



Designation: D7151 – 15 (Reapproved 2023)

Standard Test Method for Determination of Elements in Insulating Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)¹

This standard is issued under the fixed designation D7151; 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 describes the determination of metals and contaminants in insulating oils by inductively coupled plasma atomic emission spectrometry (ICP-AES). The specific elements are listed in [Table 1](#). This test method is similar to Test Method [D5185](#), but differs in methodology, which results in the greater sensitivity required for insulating oil applications.

1.2 This test method uses oil-soluble metals for calibration and does not purport to quantitatively determine insoluble particulates. Analytical results are particle size dependent, and low results are obtained for particles larger than several micrometers.²

1.3 This test method determines the dissolved metals (which can originate from overheating or arcing, or both) and a portion of the particulate metals (which generally originate from a wear mechanism). While this ICP method detects nearly all particles less than several micrometers, the response of larger particles decreases with increasing particle size because larger particles are less likely to make it through the nebulizer and into the sample excitation zone.

1.4 This test method includes an option for filtering the oil sample for those users who wish to separately determine dissolved metals and particulate metals (and hence, total metals).

1.5 Elements present at concentrations above the upper limit of the calibration curves can be determined with additional, appropriate dilutions and with no degradation of precision.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*³

[C1109 Practice for Analysis of Aqueous Leachates from Nuclear Waste Materials Using Inductively Coupled Plasma-Atomic Emission Spectroscopy](#)

[D923 Practices for Sampling Electrical Insulating Liquids](#)

[D1744 Test Method for Determination of Water in Liquid Petroleum Products by Karl Fischer Reagent](#) (Withdrawn 2016)⁴

[D2864 Terminology Relating to Electrical Insulating Liquids and Gases](#)

[D4307 Practice for Preparation of Liquid Blends for Use as Analytical Standards](#)

[D5185 Test Method for Multielement Determination of Used and Unused Lubricating Oils and Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry \(ICP-AES\)](#)

[E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods](#)

[E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method](#)

3. Terminology

3.1 Definitions for general terms are found in Terminology [D2864](#).

3.2 *Definitions of Terms Specific to This Standard:*

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 Eisentraut, K. J., Newman, R. W., Saba, C. S., Kauffman, R. E., and Rhine, W. E., *Analytical Chemistry*, Vol 56, 1984.

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.