



Designation: D923 – 15 (Reapproved 2023)

Standard Practices for Sampling Electrical Insulating Liquids¹

This standard is issued under the fixed designation D923; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 These practices cover sampling of new electrical insulating liquids including oils, askarels, silicones, synthetic liquids, and natural ester insulating liquids as well as those insulating liquids in service or subsequent to service in cables, transformers, circuit breakers, and other electrical apparatus. These practices apply to liquids having a viscosity of less than $6.476 \times 10^{-4} \text{ m}^2/\text{s}$ (540 cSt) at 40 °C (104 °F).

1.2 Representative samples of electrical insulating liquids are taken for test specimens so that the quality pertinent to their use may be determined. The quality in different portions of a given container, or the average quality of the whole bulk may be ascertained if desired.

1.3 The values stated in SI units are regarded as the standard where applicable. Inch pound units are used where there is no SI equivalent.

1.4 These practices also include special techniques and devices for sampling for dissolved gases-in-oil (DGA) (D3612), water (D1533) and particles (D6786).

1.5 For ease of use, this document has been indexed as follows:

Section Title	Section/ Paragraph
Mandatory Conditions and General Information Description of Sampling Devices and Containers	Section 5 Section 6, Annex A1, Appendix X2
Most Frequently Used Sampling Techniques for Electrical Apparatus	
Collecting Samples from Electrical Equipment Using Bottles and Cans	Section 7, Appendix X1, Appendix X2
Collecting Samples from Electrical Equipment Using Glass Syringes (DGA and Water Analysis)	Section 8
Collecting Samples from Electrical Equipment Using Stainless Steel Cylinders (DGA and Water Analysis)	Section 9

¹ These practices are under the jurisdiction of ASTM Committee D27 on Electrical Insulating Liquids and Gases and are the direct responsibility of Subcommittee D27.07 on Physical Test.
Current edition approved Dec. 1, 2023. Published December 2023. Originally approved in 1947. Last previous edition approved in 2015 as D923 – 15. DOI: 10.1520/D0923-15R23.

Section Title	Section/ Paragraph
Sampling of Cans, Drums, Tank Cars, Tank Trucks and Small Electrical Equipment	
Sampling Using the Dip-Type Device (drum thief)	Section 10
Sampling Using the Pressure-Type Device	Section 11, Annex A1.1
Sampling Using the Tank Car-Type Device	Section 12, Annex A1.2
Sampling Cable Feeders	
Mandatory Conditions	Section 13
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Sampling Using the Manifold-Type Device	Section 15, Annex A1.3
Cleaning, Preparation, Storage, and Handling of Sampling Containers	Section 16
Storage, Packaging and Shipping of Samples	Section 17
Cleaning and Storage of Sampling Devices	Section 18
Sample Information	Section 19
Mandatory Information—Construction of Sampling Devices	Annex A1
Determination of Electrical Apparatus Temperature	Appendix X1
Sample Container Types	Appendix X2

1.6 Handle askarels containing polychlorinated biphenyls (PCBs) according to federal and local regulations existing for that country. For example, the federal regulations concerning PCBs in the United States can be found in 40 CFR Part 761.

1.7 Properly contain, package and dispose of any liquid or material resulting from the use of these practices in a manner that is in accordance with local and state regulations specific to the country in which the samples are taken.

1.8 *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.* Specific warning statements are given in 1.6, 1.7, Section 5, 10.1, 13.2, 15.2.3, Section 16, and 18.2. These practices involve close contact with the electrical insulating liquids being sampled as well as liquids and other materials used to clean the sampling tools and devices. When required, or as a matter of diligence to personal safety, use personal protective equipment (PPE).

1.9 *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:²

- D1533** Test Method for Water in Insulating Liquids by Coulometric Karl Fischer Titration
- D1933** Specification for Nitrogen Gas as an Electrical Insulating Material
- D3612** Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography
- D4057** Practice for Manual Sampling of Petroleum and Petroleum Products
- D6786** Test Method for Particle Count in Mineral Insulating Oil Using Automatic Optical Particle Counters

3. Terminology

3.1 Definitions:

3.1.1 *sampling, v*—the obtaining of that amount of a material which is adequate for making the required tests and which is representative of that portion of the material from which it is taken.

3.1.1.1 *Discussion*—In most cases the detection of contaminants that are not ordinarily dispersed uniformly through the liquid being sampled, such as water or solid particles, necessitates taking samples at specific locations where the contaminants are likely to be found. For a liquid having a relative density (specific gravity) less than one, water and some other impurities are most likely to be found on or near the bottom. In the case of a liquid having a specific gravity greater than one, some of these impurities are most likely to be found on or near the surface.

4. Significance and Use

4.1 Accurate sampling, whether of the complete contents or only parts thereof, is extremely important from the standpoint of evaluating the quality of the liquid insulant sampled. Obviously, examination of a test specimen that, because of careless sampling procedure or contamination in sampling equipment, is not directly representative, leads to erroneous conclusions concerning quality and in addition results in a loss of time, effort, and expense in securing, transporting, and testing the sample.

4.2 A study of gases and moisture contained in insulating oils from transformers and other electrical power apparatus can frequently give an early indication of abnormal behavior of the apparatus, and may indicate appropriate action be taken on the equipment before it suffers greater damage. Specific gas and moisture content can be determined from oil sampled for this purpose.

5. Mandatory Conditions and General Information

5.1 Mandatory Conditions when Sampling Electrical Apparatus:

5.1.1 Energized electrical apparatus being sampled must have a positive pressure at the sampling outlet, so as not to introduce an air bubble into the apparatus during the sampling process. Refer to 7.2.

5.1.2 Do not draw samples from any energized electrical equipment with a small volume of oil, especially those that require the addition of oil to maintain the electric strength of the insulation system. If the proper level or existing level can not be accurately determined do not proceed.

5.1.3 Maintain the insulating fluid within the electrical apparatus being sampled at a level that will not reduce the electric strength of the insulation system.

5.1.4 Do not sample electrical apparatus if only a drain plug is provided, as it would be difficult to control the flow.

5.1.5 Do not draw samples from energized instrument transformers such as CTs and PTs.

5.1.6 Do not draw samples from an energized switch or the cable termination compartment of network transformers.

5.2 General Information:

5.2.1 Take and handle samples or test specimens in such a manner as to avoid the loss or gain of properties for which they are being tested. Some tests are greatly affected by minute traces of impurities, and it is imperative that utmost precautions be taken to prevent contamination when obtaining samples. Due to the hygroscopic tendency of insulating liquids, it is important to minimize exposure to the atmosphere of the sample being taken.

5.2.2 Take a sufficient quantity of liquid as a sample to cover the requirements of the respective tests to be made. Make reference to the procedures governing these tests to ascertain the quantity of liquid for each test specimen and the number of test specimens required.

5.2.3 When samples are to be taken the temperature of the liquid should be equal to or greater than the temperature of the surrounding air in order to minimize the possibility of condensed moisture from the air being absorbed by the liquid during the sampling process, particularly in a humid atmosphere.

5.2.4 When taking samples of liquid from large storage tanks, transformers, oil-circuit breakers, gravity-fed reservoirs on oil-filled cable feeders, and other electrical equipment, the electrical equipment drain valve is usually adequate. However, when high relative humidity conditions exist and it is desired to obtain samples through a closed system, the manifold in Fig. 10 is recommended.

5.3 General Information when Sampling Electrical Apparatus:

5.3.1 All non-hermetically sealed equipment, filled with insulating liquid having a relative density (specific gravity) less than 1, should be provided with the sampling outlet located at the bottom of the tank so that bottom samples of the oil may be obtained.

5.3.2 All non-hermetically sealed equipment, filled with insulating liquid having a relative density (specific gravity)

² 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.