



Designation: D5670 – 95 (Reapproved 2023)

Standard Test Method for Rubber—Determination of Residual Unsaturation in Hydrogenated Nitrile Rubber (HNBR) by Infrared Spectrophotometry¹

This standard is issued under the fixed designation D5670; 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 covers the percentage of residual unsaturation (double bonds in unhydrogenated butadiene) in hydrogenated nitrile rubber and is based on infrared examination of rubber films cast from solution.

1.2 This test method is applicable to all grades of hydrogenated nitrile rubber in the raw state.

1.3 This test method assumes that specimens and infrared spectra are prepared and analyzed by experienced personnel and that the equipment is operated according to the manufacturer's direction for optimum performance. No details for operation of infrared spectrophotometers are included in this test method.

1.4 Since it is customary in infrared spectrophotometry to use wavenumbers (cm^{-1}) rather than Hertz (Hz), the unit for frequency in the SI system, the former is employed throughout this test method.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.6 *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.*

1.7 *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

D4483 Practice for Evaluating Precision for Test Method Standards in the Rubber and Carbon Black Manufacturing Industries

E932 Practice for Describing and Measuring Performance of Dispersive Infrared Spectrometers

E1421 Practice for Describing and Measuring Performance of Fourier Transform Mid-Infrared (FT-MIR) Spectrometers: Level Zero and Level One Tests

3. Summary of Test Method

3.1 A specimen of the raw rubber is purified by precipitation with methanol from a solution in methyl ethyl ketone or by extraction of the solid rubber with methanol in a Soxhlet apparatus.

3.2 The purified rubber specimen is again dissolved in methyl ethyl ketone and a film is cast on a potassium bromide (KBr) disc.

3.3 The infrared spectrum of the film is obtained with a Fourier Transform Infrared Spectrophotometer (FT-IR) or a dispersive infrared spectrophotometer.

3.4 The corrected absorbance of the specific absorption bands for acrylonitrile (ACN), butadiene (BD), and hydrogenated butadiene (HBD) are determined using the baseline method and the percentage of residual unsaturation (double bonds in unhydrogenated butadiene) is calculated with the aid of absorbance factors from the referenced literature.³

4. Significance and Use

4.1 Hydrogenated nitrile rubbers are available at different levels of unsaturation and different acrylonitrile content. Highly saturated grades offer optimum resistance to aging,

¹ This test method is under the jurisdiction of ASTM Committee D11 on Rubber and Rubber-like Materials and is the direct responsibility of Subcommittee D11.11 on Chemical Analysis.

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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.

³ Brück, D., Kautschuk, Gummi, *Kunststoffe*, Vol 42, 1989, pp. 107–110 and 194–197.