Designation: D 3284 – 99

Standard Test Method for Combustible Gases in the Gas Space of Electrical Apparatus Using Portable Meters[1]

This standard is issued under the fixed designation D 3284; 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 field test method covers the detection and estimation of combustible gases in the gas blanket above the oil or in gas detector relays in transformers using portable instruments. It is applicable only with transformers using mineral oil as the dielectric fluid. Gases dissolved in the oil and noncombustible gases are not determined. A method of calibrating the instruments with a known gas mixture is included.

1.2 This test method affords a semi-quantitative estimate of the total combustible gases present in a gas mixture. If a more accurate determination of the total amount of combustible gases or a quantitative determination of the individual components is desired, use a laboratory analytical method, such as Test Method D 3612.

1.3 *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.* Specific precautionary statements are given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*

D 3612 Test Method for Analysis of Gases Dissolved in Electrical Insulating Oil by Gas Chromatography[2]

2.2 *IEEE Standard:*

C57.104 Guide for the Interpretation of Gases Generated in Oil-Immersed Transformers[3]

3. Summary of Test Method

3.1 A sample of gas is diluted to a fixed ratio with air and introduced into the meter at a pressure of approximately one atmosphere. Any combustible gases present are catalytically oxidized on the surface of a sensor which is an element of a Wheatstone bridge. When combustible gases oxidize on the surface, they increase the temperature of the element, which changes its resistance and upsets the balance of the bridge.

3.2 The change in the resistance of the indicating elements in the bridge circuit is indicated on a meter, which is usually calibrated to read in percent total combustible gas.

4. Significance and Use

4.1 Arcing, partial discharge, and localized overheating in the insulation system of transformers result in chemical decomposition of the insulating oil and other insulating materials. This may generate various gases, some of which are combustible. Typically, gases are generated in the oil and then partitioned into the gas space according to their individual solubilities. Gases which are highly oil-soluble, such as acetylene, may not be in significant quantities in the gas space until an incipient fault has progressed to a very serious condition or failure of the transformer. Gases such as carbon monoxide and hydrogen which have low solubilities in oil can make up a large fraction of the combustible gases in the gas space. Detection of these gases is frequently the first available indication of a malfunction. Portable combustible gas meters are a convenient means of detecting the presence of generated gases.

4.2 Normal operation of a transformer may result in the formation of some combustible gases. The detection of an incipient fault by this method involves an evaluation of the amount of combustible gases present, the rate of generation of these gases, and their rate of escape from the transformer. Refer to IEEE C57.104 for detailed information on interpretation of gassing in transformers.

5. Interferences

5.1 In this test method it is essential that sufficient oxygen be present in the gas mixture to oxidize the combustible gases. Since the gas blanket in a transformer is usually an inert gas, it is necessary to dilute the sample gas with a known amount of air. This is usually accomplished by either introducing air and the sample gas into the instrument in known ratios through fixed orifices, or by mixing known quantities of air and test specimen externally by displacement over water before introduction into the instrument. The working range of these instruments is between the low limit of sensitivity and about

[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 D27.03on Analytical Tests.

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[2] *Annual Book of ASTM Standards*, Vol 10.03.

[3] Available from IEEE, 445 Hoes Lane, Piscataway, NJ 08855-1331.