



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

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1. Scope

1.1 These test methods cover 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, recent developments have made available single-beam Fourier-transform rapid scan infrared spectrophotometers. By computerized subtraction techniques, ratio methods can be used. This equipment may be suitable if it complies with the specifications described in Table 1.

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 batch-to-batch variation is clearly established.

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 Test Method for Sampling Electrical Insulating Liquids²

E 131 Terminology Relating to Molecular Spectroscopy³

E 168 Practices for General Techniques of Infrared Quantitative Analysis³

¹ These test methods are under the jurisdiction of ASTM Committee D-27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.03 on Analytical Tests.

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² Annual Book of ASTM Standards, Vol 10.03.

³ Annual Book of ASTM Standards, Vol 03.06.

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 sample 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 sample oil is compared with a reference spectrum obtained with oil from a previous sample or the qualification oil.

4.1.2 **Differential Test Method**—Two cells having the same sample path length are filled, one with sample oil 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 sample.

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 spectra are the sum total of all the spectra of the individual components. Because the absorption bands of the components may overlap, the spectrum of the oil is not as sharply defined as that for a single compound. For these reasons, these test methods may not in every case be suitable for the quantitative estimation of the components of such a complex mixture as mineral oil.