EXTERNAL VISUAL INSPECTION OF FLEXIBLE HEATERS

ESCC Basic Specification No. 2054009

Issue 3	March 2018

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DOCUMENTATION CHANGE NOTICE

(Refer to https://escies.org for ESCC DCR content)

DCR No.	CHANGE DESCRIPTION
1072, 1106	Specification upissued to incorporate changes per DCRs.

TABLE OF CONTENTS

1 SCOPE

This specification, to be read in conjunction with ESCC Basic Specification No. 20500, External Visual Inspection, contains additional requirements for Flexible Heaters.

They shall apply, where relevant, to each component inspected.

2 GENERAL REQUIREMENTS

2.1 APPLICABILITY

The following criteria may not be varied or modified after commencing any inspection stage. Any ambiguity or proposed minor deviation shall be referred to the ESCC Executive for resolution and approval.

2.2 PROCEDURE

All items shall be examined in such a manner that a minimum of handling and movement of the component is involved. During handling of components, lint free gloves/finger cots shall be used.

2.3 MAGNIFICATION

All items shall be examined with a binocular or stereoscopic microscope under a magnification of between 2X and 15X depending upon track width.

2.4 MOUNTING FIXTURES

Suitable fixtures may be used to assist in the inspection process provided they do not of themselves cause damage to the device.

2.5 ILLUMINATION

The samples are illuminated in such a manner that all aspect defects listed below will be revealed.

3 TERMS AND DEFINITIONS

Blister - Delamination in the form of a localised swelling and separation between base material and conductive foil or coverlay.

Bubble - An entrapment of air or gas in a protective coating.

Deformation - All metallic foil defects such as dents, folds, bumps and blisters.

Delamination - A separation between base material and conductive foil.

Flattened wire - A wire become flat during pressing operations.

Inclusions - Foreign particles, metallic or non-metallic, entrapped in an insulating material.

Metallic islet - An unetched little metallic area reducing insulation between two tracks.

Misregistration - Imperfect registration.

Nick - A cut in the edge of a track.

Notch - A cut in the wire insulation.

Pad - The metallic extension where wire is welded.

Paving-block - Insulating pavement making encapsulation of wires.

Pinhole - An imperfection in the form of a small hole that penetrates entirely through the layer of metal.

Protrusion - Metallic protuberance in the edge of a track.

Ragged edge - Edge with tears, impacts, notches or other damage.
Scratch - A narrow furrow or groove in a surface.
Slip - Slipping of tracks during coverlay lamination cycle.
Spot - A blot on a metallic surface or in an insulating material.

4 DETAILED REQUIREMENTS

4.1 GENERAL

A component shall be rejected if it exhibits one or more of the defects listed in any of the following paragraphs. Where applicable, drawings are included to provide additional explanatory material.

The external visual inspection includes the verification of:

- Dimensions.
- Marking.
- Materials.
- Mechanical defects.

4.2 DIMENSIONS AND MARKING

Dimensions and marking shall be inspected in accordance with the requirements of ESCC Basic Specification No. 20500, Paras. 4.6 and 4.7.

All letters and numbers shall be clearly legible without the use of optical resources.

Dimensional tolerances shall be as specified in the relevant ESCC Detail Specification.

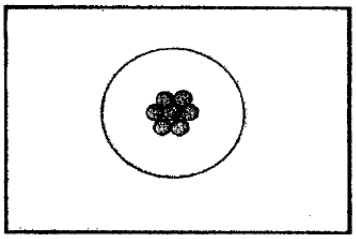
4.3 MATERIALS

The materials used shall be verified for conformance to the requirements of the applicable ESCC Detail Specification.

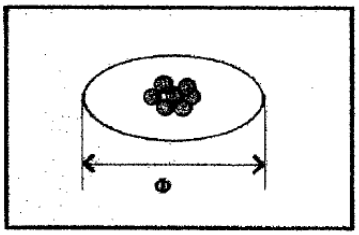
The production records shall be checked to ensure that the specified material requirements are met.

4.4 LEADWIRES

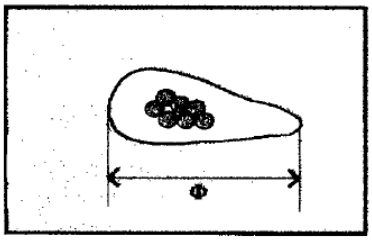
4.4.1 Flattened Wire



GOOD
Wire is intact.



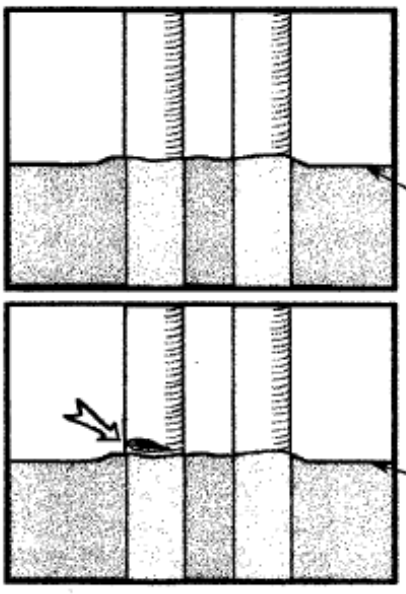
ACCEPTABLE
Wire is slightly flattened.
Rule: Ø ≤ 1.4 × Nominal diameter.



REJECTED
Wire is flattened.
Rule: Ø ≤ 1.4 × Nominal diameter.

4.4.2 Integrity

Notches and scratches on wire insulation.



GOOD

Wire is intact.
No visible defect, without the use of optical resources.

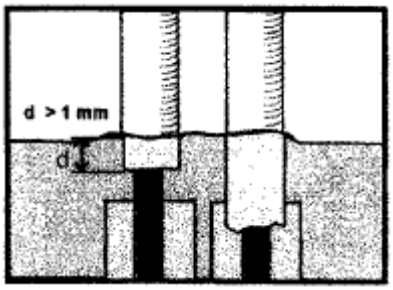
REJECTED

Visible defects on the wire insulation:
- Deep scratch or notch.
- Slight cut.

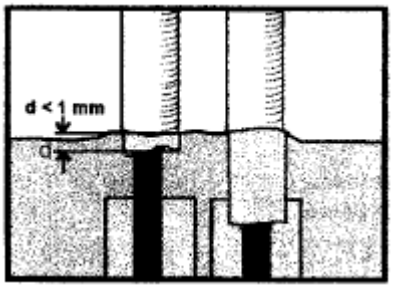
4.5 WELDED LEAD CONNECTIONS

4.5.1 Location of Lead Wire

(a) Position in relation to heater edge.

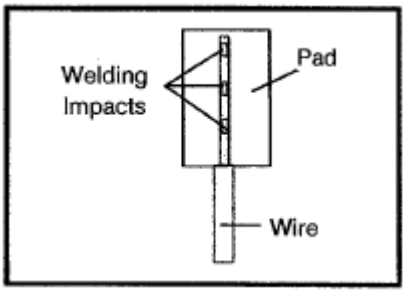


GOOD
The wire insulation penetration under the Kapton is equal to or greater than 1mm.

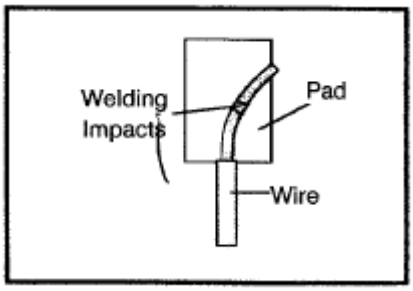


REJECTED
The wire insulation penetration under the Kapton is less than 1mm.

(b) Wire position on connection pad.

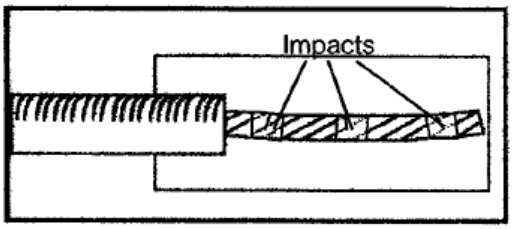


GOOD
The wire is well centred.
The wire is right or slightly bowed.
Twist is regular, strands are well joined (see also Para. 4.4.1).

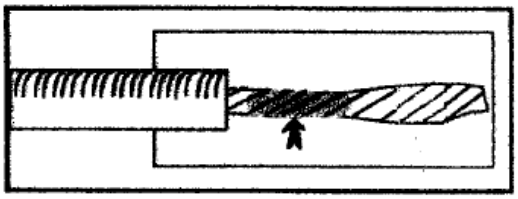


REJECTED
Wire outside pad.
Welding impacts are insufficient (< 2).

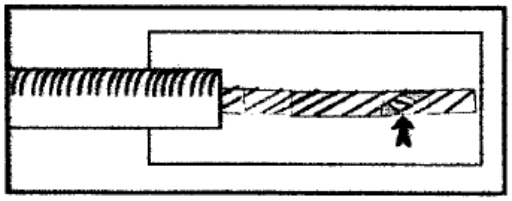
4.5.2 Visual Aspect



GOOD
No discoloration on the welding area.
No broken strands.
No free element (detached or projecting).



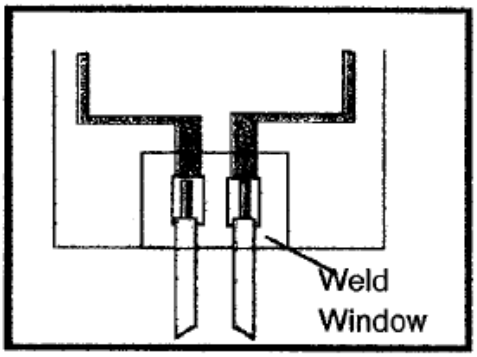
REJECTED
Discoloration of the welding area.



REJECTED
Broken strand.

4.5.3 Weld Window (if applicable)

(a) Examination of weld window itself and its environment.



GOOD

No unsticking.

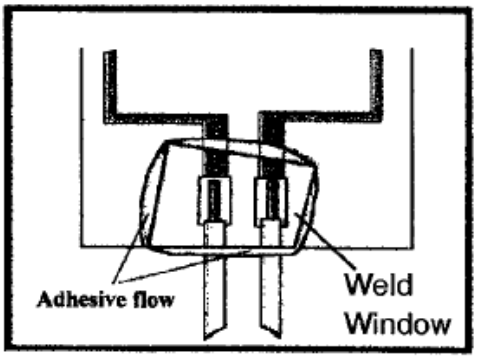
No adhesive flow.

Good position. In particular the Kapton pad covers the opening of the upper coverlay for double-sided heaters.

No bubbles in the adhesive.

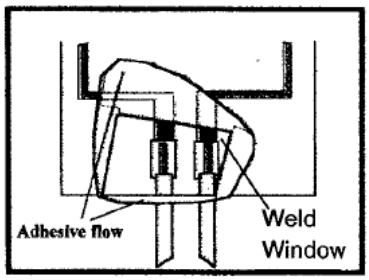
Good wire encapsulation (no void at the end of the sheath next to bare areas).

+



ACCEPTABLE
Adhesive flow next to wires ≥ 2mm.
Crosswise position but wire encapsulation is correct.

N.B.
Removal of excess adhesive with scalpel is not allowed.



REJECTED

Excessive adhesive flow ≥ 2mm next to wires. Bad wire encapsulation.

Local unsticking.

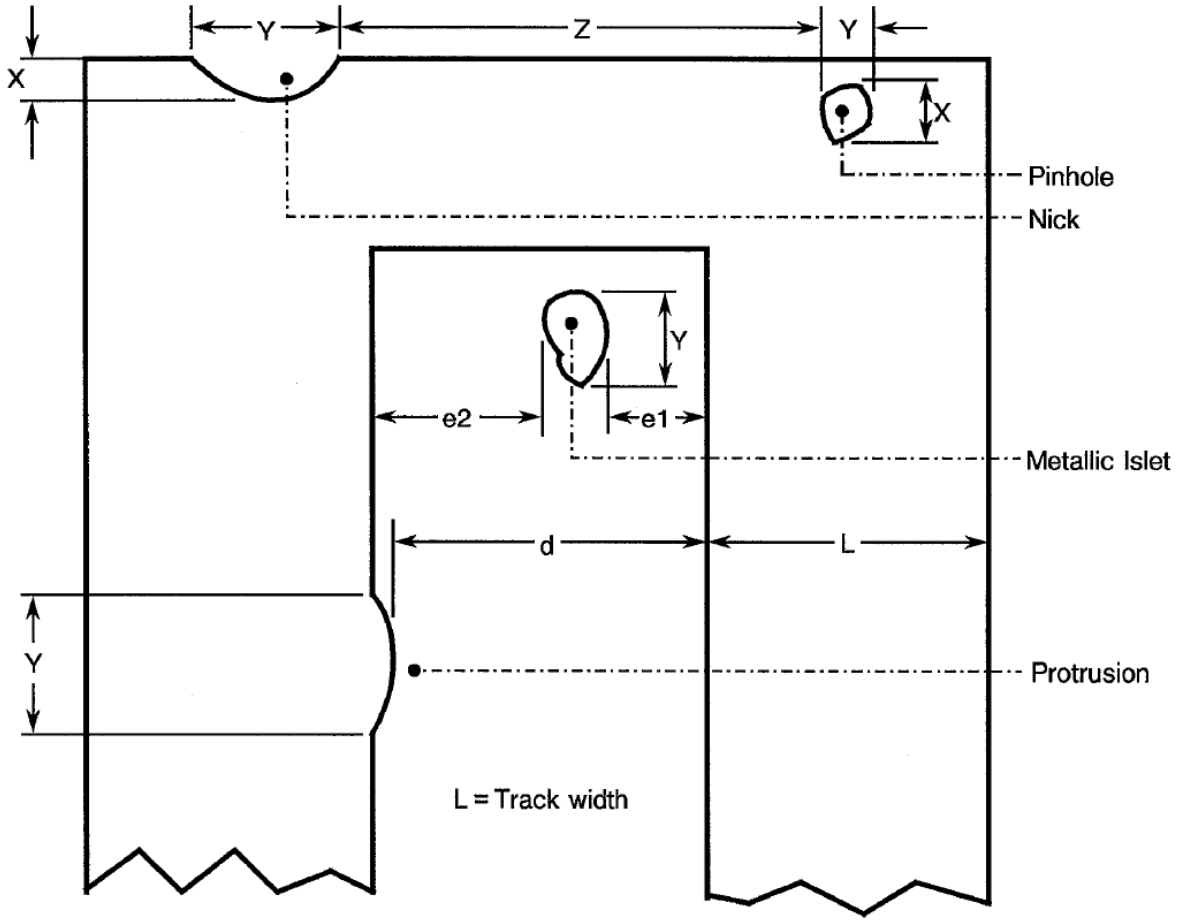
Bad coverage of the opening of the upper coverlay for double-sided heaters.

N.B.

Removal of excess adhesive with scalpel is not allowed.

4.6 CONDUCTOR ETCHING

4.6.1 General



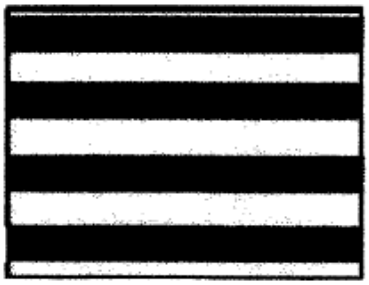
4.6.2 Nicks and Protrusions

Distance between tracks ≤ 0.8mm:

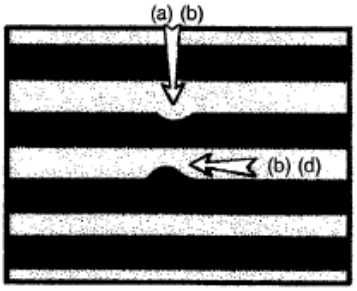
(a) X ≤ 30% of L.
(b) Y ≤ 0.5mm.
(c) Z: Minimum space between two defects = 5mm.
(d) d ≥ 0.05mm.

Distance between tracks > 0.8mm:

(a) X ≤ 25% of L.
(b) Y ≤ 1mm.
(c) Z: Minimum space between two defects = 1.5mm.
(d) d ≥ 0.05mm.

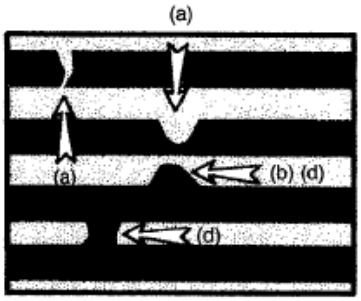


GOOD
No visual defects.



ACCEPTABLE
Track width reduction (a) and length of defect (b) are less than permitted limits.

Distance between tracks (d) is greater than 0.05mm and length of defect (b) is less than permitted limits.



REJECTED
Track width reduction (a) or length of defect is more than permitted limits.

Cut track (a).

Distance between tracks (d) is less than permitted limits or length defect (b) is more than permitted limits.

Short circuit between tracks (d).

4.6.3 Metallic Islets and Inclusions

Distance between tracks ≤ 0.8mm:

(a) Y ≤ 1mm.

(b) Z: Minimum space between two defects = 5mm.

(c) e1 + e2 ≥ 50µm. When adjacent tracks are from different resistors, this requirement becomes: e1 = e2 ≥ 50µm.

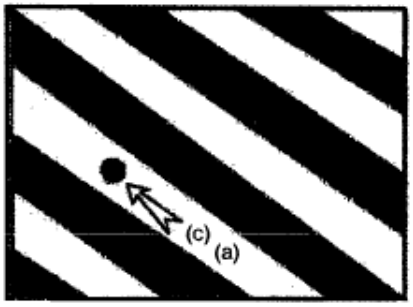
Distance between tracks > 0.8mm:

(d) Y ≤ 1.5mm.

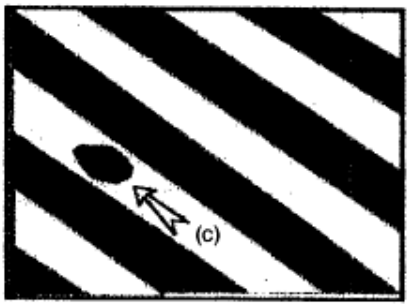
(e) Z: Minimum space between two defects = 1.5mm.

(f) e1 + e2 ≥ 50µm. When adjacent tracks are from different resistors, this requirement becomes: e1 = e2 ≥ 50µm.

GOOD
No metallic islet between tracks.



ACCEPTABLE
Gap between inclusion and tracks (c) is more and length of inclusion (a) is less than permitted limits.



REJECTED
Gap between inclusion and tracks (c) is less than permitted limits.

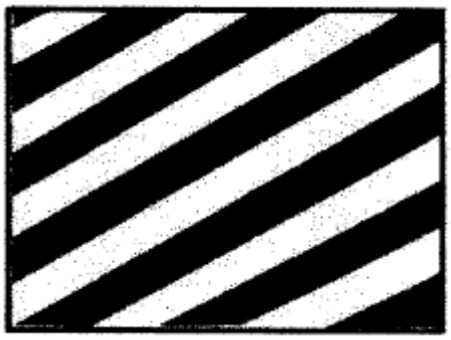
4.6.4 Lack of Metal

Track width ≤ 0.8mm:

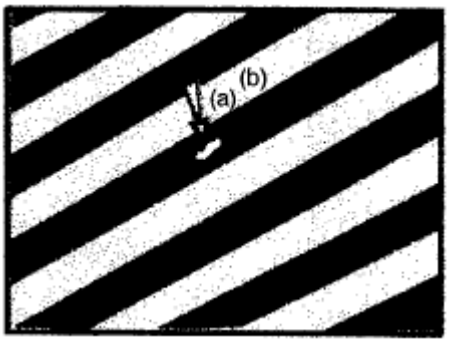
(a) X ≤ 30% of L.
(b) Y ≤ 0.5mm.
(c) Z: Minimum space between two defects = 5mm.

Track width > 0.8mm:

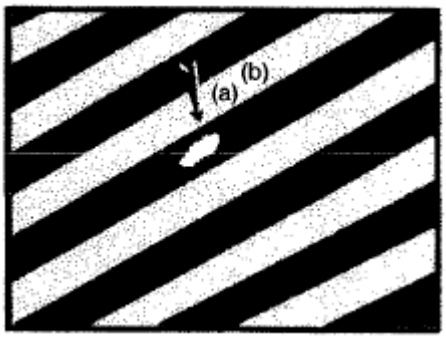
(d) X ≤ 25% of L.
(e) Y ≤ 1mm.
(f) Z: Minimum space between two defects = 1.5mm.



GOOD
No pinholes on tracks.



ACCEPTABLE
Track width reduction (a) and length of defect (b) are less than permitted limits.



REJECTED
Track width reduction (a) or length of defect (b) is more than permitted limits.

4.6.5 Other Random Defects

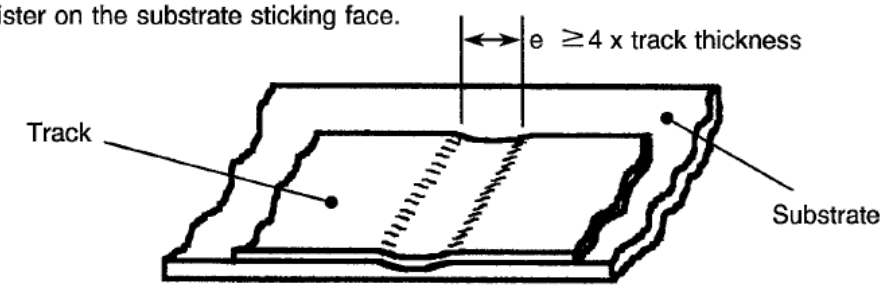
(a) Short-circuits and cuts are rejected in every case.
(b) Reduced insulation, reduced width, etc... (see Para. 4.6.1 for criteria).

4.7 DEFORMATION

4.7.1 Folds

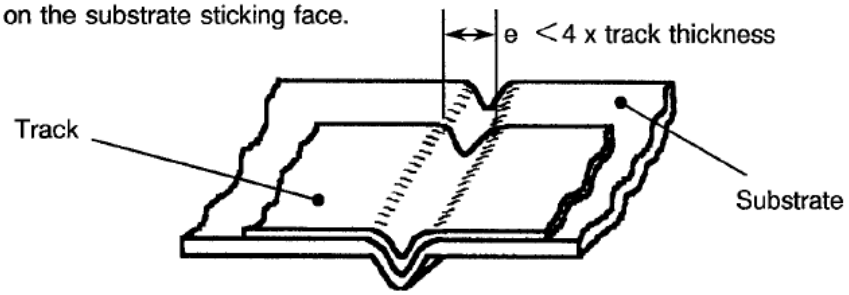
ACCEPTABLE

Gentle curve.
No blister on the substrate sticking face.



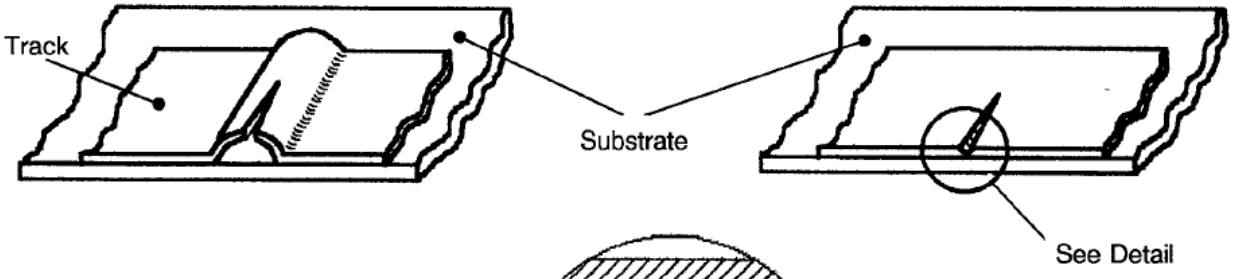
REJECTED

Sharp curve.
Rugged fold.
Blister on the substrate sticking face.

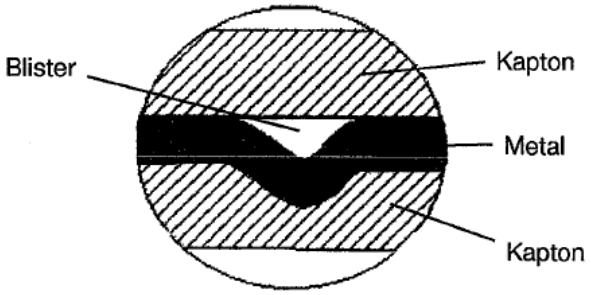


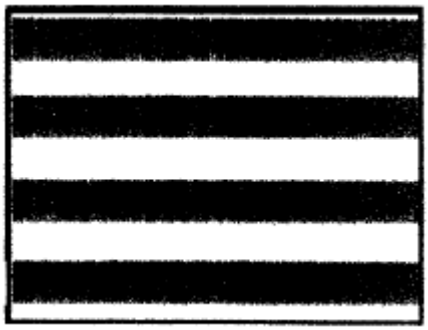
REJECTED

Void between track and substrate.
Torn track.

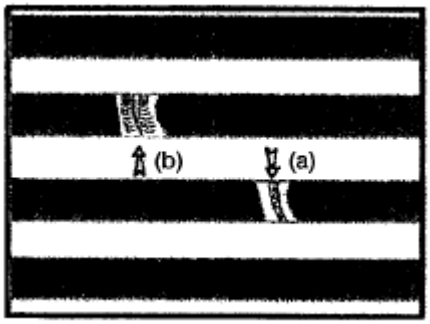


DETAIL

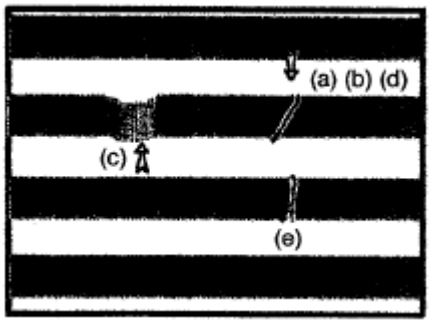




GOOD
No visual defects.
No visible fold.

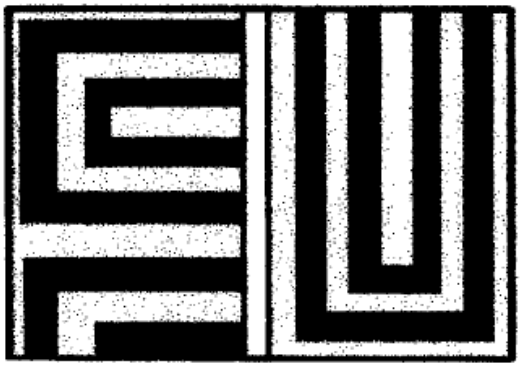


ACCEPTABLE
Fold is not very pronounced.
Fold width is ≥ 4 x track thickness.
No obvious delamination.
No bump on heater surface.
Fold does not result in an overthickness.

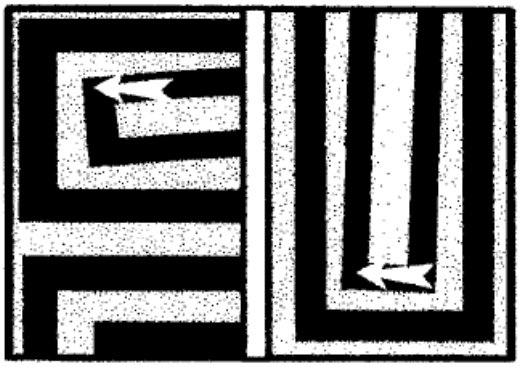


REJECTED
Fold is very pronounced.
Rugged fold.
Fold results in delamination.
Nail detectable overthickness.
Pronounced deformation and width fold below 4 x track thickness.

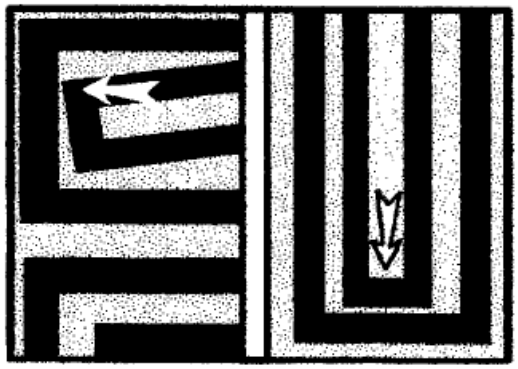
4.7.2 Slips



GOOD
No track slippage.



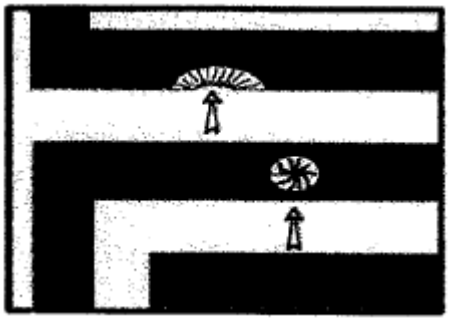
ACCEPTABLE
Track slipped but minimum spacing between tracks is > 50µm.



REJECTED
Track slipped: minimum spacing between tracks is < 50µm.

4.7.3 Local Deformation

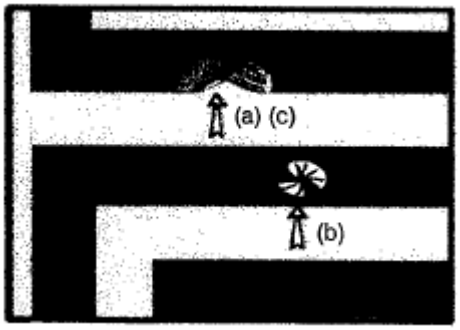
GOOD
Tracks are smooth and without visible deformation.



ACCEPTABLE
Deformation is well localized

Bump involves:
- Neither overthickness.
- Nor delamination.

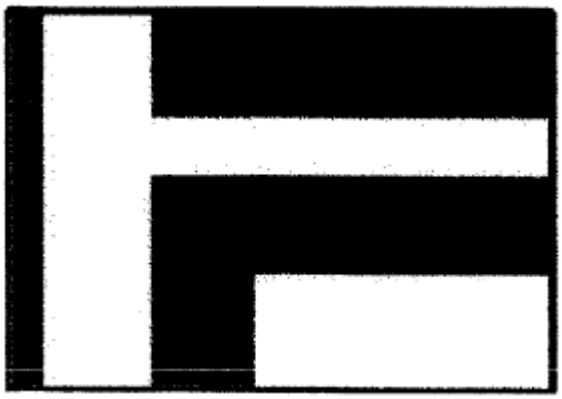
N.B. Acceptance criteria: No nail detectable deformation.



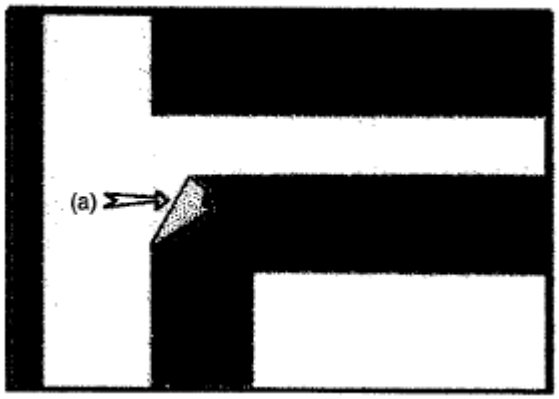
REJECTED
Excessive and large deformation.
Visible marks of cracking.
Nail detectable overthickness.

4.8 BLISTERING AND DELAMINATION

4.8.1 Track Unsticking

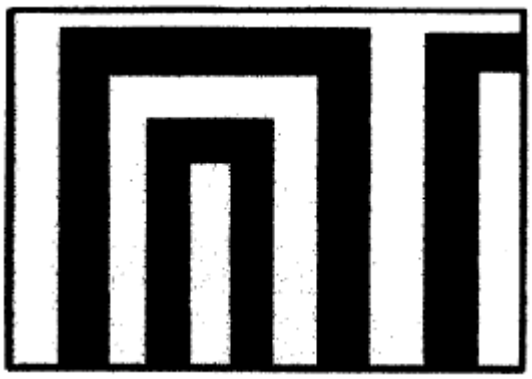


GOOD
No track area unstuck from the substrate.

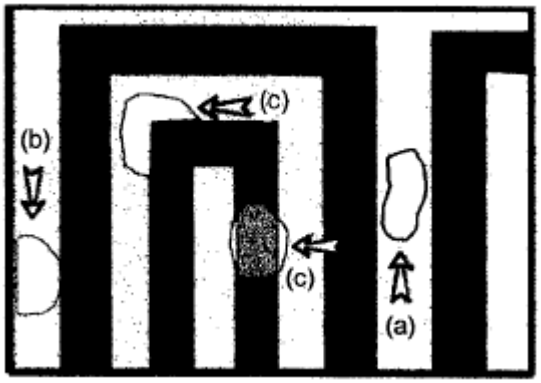


REJECTED
Moved and/or folded track corner.
Kapton coverlay perforated during the pressing step.
Unstuck track corner.

4.8.2 Delamination



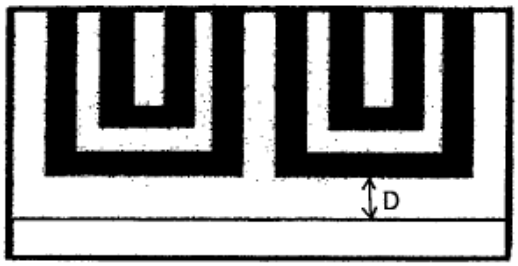
GOOD
No visible point of delamination.



REJECTED
Bubbles:
- Cause excessive delamination between tracks.
- Stretch from track to heater edge.
- Are between track and substrate.

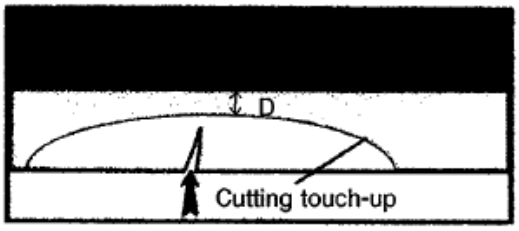
4.9 RAGGED EDGES

N.B. GENERAL RULE Minimum distance track/heater edge D = 0.4mm.



GOOD

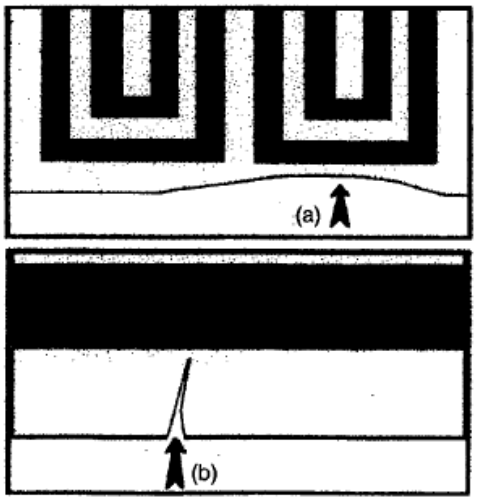
Minimum distance D is respected. Heater edge is without notch.



ACCEPTABLE

The heater edge is notched. This notch will be touched up (rounded) if:

- The notch is not in an area around lead wires (5mm on both sides).
- The minimum distance D is respected.



REJECTED

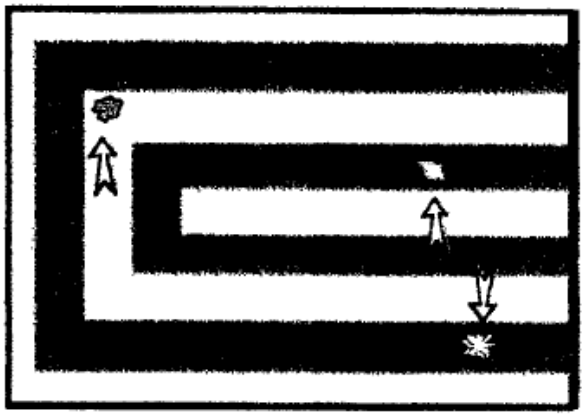
The minimum distance D is not respected.

The notch is too profound and cannot be rounded with regard to the minimum distance.

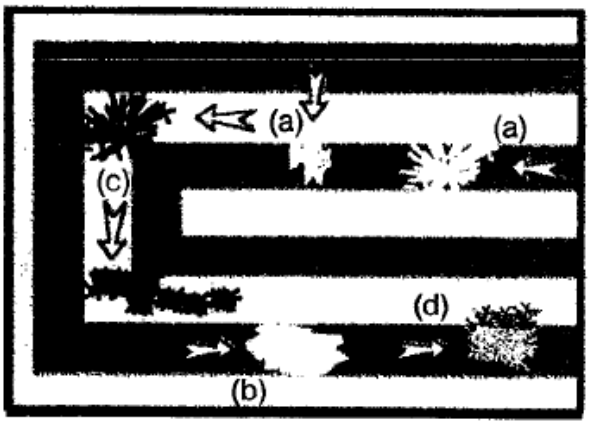
4.10 ASPECT DEFECTS

4.10.1 Spots

GOOD
No spot visible on the heater.



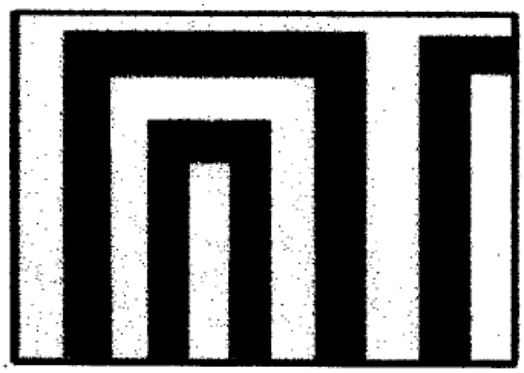
ACCEPTABLE
Isolated patch:
- Without presence of delamination.
- Gap between patch and tracks and length of patch less than permitted limits (see Para. 4.6.3).



REJECTED
Large patches on and between tracks.
Patches showing delamination.
Group of patches.
Dark patches on the metallic surfaces.

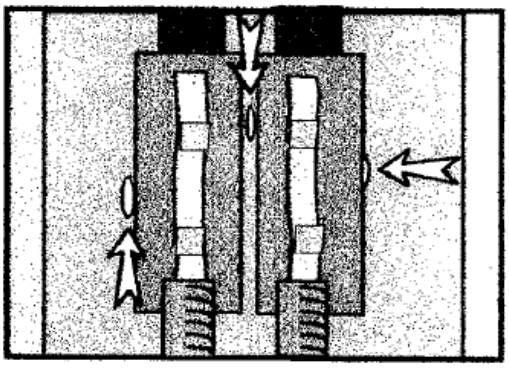
4.10.2 Bubbles

See also Para. 4.8.2, Delamination.



GOOD

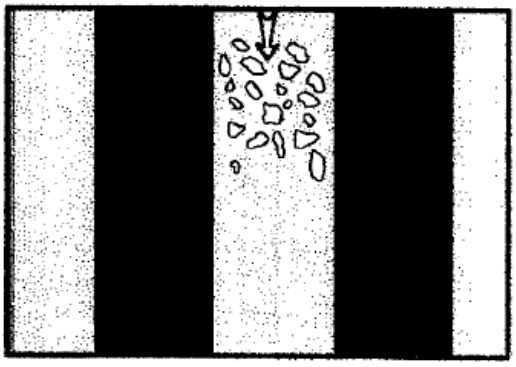
No bubble visible on the heater.



ACCEPTABLE

Bubbles coupled with metallic pad with regard to the following criteria:

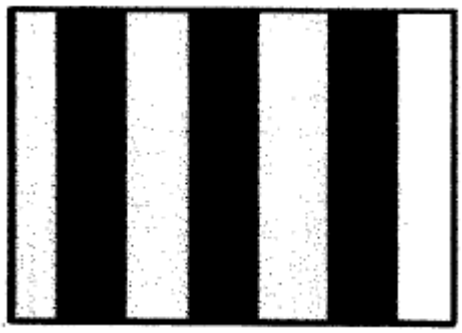
- Size: 0 up to 200µm.
- Number: 5 maximum.



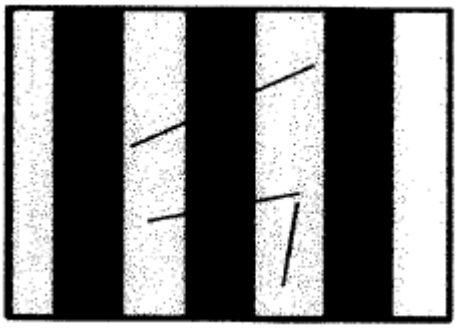
REJECTED

Bubbles make groups of white spots.

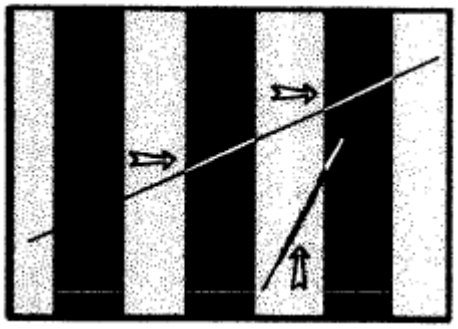
4.10.3 Surface Scratches



GOOD
No evidence of scratch.

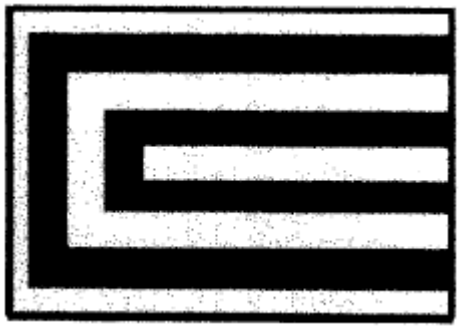


ACCEPTABLE
Gentle scratches without Kapton removal or discontinuity.



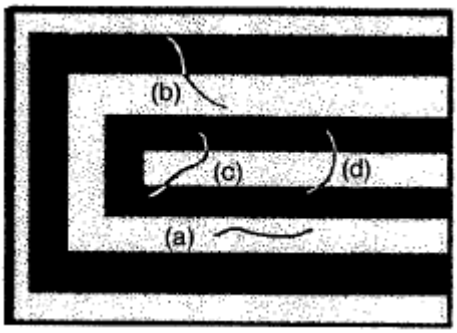
REJECTED
Deep scratches with Kapton removal. Scratches exposing metal.

4.10.4 Non-Metallic Inclusions



GOOD

No evidence of inclusion on or between tracks.



ACCEPTABLE

(a) Inclusion respecting minimum spacing.

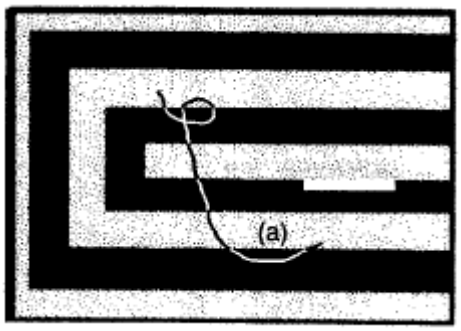
(b) Inclusion does not make a whole bridge between two tracks (50µm respected).

(c) Discontinuous inclusions (50µm).

(d) Inclusion making a bridge between two tracks:

- Limited length (≤ 2mm); the limit of 2mm has to be measured as the maximum distance (segment) between the 2 extreme points of the inclusion. The non-metallic inclusion may have any geometrical shape.
- Limited number according to the heater surface:
  0 up 20cm^2:
  - 3 inclusions accepted by area of 10cm^2.
  - 1 supplementary inclusion up 100cm^2.

  Beyond 100cm^2:
  - 11 inclusions accepted.
  - Proximity criterion: 3 inclusions maximum in a 2cm diameter circle.



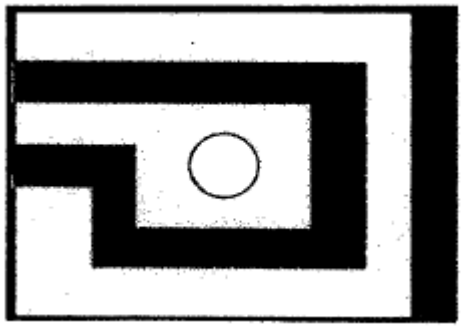
REJECTED

(a) Inclusion making a bridge between two tracks whose number and/or configuration are not covered by previous criteria (length > 2mm).

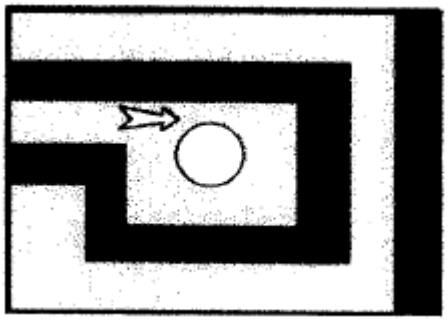
(b) Bright inclusion or being reminiscent of metallic glare.

(c) Metallic inclusion.

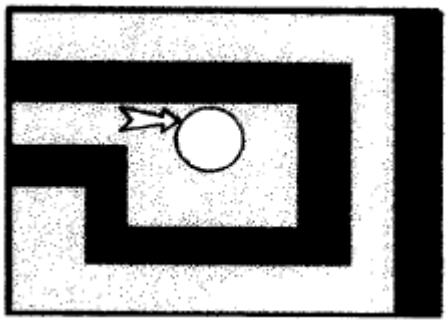
4.11 MISREGISTRATION



GOOD
Perforations are well centred in relation to tracks.



ACCEPTABLE
Perforations are misregistered in relation to tracks, but spacing between perforation edge/track edge is better than acceptable minimum (0.4mm).



REJECTED
Spacing between perforation edge/track edge is less than acceptable minimum (0.4mm).