A New, Modular, High-Temperature Auxiliary Oven to Extend Gas Chromatography Capabilities

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Overview

Purpose: We present a newly developed , high-temperature modular auxiliary oven for the Thermo Scientific™ TRACE™ 1300 Series Gas Chromatograph (GC).

The adoption of this auxiliary oven, combined with the proprietary patent-pending technology of the Instant Connect injector and detector modules, gas chromatography capabilities can be extended to routinely accommodate four -detector applications in a very small footprint or to house complex multi-column, multi-detector applications.

Introduction

The TRACE 1300 Series GC is the first and only gas chromatograph featuring user-installable Instant Connect injector and detector modules that can be easily swapped by the user to ensure extreme versatility, as shown in Figure 1. Their plug-in concept allows the user to mount modules and quickly replace them and be readily operative with a new GC configuration a few minutes after installation. This unique, modular design allows users to tailor the GC configuration to accommodate a new application or to upgrade from a single to a dual-channel set-up ,or the user can adopt spare injector or detector modules to reduce non-productive maintenance downtime to zero.

The Instant Connect injector modules include the injector body, the pneumatic lines and electronics for temperature and carrier gas control in a compact and self sufficient build. When present, the whole backflush pneumatics are integrated into the same manifold, without the need for external tubing and connections, minimizing the risk of leaks. The injector body and filters can be quickly accessed for easy maintenance and substitution of parts.

FIGURE 1. The TRACE 1310 GC connected to a Thermo Scientific™ TRACE™ 1310 Auxiliary Oven, with an instant connect module being installed by the user.

The whole pneumatics are also integrated into the manifold of every Instant Connect detector module. Every detector guarantees wider linear range and an acquisition rate of up to 300 Hz, which is ideal for fast GC applications. Their miniaturized cell volume allows a considerable reduction of gases flowing through the cell, making these detectors ideal for narrow-bore columns applications and enhances the detector sensitivity.

For example, in the case of a Thermal Conductivity Detector (TCD), the reference gas flow is also used as make-up for the column effluent to ensure sharp analytical peaks. The TCD design has been optimized to be compatible also with 1/8 in. and 1/16 in. packed columns for laboratories still adopting those. The TCD and SSL-BKF (backflush) modules are shown in Figure 2.

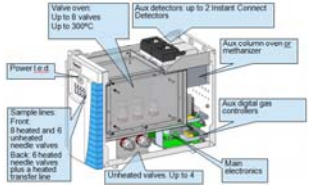
FIGURE 2. Images of an Instant Connect SSL-BKF Module (left) and a TCD detector module (right).

TRACE 1310 Auxiliary Oven

A number of complex mixture analyses are usually resolved using GC multi-column switching solutions. Even if the analytical flow is apparently simple, these solutions require rather complex hardware from a construction perspective. The hardware can become more complicated when the column set chosen for a specific application and the valves used for flow switching cannot withstand the same temperature range. Rather than adopting multiple, independent small oven chambers appended on the GC side or top panel, the modular TRACE 1310 Auxiliary Oven has been developed. The internal view of the oven is shown in Figure 3.

This auxiliary oven can accommodate up to six rotary valves or eight diaphragm valves, allows multiple heated or unheated sample streams to be connected to the system, and optionally expands the GC capabilities to simultaneously run up to four Instant Connect detectors.

FIGURE 3. Internal view of the TRACE 1310 Auxiliary Oven.

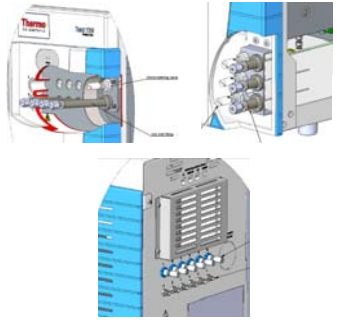


Sample Connectivity

Gas samples can be delivered directly to the TRACE 1310 Auxiliary Oven through many different methods. Heated sample lines can be connected to the front or the back of the auxiliary oven, while unheated samples can be delivered to the front lower part of the oven to be driven by the four unheated valves.

In addition, when it is necessary to ensure a constant temperature to the gas stream to be analyzed, a heated transfer line can be connected onto the back panel of the auxiliary oven bringing the heated gas sample directly into the primary oven chamber.

FIGURE 4. Sample connectivity on the TRACE 1310 Auxiliary Oven. Upper front connection for heated samples (left), unheated connections (right) and rear sample connections (bottom drawing).



Four Instant Connect Detector Capabilities

Four detectors can be installed by the user and run simultaneously on a system comprised of the TRACE 1300 Series GC and the TRACE 1310 Auxiliary Oven. Two detectors will be mounted on the GC, and the other two on the auxiliary oven. In this way, for example, it is possible to add a fourth channel to the existing three-detector applications for the determination of sulfur-containing species, as seen in refinery gas analyzers.

This four-detector capability has also been used to combine two dual-channel determinations onto the same system. For example, Figure 5 displays the chromatograms of BTEX analyzed on one FID and of permanent gases analyzed on a TCD. The same set up was repeated twice in the same GC. Excellent RSD% are achieved on both channels.

FIGURE 5. Chromatogram of a BTEX mix (left) and Permanent Gases (right).

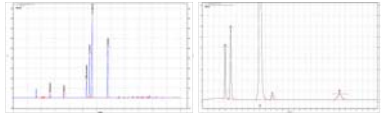


FIGURE 6. Area RSD % of Permanent Gases on the two TCDs. Data courtesy of Interscience (NL).

Application Examples

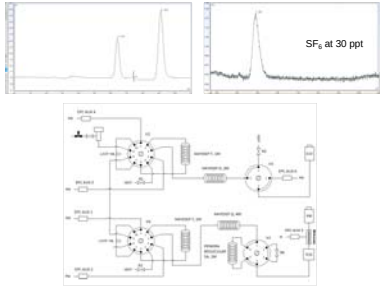
Green House Gases Determination

The system comprised of a TRACE 1300 Series GC and the TRACE 1310 Auxiliary Oven has been used to run the greenhouse gases application.

Using a 3-detector setting (with FID, TCD, and ECD), the following target analytes were measured: CO_2, CH_4, N_2O, SF_6, Oxygen and Nitrogen.

In the chromatograms in Figure 7, it is possible to observe the great sensitivity for SF6 on the ECD.

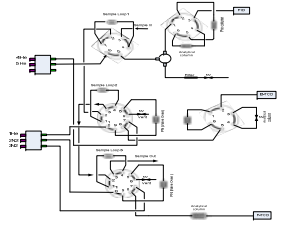
FIGURE 7. FID and ECD chromatograms obtained with the Green House Gases Analyzer and its schematics.



Refinery Gas Analyses

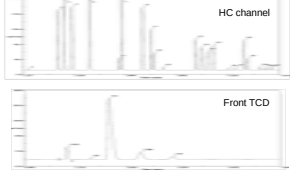
One of the classic multi-column, multi-valve applications, a refinery gas analysis (RGA), has been implemented with excellent results on the TRACE 1310 GC and the TRACE 1310 Auxiliary Oven, using two TCD detectors and one FID detector. The fourth detector place can be used for a flame photometric detector, as an example. Figure 8 shows the schematics of the fast refinery gas analyzer.

FIGURE 8. Schematics of a Fast Refinery Gas Analyzer.



The hydrocarbon channel was on the TRACE 1310 GC, while the two TCDs were mounted on the auxiliary oven. A run time of seven minutes was used, achieving Area RSD below 2%.

FIGURE 9. Fast RGA chromatograms.



Conclusion

The new TRACE 1310 Auxiliary Oven expands the capabilities and applicability of the modular TRACE 1300 Series GC platform.

The optional four-detector capabilities, the secondary oven chamber, and the possibility of connecting multiple sample streams, either heated or not, make this auxiliary oven the ideal choice for engineered GC systems and for consolidating multiple analyses onto a single GC system.

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