



Designation: B 813 – 00

Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube¹

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INTRODUCTION

This specification covers a series of specific requirements for liquid and paste fluxes. It also incorporates a series of test methods that establish the procedures on how to measure these properties. The format of this specification initially defines the specification requirements followed by the specific test methods in the order in which they are to be performed.

1. Scope

1.1 This specification establishes the requirements and test methods for liquid and paste fluxes for joining by soldering of copper and copper alloy tube and fittings in plumbing, heating, air conditioning, mechanical, fire sprinkler, and other similar systems.

NOTE 1—This specification does not apply to fluxes intended for electronic applications.

1.2 Solder fluxes are to be tested in accordance with the requirements of this specification by an independent testing laboratory. Testing, measuring equipment, and inspection facilities shall be of sufficient accuracy and quality to comply with the requirements of this specification.

1.3 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 The following hazard caveat pertains to Sections 11-19. *This standard does not purport to address the safety problems, 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 applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The following documents of the issue in effect on the date of materials purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:

B 32 Specification for Solder Metal²

B 88 Specification for Seamless Copper Water Tube³

B 88M Specification for Seamless Copper Water Tube [Metric]³

B 152 Specification for Copper Sheet, Strip, Plate, and Rolled Bar³

B 152M Specification for Copper Sheet, Strip, Plate and Rolled Bar [Metric]³

B 280 Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service³

B 846 Terminology for Copper and Copper Alloys³

D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test⁴

D 1200 Test Method for Viscosity by Ford Viscosity Cup⁵

2.3 *Other*:

1986 Amendments to the Safe Drinking Water Act⁶

3. General Requirements

3.1 The flux shall be suitable for joining copper tube and fittings by soldering in the size ranges shown in Table 1 of Specifications B 88 and B 88M and Tables 4 and 5 of Specification B 280.

3.2 The flux shall remain active over the temperature range of the soldering operation, removing and excluding oxides from the metal surfaces in the joint.

3.3 The flux shall be suitable for use with all solders listed in Table 5 of Specification B 32 as well as the more recently developed solder alloys suitable for the applications in the scope of this specification.

3.4 The flux shall allow the solder to adequately wet and spread on the surfaces being soldered.

3.5 The flux residue shall be water flushable after soldering.

3.6 The flux residue shall not be corrosive after soldering.

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² *Annual Book of ASTM Standards*, Vol 02.04.

³ *Annual Book of ASTM Standards*, Vol 02.01.

⁴ *Annual Book of ASTM Standards*, Vol 05.01.

⁵ *Annual Book of ASTM Standards*, Vol 06.01.

⁶ Available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402.

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3.7 The flux shall not release toxic fumes during the soldering operation or toxic substances into the water in the completed system.

3.8 The flux shall adhere to the copper and copper alloys under anticipated temperature, joint geometry, joint position, job site, and weather conditions.

3.9 The flux shall not contain more than 0.2 % lead in accordance with the 1986 Amendments to the Safe Drinking Water Act.

4. Terminology

4.1 For terms related to copper and copper alloys, refer to Terminology B 846 for terms specific to this standard.

4.2 Definition:

4.2.1 *flux, n*—a chemically active substance that is used to remove and exclude oxides from the joint area during heating and that ensures that the melted solder will wet the surfaces to be joined.

5. Spreading Factor

5.1 Spreading of the solder is determined by measuring the height (h) of a solder bead on a standard test sheet following the specified heating cycle. Spread factor (SF) is calculated as follows:

$$SF = 100 (1.0 - h) \quad (1)$$

where:

h = the maximum height of the solder bead, mm.

5.2 A flux is considered to have acceptably influenced the spreading of solder on the copper surfaces when the average spreading factor is at least 50 (see Section 13).

5.3 The spreading test shall show a balanced action by forming a regular and even solder layer.

6. Aggressiveness Requirements

6.1 From a standard test sheet on which a specimen has been prepared with solder (see Section 15), the resistivity of the aqueous solution shall be more than 100 000 Ω cm.

6.2 From a standard test sheet on which a specimen has been prepared without solder (see Section 16), the resistivity of the aqueous solution shall be more than 85 000 Ω cm.

7. Corrosiveness Requirements

7.1 There shall be a clear indication that in the areas of flux reaction, the sheets shall show a corrosion and residue-free surface comparable with the unwetted areas as determined by visual inspection in accordance with Section 17.

7.2 Corrosiveness shall be reported in accordance with one of the classifications listed as follows (see Test Method D 130):

Classification	Description
1	Slight tarnish
2	Moderate tarnish
3	Dark tarnish

8. Viscosity Requirements

8.1 The viscosity of liquid fluxes shall be less than 180 s as determined using a No. 2 Ford flow cup in accordance with Section 18.

9. Residue Flushing Requirements

9.1 Flushing of the residue shall be determined by weight loss.

9.2 The loss of weight of each sheet shall be determined by comparing the average weight before and after the test procedure. The weight loss of the flux residue shall be more than 99 % in accordance with Section 19.

$$\% \text{ Weight Loss } (d) = 100 - \frac{(c - a)}{(b - a)} \times 100 \quad (2)$$

where:

a = weight of degreased, flushing-test sheet, g;

b = weight of degreased, flushing-test sheet plus the weight of applied flux, g; and

c = weight of dried, flushing-test sheet after flushing, g.

10. Sampling

10.1 Samples of flux taken for the purpose of the tests listed in this specification shall be selected from the stock of the manufacturer and shall be representative of the material being evaluated.

11. Specimen Preparation

11.1 *Standard Quantity of Solder Metal*—A standard quantity of solder metal shall be a sample of 60:40 tin-lead (Alloy Grade Sn60), measuring 6.0 mm in diameter by 0.86 mm in thickness, weighing approximately 0.21 g, that has been degreased with trichloroethylene.

11.2 *Standard Quantity of Flux*—A standard quantity of flux shall be 0.003 mL as measured by a precision pipet or other volumetric measuring devices with equivalent precision.

11.3 *Standard Test Sheet*—A standard test sheet shall be a piece of copper 35 by 35 by 1 mm thick of Copper UNS No. C12200 (deoxidized high residual phosphorus) produced in accordance with Specifications B 152 or B 152M.

11.3.1 Preparation:

11.3.1.1 The sheet is abraded three times with a waterproof sand or emery paper (Grit No. 360), each time perpendicular to the previous direction. One corner of each test sheet shall be bent upwards to permit handling. It is degreased with calcium carbonate mixed with water to a paste consistency with which the test sheet is rubbed using a wad of cotton. The residue is flushed off by a strong jet of tap water. The test sheet is considered to be degreased when it is completely moistened by water when flushed.

11.3.1.2 In any of the following steps in which the test sheets must be handled, use forceps or laboratory tongs. The sheet is then etched for 15 s in an etching solution formulated as follows:

(a) *Etching Solution*—(1-L etching solution contains 200-g chromic acid anhydride (CrO_3) and 125-mL sulfuric acid (specific gravity 1.84) reagent grade, balance distilled water, diluted to 1 L.)

(b) Finally, the sheet is rinsed thoroughly with distilled water (60 to 70°C), immersed in ethanol (ACS Grade), and allowed to dry.

11.4 *Resistivity Test Specimen*—The resistivity test specimen is the condition of the standard test sheet on which have been deposited standard quantities of flux and solder metal.