



TOGA

Transformer Oil Gas Analyser

ES200

- Fully automated Transformer Oil Gas Analyser
- According to ASTM D3612c
- Automated instrument performance verification
- High uptime due to modular injector/detector technology

Get ready for tomorrow's analytics

Transformer Oil Gas Analyser - ES200

Transformer oil is a highly refined mineral oil used in electrical transformers. It has excellent insulating properties, suppresses corona and arcing, and serves as a coolant. In cases where an electrical error has taken place, the oil undergoes a breakdown into component gases which can identify and relate to the type and severity of the electrical fault. ASTM D3612c describes extraction and determination of gases in transformer oil based on headspace sampling.

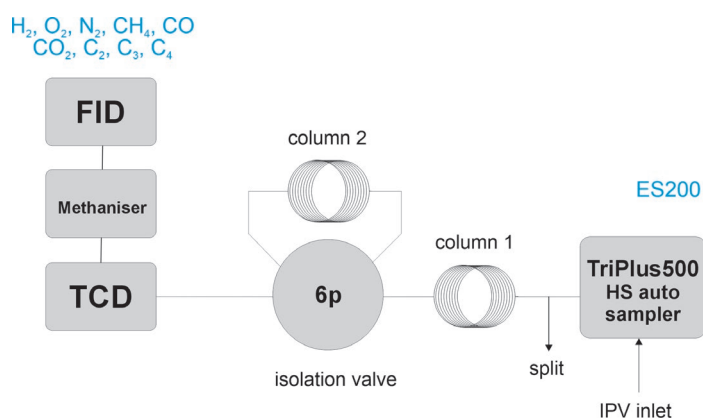


Figure 1. Schematic diagram TOGA

Transformer Oil Gas Analyser - Principle

An aliquot from the vapour phase above a transformer oil sample is injected from a sealed vial using a headspace autosampler. After passing through the first separation column, $H_2, O_2, N_2, CH_4,$ and CO are isolated on the second separation column by switching valve E1. As a result, $CO_2, C_2H_2, C_2H_4,$ and C_2H_6 are detected first.

After valve E1 is switched back to its initial position, $H_2, O_2, N_2, CH_4,$ and CO are detected by the TCD–methaniser–FID tandem. By actuating valve E1 again, C_3 and C_4 components are directed to the detector (see Figures 1, 4, and 5). CO and CO_2 are converted to CH_4 in a methaniser, enabling sensitive FID detection at ppm levels.

The analyser is constructed with diaphragm valves and InstantConnect detector technology, providing a robust and flexible instrument. An optional gas injection valve in series with the HS autoamplifier is available for manual injection of samples and standards.

Headspace sampling

The oil samples are automatically injected using Thermo TriPlus 500 headspace autosampler with 12, 120 or 240 sample position trays. This system uses the closed loop injection principle, so loss of components or false results from ambient gases are avoided. Each sample is individually equilibrated at $70\text{ }^\circ\text{C}$. The required equilibration time is minimised by using the mixer function of the autosampler. The headspace sample is injected by (1) pressurisation of the vial (2) expansion to a loop (3) transferring the loop content to the separation columns (see figure 3). To guarantee the expected sample integrity at every analysis, each vial is automatically checked for possible leaks just prior to the loop filling stage.

The Chromeleon chromatography data system is seamlessly integrated with TriPlus 500 HS autosampler, offering a single point of control for optimal simplicity and convenience.



Figure 2. Transformer oil gas analyser with headspace sampling

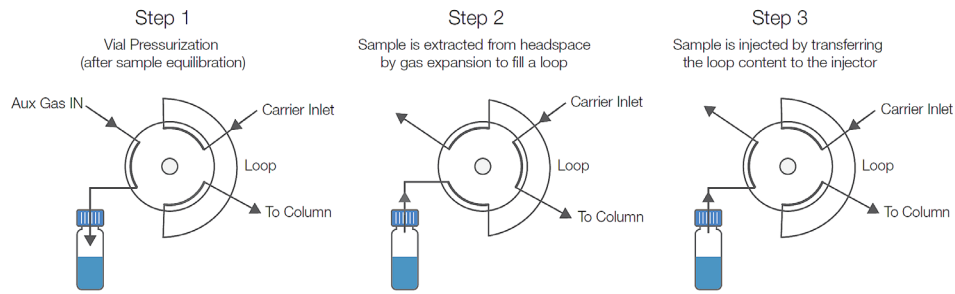


Figure 3. TriPlus 500 headspace autosampler; vial pressurising - loop filling - injection

Results

Figure 4 and 5 show the results of 10 and 100 ppm dissolved gases in oil standards on FID and TCD. Figure 6 shows the achieved limits of detection per component and by which detector.

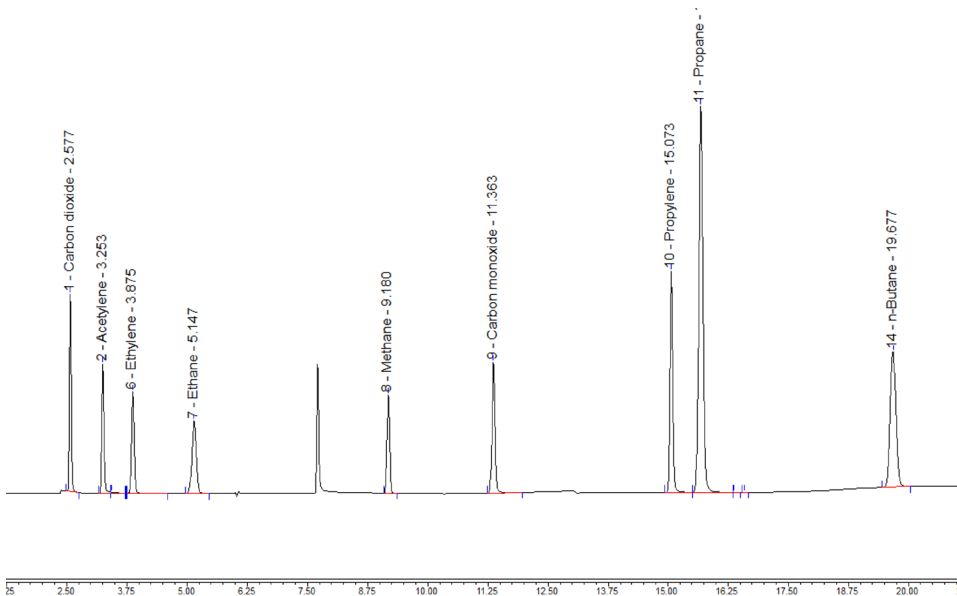


Figure 4. Chromatogram FID-Methaniser, 50-200 ppm concentration range

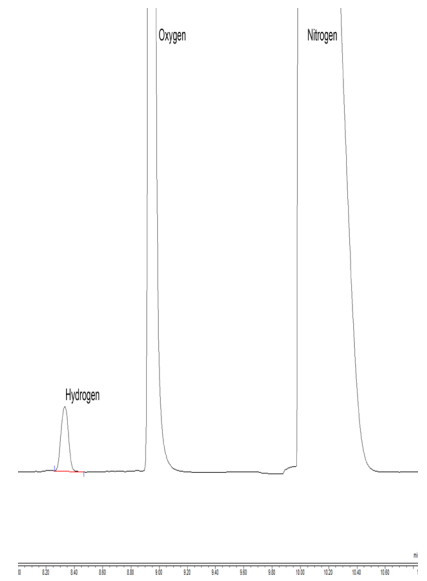


Figure 5. Chromatogram TCD

Option to verify instrument performance and kit for standard and sample preparation

A kit is available to facilitate (1) instrument performance verification and (2) preparation of standards and samples:

(1) Instrument performance verification

A series of empty sample vials is placed in the headspace autosampler. The vials are automatically loaded with calibration gas, and subsequently analysed. This process allows for the assessment of the analytical instrument's repeatability by calculating the Relative Standard Deviation (RSD%) using the Chromeleon data system. Additionally, this method allows verification of peak shape and separation.

(2) Preparation of calibration standards and sample loading

The kit includes all necessary components for manually preparing calibration standards using blank oil and calibration gas. This eliminates the need for third-party calibration standards and ensures correct sample loading into the sample vials.

Component	ppm	RSD%
CO ₂	10000	0.162
Ethylene	3000	0.146
Ethane	2000	0.155
Acetylene	1000	1.181
Methane	1000	0.176
Propane/propylene	3000	0.201
Carbon monoxide	2000	0.132
Hydrogen	500	0.732
Oxygen	250000	0.092
Nitrogen	720000	0.245

Figure 6. Instrument performance verification report, showing analyser repeatability using a calibration gas

Specification

- Thermo GC1600 with InstantConnect TCD, FID and methaniser
- Used carrier gas: Argon
- Thermo Triplus 500 Headspace autosampler
 - number of vials: 12, 120 or 240
 - vial volume: 10, 20 and 22 ml
- Two 0.53mm ID separation columns
- Heated valve oven with one 6-port diaphragm valve
- Chromeleon CDS data system
- Standardised method: ASTM D3612c
- Analysis time: 20 minutes
- Repeatability < 5% RSD at 100ppm concentration level (n=10)
- Limit of detection:

Component	Detection limit (ppm)
Hydrogen	< 10
Oxygen	< 60
Nitrogen	< 150
Carbon monoxide	< 0.2
Carbon dioxide	< 0.2
Methane	< 0.2
Acetylene	< 0.2
Ethylene	< 0.2
Ethane	<0.2
Propane	< 0.2
Propylene	< 0.5
n-Butane	< 0.5

Figure 7. Limit of detector per component

Ordering information	ES20X - ABCDE	(includes TriPlus500 Headspace sampler with 12 pos tray)		
	ES21X - ABCDE	ES20X + GSV for manual injection		
code X	0	1	2	3
GC model, power	1600, 230V	1610, 230V	1600, 115V	1610, 115V

For the selection of options (e.g. valve type and passivation, pressure and moisture sensors, autosampler upgrades, power plug type and more), [see the options table in the order guide.](#)

About GAS

Global Analyser Solutions provides GC & GC-MS solutions for Energy, Refinery, Chemical and Environmental markets. Our analysers address a broad spectrum of measuring requirements with high precision and reliability. Please reach out for more information on our website.

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