



Designation: D6248 – 21

# Standard Test Method for Vinyl and Trans Unsaturation in Polyethylene by Infrared Spectrophotometry<sup>1</sup>

This standard is issued under the fixed designation D6248; 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 test method covers most types of polyethylene, those ethylene plastics consisting of ethylene and  $\alpha$ -olefin comonomers longer than propylene, and blends of the above in any ratio.

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

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.* Specific hazards statements are given in Section 8.

NOTE 1—There is no known ISO equivalent for this standard.

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:<sup>2</sup>

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D1505 Test Method for Density of Plastics by the Density-Gradient Technique

D3124 Test Method for Vinylidene Unsaturation in Polyethylene by Infrared Spectrophotometry

E131 Terminology Relating to Molecular Spectroscopy

E168 Practices for General Techniques of Infrared Quantitative Analysis

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.70 on Analytical Methods.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E275 Practice for Describing and Measuring Performance of Ultraviolet and Visible Spectrophotometers

## 3. Terminology

3.1 *General*—The units, symbols, and abbreviations used in this test method appear in Terminology E131.

## 4. Summary of Test Method

4.1 The band at  $965\text{ cm}^{-1}$  is characteristic of the trans-vinylene substituted group. The band at  $908\text{ cm}^{-1}$  is characteristic of the terminal vinyl group.

4.2 These bands are not seriously overlapped by interfering groups from the polymer. The vinyl absorbance at  $908\text{ cm}^{-1}$  is close to the absorbance band from terminal methyl groups on chains longer than ethyl, at  $895\text{ cm}^{-1}$ . This interference is minimal for most products. Inclusion of the bromination and spectral subtraction step from Test Method D3124 has been found to improve the results for some very low density products.

4.3 Integrated absorbance is used in this test method. Integrated absorbance is found by integrating the spectrum over the absorbance band when the spectrum is plotted as absorbance versus frequency, in  $\text{cm}^{-1}$ . Most spectral manipulation software contains algorithms for adequately determining baseline corrected integrated absorbencies.

4.4 Calibration is performed using a solution of 1-octene for normal vinyl groups, and trans-3-hexene for trans-vinylene groups.

## 5. Significance and Use

5.1 There are three types of olefinic groups present in sufficient concentrations to warrant consideration, one or more of that can normally be found in any polyethylene. The three types are trans-vinylene,  $\text{R-CH=CH-R'}$ , sometimes referred to as trans-internal unsaturation; vinylidene or pendent methylene,  $\text{RR'C-CH}_2$ ; and vinyl unsaturation,  $\text{R-CH=CH}_2$ , also referred to as terminal unsaturation.

5.2 The type and quantity of these groups can influence the chemical and physical properties of the resin. Information