# NAVSO P-3641: Navy Power Supply Reliability Design & Mfg Guidelines (NAVMAT P4855-1)

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## 4.5 MANUFACTURING CONSIDERATIONS

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Quality manufacturing processes are crucial to producing reliable power supplies. The following guidelines have been developed to assist in this endeavor.

RECEIVING INSPECTION CONTROL ON COMPONENTS

The objective of the receiving/inspection process is to prevent detrimental impact to both schedule and cost resulting from receiving and installing defective components. It is recommended that the tests and inspections listed in the Component Screening and/or Special Controls section of this document be performed on a 100% or sample basis as indicated.

Testing of components includes but is not limited to the following nondestructive and destructive tests and inspections.

(1) Nondestructive Tests

a. Electrical
b. Hermeticity
c. X-ray
d. PIND
e. Component marking permanency.

(2) Destructive Tests

a. De-lid/de-pot
b. Pull test on bonds, both internal and external
c. Plating adhesion
d. Lead solderability
e. Microscopic examination (preferably with a scanning electron microscope).

Each lot that does not successfully pass all of the tests should be returned to the component manufacturer with notification as to the cause for rejection. Concurrence with and positive corrective action relative to the deficiency should be requested/required in writing by a specific date. The test data and manufacturer's response need to be recorded as component performance history.

COMPONENT MOUNTING

It is recommended that components be inserted via automatic or semi-automatic component insertion equipment whenever possible. This ultimately prevents components from being inserted backwards or in the wrong location. If such equipment is used, the sequence and placement of components must be validated by "first piece" inspection. When using automatic polarity checking with this equipment, the accidental application of high-voltage pulses must be prevented.

Manufacturing personnel should verify their own work prior to submitting an assembly to inspection.

Components that are sensitive to ESD or voltage transients should be protected via appropriate containers and workstation grounding.

SOLDER JOINTS AND SOLDER PROCESSES

A key precondition to a good solder joint is pre-tinning of all leads/pins prior to assembly. For maximum reliability and consistency, the solder joints should be made via automated processes:

(1) Wave solder for pin-in-hole connections

(2) Semi-automatic for surface mounting (e.g., flatpacks).

All solder joints should be inspectable; this requires that blind-hole solder joints be restricted in the design.

For pin-in-hole solder joints, the solder should penetrate through the barrel of a PTH. This applies also to wires, transformers, connectors, etc., and requires that the solder joint be made from the side of the PWB/MIB opposite that on which the component is located.

Make all wire connections to a PWB/MIB only on the component side of the PWB/MIB to simplify assembly, rework and repair, and to minimize handling damage.

Flux must not become entrapped due to a blockage at one end of the PTH; this has a high potential for causing a poor solder joint which will fail at a later time.

Cavities are a natural place for moisture, foreign material, or solder to get trapped and/or wedged, resulting in an electrical short to the frame. This can be prevented by either:

(1) Designing the cavity out,

(2) Making the cavity sufficiently large so as to reduce the risk of entrapment,

(3) Coating the area to prevent the short from occurring, or

(4) A combination of the latter two techniques.

ASSEMBLY LEVEL

Loose Particles

Loose particles can cause shorts. Prevent them from getting into the power supply during the assembly cycle. The mechanical design can reduce the problem of loose particles by eliminating convenient places (e.g., cavities) into which they may settle. The manufacturing processes should provide facilities (e.g., Plexiglass shields on lead-clipping benches) to prevent the particles from getting into an assembly. As a final assembly procedure, the power supply as well as the individual assemblies should be turned upside down and shaken in order to get rid of any particles.

Susceptibility to Solvents

There are several cleaning solutions and/or processes that can cause an electrical failure at a later time. One mechanism is chloride contamination that evolves into an electrical short; e.g., chemical reaction with the aluminum foil inside an aluminum electrolytic capacitor. (Refer to paragraph 4.2 for a method of preventing this interaction.) "Circuit coolant" used to test portions of a circuit at low temperature can cause damage from electrostatic charge and chemical contamination. Semiconductor isolating washers may not all have the same resistance to chemical solvents. Solvents such as methyl ethyl ketone (MEK) should be avoided.

Wire Routing

Wires are susceptible to being broken and/or pinched, especially during or after a rework/repair operation. To avoid such problems, as well as to prevent crosstalk, care must be taken in the decisions to use a wire (or harness) and its placement and routing.

Handling Damage

The reliability obtained with good design and manufacturing processes can be degraded by poorly designed fixtures and containers, and damage caused by inadequately trained personnel. Consideration of these factors can reduce handling damage substantially during assembly and rework/repair operations.

Power Device Mounting

The potential reliability gain by eliminating the use of thermal grease and using the thermal conductive plastic impregnated fiberglass isolators can be destroyed if proper torquing requirements are not precisely followed. Too much pressure can rupture the isolator, thus allowing an electrical short to develop between the "hot-case" device and heat sink, while too little pressure will result in poor thermal conductivity and, hence, a higher junction temperature. Great care must be taken in selection and installation of shoulder washers to obtain proper pressure.

Manufacturer's tables can be used as a guide to establishing torquing requirements; however, caution should be exercised because of the wide variation in pressure obtained as a function of the mechanical resistance between the screw head, or nut and the washer or other bearing surface. Experimental results may be required to obtain the optimum torque required.

INSPECTION

Manufacturing personnel should verify their own work prior to submitting an assembly to inspection. Inspection and assembly personnel should have as many visual aids as possible. Examples of effective visual aids are blown-up color photographs of the completed work at each stage of assembly for each assembly and next higher level of assembly.

REWORK

Workmanship errors found during the inspection process should be corrected by the initial-build personnel.

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