



Thermo Scientific ConFlo IV
Universal Interface

Continuous Flow Interface **Isotope Ratio MS**

Thermo
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ConFlo IV Universal Interface

for Continuous Flow Isotope Ratio MS

The development of Continuous Flow carrier gas assisted techniques has dominated the growth of Isotope Ratio Mass Spectrometry for the last two decades with our series of ConFlo interfaces. Now we have developed the Thermo Scientific ConFlo IV, the first universal Continuous Flow interface, which allows simultaneous attachment of multiple sample preparation devices with different carrier gas flow regimes to the same Isotope Ratio MS.

Powerful new features of the ConFlo IV Universal Interface include intelligent connection to all necessary reference gases, automatic sample-size recognition, sample and reference signal matching and self-diagnosis. The ConFlo IV takes significant steps towards full automation of the stable isotope laboratory, maximizing system utilization and uptime.

Features

- Higher sample throughput and less idle time
- Continuous and unattended analysis utilizing three preparation devices
- Software controlled standby and start up of Trace GC and Flash 2000 and Flash 2000 HT for IRMS
- smartEA™ mode: automatic detection and adjustment of sample gas to reference gas intensities
- Computer-controlled auto-dilution of sample gases based on TCD signals from the EA
- Five reference gases always available
- Sample analysis and referencing of all CNOHS species in a batch sequence
- Lowest consumption of reference gases
- Computer-controlled reference gas intensities
- Auto-determination of linearity, stability, and H_3^+ factor
- Integrated system monitoring and self-diagnosis

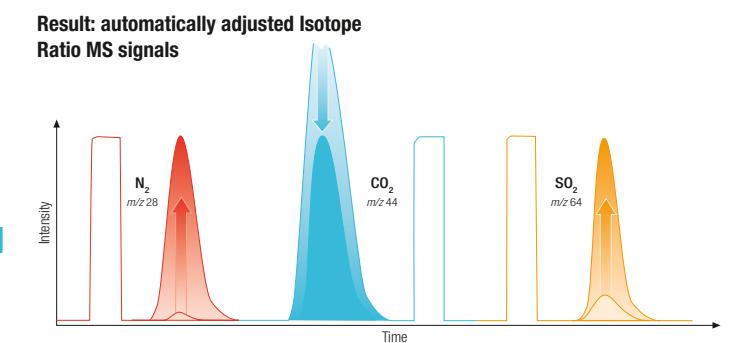
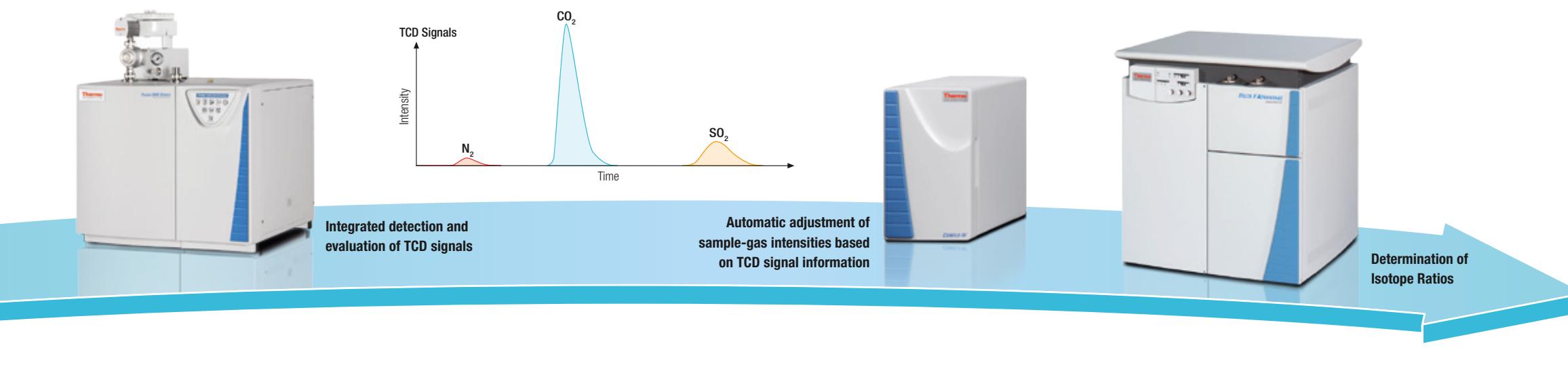


Several thousand Continuous Flow preparation devices are in use with existing Isotope Ratio MS, most of which have more than one preparation device. The Thermo Scientific ConFlo IV Universal Interface optimizes the utilization of the Isotope Ratio MS by handling the switch between preparation devices, including activation and deactivation, as well as change of reference gases. Preparation units can be regenerated and loaded while others are in operation. The switch between applications can take place at any time, without operator assistance. System parameters sensitive to data quality can be automatically checked within all sample sequences.

The ConFlo IV is the first universal interface which implements the fundamental principle of Dual Inlet Isotope Ratio MS: identical treatment of sample and standard. Intensities of the transient sample and reference gas signals in a He carrier gas stream can now be matched, leading to improved precision and reliability.

smartEA: The first intelligent EA-IRMS

Flexible computer-controlled auto-dilution of sample gases based on TCD signals



Principle of IRMS

The measurement of isotope ratios requires that a sample gas is measured relative to a reference gas of a known isotope ratio. Signal intensities of reference and sample gas should be matched as closely as possible in order to achieve the best data quality. The Thermo Scientific ConFlo IV interface matches the sample and the reference gas signals for highest precision and long-term performance.

smartEA Mode

The combination of ConFlo IV and Flash 2000 and Flash 2000 HT builds the first intelligent EA-IRMS system.

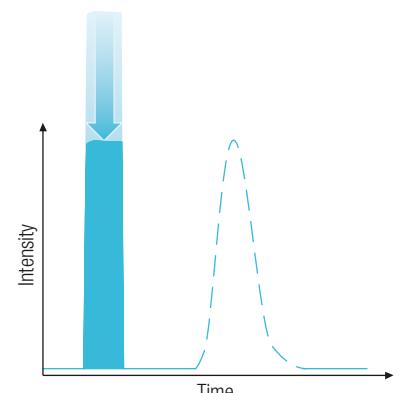
In the smartEA mode, the Thermo Scientific Flash 2000 and Flash 2000 HT reports the TCD (Thermal Conductivity Detector) responses to the Thermo Scientific Isodat software, which calculates the optimal dilution for each gas species in the sample. The ConFlo IV interface applies the dilution to each gas species matching sample and reference gas intensities.

Auto-Dilution

Because there is considerable variability in nature in the relative amounts of C/N/S and H/O, and because the ionization efficiencies of the analyte species differ significantly, Continuous Flow sample preparation leads to a very dynamic range of signal intensities. The ConFlo IV Universal Interface is designed to handle this large and variable dynamic range of elements and isotopes using He-dilution technology. The dilution happens in the open split, at the very last point before transfer into the ion source, eliminating any possible isotopic effects on the sample gas.

Reference Gas Injection

For the purpose of sample-standard referencing in Continuous Flow applications, cylinders of calibrated reference gases can be used for extended periods of time. Reference gases are supplied in μL amounts through inert capillaries into the reference gas injection port, creating a rectangular, flat-topped peak of reference gas without changing any pressures or gas flows. The use of reference gases for standardization, instead of reference bulk material, reduces the operational costs by almost 50%, while increasing the sample throughput by almost 50%. The reference gas consumption is negligible and thus, gases can be kept trickling continuously, ensuring constant conditions in the supply lines and pressure regulators.



System Monitoring & Self Diagnosis

The ConFlo IV interface is designed to enable unattended operation of the Thermo Scientific Isotope Ratio MS over a long series of sequences utilizing different preparation systems. In such a scenario, it is advantageous to determine system parameters such as stability, isotope linearity, and H_2^+ factor, prior to the automatic start of a new application.

The ConFlo IV interface applies these tests including storage, evaluation, and application of the determined parameters. For the first time in Continuous Flow applications, a fast and automated monitoring of system parameters, is possible.

Multiple preparation devices –

One interface: ConFlo IV

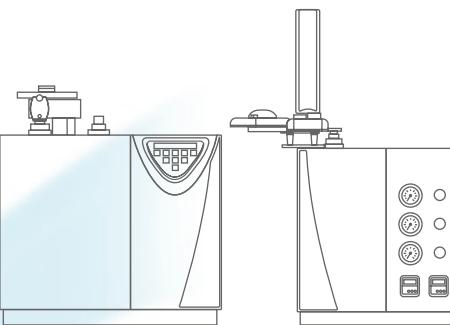
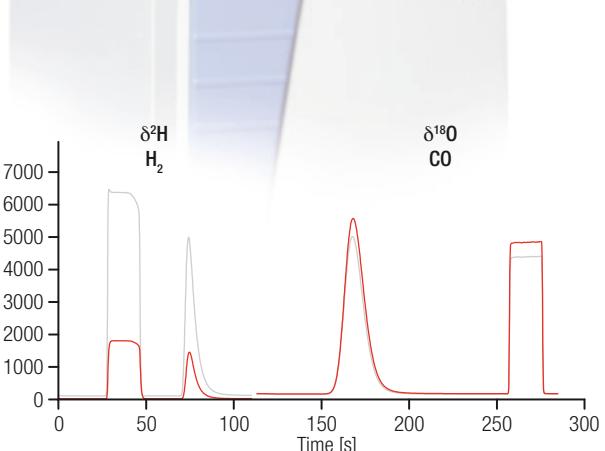
Multiple Inlet Control

Multiple preparation and inlet devices can operate within the same batch of sequences with the Thermo Scientific ConFlo IV Universal Interface, allowing continuous and unattended sample analysis. Additional samples can be uploaded and appended to the batch of sequences without any interruption of the actual data acquisition. More samples can be added to the active preparation device or a completely new application can be set up on a separate device and appended, waiting for completion of the actual analyses.

The next device will then automatically be activated and diagnosed for the next application, while the other device will be set to idle or standby. System parameters, which are important to the performance and integrity of data, such as system stability, signal linearity and the H_3^+ factor, can be monitored automatically at any time before, after and even within sample sequences. As an example, the H_3^+ factor could be measured several times. Each H_3^+ factor is stored in the history log file to be used for the next δD analysis.

Continuous Sample Analysis

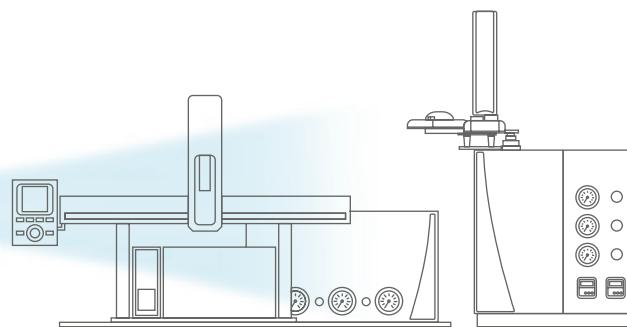
- Sample upload and sequence extension during analysis
- Switch between preparation devices without operator attendance
- System parameter monitoring at any part of the sequence
- Five reference gases always available
- Stand-by and reactivation of Thermo Scientific TRACE GC Ultra and Flash 2000 and Flash 2000 HT



Multi Element System

$\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$ from one EA and δD and $\delta^{18}\text{O}$ from one TC/EA analysis

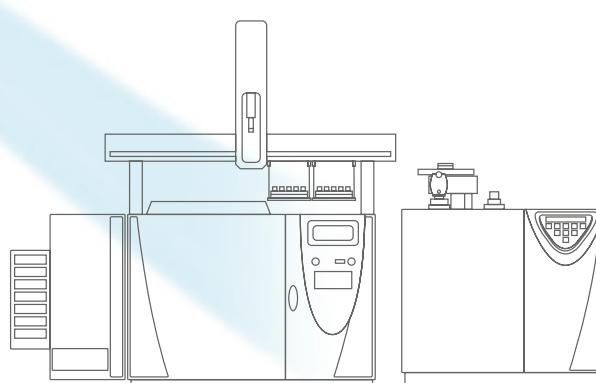
The combination of a dynamic flash combustion elemental analyzer (EA) with a high temperature conversion elemental analyzer (TC/EA) can measure $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$, $\delta^{18}\text{O}$ and δD . The ConFlo IV interface controls the five reference gases required for such analysis, saving time and money. The wide dynamic range to be expected in elemental compositions is addressed by its unique auto-dilution system.



Water Analysis System

$\delta^2\text{H}$ and $\delta^{18}\text{O}$ from Equilibration with the Thermo Scientific GasBench and from High Temperature Conversion with the Thermo Scientific TC/EA

The versatile combination of TC/EA and GasBench II allows high throughput and high precision isotopic analysis of small water samples. The TC/EA quantitative high temperature C-reduction allows fast screening of δD and $\delta^{18}\text{O}$ from a single injection of a water sample within less than six minutes for samples as small as 0.1 μL . The GasBench II provides highest precision δD or $\delta^{18}\text{O}$ results by isotope equilibration of water samples with H_2 or CO_2 gas in the headspace. Hence, it allows analyzing waters with high amounts of dissolved solids. While 96 water samples ($\geq 200 \mu\text{L}$) are equilibrating in the GasBench II, more than 200 water samples are screened by the TC/EA. At the end of the TC/EA analyses, system parameters can be checked automatically, followed by the start of the GasBench II analyses. Both applications benefit by the flexible auto-dilution and reference gas control capabilities of the ConFlo IV interface.



Bulk EA and CSIA Systems

CSIA with GC-C/TC and Bulk Analysis with EA and TC/EA

The combination of any Flash 2000 and Flash 2000 HT for Isotope Ratio MS with the Thermo Scientific GC-C/TC III allows fast and precise bulk analysis of complete samples, as well as the analysis of all individual compounds in complex mixtures. The Flash 2000 and Flash 2000 HT gives the direct link between international accepted standards and reference compounds for GC-C/TC applications. The EA-GC combination exemplifies the range of possibilities that are opened up by the ConFlo IV Universal Interface: completely integrated device and autosampler control, acquisition and reporting of additional detector traces (TCD, FID), all range control and auto-dilution features including the smartEA mode, fully integrated standby mode, and reactivation of both devices.

Thermo Scientific ConFlo IV Universal Interface – One interface for all Continuous Flow Isotope Ratio MS devices

The flexibility of the ConFlo IV interface, combined with the power of the Isodat script language ISL, allows it to be used as an interface, with any continuous flow sample preparation device, either from either Thermo Fisher Scientific or provided by the user. Some of the fully automated features of the ConFlo IV interface need direct communication with the preparation device and are therefore specific to Thermo Scientific devices (FlashEA 1112 IRMS, FlashEA 1112 HT, Flash 2000 and Flash 2000 HT, Trace GC and Trace GC Ultra). The ConFlo IV interface can be controlled by all fiber-line based Isotope Ratio MS, the DELTA V Plus, DELTA V Advantage, DELTA^{Plus} XP, DELTA^{Plus} Advantage and MAT 253 using the Isodat software suite.

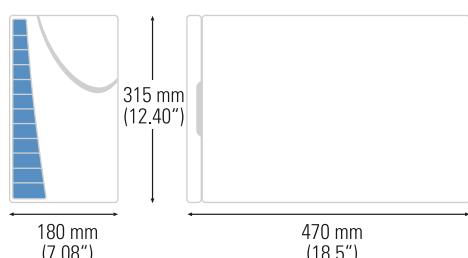
- Elemental analyzers
- Gas chromatographs
- Liquid chromatographs
- Multiple loop injection devices
- Gas injection and separation units with flows of 2 - 100 mL/min
- Trace gas preconcentration devices
- Laser ablation and combustion devices
- DOC/DIC analyzers

Reference Gases Used for Applications

Pure nitrogen gas, N₂, carbon dioxide, CO₂, and sulfur dioxide, SO₂, are used as reference gases for δ¹⁵N, δ¹³C and δ³⁴S determination by combustion reactions. Sulfur dioxide is applied through a heated reference injection port. Pure hydrogen gas, H₂, and carbon monoxide gas, CO, are used for δ²H and δ¹⁸O determination by high temperature conversion reactions.

ConFlo IV Dimensions

470 x 180 x 315 mm
18.5" x 7.08" x 12.4" (w x d x h)



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Thermo Fisher Scientific (Bremen) GmbH
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Africa-Other +27 1 70 1840
Australia +61 3 9757 4300
Austria +43 1 333 50 34 0
Belgium +32 53 73 42 41
Canada +1 800 530 8447
China +86 10 8419 3588
Denmark +45 70 23 62 60

Europe-Other +43 1 333 50 34 0
Finland/Norway/Sweden +46 8 556 468 00
France +33 1 60 92 48 00
Germany +49 6103 408 1014
India +91 22 6742 9434
Italy +39 02 950 591

Japan +81 45 453 9100
Latin America +1 561 688 8700
Middle East +43 1 333 50 34 0
Netherlands +31 76 579 55 55
New Zealand +64 9 980 6700
Russia/CIS +43 1 333 50 34 0
South Africa +27 11 570 1840

Spain +34 914 845 965
Switzerland +41 61 716 77 00

UK +44 1442 233555

USA +1 800 532 4752

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