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Standard Specification for Electrolytic Capacitor Paper[1]

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1. Scope

1.1 The specification covers electrical papers suitable for use as separators in electrolytic capacitors.

1.1.1 These papers are not primary dielectrics as are the kraft capacitor tissues.

1.2 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 202 Test Methods for Sampling and Testing Untreated Paper Used for Electrical Insulation[2]

D 1099 Test Method for Water Soluble Sulfates in Paper and Paperboard[3]

D 1930 Specification for Kraft Dielectric Tissue Capacitor Grade[4]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[5]

3. Types and Grades

3.1 Electrolytic separator papers are divided into two types, based on the fiber composition:

3.1.1 Kraft wood fibers, and

3.1.2 Long, nonwood cellulose fibers from leaf, stem, or seed-hair sources.

3.2 Within each type, these papers are subdivided into grades, based on apparent density (see Table 1).

4. Basis of Purchase

4.1 Orders for material to this specification shall specify paper, type, grade, thickness, width, and diameter of rolls in accordance with this specification. For example: electrolytic capacitor paper (Type I, Grade 5) 0.002 by 2 in. (0.051 by 51 mm); rolls 6-in. (150-mm) outside diameter by 1⅛-in. (28-mm) inside diameter core ASTM Specification D 2753.

5. Materials and Manufacture

5.1 This paper shall be made from either unbleached sulfate pulp of coniferous origin or from long, nonwood, unbleached cellulose fibers, of stem leaf or seed-hair origin.

5.2 Very high degrees of physical uniformity and cleanliness are essential to a satisfactory sheet.

6. Chemical Requirements

6.1 The chemical properties of the paper shall conform to the requirements listed in Table 2.

7. Physical Requirements

7.1 The physical properties of the paper shall conform to the requirements prescribed in Table 3 as well as the density requirements prescribed in Table 1.

7.2 The material shall be uniform in thickness, density, and formation. It shall be as free from welts, wrinkles, creases, slime spots, stains, weak spots, tears, cuts, resin, dirt, and metallic particles, as is consistent with good manufacturing processes and in keeping with the requirements of this specification.

8. Condition of Rolls

8.1 The paper shall be supplied in rolls, slit to the ordered width, within the tolerance specified in Table 4.

8.2 Splices in rolls are undesirable but where necessary splices shall be made with an adhesive, such that the spliced area shall meet all requirements of Table 2, except the limits on moisture content. The number of splices permitted shall be agreed upon between the purchaser and the supplier.

8.3 The internal diameter of each core shall at no point be less than the specified nominal value nor shall it exceed that nominal value by more than 1/16 in. (2 mm) or 2 %, whichever is greater.

8.4 Both faces of each roll shall be at a 90° angle to the axis of the core (tolerance + 1 %), and no turn of paper shall extend more than 1/64 in. (0.4 mm) beyond the edge of an adjoining turn nor more than 1/32 in. (1 mm) beyond the principal plane of either face.

8.5 Rolls shall be firmly wound to the specified outer diameter, +0, −½ in., and their circumferences shall be free of humps or flat spots.

8.6 The methods of evaluating characteristics listed in 8.4 and 8.5 shall be agreed upon between the purchaser and the seller.

9. Interpretation of Requirements

9.1 For purposes of determining conformance with this specification, an observed or calculated value shall be rounded off, in accordance with the Section on Rounding-Off Method of Practice E 29.

9.2 Unless otherwise stated, all limits in this specification apply to the test determination applicable to a unit sample as defined in Test Methods D 202. Values beyond the stated limits classify the unit as a minor defective unit or as a major

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[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] Discontinued; see *1979 Annual Book of ASTM Standards*, Part 20.

[4] Discontinued; see *1986 Annual Book of ASTM Standards*, Vol 10.01.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

TABLE 1 Grades, Densities, and Thickness Ranges

Types	Grade	Fiber	Wet-Dry Apparent Density, g/cm³			Thickness Range, mils (μm)
			nominal	min	max	
I	1	wood	0.70	0.65	0.75	1 to 2 (25 to 51)
I	2	wood	0.65	0.60	0.70	1 to 2 (25 to 51)
I	3	wood	0.55	0.50	0.60	1 to 2 (25 to 51)
I	4	wood	0.45	0.40	0.50	1 to 4 (25 to 102)
I	5	wood	0.40	0.35	0.45	2 to 2.5 (51 to 64)
II	11	nonwood	0.88	0.78	0.98	0.65 (16.5)
II	12	nonwood	0.58	0.50	0.66	1 to 3 (25 to 76)
II	13	nonwood	0.27	0.23	0.31	2 to 5 (51 to 127)

TABLE 2 Chemical Requirements

Type and Grade	Property	Limits	
		min	max
all Types I	Ash, %	...	0.5
all Types II		...	0.25
all	Water-soluble chlorides, ppm	...	8.0
all	Chlorides, total, ppm	...	80.0
all	Moisture as received, %	4	8
all	Aqueous extract conductivity, μS/cm[A]	...	...
Type I	Wood fiber paper	...	0.67
Type II	Non-wood fiber paper	...	1.0
all	Acidity or alkalinity, microequivalents/g	...	1.0
Type II, Grade 13	Sulfates, ppm	...	20
all others		...	none

[A] 1 μS/cm = 0.1 mS/m.

defective unit, depending on the importance attached to the property measured.

9.2.1 Moisture, ash, and water absorption are minor properties. All others are considered major properties.

10. Sampling

10.1 Samples shall be taken and acceptability judged as prescribed in the Sections on Sampling to Waiver of Requirements of Test Methods D 202, with these restrictions:

10.1.1 A *lot* is paper of a single type, grade, and thickness, made during a designated period (normally not to exceed 1 week) on a given machine, and identified by a manufacturer's lot number.

10.1.2 A *unit of product* is an individual roll (or bobbin) of paper in a lot as cut to meet the customer's order.

11. Test Methods

11.1 The properties in this specification shall be determined in accordance with Test Methods D 202 except as otherwise provided herein.

11.2 Thickness shall be determined according to Method D of Test Methods D 202, using an instrument whose pressure foot is descending at a rate of 45 ± 15 mil/s (1.14 ± 0.38 mm/s) at the moment of contact. For paper below 2 mil, a multiple stack of ten sheets shall be used for the specimen.

11.3 Sulfates shall be determined in accordance with Test Method D 1099 on samples taken in accordance with Test Methods D 202.

11.4 Total chlorides will be determined on samples in accordance with Test Method D 1161 on samples taken in accordance with Test Methods D 202.

12. Packaging and Package Marking

12.1 *Packaging*—The paper shall be packaged in protective wrappers, boxes, or cartons so constructed as to ensure acceptance by common or other carriers for safe transportation to the point of delivery, unless otherwise specified in the contract or order.

12.2 *Marking:*

12.2.1 Each roll shall be identified in a manner agreed upon by the purchaser and the supplier with the manufacturer's identification, lot number, mill roll or reel number, width, and measured thickness to the nearest 0.01 mil. Items not required by the purchaser may be omitted.

TABLE 3 Physical Requirements

Type	Grade	Thickness, mils (μm)			Dry coverage, $in.^2/lb \times 10^3$ $(m^2/g) \times 10^{-3}$ ±10 %	Absorption, min, Water Rise/5 min	
		nominal	min	max		Eighths of an inch	mm
I	1	1 (25)	0.9 (23)	1.1 (28)	39.5 (55.3)	1	3.2
I	1	2 (51)	1.8 (46)	2.2 (56)	19.8 (27.7)	2	6.4
I	2	1 (25)	0.9 (23)	1.1 (28)	42.5 (59.5)	2	6.4
I	2	2 (51)	1.8 (46)	2.2 (56)	21.3 (29.8)	4	12.7
I	3	1.2 (30)	1.08 (27.4)	1.32 (33.6)	41.9 (58.7)	4	12.7
I	3	2 (51)	1.8 (46)	2.2 (56)	25.1 (35.1)	11	35
I	4	2.0 (51)	1.8 (46)	2.2 (56)	30.7 (40.1)	12	38
I	4	2.5 (63)	2.2 (56)	2.75 (70)	24.6 (34.4)	14	44.5
I	4	4.0 (102)	3.6 (91)	4.4 (112)	15.4 (21.6)	20	63.5
I	5	2 (51)	1.8 (46)	2.2 (56)	34.6 (48.4)	12	38
I	5	2.5 (63)	2.2 (56)	2.75 (70)	27.6 (38.6)	12	38
II	11	0.65 (17)	0.59 (15)	0.71 (18)	48.3 (67.6)	3	9.5
II	12	1.0 (25)	0.9 (23)	1.1 (28)	47.7 (66.8)	2	6.4
II	12	2.0 (51)	1.8 (46)	2.2 (56)	23.8 (33.3)	4	12.7
II	12	3.0 (76)	2.7 (68)	3.3 (84)	15.9 (22.3)	6	19
II	13	1.2 (30)	1.08 (27.4)	1.32 (33.6)	85.3 (119.4)	6	19
II	13	1.5 (38)	1.35 (34.3)	1.65 (46.1)	68.3 (95.6)	10	32
II	13	2.0 (51)	1.8 (46)	2.2 (56)	51.2 (71.7)	16	51