

## Thermo Scientific ConFlo IV Universal Interface



*The Universal Interface  
for Continuous Flow Isotope Ratio MS*

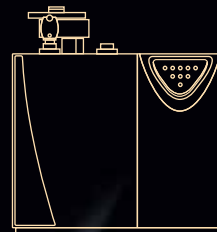
## The Universal Interface for Continuous Flow Isotope Ratio MS

The development of Continuous Flow carrier gas assisted techniques has dominated the growth of Isotope Ratio Mass Spectrometry for the last two decades with the series of our 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.

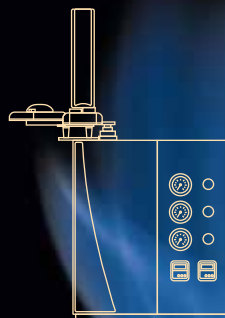
### Unique Features of the New ConFlo IV :

- Higher sample throughput and less idle time
- Continuous and unattended analysis utilizing 3 preparation devices
- Software controlled standby and startup of Trace GC and Flash EA
- 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

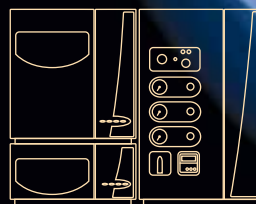
Powerful new features of the ConFlo IV Universal Interface include intelligent connection to all necessary reference gases, automatic sample size recognition, sample and reference signal matching and self-diagnosis. The ConFlo IV takes significant steps towards full automation of the stable isotope laboratory,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



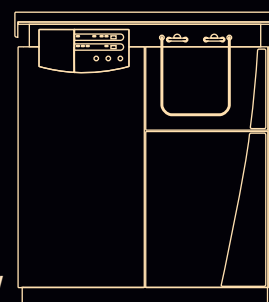
Flash EA™



TC/EA



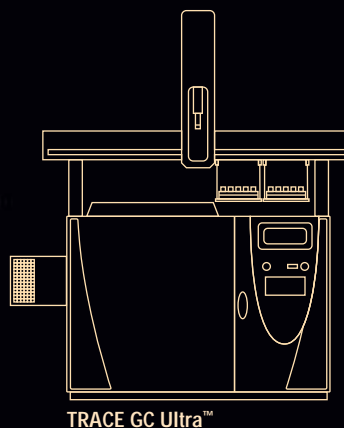
Surveyor™ with LC IsoLink



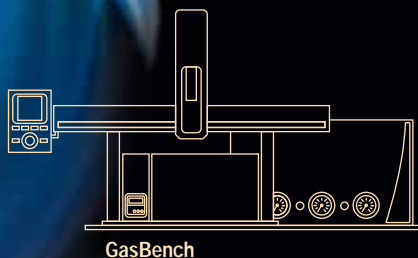
DELTA V

# ConFlo IV Universal Interface

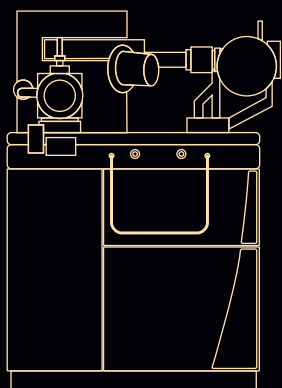
## for Continuous Flow Isotope Ratio MS



TRACE GC Ultra™



GasBench



MAT 253

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 principal 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.

### 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 quality of data. The Thermo Scientific ConFlo IV matches the sample and the reference gas signals for highest precision and long term performance.

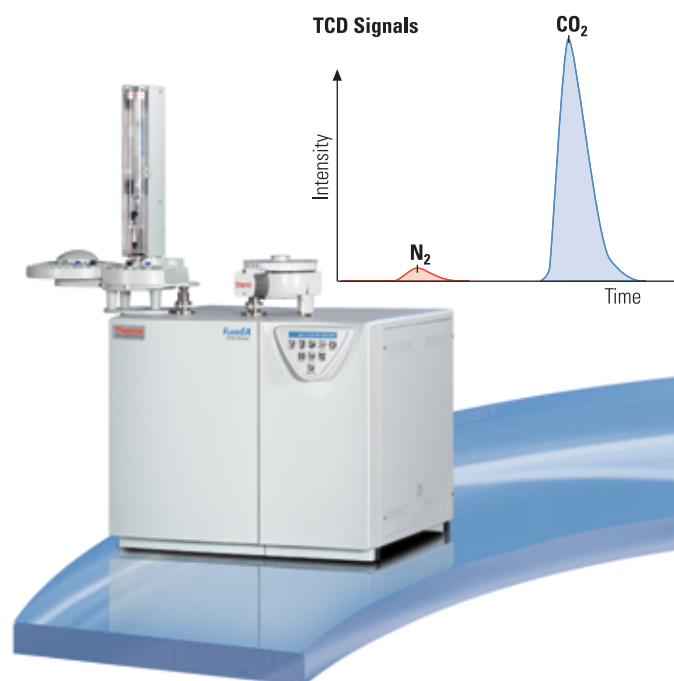
# smartEA™ The First Intelligent EA-IRMS

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

### 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 is designed to handle this large and variable dynamic range of elements and isotopes using patented 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.

\*Patent US 5,424,539

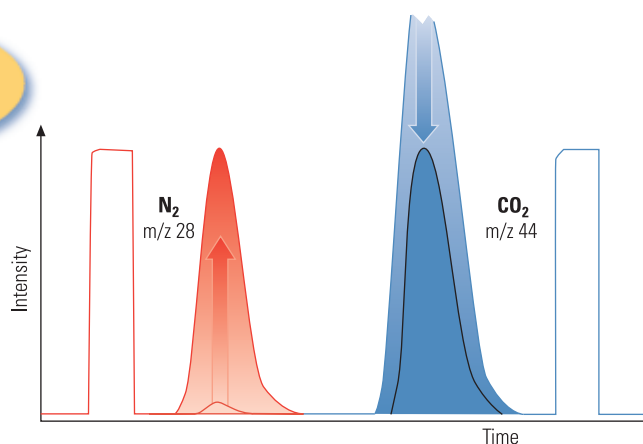


NEW

### smartEA Mode

The combination of ConFlo IV and FlashEA builds the first intelligent EA-IRMS system.

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



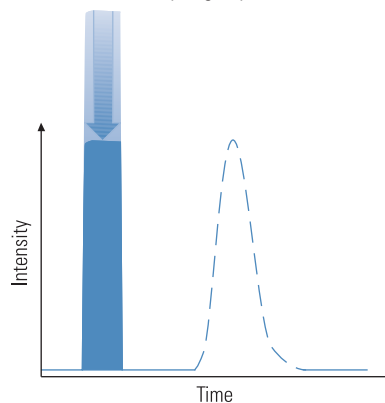
**Result: Automatically adjusted  
Isotope Ratio MS signals**

## Reference Gas Injection

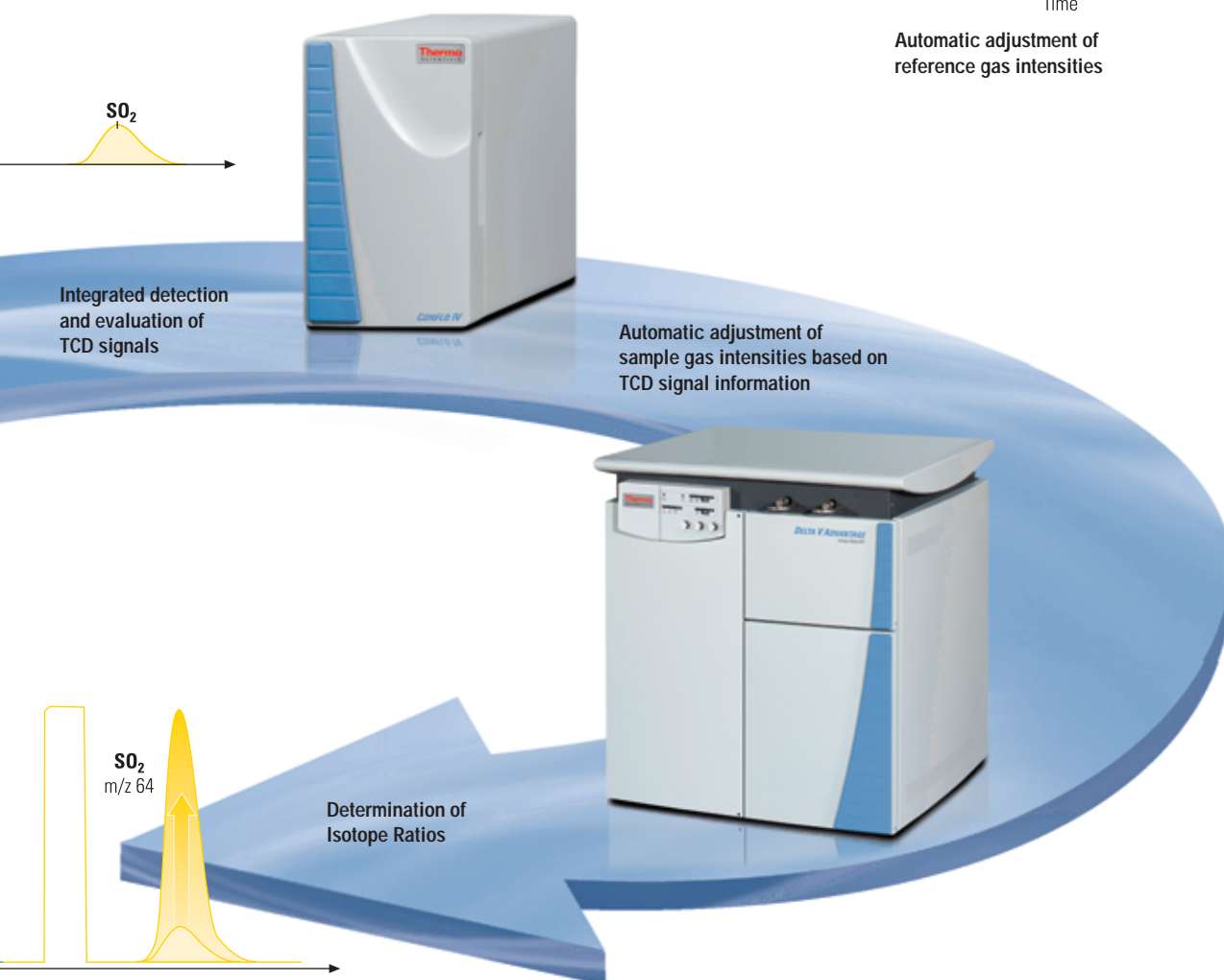
For the purpose of sample-standard referencing in Continuous Flow applications, cylinders of calibrated reference gases can be used for extended periods of time. Reference gases are supplied in  $\mu\text{L}$  amounts through inert capillaries into the Reference Gas injection port, creating a rectangular, flat-topped peak of reference gas without changing any pressures or gas flows. The use of reference gases instead of reference bulk material for standardization 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.

## Automatic Range Control

The ConFlo IV provides automated adjustment of the intensities of the reference gas pulses. As a consequence, and for the first time in Continuous Flow Isotope Ratio MS, the reference gas intensities can be matched to the intensities of sample gas pulses. Hence, the fundamental principle of Isotope Ratio MS, equal conditions for sample and reference gases, can be applied to all Continuous Flow applications.



Automatic adjustment of reference gas intensities



## System Monitoring & Self Diagnosis

The ConFlo IV 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  $\text{H}_3^+$  factor prior to the automatic start of a new application.

The ConFlo IV 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 -

## 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 even a complete new application can be set up on a separate device and appended, waiting for completion of the actual analyses.

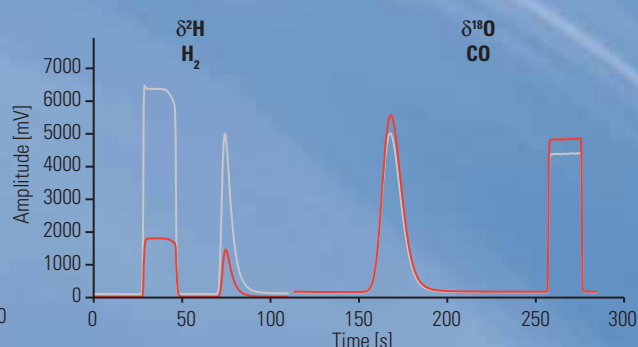
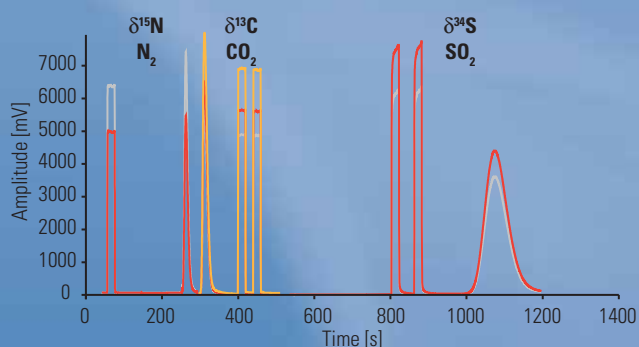
The next device will then automatically be activated and diagnosed for the next application while the other device will be set to idle or standby. System parameters important to the performance and integrity of data, such as system stability, signal linearity and the  $H_3^+$  factor, can be monitored 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  $\delta D$  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 EA

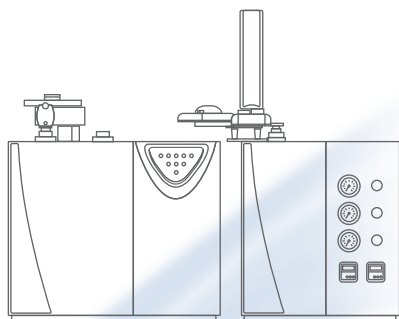


## Multi Element System: One Interface - Five Elements CNOHS





# - One Interface: ConFlo IV



## Multi Element System

$\delta^{13}\text{C}$ ,  $\delta^{15}\text{N}$  and  $\delta^{34}\text{S}$  from one EA and  $\delta\text{D}$  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  $\delta\text{D}$ . The ConFlo IV 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 the ConFlo IV's unique auto-dilution system.

## Water Analysis System

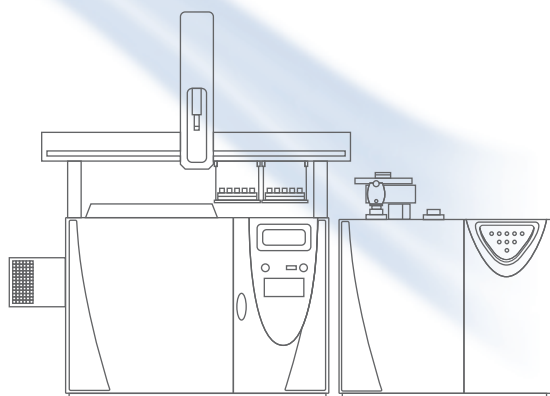
$\delta^2\text{H}$  and  $\delta^{18}\text{O}$  from Equilibration with the Thermo Scientific GasBench and from High Temperature Conversion with the Thermo Scientific TC/EA

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  $\delta\text{D}$  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  $\mu\text{L}$ . The GasBench II provides highest precision  $\delta\text{D}$  or  $\delta^{18}\text{O}$  results by isotope equilibration of water samples with  $\text{H}_2$  or  $\text{CO}_2$  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.

## Bulk EA and CSIA Systems

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

The combination of any FlashEA 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 EA 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: 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 – 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 the ConFlo IV to be used as an interface with any Continuous Flow sample preparation device, from Thermo 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 devices from Thermo Scientific (FlashEA 1112 IRMS, FlashEA 1112 HT, Trace GC and Trace GC Ultra). The ConFlo IV can be controlled by all fiber-line based Isotope Ratio MS from Thermo Scientific, the DELTA V Plus, DELTA V Advantage, Delta<sup>Plus</sup> XP, Delta<sup>Plus</sup> Advantage and MAT 253 using the Thermo Scientific Isodat software suite.

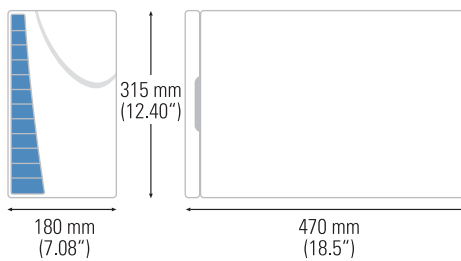
### Reference Gases Used for Applications

Pure nitrogen gas, N<sub>2</sub>, carbon dioxide, CO<sub>2</sub>, and sulfur dioxide, SO<sub>2</sub>, are used as reference gases for  $\delta^{15}\text{N}$ ,  $\delta^{13}\text{C}$  and  $\delta^{34}\text{S}$  determination by combustion reactions. Sulfur dioxide is applied through a heated reference injection port. Pure hydrogen gas, H<sub>2</sub>, and carbon monoxide gas, CO, are used for  $\delta^2\text{H}$  and  $\delta^{18}\text{O}$  determination by high temperature conversion reactions.

- 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

### 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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