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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3678

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Submitted for recognition as an American National Standard

Polytetrafluoroethylene (PTFE) Moldings and Extrusions Unfilled, Pigmented, and Filled Components

1. SCOPE:

1.1 Form:

This specification covers several grades of virgin polytetrafluoroethylene (PTFE) resin which may be compounded with pigment and fillers in the form of extruded or molded rods or tubes which are sintered after molding or, in the case of extrusions, sintered during the extrusion process.

1.2 Application:

These products have been used typically for mechanical parts such as back-up rings, seals, and bearings requiring dimensional stability up to 450 °F (232 °C) with good mechanical properties, but usage is not limited to such applications. Each application should be considered individually.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7154 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 792	Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 4745	Filled Compounds of Polytetrafluoroethylene (PTFE) Molding and Extrusion Materials
ASTM D 4894	Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials

3. TECHNICAL REQUIREMENTS:

3.1 Detail Specifications:

The requirements for a specific product shall consist of all requirements specified herein in addition to requirements specified in the applicable detail specification. In case of conflict between requirements of this specification and an applicable detail specification, requirements of the detail specification shall govern.

3.2 Material:

All products shall be molded or extruded from fresh virgin or filled polytetrafluoroethylene (PTFE) powder. The virgin PTFE powder used in both unfilled and filled compounds to this specification shall conform to ASTM D 4894, Type II or Type IV. The blending of fillers with the virgin PTFE for each type shall be as shown in Table 1.

TABLE 1 - Material Types

Type	Description	Detail Specification
1	Virgin PTFE	AMS 3678/1
2	PTFE filled with 15% graphite	AMS 3678/2
3	PTFE filled with 15% glass fiber and 5% molybdenum disulfide	AMS 3678/3
4	PTFE filled with 25% glass fiber	AMS 3678/4
5	PTFE filled with inorganic pigment	AMS 3678/5
6	PTFE filled with 60% bronze powder	AMS 3678/6

3.2.1 Virgin polytetrafluoroethylene shall mean resin that has no pigment or filler added and the resin has not experienced any previous pressure or heat history.

3.2.2 Filled material shall mean that at least one pigment or filler has been uniformly blended with the virgin PTFE polymer prior to any pressure or heat process. The percentage(s) of pigment(s) or filler(s) added shall be measured by weight.

3.2.3 Pigmented material shall mean that a small percentage of inorganic pigment which may also include a color enhancing agent, total additive(s) usually less than 2% by weight, has been added to color the material and uniformly blended.

3.2.4 Type I material is used typically for backup rings and seal components for static and light duty dynamic applications. Type 1 materials can be used to seal against steel, stainless steel, chromium plating, bronze, bare or anodized aluminum and aluminum alloys, and ceramic coatings. Type 1 materials have the highest wear rate and lowest coefficients of friction.

3.2.5 Type 2 material is used typically in seal components for dynamic reciprocating and rotary applications. Type 2 materials have better extrusion resistance than Type 1 materials. Type 2 materials can be used to seal against the same materials as Type 1 materials. Type 2 materials have much better wear resistance than Type 1 materials with slightly higher coefficients of friction.

3.2.6 Type 3 material is used typically in seal components where resistance to high temperature and pressure is required along with very good wear resistance. Type 3 materials are used to seal against steel, stainless steel, and chromium plate in a lubricated environment.

3.2.7 Type 4 material is used typically for dynamic seals. Type 4 materials have better extrusion resistance but slightly higher coefficients of friction than Type 3 materials. Type 4 materials are used to seal against the same materials as Type 3 materials in a lubricated environment.

3.2.8 Type 5 material is used typically for backup rings and seal elements in both static and dynamic applications. Type 5 materials have essentially the same physical properties as Type 1 materials with better wear resistance as a result of the presence of the inorganic pigment. Type 5 material is used to seal against steel (with the exception of nitrided steel), stainless steel, chromium plate, and anodized aluminum and aluminum alloys in both dry and lubricated environments. As opposed to Type 1 and Type 2 materials, Type 5 materials should not be used against bare aluminum or aluminum alloy.

3.2.9 Type 6 material is used typically for bearing and wear ring applications in a lubricated environment against steel, stainless steel, and chromium plate. Type 6 material has very good compressive strength and abrasion resistance.

3.2.10 Unless a specific type is ordered, Type 1 shall be supplied.

3.3 Properties:

The product shall conform to the requirements of this specification and those shown for each type in the applicable detail specification; tests shall be performed on production product in accordance with specified test methods, insofar as practicable.

3.3.1 Color shall be as described for each type with no discoloration or inclusions detrimental to the performance requirements of the final components. For Type 5, color is solely dependent upon pigment chosen by the supplier.

3.4 Quality:

Moldings or extrusions as received by purchaser shall be uniform in quality and color, smooth, as free from foreign material as commercially practicable, and free from internal imperfections detrimental to usage of the material.

3.5 Sizes and Tolerances:

Dimensions and tolerances of moldings or extrusions shall be as agreed upon by purchaser and supplier or as stated on purchase order.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of moldings or extrusions shall supply all samples and shall be responsible for the performance of all required tests for each lot of moldings or extrusions. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the moldings or extrusions conform to the specified requirements. Manufacturer of machined parts shall furnish substantiating test data acquired by the manufacturer of moldings or extrusions. Purchaser of parts machined from moldings or extrusions also reserves the right to perform confirmatory testing provided the parts will yield samples that conform to the testing procedure(s) listed in 4.5.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: All technical requirements are acceptance tests and shall be performed on each lot of moldings or extrusions (See 4.3.1.2).

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 Acceptance Tests: Sufficient production moldings or extrusions or parts shall be taken at random from each lot to perform required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified, not less than three.

4.3.1.1 A batch of virgin PTFE polymer shall not exceed 4400 pounds (2000 kg) and a batch of filled or pigmented PTFE polymer shall not exceed 200 pounds (91 kg).

4.3.1.2 A lot of moldings or extrusions shall be all the parts made from the same batch of compound in one continuous run and presented for manufacturer's inspection at one time.

4.3.1.3 A statistical sampling plan, acceptable to purchaser may be used in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

4.4 Approval:

4.4.1 Sample product shall be approved by purchaser before product for production use is supplied, unless such approval is waived by purchaser. Results of the tests on production product shall be essentially equivalent to those on the approved sample. Production product made by a revised procedure shall not be shipped prior to receipt of reapproval. If necessary to make any change in parameters for the process control factors, manufacturer shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample product.

4.4.2 Manufacturer of the product shall make no significant change in material, processes, or control factors from those on which the approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the product.

4.5 Test Methods:

Shall be as follows:

4.5.1 Tensile strength and elongation shall be determined in accordance with ASTM D 4894 and the test specimens shall be prepared from either a sample molding or extrusion as specified or from a production molding or extrusion of sufficient size. Test specimens for rods and tubes, where size permits, shall conform to ASTM D 4894, Figure 11, except that rods 0.250 inch (6.35 mm) and under in diameter may be tested in full cross-section. The initial jaw separation shall be 0.875 inch ± 0.005 (22.2 mm ± 0.13) and the speed of testing shall be as specified for each type per ASTM D 4745 or ASTM D 4894. Type 5 material should be tested in accordance with the requirements of Type 1 material.

4.5.1.1 For compression molded material, the sample should be pulled in the direction of molding (axial direction) where physical dimensions permit. Where this is not possible, the sample should be perpendicular to the direction of molding (circumferential direction). For isostatic molded rods or tubes, the sample may be taken from either the axial or circumferential direction. For extrusions, the sample should be pulled in the direction of molding (axial direction). The values shown for each type are the minimum values required.

4.5.2 Specific gravity shall be determined in accordance with ASTM D 792, Method A with two drops of wetting agent added to the water.