UNSIGNED HARDCOPY
NOT CONTROLLED

Subject: Soldering (Non-Electrical)

APPROVED BY Manager, Hardware Engineering

STATUS Maintenance Revision

PURPOSE Covers the general requirements for soldering metal parts of non-electrical assemblies. Requirements of this instruction shall be followed by L-3 Communications Corporation, Link Simulation & Training Division (hereafter referred to as Link) personnel when soldering metal parts of nonelectrical assemblies.

AFFECTED FUNCTIONS Hardware Engineering
Manufacturing

REFERENCES A-A-51128 Torch Kit, Soldering (Propane Gas)
QQ-S-571 Solder; Tin-Alloy, Tin Lead Alloy and Lead Alloy

DEFINITIONS None

1. Requirements

1.1 Solder equipment - operator. Link Quality Assurance shall be responsible for the qualification of soldering equipment operators and for the suitability of the equipment to be used.

a. Procedure. When specified, the soldering procedure shall be established, recorded, and certified prior to initiation of a quality production run. The procedure shall be maintained on file for reference as required by authorized persons.

b. Procedure record. The recorded procedure shall include, but not be limited to, the following factors:

(1) Drawing or sketch of the item to be soldered.

(2) Base metal(s). (Aluminum, Stainless Steel, low and medium carbon Steel, and Galvanized Steels.)

(3) Solder type.

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(4) Flux type.

(5) Heating medium.

(6) Heat range.

(7) Flux removal method.

c. Sample specimen. A sample specimen, prepared in accordance with the established procedure, shall be retained and made available for comparative evaluation of follow-on items of like design to be produced by the established procedure.

1.2 Solder metal and flux. Solder metal (Tables I, II, and III) and flux shall conform to QQ-S-571.

Table I Tin-Lead Solders

Nominal composition (percent)		Temperature ˚F (˚ C)			Specification classification	Application
Tin	Lead	Solidus	Liquidus	Pasty range	QQ-S-571	
30	70	361 (183)	491 (255)	130 (54)	Pb 70	Torch soldering

Table II Tin-Antimony Lead Solders

Nominal composition (percent)			Temperature ˚F (˚ C)			Specification classification	Application
Tin	Antimony	Lead	Solidus	Liquidus	Pasty range	QQ-S-571	
30	1.6	68.4	364 (184)	482 (250)	118 (48)	Sn30	Torch soldering except on galvanized iron

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Table III Tin-Silver and Lead-Silver Solders

Nominal composition (percent)			Temperature ˚F (˚ C)			Specification classification	Application
Tin	Lead	Silver	Solidus	Liquidus	Pasty range	QQ-S-571	
__	97.5	2.5	579 (304)	579 (304)	0 (-18)	Ag 2.5	On copper, brass and similar metals using torch heat. Susceptible to corrosion.
1.0	97.5	1.5	588 (309)	588 (309)	0 (0-18)	Ag 1.5	On copper, brass, and similar metals using torch heat.

1.3 Joint preparation.

a. Cleaning. The mating surfaces and adjacent areas of all parts to be joined shall be thoroughly cleaned to remove all oil, grease, paint, pencil marking, drawing or cutting lubricant, dirt, scale, artificial oxide, or rust film and any other foreign substance. For the removal of oil or greases from surfaces, either solvent or alkaline degreasing shall be used.

b. Deburring. Burrs shall be removed to permit proper fitting of parts and metal flow. Hand filing, scraper, shave hook, or power-driven abrasive wheels or discs shall be used.

c. Joint design. Two basic types of joint design shall be used for soldering namely the lap joint and the butt joint. The lap joint shall be used, whenever possible, as this joint offers the greatest possibility of obtaining maximum strength joints in an assembly. Butt joints cross section shall be equal to the cross-sectional area of the smaller member. The butt joint must be free of defects to be efficient and may only be used where sealing is the primary requirement.

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d. Joint selection. The selection of a joint design for a specific application shall depend largely on the requirements of the assembly, as well as heating method to be used, fabrication techniques prior to soldering, quantities to be soldered, and method of applying solder.

e. Fit. Unless otherwise specified, clearance between mating surfaces of furnace soldered steel parts shall not exceed .003 inch (0.076 mm). When other methods are used, clearance between mating surfaces shall not exceed .006 inch (0.152 mm), with the following exceptions: in areas of a joint where one or both mating surfaces are intentionally beveled, or when precoated metals are used, a clearance of .001 inch (0.025 mm) or less shall be required. In fabrication of aluminum assemblies where sheets clad with soldering metal are employed, joints shall make contact, as the cladding material provides sufficient clearance. When a cladding material is not employed, parts shall be positioned and assembled so that the clearance between mating surfaces is .005 inch (0.127 mm) to .015 inch (0.381 mm), when a chemical flux is used, and between .002 inch (0.050 mm) to .010 inch (0.254 mm) when a reaction flux is used, unless otherwise specified on the drawing. Unless otherwise specified, joint clearance for copper and copper alloys shall be maintained from .003 inch (0.076 mm) to .005 inch (0.127 mm).

f. Assembly of parts. Parts to be joined shall be held in position by jigs, clamps, supports, or by self-fixturing. Fixtures used to hold parts and assemblies in alignment during soldering shall be designed to allow expansion and contraction. Jigs, fixtures, and clamps shall be of noncontaminative materials and should only involve point or line contact. When authorized by the procuring activity, staking, pinning, riveting, tack welding or spot welding may be used for positioning of parts, but shall not be located in areas subject to high stresses in service. On closed assemblies, vent holes shall be located and drilled as specified. Stop-off materials may be used to restrict the flow of solder metal when required.

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g. Application of flux. Flux shall be applied to the surfaces to be soldered. The flux, used alone or from a flux-cored solder, when heated, shall be fluid and effective in removing and excluding oxides and other impurities from the joint being soldered. The flux should allow lowering of the surface tension of the molten solder, so that the solder will flow readily and adhere to the metal. The flux shall be readily displaced from the metal by the molten solder.

h. Application of solder metal. Sufficient soldering alloy, in the form of wire, shims, strip, powder with a residue free of chemical agents, or plated form (solder-flux paste), shall be preplaced or fed in close proximity to the joint, preferably on one side only, in sufficient quantity to produce a satisfactory joint. Joints having one end inaccessible to visual inspection shall have the solder metal placed at the blind end prior to assembly, whenever it is practicable to do so.

1.4 Soldering methods.

a. Type II - flame soldering. A gas-burning torch for soldering shall be controlled by the size, mass, and configuration of the assembly to be soldered. Time for performing the operation will also be a factor in equipment selection. Depending upon the temperature and amount of heat required, fuels such as acetylene, propane, butane, and natural gas may be used in open air or with compressed air or oxygen. Portability will be another factor in selection of a torch. For fieldwork, a soldering torch kit, A-A-51128, using propane gas, may be used for torch soldering.

b. Procedure. Parts shall be preheated with a neutral or slightly reducing flame to bring the entire joint uniformly to the liquidus temperature of the solder, but no higher than necessary to provide a satisfactory joint. Localized overheating shall be avoided. The solder may be introduced at one edge of the interstice, or in a groove provided for one of the mating surfaces, and shall flow by capillary action to fill the interstice.

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1.5 Quality considerations.

a. Workmanship. Soldered assemblies shall be processed in a careful and workmanlike manner. The soldering shall be free of scratches, roughness, sharp edges, dullness, looseness, blistering, foreign matter, and other evidence of poor workmanship that will render the assemblies unsuitable for the purposes intended.

b. Appearance. A solder joint shall have a bright, noncrystalline, metallic appearance (the degree of brightness may vary with the solder used) with good adherence and shall be clean and smooth. Solder shall cover the joint and form a slight fillet between the terminal area and each side of the joint. The joined surfaces shall be covered with a coating of solder that leaves the general outline of the surfaces visible, although the joint itself may be obscured.

c. Flow and wetting action. The solder connection shall indicate compatibility between the solder and the surfaces being joined, evidenced by good flow and wetting action. Wetting and proper compatibility shall be achieved when the solder fillet feathers and thins out at the edges and bonds to the base material in those areas where sufficient joint area exists to allow solder spread. Solder fillets at cylindrical surfaces, formed at a direction other than parallel with the cylinder axis, shall form a fillet which blends to the cylindrical surface tangentially.

d. Lines of demarcation. A line of demarcation, where solder fillet blends to surfaces being joined, shall be acceptable provided wetting has been achieved.

e. Contour. The contour of an outside solder joint shall be of a uniform radius, with a minimum amount of excess solder or flash, over the adjacent surfaces. All sharp projections shall be removed.

f. Porosity. A porosity defect is the result of gases being expelled. It appears as small, round, smooth-edged pockets on the surface of the solder metal. The presence of porosity is undesirable but is acceptable, unless otherwise specified, provided the number, depth, and area of concentration does not interfere with the function of the completed assembly.

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g. Blisters. A blistered surface condition, resulting from the overheating of the base metal, shall be cause for rejection.

h. Residual flux. No residual flux shall be permitted on the surface of a joint, except those from organic-based or rosin-based fluxes where residues are noncorrosive. In the foregoing cases, residual flux may be left in place unless removal is dictated by the applicable drawing or specification, appearance, or because the joint area is to be painted or otherwise coated.

i. Excessive solder alloy. Soldering metal in excess of that required for the joint is acceptable provided the excess solder metal does not interfere with the function of the completed assembly.

j. Unmelted solder alloy. The presence of unmelted soldering alloy in a joint is undesirable and shall be cause for rejection of the part.

k. Penetration. Solder alloy must appear on all edges of a joint, indicating proper flow through the joint. Lack of penetration shall be cause for rejection of the part.

l. Cold solder joint. Solder shall adhere smoothly to the parts being joined. The joint shall not be chalky in appearance, lacking metallic luster, nor shall it have a rough, gritty, piled-up surface. A cold solder joint shall be cause for rejection of the part.

m. Disturbed solder joint. The solder connection shall not have an irregular; dull, rough appearance caused by movement of the joint before the solder has fully solidified. This defect shall be cause for rejection, as there may be a poor mechanical connection.

n. Total aggregate area. When specified, the unsoldered area including trapped flux, scattered porosity, and voids shall not exceed 20 percent of the faying surface of the respective joint for aluminum and aluminum alloys and 15 percent for all other metals.

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2. Quality Assurance Provisions

2.1 The Quality Assurance Organization shall be responsible for assuring that the workmanship meets the minimum requirements specified herein.

3. Preparation For Delivery (Not Applicable)

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