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CONTENTS

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Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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INTRODUCTION

Dissolved gas analysis (DGA) is one of the most widely used diagnostic tools for detecting and evaluating faults in electrical equipment filled with insulating liquid, independently of whether this is mineral oil, ester or silicone insulating liquid. However, interpretation of DGA results is often complex and should always be done with care, involving experienced personnel. The standards for gas-in-oil interpretation are understood as a guideline tool. For although there is a scientific basis for explaining the formation of gases, the interpretation of the data in terms of cause of failure(s) is not an exact science but derived from empirical evidence from which rules of interpretation have been deduced.

Similar guidance for DGA evaluation (interpretation) exists already for mineral oil anchored in numerous national and international standards, for example IEC 60599 or IEEE Std C57™.104-2019 [35][1]. IEEE Std C57™.155-2014 [36] describes the evaluation of the dissolved gas analysis of esters (mainly natural esters) based on absolute values.

Synthetic ester insulating liquids have been used in electrical equipment since the late 70s, natural esters since the late 90s. The electrical energy demand is growing and with it the demand for synthetic and natural esters. Synthetic and natural esters are often used in susceptible environmental areas, due to their high flash and fire points (when stringent fire requirements are demanded) and extended to numerous applications, even independently of their limited flammability. There are some standards for the maintenance of the liquid itself but few for the interpretation of the dissolved gas analysis. This document gives guidance for the interpretation of dissolved gas analysis in ester-filled equipment.

[1] Numbers in square brackets refer to the Bibliography.

1 Scope

This document gives guidelines to the transformer operator in evaluating dissolved gas analysis (DGA) data obtained from natural ester according to IEC 62770 [31] and synthetic ester according to IEC 61099 [29] in liquid filled transformers and similar equipment. Due to limited information on equipment filled with mono- and blended esters (IEC 63012 [33]) at present they are included in Annex D.

Ester liquids are present in the whole range of applications including transport and distribution networks, industrial, traction, wind and solar transformers as reflected in the tables related to the data gathered in this document. Nowadays their use has been extended to power transformers. Ester liquids are also increasingly used in combination with tap-changers. Due to insufficient DGA data available, switching equipment is excluded from this document.

This document includes the following:

– gas generation in a natural or synthetic ester-filled transformer;
– gas concentration guide values valid for the use of DGA interpretation tools;
– methods for the interpretation of the dissolved gas results;
– recommended actions based on the interpretation of dissolved gas analysis results;
– examples of faulty equipment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60475, *Method of sampling insulating liquids*

IEC 60567:2023, *Oil-filled electrical equipment - Sampling of free gases and analysis of free and dissolved gases in mineral oils and other insulating liquids - Guidance*

IEC 60599:2022, *Mineral oil-filled electrical equipment in service - Guidance on the interpretation of dissolved and free gases analysis*

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[26] IEC 60296, *Fluids for electrotechnical application - Mineral insulating oils for electrical equipment*

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[2] This publication has been superseded by C57.104-2019.

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[37] IEC 60156*, Insulating liquids - Determination of the breakdown voltage at power frequency - Test method*