## Soldering Electrical Connections

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1.0 SCOPE
This procedure implements NASA-STD-8739.3, Requirements for Soldered Electrical Connections. This procedure is applicable to high reliability hardware and is based upon a nationally recognized standard and is considered certified due to (Your Co’s) conformity with the standard. Deviation from the standards referenced herein must be based upon hardware heritage, engineering supported data or nationally recognized replacement standards in the event the NASA standard becomes obsolete. This procedure is subject to NASA (JPL and/or GSFC) review and acceptance.

2.0 REFERENCES
Unless otherwise specified herein, compliance to the following documents is mandatory for training and production soldering. In the event of conflict between this document and any referenced document, the provisions of this document shall take precedence.

2.1 MIL-HDBK-263, Electrostatic Discharge Control Handbook
2.2 MIL-STD-1686, Electrostatic Discharge Control Program
2.3 NASA Training Program, Instructor Workbook for Hand Soldering
2.4 NASA-STD-8739.3, Requirements for Soldered Electrical Connections
2.5 NASA Training Program, Student Workbook for Hand Soldering
2.6 Training Certification Card, (Your #)
2.7 Training Log, (Your #)
2.8 Visual Acuity Record, (Your #)
2.9 Work Instruction, (Your #), Soldering Instruction

3.0 EQUIPMENT, compliant with NASA-STD-8739.3
3.1 4X to 10X magnification inspection tool
3.2 Insulation strippers
3.3 Soldering pot
3.4 Soldering iron
3.5 Static discharge prevention equipment
3.6 Various hand tools

4.0 MATERIALS, compliant with NASA-STD-8739.3
4.1 Aluminum Oxide Cloth, 320 grit or finer
4.2 (Your P/N), Polyurethane Conformal Coating, Type I, II, III or IV, hardness sample is not required
4.3 Electroclean EC-A(3), Flux Remover or equivalent
4.4 MIL-I-22129, Insulation Tubing, Non-rigid
4.5 MIL-I-23053, Insulation Sleeving, Semi-rigid
4.6 Solder, 60/40 or 63/37 or equivalent, J-STD-006
4.7 Solvent, Isopropyl Alcohol or equivalent
4.8 Type RMA or Type R Rosin Flux or equivalent, J-STD-004

5.0 OPERATOR/INSPECTOR QUALIFICATION

5.1 Prerequisites
A vision and color test is required to be passed prior to the start of the soldering training program. (Your Co) Form, (Your #), Visual Acuity Record, shall be completed and on file the first day of class.

5.2 Personnel Certification
Personnel responsible for producing and inspecting soldered electrical connections compliant with NASA-STD-8739.3 shall be certified to perform such work and inspections by a NASA Certified, Level B, Soldering Instructor, utilizing the provisions contained in the documents referenced in paragraph 2.

5.2.1 Limited Personnel Certification
Operator and Inspection personnel may be authorized to perform limited operations and processes of NASA-STD-8739.3. The limited operation or process shall be stated on the certification card. The Limited Certification Program shall be defined by a Work Instruction prior to implementation.

5.2.2 Level B Instructor Certification
The (Your Co) Soldering Instructor shall be certified by a Level <A> NASA Instructor according to the provisions of NASA-STD-8739.3.

5.3 Training Requirements
Students are required to fabricate and inspect soldered electrical connections to the extent necessary to support production designs and to attain a body of knowledge sufficient to pass the exams contained in the Student Workbook for NASA-STD-8739.3.
Soldered connections shall consist of terminals and a Printed Wiring Board (PWB), and shall be of sufficient complexity to support production designs. Terminal designs shall consist of hook, turret, cup, bifurcated and pierced. The PWB shall consist of connection designs such as those found in a commercial Hobby project or other source as specified by the Soldering Instructor.

5.3.1 Training Material
The Training Program shall consist of the requirements of: 1) NASA-STD-8739.3, 2) NASA Student Workbook for NASA-STD-8739.3, 3) NASA Video Presentation of Soldered Electrical Connections, 4) requirements specified herein.

5.3.2 Soldering Fabrication Test Requirements
Acceptance criteria for soldered electrical connections from NASA-STD-8739.3 are described in Chapters 1 through 15 and Appendix A, Part I and II; however, a (Your Co) Work Instruction shall define the minimum fabrication attributes required for each classroom PWB and Terminal. Proficiency tests shall be defined in the Work Instruction. The PWB and Terminal Fabrication
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5.4 Qualification and Certification Records

The Instructor shall maintain the following written records of student qualification:
1) PWB Fabrication Test Score, 2) PWB Inspection Test Score, 3) Visual Examination Test Score, 4) Terminal Fabrication Test Score, 5) Training Log, (Your #).

The Instructor shall issue a Certificate of Achievement signed by the (your Co) Training Supervisor and the Soldering Instructor. The Certificate shall identify the student's name, issue date and expiration date of the certification. In addition, a wallet sized Training Certification Card, (Your #), shall be issued that identifies the NASA-STD-8739.3, any applicable limitation, the issue date and the expiration date.

The Certificate of Achievement or Training Certification Card is not required to be immediately presented by the Operator or Inspector, but shall be readily retrievable upon demand.

6.0 AMENDMENTS to NASA-STD-8739.3 for Production Application (based on heritage)

6.1 Electrostatic Discharge Program

ESD control and prevention and ESD sensitive component protection and storage shall be accomplished to the extent necessary utilizing tailored provisions of NASA-STD-8739.7, MIL-STD-1686 and/or MIL-HDBK-263.

6.2 Soldering Iron Preparation

Oxidized tips shall be cleaned or replaced. Plated tips may be cleaned using 320 grit or finer aluminum oxide cloth.

6.3 Insulation of Wire and Component Leads

A component lead or wire lead shall be insulated when it is located within 1/32" of an adjacent and uninsulated conductive element that is designed to be electrically isolated; 1/64" clearance is acceptable if the uninsulated junction is to be conformal coated. The insulating material shall conform to MIL-I-23053 or MIL-I-22129. Insulating material may be applied by wrapping 2 or more longitudinally slit sleeves in overlapping layers or by a single longitudinally slit length of tubing and shall be prevented from movement by conformal coating.

6.4 Conductor Attachment to Terminals

Conductor sizes 16 AWG and larger may be attached without a wrap. The termination end of the conductor must extend 1/32" minimum through a hook or pierced terminal; no more than 1/32" beyond the base of a bifurcated terminal and no more than 1/32" beyond the edge of a pierced terminal when the conductor is secured as a lap termination.
6.4.1 Repositioning
Components that are improperly located after soldering shall be removed and if necessary leads shall be straightened and reformed to permit correct component placement. Component leads shall not be reformed by mechanical methods to reposition an installed component.

6.5 Wire Termination
Clipped ends of component or wire leads that expose copper is permissible if the item is to be conformal coated. Slight scratches or indentations on the solder fillets made by cutting tools or incidental mechanical abrasion are acceptable.

6.6 Special Requirements
The engineering drawing shall take precedence when special requirements exist that are not in conformance with this procedure.

6.7 Soldered Electrical Connections for Non-High Reliability Hardware (Shop Practice)
The following workmanship standards apply to non-high reliability soldered electrical connections:
a) Smooth, b) Nonporous, c) Satin to Bright Finish, d) Wet all Elements, e) Fillet between Connection Elements, f) Stress Relief in Leads or Conductors, g) and exceptions to NASA-STD-8739.3 listed in paragraph 6.1 through 6.6 herein;
6.7.1 The lay of a multi-stranded wire lead in a soldered electrical connection may be disturbed if its shape is uniform and it conforms to items 6.7.1a through 6.7.1g herein;
6.7.2 The lead contour may be obscured if the connection conforms to items 6.7.1a through 6.7.1g herein;
6.7.3 The maximum insulation clearance may be exceeded for encapsulated wire leads

7.0 ENVIRONMENTAL, HEALTH AND SAFETY (EHS)
Adherence to applicable federal, state, local and (Your Co) environmental, health and safety requirements is mandatory.