

Gas Chromatography

Clarus 590 Gas Chromatograph



The PerkinElmer Clarus® 590 Gas Chromatograph (GC) is a fully automated gas chromatograph. The system offers the capabilities required for laboratories performing large numbers of routine analyses as well as those involved in research and development. All instrument functions are set up and monitored through a touch screen. The intuitive graphical user interface includes a real-time chromatogram display and eight-language support.

Oven

The Clarus 590 GC oven provides easy access to columns. The oven gives excellent temperature control and fast cool-down times for maximum productivity. All temperature and time functions are microprocessor controlled and are shown on the touch-screen display. Software selectable coolant time-out and coolant cut-in temperatures ensure economical subambient operation.

Volume:	10,600 cm ³	
Temperature range:	10 °C above ambient to 450 °C or -99 °C to 450 °C with subambient accessory	
Column overheat protect:	User settable up to 450 °C	
Temperature programmer:	3 ramp, 4 plateaus	
	Minimum Range	Increment
Initial oven temperature:	-99 °C to 450 °C	1 °C
Initial time:	0 to 999 min	0.1 min
Rate:	0.1 to 45 °C/min	0.1 °C
Plateau time:	0 to 999 min	0.1 min
Final oven temperature:	-99 °C to 450 °C	1 °C
Cool-down times:	250 °C to 50 °C: 4.8 min 200 °C to 50 °C: 3.8 min 50 °C to 0 °C*: 2.6 min 50 °C to -30 °C*: 3.4 min *with liquid CO ₂	

Pneumatics

A full range of pneumatic options provides optimum performance with all types of columns and detectors. The Clarus 590 GC may be ordered with or without PPC (programmable pneumatic control). There are up to 12 PPC zones configured as 2 carrier (2 zones each), 2 detector (2 zones each) and 4 auxiliary channels.

Carrier gas pneumatics

- PPC or manual pneumatics are available for all injectors
- Carrier PPC zones compensate for variations in ambient temperature and pressure for maximum stability
- Split vent pneumatics are included with the Clarus 590 split/splitless and PSS (programmable split/splitless) injectors
- PPC provides direct setting of split flow rates and ratios
- Split vent PPC zones compensate for variations in ambient temperature for maximum stability
- PPC provides direct setting in mL/min, psig or kPa or cm/sec
- Automatic leak testing with PPC
- Three-ramps pressure program
- Pneumatic program rates:
 - 0-100.0 psi/min
 - 0-100.0 mL/min
 - 0-200.0 cm/sec
 - or ballistic

Detector pneumatics

- PPC or manual pneumatics are available for all detectors
- PPC provides direct setting in mL/min
- Detector PPC zones compensate for variations in ambient temperature for maximum stability

Auxiliary pneumatics

- Four auxiliary zones
- PPC provides direct setting in mL/min, psig or kPa
- Auxiliary PPC zones compensate for variations in ambient temperature for maximum stability

Autosampler

The Clarus 590 GC offers an optional, built-in syringe autosampler for maximum sampling capabilities. All control is accomplished through the keyboard or by a data system such as TotalChrom®.

Injection speed:	Normal, fast, slow
Program modes:	Two methods may be programmed
Number of sample positions:	108, plus one priority
Vial size:	2-mL (0.25 mL with insert) crimp-top caps 2-mL screw-top caps
Number of waste and wash vials:	Four waste and four wash
Waste and wash vial size:	4 mL
Syringe size:	0.5 µL, 5.0 µL or 50.0 µL
Sampling volume:	0.1 µL to 0.5 µL from the 0.5-µL syringe in 0.1-µL increments or 0.5 µL to 5.0 µL from the 5.0-µL syringe in 0.5-µL increments or 5.0 µL to 50.0 µL from the 50.0-µL syringe in 5.0-µL increments
Viscosity settings:	0-15
Maximum number of injections/vial:	15
Maximum number of solvent postwashes:	15
Maximum number of sample pumps:	15
Maximum number of sample prewashes:	15
Minimum sample volume required:	5 µL when used with the 0.25-mL vial insert; 350 µL when used with the 2-mL vial
Reproducibility:	< 0.5% RSD for packed columns 1% C ₉ in C ₇ , 1 µL injected
Sample pre-rinse:	Prepares the autosampler syringe in advance of the GC becoming ready

Injectors

The Clarus 590 GC supports a comprehensive array of injectors that provides accuracy and precision to all of your sampling applications. Up to two injectors may be installed and operated with independent temperature control. Every injector is available with PPC or manual pneumatics.

Injectors, continued

Packed-column injector

- Removable glass liner for trapping nonvolatile residues
- Adapter for on-column injection to wide-bore capillary columns
- 50 °C to 450 °C in 1 °C increments
- 1/8-inch fitting
- 1/4-inch column adapter available
- Manual pneumatics – choice of flow controller with head-pressure gauge, or flow controller with head-pressure gauge and digital display of flow
- PPC pneumatics – programmed flow or pressure includes readout which displays pressure or column flow

Split/splitless capillary injector

- Split ratio easily adjustable for a wide range of analysis conditions
- Charcoal trap in split vent prevents contamination of split valve and lab air
- Two choices of liner: 2-mm and 4-mm internal diameter
- 50 °C to 450 °C in 1 °C increments
- Manual pneumatics – pressure regulator (0-60 psig) for digital display of column head pressure. Automatic control of split vent solenoid valve
- PPC pneumatics – four software configurable modes: programmed flow, programmed pressure, programmed velocity or constant flow. Vacuum compensation software selectable
- PPC pneumatics include automatic control of split vent by split flow or split ratio

Programmable on-column capillary injector

- Temperature-programmable inlet
- Three-ramps temperature program
- Oven tracking mode for simple operation
- 50 °C to 500 °C in 1 °C increments
- Heating rate of 1 °C/min to 200 °C/min or ballistic
- Cools down from 380 °C to 50 °C in less than 6 minutes, while the oven is cooling in the same temperature range and with an FID at 380 °C
- 1/16-inch fitting
- Manual pneumatics – choice of flow controller with head-pressure gauge, or flow controller with head-pressure gauge and digital display of flow
- PPC pneumatics include readout which displays pressure and column flow

PSS – programmable split/splitless capillary injector

- Temperature-programmable inlet
- Large-volume injection of up to 50 µL with autosampler, 150 µL manually
- Three-ramps temperature program
- Oven tracking mode for simple operation with on-column injection
- Split ratio easily adjustable for a wide range of analysis conditions
- Three choices of liner available: 1-mm and 2-mm i.d. and on-column
- Charcoal trap in split vent prevents contamination of split valve and lab air
- 50 °C to 500 °C in 1 °C increments
- Cools down from 380 °C to 50 °C in less than 5 minutes, while the oven is cooling in the same temperature range and with an FID at 380 °C
- Heating rate of 1 °C/min to 200 °C/min or ballistic
- 1/16-inch fitting
- Manual pneumatics – pressure regulator (0-60 psig) for digital display of column head pressure. Automatic control of split vent solenoid valve
- PPC pneumatics – four software configurable modes: programmed flow, programmed pressure, programmed velocity or constant flow. Vacuum compensation software selectable
- PPC pneumatics include automatic control of split vent by split flow or split ratio

Swafer

Swafer™ micro-channel flow technology is an innovative and user-friendly approach to automate flow-switching applications. From simple techniques like switching between liquid and headspace injections or connecting two detectors to a single column, to sophisticated multidimensional separations on complex samples, the Swafer technology can enhance productivity in most analytical labs.

- Complete independence of the column from injectors or detectors
- Can assist users in removing unwanted sample residue from columns after analysis or switching between injectors and detectors for analytical flexibility
- Manages difficult separations, delivering richer information
- Swafer Utility Software (SUS) designed to assist users in setting up and characterizing the performance of their PerkinElmer Swafer systems
- Easy setup configuration change, without requiring service information
- Available only with PPC pneumatics

PreVent

- Unique PerkinElmer sample management system
- Available only on the Clarus 590 GC with PSS and PPC pneumatics
- Includes injector and detector restrictors
- PreVent™ time-saver mode prevents higher boiling components or residues from going through the column and the detector.
- PreVent enhanced large-volume injection (ELVI) mode isolates the column and detector from the effects of high levels of solvent. Eliminate solvent flooding of the column or allow the use of solvents such as methylene chloride with an ECD.
- PreVent isolation mode allows a septum change without interrupting carrier flow. Perform maintenance on the inlet WHILE chromatography is taking place.
- ProTect™ mode eliminates contamination by preventing heavy components in the sample from reaching the expensive and retentive chromatographic column. Allows back flushing during chromatographic run.
- MSVent™ mode allows changing of columns without cooling and venting the Clarus 560 GC/MS, reducing instrument downtime, offering a significant time savings. In addition, MSVent facilitates connection of the vent to a second detector for dual signal capability, providing greater flexibility and enhancing productivity.

Gas sampling valves

- Wide offering of 4-, 6-, 8- and 10-port valves
- Large range of valved systems and standard analyzers available
- Keyboard controlled
- 1/16- or 1/8-inch fittings

Detectors

A wide choice of detectors optimized for sensitivity and selectivity is available for use with the Clarus 590 GC. Whether you choose the Flame Ionization Detector, the Thermal Conductivity Detector, the Electron Capture Detector, and/or environmental-specific detectors, all conform to the highest industry standards for reliability and performance. Every detector is available with PPC or manual pneumatics. Up to two detector modules may be installed and operated simultaneously with independent temperature and pneumatic control.

Flame Ionization Detector (FID)

- Wide linear dynamic range
- No makeup gas required due to efficient sweeping of column effluent by hydrogen combustion gas
- Air flow designed to minimize contamination and residue buildup
- 1/8-inch fittings; also includes 1/16-inch capillary adaptor
- Manual pneumatics – pressure regulator for hydrogen, needle valve for air
- PPC pneumatics – software flow control of hydrogen and air
- “Flame out” warning and ready interlock
- Automatic ignite on units installed with PPC

Operating temperature:	100 °C to 450 °C in 1 °C increments
Minimum detectable quantity:	$< 3 \cdot 10^{-12}$ g C/sec octane at a S/N = 2 to 1
Linearity:	$> 10^7$
Signal filtration:	50, 200, 800 msec
Makeup gas:	Not required

Electron Capture Detector (ECD)

- High sensitivity
- Excellent selectivity
- High operating temperature for maximum stability
- 1/8-inch fittings
- Manual pneumatics – needle valve for makeup gas
- PPC pneumatics – software flow control of makeup gas

Source:	15 mCi ^{63}Ni
Temperature protect:	470 °C by software
Carrier gas:	Either Ar/ CH_4 or N_2
Operating temperature:	100 °C to 450 °C in 1 °C increments
Minimum detectable quantity:	< 0.05 pg perchloroethylene with argon/methane or nitrogen
Linearity:	$> 10^4$
Signal filtration:	200, 800 msec
Makeup gas:	Standard

Thermal Conductivity Detector (TCD)

- Capillary-column compatible
- Proven constant current design
- Software protection to prevent filament burnout
- Ideal for series operation
- 1/8-inch fittings
- Manual pneumatics – reference gas flow controller
- PPC pneumatics – software flow control of reference gas

Operating temperature:	100 °C to 350 °C in 1 °C increments
Sensitivity:	9 µV/ppm nonane at 160 mA at the bridge with a detector temperature of 100 °C
Minimum detectable quantity:	Typically < 1 ppm nonane
Linearity:	> 10 ⁵
Power supply:	Constant current with four selectable settings: 1: ±40 mA 2: ±80 mA 3: ±120 mA 4: ±160 mA
Signal filtration:	50, 200, 800 msec
Filament protection:	Self-limiting and resetting after transient overloads in either channel
Makeup gas:	Not required for 0.32- to 0.53-mm i.d. columns with flows ≥ 5 mL/min Required for 0.25-mm or smaller i.d. columns

Photoionization Detector (PID)

Special detector for water pollution analysis of samples containing aromatic compounds.

- Internal power supply and lamp control
- Series operation kit available
- 1/8-inch fittings
- Manual pneumatics – needle valve for makeup gas
- PPC pneumatics – software flow control of makeup gas

Operating temperature:	100 °C to 250 °C in 1 °C increments (can be set to 350 °C for cleaning)
Minimum detectable quantity:	< 10 pg benzene
Linearity:	> 10 ⁷
Signal filtration:	50, 200, 800 msec
UV source lamp:	10.2 eV
Input range:	1, 20
Makeup gas:	Standard

Nitrogen Phosphorus Detector (NPD)

- Modular design
- Change bead in less than one minute
- Prealigned bead
- Rapid conditioning, up and running in less than two hours
- 1/8-inch fittings
- Manual pneumatics – pressure regulator for hydrogen, needle valve for air
- PPC pneumatics – software flow control of hydrogen and air

Operating temperature:	100 °C to 450 °C in 1 °C increments
Minimum detectable quantity:	5 • 10 ⁻¹³ g N/sec 2,4-dimethylaniline 5 • 10 ⁻¹⁴ g P/sec tributylphosphate
Linearity:	> 10 ⁴
Signal filtration:	50, 200, 800 msec
Selectivity:	50,000:1 (N/C) 10:1 (P/N)
Input range:	1, 20
Makeup gas:	Not required

Flame Photometric Detector (FPD)

- Clarus 590 GC software controls photo-multiplier tube voltage
- Clarus 590 GC software linearizer for sulfur mode
- 1/8-inch fittings
- Manual pneumatics – needle valve for hydrogen, pressure regulator for air
- PPC pneumatics – software flow control of hydrogen and air

Operating temperature:	250 °C to 450 °C in 1 °C increments
Minimum detectable quantity:	1 • 10 ⁻¹¹ g S/sec thiophene 1 • 10 ⁻¹² g P/sec tributylphosphate
Linearity:	Sulfur 10 ² (log-log) Phosphorus 10 ³
Signal filtration:	50, 200, 800
Selectivity:	10,000:1 (S/C) 100,000:1 (P/C)
Makeup gas:	Not required

Touch-screen graphical user interface

The touch-screen graphical user interface incorporates a number of key features:

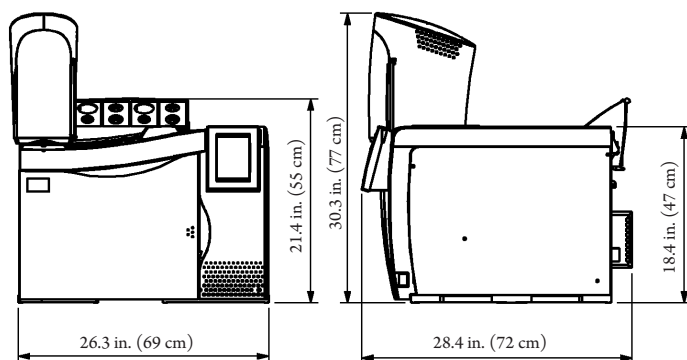
- Multi-language support (i.e. English, French, Italian, German, Spanish, Japanese, Chinese and Russian)
- Real-time graphic display of chromatogram
- Injection countdown for manual injections
- Column pressure/flow/velocity calculator
- More upgradable firmware
- Preventative maintenance counter
- Password protection
- Graphical display of temperature and pneumatic programs
- Status-summary screen
- Log file
- Resolution: 240 x 320
- 256-color display
- Meaningful error/alarm messages

Other Clarus 590 GC features

- Complete instrument control available under TotalChrom®, TurboMass™ and Waters® Empower® 3 Software
- Recorder attenuation range from 1 to 65,536 in binary steps for TCD, ECD, PID, FPD and NPD
- Long-term battery backup of GC methods, autosampler programs, flow and temperature-calibration data
- Software calibration of oven temperature and carrier gas flow with PPC and manual pneumatics
- Full instrument control via external computer
- Five stored methods
- Auxiliary heated zone for accessory devices

Physical details

Power requirements:	120 V $\pm$ 10%, 50/60 Hz, 2.0 kVA* 230 V $\pm$ 10%, 50/60 Hz, 2.0 kVA * On an independent 20-amp line
Ambient temperature:	10 °C to 32 °C
Ambient humidity:	80% maximum relative humidity without condensation
Mean BTU output:	3400
Weight	
GC:	49 kg (108 lb)
Autosampler:	4.5 kg (10 lb)



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