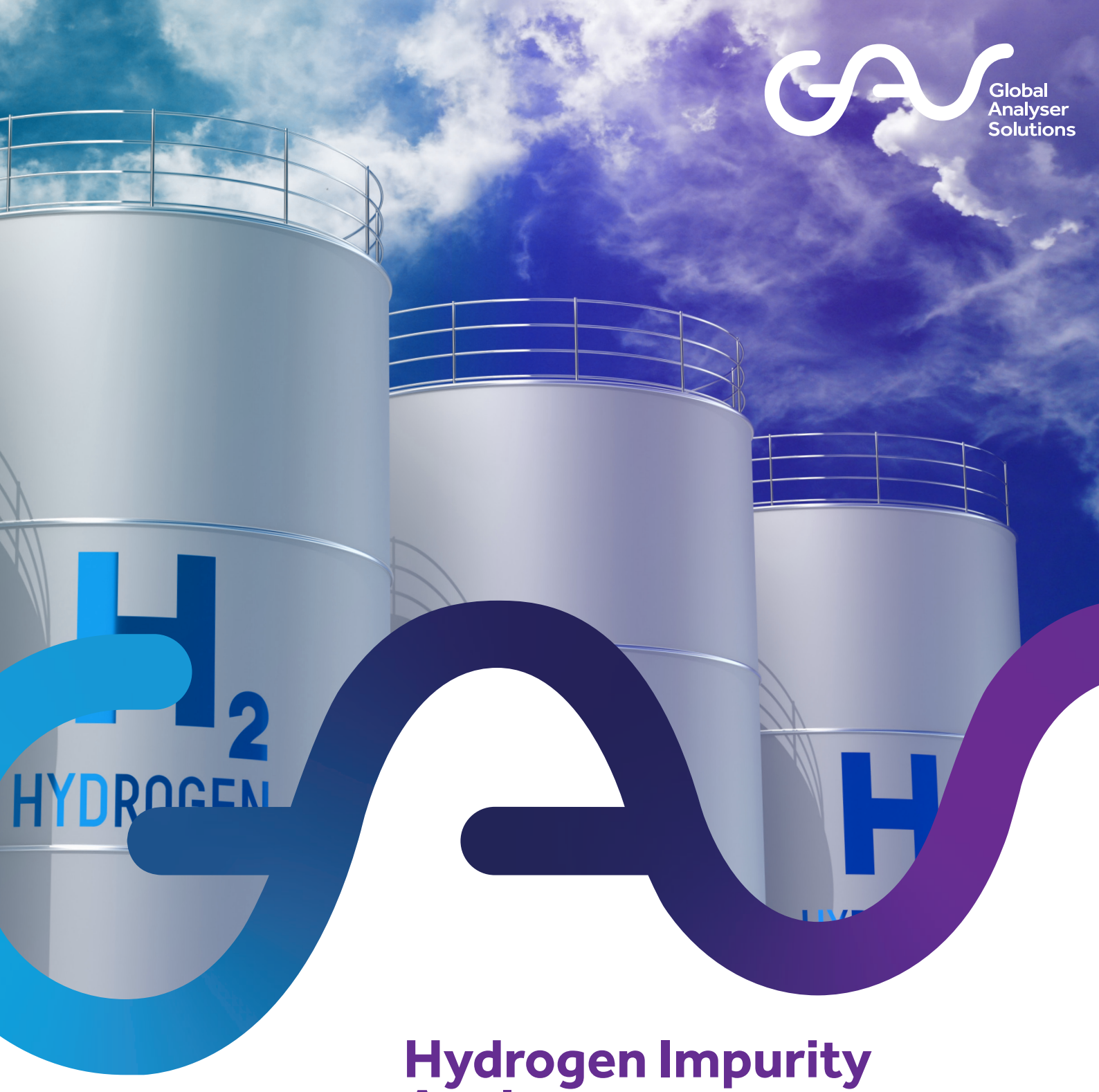

Hydrogen Impurity Analyser

ER100 | 110

- Green hydrogen testing
- ISO 21087 (based on ISO 14687)
- PEM fuel cell applications and risk assessments
- Combined GC / GC-MS methodology

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Hydrogen Impurity Analyser

Fuel cell electric power is a promising zero-emission alternative to combustion engines, particularly for heavy-duty transport, buses, trains, and other applications requiring long range and rapid refuelling. Fuel cell performance depends on sensitive platinum catalysts and proton exchange membranes (PEM), which are highly susceptible to trace hydrogen impurities. Contaminants introduced during hydrogen production, purification, storage, transport, or dispensing can reduce efficiency, shorten fuel cell lifetime, and damage critical components. Maintaining hydrogen quality in accordance with standards such as ISO 21087 is therefore essential. Reliable trace impurity analysis enables quality assurance throughout the hydrogen supply chain, ensuring safe, efficient, and long-term fuel cell operation.

Principle of operation

This product note describes two analyser configurations. Configuration ER100 has two analytical channels for measuring a part of the components as specified by ISO 21087:

(1) Carbon monoxide, carbon dioxide, methane and total hydrocarbon content (THC) using methaniser-FID (Flame Ionisation Detector).
(2) Argon, oxygen and nitrogen using Pulsed Discharge Detector (PDD). A Thermal Conductivity Detector (TCD) is offered as an option for high ppm concentration levels. The analyser is based on Thermo Trace GC 1600.

Configuration ER110 has two additional channels, using a second Thermo Trace GC 1600 for measuring:

(3) Helium using TCD
(4) Sulphur components, ammonia, Volatile Organic Compounds (VOC) and individual hydrocarbons using a mass spectrometer equipped with Advanced Electron Impact source. See figure 1.

Specifications

ER100

- Thermo Trace GC 1600 with four diaphragm gas switching valves (rotary valves are optional), methaniser-Flame Ionisation Detector (FID), PDD (Pulsed Discharge Detector); TCD optional
- 5 separation columns
- Run time 10 minutes
- Limits of detection: see figure 6

ER110, in addition to ER100:

- Second Thermo Trace GC 1600 with two diaphragm valves, TCD and ISQ mass spectrometer with AEI source
- 2 separation columns
- Runtime: 15 minutes
- Limits of detection: see figure 6

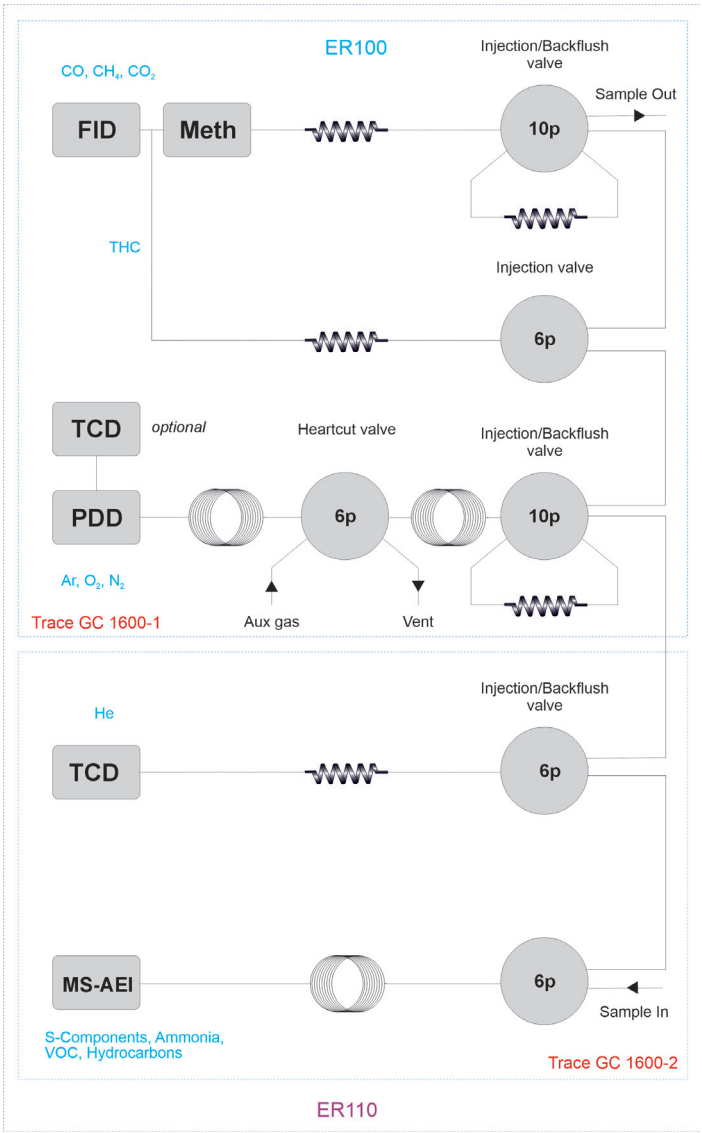

Figure 1 Hydrogen Impurity Analyser diagram for ER100 and ER110

Results

Figures 2, 3, 4 and 5 show the chromatograms of the described channels.

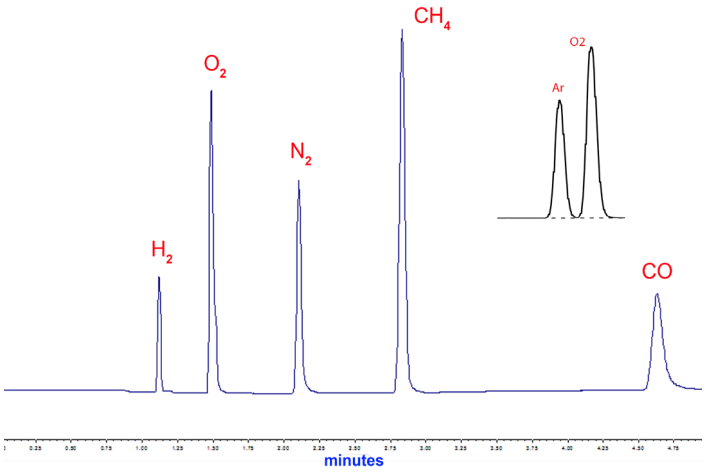

Figure 2 Permanent gases using GC-PDD. 5 ppm standard.

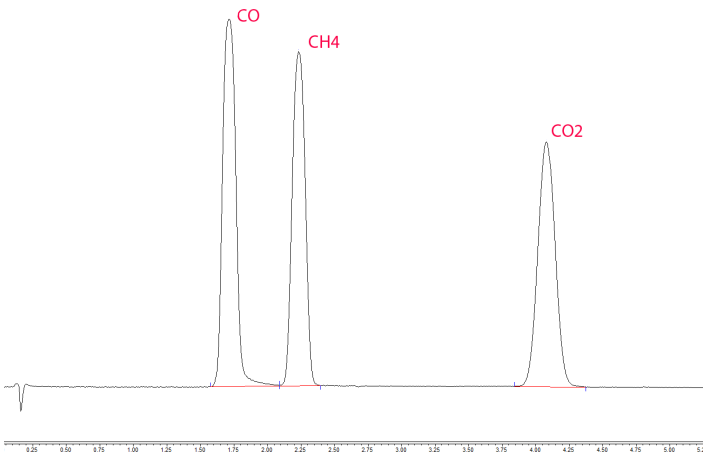

Figure 3 CO, CH_4 and CO_2 analysed with M-FID. 5 ppm concentration level.

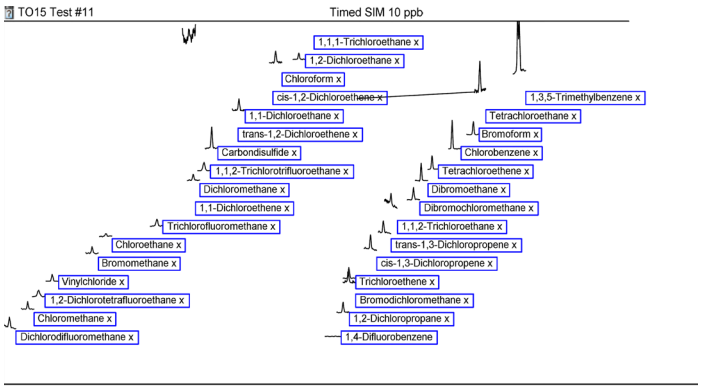

Figure 4 Halogenated components using GC-MS-AEI. 10 ppb standard.

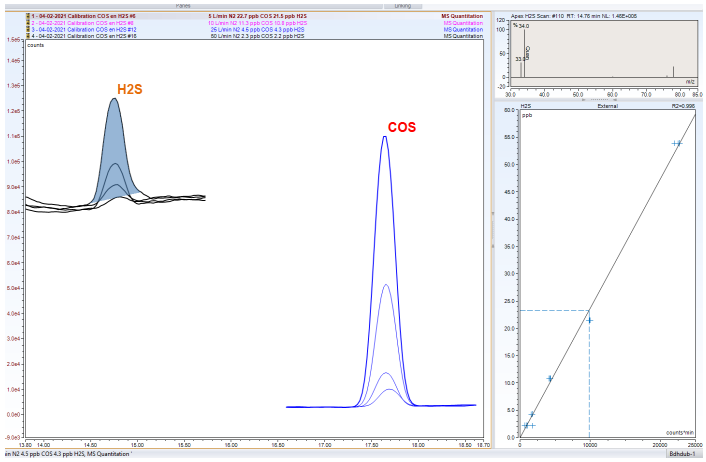

Figure 5 Overlay of 5 H_2S/COS concentration levels using GC-MS-AEI:
H_2S: 2.2, 4.3, 10.8, 21.5 and 53.9 ppb
COS: 2.3, 4.5, 11.3, 22.7 and 56.6 ppb

Impurity	Limit ISO 14687/21087 (umol/mol)	Technique	Instrument LOD (umol/mol)
Total hydrocarbons	2	M-FID	0.1
Oxygen	5	PDD	0.1
Helium	300	TCD	10
Nitrogen	300	PDD	0.1
Argon	300	PDD	0.1
Carbon dioxide	2	M-FID	0.1
Carbon monoxide	0.2	M-FID	0.1
Total sulphur components	0.004	MS-AEI	0.001 (per comp.)
Formaldehyde	0.2	MS-AEI	0.03
Ammonia	0.1	MS-AEI	0.02
Organic halogenated components, VOC, hydrocarbons	0.05	MS-AEI	0.001 (per comp.)

Figure 6 Hydrogen Impurities Analyser. Analysed components per detector and limits of detection.
Blue: ER100
Blue + black: ER110

Ordering information	ER10X - ABCDE - Single GC configuration ER11X - ABCDE - Dual GC configuration			
code X	0	1	2	3
GC model, power	1600, 230V	1610, 230V	1600, 115V	1610, 115V

For selecting options ABCDE (e.g. valve type and passivation, pump and vacuum sampling, rotameter and sample connections, pressure and moisture sensors, hydrogen sensor for safety shut-off, power plug type and more), see the options table in the order guide.

About GAS

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