AWARD-WINNING RESULTS

2400 Series II CHNS/O Elemental Analysis
Organic Elemental Analysis

PerkinElmer®
For the Better

PROVEN
PERFORMANCE
RELIABLE
RESULTS

Raising the Standard

The PerkinElmer® 2400 Series II CHNS/O Elemental Analyzer (2400 Series II) is a proven instrument for the rapid determination of the carbon, hydrogen, nitrogen, sulfur or oxygen content in organic and other types of materials. It has the capability of handling a wide variety of sample types in the field of pharmaceuticals, polymers, chemicals, environmental and energy, including solids, liquids, volatile and viscous samples.

Based on the classical Pregl-Dumas method, samples are combusted in a pure oxygen environment, with the resultant combustion gases measured in an automated fashion. The design has been field-proven in thousands of laboratories around the world. High-speed microprocessor control, solid-state components and built-in diagnostics provide confidence in performance and reliability.

Quick Glance

- One analyzer with three modes of operation: CHN, CHNS and Oxygen

- Advanced combustion design for handling virtually any type of sample

- Frontal Chromatography for simple, reliable and accurate measurements

- EA 2400 Data Manager software for easy data handling

OPERATION MODES

The EA 2400 Data Manager simplifies data handling and allows convenient storage and reporting capabilities. In addition, PerkinElmer offers the best quality reagents to provide the highest measurement of accuracy and precision.

Unlike other elemental analyzer designs, the 2400 Series II has easy access to all components for routine care and maintenance.

Multiple modes of operation

The 2400 Series II offers multiple analysis options: CHN, CHNS or Oxygen mode. As a user, you may choose one or more options to meet your laboratory's needs. Changeover to different modes of operation only requires a few simple steps. The optional Column Switching Accessory (CSA) makes switching to the Oxygen mode very convenient.

The **CHN mode** is the most widely used of the analysis modes. A range of reagents and the ability to optimize the combustion parameters offer flexibility for analyzing virtually any sample types. Interfering elements such as halogens and sulfur are removed before detection.

The **CHNS mode** is specifically designed to simultaneously determine carbon, hydrogen, nitrogen and sulfur in organic materials.

The **Oxygen mode** is optimized for the automatic determination of oxygen in organic materials by pyrolyzing the sample.

Upgradeability

The 2400 Series II can be upgraded at any time to add additional mode capability to suit the needs of your laboratory.

Automated weight entry

Accurate weighing of samples is a prerequisite for organic elemental analysis since results are presented on a weight percent basis.

To avoid transcription errors, the 2400 Series II provides automatic weight entry from the cost-effective PerkinElmer AD-6 Autobalance as well as other ultra microbalances. Using proven PerkinElmer balance technology, the AD-6 ultra mircobalance provides exceptional resolution and accuracy for the best results.

Unlike other elemental analyzer designs, the **2400 Series II** has easy access to all components for routine care and maintenance.

CHN and CHNS

A schematic diagram of the PerkinElmer 2400 Series II CHNS/O Elemental Analyzer is shown in Figure 1.

The CHN and CHNS modes are based on the classical Pregl-Dumas method where samples are combusted in a pure oxygen environment, with the resultant combustion gases measured in an automated fashion.

The 2400 Series II system is comprised of four major zones:

• Combustion Zone

• Gas Control Zone

• Separation Zone

• Detection Zone

In the **Combustion Zone,** samples encapsulated in tin or aluminum vials are inserted automatically from the integral 60-position autosampler or manually using a single-sample auto injector.

> Users have the flexibility of optimizing **static** and **dynamic combustion conditions** to meet the specific sampling need of their laboratory.


Principle of operations
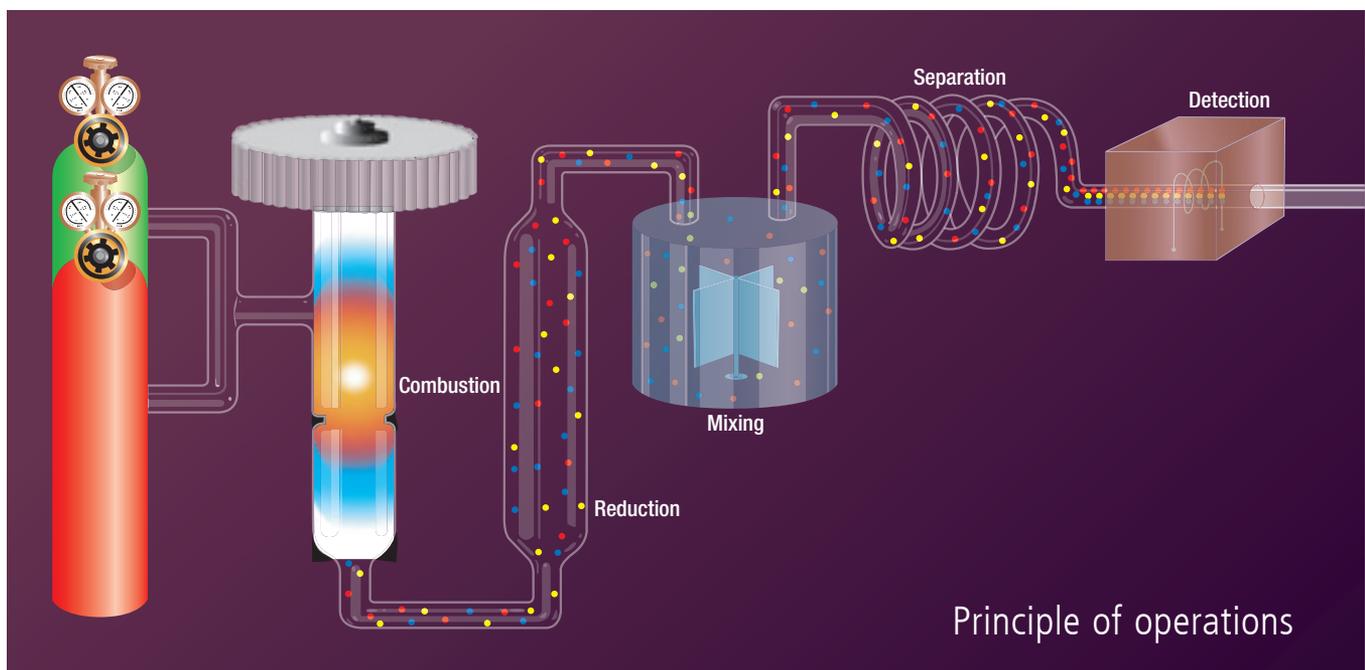
Figure 1. 2400 Series II CHNS/O Schematic.

In the presence of excess oxygen and combustion reagents, samples are combusted completely and reduced to the elemental gases CO_2, H_2O, N_2 and SO_2. Users have the flexibility of optimizing static and dynamic combustion conditions to meet the specific sampling need of their laboratory. The combustion products are then passed to the **Gas Control Zone** of the 2400 Series II.

Gases are captured in the mixing chamber of the Gas Control Zone. Here, gases are rapidly mixed and precisely maintained at controlled conditions of pressure, temperature and volume. By controlling the product gases from combustion/pyrolysis to the same exact conditions (pressure, volume and temperature) for every run, outside influences (barometric pressure changes, altitude) are eliminated. The combustion process is separated from the column and detector which gives the flexibility of varying combustion conditions in the same series of runs without influencing separation and detection and the gases are mechanically homogenized therefore providing precision and accuracy.

After homogenization of product gases, the mixing chamber is depressurized through a column in the **Separation Zone** of the instrument. The separation approach used is a technique known as Frontal Chromatography.

As the gases elute, illustrated in Figure 2, they are measured by a thermal conductivity detector in the **Detection Zone** of the analyzer. Since measurements in this design are made as stepwise changes from the carrier gas baseline, the variations associated with the quantification of peak signals in other CHNS/O analyzers is eliminated.

Oxygen

The oxygen determination method used with the 2400 Series II analyzer is based on the classical Unterzuacher method which incorporates the modifications of Oita, Conway and Culmo. The sample is pyrolyzed in a helium/hydrogen (95%:5%) atmosphere at 1,000 °C. The resulting products of reaction containing oxygen are converted to carbon monoxide over the platinized carbon reagent. The carbon monoxide and other gases pass through a scrubber where interferences are removed. The carbon monoxide is then controlled, separated and determined in the same fashion as above.

**The PerkinElmer
2400 CHN Elemental Analyzer**

Steady State Readout

H_2O

CO_2

N_2

Baseline
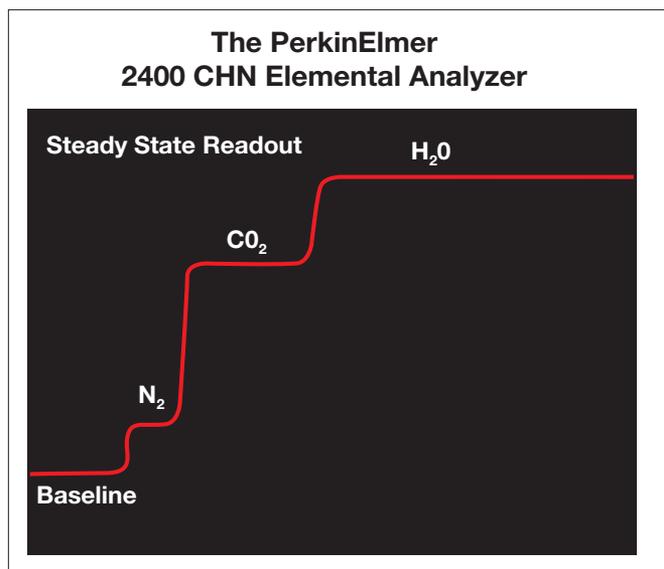
Figure 2. Chromatogram.

Only the best reagents, tubes and sample vials assure optimum analyzer performance. Every genuine PerkinElmer consumable and reagent is of high quality and designed specifically for your PerkinElmer instrument.

Operating gases

In the CHN and CHNS modes, operating gases include oxygen, for combustion of sample materials, and a carrier gas – either helium or argon. The use of argon as an optional carrier gas is unique to this design and assures cost-effective use of the Elemental Analyzer in those areas of the world where helium is difficult to obtain due to price or availability.

In the Oxygen mode, the operating gas is helium when using silver vials or helium/hydrogen mixture when using tin vials.

Optimized combustion flexibility for best performance

Combustion is the most critical step to the success of the measurements and ultimately affects the accuracy and precision of the final result: the weight percent of the element or elements being measured. The 2400 Series II provides advanced combustion conditions of temperature, time and available oxygen (or pyrolysis gas in the case of Oxygen mode). The user has the flexibility to increase the sample's combustion time in the oxygen atmosphere as well as the amount of oxygen that is introduced allowing for complete combustion of virtually any type of sample.

Gas control zone

The thorough mechanical homogenization of product gases under the controlled conditions of pressure, temperature and volume are important in order to achieve the most precise results.

Frontal chromatography for highest reliability

In the 2400 Series II, there is selective retention of the gases to produce a steady-state, stepwise signal rather than a peak signal (Figure 2). This technique allows for a simpler, more reliable and accurate determination of the combustion gases than other CHNS/O systems which use a peak separation method.

Laboratory efficiency

The 2400 Series II offers fast analysis times, optimizing efficiency and precision. A typical CHN analysis is accomplished in under six minutes, CHNS in eight minutes and oxygen in four minutes.

A unique wake-up routine allows the automatic equilibration and standardization of the 2400 Series II at an operator-selected date and time. This feature allows the system to be ready when you are.

A 60-position autosampler allows unattended operation night or day. The autosampler design has been tested through millions of cycles, both in accelerated quality assurance testing, and most importantly, in labs like yours throughout the world.

Diagnostic routines monitor electronic and pneumatic components for proper operation and alert the operator in the rare event that a failure is encountered. A program-mable gas saver valve allows for the automatic reduction of carrier gas flow rate when the analyzer is not in use.

Consumables

Only the best reagents, tubes and sample vials assure optimum analyzer performance. Every genuine PerkinElmer consumable and reagent is of high quality and designed specifically for your PerkinElmer instrument.

Convenient kits for 2,000, 4,000 or 10,000 experiments simplify ordering and eliminate waste.

Figure 3. CHNS kit (500).

EA 2400 DATA MANAGER

This powerful data management software is intuitive and user-friendly, providing a wide range of standard features and capabilities giving you more flexibility. Combined with the proven 2400 CHNS/O Series II Elemental Analyzer, PerkinElmer customer service and support, and the highest quality reagents and supplies, you can be sure you are receiving a complete, robust system for accurate, reliable material characterization.

Software capabilities

The EA 2400 Data Manager is a SQL-based software. It allows the use of a standard PC to collect and store data, perform advanced calculations, recalculate a result, run queries (searches), generate statistics, create reports and archive data. For regulated environments, it is compliant with 21 CFR Part 11.

The software lets you:

• Browse a list of run results that have been collected from the instrument.

• Browse a list of instrument diagnostic messages such as leak test results or instrument status information.

• Browse a list of user-defined queries that enable you to search for a specific set of run results.

Figure 4. Run Results screen.

In addition you can also:

• Filter the browsing to **show specific run results.**

• **Search for run results** by date and time, user ID, Project ID, mode, run type and sample ID.

• **Customize the columns** you wish to display in the results table.

• Select multiple runs to **perform advanced calculations, recalculations or statistical analyses.**

Figure 5. Advanced Calculations screen.

Advanced calculations

Advanced Calculations are standard features in the software allowing users to:

• Perform **Elemental Ratio** calculations of H/C, N/C, S/C or C/N.

• Determine the simplest **Empirical Formula** of a sample to help to confirm an unknown.

• Determine % **Polymer** in a co-polymer formulation or blend using a hetero-element.

• Analyze **Mixtures** when a reasonable element differential exists between two compounds.

• Study newly synthesized organic compounds for the amount of **Solvent of Crystallization.**

• Correct the result % on all elements to a dry basis when the moisture content is known.

• Determine the **Heating Value** in kJ/g of a material when the CHNS and O percentages are known. This is defined as the theoretical amount of energy released as the material combusts in the oxygen atmosphere.
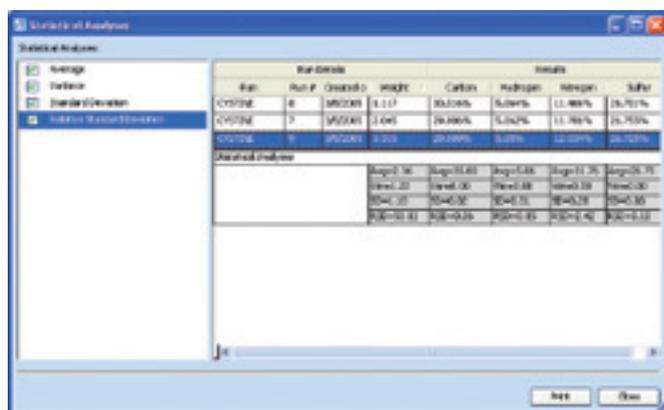

Figure 6. Statistical Analysis screen.

Statistical analyses

Statistics provide a method or basis to better understand your data. The EA 2400 Data Manager offers a choice of Average, Standard Deviation, Variance and Relative Standard Deviation analysis.

Reporting and exporting

If you wish you can print the table of selected runs or an entire results table, or you can use one of the available predefined report templates. You may chose to either print the hard copy and/or save the report using pdf-, doc- or rtf-file format.

Data can be exported to a csv- or xls- file format.

Diagnostics

The diagnostic information provided from the instrument is stored providing a permanent record of instrument history and status.

Enhanced security for regulated environments

In response to 21 CFR Part 11 and the increasing data security requirements in some industries, PerkinElmer's Enhanced Security™ (ES) feature offers the technical compliance tools needed to meet these mandatory regulations.

Queries

The Query (search) Setup capability allows you to select criteria to be used to generate a very specific search of the run results in the database. Query definitions can be saved and made available to all users or only the user that created the query.
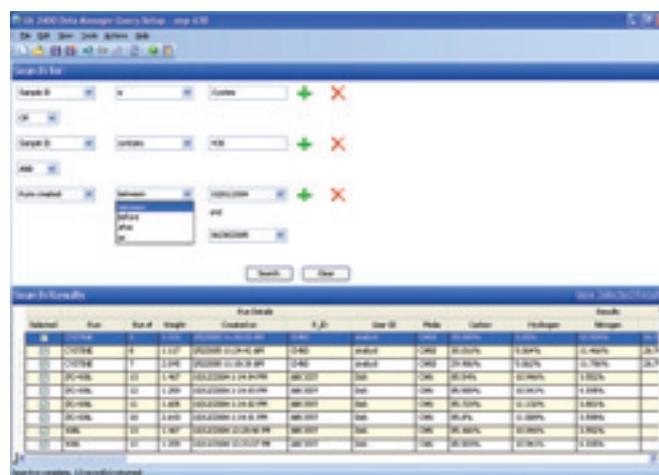
Figure 7. Search screen.

EA 2400 Series II Specifications

	EA 2400 SERIES II	TECHNICAL DESCRIPTION
Instrument Design		
Combustion Approach	Static and Dynamic	A mixture of two combustion techniques to ensure complete sample combustion
Furnace Design	Vertical	
Combustion Furnace Temp.	100 – 1100 °C	
Reduction Furnace Temp.	100 – 1000 °C	
Pyrolysis Furnace Temp.	100 – 1100 °C	
Sample Temp.	≥1800 °C	High heat, oxygen environment (static & dynamic introductions before and after the sample drops), the presence of combustion reagents and the beneficial exothermic reaction of the tin capsule makes for the most advanced and flexible combustion processes available.
Separation Technique	Frontal Chromatography	Selective retention of the gases to produce a steady-state, stepwise signal allows for a simpler, more reliable and accurate determination of the combustion gases
Detector	TCD (Thermal Conductivity Detector)	
Gas Requirements		
Carrier Gas	Helium or Argon	
Combustion Gas	Oxygen	CHN or CHNS Mode
Pyrolysis Gas	5-8% H in He	Oxygen Mode
Pneumatic Gas	Air, Nitrogen or Argon	
Cost Saving Features		
Gas Saver	Included	Reduced carrier gas usage outside of operation periods.
Flexible Carrier Gas	Helium or Argon	
Optimized Combustion	Included	Allows for customizable combustion conditions to ensure complete combustion while minimizing oxygen use.
Copper Reduction Agent Regeneration	Optional	Connection to hydrogen gas mixtures facilitates reduction of copper reducing agent for reuse.
Productivity Features		
Autosampler	60 position	Pneumatic auto drop.
Automatic Weight Transfer	Optional	Eliminates the need for manual input of weights. Compatible with the PerkinElmer AD-6000 Ultra Microbalance; and the Mettler Toledo® UMX2.
Automatic Shutdown and Wake-up	Included	For reducing furnace temperatures at user defined times and dates as well as reheating and calibration.
Column Switching Accessory	Optional	For convenient switching between Oxygen and CHN/CHNS modes

Software Features

21 CFR Part 11	PerkinElmer Enhanced Security™ (ES)	
Advanced Calculations	Elemental Ratio, simplest Empirical Formula, % Polymer, Solvent of Crystal-lization, Dry Basis and Heating Value	A series of calculations providing information such as the CN ratio or the calculated amount of heat released upon combustion.
Record of Analysis	Sample; optimize combustion conditions background (blank) and calibration (Kfactor) values	
Statistical Analyses	Average, Standard Deviation, Variance and Relative Standard Deviation	
Diagnostic Recording	Included	Providing permanent record of instrument timing, leak testing and condition monitoring.

Performance

Accuracy	≤0.3%	In Helium carrier gas and certified reference materials
Precision	≤0.2%	In Helium carrier gas using certified reference materials

Analysis Times

CHN	6 mins
CHNS	8 mins
Oxygen	4 mins

Sample Size

Range	0 to 500 mg	Sample type dependent.

Analytical Range

C	0.001-3.6 mgs
H	0.001-1.0 mgs
N	0.001-6.0 mgs
S	0.001-2.0 mgs
O	0.001-2.0 mgs

Site Requirements

Dimensions (HxWxD)	61 cm. (24 in.) x 55 cm. (22 in.) x 55 cm. (22 in.)
Weight	45 Kg (99 lb.)
Power Requirements	100 – 230 VAC

For a complete listing of our global offices, visit www.perkinelmer.com/ContactUs

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