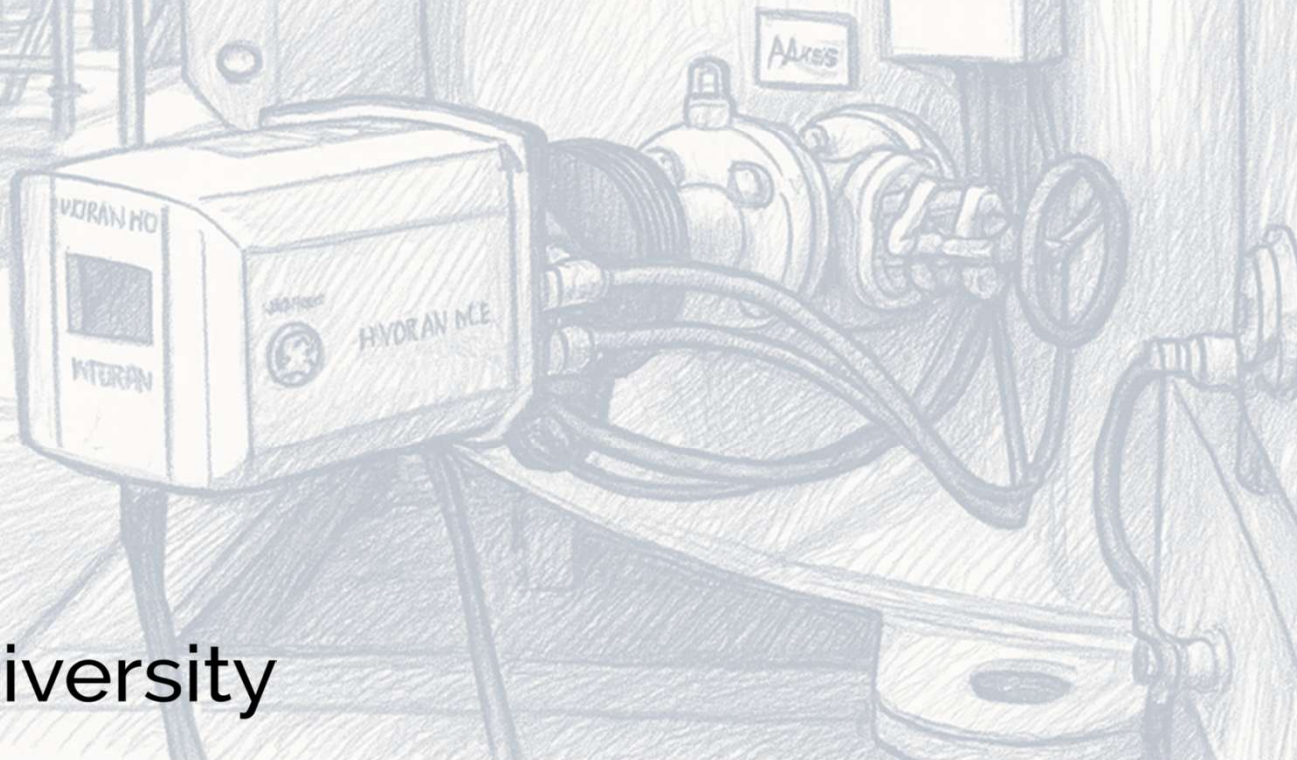


Electricity | Power transformers

## Dissolved Gas Analysis (DGA) monitoring device



# 1

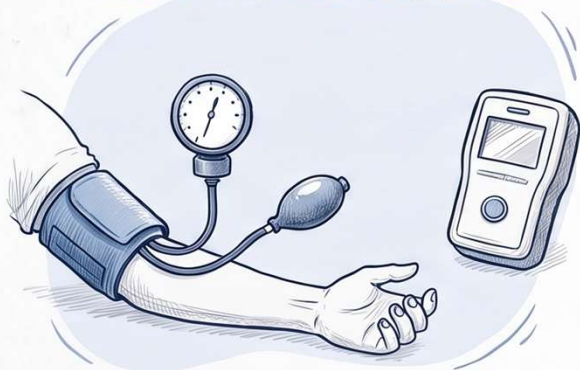
## Dissolved Gas Analysis (DGA) monitoring device

### ***Dissolved Gas Analyser***

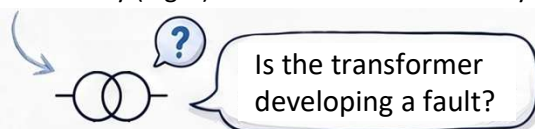
A system for the continuous monitoring of dissolved gases and water content in oil, which alerts operators to developing latent faults in the transformer

Dissolved gas analysis (DGA) is the key method for monitoring the internal condition of a transformer whilst it is in operation. There are three levels of equipment, ranging from a simple alert to a comprehensive diagnosis.

### LEVEL 1 : MONITORING



**like taking a blood pressure reading:** indicates a general abnormality (1 gas) + moisture without identifying the cause

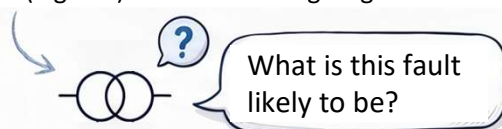


| Level              | Monitoring                              |
|--------------------|-----------------------------------------|
| Measuring capacity | 1 gas (H <sub>2</sub> equi.) + moisture |

### LEVEL 2 : DIAGNOSIS



**like a blood test:** identifies the type of fault (5 gases) + moisture using targeted indicators

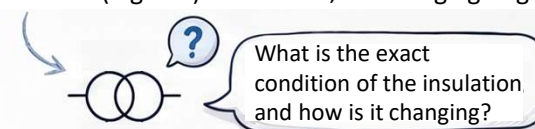


| Level              | Diagnosis          |
|--------------------|--------------------|
| Measuring capacity | 5 gases + moisture |

### LEVEL 3 : EXPERT

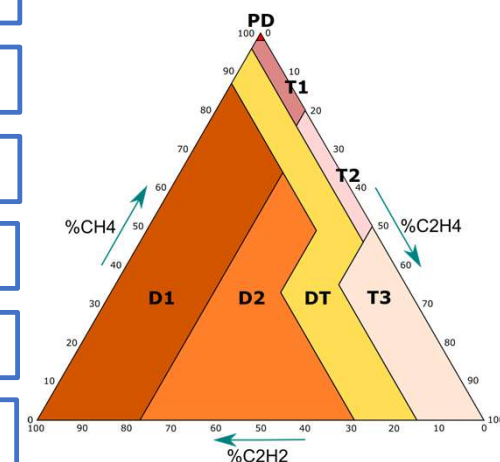


**like a full medical check-up:** provides a comprehensive biological assessment (9 gases) + moisture, including ageing of insulation



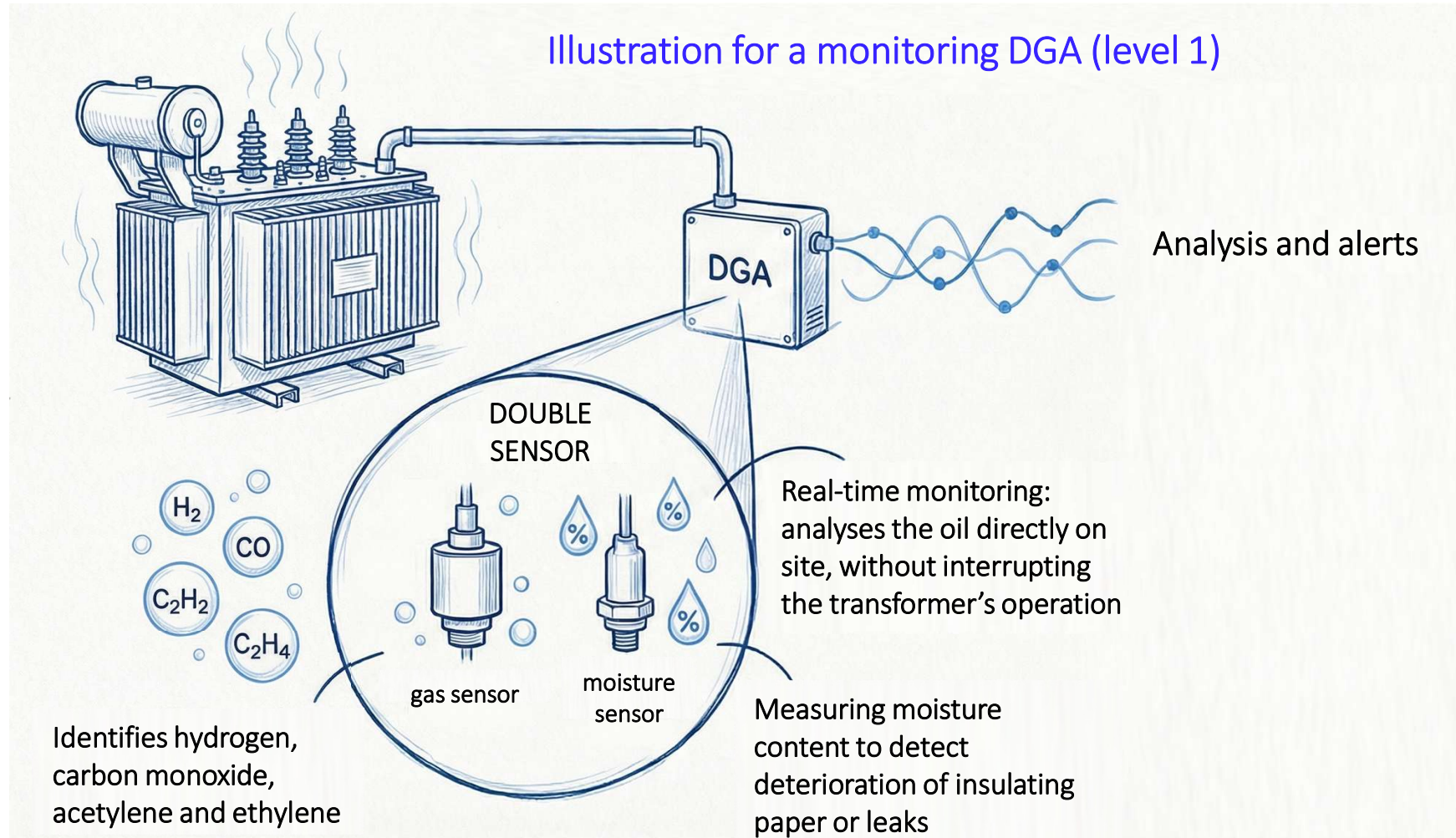
| Level              | Expert             |
|--------------------|--------------------|
| Measuring capacity | 9 gases + moisture |

|    | Criteria                    | DGA<br>monitoring<br>(level 1)                                                                                               | DGA<br>diagnosis<br>(level 2)                                                                                               | DGA<br>expert<br>(level 3)                                                                                                                                                                                        |
|----|-----------------------------|------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 01 | Gases measured              | composite gas<br>(H <sub>2</sub> , C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , CO)<br>+ H <sub>2</sub> O | H <sub>2</sub> , CH <sub>4</sub> , C <sub>2</sub> H <sub>2</sub> ,<br>C <sub>2</sub> H <sub>4</sub> , CO + H <sub>2</sub> O | H <sub>2</sub> , CH <sub>4</sub> , C <sub>2</sub> H <sub>6</sub> , C <sub>2</sub> H <sub>4</sub> ,<br>C <sub>2</sub> H <sub>2</sub> , CO, CO <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub><br>+ H <sub>2</sub> O |
| 02 | Investment                  | €                                                                                                                            | €€                                                                                                                          | €€€                                                                                                                                                                                                               |
| 03 | IEC60599 diagnosis          | no                                                                                                                           | yes                                                                                                                         | yes                                                                                                                                                                                                               |
| 04 | Duval's triangle            | no                                                                                                                           | yes                                                                                                                         | yes                                                                                                                                                                                                               |
| 05 | Automatic diagnosis         | very limited                                                                                                                 | good                                                                                                                        | highly advanced                                                                                                                                                                                                   |
| 06 | Detection of thermal faults | partial                                                                                                                      | yes                                                                                                                         | yes                                                                                                                                                                                                               |
| 07 | Detection of electric arc   | no                                                                                                                           | yes                                                                                                                         | yes (more accurate)                                                                                                                                                                                               |
| 08 | Detection of paper ageing   | no                                                                                                                           | partial                                                                                                                     | yes (CO <sub>2</sub> /CO ratio)                                                                                                                                                                                   |
| 09 | Diagnostic accuracy         | low                                                                                                                          | good                                                                                                                        | very high                                                                                                                                                                                                         |



Duval's triangle



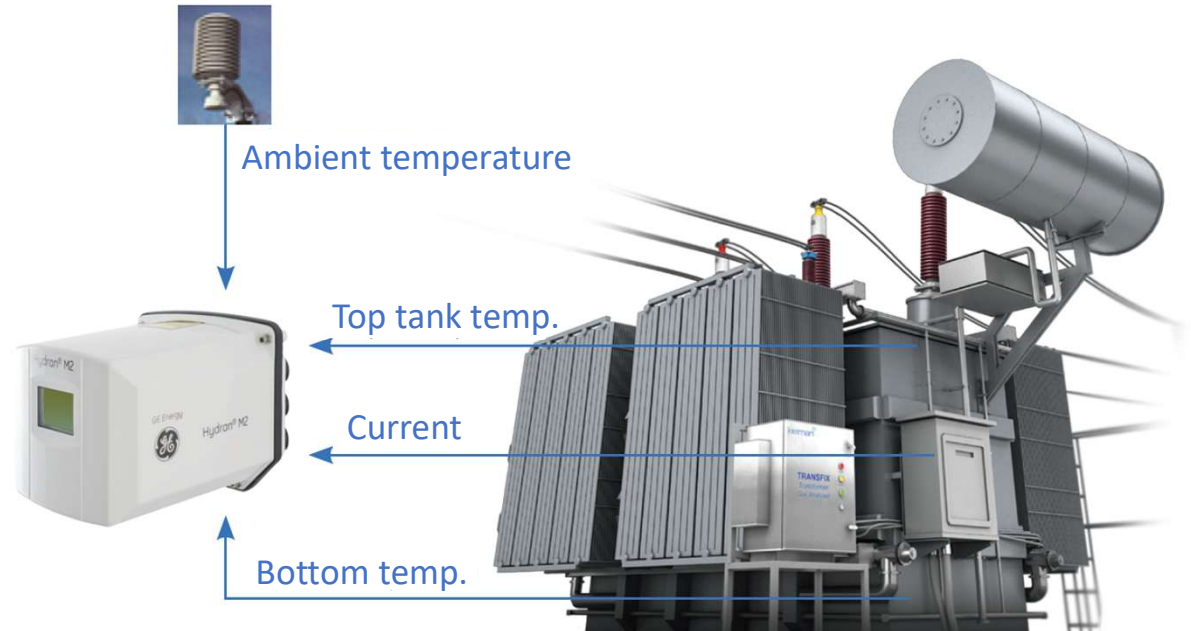


# 1

## Dissolved Gas Analyser (DGA)

Installation : on a dedicated valve on the tank

Maintenance : low maintenance (no moving parts)



Source of the image on the right : GE technical documentation for the Hydran M2

| Transformer types                                       | Recommended DGA          |
|---------------------------------------------------------|--------------------------|
| MV/LV distribution                                      | Not applicable           |
| MV distribution                                         | Level 1                  |
| Major industrial site                                   | Level 1, or even level 2 |
| EHV/HV network                                          | Level 2                  |
| Power generation plant (powerstation)                   | Level 2, or even level 3 |
| EHV transformers (typically >100MVA)                    | Level 3                  |
| Strategic transformer (unavailability extremely costly) | Level 3                  |

LV : Low voltage

MV : Medium voltage

HV : High voltage

EHV : Extra high voltage

## Compatibility of oils with DGAs

| Oil type | Compatibility                                                                                 |
|----------|-----------------------------------------------------------------------------------------------|
| Mineral  | Yes                                                                                           |
| Esters   | <b>More and more</b><br>Contact the manufacturer, as the alarm limits may need to be adjusted |
| Silicone | <b>Usually not</b><br>Contact the manufacturer to check                                       |



## 1

## Dissolved Gas Analyser (DGA)

Checks during Factory  
Acceptance Tests(FAT)Monitoring  
DGA  
(level 1)Diagnosis  
DGA  
(level 2)Expert  
DGA  
(level 3)

|    |                                   |     |     |     |
|----|-----------------------------------|-----|-----|-----|
| 01 | Visual check                      | yes | yes | yes |
| 02 | Mechanical check                  | yes | yes | yes |
| 03 | Checking of the oil connections   | yes | yes | yes |
| 04 | Leak test                         | yes | yes | yes |
| 05 | Checking of the electrical supply | yes | yes | yes |
| 06 | Communication verification        | yes | yes | yes |
| 07 | Verification of the I/Os          | yes | yes | yes |
| 08 | Alarm simulation                  | yes | yes | yes |
| 09 | Verification of the gas analysis  | no  | yes | yes |
| 10 | Verification of diagnoses         | no  | yes | yes |

## Site acceptance tests (SAT)

Monitoring  
DGA  
(level 1)Diagnosis  
DGA  
(level 2)Expert  
DGA  
(level 3)

|    |                                      |             |             |                    |
|----|--------------------------------------|-------------|-------------|--------------------|
| 01 | Assembly check                       | yes         | yes         | yes                |
| 02 | Valve control                        | yes         | yes         | yes                |
| 03 | Leak test                            | yes         | yes         | yes                |
| 04 | Power-up                             | yes         | yes         | yes                |
| 05 | Communication verification           | yes         | yes         | yes                |
| 06 | Vérification de la mesure d'humidité | yes         | yes         | yes                |
| 07 | DGA measurement check                | yes         | yes         | yes                |
| 08 | Alarm check                          | yes         | yes         | yes                |
| 09 | Validation by a laboratory DGA       | Recommended | Recommended | Highly recommended |