



Designation: D 2144 – 01

Standard Test Methods for Examination of Electrical Insulating Oils by Infrared Absorption¹

This standard is issued under the fixed designation D 2144; 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 These test methods are to be used for the recording and interpretation of infrared absorption spectra of electrical insulating oils from 2.5 to 25 μm (4000 to 400 cm^{-1}).

NOTE 1—While these test methods are specific to ratio recording double-beam dispersive spectrophotometers, single-beam and HATR (horizontal attenuation total reflectance), Fourier-transform rapid scan infrared spectrophotometers may also be used. By computerized subtraction techniques, ratio methods can be used. Any of these types of equipment may be suitable if they comply with the specifications described in Practice E 932.

1.2 Two test methods are covered, a Reference Standard Test Method and a Differential Test Method.

1.3 These test methods are designed primarily for use as rapid continuity tests for identifying a shipment of oil from a supplier by comparing its spectrogram with that obtained from previous shipments, or with the sample on which approval tests were made. They also may be used for the detection of certain types of contamination in oils, and for the identification of oils in storage or service, by comparison of the spectra of the unknown and known oils. The test methods are not intended for the determination of the various constituents of an oil.

1.4 **Caution**—Infrared absorption is a tool of high resolving power. Conclusions as to continuity of oil quality should not be drawn until sufficient data have been accumulated so that the shipment-to-shipment variation is clearly established, for example.

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

2. Referenced Documents

2.1 ASTM Standards:

D 923 Practices for Sampling Electrical Insulating Liquids²

¹ These test methods are under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.03 on Analytical Tests.

Current edition approved April 10, 2001. Published June 2001. Originally published as D 2144 – 63 T. Last previous edition D 2144 – 94.

² *Annual Book of ASTM Standards*, Vol 10.03.

E 131 Terminology Relating to Molecular Spectroscopy³

E 168 Practices for General Techniques of Infrared Quantitative Analysis³

E 932 Practice for Describing and Measuring Performance of Dispersive Infrared Spectrophotometers³

3. Terminology

3.1 **Definitions**—For definitions of terms and symbols, refer to Terminology E 131.

4. Summary of Test Methods

4.1 The infrared absorption spectrum may be recorded on the spectrophotometer by either of the two test methods outlined below. In both test methods differences in wavelength or frequency and intensity of the absorption bands are observed and measured.

4.1.1 **Reference Standard Test Method**—An infrared cell filled with the insulating oil test specimen is placed in the sample beam of the spectrophotometer. With the shutter of the reference beam open, the infrared absorption spectrum is recorded over the entire range of the instrument. The absorption spectrum of the test specimen is compared with a reference spectrum obtained with oil from a previous test specimen or the qualification oil.

4.1.2 **Differential Test Method**—Two cells having the same sample path length are filled, one with the test specimen and the other with the reference oil. The filled cells are then placed in the paths of the sample and reference beams, respectively, and the differential absorption spectrum recorded. This spectrum is then compared with the reference differential spectrum obtained in a similar manner with the same cells filled with the reference oil.

5. Significance and Use

5.1 The infrared spectrum of an electrical insulating oil is a record of the absorption of infrared energy over a range of wavelengths. The spectrum indicates the general chemical composition of the test specimen.

NOTE 2—The infrared spectrum of a pure chemical compound is probably the most characteristic property of that compound. However, in the case of oils, multicomponent systems are being examined whose

³ *Annual Book of ASTM Standards*, Vol 03.06.