



Designation: D4243 – 23

Standard Test Method for Measurement of Average Viscometric Degree of Polymerization of New and Aged Electrical Papers and Boards¹

This standard is issued under the fixed designation D4243; 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 test method describes a standard procedure for determining the average viscometric degree of polymerization (abbreviated $\overline{DP}_v$) of new or aged electrical papers. The determination is made by measuring the intrinsic viscosity of a solution of the paper in an appropriate solvent.

1.2 The degree of polymerization (or the degree of condensation) of a particular cellulose molecule is the number of anhydro- β -glucose monomers, $C_6H_{10}O_5$, in the cellulose molecule. Within a sample of paper, not all the cellulose molecules have the same degree of polymerization so that the mean value measured by viscometric methods is not necessarily the same as that which are obtained by other methods.

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use. See Section 9.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

¹ This test method is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.01 on Electrical Insulating Products.

Current edition approved May 1, 2023. Published May 2023. Originally approved in 1983. Last previous edition approved in 2016 as D4243 – 16. DOI: 10.1520/D4243-23.

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.

D1711 Terminology Relating to Electrical Insulation

2.2 Other Document:

IEC 60450 Measurement of the Average Viscometric Degree of Polymerization of New and Aged Electrical Papers³

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology D1711.

4. Summary of Test Method

4.1 This test method measures the specific viscosity of a solution of the paper in cupriethylene-diamine. From this measurement the intrinsic viscosity of the solution is deduced, and from this the degree of polymerization is easily calculated.

4.2 This test method follows very closely the procedures specified in IEC 60450.

5. Significance and Use

5.1 This test method applies to all papers made from unmodified cellulose, as used in transformer, cable, or capacitor manufacture. It applies to new or aged papers. For information, Appendix X1 shows an example of statistical distribution of $\overline{DP}_v$ values for new papers intended for the insulation of transformers, together with information relative to cable and capacitor papers. Nevertheless, where evaluating the decomposition stage of aged papers, take care to use, as a reference, the $\overline{DP}_v$ value of the new paper of the very same origin; $\overline{DP}_v$ of new papers being a function, among other factors, of their specific gravity and of their manufacturing process.

5.2 This test method can also be used for the determination of the intrinsic viscosity of solutions of chemically modified papers, provided that these dissolve completely in the selection solvent. Use this test method with caution when it is applied to papers with mineral fillers.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.