Designation: F 584 – 06

Standard Practice for Visual Inspection of Semiconductor Lead-Bonding Wire[1]

This standard is issued under the fixed designation F 584; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers conditions for nondestructive visual inspection of the surface finish of spooled aluminum and gold wire used for making internal semiconductor device connections and hybrid microelectronic connections.

1.2 This practice specifies the recommended lighting, magnification, and specimen positioning for inspecting spooled wire under an optical microscope.

1.3 Photographs (Figs. X1.1-X1.5) are included in Appendix X1 as guides to aid the inspector in identifying particular surface conditions. These photographs are not intended as standards for specifying wire surface quality.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the aplicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:* [2]

F 72 Specification for Gold Wire for Semiconductor Lead Bonding

F 487 Specification for Fine Aluminum–1 % Silicon Wire for Semiconductor Lead-Bonding

2.2 *Federal Standard:*

Fed. Std. No. 209B Clean Room and Work Station Requirements, Controlled Environment[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *chatter marks—for the purposes of this practice*—repetitive closely spaced wire surface blemishes.

3.1.2 *dark area—for the purposes of this practice*—wire surface shadowed from direct light-source illumination.

3.1.3 *fingerprint—for the purposes of this practice*—residual surface contamination deposited during handling.

4. Summary of Practice

4.1 The wire spool to be inspected is first mounted on a holding fixture that permits rotation of the spool about its axis. The spool fixture is then placed on the stage of a binocular microscope. The wire surface is illuminated with light incident at a grazing angle; the microscope and fixture are positioned so that the microscope field shows the partially shadowed wire wrap just adjacent to the brilliantly lit surface at the top of the spool.

4.2 Inspection is accomplished by slowly rotating the spool about its axis and moving the fixture over the microscope stage until the operator has viewed the entire exposed wire surface area under partially shadowed illumination.

4.3 The defects to be identified, the manner in which their presence is reported, and the manner in which the wire surface quality is to be characterized should be agreed upon by the parties to the inspection.

NOTE 1—Viewing a wire spool in the partial shadow of glancing illumination is particularly revealing of surface flaws and soil. The viewing arrangement amounts to dark-field illumination with imperfections appearing as bright glints on the wire surface.

[1] This practice is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.07 on Interconnection Bonding/Carrier Bonding.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

5. Significance and Use

5.1 Spooled wire viewed under bright direct lighting or in deep shadow generally exhibits a flawless appearance. Proper arrangement of the viewing angle and illumination, however, permits accurate observation of wire-surface condition. This practice specifies the conditions under which reliable and reproducible surface finish inspection may be achieved. Such inspection is appropriate for evaluating surface quality with respect to the requirements in Specifications F 72 and F 487.

5.2 Surface smoothness and degree of cleanliness may affect the performance of wire. This practice may be used to determine whether or not spooled wire meets performance-based surface finish criteria agreed upon between a manufacturer or supplier and a wire purchaser.

5.3 The magnification recommended may not be sufficient to permit detection of all defects on the wire surface affecting wire performance; however, it is sufficient to permit an inspector to determine the overall state of the wire finish and the manner in which the wire lies on the spool.

6. Apparatus

6.1 *Binocular Microscope*—A microscope equipped with zoom objective lens with basic magnification ranges up to 30 or 40×.

6.2 *Eyepieces*, wide-field, with 10× magnification for a binocular microscope.

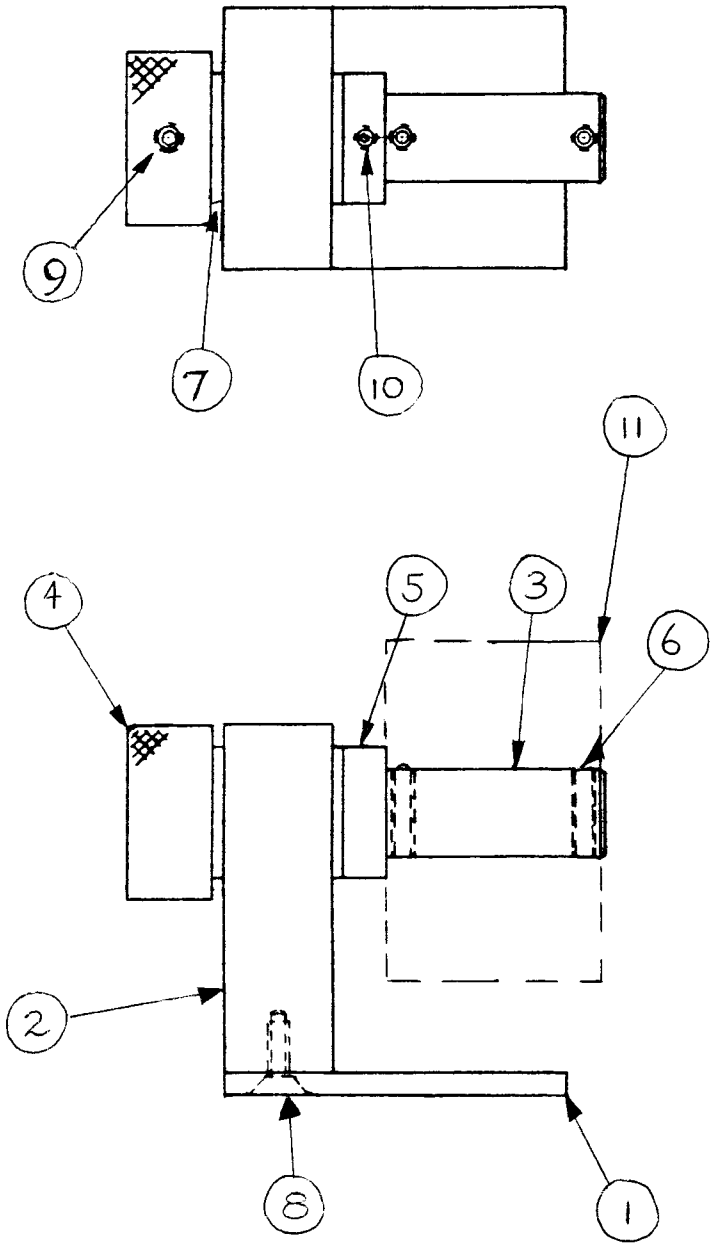
6.3 *Light Source*—Use a fluorescent light similar to that in Fig. 1.

6.4 *Spool Inspection Jig*, either of two types as follows:

6.4.1 *Jig*—A fixture of the mandrel type shown in Fig. 2,[4] capable of positioning the spool so that the spool axis is horizontal, and incorporating means for rotating the spool 360 deg about its axis during inspection, or

[4] A detailed working drawing of the apparatus is available at a nominal cost from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Order Adjunct ADJF0584.

FIG. 1 General Arrangement of Apparatus



1 Base plate
2 Support member
3 Shaft
4 Knob
5 Retaining collar
6 Spring-loaded pin, with the fixed portion threaded or force-fitted into the shaft
7 Nylon washer to fit loosely over shaft, outside diameter less than that of knob, 0.16 mm thick
8 Screws to fasten base plate to support member
9 Set screw for mounting knob to shaft
10 Set screw for mounting collar to shaft
11 Position of spider for mounting spools with larger inner diameters than will fit the shaft

FIG. 2 One Form of Spool Inspection Jig

6.4.2 *Machinist's V-Block*, of suitable size to support the spool on its rims, with no contact between the V-block and the wire.

NOTE 2—Use of the jig fixture is recommended. The jig provides more convenient and sturdier support during inspection and minimizes the possibility of spool contamination from handling. The jig dimensions shown are intended for standard spools described in Specification F 72. For occasional inspection, or for some particular spool designs, construction of a jig may not be warranted. The use of the V-block may then be a practical substitute for the jig, although much greater operator care not to damage the wire will be required.

6.5 *Clean Room or Work Station*—Laminar-flow facility satisfying requirements for Class 1000 or higher, as defined in Fed. Std. No. 209B.

7. Sampling

7.1 This practice is not intended for use as a 100 % screen; therefore, sampling of spools is required.

7.2 The sample should be representative of spools for the intended use. The size of the sample and the method of selection should be agreed upon by the parties to the inspection.

7.2.1 If sampling by lot is used, the definition of what constitutes a lot should be agreed upon by the parties to the inspection.

8. Procedure

8.1 In the clean room or at the clean work station, mount the spool to be examined onto the jig or V-block.

8.2 Position the jig or V-block so that the spool is in the field of view of the microscope.

8.3 Position the light source so that (1) the light strikes the spool at an angle of approximately 45° to the horizontal, (2) the light source is in the vertical plane that includes the spool axis, and (3) the distance between the light source and that part of the upper surface of the spool in the microscope field is 18 cm (7 in.) (see Fig. 1).

8.4 Set the microscope magnification to 30×.

NOTE 3—Magnification of 30× provides sufficient resolution and permits relatively fast and efficient inspection. In the course of the inspection, higher or lower magnifications may be used, as necessary, to provide a better view of areas of particular interest. In no case shall the magnification be set so high that the depth of field is less than one half the wire diameter.

8.5 Adjust the spool position and microscope focus so that the partially shadowed wire wrap just adjacent to the brilliantly illuminated surface at the top of the spool is in clear view.

8.6 Start the examination at either the left or right boundaries of the spool. Viewing the partially shadowed area of wire wrap, slowly rotate the spool 360° about its axis. Note the appearance of the wire surface and record the presence of defects in the agreed-upon manner (see 4.3).

NOTE 4—Figs. X1.1-X1.5 in Appendix X1 illustrate typical surface finish conditions.

8.7 Continue the examination by moving the spool along its axis in steps one viewing-field-width long and repeat 8.6 until the entire spool surface has been viewed.

8.8 Remove the spool from the microscope stage at the conclusion of the inspection.

9. Report

9.1 Report the following information:

9.1.1 Date of inspection,

9.1.2 Operator identification,

9.1.3 Spool lot identification,

9.1.4 Number of spools inspected,

9.1.5 Number of spools, total, in inspection lot,

9.1.6 Viewing magnification used if other than 30×, and

9.1.7 Information on wire surface recorded in 8.6.

10. Keywords

10.1 bonding wire; inspection; lead-bonding wire; semiconductor packaging; visual inspection; wire

APPENDIX

(Nonmandatory Information)

X1. PHOTOMICROGRAPHS OF TYPICAL WIRE DEFECTS AND OF DEFECT-FREE WIRE SURFACE

X1.1 See Figures Figs. X1.1-X1.5

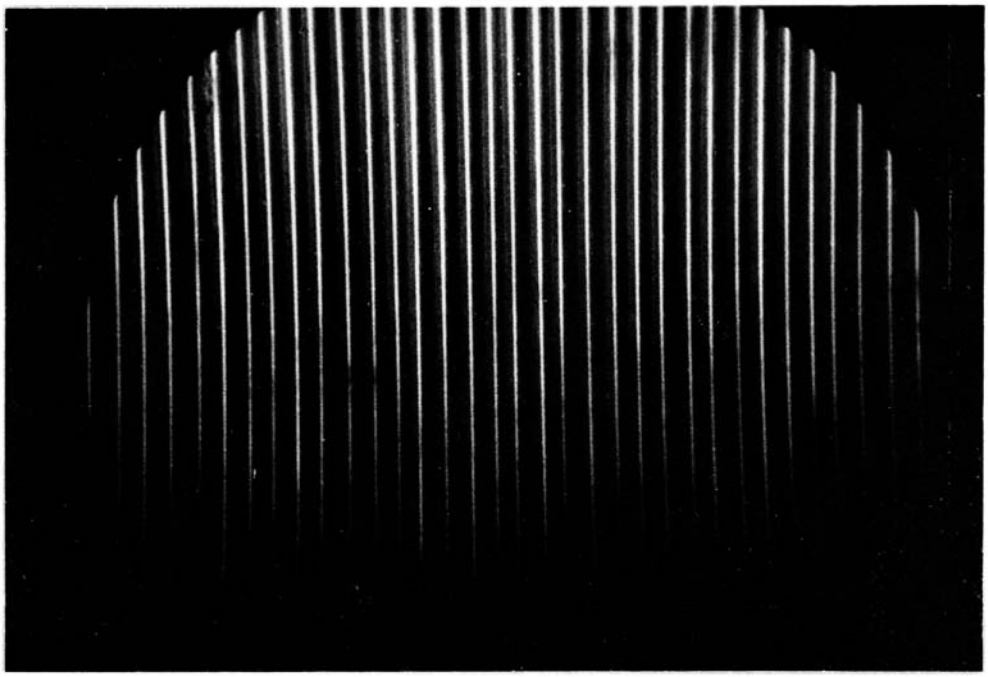


FIG. X1.1 Wire with Defect-Free Surface

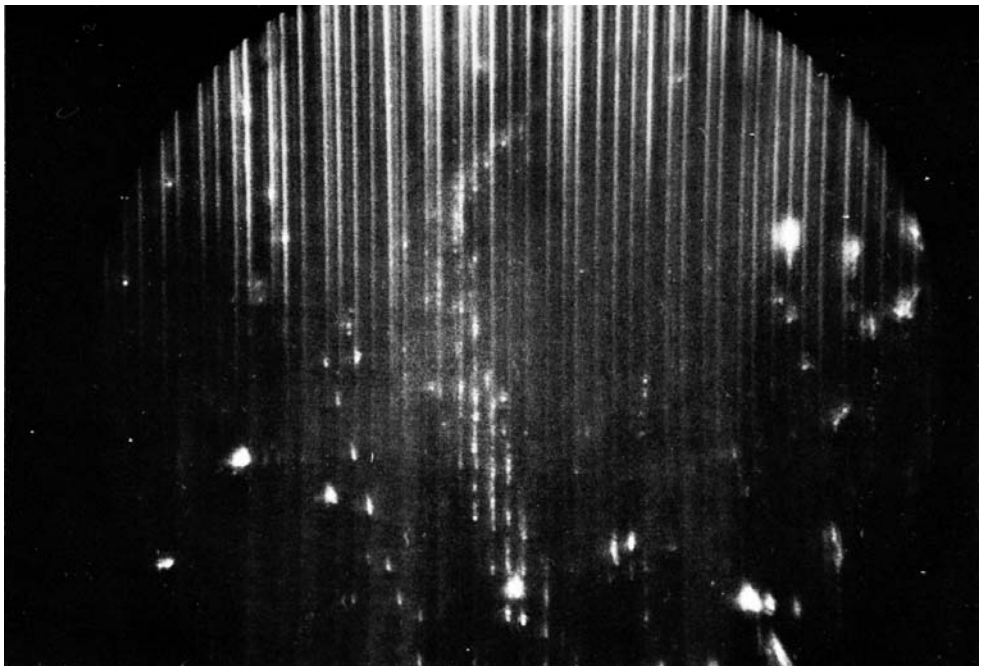


FIG. X1.2 Wire Contaminated by Fingerprint

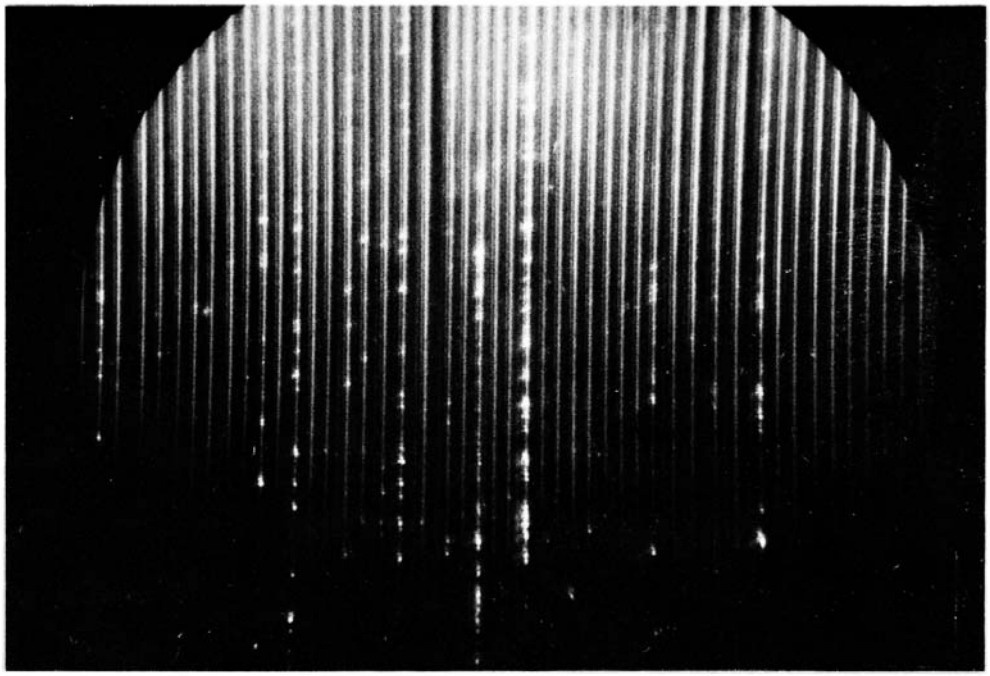


FIG. X1.3 Wire with Mechanical Damage (Scratches and Nicks)

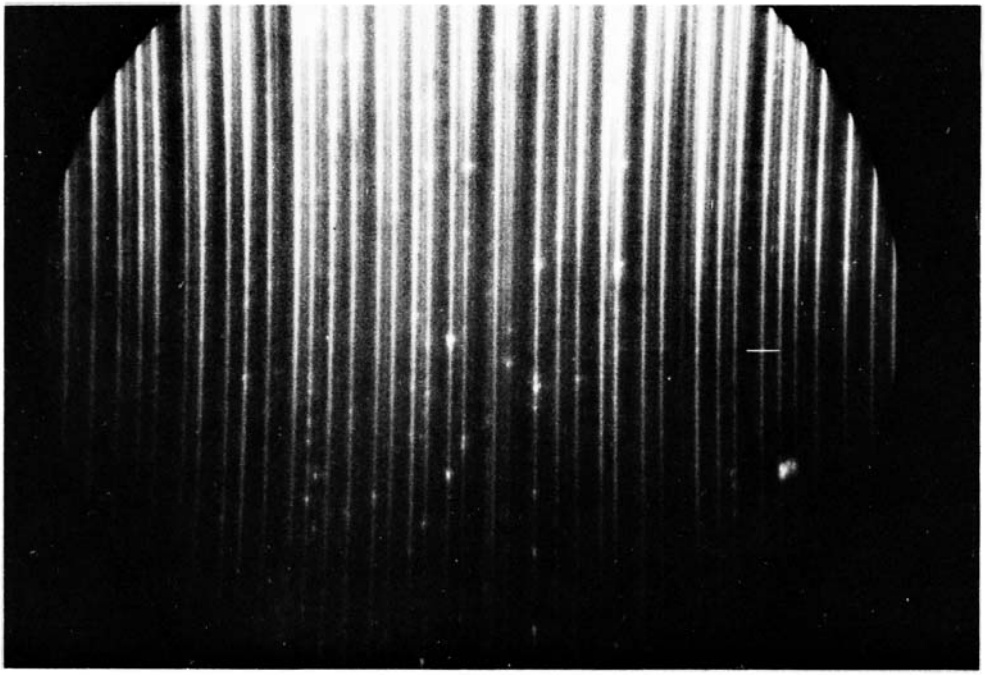


FIG. X1.4 Wire with Mechanical Damage (Stretch or Chatter Marks)

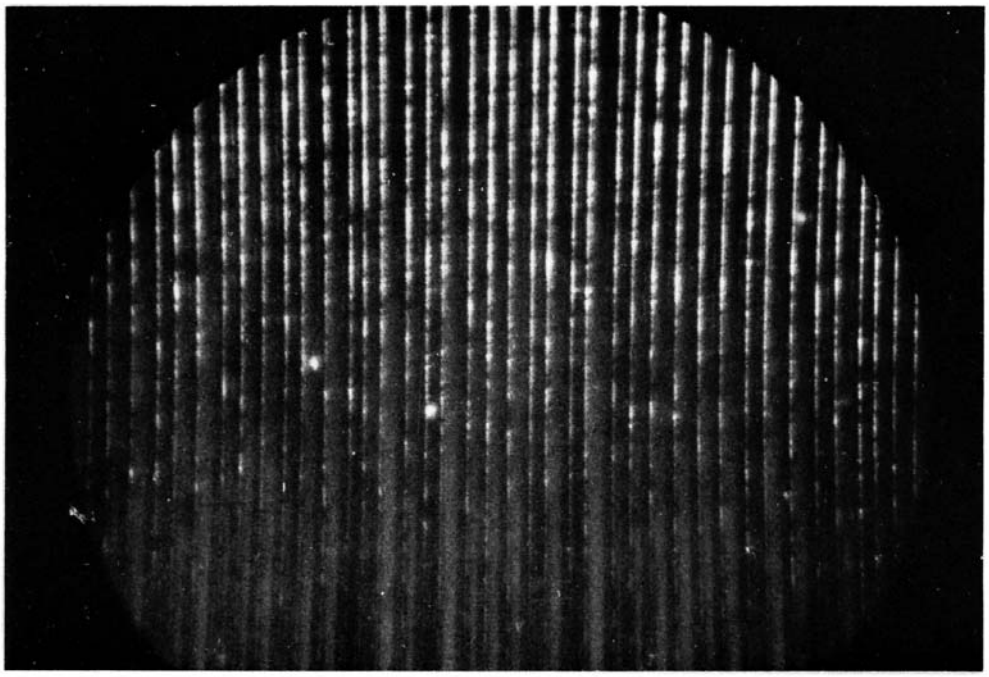


FIG. X1.5 Wire with Light Mechanical Damage (Minor Nicks)