Designation: E832 – 81 (Reapproved 2013)

Standard Specification for Laboratory Filter Papers[1]

This standard is issued under the fixed designation E832; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers two types of filter paper for use in chemical analysis and provides procedures for the complete evaluation of the filter papers.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D774/D774M Test Method for Bursting Strength of Paper (Withdrawn 2010)[3]

2.2 *TAPPI Standards:*[4]

T 413 Ash in Paper

T 429 Alpha-Cellulose in Paper

T 509 Hydrogen Ion Concentration (pH) of Paper Extracts—Cold Extraction Method

3. Types and Classes

3.1 The types and classes of filter paper are as follows:

3.1.1 *Type I*—To be used for qualitative analysis (low ash content):

3.1.1.1 *Class AA,* for very coarse and gelatinous precipitates, very fast flow rate.

3.1.1.2 *Class A,* for coarse and gelatinous precipitates, fast flow rate.

3.1.1.3 *Class B,* for medium-size precipitates, medium flow rate.

3.1.1.4 *Class C,* for fine precipitates, slow flow rate.

3.1.1.5 *Class D,* hardened to facilitate scraping, for fine precipitates, slow flow rate.

3.1.2 *Type II*—to be used for quantitative analysis (ashless papers):

3.1.2.1 *Class E,* for coarse and gelatinous precipitates, fast flow rate.

3.1.2.2 *Class F,* for medium-size precipitates, medium flow rate.

3.1.2.3 *Class G,* for fine precipitates, slow flow rate.

4. Manufacture

4.1 The papers shall be made from such materials and by such methods as to ensure compliance with the requirements of Section 10, and shall be clean and free of imperfections that would affect their performance.

4.2 The papers shall be converted into circles, sheets, or any required sizes.

5. General Requirements

5.1 All classes of filter paper shall comply with the requirements given in Table 1 and Table 2 and Section 11.

5.2 The ash content of the Type II circles shall not exceed 0.01 %.

5.3 Class D filter papers shall have a surface hard enough to permit scraping collected precipitates off the sheet.

6. Sampling

6.1 If testing is required, the sample of each class shall be representative of the shipment, and specimens shall be taken at random from at least 3 % of the total packages.

7. Retests

7.1 If the results of the tests indicate noncompliance with the requirements of Table 1 and Table 2, or other factors described within this specification, take another representative sample of the shipment, selecting the specimens from different packages than those from which the first sample was taken.

7.2 Then test the second sample for compliance with this specification.

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[1] This specification is under the jurisdiction of ASTM Commmittee E41 on Laboratory Apparatus and is the direct responsibility of Subcommittee E41.01 on Apparatus.

Current edition approved Nov. 1, 2013. Published December 2013. Originally approved in 1950. Last previous edition approved in 2008 as E832 – 81 (2008). DOI: 10.1520/E0832-81R13.

[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] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Technical Association of the Pulp and Paper Industry (TAPPI), 15 Technology Parkway South, Norcross, GA 30092, http://www.tappi.org.

TABLE 1 General Requirements

Property	Requirement
alphacellulose content, min, %	95
pH value	5.0 to 8.0

TABLE 2 Wet Bursting Strength

Class	Water Flow Rate and Retention of Precipitates		
	Wet Bursting Stength min, aug points	Maximum Water Flow Rate, aug, s	Retention of Precipitates—Filtrate Clear from:
AA	3.0	10	ferric hydroxide
A	3.0	20	ferric hydroxide
B	3.5	40	lead sulfate
C	4.0	150	barium sulfate
D	45.0	300	barium sulfate
E	3.0	20	ferric hydroxide
F	3.5	40	lead sulfate
G	4.0	150	barium sulfate

7.3 If the results of the retests indicate noncompliance with this specification, immediately consult the manufacturer for assistance in rectifying the problem.

8. Packaging and Marking

8.1 Flat circles of filter paper shall be packaged in units of 100 circles of the same diameter. Prefolded or fluted circles shall be packaged according to trade custom.

8.2 Each unit or package shall be marked with the manufacturer's name, size of circles, or catalog and lot number.

9. Test Methods

9.1 The most important tests to be performed are:

9.1.1 *pH Value*—Determine in accordance with TAPPI Method T 509.

9.1.2 *Alpha-Cellulose*—Determine in accordance with TAPPI Method T 429. This test may or may not be used for lot to lot determination.

9.1.3 *Ash Content*—Determine in accordance with Section 10.1 or TAPPI Method T 413, applicable for Type II papers.

9.1.4 Retention of precipitates, simple method to determine retention ability of filter paper as determined in accordance with 10.2.

9.1.5 *Water Flow Rate*—Determine the flow rates of filter paper in accordance with 10.3 or the Herzberg method (measurement of time for the filtration of 100 mL of prefiltered distilled water with a filter surface of 10 cm^2at a constant pressure of 50 mm water column).

9.1.6 *Wet Bursting Strength*—Determine in accordance with 10.4.

10. Test Methods

10.1 *Ash Content:*

10.1.1 *Apparatus:*

10.1.1.1 *Crucibles,* 20-mL platinum, with tightly fitting covers. One for each sample.

10.1.1.2 *Heat Source*—An electric muffle furnace with an operating temperature of approximately 925°C is recommended, but a gas burner yielding a similar temperature is sufficient.

10.1.1.3 *Test specimens,* having a mass of at least 6 g, representative of the sample obtained as prescribed in Section 6, and cut in the shape of whole circles of the same diameter or small strips measured for area.

10.1.2 *Procedure:*

10.1.2.1 Heat the crucibles with their respective covers to approximately 925°C. Cool in a desiccator and weigh to the nearest 0.1 mg. Add the specimen into crucible.

10.1.2.2 Heat the covered crucible plus test specimen gradually until smoking ceases, remove cover, then continue heating until the maximum temperature of 925°C is reached and maintain for 2 h. Replace the cover and cool the covered crucible in a desiccator until temperature equilibrium with the surrounding air is reached. Weigh the crucible and contents to the nearest 0.1 mg. Ignition is considered to be complete when the weight of the covered crucible and ash does not change by more than 0.2 mg after reheating at 925°C for 30 min.

10.1.2.3 *Blank*—Carry a tare crucible with cover through all operations in exactly the same manner as the crucibles containing specimens, as a check on possible loss of mass of the crucibles themselves.

10.1.2.4 Test at least two specimens per sample.

10.1.3 *Calculation and Report*—Calculate and report the ash, corrected for the results of the blank test, to two significant figures. Determine the weight percentage of the paper dried at 105°C.

10.1.4 *Precision*—Duplicate determinations shall agree as follows:

Ash, %	Rounded to Nearest	Reproducibility, %
0.025	0.001	0.003
0.025 to 0.01	0.005	0.01
0.1	0.01	0.02

10.2 *Retention of Precipitates:*

10.2.1 *Apparatus:*

10.2.1.1 *Glass Funnels,* 60°, having stems about 6 in. long.

10.2.2 *Reagents:*

10.2.2.1 *Alcohol* (95 %)—Ethanol or formula No. 30.

10.2.2.2 *Ammonium Hydroxide*—Add one part, by volume, of cp ammonium hydroxide (NH_4 OH) to one part by volume of distilled water.

10.2.2.3 *Barium Chloride Solution* (50 g/L)—Dissolve 58.5 g of cp barium chloride ($BaCl_2 \cdot 2H_2$ O) in distilled water and dilute to 1 L.

10.2.2.4 *Ferric Chloride Solution*—Dissolve 10 parts by weight of cp ferric chloride ($FeCl_3 \cdot 6H_2$ O) in 100 mL of distilled water.

10.2.2.5 *Hydrochloric Acid* (sp gr 1.19).

10.2.2.6 *Lead Acetate,* cp anhydrous.

10.2.2.7 *Potassium Sulfate* (K_2 SO_4) cp.

10.2.2.8 *Sulfuric Acid* (6 *N*).

10.2.3 *Procedure:*

10.2.3.1 Determine retention of precipitates by examining the filtrate from freshly prepared suspensions of ferric hydroxide, lead sulfate, or barium sulfate, after filtering through specimens of the filter paper under test. To examine the filtrate, swirl it in the flask to collect any precipitate present in the center of the bottom of the flask, and then view the filtrate from above against a black background. In this manner 0.3 mg

or less can be detected. Complete retention of fine precipitates is indicated by the absence of visible barium sulfate ($BaSO_4$) in the filtrate.

10.2.3.2 *For Retention of Ferric Hydroxide*—Add a slight excess of dilute NH_4 OH to the cold (room temperature) $FeCl_3$ solution and shake, then promptly filter the suspension through one specimen of the filter paper under test, using a 60° funnel, into an Erlenmeyer flask, examine the filtrate as directed in 10.2.3.1. Test at least four specimens per sample.

10.2.3.3 *For Retention of Lead Sulfate*—Dissolve 10 g of lead acetate in 100 mL of distilled water; filter through a filter paper capable of retaining $BaSO_4$. Then add 40 mL of 6 *N* H_2 SO_4 and 80 mL of alcohol. After the mixture has stood for 4 h, filter the suspension through one specimen of the filter paper under test, in a 60° long-stemmed glass funnel into an Erlenmeyer flask. Wash the precipitate and the precipitation flask with dilute H_2 SO_4 (5 mL of concentrated acid to 100 mL of distilled water). Then wash the precipitate on the paper with alcohol. Examine the filtrate as directed in 10.2.3.1. Test at least four specimens per sample.

10.2.3.4 *For Retention of Barium Sulfate*—Dissolve 0.55 g of K_2 SO_4 in 275 mL of water and add 1.0 mL of HCl. This volume of solution contains the equivalent of about 0.1 g of sulfur. Heat the solution to the boiling point and, when at that temperature, add slowly and with continuous stirring 25 mL of $BaCl_2$ (50 g/L). Let the mixture stand without agitation for from 2 to 6 h at a temperature between 70 and 100°C.

NOTE 1—It is very important to have the specified acid concentration and to keep the solution boiling during the precipitation.

10.2.3.5 Fold four of the filter papers in the usual way for filtration and place them in separate funnels. Stir the precipitate suspension until the $BaSO_4$ is evenly distributed throughout the liquid. Then filter about 50 mL through each cone of paper, collecting the filtrates in 250-mL Erlenmeyer flasks. Examine the filtrate in the flasks as directed in 10.2.3.1.

10.3 *Water Flow Rate:*

10.3.1 *Apparatus:*

10.3.1.1 *Glass Funnel,* 60°.

10.3.1.2 *Buret,* 50-mL.

10.3.2 *Procedure:*

10.3.2.1 Use distilled water that has been prefiltered through the test paper or through an 0.45-µm membrane. Prepare three of four times as much water as is necessary to fill the folded paper cones to be tested.

10.3.2.2 Carefully fold a circle of the filter paper in the usual way, to form a 60° cone, having a diameter of 11 cm. Place it in a 60° glass funnel and fill it with the prefiltered water. Press down the folds to expel all air pockets and to make the three plies smooth and in good contact. Allow about three fourths of the water to filter, then pour off the excess, saving the water to wet other test specimens. Remove the wet paper cone from the funnel and suspend it freely over the buret by supporting the cone in a wire loop of such diameter that it supports the cone at about two thirds of the distance from the apex to the rim.

10.3.2.3 Using prefiltered water having a temperature of 23 ± 2°C, pour into the cone, all at once, a known volume that is approximately two thirds of the volume of the cone. When one fifth of the water has filtered through into the buret, start a stop watch. When half the remaining volume has filtered through, stop the stop watch and record the time in seconds. Test at least 10 circles, using the same water over and over and adding it from the prepared supply as found necessary.

NOTE 2—A suitable volume of water initially poured in, for filter circles 11 cm in diameter, is 25 mL.

10.3.2.4 The time required to filter half the volume of water remaining in the conical filter is substantially the same for any given paper, irrespective of the size of the test specimen.

10.3.3 *Report*—Report the filtration time in seconds and state the diameter in *centimetres* of the filter paper used for the test.

10.4 *Wet Bursting Strength:*

10.4.1 *Procedure* Clip together a pack of five squares (64 mm by 64 mm) of the filter paper, and immerse the pack in distilled water at 23 ± 2°C for 5 min. Remove the pack from the water, and allow it to drain while suspended for 10 s. Then immediately measure the bursting strength of the wet pack in a Mullen tester that conforms with the requirements of Method D774/D774M, test for bursting strength of paper. Test at least five and preferably ten packs.

10.4.2 *Report*—The report shall state the number of tests made, and the average, maximum, and minimum test results.

11. Visual Inspection

11.1 Circles from each package of the sample shall be inspected visually for compliance with Section 3.

12. Ascertaining Compliance with Specification

12.1 The data generated through performance of the test methods outlined in Section 9 shall be compared with Table 1 and Table 2 to determine compliance.

13. Keywords

13.1 filter; laboratory; papers