

DGA Testing

Introduction

Dissolved gas analysis (DGA) is a test used to assess paper-oil insulation systems, and the most commonly used technique for oil-insulated power transformers. Over time (and due to electrical stresses and thermal decomposition), the cellulose paper and insulating (mineral) oil in paper-oil insulation systems break down and forms gases which are dissolved in the oil. In DGA testing, a sample of oil is collected and analysed for the types, volumes, concentrations and formation rates of dissolved gases. This can provide important information on the condition of the insulation system, as well as the nature of the electrical disturbances that the system has been subjected to.

Gas decomposition typically involves chemical reactions that break up the carbon and hydrogen bonds of the hydrocarbon chains in both the cellulose and oil. The following gases are most commonly formed and are considered the most significant in the context of DGA testing:

- From insulating oil: hydrogen (H_2), methane (CH_4), acetylene (C_2H_2), ethylene (C_2H_4) and ethane (C_2H_6)
- From cellulose: hydrogen (H_2), methane (CH_4), carbon monoxide (CO) and carbon dioxide (CO_2)

Interpretation of Results

ANSI/IEEE Std C57.104 [1] provides guidance on concentration limits of the key gases:

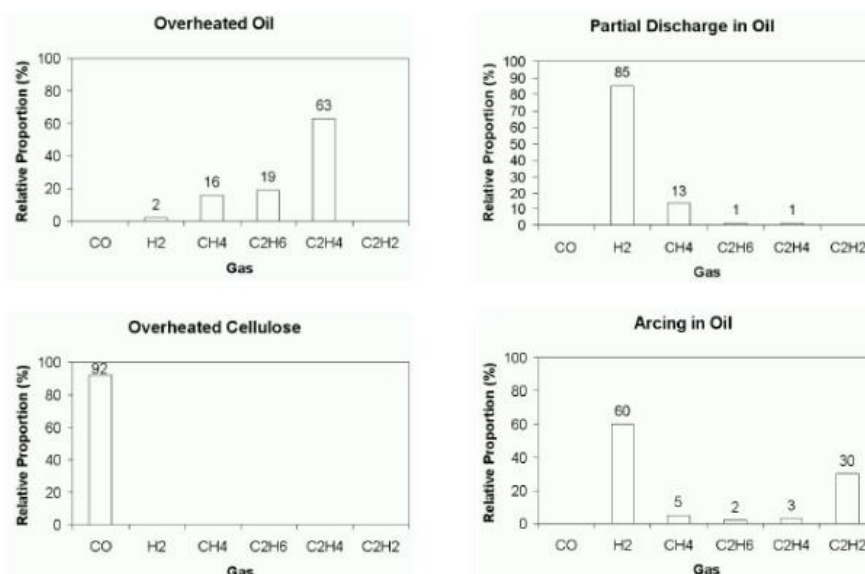
Dissolved gas concentration limit (ppm)								Interpretation
Hydrogen (H_2)	Methane (CH_4)	Acetylene (C_2H_2)	Ethylene (C_2H_4)	Ethane (C_2H_6)	Carbon monoxide (CO)	Carbon dioxide (CO_2)	TDC G (*)	
100	120	1	50	65	350	2500	720	Satisfactor

								y
101 - 700	121 - 400	2 - 9	51 - 100	66 - 100	351 - 570	2500 - 4000	721 - 1920	Fault may be present
701 - 1800	401 - 1000	10 - 35	101 - 200	101 - 150	571 - 1400	4001 - 10000	1921 - 4630	Fault probably present
>1800	>1000	>35	>200	>150	>1400	>10000	>4630	Continued operation could result in failure

(*) TDCG = Total dissolved combustible gas

Types of Faults

The relative proportions of gas types can suggest the type of fault that has occurred in the transformer to form the particular gases, as shown in the figure below (courtesy of IEEE C57.104):



Source:

http://www.openelectrical.org/wiki/index.php?title=DGA_Testing