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IPC-TM-650
TEST METHODS MANUAL

Number	
2.6.10	
Subject	
X-Ray (Radiography), Multilayer Printed Wiring Printed Board Test Methods	
Date	Revision
8/97	**A**
Originating Task Group	
Board T.M. Task Group, 7-11d	

1.0 Scope This non-destructive inspection method is needed to ascertain the following conditions:

a. Innerlayer shift is within acceptable tolerances.

b. One or more inner layers have not been reversed.

c. Drilled holes are aligned with pads to the extent that any break-out is within acceptable tolerances.

d. The minimum distance between a drilled hole and a ground plane clearance is within acceptable tolerances.

The test method will entail passing X-rays through the test specimen and converting the transmitted X-ray image into a visual image through the use of either X-ray film or a flouroscopic (real time) device.

Cautionary notes:

The construction of the multilayer with respect to; number of layers, thickness of copper and presence other metals such as heat sinks (e.g. Invar), will determine the power and sensitivity of the X-ray apparatus which can be used. All X-ray apparatus should be registered with the appropriate state or regional Radiation Control agency.

A radiation safety program should be implemented.

2.0 Applicable Documents

MIL-STD-883 Method 2012.5, Radiography

3.0 Test Specimen The Test specimen shall be a multilayer printed wiring board having a maximum size of 20 x 24 inches.

4.0 Apparatus or Material (Ref. MIL-STD-883C).

The apparatus and materials for this test shall include:

4.1 A radiographic (X-ray) source for generating X-rays of sufficient voltage and power to penetrate the test specimen. The focal distance and focal spot size of the source shall be adequate to produce a well defined image of a 0.001 inch copper wire.

4.2 If film is the imaging medium The film used is to be a fine grain single emulsion X-ray film with resolution capable of resolving a 0.001 copper wire and fray scale capable of detecting the shift of a single layer.

4.3 Film holder A lead backed film holder to prevent back scatter of radiation.

4.4 Radiographic Viewer Capable of 0.001 inches resolution.

4.5 Radiographic quality standards Suitable Image Quality Indicator capable of verifying the ability to detect all specified defects.

4.6 Film processing means Manual tray development or a film processor is to be used. If the film processor has a glove box and suitable film holders, a dark room is not required. If manual tray development is used, a dark room is required.

4.7 Silver film densitometer Capable of measuring silver film density up to 3.0.

4.8 If a fluoroscopic (real time) X-ray inspection system is used, the X-ray image detecting device or x-ray camera should be capable of resolving a 0.001 copper wire and a gray scale capable of detecting the shift of a single layer of the specimen.

4.8.1 A means is to be provided for recording or making a hard copy of the fluoroscopic (real time) X-ray image.

4.9 Image Identification Each radiographic image (film or real time) shall be identified with the following information:

- Manufacturer's name
- Part number
- Serial number (when applicable)
- Date code (if marked on specimen)
- View number
- Reference code for x-ray procedures used.

5.0 Procedure

5.1 Preparation Alignment of the X-ray beam center line, specimen inspection area and image detector field of view must be insured so that parallax distortion does not adversely effect the interpretation of the result. (See reference)

Parallax displacement distortion will be indicated when round holes appear oval or ''cats eyed'' on the X-ray image. For a hole drilled through a panel of thickness, t, and offset from the center of the X-ray beam axis by the angle A, the parallax displacement between the top and bottom of the hole will be equal to *txTran A.*

5.2 Radiographic Quality Standard A radiographic quality standard such as an ASTM Image Quality Indicator or other agreeable indicator shall be used on all radiographic studies.

5.3 Exposure when film is used The necessary X-ray penetration exposure will depend on the construction of the multilayer, X-ray source anode voltage, the anode current, the distance from the source to the film plane and the speed or sensitivity of the film. The exposure should be sufficient to produce an optical density of at least 2.0 at those portions of the film receiving the highest X-ray exposure, such as, holes or unattenuated areas. In addition the conditions of paragraph 1.0 with respect to resolution and gray scale must be met. The exposure apparatus for film can consist of an industrial shielded X-ray cabinet with a nominal anode voltage of 80 kilovolts, nominal anode current of *3 millgrams* and a focal spot to film distance adequate to avoid parallax distortion of the X-ray film image.

5.4 Exposure for realtime systems The X-ray source operating parameters must be matched to the X-ray camera sensitivity of the system to produce an X-ray image of sufficient quality to comply with the conditions of paragraph 1.0.

6.0 *Notes* None