



Standard Specification for Phenolic Raw Materials for the Use in Bearing Cages¹

This standard is issued under the fixed designation F2953; 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 specification covers basic characteristics required for porous laminated phenolic materials intended for use as instrument and thin-section ball-bearing retainers (cages) and the methods of determining these characteristics.

1.2 *Forms*—Sheets, rolled tubes, molded tubes, and rods are recommended forms of laminated material covered by this specification.

1.3 *Intended Use*—Materials produced to this specification are intended for use as ball-bearing retainers (cages). Temperature range is limited to 250°F (117°C) and below.

1.4 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

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 applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*:²

- D618 Practice for Conditioning Plastics for Testing
- D695 Test Method for Compressive Properties of Rigid Plastics
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

2.2 *ANSI/ASQC Standard*:³

- ANSI/ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

¹ This test method is under the jurisdiction of ASTM Committee F34 on Rolling Element Bearings and is the direct responsibility of Subcommittee F34.06 on Aerospace.

Current edition approved June 1, 2012. Published November 2012. DOI: 10.1520/F2953-12.

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 American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203, http://www.asq.org.

2.3 *Federal Standard*:⁴

- MIL-STD-129 Military Making for Shipment and Storage

3. Classification

3.1 The material shall be furnished in the following types and forms as specified:

| Type | Description |
|-------|--|
| FB | Rolled tube made from cotton fabric weighing 4 oz/yd ² (0.14 kg/m ²) or less, with a nominal thread count of 80 by 80 threads per inch (31.5 by 31.5 cm). |
| FBEFW | Rolled tube made from cotton fabric weighing 4 oz/yd ² (0.14 kg/m ²) or less, with a nominal thread count of 100 by 100 threads per inch (39.4 by 39.4 cm). |
| FBEFW | Rolled tube made from cotton fabric weighing 3 oz/yd ² (0.1 kg/m ²) or less, with a nominal thread count of 130 by 130 threads per inch (51.2 by 51.2 cm). |

4. Ordering Information

4.1 Procurement documents should specify the following:

- 4.1.1 Title, designation, and date of this specification;
- 4.1.2 Type required (see Section 3); Property values for tubes (see Table 1);
- 4.1.3 Dimensions required; and
- 4.1.4 Special marking required (see 9.2).

4.2 Required test data shall be requested at the time the purchase order is submitted and listed on the purchase order.

5. Order of Precedence

5.1 In the event of a conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

6. Performance Requirements

6.1 Performance requirements for sheet laminated materials shall be as specified in Table 2.

6.2 *Tubes*—The tubes shall consist of base material (reinforcement) as described in 6.3 impregnated and bonded with a non-plasticized phenolic resin. Tubes will be made by passing the impregnated material over heated rolls and winding the

⁴ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

TABLE 1 Performance Requirements for Tubes

| ASTM Test Method D348 | PB | FB | FBFW | FBEFW |
|---|-----------|-----------|-----------|-----------|
| Acetone extraction (Maximum %) | 1.5 | 1.5 | 1.5 | 1.5 |
| Compressive strength axial ^A (Minimum psi) | 18 000 | 28 000 | 28 000 | 28 000 |
| Specific gravity ^A (Range gm/cc) | 1.24-1.34 | 1.24-1.34 | 1.28-1.38 | 1.28-1.38 |

^A Pounds per square inches (psi). 1 psi = 6.8948 kPa. Test is limited to tubes 0.250-in. (0.635-cm) and greater ID. One specimen to be taken from center of sample tube. The other two specimens to be taken 1 in. (2.54 cm) from each end of the sample tube.

heated material onto a mandrel while applying pressure to the material/mandrel. The overwrapped mandrel is then placed in an oven to cure the tube.

6.3 Base Materials:

6.3.1 *Cotton Fabric Construction*—The material shall consist of a woven cotton fabric substrate impregnated and bonded with a phenolic resin matrix and processed to meet the requirements of this specification (see [Table 3](#)). Finished fabric shall be de-sized, washed, and bleached, with remaining impurities per acetone extraction, not greater than 1.5 % after finishing. See [8.5](#) for method of test.

6.3.2 *Paper*—Type PB tubes shall be made from a saturating grade of paper. The caliper of the paper shall be between 2 and 6 mils (0.05 and 0.15 mm). The paper shall be bleached.

6.4 *Property Values*—Tubes shall conform to the property values shown in [Table 1](#) when tested in accordance with [Section 8](#). The property value requirements for special sizes of tubes shall be as specified in the purchase order (see [Section 4](#)).

6.4.1 *Diameter of Rolled Round Tubes*—The range of sizes for rolled round tubes shall be as specified in [Table 4](#). The inside diameter and outside diameter shall be included in the part number. An example of a part number for a rolled tube with an inside diameter of 0.188 in. (0.478 cm) and an outside diameter of 0.250 in. (0.635 cm) is TRR-0.188/0.250. The wall thickness tolerances for finished outside diameter shall be as specified in [Table 5](#).

6.4.2 *Diameter of Molded Round Tubes*—The range of sizes of molded round tubes shall be as specified in [Table 4](#). The inside diameter and outside diameter shall be included in the part number. An example of a part number for a molded round tube with an inside diameter of 0.125 in. (0.318 cm) and an outside diameter of 0.188 in. (0.478 cm) is TMR-0.125/0.188. The wall thickness tolerances for finished outside diameter shall be as specified in [Table 5](#).

6.4.3 *Diameter of Rods*—The range of sizes and tolerances for rods shall be as specified in [Table 4](#). The outside diameter of the rod shall be included in the part number.

6.4.4 *Thickness of Sheets*—The thickness of laminated sheets, permissible variations, and the applicable part number shall be as specified in [Table 7](#).

6.5 *Prepreg*—The prepreg shall be used within six months when stored at 68 ± 5.4°F (20 ± -14.7°C) and 50 % maximum relative humidity.

6.6 *Resin*—Shall be used and stored within the manufacturer’s requirements.

6.7 *Surface Defects*—Finished OD diameters shall be free from blisters, loose layers, resin pockets, voids and wrinkles. Finished walls shall show no checks or cracks between the laminations on machined or sawed edges. As an option, a buyer may request an unfinished OD or trimmed length or both.

6.8 *Warpage*—The warpage of material furnished in the tube form, as delivered, shall not be greater than the following (see [8.4](#)):

| Tubes and Rod Outside Diameter (OD) and Sheet Thickness Inch | Permissible Warp Maximum Percent | |
|---|-------------------------------------|-------------|
| | Sheets | Tubes / Rod |
| 0.031 up to 0.063 | 5.0 | (---) |
| 0.063 up to 0.126 | 2.5 | (---) |
| 0.126 up to 0.251 | 1.0 | 2.0 |
| 0.251 up to 0.750 | 0.5 | 1.0 |
| 0.750 to Max. | 0.25 | 0.5 |

NOTE 1—Percentage of warp is specified in terms of 36-in. (91-cm) material lengths.

6.9 *Color*—The natural color of the tubes may vary and is not a cause for rejection.

6.10 Tolerances:

6.10.1 *Lengths*—Unless otherwise specified (see [Section 4](#)), tubes shall be furnished in manufacturer’s standards lengths.

6.10.2 Diameters and Wall Thickness:

6.10.2.1 *Sizes*—The ID, OD, and wall thickness of the tubes shall be specified by any two, but only two, dimensions (see [Section 4](#)).

6.10.2.2 *Tolerances on Diameters*—Unless otherwise specified (see [Section 4](#)), ID and OD for tubes shall conform to the specified dimensions for nominal ID or OD within the tolerances shown in [Table 4](#).

6.10.2.3 *Tolerances on Wall Thickness*—Unless otherwise specified (see [Section 4](#)), tubes shall conform to the specified dimensions for nominal ID and OD, but variations in wall thickness shall not be greater than the tolerances shown in [Table 5](#).

6.11 *Surface Finish*—Tubes shall be finished to meet the customer requirements.

6.12 *Degree of Cure*—Acetone extractable matter shall be not greater than 1.5 % (see [8.5](#)).

7. Verification

7.1 *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the customer. The customer reserves the right to perform any of the inspections set forth in this specification when such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

7.2 Conformance Inspection:

7.2.1 *Sampling for Conformance Inspection*—Sampling for conformance inspection shall be performed in accordance with

TABLE 2 Performance Requirements for FB Sheets

| Requirement | Condition | ASTM Test Method | Unit | Thickness (in.) ^A | | | | | | | | | | |
|-------------------------------|------------------------|------------------|-------------|------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------------|------|
| | | | | 0.031 | 0.062 | 0.094 | 0.125 | 0.188 | 0.250 | 0.500 | 0.750 | 1.000 | 1.001 – Max. | |
| Impact strength ^B | | | | | | | | | | | | | | |
| Lengthwise: | E-48/50 | D229 | Min. ft-lbs | | | | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 | 1.25 |
| Crosswise: | | | per inch | | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Flexural strength | | | | | | | | | | | | | | |
| Lengthwise: | A | D229 | Min. psi | 16 000 | 16 000 | 16 000 | 16 000 | 16 000 | 16 000 | 15 000 | 15 000 | 14 500 | 14 500 | |
| Crosswise: | | | psi | 14 000 | 14 000 | 14 000 | 14 000 | 14 000 | 14 000 | 13 500 | 13 500 | 13 000 | 13 000 | |
| Thermal endurance | | D2304 | Min. psi | | | | | | | | | | | |
| Flexural strength: | | | psi | | | | | | | | | | | |
| Bonding strength ^B | A | D229 | Min. pounds | | | | | | | 1600 | 1600 | 1600 | 1600 | |
| | D-48/50 | | Max. | | | | | | | 1500 | 1500 | 1500 | 1500 | |
| Water absorption | D ₁ – 24/23 | D229 | percent | 4.00 | 1.95 | 1.55 | 1.30 | 1.00 | 0.95 | 0.70 | 0.60 | 0.55 | 0.55 | |
| Silicone content | E-168/185 | | ppm | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | |

^A 1 in. = 2.54 cm. 1 lb = 0.45 kg. 1 psi = 6.8948 kPa.
^B Maximum thickness tested shall be 2.000 in. (5.08 cm).

TABLE 3 Cotton Fabrics

| FB | FBFW | FBEFW |
|-------------------|-------------------|-------------------|
| 80 × 80 | 100 × 100 | 130 × 130 |
| Tolerance of ±5 % | Tolerance of ±5 % | Tolerance of ±5 % |

ASQC-Z1.4 unless otherwise specified. For purpose of sampling, an inspection lot for examination and tests shall consist of all materials of the same type dimensions, resin, and base material from one impregnation run.

7.2.2 *Examination of Material*—Examination of material shall be made in accordance with 7.4. The lot size for determining the sample size in accordance with ASQC-Z1.4 shall be expressed in units of tubes.

7.3 *Appearance and Workmanship*—The sample unit for the following examination shall be tubes of the specified lot. The inspection level shall be per ASQC-Z1.4, Level II with acceptance quality levels (AQLs) as follows: 1.5 for major defects and 6.5 for minor defects. Classifications of defects are listed in Table 6.

7.4 *Testing*—Tubes shall be tested for applicable characteristics as indicated in Table 1 on each lot presented for inspection. The inspection level for determining the sample size shall be S-1 per ASQC-Z1.4 except that not less than two sample units shall be randomly selected from a lot. The lot size shall be expressed in units of tubes. The AQL shall be 6.5. Describe all failures and report all values on which test results are based.

8. Test Methods

8.1 *Measurements*—Tube shall be examined and dimensions other than length recorded to the nearest 0.001 in. (0.00254 cm). Length shall be measured to the nearest; 0.0625 in. (0.1588 cm) for less than 1-in. (2.5-cm) OD diameter, 0.125 in. (0.3175 cm) for less than 2-in. (5-cm) OD diameter, 0.250 in. (0.635 cm) for less than 4-in. (10-cm) OD diameter, and 1.0 in. (2.54 cm) for OD diameters greater than or equal to 4 in. (10 cm).

8.2 Axial Compressive Strength:

8.2.1 The axial compressive strength shall be determined by Table 1 and Test Method D695, except that the specimen length shall be 1 in. (2.54 cm) for tubes to 2-in. (5-cm) OD or less with wall thickness of 0.0625 in. (0.1588 cm) or over.

8.2.2 The axial compressive strength requirement and test method for tubes over 2 in. (5 cm) in OD or with walls less than 0.0625 in. (0.1588 cm) will be as specified in the purchase order.

8.3 *Specific Gravity*—The specific gravity shall be as determined by Test Methods D792.

8.4 *Warpage*—The warpage of material furnished in the tube form, as delivered, shall be not greater than the following (8.4.1 – 8.4.3):

8.4.1 *Apparatus*—A horizontal flat surface and rigid bar with a vertical plane surface firmly fixed at right angles to the flat surface shall be at least as long as the specimen to be tested. The height of the bar shall exceed by one half the outside diameter of the tube. Feeler gauges shall also be required.

8.4.2 *Procedure*—The specimen shall be placed on the horizontal flat surface and rotated against the vertical plane surface of the rigid bar. The bar shall be firmly fastened to the horizontal flat surface. The maximum separation between the tube and the vertical plane surface shall be measured to the nearest 0.001 in. (0.0025 cm).

8.4.3 *Report and Calculation*—Warp or lack of bearing straightness shall be reported as the maximum separation or any part of the tube from a straight edge which contacts the ends of the specimen. The maximum length tested for warpage shall be 18 in. (46 cm). The warpage shall then be calculated as follows:

$$W = [(36 D)/L^2] \times 100 \tag{1}$$

where:

- W = percentage of warp, calculated to a 36-in. (91-cm) length,
- D = maximum deviation of tube from straight edge in inches (centimetres), and
- L = length of tube in inches (centimetres).

TABLE 4 Tolerances on Diameters of Rolled Tubes, Molded Tubes, and Rods

| Nominal Diameters, in. ^{A,B} | Tolerances (±) | |
|---|-------------------------------------|---|
| | Inside Dia. (in.) ^B (ID) | Ground Outside Dia. (in.) ^B (OD) |
| 0.090 up to 0.750 | 0.003 | 0.005 |
| 0.750 up to 2.000 | 0.004 | 0.005 |
| 2.001 – 4.000, inclusive ^C | 0.008 | 0.008 |
| 4.001 – 12.000, inclusive ^C | 0.010 | Ground, turned or (as wound) 0.025 (+ only 0.050 min.) |
| 12.001 – 18.000, inclusive ^C | 0.030 | Turned only or (as wound) 0.030 (+ only 0.060 min.) |
| 18.001 up to 24.000, inclusive ^C | 0.040 | 0.035 (+ only 0.070 min.) |
| 24.001 to 48.000, inclusive ^C | 0.060 | 0.040 (+ only 0.080 min.) |

^A The term “up to” means “up to but not including.”

^B 1 in. = 2.54 cm.

^C Rolled tube only.

TABLE 5 Tolerances on Wall Thickness of Rolled Tubes and Molded Tubes

| Wall Thickness ^A | Form | Thickness Tolerances (±) from Average Wall Thickness of Individual Tube (in.) | | | | | |
|--------------------------------|-------|---|------------------|-----------------|---|------------------|-----------------|
| | | Type PB Inside Diameter (in.) | | | Type FB, FBFW, FBEFW Inside Diameter (in.) | | |
| | | 0.125 – 0.250 | 0.251 – 0.500 | 0.501 – Max. | 0.188 – 0.250 | 0.251 – 0.500 | 0.501 – Max. |
| 0.031 up to 0.062 | TRR | 0.006 | 0.006 | 0.006 | 0.010 | 0.010 | 0.008 |
| | (TMR) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) | (0.008) |
| 0.062 up to 0.126 | TRR | 0.007 | 0.007 | 0.007 | 0.011 | 0.011 | 0.009 |
| | (TMR) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) | (0.011) |
| 0.126 up to 0.251 | TRR | 0.009 | 0.009 | 0.009 | 0.013 | 0.013 | 0.011 |
| | (TMR) | (--) | (0.015) | (0.011) | (--) | (0.015) | (0.011) |
| 0.251 to 0.500, inclusive | TRR | 0.011 | 0.011 | 0.011 | 0.015 | 0.015 | 0.013 |
| | (TMR) | (--) | (--) | (0.013) | (--) | (--) | (0.013) |

^A The term “up to” means “up to but not including.”

TABLE 6 Classification of Defects

| Examination | Defect | Classification | |
|----------------------------------|--|----------------|-------|
| | | Major | Minor |
| Appearance and Workmanship | Not uniform in texture and finish | | X |
| | Presence of foreign matter, grit, or abrasives | X | |
| | Any crack, break, bulge, blisters, wrinkles, scratches, dents, voids or resin pockets detrimental to finished part | X | |
| | Any separation of laminations | X | |
| | Laminations not as specified Ragged or rough edges or sides | X | |
| | Fabric not continuous | X | |

8.5 *Acetone Extraction*—Acetone extraction shall be used to determine amount of acetone soluble matter remaining in laminated phenolic products.

8.5.1 *Apparatus:*

8.5.1.1 *Sieves*—The set of sieves used shall consist of Nos. 40 (425 µm) and 140 (106 µm), with a cover and receiving pan, conforming to the requirements of Specification E11 for wire cloth sieves for testing purposes.

8.5.1.2 *Extraction Apparatus*—The apparatus may be of the type shown in Fig. 1 or a Wiley-Richardson type as shown in Fig. 2. The former type is better for use with small electric hot plates, while the latter controls the temperature so that the rate of extraction can be regulated accurately.

8.5.1.3 *Drying Dishes*—The drying dishes shall be light-weight dishes, approximately 2.5 in. (63.5 mm) in diameter and 1.5 in. (38.1 mm) in height.

8.5.2 *Preparation of Sample:*

8.5.2.1 *Precautions*—Extreme care shall be taken during the preparation of the sample for extraction. The sample shall be

from drilling if possible; however, if not possible, other means of producing particles equivalent to drilling may be used. Drillings taken from a large tube shall be representative of all sections of the tube in equal proportions. The drill for sampling shall be kept sharp so no extreme heating of the material shall occur during drilling, which will tend to pre-cure the material.

8.5.2.2 *Obtaining Samples*—If impracticable to obtain samples by drilling, the parts may be broken up with a lathe, planer, milling machine, or grinder. A mortar and pestle or a pebble mill is considered equal to a grinder provided no perceptible heating occurs during the grinding procedure. A sharp file or rasp may be used for procuring the sample when the size or shape of the part is such that there is no other method.

8.5.2.3 *Particle Size*—The particles of the sample shall pass through the No. 40 (425-µm) sieve with minimum reworking or grinding. When preparing the sample, the smallest volume shall be obtained for a unit weight of material.

TABLE 7 Thickness of Laminated Sheets^A

| Nominal Thickness (in.) | Permissible Variations (± in.) |
|----------------------------|-----------------------------------|
| 0.015 | 0.0035 |
| 0.020 | 0.004 |
| 0.025 | 0.0045 |
| 0.031 | 0.005 |
| 0.047 | 0.0055 |
| 0.062 | 0.006 |
| 0.094 | 0.007 |
| 0.125 | 0.008 |
| 0.156 | 0.009 |
| 0.188 | 0.010 |
| 0.219 | 0.011 |
| 0.250 | 0.012 |
| 0.312 | 0.0145 |
| 0.375 | 0.017 |
| 0.438 | 0.019 |
| 0.500 | 0.021 |
| 0.625 | 0.024 |
| 0.750 | 0.027 |
| 0.875 | 0.030 |
| 1.000 | 0.033 |
| 1.125 | 0.035 |
| 1.250 | 0.037 |
| 1.375 | 0.039 |
| 1.500 | 0.041 |
| 1.625 | 0.043 |
| 1.750 | 0.045 |
| 1.875 | 0.047 |
| 2.000 | 0.049 |

^A On sheets of nominal thickness not listed in this table, the permissible variations shall be the same as for the next greater thickness. 1 in. = 2.54 cm.

8.5.2.4 Sample Sieving—The sample shall be sieved through a No. 40 (425- μ m) sieve and the particles not passing through shall be reground and blended with the original material passing through the sieve. After assembling the Nos. 40 and 140 (425- and 106- μ m) sieves and the receiving pan, the sample shall be placed in the top sieve, covered, and the entire sample shall be re-sieved either by a mechanical sieve shaker or hand sieving. If the hand-sieving method is used, the sieve shall be rotated with slight tapping, the period of rotation being 5 min.

8.5.2.5 Post Sieving—After sieving, the sample (that portion that has passed through the No. 40 (425- μ m) sieve and has been retained on the No. 140 (106- μ m) sieve) shall be placed immediately in an airtight container to prevent absorption of moisture by the powder and any consequent error as a result.

8.5.3 Conditioning—Condition the test specimens at $73 \pm 4^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity for not less than 40 h before testing in accordance with Practice **D618**, Procedure A, for those tests in which conditioning is required.

8.5.4 Test Conditions—Conduct tests in a standard laboratory atmosphere of $73 \pm 4^\circ\text{F}$ ($23 \pm 2^\circ\text{C}$) and $50 \pm 5\%$ relative humidity unless otherwise specified in the test methods or in this specification.

8.5.5 Procedure:

8.5.5.1 Extraction—The extraction procedure shall be carried out in triplicate. Weigh a 0.106-oz (3.000-g) portion of the powdered sample into a tared, acid-hardened, open-texture quantitative filter paper, 4.9 to 5.9 in. (12.5 to 15 cm) in

diameter, or into a standard, single-thickness extraction thimble, 3.14 by 0.9 in. by (80 by 22 mm), trimmed if necessary. After folding over, the thimble or filter paper with sample is ready to insert in the siphon.

8.5.5.2 Siphoning—Press the filter paper or thimble containing the weighed sample into the siphon such that the outlet at the bottom is not plugged. Place the condenser and the siphon in the extraction tube and add 17 fl oz (500 mL) of cp acetone. Start the water through the condenser and adjust the heat so that the siphon fills and empties between 15 and 20 times/h. (If an oil water bath is used for heating, the height of the liquid in the bath should not come above 1 in. (2.5 cm) below the highest level of the acetone in the siphon before the siphon starts to discharge). This rate shall be carefully maintained, and the sample shall be extracted for 4 h. After the siphon empties, remove the flask and pour the contents into an individually weighed dish. Wash the flask three times with the smallest possible quantity of acetone, using a wash bottle, and add the washings to the extracted liquid in the dish.

8.5.5.3 Drying—Place the dish in a well-ventilated drying chamber maintained at $122 \pm 7.2^\circ\text{F}$ ($50 \pm -13.7^\circ\text{C}$). (It is very important that the specified temperature be maintained, otherwise, consistent results cannot be obtained between different laboratories. An electrically heated oven should not be used unless it is exceedingly well ventilated, as the acetones are likely to come in contact with the heated coils and cause an explosion.) Dry the sample to constant weight. Between dryings, all dishes containing the residue shall be kept in a desiccator to prevent the absorption of moisture.

8.5.6 Calculation and Report:

8.5.6.1 Calculation—Calculate the percentage of acetone-extractable matter in the specimen as follows:

$$\text{Acetone - extractable matter, \%} = [(W - D)/S] \times 100 \quad (2)$$

where:

W = weight of the dish and extract [ounce (gram)],
 D = weight of the dish [ounce (gram)], and
 S = weight of the original sample [ounce (gram)].

8.5.6.2 Report—The report shall include the percentage of acetone-extractable matter for each sample and the average percentage of acetone-extractable matter for three samples.

9. Packaging and Package Marking

9.1 Packaging—Material to be packaged per vendor's accepted standard practice unless detailed requirements are specified in the contract.

9.2 Marking—Shipping containers shall be marked in accordance with MIL-STD-129.

9.3 Tube lot traceability.

10. Keywords

10.1 ball bearing cage; ball bearing separator; fabricated; laminated; phenolic; plastic

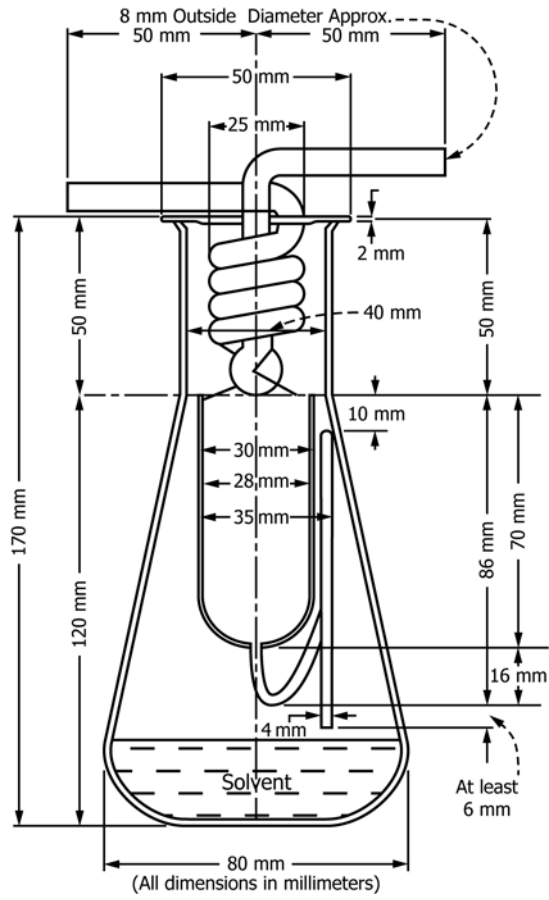


FIG. 1 Extraction Apparatus

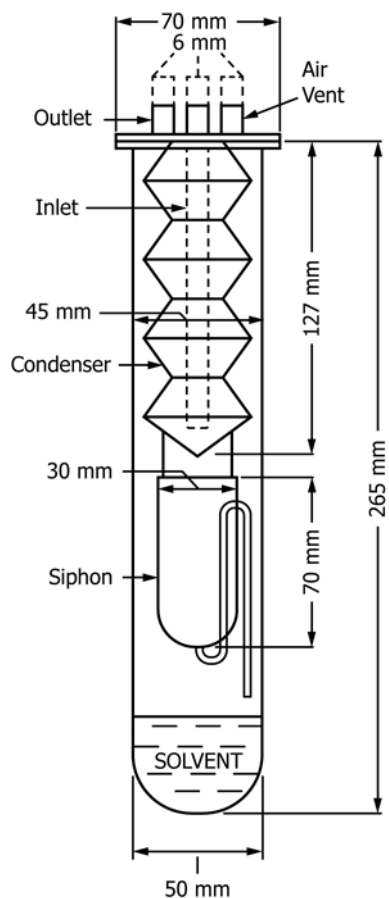


FIG. 2 Wiley-Richardson Type Extraction Apparatus

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; http://www.copyright.com/