

Clarus 600

Gas Chromatograph



the fastest
injection-to-injection time
in conventional gas chromatography

Clarus 600 Gas Chromatograph – the innovation is simply its speed



Clarus 600 Gas Chromatograph

Every fast-paced, high-volume laboratory shares a common goal: to speed up analytical cycle times. Now, PerkinElmer delivers with its latest innovation in GC, the high-performance **Clarus® 600 Gas Chromatograph**.

Powered by the fastest available heat-up and cool-down conventional oven

PerkinElmer has always led the way with innovations in gas chromatography and the Clarus 600 Gas Chromatograph (GC) is no exception. It features a unique, high-performance oven with the fastest combined heat-up and cool-down rate in a conventional GC oven design. The resulting shorter injection-to-injection time will significantly increase your throughput and productivity by speeding your analytical cycle time. And higher productivity means a rapid return on your investment (ROI).

The Clarus 600 GC is built with many other PerkinElmer® GC innovations that add ease-of-use, flexibility and remove the barriers to productivity that can arise with more demanding samples and applications. These include our exclusive optional PreVent™ pressure-balanced system and hundreds of possible programmable pneumatic control (PPC) configurations that enable us to build dedicated analyzers for unique application challenges. For data management and reporting, PerkinElmer's award-winning TotalChrom® Chromatography Data Systems (CDS) make managing data easier than ever. Plus, our instruments are the only gas chromatographs with an intuitive touch-screen interface with real-time signal display and eight-language support – this means easy operation for you.

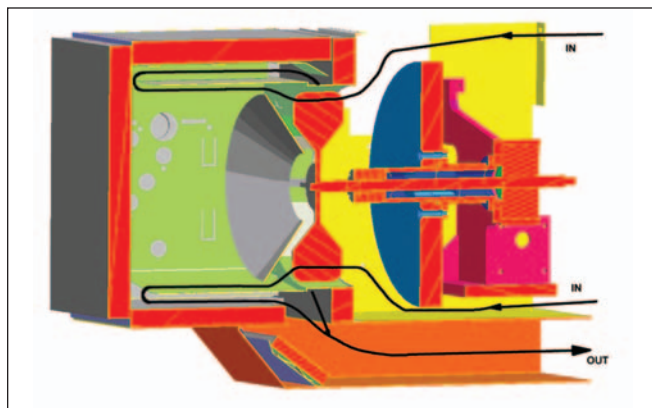
the Clarus 600 GC

maximizes your GC productivity

Shorten injection-to-injection time with a high-performance oven

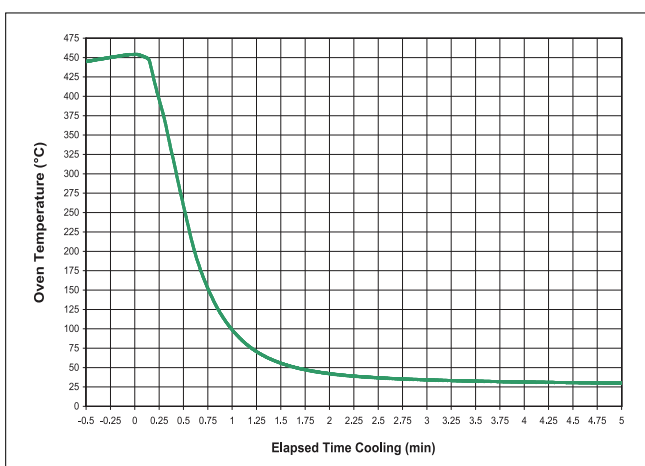
The unique oven design of the Clarus 600 GC provides the fastest available heat-up and cool-down rate, enabling shorter injection-to-injection and analytical cycle times, maximizing your sample throughput.

- **Fast oven heat-up rates** allow faster chromatography using a high-power heating element combined with the spatial and physical properties of the oven.
- **Fastest available cool-down rate** is delivered using forced convection air. The path of the air stream maximizes the effect of the convective cooling by passing air directly over the heated components, including the oven insulation.
- **Fan speeds supplement oven heat-up and cool-down:*** During the heating cycle, relatively slow fan speeds are applied to achieve good heating ramp rates while, during the cooling cycle, higher fan speeds are utilized to provide the fastest cooling rates.
- **Novel twin-walled oven design with concentric air exhaust*** allows faster oven cooling to reduce injection-to-injection times and allows chromatography at near-ambient temperatures.
- **SOFTcooling™ capability*** prevents ingress of detector gases into the hot column on the onset of cooling as well as ghost peaks due to column-bleed chilling during cool-down of the previous run.



Unique airflow paths allow the fastest combined oven heat-up and cool-down rates.

- **More program steps.** Up to 10 oven-temperature program steps are available to support the most demanding applications.
- **Autosampler pre-rinse performs time-consuming syringe rinse** with sample before the GC becomes ready, saving time in between runs and reducing injection-to-injection time.



Clarus 600 GC typical oven cooling profile.

QUICK GLANCE

- Oven cool-down from 450 °C to 50 °C in *less than 2 minutes*.
- Unique high-performance conventional oven *speeds cycle times*.
- Integrated autosampler adds *flexibility* and *automation*.
- Temperature programmable inlets deliver *performance* and *flexibility* for more demanding applications.
- Programmable pneumatic control (PPC) adds *automation* efficiencies.
- Exclusive optional PreVent pressure-balanced system enhances *performance* and *productivity*.
- Innovative, intuitive touch-screen interface makes *operation easy* – no training required.
- Scalable TotalChrom Chromatography Data Systems (CDS) make data management and reporting *easier than ever*.
- PerkinElmer's complete offering allows *easy integration* of best-in-class mass spectrometer, headspace, headspace trap or thermal desorption.

* patent pending

integrated technologies

maximize automation capabilities

Gain flexibility and automation capability with best-in-class integrated Autosampler

The totally integrated Clarus GC Autosampler provides a mechanically robust, dependable system with the flexibility and automation capability you need.

- **Accommodates three syringe sizes** (0.5, 5.0 and 50 μ L) **and three injection speeds** (slow, normal and fast) for complete application flexibility.
- **Unobstructed access to both injection ports** permits any combination of analyses for the most efficient utilization of the gas chromatograph.
- **Fully controllable from the Clarus 600 GC touch screen**, featuring run status and automation logs that show whether there was any deviation from the preprogrammed method conditions.
- **Optical sensors consistently monitor system integrity** to ensure your analytical runs proceed as planned.

Maximize flexibility and performance with temperature-programmable inlets

For more demanding applications, the Clarus 600 GC inlet positions are programmed with a range of temperature-programmable inlets. Options include two enhanced capillary injectors: programmable split/splitless (PSS) and programmable on-column (POC). These provide the following benefits:

- **Significantly reduce risk of sample degradation**, thereby maximizing accuracy and precision over a wide range of sample volumes.
- **Prevent contamination of gas lines and regulators** with the PSS system's integrated charcoal trap. It cleans the split effluent, while removing the possibility of analyte discharge to the atmosphere. The trap also provides a "pressure buffer" for vaporizing samples, delivering the lowest available discrimination.



The Clarus GC Autosampler, fully controllable from the Clarus 600 GC, provides flexibility and automation.

Add automation efficiencies with programmable pneumatic control (PPC)

PPC offers additional capability and levels of performance not attainable with manual pneumatic systems, allowing analysis of a wide range of samples. PPC allows you to:

- **Control and monitor all injector, detector and auxiliary gases electronically**, using the Clarus 600 touch-screen interface.
- **Eliminate labor-intensive and complex steps associated with measuring and setting flows manually.** You set all flows and pressures of all the instrument

gases on the touch screen. No more knobs or complicated software. For instance, to set up split ratios, you simply enter the required ratios on the touch screen and the Clarus 600 GC automatically calculates and adjusts the split vent to the correct flow for the selected column flow.

- **Quickly and easily set up the detector combustion or makeup gases**, reducing variability in instrument setup due to operator bias or environmental conditions. You can enter published methods exactly as written, without trial and error, saving time and increasing reproducibility.



How does PPC work?

Using PPC, the Clarus 600 GC automatically adjusts carrier-gas flows to compensate for variations of ambient temperature and pressure, providing constant retention times under widely varying conditions. This greatly enhances system stability even in extreme environments. With flexible flow velocity and pressure control, you can program the carrier gas for optimal column performance.

Constant mass-flow control simplifies setup and shortens analysis time while improving performance of certain detectors, including those sensitive to mass-flow changes such as thermal conductivity detectors and nitrogen phosphorus detectors.

A single PPC method stores all temperatures, gas flows and pressures, making it easy to follow standard operating procedures (SOPs). Simply recall the method to establish complete operating conditions. If you need a greater level of data management, the Clarus 600 GC's TotalChrom CDS can control and store all operating conditions with the chromatographic data and the method.

Using PPC also greatly enhances confidence in system performance and accuracy. By monitoring deviations from the pneumatic set-points, the Clarus 600 GC can automatically shut down if leaks are suspected. The system constantly monitors the status of the combustion gas. If the Clarus 600 GC detects that the flame is out and automatic reignition fails, it turns off combustion gas supplies, preventing injection and possible loss of valuable samples.

our PreVent system

enhances performance & productivity

The Clarus 600 GC features our exclusive, optional PreVent pressure-balanced system, an innovative productivity tool that works in concert with the temperature programmable PSS injector and the PPC. The PreVent system provides five modes of operation that enhance performance and productivity by:

- Increasing analytical throughput
- Managing difficult samples
- Protecting the column and chromatograph
- Lowering detection limits
- Simplifying maintenance

PreVent modes of operation

- **Time Saver mode** selectively prevents high molecular weight components from going through the chromatographic separation system and detector. Reduces analysis time, while improving system stability and overall uptime.
- **Enhanced Solvent Purge mode** can reduce effects of high solvent levels in the column and detector more completely than PSS alone to eliminate solvent

flooding of the column. Removes the influence of excess solvent from the system, allowing use of methylene chloride as a solvent with an ECD.

- **Isolation mode** allows a septum change without interruption of carrier flow to the column, minimizing downtime and allowing routine maintenance on the inlet without impacting system stability. The system is available immediately for analysis following maintenance with no need to equilibrate the column or purge the mass spectrometer.
- **ProTect™ mode** prevents heavy components in the sample from reaching the expensive and very retentive chromatographic column.
- **Enhanced large-volume injection (ELVI) mode** allows injection of a large sample volume (up to 50 μL using the Clarus GC Autosampler) without degradation in chromatographic performance. Sample volumes greater than 50 μL can be injected manually, with sample size limited only by the capacity of the PSS liner to contain the liquid sample during injection. LVI plus solvent purge provide extreme flexibility.

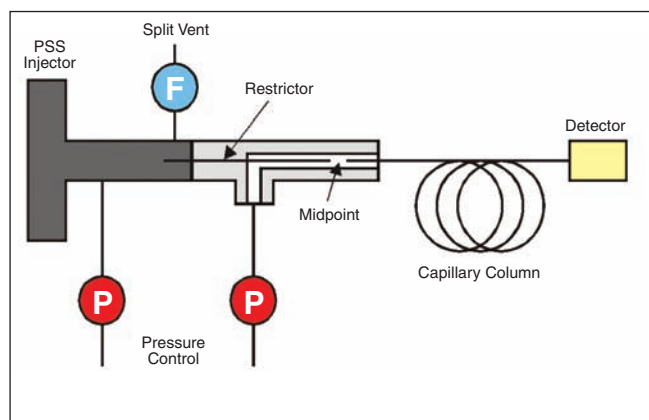
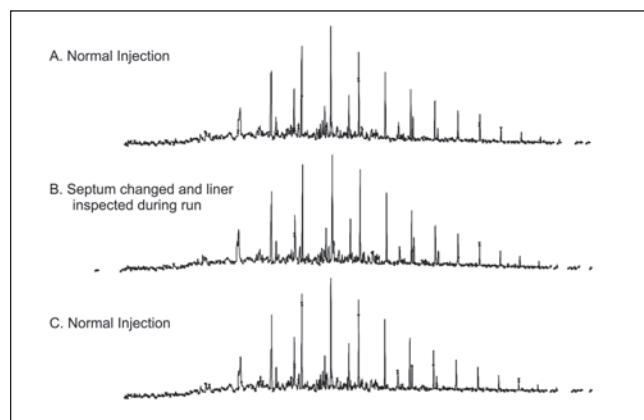


Diagram of PreVent with injector restrictor installed.



Three successive injections of diesel oil run in Isolation mode. Septum changed and injector liner inspected during run B.

innovative touch-screen interface

makes operation easy

You won't find a more intuitive instrument user interface than the full-color touch screen on the Clarus GC. So easy-to-use, virtually no training is required. No more confusing keypads and user manuals!

Smooth navigation brings GC analysis to your fingertips

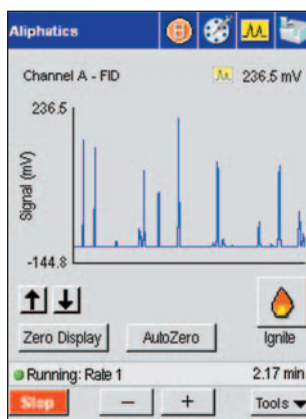
Clear and concise visual language guides you through the system. With single-touch access to the functions you need, the Clarus 600 GC touch screen eliminates drilldown, simplifying instrument control. Icon buttons define the type and status of each heated zone and each injector and detector is identified by a unique icon, which is color coded by channel.

Multiple language support makes the Clarus 600 a global GC

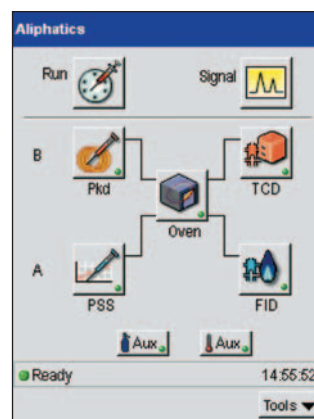
The Clarus 600 GC comes with multilingual capability, including error messages, so you can work in the language of your choice – and you can easily switch to different languages. This ensures your entire staff is at ease when working with the system. So whether you speak English, Spanish, French, Italian, German, Russian, Japanese or Chinese, the Clarus 600 GC makes perfect sense.

Automatic monitoring simplifies maintenance

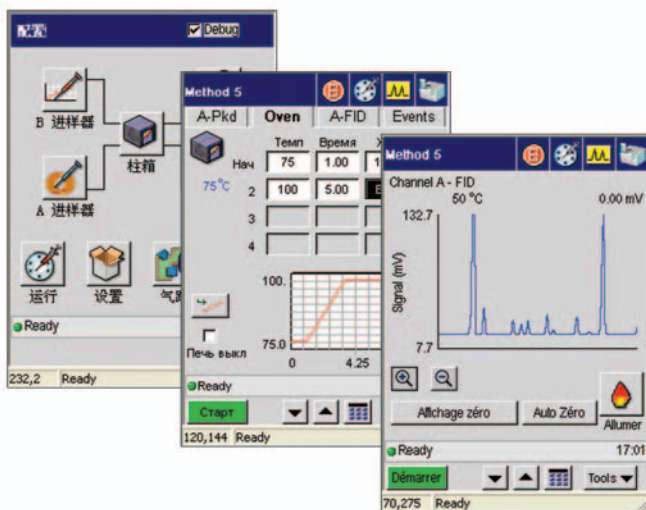
The touch-screen interface keeps track of the number of injections so you know when to replace septa and perform routine maintenance on the system, eliminating the need to track this important information on paper. It tracks total number of injections and elapsed time; both can be reset. It gives proactive warning and user-error messages, using real words instead of cryptic codes. The Clarus 600 GC also offers the ability to turn off the flame ionization detector (FID) and other instrument parameters overnight or over the weekend.



Real-time chromatogram is displayed continuously, allowing you to monitor your runs.



Icon buttons allow quick and easy recognition of injectors and other devices.



Available in eight languages, the Clarus 600 GC speaks everyone's language (Chinese, Russian and French shown above).

create an integrated analytical solution

for your performance and throughput needs

Combine the Clarus 600 GC with our high-performance mass spectrometer, market-leading TurboMatrix sample handling, flexible user-friendly software and world-class service and support for an integrated, complete analytical solution. Whatever your performance and throughput needs, and for *any* application – environmental, chemical, flavor and fragrance, food and beverage, forensic or pharmaceutical – PerkinElmer delivers on your expectations.

Clarus 600 Gas Chromatograph/Mass Spectrometer

The rugged, high-performance Clarus 600 MS is a best-in-class quadrupole mass spectrometer, acquiring spectra at up to 65 scans/second across a GC peak. Its wide mass range (1-1200 u) encompasses a variety of applications, and a high signal/noise offers many new possibilities for analysis. The system's Clarus 600 GC, with its fast heat-up and cool-down oven, contributes to maximizing throughput and productivity. Coupled with easy-to-use TurboMass™ software, the result is a powerful GC/MS to drive your laboratory analyses.



TurboMatrix Headspace and Headspace Trap

Our TurboMatrix Headspace and high-sensitivity Headspace Trap samplers provide unparalleled precision and ease-of-use for many GC and GC/MS applications. Advanced technology and thoughtful design ensure that our systems can meet the diverse sensitivity requirements of different applications. You choose the system you need based on your performance and throughput requirements. Our proven TurboMatrix Headspace technology delivers on your expectations.



TurboMatrix Thermal Desorbers

Our family of five different TurboMatrix Thermal Desorbers allows you to match throughput and technology to your laboratory and applications needs. Choose from single-tube and automated 50-tube configurations, with PPC or manual pneumatics.

Use this clean technique to simplify and speed up a wide range of GC applications, including indoor and outdoor air monitoring, analysis of flavors/fragrances and analysis of outgassing volatile compounds from packaging, polymers, pharmaceuticals and semiconductor materials such as those used in the manufacture of disc drives and wafers.



Flexible, expandable data-handling solutions – TotalChrom CDS

PerkinElmer's award-winning TotalChrom Chromatography Data Systems (CDS) is the industry standard in chromatography software. With its scalable architecture, 21 CFR Part 11 compliance features and proven algorithms, TotalChrom CDS offers a computing strategy to manage your growing volume of chromatography data quickly, efficiently and safely in both regulated and non-regulated environments. The software features TC Publisher™ which is simply the world's best chromatography reporting package available. Operating in a Microsoft® Windows® environment, TotalChrom CDS can control up to eight instruments.

The combination, our Clarus 600 GC with TotalChrom CDS, provides a total laboratory solution from data collection and analysis to reporting and storage. Whatever your data-handling requirements, there is a TotalChrom system to fit your budget and your technical demands.

Expert, end-to-end service and support

PerkinElmer manufactures and supports the broadest range of instruments, reagents and consumables in the industry. With over 60 years of experience, our knowledge, skills and expertise are unparalleled.

We have the largest and most experienced service force in the industry, so you can count on us to be there when you need us. Our 1200 factory-trained and certified engineers have an average 15 years of experience maintaining leading-edge scientific equipment, including preventative maintenance, validation support and instrument repair. Plus, you can rely on end-to-end training and technical and applications support, from sample handling through data handling.



find turnkey solutions

PerkinElmer applies its knowledge and expertise to develop customized analyzers for a wide range of specialized application challenges in many industries. These systems combine our proven gas chromatography products, software and accessories with input from customers and relevant regulatory agencies. Because the analyzers and systems are integrated and performance-tested before shipment, no complex setup or method development is required during installation.

Petrochemical analysis from “hydrogen to asphalt”

The analytical challenges of monitoring and controlling petrochemical processes and products are as complex as the chemical processes themselves. The term “hydrogen to asphalt” categorically represents the breadth and depth of raw materials and products derived from crude oil. Each category has a set of analytical requirements that include single- or multiple-component analysis plus the determination of metals and carbon content. Analytical methodologies play a critical role in ensuring that manufacturing conditions are monitored and that product quality is consistently maintained.

Refinery gas analysis includes hydrocarbon mixtures in refinery feed stocks and products such as naphtha, reformate, alkylate and gasoline. Natural gas analysis includes a family of gas analyzers to address a full range, including H_2 , O_2 , N_2 , CO_2 and C_1 through C_5 as well as C_6 and higher hydrocarbons.

PerkinElmer-ARNEL analyzers provide gas chromatography solutions from sample-handling interfaces to data handling. These systems monitor every aspect of your application including refinery gas analysis, simulated distillation, natural gas analysis, transformer oil gas analysis and trace sulfur analysis. PerkinElmer's analytical solutions meet or exceed published methodologies and address your specific analysis criteria.

Fuel and glycol in used lubricating oil

Fuel passes into the lubricating oil during normal engine operation. Changing the oil prematurely is wasteful and expensive, while changing the oil too late may cause damage to engine bearings, pistons, rings and liners. Testing the oil regularly will detect oil degradation as it occurs and can predict when the oil will need to be changed. Similarly, the presence of ethylene glycol in used lubricating oil is an indication of antifreeze coolant leakage into the crankcase of an internal combustion engine, thus predicting engine-wear problems.

The Clarus GC with PPC, integral autosampler, a single flame ionization detector, programmable split/splitless (PSS) injector and PreVent affords a robust and high-throughput analysis of fuel in used oil. When configured with a TurboMatrix 110-position Headspace sampler, the integrated GC system provides up to a ten-fold increase in throughput (~1.5-3.5 min per sample) for the analysis of glycol content in used oil.

Analysis of biodiesel

Biodiesel is a renewable fuel from natural oils like soybean oil, rapeseed oil or animal fats and can be used as a substitute for diesel fuel. It is cleaner burning than petroleum diesel and has less sulfur content, reducing emissions.

Glycerin content can indicate the quality of biodiesel. Glycerin can be in the form of free glycerin or bound glycerin in the form of glycerides. A high content of free and total glycerin can lead to buildup in fuel tanks, clogged fuel systems, injector fouling and valve deposits.

The Clarus GC can serve as a tool offering a simple, sensitive and reliable method that requires only a small amount of sample preparation for process troubleshooting during biodiesel production to

to unique application challenges

ensure trouble-free operation of the fuel in diesel engines. Monitoring the level of free glycerin and any unrelated mono-, di- and triglycerides will indicate the efficiency and progress of the chemical reaction during the process of making biodiesel.

Ozone precursor analyzers developed with the U.S. EPA

In the United States, the Clean Air Act of 1970 gave the Environmental Protection Agency (EPA) responsibility for maintaining clean air. Six parameters are measured routinely in ambient air: SO_x, NO_x, PM₁₀, Pb, CO and ozone. In the 1990s, the Clean Air Act was expanded to include volatile organic compounds (VOCs) that contribute to the formation of ground-level ozone. These measurements are implemented through Photochemical Assessment Monitoring Stations (PAMS). Similar recommendations have also been made in Europe following the 1992 Ozone Directive and United Nations Economic Commission for European protocol on controlling VOC emissions.

In conjunction with the U.S. EPA, PerkinElmer developed an analyzer and methodology for collecting and automatically measuring C₂-C₁₁ without the use of liquid cryogen. The PerkinElmer Ozone Precursor Analyzers, available with PPC, incorporate an on-line TurboMatrix Thermal Desorber and the Clarus Gas Chromatograph.

Rapid blood-alcohol analysis

Accuracy and precision are critical in blood-alcohol analysis because the toxicologist not only has to be confident in his or her results, but also must be prepared to withstand tough cross examination by defense attorneys. In addition, crime laboratories must comply with state regulations regarding blood-alcohol testing, including proficiencies which require the result to be within $\pm 10\%$.

For this application, you can couple the Clarus GC with a TurboMatrix Headspace sampler, the industry standard around the world for the determination of alcohol in blood. For high throughput, the TurboMatrix HS 110 can process a full magazine of 110 sample vials in three hours.



PerkinElmer, Inc.

PerkinElmer, Inc. is a global technology leader focused in the following businesses – Life and Analytical Sciences and Optoelectronics. Combining operational excellence and technology expertise with an intimate understanding of its customers' needs, PerkinElmer creates innovative solutions that accelerate drug discovery, enhance research productivity, help meet regulatory requirements, improve time-to-market and increase manufacturing efficiencies.

PerkinElmer – the clear choice in gas chromatography

PerkinElmer is the only chromatography supplier who develops, manufactures, supports and services every product it offers to provide a truly integrated system.

This means one expert supplier – with best-in-class instruments and a world-class service and support organization – can address all of your applications and troubleshooting needs, from sample handling to data handling.

Clarus 600 GC – our latest innovation in GC delivers for you!

Get more information about how you can boost your GC productivity with the innovative Clarus 600 GC and its fast injection-to-injection and analytical cycle times. Learn how a total integrated system and the support to go with it can benefit your lab. Visit www.perkinelmer.com/gc or call your local sales office.

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