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MILITARY SPECIFICATION

SOLDERING OF METALLIC RIBBON LEAD MATERIALS TO SOLDER COATED TERMINALS, PROCESS FOR REFLOW

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

1. SCOPE. This specification covers a process for reflow surface soldering metallic ribbon materials to solder coated terminal areas on printed board assemblies.

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	Soldering, Tin Alloy, Tin-Lead Alloy and Lead Alloy

Military

MIL-F-14256	Flux, Soldering, Liquid (Rosin Base)
MIL-P-28809	Printed Wiring Assemblies
MIL-S-45743	Soldering, Manual Type, High Reliability, Electrical and Electronic Equipment
MIL-P-46843	Printed Wiring Assemblies

FSC THJM

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, U.S. Army Missile Command, ATTN: DRSMI-RCS, Redstone Arsenal, AL 35809 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

STANDARDS

Military

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-429	Printed-Wiring and Printed Circuits, Terms and Definitions

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions may be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein.

IPC-S-80 (Dec 1970)	Edge Dip Solderability Test for Printed Wiring Boards

(Application for copies should be addressed to the Institute of Printed Circuits, 1716 Howard Street, Evanston, IL 60202).

2.3 Conflict of documents. In case of conflict between any requirement specified herein, and any contained in the engineering documentation (including other specifications or standards referenced therein) the requirements of the engineering documentation shall prevail.

3. REQUIREMENTS

3.1 Applicability. These requirements are applicable to reflow soldering performed by resistance, infrared, or other automatic or manual machine techniques.

3.2 Materials. Except when otherwise specified on detail drawings, the materials utilized in soldering operations shall conform to the requirements below.

3.2.1 Solder. An Sn 60 or Sn 63 tin-lead solder conforming to QQ-S-571 shall be used.

3.2.2 Flux. A flux shall be used for all soldering operations. Only rosin based fluxes conforming to QQ-S-571 and MIL-F-14256 shall be utilized. Type RA flux shall not be used except on printed board assemblies without stranded wires.

3.2.3 Cleaning solvent. Solvents to be used for the removal of process contaminants and residues from parts and solder joints shall be compatible with the materials in the parts being cleaned.

3.3 Facilities, equipment and tools.

3.3.1 The soldering facility.

3.3.1.1 Temperature and humidity. The temperature shall be maintained at 75°F plus or minus 9°F (24°C plus or minus 5°C) and the relative humidity shall not exceed 65 percent. Where low humidity (30% or lower) is encountered, grounding or other precautions shall be taken to prevent degradation of components which are sensitive to static electrical charges.

3.3.1.2 Control of airborne contaminants. Manufacturing operations or other activities which produce airborne contaminants shall not be permitted in the room containing the soldering area. Positive pressure shall be maintained in the soldering room, relative to adjacent rooms where such contaminants are produced, unless the rooms are separated by two doors with a minimum of 10 lineal feet of dead air space between them. Evidence of visible accumulation of contaminants on work benches, tools, components, etc., shall be cause for corrective action.

3.3.1.3 Vapors. Toxic or volatile vapors shall be exhausted in accordance with OSHA standards.

3.3.1.4 Work station maintenance. Work areas and tools shall be maintained in a clean and orderly condition. All dirt, grease, flux, solder spatter, chips, and other contaminating foreign material shall be promptly removed. Eating, smoking and drinking at the soldering work station shall not be permitted, and precautions shall be taken to preclude contaminating by-products of such activities from the stations.

3.3.1.5 Work station lighting. Working surface lighting of soldering stations shall be 100 foot-candles minimum (1077 lm/m^2).

3.3.2 Soldering equipment. The soldering devices and machines used shall heat the joint rapidly and have the capacity to maintain the correct temperature during repetitive solder operations with a maximum temperature variation of ± 10°F (5.6°C) of the nominal

soldering temperature. The soldering equipment shall not produce magnetic fields or introduce electrical currents that could degrade the components being soldered nor shall it be of such configuration that damage or inadvertent over heating of adjacent components will occur. When direct contact is made between the heat source and the metals to be joined, the heat source shall not cause damage to the board or components or contaminate the solder.

3.3.3 Soldering tools and equipment. Tools shall not cut, nick, or in any way damage leads, components, or the printed board, and shall be in accordance with the applicable paragraphs of MIL-S-45743.

3.4 General soldering requirements.

3.4.1 In-process handling and storage. The printed boards, components, and assemblies shall be protected from contamination and damage during handling, assembly, and storage operations. Soldered subassemblies and assemblies shall, subsequent to cleaning operations and prior to any encapsulating processing, be handled to preclude contamination.

NOTE: Printed board assemblies should be handled only by the edges or with lint-free gloves that are also free of oils, solvent residue, soil, or other contaminants that could be transferred to the assemblies.

3.4.2 Soldering equipment. Soldering equipment and machines shall be maintained per the manufacturer's instructions. Operating procedures describing the soldering process and the proper operation of automatic or manual soldering machine and associated equipment will be available by written instructions for soldering personnel.

3.4.3 Solderability. All materials to be soldered that do not conform to the requirements of MIL-STD-202, Test Method 208, and all printed circuits/wiring that do not conform to IPC-S-801 shall be retinned or replated to provide solderability conforming to the MIL-STD-202 or IPC-S-801 requirements, as applicable. The gold on gold plated parts shall be removed from those areas to be soldered by a double tinning operation, to prevent solder embrittlement. As an alternative, the gold may be removed, and a single tinning operation performed. More active fluxes than those specified in 3.2.2 may be used provided all contaminants are removed within one hour from the time that the item was retinned.

3.5 Operations prior to soldering.

3.5.1 Precleaning. Printed board assemblies shall be clean prior to start of the soldering operations. Cleanliness of the printed wiring assembly shall be sufficient to insure solderability.

3.5.2 Ribbon lead geometry. Ribbon leads shall be formed per the applicable paragraphs of MIL-S-45743.

3.5.3 Solder-thickness. Unless otherwise specified in engineering drawings or specifications, the thickness of solder coating on components leads or ribbon conductors shall be 0.0005 to 0.002 inch (0.0129 mm to 0.05 mm) on each side. The coating shall extend from the end of the lead up to and including the radius of the first bend but shall not extend past the radius of the second bend.

3.5.4 Flux application. Prior to start of the soldering process, a thin uniform coating of flux shall be applied to the pad surfaces or joint area where the component leads are to be soldered.

3.6 The soldering operation.

3.6.1 Soldering. The leads to be joined shall be heated to the flow temperature of the solder. The application of heat shall be controlled during the soldering operation to prevent damage to the assembly (e.g., base material, adjacent connections, electrical components). The parts being soldered shall be held in place and not allowed to move in relation to one another until the solder has completely solidified.

3.6.2 The soldered joint. The soldered joints shall have a smooth, bright appearance and shall be free from scratches, roughness, sharp edges, dullness, looseness, blistering or any other evidence of poor workmanship. There shall be no dirt, chips or other foreign matter. Solder shall cover the conductor, or component lead, and the solder shall form a smooth fillet between the terminal area and each side of the conductor. The contour of the conductor shall be visible after soldering. There shall be no defects as listed in MIL-S-45743.

3.7 Rework and touchup. Any rework or touchup by manual soldering shall be in accordance with MIL-S-45743.

3.8 Cleaning.

3.8.1 Cleaning the printed board assembly. Excess solder shall be removed so that the connection is clean. Mechanical methods such as filing, grinding, or scraping shall be not be used. Within 1 hour after the solder has completely solidified, all residual flux and soils shall be removed using solvents or combinations of solvents which will remove polar and nonpolar contaminants. After final cleaning, finished products shall not be contaminated by handling or environment.

3.8.2 Resistivity of solvent extract. When uncoated printed wiring assemblies are tested as specified in 4.3.2 the resistivity shall be not less than 2,000,000 ohm-centimeter for each unit of 10 square inches (64.5 Cm^2) of board surface (counting both sides but not counting the surface area of the components).

3.9 Qualification of solder personnel. Qualification of soldering operators and soldering inspectors will be by certificate of training per MIL-S-45743 and the manufacturer's (of the soldering equipment) operating instructions.

3.10 Workmanship. The workmanship, utilized in accomplishment of the processes specified herein, shall be of a level of quality adequate to assure that the processed products shall meet the performance requirements of the applicable product drawings and specifications, relative to these processes. The solder connections shall have a smooth, bright appearance with metallic luster and shall not have a chalky, gritty, or irregular surface, not exhibit points (peaks), pits, scars, fractures, trapped flux, foreign materials, or have holes which expose base metal (where the bottom is not visible, exposed base metal will be assumed). The connections shall be completely covered by solder to the extent that no base metal is visible, including the copper ends of cut wire or leads. Solder beads shall not project from terminals, nor shall solder spatter exist on adjacent components or surfaces.

NOTE: The visual standards provided as figures in MIL-S-45743 are intended as aids in determining acceptability of processed products. It is expected that strict adherence to the specified requirements should result in a general quality of workmanship equal to the applicable upper illustrations. The applicable center illustrations represent minimum acceptable standards which are undesirable as a general condition but are acceptable. The applicable

bottom illustration represents unacceptable conditions. Corrective action should be taken when general quality of workmanship is not in accordance with the applicable upper illustration.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein unless disapproved by the government. The government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure that suppliers and services conform to prescribed requirements.

4.2 Quality conformance inspection.

4.2.1 One hundred percent inspection. Each soldered connection and its associated wiring or leads shall be visually inspected to determine conformance to the requirements specified herein. MIL-S-45743 provides a list of defects with reference to the applicable requirements. Any defect shall be cause for rejection.

4.2.2 Sampling inspection. Sampling for cleanliness of uncoated printed board assemblies, utilizing the resistivity of solvent extract method, shall be in accordance with the applicable provisions of MIL-P-46843 or MIL-P-28809.

4.2.3 Process inspection. Surveillance shall be conducted on a continuous basis to assure that the requirements for tools, materials, handling, equipment, facilities, and processes specified herein are strictly adhered to. Any noncompliance shall be grounds for rejection of the material processed.

4.3 Inspection methods.

4.3.1 Visual inspection. Visual inspection shall be performed utilizing a minimum of 4X magnification. Lighting shall equal or exceed the requirement of 3.3.1.5. A clear incandescent light should be used for detection of uncovered copper. When solder connections are suspected as defective, magnification commensurate with the size of the connection shall be used to aid the visual inspection.

As a guideline, magnification for visual inspection of connections in microminiature, miniature, and standard assemblies may be limited to 70X, 30X, and 10X respectively.

4.3.2 Cleanliness test. The resistivity of solvent extract method for cleanliness testing of uncoated printed wiring assemblies shall be in accordance with the applicable provisions of MIL-P-46843 or MIL-P-28809.

4.4 Inspection standard. The applicable figures of MIL-S-45743 and any additional provisions provided or approved by the procuring activity, shall be utilized in determining compliance with the requirements of this specification.

4.5 Qualification and certification. Prior to performance of the requirements of this specification all soldering personnel qualification and certification shall be verified to be in accordance with 3.9.

5. PREPARATION FOR DELIVERY

This section is not applicable to this specification.

6. NOTES

6.1 Intended use. The process in accordance with this specification covers the soldering of integrated circuit flatpack leads or other metallic ribbon materials to solder coated substrates by reflow soldering methods. The reflow soldering process allows one metal to be joined to another by heating and melting solder that has previously been deposited or preplated on both metal surfaces to be jointed. The addition of solder at the time of connection is not necessary. Reflow soldering can be accomplished using parallel-gap resistance, shorted-bar resistance, hot air, infrared and thermal transfer soldering techniques.

6.2 Order data. Ordering data shall include the following:

a. Title, number and date of this specification.

b. If certification of operators is not required. (See 3.9 and 4.5)

6.3 Cleaning solvents. Cleaning solvents as listed in MIL-S-45743 have been found suitable for the removal of contaminants and residues from parts, assemblies and solder connections.

6.4 Terms and definitions. Definitions applicable to this specification shall comply with MIL-STD-429 and MIL-S-45743.

Custodian:
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Air Force - 11

Review Interest:
Army - MR, EL
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1. DOCUMENT NUMBER

2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION

4. TYPE OF ORGANIZATION *(Mark one)*

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- ☐ 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

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