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100 Barr Harbor Dr., West Conshohocken, PA 19428
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Standard Test Method for Solderability of Metallic-Coated Products¹

This standard is issued under the fixed designation B 678; 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 test method provides a procedure for evaluating the solderability of metallic-coated products and test specimens to assure satisfactory performance in manufacturing processes requiring soldering with soft (tin-lead) solder and rosin flux. This test method is applicable only for testing coatings that are normally readily solderable such as: tin, tin-lead alloy, silver, and gold.

1.2 This test method is qualitative and broadly applicable. It is easy to perform and requires only simple equipment. There are other solderability tests not covered by this test method that are more applicable to specific situations, yield quantitative results, or both. Several are described in the literature.² This is a “go-no-go” test and does not grade solderability as excellent, good, fair, etc.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

B 32 Specification for Solder Metal³

D 509 Test Methods of Sampling and Grading Rosin⁴

D 1193 Specification for Reagent Water⁵

3. Summary of Test Method

3.1 The specimen to be tested is coated with rosin flux, dipped briefly into molten tin-lead solder, and examined for complete and uniform coverage by the solder. When specifically required, the specimens are artificially aged before testing by exposure to hot, humid air.

4. Significance and Use

4.1 In order that a sound solder joint be formed simply and quickly in a production operation, the molten solder must readily wet and spread over the surfaces of the products being joined. For this to happen, the surfaces must be clean or be soiled only with contaminants that are easily removed by an appropriate flux. It often is necessary that the flux be only strong enough to remove the normally occurring soils. A more aggressive flux may corrode the product and have other harmful effects. Nonactivated rosin in alcohol is the standard flux used in this test method; however, provision is made for the use of other fluxes. Since rosin is a mild flux, it provides better discrimination between acceptable and unacceptable solderability in marginal cases than do more active fluxes.

4.2 Metallic coatings are frequently used to provide solderable surfaces. But, an improperly produced coating may not yield the required solderability. There are many coating defects that cause poor solderability including porosity, codeposited impurities, incorrect thickness, and surface contamination. It may be difficult or impractical to test a coating directly for each of the undesirable conditions. In these instances solderability is tested. Products that pass the solderability test can be expected to solder satisfactorily in production. In the case of failure to pass the test, the test results will not reveal the cause of the inadequate solderability, though, with experience, an operator may be able to identify the cause.

4.3 This test method measures the ability of a coated product to be soldered with 60/40 tin/lead solder using a nonactivated rosin flux. This solder and this flux, or an activated form of it, are generally used in the assembly of electronic products.

4.4 It is intended that the tested specimens be components of electronic products or articles with the same general shape and mass. Articles that are much more massive than this will heat up too slowly during the solder immersion. If more massive specimens are to be tested, a longer immersion time will have to be used, the time to be determined by experiment.

4.5 If the specimen tested is longer than 25 mm, its bottom end will be in the solder for significantly longer than the specified time. Therefore, if the specimen is longer than 25 mm, the results obtained at the bottom end of the specimen are invalid. This part of the specimen shall be discounted in the evaluation of the results. A second set of tests can be run on additional specimens in which the specimens are only partly immersed. These would be used to evaluate the bottom ends.

¹ This test method is under the jurisdiction of ASTM Committee B-8 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.10 on General Test Methods.

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² Long, J. B., “A Critical Review of Solderability Testing,” in *Properties of Electrodeposits, Their Measurement and Significance*, edited by Richard Sard, Henry Leidheiser, Jr., and Fielding Ogburn, The Electrochemical Society, 1975.

Harding, W. B., “Solderability Testing,” *Plating*, Vol 52, No. 10, October 1965, pp. 971–981.

³ *Annual Book of ASTM Standards*, Vol 02.04.

⁴ *Annual Book of ASTM Standards*, Vol 06.03.

⁵ *Annual Book of ASTM Standards*, Vol 11.01.

5. Flux

5.1 The flux shall be a 25 ± 5 mass % solution of water-white rosin, as defined by Methods D 509, Grade WW, dissolved in isopropyl alcohol of a minimum purity of 99 mass % (Note 1). A different flux, such as mildly activated and activated rosin fluxes, may be used if the specifying authority requires it. Such deviation from the standard shall be stated in the test report.

NOTE 1—Suitable fluxes are commercially available. Care must be taken that the commercial flux used is nonactivated, rosin flux. Commercial fluxes of higher concentration may be thinned with isopropyl alcohol to give the required concentration.

5.2 Solder:

5.2.1 The solder shall be an alloy of 60 mass % tin and 40 mass % lead that conforms to alloy Grade 60A of Specification B 32.

5.2.2 The composition of molten solder will gradually change because of oxidation. Also, the immersion of test specimens can introduce metallic impurities into the solder. For these reasons, the solder shall be replaced after being molten for 8 h unless chemical analysis shows it to meet the requirements of 5.2.1.

5.3 Water—The water used in the aging chamber shall be distilled or deionized water meeting the requirements for Type II or Type III reagent water as defined in Specification D 1193.

6. Sampling

6.1 The nature and the number of specimens shall be given by the specification covering the coating or the coated product or other governing document.

7. Apparatus

7.1 *Solder Pot*, large enough that when it is filled to its normal capacity the mass of the solder is at least 100 times the mass of the specimen that will be tested.

NOTE 2—If there is insufficient solder in the pot, the immersion of a room-temperature specimen will cool the solder out of the test range.

8. Procedure

8.1 Do not clean the specimens. The solderability test is to be performed on them in their as-received condition. If in the normal production process the specimens are cleaned before they are soldered, it may be preferred to clean the test specimens in the same way. If such cleaning is required, it shall be specifically called for. Avoid contaminating the specimens. Particularly do not touch the areas to be tested with bare hands. Use tweezers, forceps, cotton gloves, or other appropriate means.

8.2 For tin and tin-lead coatings, if it is required that the specimens be aged before solderability testing, proceed as directed in 8.3. If the specimens are not to be aged, start the tests with 8.5.

8.3 Suspend the specimens in a vessel above boiling water and leave them there with the water boiling continuously for 24 h. Keep the vessel covered and assure that the specimens do not touch the side of the vessel and that the lower edges of the

specimens are from 50 to 100 mm above the surface of the boiling water. Arrange the cover of the vessel and the condenser, if used, so that the condensed water does not drip onto the specimens.

8.4 Remove the aged specimens from the vessel and allow them to air-dry and air-cool.

8.5 Perform the remaining steps on each specimen one at a time. Dip the specimen into the flux. Remove it and allow it to drain for 30 to 60 s.

8.6 Just before the next step, skim the surface of the molten solder with a clean stainless steel scraper, stir the solder with a clean stainless steel rod, and skim the surface again. The temperature of the solder shall be $245 \pm 5^\circ\text{C}$.

8.7 Immerse the specimen into the solder at a speed of 25 ± 5 mm/s, hold it in the solder for 5 ± 0.5 s, and remove it from the solder at a speed of 25 ± 5 mm/s.

NOTE 3—The simplicity of the test can cause a casual attitude toward the times and rates specified. Unless the operator adheres to the times and rates, a significant variability in the results can occur. There are commercial automated dipping devices that, if used, will eliminate operator variability.

8.8 After the solder coating solidifies, remove the flux residue with isopropyl alcohol or other solvent.

8.9 Examine the solder coating on the specimen using, if necessary, up to 10X magnification. Evaluate the adherence of the coating by probing or scraping it with a sharp point or a sharp blade.

8.10 The specimen shall be judged to have passed the test if the solder coating is adherent, bright, smooth, and uniform over at least 95 % of the tested surface. The remaining 5 % may contain small pin holes, dewetted areas, and roughness. If the specimens are flat coupons, the areas within 3 mm of the edges shall be excluded from the evaluation. It is recommended that tested specimens exhibiting the worst allowable cases be retained and used as acceptance standards.

9. Report

9.1 The test report shall contain the following information:

9.1.1 The ASTM designation, including the issue date, of this method,

9.1.2 A description of the specimens tested,

9.1.3 Whether the specimens were cleaned before testing, and, if so, the process used (see 8.1).

9.1.4 Whether the specimens were aged,

9.1.5 Whether the test was performed manually or with an automatic dip tester,

9.1.6 Any deviations from the standard method (for example, nature of flux, nature of solder, time of immersion),

9.1.7 The number of specimens tested and the number of specimens that failed the test, and

9.1.8 A description of the nature of any failed specimens.

10. Precision and Bias

10.1 No statement is made either on the precision or on the bias of this test method for measuring solderability because the test results merely state whether there is conformance to the criteria for success specified in the procedure.

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