

# INTERNAL TRANSFORMER FAULTS

## Dissolved Gasses Analysis (DGA)

### WHAT?

A dissolved gasses analysis (DGA) determines if there are internal problems within the transformer. DGA is one of the most important analyses performed on transformer oil.

### WHY?

The DGA analysis results enable preparation of recommendations to increase the availability and reliability of transformers by defining appropriate maintenance actions (dehydration, partial discharge measurements, cooling upgrade, and internal inspection among others).

### HOW?

Each type of internal transformer fault—such as partial discharges, insufficient cooling, or a local hot spot—generates a unique combination of gasses in the insulating oil. Laborelec determines the type of gas and calculates the ratios between the different gasses and their rate of change. The information obtained enables us to define the type of internal fault and the criticality and evolutionary stage of this fault.

Laborelec follows the IEC 60599 or ASTM D3612 test methods to determine the content of the different dissolved gasses. Our experts use the headspace method (HS) to extract these gasses for analysis. They use a GC-FID/TCD gas chromatograph equipped with two detector types—a Flame Ionization Detector (FID) and a Thermal Conductivity Detector (TCD) to accomplish this.

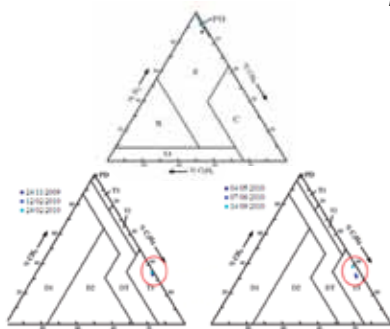
**Frequency of analysis:** every 6 to 24 months

CASE	R2 $C_2H_2/C_2H_4$	R1 $CH_4/H_2$	R5 $C_2H_4/C_2H_6$	SUGGESTED FAULT DIAGNOSIS
0	<0.1	>0.1 to <1.0	<1.0	Unit normal
1	<0.1	<1.0	<1.0	Low-energy density arcing—PD
2	0.1 to 3.0	0.1 to 1.0	>3.0	Arcing—High-energy discharge
3	<0.1	>0.1 to <1.0	1.0 to 3.0	Low temperature thermal
4	<0.1	>1.0	1.0 to 3.0	Thermal <700°C
5	<0.1	>1.0	>3.0	Thermal >700°C

The Rogers' Ratio Method is one way of interpreting the results of the DGA.



Example of an internal transformer fault (sparking) discovered through regular dissolved gasses analyses.



Dr. Michel Duval developed several triangles for the interpretation of the DGA results and the follow-up of the evolution of the internal transformer fault.

ANALYSIS	METHOD	REQUIRED OIL VOLUME
Dissolved gasses (**)	IEC 60567	125 ml
Dissolved metals	ASTM D7151	100 ml
Water content	IEC 60814	25 ml



(\*\*): Analyses performed under ISO 17025 accreditation—Measurement uncertainties available on demand