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Standard Practice for Determination of Structural Features in Polyolefins and Polyolefin Copolymers by Infrared Spectrophotometry (FT-IR)[1]

This standard is issued under the fixed designation D5576; 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 practice covers infrared procedures for determining the molecular structural features in polyolefins and polyolefin copolymers. The structural features of primary concern are the types and numbers of branches. Although this practice centers its attention on polyolefins and polyolefin copolymers, the techniques, with proper modification, can be used for some other polymers as well.

NOTE 1—Quantitative determinations require either an internal or an external evaluation of sample thickness. ASTM test methods available for specific features are listed in Tables 1 and 2.

1.2 *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 to determine the applicability of the regulatory limitations prior to use.*

NOTE 2—There is no similar or equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D883 Terminology Relating to Plastics

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

D1600 Terminology for Abbreviated Terms Relating to Plastics

D2238 Test Methods for Absorbance of Polyethylene Due to Methyl Groups at 1378 cm^{-1}

D3124 Test Method for Vinylidene Unsaturation in Polyethylene by Infrared Spectrophotometry

D3594 Test Method for Copolymerized Ethyl Acrylate In Ethylene-Ethyl Acrylate Copolymers

D5594 Test Method for Determination of the Vinyl Acetate Content of Ethylene-Vinyl Acetate (EVA) Copolymers by Fourier Transform Infrared Spectroscopy (FT-IR)

D6248 Test Method for Vinyl and Trans Unsaturation in Polyethylene by Infrared Spectrophotometry

E131 Terminology Relating to Molecular Spectroscopy

E168 Practices for General Techniques of Infrared Quantitative Analysis

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

IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern System

3. Terminology

3.1 *Definitions*—For definitions of plastics terms used in this practice see Terminology D883 and D1600.

3.2 Units, symbols and abbreviations used in this practice appear in Terminology E131 or IEEE/ASTM SI-10.

4. Summary of Practice

4.1 Infrared absorption bands suitable for quantitative analysis by FT-IR are listed in Tables 1 and 2. These are only typical bands and are not to be construed as exhaustive.

4.2 For quantitative determinations, sample specimen thickness is measured internally at some band representing the basic chain structure, such as 2019 cm^{-1} for polyethylene, or externally using a micrometer (see Tables 1 and 2 for ASTM test methods).

NOTE 3—**Warning:** Molding can cause carbonyl formation due to oxidation. This should be checked in the 1700 to 1750 cm^{-1} range.

5. Significance and Use

5.1 The structural features expressed by these determinations affect the ultimate polymeric properties and are useful in showing correlations with many performance properties.

6. Apparatus

6.1 *Infrared Spectrophotometer,* either double beam or a Fourier transform (FT-IR).

[1] This practice 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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[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**

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