



Standard Test Method for Dissolved Copper In Electrical Insulating Oil By Atomic Absorption Spectrophotometry¹

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1. Scope

1.1 This test method covers the determination of copper in new or used electrical insulating oil of petroleum origin by atomic absorption spectrophotometry.

1.2 The lowest limit of detectability is primarily dependent upon the method of atomization, but also upon the energy source, the fuel and oxidant, and the degree of electrical expansion of the output signal. The lowest detectable concentration is usually considered to be equal to twice the maximum variation of the background. For flame atomization, the lower limit of detectability is generally in the order of 0.1 ppm or 0.1 mg/kg. For non-flame atomization, the lower limit of detectability is less than 0.01 ppm.

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

1.4 *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. See 5.4 for specific precautionary statements.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 1193 Specification for Reagent Water²

D 3487 Specification for Mineral Insulating Oil Used in Electric Apparatus³

D 5222 Guide for High Fire-Point Mineral Electrical Insulating Oils³

3. Summary of Test Method

3.1 The test specimen of oil is filtered and diluted with an appropriate organic solvent and analyzed in an atomic absorption spectrophotometer. Alternate procedures are provided for

instruments employing flame and non-flame atomization. Concentration is determined by means of calibration curves prepared from standard samples.

4. Significance and Use

4.1 Electrical insulating oil may contain small amounts of dissolved metals derived either directly from the base oil or from contact with metals during refining or service. When copper is present, it acts as a catalyst in promoting oxidation of the oil. This test method is useful for research for new oils and to assess the condition of service-aged oils. Consideration should be given to the limits of detection outlined in the scope.

5. Apparatus

5.1 *Volumetric flasks*, 100-mL capacity.

5.2 *Membrane filter*, 0.45 μm .

5.3 *Burets*, 5 and 50-mL capacity.

5.4 *Atomic Absorption Spectrophotometer*—The instrument shall have an atomizer, a spectral energy source, usually consisting of a copper hollow cathode lamp, a monochromator capable of isolating the desired line of radiation, an adjustable slit, a photomultiplier tube or other photosensitive device as a light measuring and amplifying device, and a read-out mechanism for indicating the amount of absorbed radiation. **Caution:** Proper ventilation must be provided to remove toxic metal vapors.

5.4.1 Instruments employing flame atomization require a nebulizer assembly, burner head, and suitable pressure and flow regulating devices to maintain constant oxidant and fuel flow for the duration of the tests.

5.4.1.1 *Glass Syringe*, 10-mL capacity.

5.4.2 Instruments employing non-flame atomization require a suitable pressure regulating device to maintain an inert atmosphere.

5.4.2.1 *Graphite Furnace* with background correction.

5.4.2.2 *Output Device, Printer or Strip Chart Recorder* (if permanent record is required).

5.4.2.3 *Pipets*, 1 and 5- μL .

¹ This test method is under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and is the direct responsibility of Subcommittee D27.03 on Analytical Tests.

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² *Annual Book of ASTM Standards*, Vol. 11.01.

³ *Annual Book of ASTM Standards*, Vol 10.03.