Designation: D1755 – 15

Standard Specification for Poly(Vinyl Chloride) Resins[1]

This standard is issued under the fixed designation D1755; 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 the establishment of requirements for homopolymers of vinyl chloride in original powder form intended for subsequent mixing and processing in thermoplastic compositions. These resins have a nominal specific gravity of 1.4 and a theoretical chlorine content of 56.8 %.

1.2 Two types of resin have been recognized: general purpose (suspension or mass) and dispersion. When mixed with plasticizer, general-purpose resins yield a dry or moist powder while dispersion resins yield a liquid slurry. Since many resins are polymerized to meet special requirements, a system of classification has been provided that permits a wide choice of grades.

1.3 The values stated in SI units are to be regarded as the standard.

1.4 *This standard does not purport to address all of the safety problems, 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.*

NOTE 1—This standard and ISO 1264 – 1980 address the same subject matter, but differ in technical content.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D495 Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation

D883 Terminology Relating to Plastics

D1125 Test Methods for Electrical Conductivity and Resistivity of Water

D1243 Test Method for Dilute Solution Viscosity of Vinyl Chloride Polymers

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1823 Test Method for Apparent Viscosity of Plastisols and Organosols at High Shear Rates by Extrusion Viscometer

D1824 Test Method for Apparent Viscosity of Plastisols and Organosols at Low Shear Rates

D1895 Test Methods for Apparent Density, Bulk Factor, and Pourability of Plastic Materials

D1921 Test Methods for Particle Size (Sieve Analysis) of Plastic Materials

D2132 Test Method for Dust-and-Fog Tracking and Erosion Resistance of Electrical Insulating Materials

D2396 Test Methods for Powder-Mix Time of Poly(Vinyl Chloride) (PVC) Resins Using a Torque Rheometer

D3030 Test Method for Volatile Matter (Including Water) of Vinyl Chloride Resins

D3367 Test Method for Plasticizer Sorption of Poly(Vinyl Chloride) Resins Under Applied Centrifugal Force

D3892 Practice for Packaging/Packing of Plastics

E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology D883 and Terminology D1600, unless otherwise indicated.

4. Classification

4.1 *Types*—This specification covers two types of resin:

4.1.1 *Type GP*—General-purpose suspension or mass resins.

4.1.2 *Type D*—Dispersion resins primarily intended for use in organosols and plastisols.

4.2 *Grades*—This specification provides for as many grades of resin as it is feasible to be selected from the possible combinations of requirements in Table 1 and Table 2. A grade is designated by first indicating the type (GP or D), followed by cell numbers for each property in the order in which they are listed in Table 1 and Table 2. Where there is no interest in a property, a "0" is entered in place of a cell number. If it were desirable, it is acceptable to extend a cell limit by half the cell range into the next higher or lower cell, but not both. When this is done, it is indicated by a dash above the cell number ($\bar{n}$) if the extension is into the higher cell, or a dash below ($\underline{n}$) if into the lower cell. Extension of cell limits applies only to cells

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[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.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 Type GP, General-Purpose Resin Requirements

Designation Order No.	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Dilute solution (inherent) viscosity	unspecfied	>0.39	>0.70	>0.75	>0.87	>0.99	>1.09	>1.19	>1.29	>1.38
2	Sieve analysis, percent through No. 200 (75-µm) sieve	unspecified	0 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 79	80 to 99	100
3	Apparent (bulk) density (min):										
	g/1000 cm^3	unspecified	<144	144	233	329	426	521	617	713	≥809
	lb/ft^3	unspecified	<9.00	9.00	14.51	20.51	26.51	32.51	38.51	44.51	50.51
4	Plasticizer sorption, % DOP (min)	unspecified	<9.9	>10.0	>15.0	>20.0	>25.0	>30.0	>35.0	>40.0	...
5	Dry flow, method 'A', s/140 gms	unspecified	...	<9.9	>10.0	>12.0	>14.0	>16.0	>18.0	>20.0	...
6	Conductivity, max, µS/cm·g	unspecified	...	...	<6	≥6	...	...	...	...	...

TABLE 2 Type D, Dispersion Resin Requirements

Designation Order No.	Property	Cell Limits									
		0	1	2	3	4	5	6	7	8	9
1	Dilute solution (inherent) viscosity	unspecified	<0.90	0.90 to 0.99	1.00 to 1.09	1.10 to 1.19	1.20 to 1.29	1.30 to 1.39	1.40 to 1.49	1.50 to 159	≥1.60
2	Brookfield viscosity (RVF), poise	unspecified	0 to 24	25 to 49	50 to 74	75 to 99	100 to 124	125 to 149	150 to 174	175 to 199	>199
3	Severs viscosity, poise	unspecified	0 to 49	50 to 99	100 to 149	150 to 199	200 to 299	300 to 499	500 to 999	1000 to 1499	>1499

where ranges of properties are allowed and not where maximum or minimum values are specified. The cell number of the first property (dilute solution viscosity) is separated from those that follow by a dash.

4.3 *Inherent Viscosity Cell Number*—When selecting the inherent viscosity cell number, the number shall cover the full inherent viscosity production range for the specific product. A resin with an inherent viscosity of 1.07 to 1.11 production range would have a *5* cell number. A resin with an inherent viscosity of 1.10 to 1.14 production range would have a *6* cell number

5. General Requirements

5.1 The resin shall be in powder form.

5.2 The resin shall conform to the requirements of Table 1 or Table 2, as specified by the type and grade designation.

NOTE 2—It is possible that properties not covered, such as heat stability, color, and volatile loss, are also important for application performance in compounds.

6. Sampling

6.1 Adequate statistical sampling before packaging is an acceptable procedure. A batch or lot of material shall be considered as a unit of manufacture prepared for shipment and is permitted to consist of a blend of two or more production runs of material.

7. Number of Tests

7.1 One set of test specimens shall be considered sufficient for testing each batch.

8. Retest and Rejection

8.1 If any failure occurs, the materials shall be permitted to be retested to establish conformity.

TEST METHODS

9. Dilute Solution Viscosity

9.1 Test Method D1243.

10. Apparent (Bulk) Density

10.1 Test Methods D1895, method A or method B.

NOTE 3—Finely divided powders such as vinyl resins may collect electrostatic charges, which if present at the time of measurement, may result in variable bulk density values. An anti-static material may be premixed with the sample at concentrations of 0.05 to 0.2 weight percent to reduce this variability (Magnesium Silicate, Alumina Hydroxide Hydrate, Calcium Stearate, Silicon Dioxide or Carbon Black are examples of anti-static agents).

11. Sieve Analysis

11.1 Test Method D1921.

NOTE 4—Specifications for sieve analysis (Table 1) are primarily intended to control fines.

12. Brookfield Viscosity

12.1 Test Method D1824. Take readings using a Brookfield RVF viscometer at 20 r/min with a No. 6 spindle. Prepare the plastisol sample as follows:

12.1.1 *Plasticizer*—Di (2-ethylhexyl) phthalate (DOP).

12.1.2 *Apparatus:*

12.1.2.1 *Mixer,* planetary-gear type, equipped with flat beater mixing paddle.

12.1.2.2 *Vacuum Desiccator,* capable of being evacuated to 133 Pa (1 mm Hg).

12.1.3 *Procedure:*

12.1.3.1 Condition the mixing bowl and materials to 23± 1°C. Weigh 500 ± 0.5 g of resin into the mixing bowl. Weigh 300 ± 0.5 g of plasticizer and add it directly on top of the resin in the mixing bowl. Hand mix with the flat beater for 1 min.

12.1.3.2 Mount the bowl on the mixer and mix for 5 min at the No. 1 speed. Stop the mixer and scrape down the sides of the bowl and the beater. Resume mixing at the No. 2 speed for an additional 15 min. Note and record the temperature of the plastisol immediately after mixing. The temperature rise must not exceed 5°C. Use a cooling bath if necessary.

12.1.3.3 Place the mixing bowl in the desiccator, evacuate to 133 Pa (1 mm Hg), and allow it to remain in the desiccator for an additional 10 min after the foam collapses. Consider the time in the desiccator as part of the normal aging period. Take care to ensure that the plastisol does not overflow the container during evacuation.

13. Severs Viscosity

13.1 Test Method D1823. Determinations shall be made through a 3.17 ± 0.13-mm (0.125 ± 0.005-in.) diameter orifice at a gas pressure of 0.69 MPa (100 psi). The plastisol sample shall be prepared in accordance with 12.1.1 – 12.1.3.

14. Electrical Conductivity of Water Extract

14.1 *Definitions*—See the Definitions Section of Test Methods D1125.

14.2 *Summary of Test Method*—This test is intended to distinguish between electrical and nonelectrical grades of unprocessed resin. In general, the test will not detect relatively small differences among different lots of electrical grade resin. A water dispersion of the resin is boiled for a short time and the electrical conductivity of the solution measured. The conductivity of the water extract results from ionic impurities in the resin that adversely affect its use for electrical insulation. Electrical grade resins generally yield conductivity values less than 6 µS/cm·g.

14.3 *Apparatus:*

14.3.1 *A-C Wheatstone Bridge,* having a range up to 250 000Ω , a 100 ± 50-Hz oscillator and a sensitive null point indicator with minimum accuracy of ±2 %.

14.3.2 *Dip Cell,* having platinum electrodes and a cell constant of about 0.1 cm^{-1}, similar to the one shown in Fig. 1. The cell shall be prepared and calibrated in accordance with Test Method D495.

14.3.3 *Thermometer,* standard, in accordance with Method E2251.

14.3.4 *Electric Hot Plate.*

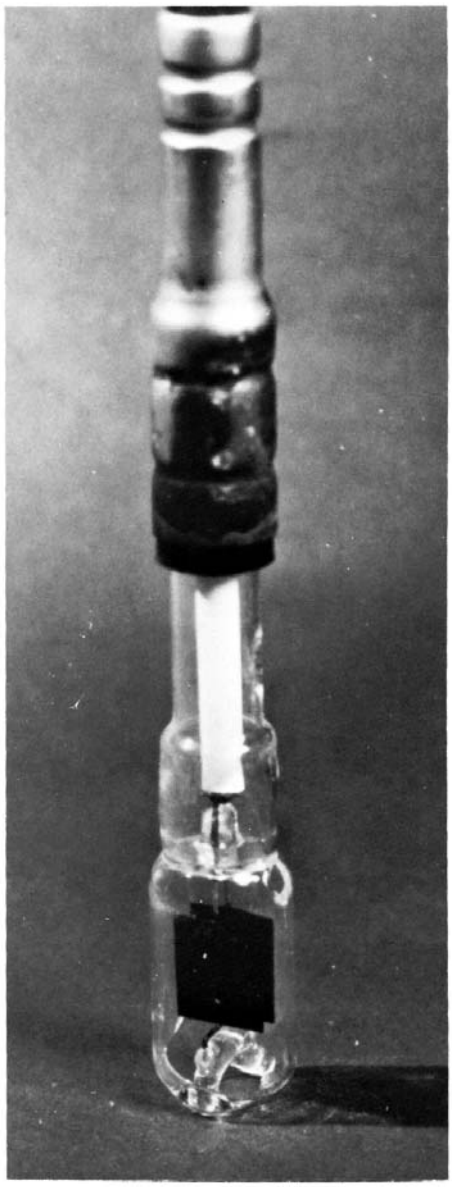

FIG. 1 Dip Cell for Electrical Conductivity Test

14.4 *Reagents:*

14.4.1 *High-Purity Water*—Water having a conductivity not greater than 1.0 µS/cm, prepared in accordance with Test Method D2132.

NOTE 5—It is also possible to obtain a high-purity water by passing ordinary distilled water through a dual-bed ion exchange column packed with an appropriate resin.

14.4.2 *Isopropyl Alcohol,* ACS reagent grade.

14.5 *Procedure:*

14.5.1 Place a resin sample weighing 2.00 ± 0.01 g in a 250-mL Erlenmeyer flask that has previously been rinsed twice with boiling, high-purity water. Add 5.0 ± 0.5 mL of isopropyl alcohol to the sample, and swirl the mixture until the resin is uniformly wet. Add 100 ± 1 mL of boiling, high-purity water, set a watch glass on top of the flask, and boil gently for 5 min. Cool rapidly to 23 ± 1°C. Allow the resin to settle, and then

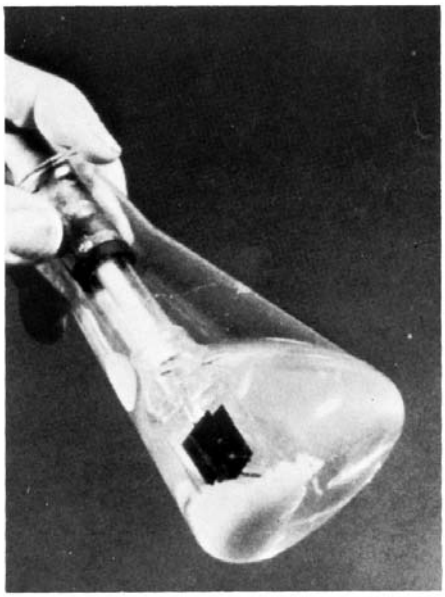

FIG. 2 Dip Cell Immersed in Flask

place the dip cell in the flask so that the electrodes are completely immersed, as shown in Fig. 2. Measure the resistance on the most sensitive scale of the bridge after 30-s immersion. Perform determinations in duplicate.

14.5.2 Between measurements, rinse the cell thoroughly in high-purity water and gently shake off any water clinging to the surface.

14.5.3 *Blank*—Make duplicate parallel determinations using 5 mL of isopropyl alcohol and 100 mL of high-purity water.

14.5.4 *Calculation*—Calculate the electrical conductivity of the extract solution as follows:

$$\text{Electrical conductivity, } \mu\text{S/cm}\cdot\text{g} = [(L/R_2 - L/R_3)/m] \times 10^6$$

where:

L = cell constant,
R_2 = resistance, Ω, of extract solution,
R_3 = resistance, Ω, of blank, and
m = sample weight, g.

14.6 *Report*—Report the average of duplicate determinations of electrical conductivity in μS/cm·g of sample.

14.7 *Precision and Bias*—The precision of the test method, calculated by analysis of the round-robin data from four laboratories, is as follows:

14.7.1 *Repeatability*—Coefficient of variation (average of replicates) within a laboratory of 14.7 %.

14.7.2 *Reproducibility*—Coefficient of variation (average of replicates) between laboratories of 17.2 %.

15. Plasticizer Sorption

15.1 *Test Method D3367.*

16. Dry Flow

16.1 *Summary of Test Method*—The dry flow characteristics of powdered resins bear a complex relationship to particle shape, structure, and size distribution. One way of measuring the flow is by measuring the time for a prescribed volume of resin to flow through a standard funnel. The funnel orifice must be large enough to permit continuous flow of dry resins without bridging.

NOTE 6—Resins of abnormally high or abnormally low moisture content will exhibit reduced nonuniform flow. It is possible that extremely dry resins will develop static changes that will impede flow; damp resin will coalesce.

16.2 *Significance*—The dry flow of a resin as determined by this test is particularly significant in conjunction with plasticizer sorption for predicting the hopper feeding characteristics of dry blended resin-plasticizer compounds.

16.3 *Apparatus:*

16.3.1 *Metal Funnel and Cup*—See the Apparatus Section in Test Method D1895, method 'A'.

16.3.2 *Stop Watch* or an electric timer of comparable accuracy.

16.4 *Procedure*—Test Method D1895, method 'A'.

16.4.1 Weight 140.0 ± 0.5 gms of resin into a cup. Close the small end of the funnel with the hand or a suitable flat strip of metal and pour the resin from the cup into the funnel. Quickly open the bottom of the funnel and start the stop watch at the same instant. Time the resin as it passes through the funnel. Repeat the procedure twice, using a different portion of resin for each determination.

NOTE 7—Finely divided powders such as vinyl resins may collect electrostatic charges, which if present at the time of measurement, may result in variable dry flow values. An anti-static material may be premixed with the sample at concentrations of 0.05 to 0.2 weight percent to reduce this variability (Magnesium Silicate, Alumina Hydroxide Hydrate, Calcium Stearate, Silicon Dioxide or Carbon Black are examples of anti-static agents)

16.5 *Report*—Report the average flow time to the nearest 0.1 s for duplicate determinations.

17. Packaging and Package Marking

17.1 All packing, packaging, and marking provisions of Practice D3892 shall apply to this specification.

18. Keywords

18.1 poly(vinyl chloride); vinyl chloride homopolymer

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D1755 - 09) that may impact the use of this standard. (October 1, 2015)

(1) Reword 1.2
(2) Reword Note 1 per D4968-09.
(3) Delete reference to D281 & E1 in section 2 Reference Documents
(4) Add reference to D3367 & E2551 in section 2, Reference Documents
(5) Reword 4.1.1 & 4.1.2
(6) Reword 5.2
(7) Reword section 6, Sampling
(8) Reword 8.1
(9) Add methods A & B to 10.1, Apparent (Bulk) Density
(10) Add new Note 3
(11) Renumber note 3 as 'new' note 4
(12) Reword 14.3.3 Thermometer, remove E1 reference, add E2551 reference
(13) Renumber 'old' note 4 as 'new' note 5
(14) Delete 15.1 – 15.8.2 & 'old' note 5
(15) New 15.1, add D3367 reference on plasticizer sorption
(16) Reword 16.1, delete last sentence
(17) Reword 16.3.1, delete 'add cup' and add 'method A'
(18) Reword 16.3.2, add electric timer reference
(19) Reword 16.4, add 'D1895, method A' reference
(20) Reword 16.4.1
(21) Add 'new' Note 7
(22) Delete 16.6 – 16.6.2
(23) Delete 17.1 – 17.2
(24) Table 1: a.) Set 'Apparent (bulk) Density' as a 'min'; b.) Plasticizer Sorption, delete 'Oil Absorption Spatula Rub-out' test and add '%DOP under applied Centrifugal Force' (D3367); c.) Dryflow, add dryflow time per D1895, method 'A' funnel, s/140 gms & delete dryflow, s/cm^3.