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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Copper In Electrical Insulating Oil By Atomic Absorption Spectrophotometry¹

This standard is issued under the fixed designation D 3635; 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 test method covers the determination of copper in new or used electrical insulating oil 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. For non-flame atomization, the lower limit of detectability is less than 0.01 ppm.

1.3 The values stated in acceptable metric 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 5.3 for specific precautionary statements.

2. Referenced Documents

2.1 ASTM Standards:

D 1193 Specification for Reagent Water²

D 2576 Method of Test for Metals in Water and Waste Water by Atomic Absorption Spectrophotometry³

3. Summary of Test Method

3.1 The sample of oil is 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.

¹ This test method is under the jurisdiction of ASTM Committee D-27 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 Discontinued; see 1980 Annual Book of ASTM Standards, Part 31.

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 and to assess the condition of service-aged oils.

5. Apparatus

5.1 *Volumetric flasks*, 100-mL capacity.

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

5.3 *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.

5.3.1 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.

5.3.1.1 *Oxidant-Air*, cleaned and dried through a suitable filter to remove oil, water, and other foreign substances.

5.3.1.2 *Acetylene*, purified grade.

NOTE 1—Acetylene cylinders should be replaced when the pressure reaches 100 psi to prevent acetone, always present, from entering and damaging the burner head.

5.3.1.3 *Glass Syringe*, ⁴ 10-mL capacity.

5.3.1.4 *Platinum Dish*, 200-mL capacity minimum.

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

5.3.2.1 *Argon*, commercial grade.

⁴ B-D Multifit syringes with glass Luer tips, available from Becton, Dickinson and Co., Rutherford, NJ have been found satisfactory for this method.