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MIL-S-50826B(MU)
1 October 1975
SUPERSEDING
MIL-S-50826A(MU)
1 November 1974

MILITARY SPECIFICATION
SOFT SOLDERED ELECTRICAL CONNECTIONS
FOR
SPECIAL WEAPONS ITEMS
INCLUDING OTHER RELATED ELECTRONIC DEVICES

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This soldering specification covers requirements and inspection criteria for soft soldered electrical connections in intricate and complex electronic or electromechanical devices related to special weapons and other associated electronic systems.

1.2 These items are high performance mission devices in which it is economically justified to inspect and accept soldered joints as individual components.

1.3 The requirements herein shall apply to all soldering operations under the contract, including those on subcontracts and purchase orders, except for those cases in which the component specifications cite other Gomernment soldering specifications.

2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

QQ-S-571 -Solder, Lead Alloy, Tin-Lead Alloy, and Tin alloy, Flux Cored Ribbon and Wire, and Solid Form
LLL-R-626 -Rosin, Gum, Rosin, Wood, and Rosin, Tall Oil

Military

MIL-A-6091 -Alcohol, Ethyl, Specially Denatured, Aircraft
MIL-E-463 -Ethyl Alcohol (for Ordnance Use)
MIL-F-14256 -Flux, Soldering, Liquid (Rosin Base)

(Copies of specifications required by suppliers in connection with specific procurement functions should be obtained from the procurement activity or as directed by the contracting officer.)

FSC 1395

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3. REQUIREMENTS

3.1 Materials.

3.1.1 Solder. The composition of the solder alloy shall conform to specification QQ-S-571, type R or type S, SN60 or SN63, tin-lead, unless otherwise specified.

3.1.2 Flux. Flux shall conform to specification MIL-F-14256 or a rosin and alcohol flux may be used. The rosin shall conform to specification LLL-R-626, grade WW. The alcohol shall conform to specification MIL-A-6091 or specification MIL-E-463, grade 2 or grade 3.

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3.1.3 Solvents. Solvents shall be non-corrosive to the metallic surfaces on which they are used, and shall not injure nor contaminate insulation materials which they may contact.

3.1.4 Marking material. The material used for inspection identification marks shall be electrically and chemically inert under all conditions specified for completed assembly.

3.2 Preparation of parts.

3.2.1 Insulation stripping. To the maximum extent practicable, the amount of conductor exposed shall be sufficient to form the joint, without requiring clipping during assembly (see 3.3.5.4). The conductor shall not show evidence of nicking, clipped or nicked strands, or other mechanical damage. The insulation shall be cleanly stripped without mechanical or thermal damage.

3.2.2 Preparation of surfaces. The surfaces of all parts to be joined shall be thoroughly clean prior to their assembly into the item. Oxides, scale, dirt, and grease shall be removed by mild abrasion or solvents. All abrasion products, solvent, and solvent residue shall be removed prior to assembly. Abrasives shall not be permitted during or after assembly operations.

3.2.3 Tinning. Except for silver plated parts, the surfaces of the parts to be joined shall be tinned with solder immediately after cleaning, and, prior to forming or preparation of the mechanical joint. Tinning of stranded conductors shall cover the entire length to be included in the joint, but shall stop short of the insulation. Tinning shall not be required when materials are supplied pretinned with SN60 or SN63 solder conforming to specification QQ-S-571, or in accordance with a Government specification establishing the tinning requirements for the particular component or material concerned.

3.3 Mechanical joining.

3.3.1 Component and wiring stress. Component leads and other wires connected to or between terminals shall be formed with sufficient slack to minimize component and/or lead stress.

3.3.2 Rigidity. The parts shall be joined in such a manner as to insure that they will not move during the soldering operation. Where this degree of rigidity is not attainable with the joint itself, suitable clamps may be used to hold the conductors in position during soldering. Clamps, braces, or other holding devices shall not cause deformation of the parts which they hold.

3.3.3 Proximity of insulation. Conductors shall be affixed to their terminals so that the end of the insulation lies from one to two times the outside diameter of the wire away from the nearest part of the finished joint, except that the minimum distance shall be 0.030-inch regardless of wire size.

3.3.4 Formation of conductors for terminal connections. Conductors shall be formed in such a manner as to avoid excessive strain on terminals or components, and without causing damage to the conductors themselves or to the

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terminals to which they are attached. The conductor shall be formed so as to achieve intimate contact with the terminal and adjacent members throughout the length of the joint. Excess length may be trimmed after forming and prior to soldering, however, individual loose strands may not be clipped out. In the latter case, the conductor shall be removed and properly prepared before reforming. (See 3.3.5.4 for formation of conductors on printed wiring boards.)

3.3.5 Formation of connections. Except as otherwise specified, all conductors to be soldered to a terminal shall be affixed in place and excess lead length trimmed before any soldering at the terminal is performed. No uninsulated conductor shall cross or intersect another uninsulated conductor or terminal, except within solder joint. A thin protective coating of flux or other acceptable material shall be applied to the formed joint whenever the soldering operation is not expected to be performed immediately, i.e., within one-half hour.

3.3.5.1 Terminal posts. Each conductor attached to a terminal post shall terminate at the post. Looping and continuation of component leads are not permitted. The wrap around the post shall be greater than 180 degrees and less than 360 degrees. Conductors shall be placed on the post, starting at the base and proceeding outward without overlap.

3.3.5.2 Multi-wire or single-wire terminal. When the leads of several components are brought together to serve as a terminal for a common connection, they shall be formed parallel to each other and to stand perpendicular to the path of the connector wire. The connector wire shall encircle all of the lead wires so as to firmly hold them in place mechanically, and shall not be less than 270 degrees in any case. Complete looping of the terminal, and continuation to the next terminal is permitted, but the wrap shall not exceed 540 degrees.

3.3.5.3 Tubular connector terminals. Conductors for attachment to tubular terminal shall be stripped and tinned to the proper length required to obtain proper insulation proximity when the conductor is inserted to the bottom of the conductor pocket. The diameter of the pocket shall be sufficiently large to accept the conductor without reduction of strands. When multi-pin connectors are used, lacing or bundling techniques shall leave each conductor free from strain.

3.3.5.4 Eyelet or plated through holes in circuit boards. Conductors which are to be attached to eyeletted or plated through holes in circuit boards shall terminate at the hole. The conductor shall be formed to enter the eyelet or hole perpendicular (within 15 degrees) to the circuit board. Unless jigs or other suitable holding methods are provided to hold parts rigidly in place, the leads must be formed on the exit side of the board to lie flat against the board forming a hook with the ends of the component leads or wire and not extending beyond the radius or edge of the eyelet or conductive pad surrounding the hole. When special holding methods are used for supporting parts, the exit leads may protrude during soldering and be clipped after soldering is completed. (See 3.5.1)

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3.3.5.5 Tab-type terminals. Tabs with external notches shall be considered as terminal posts and connected as specified in 3.3.5.1. Conductors shall approach perforated or slotted tabs in the plane of the tab, and shall be formed back in the direction of the approaching conductors after insertion through the tab. All conductors to be soldered to a single tab shall be mechanically secured before any of them are soldered. Conductors within the joint may not overlap, but conductors may be attached to both legs.

3.4 Soldering.

3.4.1 Protection from heat. Effective heat sinks and shields or adequate spacing shall be used in all cases in which components are susceptible to heat damage, or where previously soldered work is exposed to resolting.

3.4.2 Fluxing. After the surfaces to be joined have been properly cleaned and mechanically assembled, a thin coating of flux may be placed over the connection just prior to the soldering operation, or fluxing may be accomplished by use of flux cored solder.

3.4.3 Soldering. Solder shall be applied to the heated joint, not to the heating equipment, except for dip or flow soldering. All heating equipment shall be temperature controlled, and procedures shall be established, as applicable, for regular cleaning and retinning of the equipment to insure uniformity of the soldering operation throughout the entire work period of the contract. Active fluxing agents and corrosive materials shall not be used for cleaning soldering tips. Sufficient solder shall be applied to adequately cover all surfaces of the joint without flow to unwanted areas. On tubular joints where leads from cabling or other free or unsupported length of wiring is subject to flexing or movement, solder shall fill the entire cavity with a slight bulge beyond the terminal at the cable end. On tubular joints where leads are confined or enclosed within a unit and not subject to bending or flexing, solder should be applied to fill not less than 50 percent of the cavity, but may fill the cavity up to 100 percent with no overflow or extension of the solder beyond the cavity. The cycle of application of heat, application of solder, and withdrawal of heat shall be controlled in a manner to avoid repeated reheating of the joint in order to retouch deficiencies.

3.4.4 Cooling. The joint shall be allowed to cool upon the removal of the heat source. No liquids or other cooling media shall be used to accelerate cooling. Conductors shall not be disturbed until the joint has completely hardened.

3.4.5 Cleaning. After soldering is completed, all flux shall be removed from the joint and adjacent areas.

3.5 Characteristics of the completed connection.

3.5.1 Visual appearance. An acceptable solder connection shall have a smooth, shiny, clean surface. The contours of the wires and connectors shall be perceptible beneath the solder with prominent filleting between

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the surfaces of adjacent conductors. All surfaces within the joint shall be covered with solder, and there shall be no evidence of post-solder clipping, except for exit side of printed circuit boards. The extremities of the solder surface shall feather smoothly to the wire and terminal surfaces.

3.5.2 Adherence. All conductors shall be securely held by the solder, and shall show no evidence of motion when subjected to firm probing pressure from approximately 1/8 inch diameter wooden probe.

3.5.3 Specific defects. In addition to the preceding general characteristics, the joint shall be free from the following specific defects:

a. Rosin joint;
b. Cold solder connection;
c. Fractures in solder;
d. Disturbed solder connection;
e. Nicks or crushing damage;
f. Dirt or other foreign matter imbedded in the solder;
g. Excessive solder (blobs or runoff);
h. Insufficient solder (bare areas or unfilled crevices);
i. Voids or detrimental pin holes;
j. Solder beards or peaks.

3.6 Certification of operators.

3.6.1 Knowledge. Prior to the assignment of any operator to the performance of soldering operations on the contract, the contractor shall insure that the operator is familiar with the particular soldering operations and requirements for the type of items on which the work is being performed under this specification, has had adequate training in effective methods and techniques, and is familiar with appropriate standards of cleanliness needed to produce high quality workmanship.

3.6.2 Proficiency. The contractor shall require successful demonstration of proficiency and skill by actual samples embodying all types of connections required by the contracted item. The Government shall be notified of the times of performance and completion of the practice samples, and shall be given an opportunity to witness fabrication and to review results prior to the assignment of the operator to actual soldering operations on contract material.

3.6.3 Contractor certification. The contractor shall present a written certification for each soldering operator assigned to the contract, to the effect that the requirements of this section have been met. Records and samples supporting the certification shall be available for examination by the Government.

3.6.4 Requalification. Any operator who has not performed soldering operations in accordance with the applicable parts of this specification for a period of 90 days shall be required to redemonstrate proficiency prior to assignment

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to the line. Operators whose performance falls below acceptable levels shall be retrained as needed and be subjected to requalification.

3.7 Rework.

3.7.1 Quality. Reworked soldered connections shall meet all of the requirements applicable to the original connection.

3.7.2 Rework in place.

a. Hand soldered connections-- Hand soldered connections in which the mechanical joint is properly made, and which can be corrected by reheating, addition or removal of solder, and recooling may be reworked in place, provided the same protection against heat damage is used as was used in the initial soldering operation. When such corrections are made by the original operator before the material is released from the work place, they shall not be considered as defects in evaluating soldering quality. All such defects discovered by subsequent inspection shall be recorded and identified as defects and then repaired as above. While bench rework is permitted under the conditions specified, observation of an unusual frequency of reworking by an operator shall be cause for corrective action.

b. Wave or flow solder connections-- Automatic wave or flow soldering operation may be repeated for not more than one additional run providing there is not a degradation of components and printed wiring boards. Hand resoldering is permitted, if necessary, to remove icicles and bridges of solder or to add solder to the conductive circuit and component joint area.

3.7.3 Replacement of connection (by hand soldering). Except for those defects which can be corrected by rework of the solder alone, repair shall consist of completely disassembling the joint, cleaning, or replacement of damaged materials as necessary, and repetition of the entire soldering procedure.

3.7.4 Written rework procedures. The contractor shall submit his rework procedures in writing for Government approval prior to performing any rework, except for those specifically defined herein. Particular attention shall be paid to those conditions where additional protection is needed for conductors and components which were not present when the original connection was made, or where a portion of the connection has become obscured by virtue of assembly operations subsequent to the soldering.

3.7.5 Records and identification. Each reworked connection shall be distinctively marked, and records of defects requiring repair shall be maintained and be available for review by the Government.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified, the contractor is responsible for the performance of all inspection requirements

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prior to submission for Government acceptance. Inspection records indicating that required examinations and tests have been made shall be kept complete and available to the Government for the duration of the contract. The Government reserves the right to reinspect any or all work submitted in order to insure that the requirements are being met.

4.2 Examination.

4.2.1 Inspection. Prior to manufacture, the contractor shall submit a plan of inspection suitable to the Government, insuring that inspections will be made at such times that joints are clearly visible and when probing is possible. Also, that all joints in the assembly will be subjected to a uniform level of inspection.

4.2.1.1 Each joint shall be inspected for the characteristics in 4.3.4. Each defect shall be recorded.

4.2.2 Magnification. All acceptance examinations shall be performed under adequate illumination, and using a magnification of 2X. A magnification of 7X is recommended for a more detailed analysis of the exact cause of defects which were disclosed by the inspection.

4.3 Acceptance of soldered item.

4.3.1 Classification of joints.

4.3.1.1 Acceptance will be based on certifications, and compliance with acceptance criteria listed in the Classification of Defects. Total allowed defects for each category shall be the nearest whole number to the product obtained by multiplying the allowable defects per 100 by the number of connections on the completed inspection assembly. Small assemblies may be grouped to form an inspection assembly.

4.3.2 Acceptance conditions.

4.3.2.1 All assemblies containing defects in defect numbers 1 through 8 shall be rejected. Assemblies containing no more than 1.5 times allowable defects in the 100 and 200 groups may be accepted, provided immediate corrective action is taken to remove process deficiencies. Assemblies containing defect rates in excess of the above shall be rejected.

4.3.3 Certification. The contractor shall verify that all materials and processes used conform to the requirements of this specification. A certificate of analysis from the contractor or an approved laboratory shall be acceptable evidence of compliance with the chemical requirements of this specification.

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4.3.4 Classification of defects.

Table I

Defect No.	Defect	Defect Description	Allowable Defects of each type per 100 connections
1	Loose joint	Joint not soldered, or wire moves under probing	0
2	Rosin joint	Wire held partially or completely by rosin adhesion	0
3	Cold solder connection	Chalky, rough, crystalline piled up appearance of the solder at connection	0
4	Disturbed connection	Stress lines in solder and a grey appearance of the solder	0
5	Irregular connection	Fracture in the solder	0
*6	Contaminated connection	Foreign material(s) imbedded within one wire diameter of the connection	0
7	Rosin pockets or gas voids	Pinholes or pockets within one wire diameter of the connection	0
*8	Improper mechanical wrap	Wire not secure and tight to connection	0
*101	Damaged connection	Nicks, mars, scratches, broken or clipped strands.	4

*Joint must be disassembled for rework.

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Defect No.	Defect	Defect Description	Allowable Defects of each type per 100 connections
102	Insufficient solder	No solder fillet between connected parts	4
103	Base conductor metal	Conductors, terminals, or connection points not completely tinned, or in which damage has exposed bare metal	4
104	Irregular solder connection	Peaks in the solder	4
*105	Contaminated solder	Foreign material(s) imbedded in the solder outside one wire diameter	4
106	Rosin pockets or voids	Pinholes or pockets outside wire diameter	4
*107	Improper mech. wrap, minimum	Wire wrap of less than 180 degrees	4
*108	Improper terminal connection	Connections not built up from base of terminal or uninsulated wire overlap in immediate area of connection	4
*109	Absence of lead wire slack (applicable - terminal-to terminal wiring)	Wire taut between connection points	4
201	Improper mech. wrap, maximum	Wire wrap greater than 360 degrees	10
202	Excess solder	Contour of soldered parts not visible after soldering	10
203	Wicking	Tinning extends to edge of insulation	10
204	Tubular connection not convex	Completed tubular terminal not convex	10

*Joint must be disassembled for rework.

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Defect No.	Defect	Defect Description	Allowable Defects of each type per 100 connections
205	Faulty eyelet connection	Conductor wire inserted or emergent at wrong angle. Emergent conductor incorrect length.	10
206	Incorrect inspection dot	Contractor's inspection dot absent or obscures connection	10
207	Improper rework	Records or identification of reworked connection absent or incomplete	10
208	Improper insulation stripping	Insulation in finished connection extends too far from or too close to connection	10

5. PREPARATION FOR DELIVERY

There are no applicable requirements.

6. NOTES

Not applicable.

Preparing Activity:

Army -- MU

User Activities:

Army -- MU

Project No. 1395-A210

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)*: _____

b. ADDRESS *(Street, City, State, ZIP Code)*

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional

b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional

c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional

8. DATE OF SUBMISSION *(YYMMDD)*

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)

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