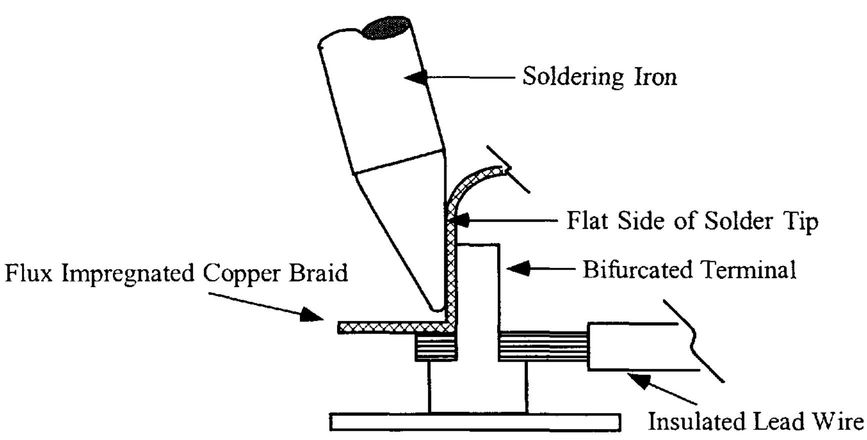

Figure 6-6. Solder Wicking, Using Flux-Impregnated Copper Braid.

Removing Insulation from Magnet Wire

Solder Pot

A typical solder pot for tinning solderable magnet wire is shown in Figure 6-7. The solder pot shall have a molten solder capacity of, at least, 1 pound (453.6 grams) minimum. The solder used shall be SN63 from a solid bar, with a composition as shown in Table 6-1. The solder pot capacity shall be maintained to, at least, 90%. The solder pot temperature shall be controlled at 260°C +/-20°C (500°F +/-25°F), when measured below the solder surface, and near the center of the solder mass away from the walls. The solder pot shall have a sufficient quantity of solder to minimize the temperature drop of the molten solder, when dip tinning. Prior to dip soldering, the dross* on the solder surface shall be removed using a stainless steel paddle. When the solder composition exceeds the contamination levels of Table 6-1, the solder shall be discarded and replaced with fresh solder.

<u>Calibration Records</u>

Records shall be maintained to ensure solder pot conformance with solder, temperature, and contamination.

<u>Grounding</u>

The soldering iron shall have a NEMA, three wire power plug. There will be less than 2 ma leakage to local ground, and 2 ohms resistance, tip-to-ground.

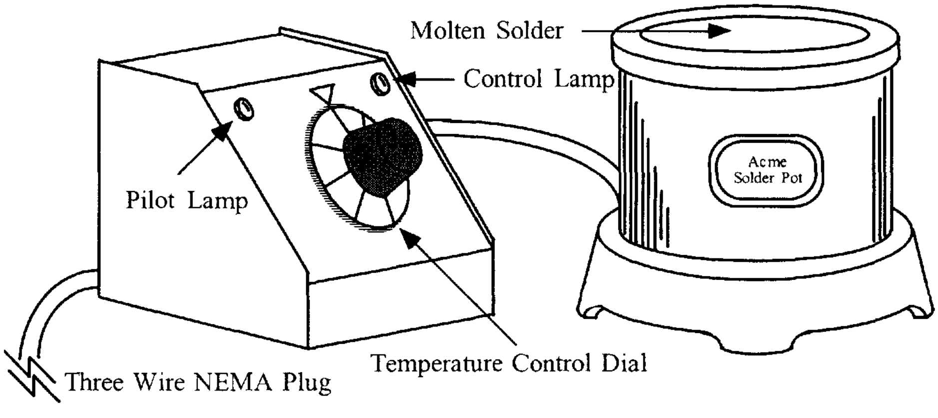

Figure 6-7. Typical Temperature Controlled Solder Pot.

*<u>dross</u> Oxide and other contaminants, which form on the surface of the molten solder.

Table 6-1

SN63 Solder		
Elements	Basic Elements Limits (%)	Impurity Limits Maximum (%)
Tin	60-65	
Aluminum		0.01
Antimony		1
Bismuth		1
Cadmium		0.01
Copper		0.5
Gold		0.2
Iron		0.02
Magnesium		0.01
Sulfur		0.02
Zinc		0.01
*Others		0.1
Lead		Remainder
*Total of all others (except lead remainder)		

Magnet Wire Stripping Using Flame

The removal, of enamel insulation on magnet wire, having a diameter 0.295 mm, (0.0116 inches 30 AWG), or smaller, can be done with a flame. Using an alcohol burner as shown in Figure 6-8, and placing the magnet wire in the upper portion of the flame, the insulation can be carefully burned black to the desired length. After the insulation has been blackened, the magnet wire should be immediately quenched in to water to regain temperature. Emery paper can now be applied to the blackened area on the magnet wire to remove the black residue left from burning. After the magnet wire has been cleaned and inspected, the wire is ready to be tinned.

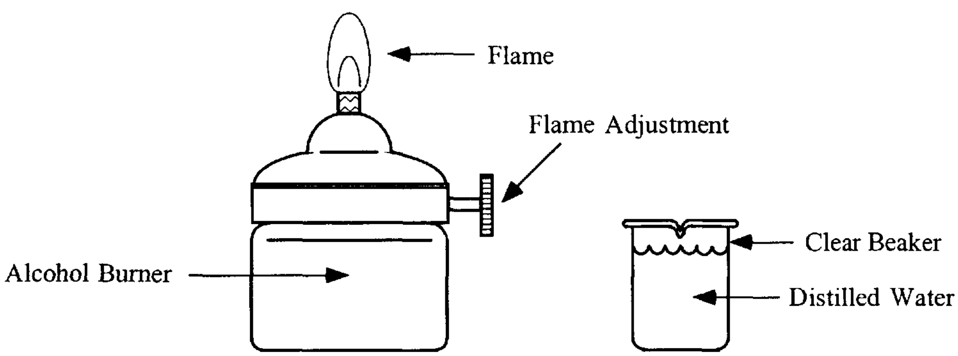

Figure 6-8. Typical Alcohol Burners, with Distilled Water for Quenching.

Magnet Wire Stripping Using an Abrasive Wheel

Abrasive wheel stripping normally involves the use of two wheels of various materials to remove the magnet wire insulation. The wire is inserted between two rotating wheels to perform the stripping. The two most common materials used for the stripping wheels are fiberglass and wire. The fiberglass material, in the wheels, wipes away the insulation, thus leaving the magnet wire clean and polished. The cone type of fiberglass strippers, shown in Figure 6-9A, is normally used for very fine wire, from 0.046 – 0.25 mm, (30-45 AWG). For medium wire, from 0.25 – 1.45 mm, (15-30 AWG), a pair of round fiberglass wheels, like those in Figure 6-9B, would be used to strip the insulation from the magnet wire. For large wire, from 0.81–7.34 mm, (1-20 AWG), a pair of round wire wheels, like those in Figure 6-9C, would be used to strip the insulation from the magnet wire. Care must be taken when selecting the correct wire wheel. Selecting the wrong wire wheel could cause a rough surface in that it would cause the removal of some of the copper conductor.

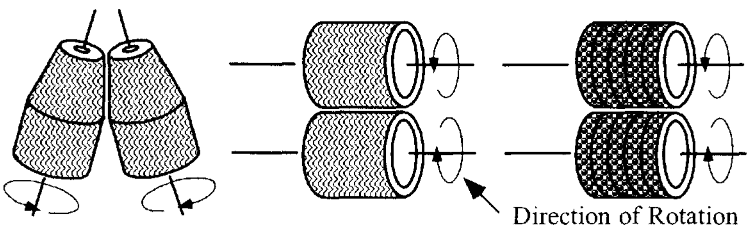

Figure 6-9. Typical Abrasive, Magnet Wire Strippers.

There is not one abrasive stripper for all sizes of magnet wire. Different abrasive wheels have to be used with different ranges of wire sizes and different types of insulation. It is necessary to choose the correct wheel type and grade, (roughness), for the gauge of wire and insulation type to be stripped. If the abrasive wheels are not adjusted with the proper tension, it will lead to grabbing and breaking of the magnet wire.

<u>Chemical Stripping Magnet Wire, (Very Toxic)</u>

Chemical stripping involves the use of a chemical reaction to break down the insulation and to remove it from the magnetic wire. There are several types of chemical strippers available that may be used. They are all very toxic. The chemical strippers are available in cream or paste, gel, and liquid.

A typical chemical stripping procedure is shown in Figure 6-10. (1) The magnet wire is placed in the toxic stripper until the insulation separates from the magnet wire. Then, it is wiped clean with a kimwipe. (2) The magnet wire is then placed in the distilled water, stirred, removed, scrubbed with an acid brush, and rinsed again. (3) Then the magnet wire is placed in the neutralizer solution, stirred, removed, and scrubbed with an acid brush, after which it is wiped clean with a kimwipe. (4) The magnet wire is then placed in the distilled water, stirred, removed, and scrubbed with an acid brush. (5) Then magnet wire is placed in the alcohol, stirred, removed, and scrubbed with an acid brush, after which it is wiped clean with a kimwipe. The magnet wire is then ready to be inspected and tinned.

The time required to remove the magnet wire insulation with chemical strippers will vary with insulation type and wire size. There are occasions when the requirements specify that the stripping to be performed does not put physical stress on the magnet wire. Chemical stripping is the only way. Chemical stripping is not a preferred method as it creates a hazardous work station requiring ventilation, special equipment, and safety training for skilled operators. The operators should be wearing special aprons, gloves, and goggles for their protection. Records shall be maintained to ensure the traceability for the manufacturers' lot and date.

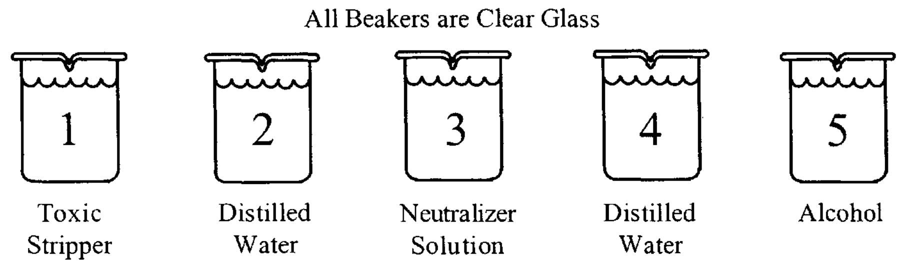

Figure 6-10. Typical, Chemical-Stripping Procedures for Magnet Wire.

<u>Magnet Wire Stripping Summarized</u>

The above paragraphs have described four ways to strip or remove the enamel insulation from magnet wire: solder pot, flame (burning), abrasive wheel, and chemical. After reviewing all four enamel stripping methods one does not stand out over the rest. Each of the stripping methods has its own advantages and disadvantages. There is not a clear-cut winner. All of the wire stripping methods, have their own unique process to remove the enamel from the magnet wire.

Each method of wire stripping is unique in itself. However, they all have the following requirements, in common:

1. They all require a work station.
2. They all require special equipment.
3. They all require special setup.
4. They all require special adjustment.
5. They all require control of records.

Any of the above wire stripping methods requires skilled operators. There has to be a written, a complete, and a thorough procedure for each of the above wire stripping methods. The operator must be capable of fine-tuning the equipment, and then be able to demonstrate the performance.

Removing Insulation from Stranded Wire

Stranded Hookup Wire

The wire used for breakout leads shall be a stranded, hookup wire, per MIL-W-16878. The insulation shall be 600 volt, unpigmented, bondable virgin TFE. For stranded hookup wire, see Table 6-2.

Table 6-2. Design Standard for Teflon Hookup Wire.

Teflon Insulated, 200°C Hookup Wire			
	MIL-W-16878E		JPL
AWG	Strands	AWG	Standard
16	19	29	ST11478-16ET
18	19	30	ST11478-18ET
20	19	32	ST11478-20ET
22	19	34	ST11478-22ET
24	19	36	ST11478-24ET
26	7	34	ST11478-26ET

Wire Stripping

When using an approved wire stripper strip, approximately 0.2 inch, (0.5 cm) of insulation from the wire to be tinned. Remove any tag, or icicle ends of wire insulation as shown in Figure 6-11. Use a pair of flush cutters or clippers.

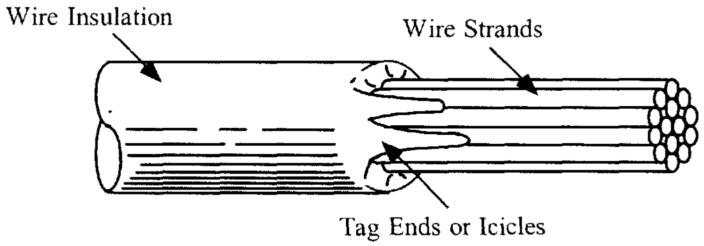

Figure 6-11. Stripped, Insulated Stranded Wire with Icicles.

If the lay of the outer wire strands has been disturbed, restore the lay by twisting the strands in the direction of the original lay. Do not handle the strands with bare fingers. Use either gloves, finger cots, or the equivalent. Do not over twist the strands, as this tends to increase the outer diameter of the conductor and may prevent insertion of the tinned wire into the bifurcated terminal. Do not attempt to restore the lay of the wires that have disturbed inner strands. Cut off the length containing the disturbed inner strands and restrip the wire. Reject wires with nicked or broken strands.

Thermal and Mechanical Wire Strippers

Only approved thermal or mechanical wire strippers should be used. A typical, thermal wire stripper is shown in Figure 6-12 and a mechanical stripper is shown in Figure 6-13. Mechanical strippers require finer adjustment to get the performance, without having cuts, nicks or a broken serve, as shown in Figure 6-22.

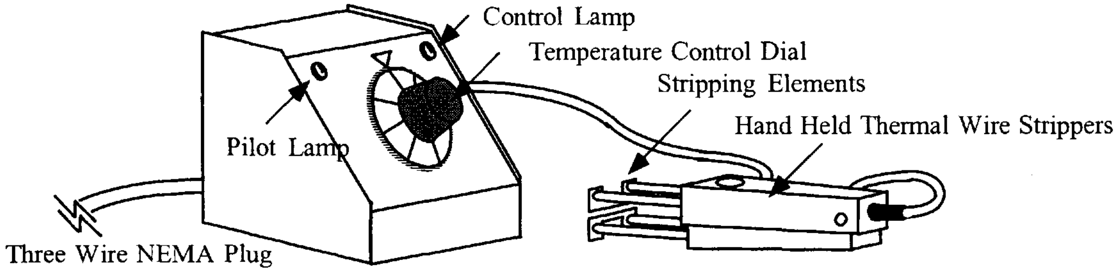

Figure 6-12. Typical, Thermal Wire Strippers.

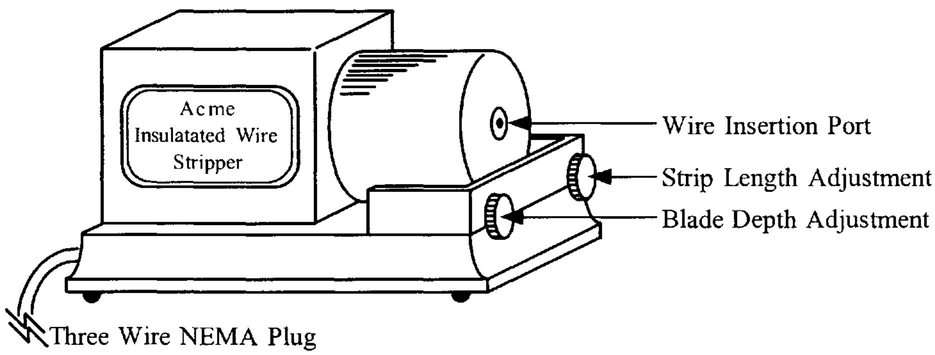

Figure 6-13. Typical, Mechanical Wire Stripper.

The damage to wires, caused by the insulation stripping process, is restricted as follows:

1. Stranded conductors shall not have cracked or severed strands.
2. The conductor insulation shall not be punctured, crushed, or otherwise damaged, to such an extent, that the wire could not pass the dielectric acceptance requirement of the wire. The ends of the insulation shall be cut square and clean, except for a few remaining fibrous strands. Do not bend the conductor strands for the purpose of removing excess fibrous strands.
3. The conductor strands shall not have evidence of plastic film deposit resulting from the thermal stripping operation.
4. The wire insulation shall not be blistered or swollen, but, a slight discoloration is acceptable when using thermal strippers.

5. The illustrated examples of acceptable and unacceptable wire stripping are shown in Figure 6-14 through 6-18 for thermal strippers, and Figure 6-19 through 6-22 for mechanical strippers.

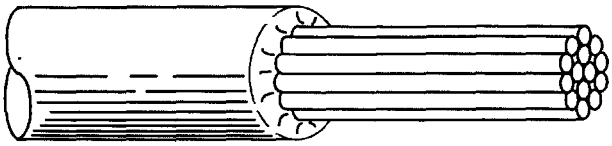

Figure 6-14. Acceptable, Thermally Stripped, Square and Clean Insulation.

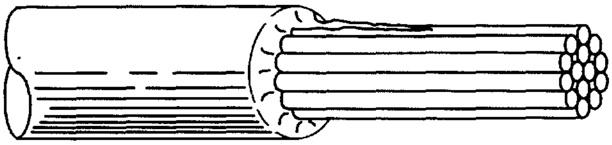

Figure 6-15. Unacceptable, Thermally Stripped, Smeared Insulation.

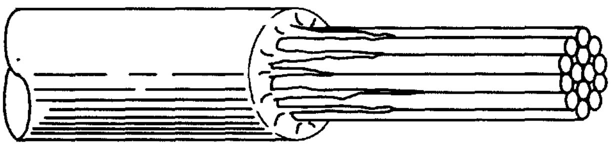

Figure 6-16. Unacceptable, Thermally Stripped, Insulation with Icicles.

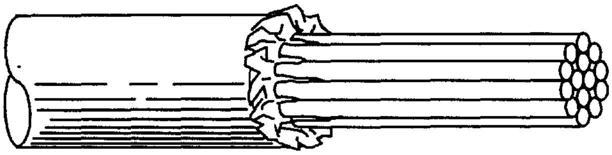

Figure 6-17. Unacceptable, Thermally Stripped, Excess Heat, Globular Appearance.

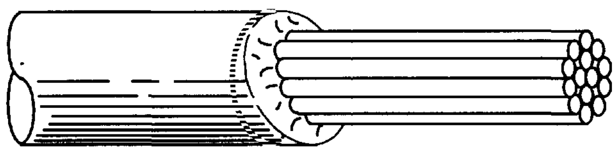

Figure 6-18. Unacceptable, Thermally Stripped, Irregular Cut Exceeding OD/4.

Mechanically Stripped

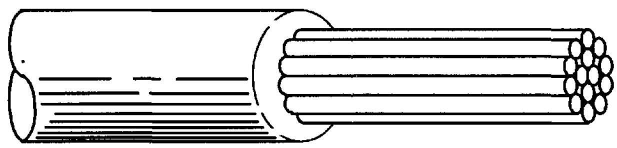

Figure 6-19. Acceptable, Mechanically Stripped, Clean Appearance.

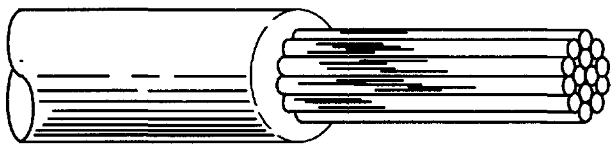

Figure 6-20. Acceptable, Mechanically Stripped, Minor Burnishing.

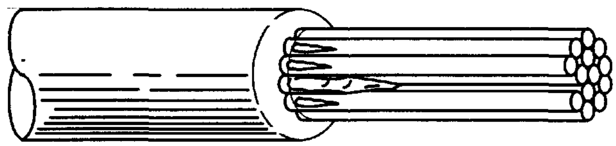

Figure 6-21. Unacceptable, Mechanically Stripped, Nicked and/or Severed Strands.

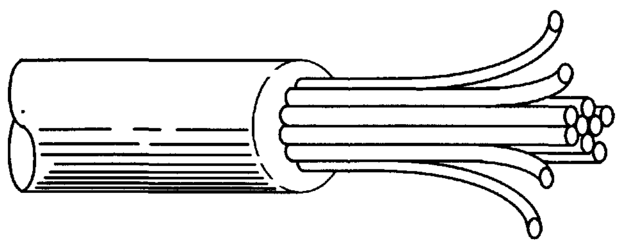

Figure 6-22. Unacceptable, Mechanically Stripped, Broken Serve.

Tinning and Retinning

General

Tinning shall be accomplished, prior to parts-to-parts installation and joint assembly. Terminals and solder-through types of magnet wire are not required to be tinned or retinned.

Tinned Surface

A tinned surface shall be continuous, smooth, without inclusions, and shall not show evidence of either nonwetting or dewetting. The strands of stranded wire shall be visible under the solder coating. There shall not be any wicking of solder under the insulation of the insulated wire. The lay of the tinned wire shall not be disturbed.

Insulation Gap

Prior to tinning, insulated wires and leads that require an insulating gap, (distance between insulation and the assembled joint), shall be stripped to a length which will afford an insulated gap, (0.30 to 0.90), inch as shown in Figure 6-23. If damaged, the lay shall be carefully restored. Damaged wire, (nicked or broken strands), or damaged insulation shall not be allowed.

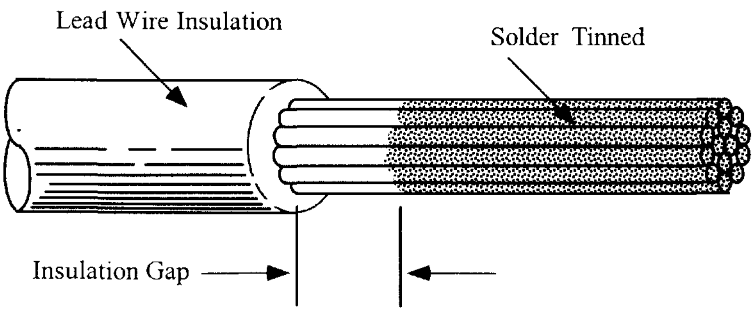

Figure 6-23. Solder Tinned, Insulated Lead Wire.

Solder Pot Tinning

Preferred Tinning

The preferred method for tinning insulated wires and leads is the hot solder dip. Dip about 1/3 of the length of the conductor to be tinned into the liquid rosin flux. After the lead end has been coated with liquid flux, then, dip the fluxed length of the conductor into the temperature-controlled solder pot, leaving adequate space for the insulation gap, and dwell for 3 seconds, See Figure 6-24. Then slowly withdraw the conductor vertically from the solder pot. Remove solder residues with an approved flux removal solvent using a brush or swab. If the contour of the wire strands is not visible after tinning, there is an excess of solder on the wire. Remove this excess solder from the wire by repeating the dip tinning procedure. Repeat the cleaning process.

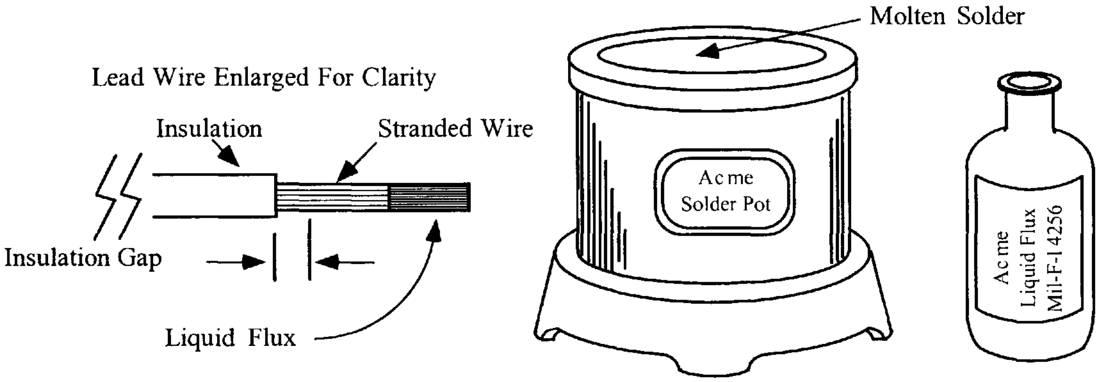

Figure 6-24. Using the Solder Pot to Dip Tin Leads.

Solder Pot Tinning Characteristics

Tinned components shall satisfy the following requirements:

1. All soldered surface are smooth, and completely, wetted with solder.
2. Lack of projections, bridging, fractures, porosity, and inclusions.
3. No flux residue on the solder joint after the cleaning process.

Insulation Damage

The tinning process shall not damage the wire insulation.

Wire Lay

The lay of the wire shall be undisturbed by the tinning process, as shown in Figure 6-23.

Soldering Iron Tinning

Soldering Iron Tinning

Dip about 1/3 of the length of the conductor to be tinned into a non-activated liquid, rosin flux. Place a clean, and well-tinned, soldering iron tip on the conductor near the center of the area to be tinned, and apply solder. Remove the soldering iron tip from the conductor by sliding the tip down the conductor, and finally, off the end, as shown in Figure 6-25. Remove solder residues with an approved flux, removal solvent using a brush or swab. If the contour of the wire strands is not visible after tinning, there is an excess of solder on the wire. Remove this excess solder from the wire by fluxing the wire and then, reheating and sliding the tip down the wire and off the cut end, without applying additional solder. Repeat the cleaning process. If excess solder is still present, reject the wire.

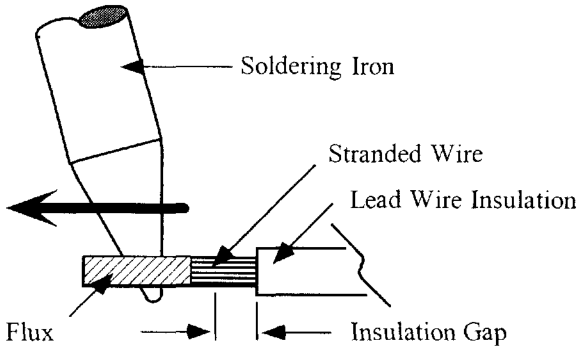

Figure 6-25. Using the Soldering Iron to Tin Insulated Leads.

Terminal Soldering

<u>All Solder Joints</u>

For all solder joints, except those containing, "solder-through," magnet wire, the soldering iron tip idling temperature shall be controlled to 315°C +/- 20°C (600°F +/- 35°F), and frequently checked by actual measurement. For solder joints containing, "solder-through", magnet wire, the tip temperature shall be controlled to 370°C +/- 20°C (700°F +/- 35°F), and frequently checked by actual measurement.

<u>Solder Flow</u>

The assembled joint shall be heated to, or above, the melting point of the solder, before the solder is applied to the assembled joint. The use of a small amount of solder, between the junction of the tip and the assembled joint, is permissible to improve heat flow. Add solder to cover any exposed ends of wire or leads and then add solder to the assembled joint. Solder may be applied at more than one point to a solder joint to provide control on the fillet size, and fill openings, as required.

<u>Immobilized Leads</u>

During the time the joint is heated, and until the solder has solidified, leads shall be immobilized to prevent movement of the soldered joint.

<u>Acceptable Solder Joint</u>

An acceptable solder joint shall be continuous, smooth, and without inclusions, with fillets that are either straight or concave, and feathered to a fine edge. There shall be no evidence of dewetting or non-wetting. The cut end of wires shall be covered with solder, and the contour of the soldered conductors shall be visible, after soldering.

<u>Final Solder Joint</u>

All excess solder not required, flux, and soldering residues shall be removed. Solder joints shall not exhibit stress lines, fractures, or cracks.

Typical Terminal Solder Joint

The lead shall enter the bifurcated terminal at 90° +/-15° to the plane of the tine, as shown in Figure 6-26, and shall meet the preferred solder profile in the above paragraphs.

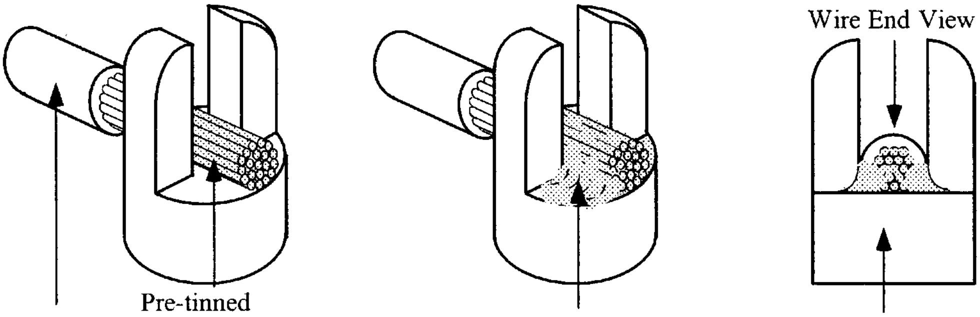

Figure 6-26. Bifurcated, Terminal Lead Entrance.

Terminal Connections

Terminal Modification

Any modification of the terminal and conductor shall be prohibited.

Bifurcated Terminals (1)

The lead or wire shall enter the terminal at 90° +/-15° to the plane of the tines and shall meet the preferred solder profile, as shown in Figure 6-27.

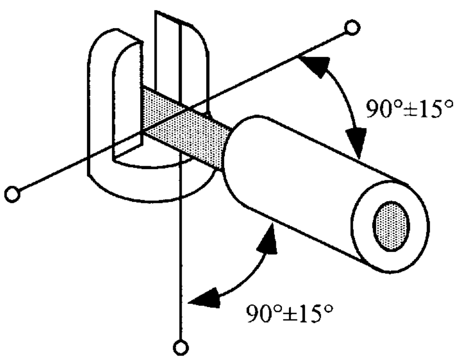

Figure 6-27. Bifurcated, Terminal Lead Entrance.

Bifurcated Terminals (2)

Magnet wire leads are attached to the bifurcated terminals, as shown in Figure 6-28. The wire shall enter the terminal at 90° +/-15° to the plane of the tines, and shall meet the preferred solder profile.

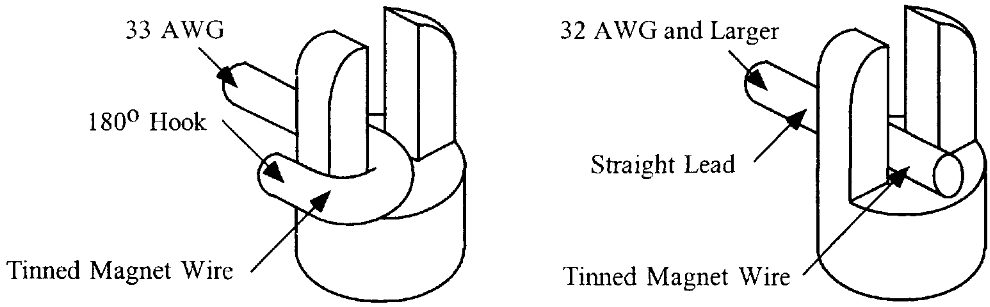

Figure 6-28. Magnet Wire Lead Attachment to Bifurcated Terminals.

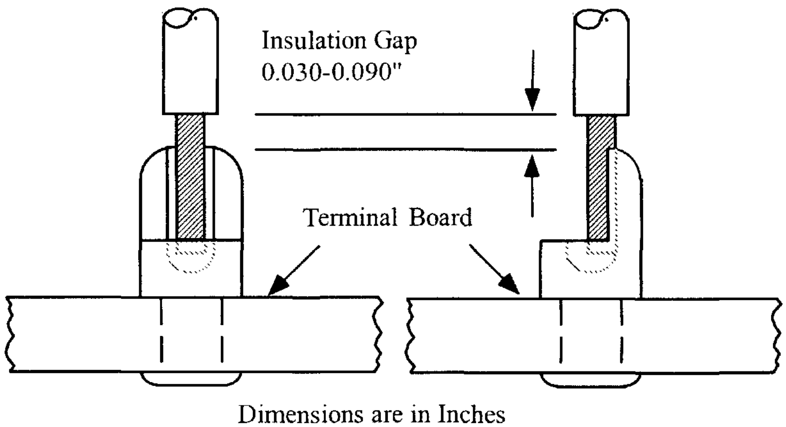

Figure 6-29. Magnet Wire Lead Attachment to Bifurcated Terminals.

<u>Bifurcated Terminals (3)</u>

Bifurcated terminals, using the standard side lead routing, is shown in Figure 6-29.

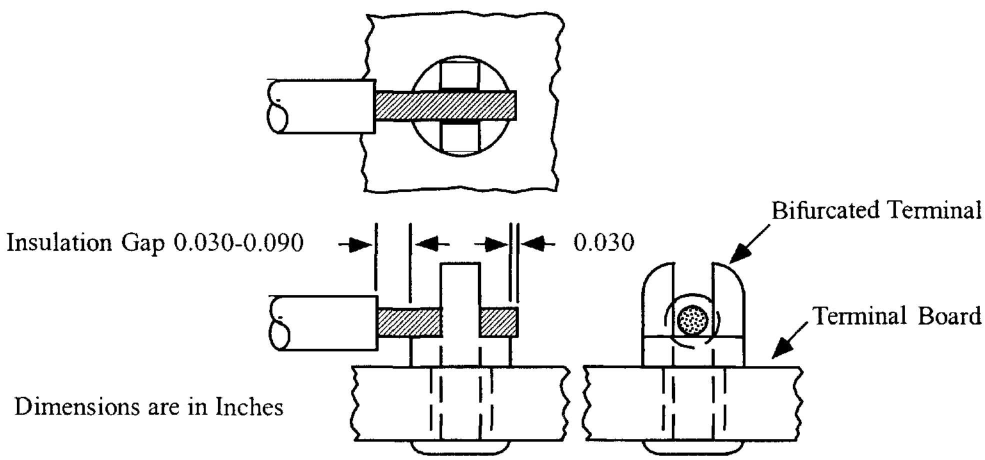

Figure 6-30. Bifurcated Terminal Side Routed.

Bifurcated Terminals (4)

Bifurcated terminals, using the non-standard bottom lead routing, is shown in Figure 6-30.

Multiple Terminations

The top lead or wire, soldered in a terminal, shall have less than one-half of its diameter above the tines, as shown in Figure 6-30.

Turret Terminals

Turret solder joints shall meet the requirements of Figure 6-33 and 6-34 in its mechanical configuration and its preferred solder profile.

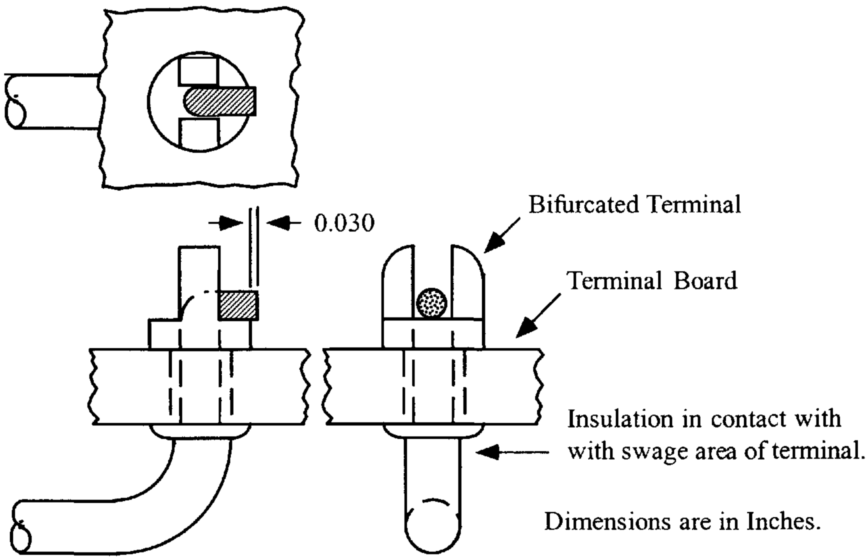

Figure 6-31. Bifurcated, Terminal Bottom Routed.

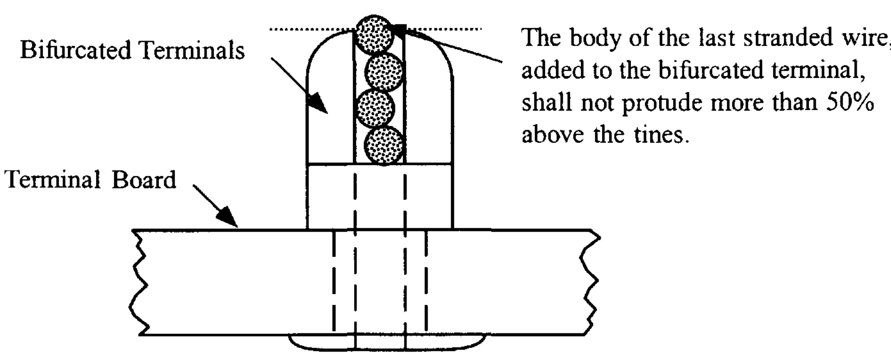

Figure 6-32. Bifurcated Terminal with Multiple Terminations.

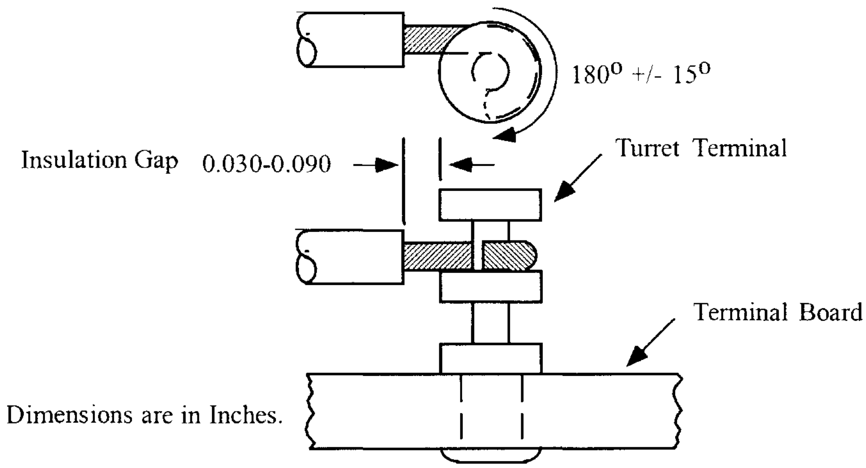

Figure 6-33. Dual, Turret Terminal, Solder Profile.

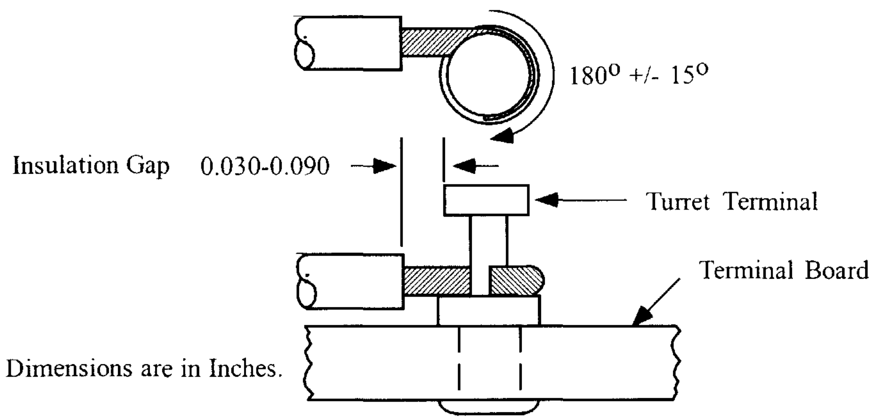

Figure 6-34. Single, Turret Terminal, Solder Profile.

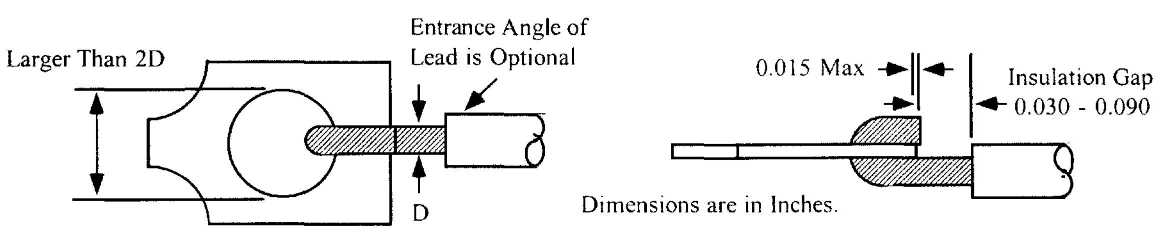

Figure 6-35. Wrapped Eyelet Terminal Joint.

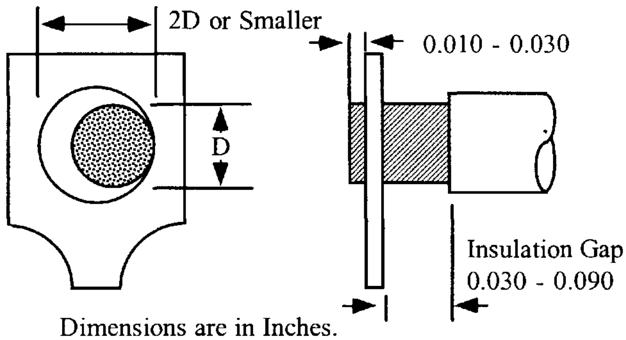

Figure 6-36. Not Wrapped, Eyelet Terminal Joint.

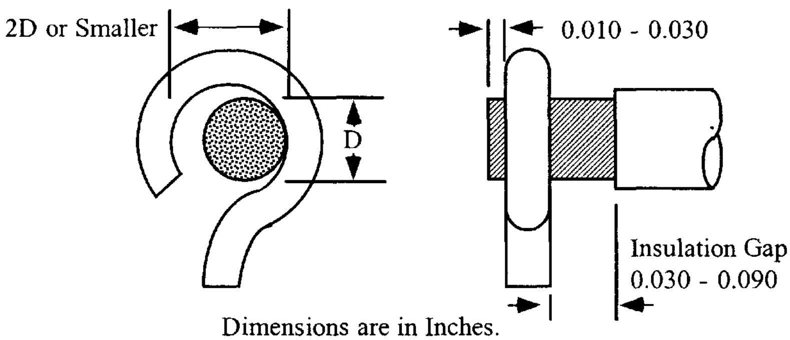

Figure 6-37. Not Wrapped, Hook Terminal Joint.

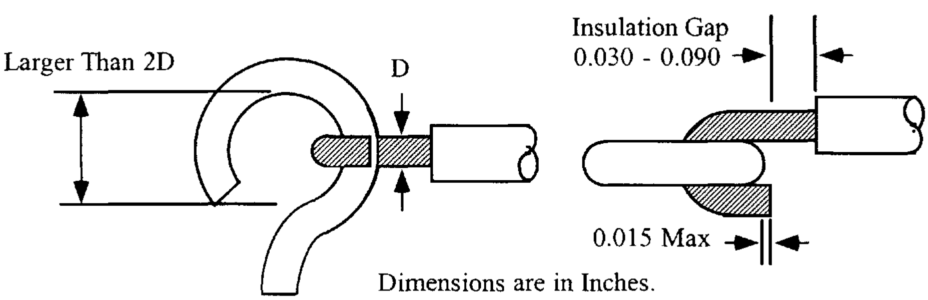

Figure 6-38. Wrapped Hook, Terminal Joint.

Preparing Interim Magnet Wire for Soldering

Interim Lead (Magnet Wire or Bus Wire)

Interim lead, wire splices shall conform to Figure 6-39. The strain relief will consist of a minimum of three turns of magnet wire wrapped tightly, then, two turns, minimum, to be soldered. The magnet wire, lead outline shall be visible beneath the solder. There shall be no overlapping of either the strain relief or the solder turns, as shown in Figure 6-40. There shall be no protruding pigtails, as shown in Figure 6-41.

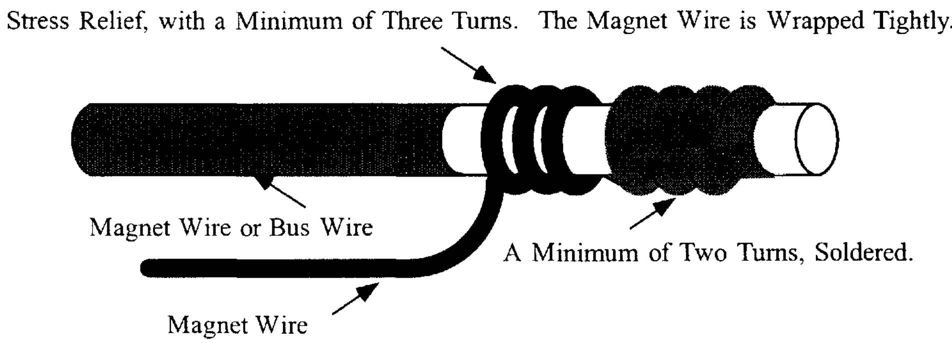

Figure 6-39. Acceptable Splice, with Smooth, Even Wrap.

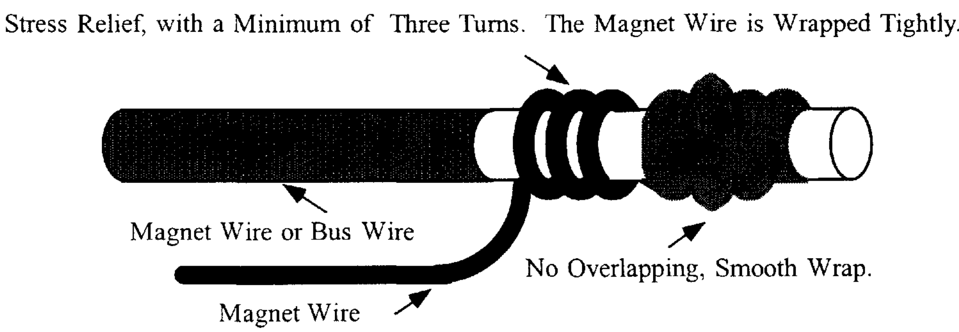

Figure 6-40. Unacceptable Splice with Overlap.

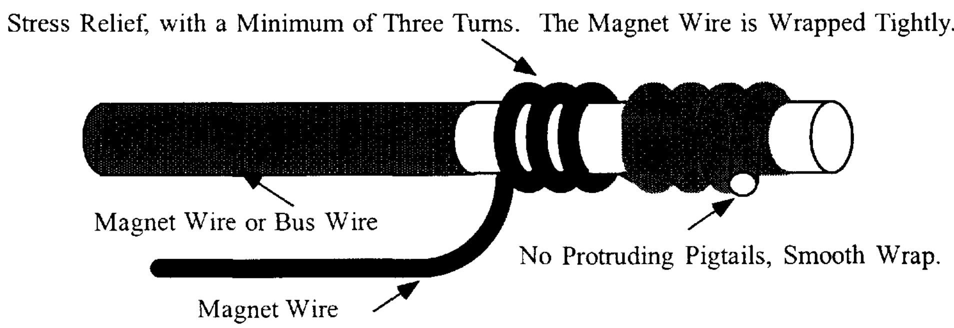

Figure 6-41. Unacceptable Splice with Protruding Pigtail.

Interim Leads with Two Magnet Wires

Interim lead wire, with two magnet wires spliced, shall conform to Figure 6-42. This interim splice shall also conform to Figure 6-40 and Figure 6-41, regarding overlapping and protruding pigtails.

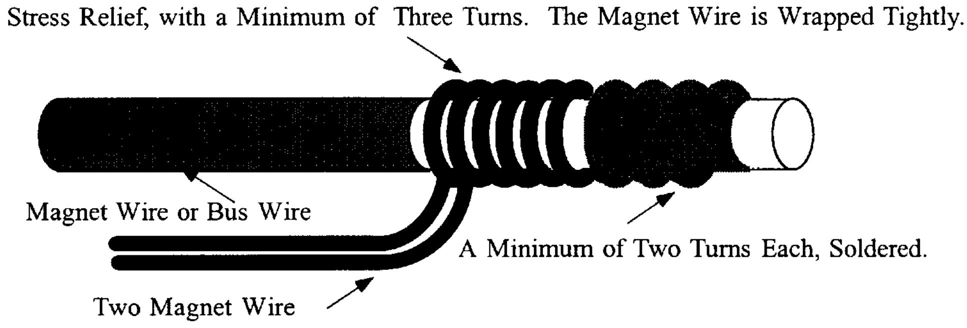

Figure 6-42. Acceptable Splice with Two Magnet Wires.

U Style Interim Lead (Magnet Wire or Bus Wire)

U style interim lead, wire splices shall conform to Figure 6-43. The strain relief will consist of a minimum of three turns of magnet wire wrapped tightly, then, two turns, minimum, to be soldered. The magnet wire, lead outline shall be visible beneath the solder. There shall be no overlapping of either the strain relief or the solder turns, as shown in Figure 6-40. There shall be no protruding pigtails, as shown in Figure 6-41.

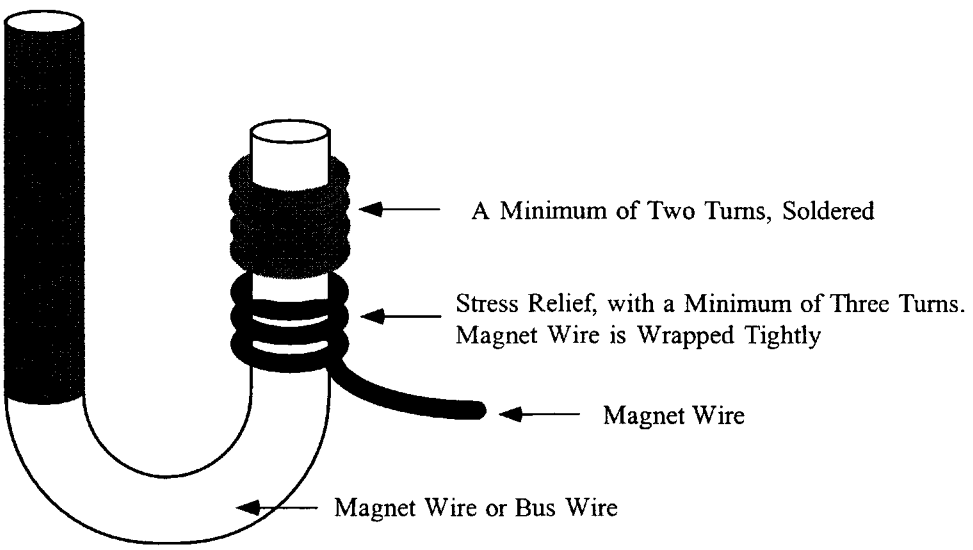

Figure 6-43. U Style, Acceptable Splice, with Smooth, Even Wrap.

Preparing Interim Stranded Wire for Soldering

<u>Interim Lead (Insulated Stranded Lead Wire)</u>

Interim lead, wire splices shall conform to Figure 6-44. The strain relief will consist of a minimum of three turns of magnet wire wrapped tightly, then, two turns, minimum, to be soldered. The outlines of both the insulated, stranded lead wire and the magnet wire lead shall be visible beneath the solder. There shall be no overlapping of either the strain relief or the solder turns, as shown in Figure 6-45. There shall be no protruding pigtails, as shown in Figure 6-46.

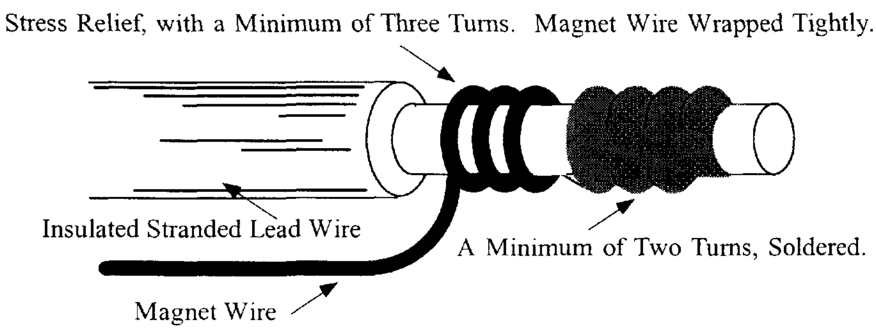

Figure 6-44. Acceptable Splice, with Smooth, Even Wrap.

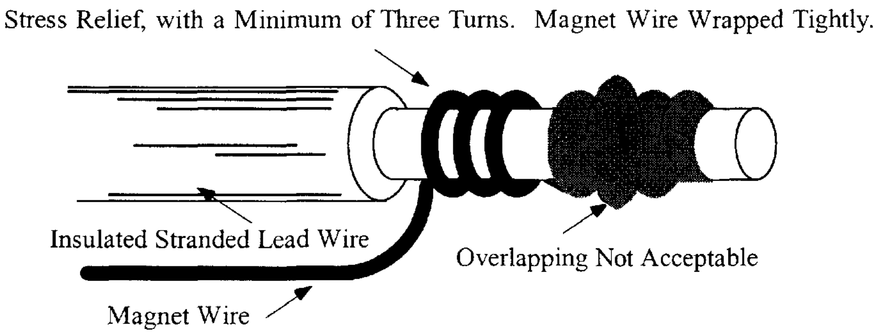

Figure 6-45. Unacceptable Splice with Overlap.

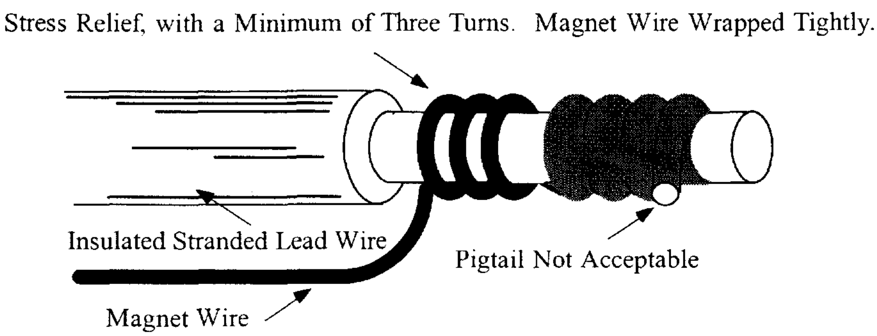

Figure 6-46. Unacceptable Splice with Protruding Pigtail.

Interim Lead (Insulated Stranded Lead Wire) with Two Magnet Wires

Interim lead wire, with two magnet wires spliced, shall conform to Figure 6-47. This interim splice shall also conform to Figures 6-45 and Figures 6-46, regarding overlapping and protruding pigtails.

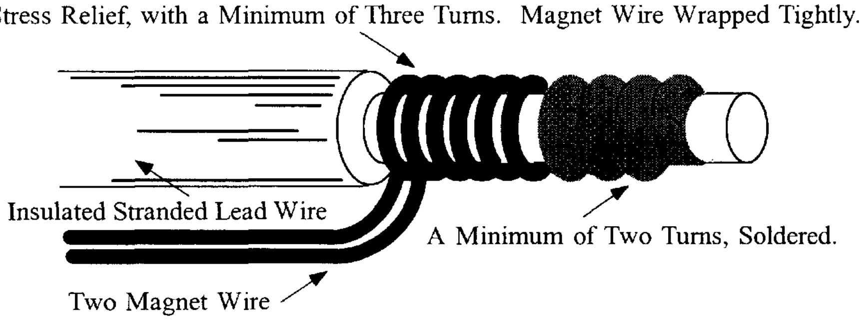

Figure 6-47. Acceptable Splice with Two Magnet Wires.

Interim Lead (Insulated Stranded Lead Wire with Shrink Sleeving)

Interim lead, wire splices using shrink sleeving shall conform to Figure 6-48. The strain relief will consist of a minimum of three turns of magnet wire wrapped tightly, then, two turns, minimum, to be soldered. The outlines of both the insulated stranded lead wire and the magnet wire lead shall be visible beneath the solder. There shall be no overlapping of either the strain relief or the solder turns, as shown in Figure 6-45. There shall be no protruding pigtails, as shown in Figure 6-46. Care must be exercised when using the heat shrink sleeving to avoid the concentration of heat at the soldered joint. Heat shall be controlled in accordance with the sleeving manufacturers' stated, recommended conditions and procedures.

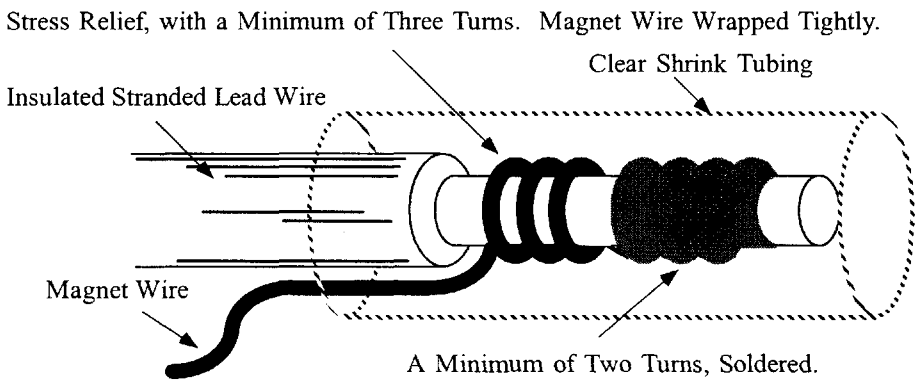

Figure 6-48. Acceptable Splice using Heat Shrink Tubing.

U Style Interim Lead (Insulated Stranded Lead Wire)

U style, interim lead, wire splices shall conform to Figure 6-49. The strain relief will consist of a minimum of three turns of magnet wire wrapped tightly, then, two turns, minimum, to be soldered. The magnet wire, lead outline shall be visible beneath the solder. There shall be no overlapping of either the strain relief or the solder turns, as shown in Figure 6-45. There shall be no protruding pigtails, as shown in Figure 6-46.

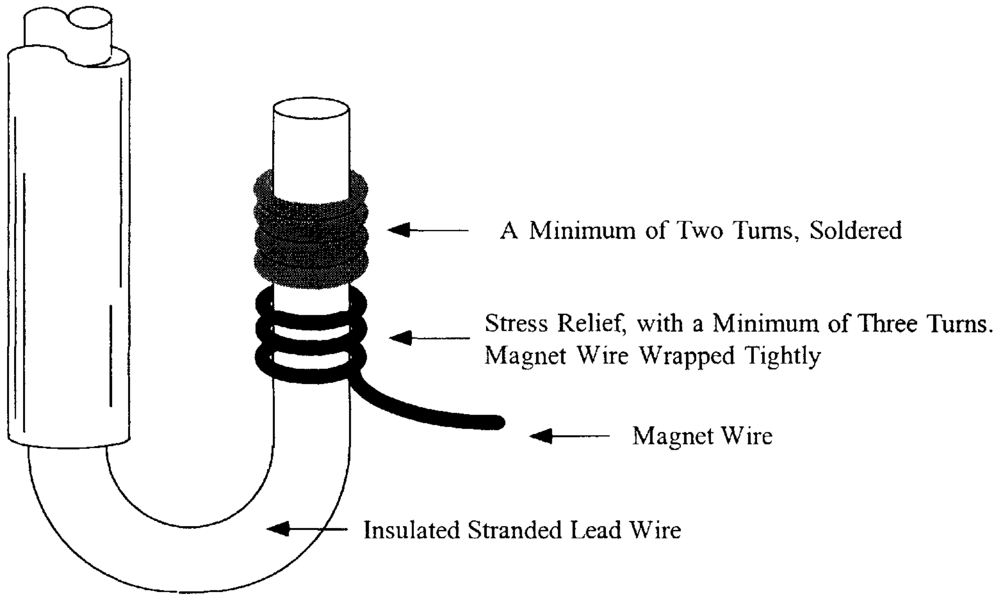

Figure 6-49. U Style Acceptable Splice, with Smooth, Even Wrap.

Splicing Magnet Wire

Internal Connection and/or Splice (20 AWG and Larger)

Terminating an internal connection or making an internal splice is shown in Figures 6-50 through 6-52. The magnet wires are brought together, cut and tinned, as shown in Figure 6-50. The wires are then wrapped with a number 24 AWG bus wire, with a minimum of 4 turns and soldered.

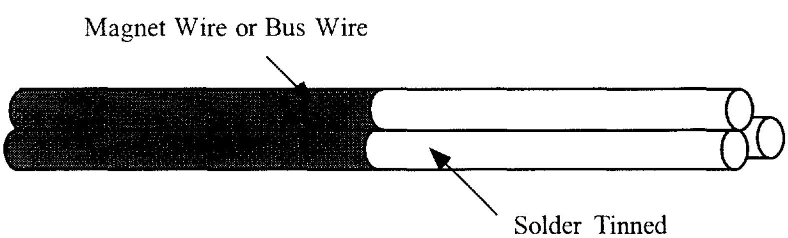

Figure 6-50. Splicing Multiple Strands of Magnetic Wire.

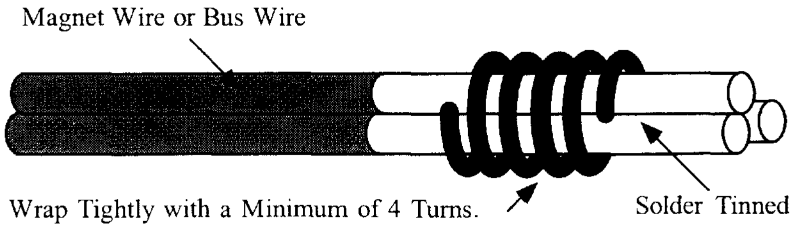

Figure 6-51. Splicing Multiple Strands of Magnetic Wire with Anchor Wrap.

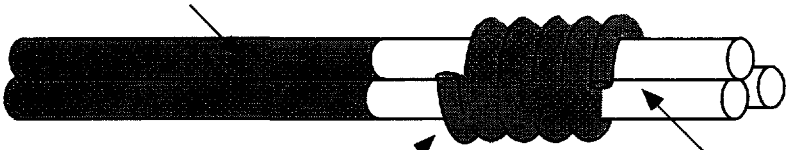

Figure 6-52. Acceptable Splice, with Smooth, Even Wrap.

Enclosures with Antirotation Terminals

Magnet Wire to Terminal Lug

The terminals used within the magnetic package must have antirotation features, as shown in Figures 6-53 through 6-57. The flattened or dimpled area thickness shall be no less than one-half the lead diameter and shall not exhibit sharp edges. The radius, R, shall not be greater than twice, or less than one times the diameter of the terminal lead. This radius shall be formed prior to soldering.

The stress relief will consist of a minimum of three turns of magnet wire wrapped tightly, then, two turns, minimum, to be soldered. The magnet wire, lead outline shall be visible beneath the solder. There shall be no overlapping of either the strain relief or the solder turns, as shown in Figure 6-53.

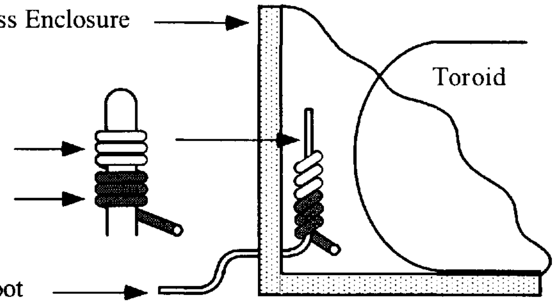

Figure 6-53. Typical, Solder Terminal on a Surface Mount Device.

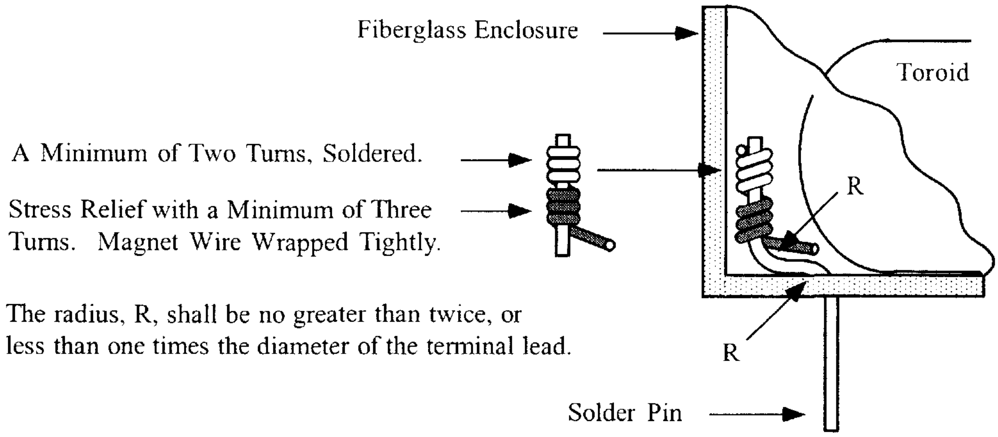

Figure 6-54. Z-Bend Solder Terminal.

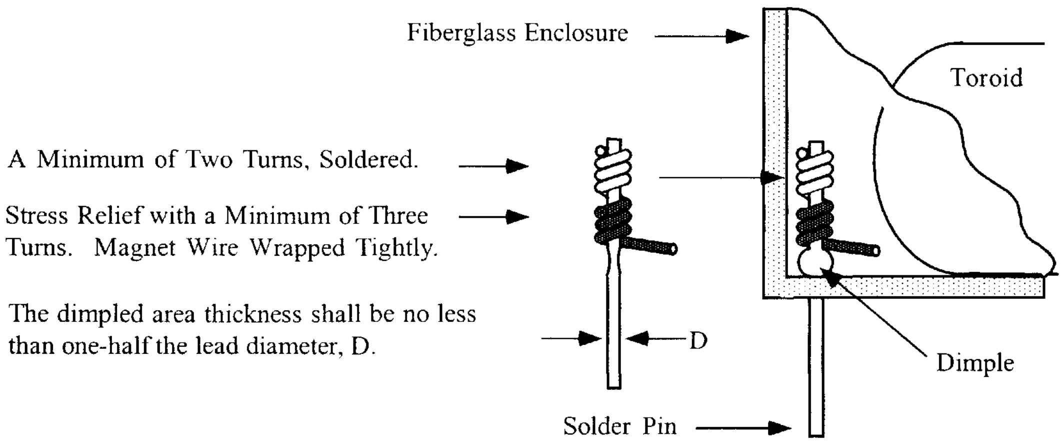

Figure 6-55. Dimpled Solder Terminal.

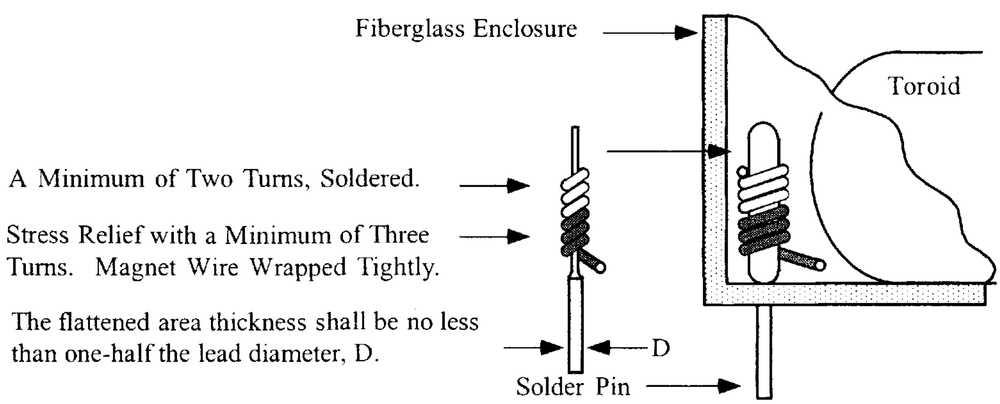

Figure 6-56. Flattened Solder Terminal.

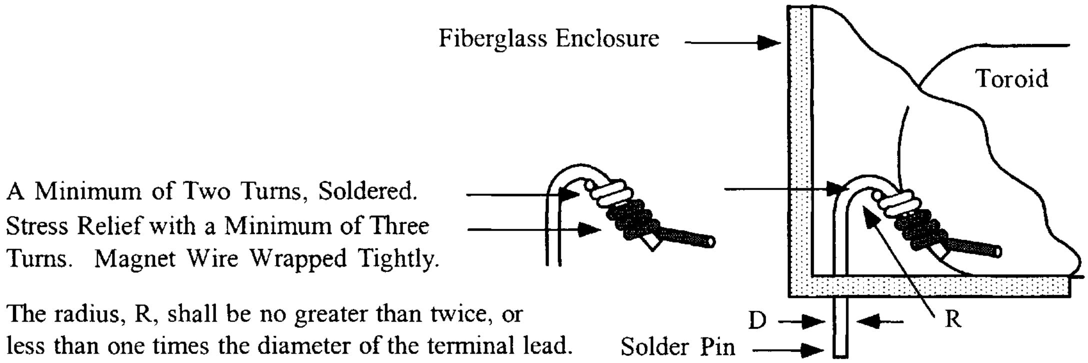

Figure 6-57. Wire Bend Solder Terminal.