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# Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Exterior Profiles Used for Fencing and Railing<sup>1</sup>

This standard is issued under the fixed designation F 964; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification establishes requirements for the material properties and physical properties, including dimensional tolerances, extrusion quality, and weatherability, of rigid poly vinyl-chloride (PVC) exterior profiles used for agricultural, commercial, residential fencing and railing. Methods for testing and for identifying exterior profile extrusions that comply with this specification are also provided.

NOTE 1—Information with regard to application, assembly, and installation should be obtained from the manufacturer and/or per ASTM XXXX.

1.2 The material used in these exterior-profiles is limited to rigid poly (vinyl chloride) (PVC) compounds in a single homogeneous extrusion or in a coextrusion of two or more PVC compounds in distinct layers.

1.3 Color-hold guidelines are provided in an appendix for the manufacturer's product development and quality performance use.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values in parentheses are provided for information only.

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:

- D 618 Practice for Conditioning Plastics for Testing<sup>2</sup>
- D 635 Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position<sup>2</sup>
- D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between  $-30^{\circ}\text{C}$  and  $30^{\circ}\text{C}$ <sup>2</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F14 on Fences and is the direct responsibility of Subcommittee F14.30 on Rigid Polymer Fence Systems.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.01.

- D 883 Terminology Relating to Plastics<sup>2</sup>
- D 1435 Practice for Outdoor Weathering of Plastics<sup>2</sup>
- D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>2</sup>
- D 1784 Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds<sup>2,3</sup>
- D 1898 Practices for Sampling of Plastics<sup>2</sup>
- D 2244 Test Method for Calculation of Color Differences From Instrumentally Measured Color Coordinates<sup>4</sup>
- D 2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)<sup>3</sup>
- D 4216 Specification for Rigid Poly Vinyl Chloride PVC and Related PVC and Chlorinated Poly Vinyl Chloride CPVC Building Products Compounds<sup>5</sup>
- D 4226 Test Methods for Impact Resistance of Rigid Poly Vinyl Chloride PVC Building Products<sup>3</sup>
- D 4726 Specification for White Rigid Poly (Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors<sup>3</sup>

## 3. Terminology

3.1 General—Definitions are in accordance with Terminologies D 883 and D 1600, unless otherwise indicated.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *capstock*—the outer layer in a coextrusion exposed to weathering.

3.2.2 *coextrusion*—the process of coextruding profiles from two or more concentric streams of PVC compounds.

NOTE 2—Separate PVC materials may be coextruded to form a multi-layered profile with each layer having different physical characteristics such as strength and weathering.

3.2.3 *reworked material*—material from the manufacturer's facility of known, compatible composition meeting the material requirement of this specification that has been reground, pelletized, or solvated after having been previously processed by molding, extrusion, and so forth.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.04.

<sup>4</sup> Annual Book of ASTM Standards, Vol 06.01.

<sup>5</sup> Annual Book of ASTM Standards, Vol 08.02.

3.2.4 *single layer profile*—profiles extruded from a single PVC compound. Weathering and other physical characteristics are uniform throughout the profile.

3.2.5 *substrate*—inner layer(s) of a coextrusion not exposed to weathering.

3.2.6 *temperate northern climate*—in weather testing, a North American metropolitan area testing site located within 73 to 100° W longitude and 37 to 45° N latitude.

3.2.7 *color-hold guidelines*—predictive target color regions within a three-dimensional model which constitute acceptable appearance retention levels of color change resulting from weathering of specific product type and color.

NOTE 3—Commercial products which demonstrate weathering behavior within reasonable conformance to these target guidelines during a 2-year test period can be anticipated to weather without exhibiting unacceptable color changes during the service life of the product.

#### 4. Significance and Use

4.1 The purpose of this specification is to establish a recognized standard of quality for rigid poly vinyl chloride (PVC) exterior profiles for use in assembling agricultural, commercial, and residential fencing and railing. The term “PVC fence” refers to complete fencing and railings systems in which the primary structural members such as posts, rails, spindles, pickets, and gates are made from PVC exterior profiles. Accessory components (not included in this specification), including bolts, screws, hinges, and latches, may be made from PVC and/or non-PVC materials. The information contained in this specification is intended to be helpful to producers, distributors, and users and to promote understanding between purchasers and sellers.

#### 5. Materials and Manufacture

5.1 The rigid poly vinyl chloride (PVC) compound for exterior-profile extrusions meeting the requirements of this specification are categorized by the cell class requirements in accordance with Specification D 4216.

5.2 The PVC compounds used for the products meeting this specification shall meet cell Class 1–10154–33–0000, Class 1–20131–13–0000, or Class 1–40131–13–0000 as defined in Specification D 4216. Compounds that have higher cell classification because one or more properties are superior to those in the specified compound are acceptable.

5.3 *Color*—The color of the profiles shall be as agreed upon between the purchaser and the seller. The color specified shall be uniform throughout a single material extrusion or throughout the capstock layer of a coextruded profile for profiles intended to be of uniform color.

5.4 The fence profiles shall be free from visible cracks, holes, foreign inclusions, or other defects.

5.5 The PVC compound, when tested in accordance with Test Method D 635, shall not exceed an average extent of burn of 4 in. (100 mm), with an average time of burn not to exceed 10 s. A sample thickness of  $0.090 \pm 0.009$  in. ( $2.3 \pm 0.2$  mm) shall be used.

NOTE 4—The flammability testing data, conclusions, and recommendations of Test Method D 635 relate solely to the measurement and description of the properties of materials, products, or systems in response to heat and flame under controlled laboratory conditions and should not be

used for the description or appraisal of the fire hazard of materials, products, or systems under actual fire conditions.

NOTE 5—No recycled (post consumer waste) may be used in the production of fence profiles.

5.6 *Reworked Material*—Clean reworked material may be used, provided that the fence profiles produced in whole or in part from the reworked materials meet all of the requirements of this specification.

5.7 The PVC compound in extruded section shall maintain uniform color and be free of any visual surface or structural changes, such as peeling, chipping, cracking, flaking, or pitting after weathering for six months and one year for white and for six months, one year, and two years for all other colors in hot, dry climate such as Phoenix, AZ; a hot humid climate, such as Miami, FL; and a temperate northern climate, when tested in accordance with 7.1.1-7.1.4.

5.8 The PVC compound shall have a minimum impact resistance of 0.6 in.-lb/mil (2670 J/m) after weathering six months and one year in a hot, dry climate such as Phoenix, AZ; a hot, humid climate, such as Miami, FL; and a temperate northern climate, when tested in accordance with 7.1.1-7.1.4.

5.9 The PVC compound shall have successfully met the weathering requirements prescribed in 5.7 and 5.8 for six months at each climatic testing site prior to use in production of exterior-profile extrusions, when tested in accordance with 7.1.1-7.1.4.

NOTE 6—The six-month test requirement constitutes a screening process to eliminate catastrophic failure.

#### 6. Physical Requirements

6.1 *Length, Height, and Width*—The specified length, height, and width of the fencing profiles shall be as agreed upon between the purchaser and the seller, or by established internal process control standards. The actual length shall be within  $\pm 1/4$  in. (6.4 mm) of the specified length and the actual height and width shall be within  $1/16$  in. (1.6 mm) of the specified height and width when measured in accordance with 8.4 and 8.5.

6.2 *Weight Tolerance*—Profile extrusion weight shall not be more than 10 % below the specified profile weight indicated in the manufacturer’s specifications.

##### 6.3 Impact Resistance

6.3.1 Round or rectangular profiles with exterior walls of uniform thickness and without internal webs shall be tested in accordance with Test Method D 2444. These profiles will have a minimum impact failure value of 0.75 ft-lbf/mil (40,050 J/m) of thickness of the wall when tested at 32°F (0°C) and 1.5 ft-lbf/mil (80,050 J/m) when tested at 73.4°F (23°C) when tested in accordance with the apparatus section of Test Method D 2444, using the “B” tup and flat plate Holder “B.” The minimum wall thickness for the profile shall determine the required impact level when tested in accordance with 8.6.

6.3.2 All other profiles are to be tested in accordance with test method D 4226, Procedure “B,” using impactor C.125. Flat sections of the profile extrusion shall have a minimum brittle impact failure of 1.2 in. lb/mil (5340 J/m).

6.4 *Warp*—The maximum allowable warp shall be 0.5 % of the length of the fence profile when determined in accordance with 8.7.

6.5 *Dimensional Stability*—The dimensional stability of the profile extrusions shall be determined in accordance with 8.9. Extrusions shall have a maximum average shrinkage of 2.4 % for all sides measured, with no single value exceeding 3 %.

NOTE 7—Expansion and contraction of the fence profile lengths must be taken in consideration in the design of the fencing system.

6.6 *Coefficient of Linear Expansion*—The fencing profiles shall have a coefficient of linear expansion not greater than  $4.4 \times 10^{-5}$  in./in. · °F ( $7.9 \times 10^{-5}$  mm/mm · °C) when tested in accordance with Test Method D 696.

NOTE 8—Expansion and contraction of the fence profile lengths must be taken in consideration in the design of the fencing system.

6.7 *Thickness of PVC Capstock*—PVC fence profiles produced by coextrusion, which contain two or more layers, shall have an outer layer (capstock) that is no less than 0.015 in. (0.38 mm) thick at any point and that does not exceed 20 % of the total wall thickness at any point.

6.8 *Bond*—For PVC profiles produced by coextrusion, the bond between the layers shall be strong and uniform. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate at any point.

## 7. Performance Requirements

### 7.1 Weathering

7.1.1 The exposures listed in Table 1 shall be conducted in order to meet the requirements of this specification. All exposures shall be conducted at an angle of 45 degrees South, plywood backed, in accordance with Practice D 1435.

7.1.2 After six months and one year exposure times, the minimum mean impact for 20 measurements conducted on the exposed specimens shall be at least 0.6 in. lb/mil (2670 J/m) in accordance with 8.6 or 8.9 respectively.

7.1.3 After each exposure time, the tested specimens shall maintain a uniform color and be free of any visual surface or structural changes such as peeling, chipping, cracking, flaking, and pitting when tested in accordance with Appendix X1.

NOTE 9—It is recommended that manufacturers utilize the color-hold guidelines in Appendix X1 of D 4726 to ensure quality performance.

7.1.4 Weatherability conformance testing requirements are to reflect performance of a “typical” extrusion system profile representing a specific PVC compound and a specific extrusion technology. In no case is there an implied requirement for testing all the various shaped profiles. The profile extrusion producer shall immediately respond in terms of compound change or extrusion technology change to unsatisfactory

**TABLE 1 Required Exposures for PVC Extrusions**

Color of PVC Extrusions	Exposure Climate	Required Exposure Times, months <sup>A</sup>
White	hot, dry (Phoenix, AZ)	6 and 12
	hot, humid (Miami, FL) northern temperate	6 and 12 6 and 12
Any other color	hot, dry (Phoenix, AZ)	6, 12 and 24
	hot, humid (Miami, FL) northern temperate	6, 12 and 24 6, 12 and 24

<sup>A</sup>It is recommended that separate specimens be used for each exposure time.

weatherability behavior of the profiles under test in any climatic test site at any stage of the weatherability testing.

## 8. Test Methods

8.1 *General*—The inspection and test procedures contained in this section are used to determine the conformance of products to the requirements of this specification. Each producer who represents his products as conforming to this specification may utilize statistically based sampling plans that are appropriate for each manufacturing process. The producer shall keep the essential records necessary to document with a high degree of assurance his claim that all the requirements of this specification have been met. Additional sampling and testing of the products, as may be agreed upon between the purchaser and the seller at the time of the execution of the sales agreement, are not precluded by this section.

### 8.2 Conditioning and Test Conditions:

8.2.1 Specimens to be tested at  $73.4 \pm 3.6^\circ\text{F}$  ( $23^\circ \pm 2^\circ\text{C}$ ) shall be conditioned in accordance with Practice D 618 for no less than one hour. Specimens to be tested at  $32^\circ \pm 3.6^\circ\text{F}$  ( $0^\circ \pm 2^\circ\text{C}$ ) shall be continued in accordance with Practice D 618 for no less than one hour.

8.3 *Sampling*—The selection of sample or samples of fence profiles shall be as agreed upon between the purchaser and the seller. In the absence of any prior agreement, the selection of sample or samples of fence shall be in accordance with the pertinent considerations outlined in Practices D 1898.

8.3.1 *Sample Marking*—Samples being tested at a test laboratory, not at the manufacturer’s location, shall be marked with a verifiable and permanent marking that shall identify the manufacturer.

8.3.2 The number of specimens or the size of the specimen must be sufficient to obtain 20 impact locations of the dropped dart for each weathering interval.

8.3.3 The thickness of any profile tested must not differ from the manufacturer’s published specification of the same profile.

8.4 *Length*—With the sample lying on a flat surface, measure the length to the nearest  $\frac{1}{16}$  in. (1.5 mm) with a steel tape. The average of three samples shall be within  $\pm\frac{1}{4}$  in. (6.3 mm) of the published length with no single sample deviating more than  $\frac{3}{8}$  in. (9.5 mm) from the nominal length.

8.5 *Height and Width*—Lay three samples on a flat surface and measure each to the nearest  $\frac{1}{16}$  in. (1.5 mm) with a steel tape or vernier calipers. The average of the three samples shall be within  $\pm\frac{1}{16}$  in. (1.5 mm) of the nominal height and width with no single sample deviating more than  $\frac{3}{32}$  in. (2.4 mm) from the nominal height and width.

8.6 *Impact Resistance*—Condition ten specimens, not less than 6 in. long ( $152 \pm 1.5$  mm), at either  $73.4^\circ \pm 3.6^\circ\text{F}$  ( $23^\circ \pm 2^\circ\text{C}$ ) or  $32^\circ \pm 3.6^\circ\text{F}$  ( $0^\circ \pm 2^\circ\text{C}$ ) and test with the apparatus described in Test Method D 2444, using a “B” tup and a “B” flat plate holder to the values in 6.3. Seven of ten specimens must pass at whichever test conditioning temperature is used. Specimens shall be temperature conditioned in accordance with 8.2. Any visible cracking, shattering, or breaking shall constitute a failure.

8.6.1 *Retest*—Should more than three specimens fail the initial impact test, select and condition ten more samples and