

SPECIFICATIONS

Gas Chromatography



GC 2400 System Gas Chromatograph

The PerkinElmer GC 2400™ System is a fully automated Gas Chromatograph with programmable pneumatic control (PPC).

Retention time (RT) repeatability is 0.008% for C14.

Oven

The GC 2400 System provides a fast heat-up and cool-down oven. 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 user interface.

Oven Heat-up

The oven provides heat-up rates in defined temperature ranges to a maximum of 115 °C/min. The heat-up rates are determined by ballistic heating of the oven, after the oven has been at 50 °C for an hour, with a single injector and a single detector heated to 250 °C. The oven heat-up rate is met over the temperature range indicated below when the instrument's nominal AC line voltage (120V oven rate, 230V oven rate) is applied to the instrument.

The typical GC 2400 System Dual-Channel ramp rates are under validation.

Table 1: * Heat-up rates determined by ballistic heating of the oven with a single injector and a single detector heated to 250 °C.

Typical GC 2400 System Dual-Channel Ramp Rates*		
Temperature Range (°C)	120 V Oven Heating (°C/min)	Fast Oven† Heating (°C/min)
50-70	66-80	115
70-115	60	105
115-175	45	85
175-300	30	55
300-450	20	35

† These ramp rates were achieved using 230 V (Preliminary specifications. Potential improvement under evaluation)

Oven Cool-down

The ballistic cool-down time for the oven from 450 °C to 50 °C is less than 4.0 minutes under the following conditions:

- 1 injector and 1 detector at 250 °C
- Lab conditions at 22 °C

Controlled cool down is also available

Specifications

Oven and Column Characteristics

Volume (HxWxD)	9 in. (229 mm) x 9 in. (229 mm) x 9.8 in. (249 mm) = 794 cubic in. Maximum usable depth = 6.3 in.
Columns	Accepts 1/8-in. o.d. stainless steel, 6 mm o.d. glass and all fused silica, packed or capillary columns 6.5-in. diameter coil. An interface adapter will be required for packed columns.

Oven Temperature

Range	Ambient + 5 °C to 450 °C. (Preliminary specifications. Potential improvement under evaluation)
Settings	Temperature is directly selectable in 0.1 °C steps throughout the temperature range
High-temp Protection	Firmware protection (prevents safety hazard)

Oven Temperature Programming

Max Temperature Ramp rate	The ramp rate temperature is under validation
Temperature Settings	Initial, final temperature, selectable within 0.1 °C increments
Time Settings	0.01 min increments
Programming Rate	Settable from 0.0 °C/min to 120.0 °C/min in 0.1 °C increments
Program Steps	100 total steps of any ramp and plateau combinations
Maximum Run Time	999.99 min per method

Pneumatics

PPC provides optimum performance with all types of columns and detectors. Each injector or detector option is ordered with PPC pneumatics. There are up to six PPC zones configured as two carrier, three detector (up to three zones each) and an auxiliary channel (up to three zones each).

- Pressure has typical control of +/- 0.001 psi for the range of 0 to 150. Pressure setpoints may be adjusted in increments of 0.001 for the range of 0-150 psi
- Carrier-gas pneumatics are included with the GC 2400 injectors
- Carrier PPC zones compensate for variations in ambient temperature and pressure for maximum stability
- Split-vent and septum purge pneumatics are included with the GC 2400 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
- Three-ramps pressure program
- Pneumatic program rates: 0-150.0 psi/min, 0-100.0 mL/min, 0-200.0 cm/sec or ballistic
- PPC provides direct setting in mL/min
- Detector PPC zones compensate for variations in ambient temperature for maximum stability
- One detector PPC can control up to three flow gases
- Pressure sensors are used for both pressure and flow control.

Pressure sensors:

- Accuracy: +/- 2% of full scale
- Repeatability: <+/-0.05 psi
- Temperature coefficient: <+/-0.01 psi/°C
- Drift: <+/- 0.1 psi/6months

- User is able to select carrier gas for He, H₂, N₂ and argon/methane as each system is calibrated for all gases during manufacturing

Auxiliary Pneumatics

One auxiliary channel (up to three zones each). Additionally, detector zones can be utilized for auxiliary zones.

Configuration dependent.

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

Autosampler

The GC 2400 System offers optional, add-on liquid syringe autosamplers for maximum sampling capabilities. The PerkinElmer AS 2400™ Liquid Sampler is fully integrated into the GC control, managed by the CDS. Hands-on operations are available through the web application or the CDS.

Autosampler Specifications

Sample Trays	Standard Capacity (up to 20 samples) and High Capacity (up to 144 samples)
Injection Tower	Up to 2 Automatic Recognition Towers, one for each injection port
Tower configurations	A tower can be switched from one position to another on same GC or from GC to another without need for reconfiguration
Injection Speed	Slow, normal and fast (less than 100 ms injecting 3 µL or less)
Program Modes	Two methods may be programmed
Vial Size	2-mL (0.3 mL with insert) crimp-top caps 2-mL screw-top caps
Waste and Wash Vials	Low-Capacity-Tray: 2 waste vials and 2 wash vials
	High-Capacity-Tray: 6 waste vials and 6 wash vials
Waste and Wash Vial Size	10 mL
Syringe Size	0.5 µL, 1.0 µL 5.0 µL or 50.0 µL
Sampling Volume	0.05 µL to 0.5 µL from the 0.5 µL syringe.
	Injection volume options: 0.05, 0.1, 0.2, 0.3, 0.4, 0.5
	0.5 µL to 5.0 µL from the 0.5 µL syringe
	Injection volume options: 0.5, 1.0, 2.0, 3.0, 4.0, 5.0
	Injection volume options: 5.0, 10.0, 15.0, 20.0, 25.0, 30.0, 35.0, 40.0, 45.0, or 50.0
Viscosity Settings	0-15
Maximum Injections Per Vial	15
Maximum solvent postwashes	25
Reproducibility	< 0.1% RSD for packed columns 1% C9 in C7, 1 µL injected
Sample Pre-rinse	Prepares the autosampler syringe in advance of the GC becoming ready
Maximum Number of Layers per Sandwich Injection	3 layers

Injectors

The GC 2400 System 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.

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-in. fitting
- 1/4-in. column adapter available
- PPC pneumatics – programmed flow or pressure includes readout which displays pressure or column flow
- PPC available in pressure range 0 - 150 psi.

Split/Splitless Capillary Injector

- Split ratio easily adjustable for a wide range of analytical conditions up up to 12500:1
- **Total flow setting range:**
 - 5-1200 mL/min N₂
 - 5-1000 mL/min Ar/CH₄
 - 5-1500 mL/min H₂ or He
- Charcoal trap in split vent prevents contamination of split valve and lab air
- Two choices of liner ID: 2-mm and 4-mm internal diameter
- 50 °C to 450 °C in 1 °C increments
- PPC available in pressure range 0 - 150 psi.
- PPC pneumatics – five software configurable modes: programmed flow, programmed pressure, programmed velocity, constant flow or pulsed pressure injection. Vacuum compensation software selectable.
- PPC pneumatics include automatic control of split vent by split flow or split ratio
- Software adjustable septum purge flow

PSS – Programmable Split/Splitless Capillary Injector

- Temperature-programmable inlet
- Two-ramps temperature program
- Oven-tracking mode for simple operation
- 50 °C to 500 °C in 1 °C increments
- Heat-up rate of 1 °C/min to 200 °C/min or ballistic
- Cools down from 380 °C to 50 °C in less than 3.5 minutes, while the oven is cooling in the same temperature range and with an FID at 380 °C
- 1/16-in. fitting

- Large-volume injection of up to 50 µL with autosampler, 150 µL manually
- Split ratio easily adjustable for a wide range of analytical conditions up up to 12500:1

Total flow setting range:

- 5-1200 mL/min N₂
- 5-1000 mL/min Ar/CH₄
- 5-1500 mL/min H₂ or He

- 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
- PPC pneumatics – five software configurable modes: programmed flow, programmed pressure, programmed velocity, constant flow or pulsed pressure injection. Vacuum compensation software selectable.
- PPC available in pressure range 0 - 150 psi
- PPC pneumatics include automatic control of split vent by split flow or split ratio
- Software adjustable septum purge flow

Detectors

A choice of detectors, optimized for sensitivity and selectivity, is available for use with the GC 2400 System. Whether you choose the flame ionization detector (FID) or the electron capture detector (ECD), all conform to the highest industry standards for reliability and performance. Every detector is available with PPC. Up to three detector modules may be installed and operated simultaneously with independent temperature and pneumatic control.

Flame Ionization Detector (FID)

- Wide linear dynamic range
- Air flow designed to minimize contamination and residue buildup
- 1/16-in. fittings; also includes 1/8-inch packed column adaptor
- PPC pneumatics – software flow control of hydrogen, air, and makeup gas
- Flame out warning and ready interlock
- Auto ignite when flameout is detected

Flame Ionization Detector (FID) Characteristics

Operating Temperature	100 °C to 450 °C in 1 °C increments
Minimum Detectable Quantity	< 1.2 pg C/s of tridecane
Linearity	> 10 ⁷
Data Collection Rate	2, 5, 10, 20, 50, 100, 200, 500, 1000 Hz
Data Rates	Up to 1,000 Hz accommodate peaks as narrow as 5 msec at half height

Electron Capture Detector (ECD)

- High sensitivity and excellent selectivity
- High operating temperature for maximum stability
- 1/8-in. fittings
- PPC pneumatics – software flow control of makeup gas

Electron Capture Detector (ECD)

Source	15 mCi ⁶³ Ni
Temperature Protect	470 °C by software
Makeup Gas	Either Ar/CH ₄ or N ₂
Operating Temperature	100 °C to 450 °C in 1 °C increments
Minimum Detectable Quantity	< 5 fg lindane with argon/methane or nitrogen. (Preliminary specifications. Potential improvement under evaluation)
Linearity	> 10 ⁴
Data Acquisition	Up to 1,000 Hz accommodate peaks as narrow as 5 msec at half height
Physical Details	
Power Consumption	2400 VA (volt-amps) for the GC 120 VA (volt-amps) for the GC
GC with Fast Heating	Fast ramp rates require power >210 volts at >15 amps
Power Specifications	120 VAC +- 10% @ 50/60 Hz +- 1% 1,000 VA, 230 VAC +- 10% @ 50/60 Hz +- 1% 1,000 VA
Power Outlets	A minimum of one dedicated 120 VAC outlet at 20 A or one 230 VAC outlet at 10 A (minimum) is required for the standard GC. Additional equipment, such as computers and printers, should be connected per their specifications but not on the same outlet as the GC.
Electrical Requirements	
Laboratory Environment	Install the GC in an indoor laboratory environment that is clean and free of drafts, direct sunlight and vibration. The laboratory should be free of flammable, explosive, toxic, caustic or corrosive vapors or gases and should be relatively free of dust. The ambient laboratory temperature should be 10-35 °C (50-95 °F) with a relative humidity of 20-80% with no condensation.
Storage	Ambient temperature: -20 °C to +60 °C (-4 °F to +140 °F) Relative humidity: 20% to 80%, without condensation
Altitude Operating	Operating: 0-2000 m; Non-operating: 0-12,000 m (sea level to 39,370 feet).
Pollution Degree	Will operate safely in environments that contain nonconductive foreign matter up to Pollution Degree 2 as defined in EN/IEC 61010-1.
European Union Industrial	The 230 V/50 Hz GC 2400 has been manufactured for use in the European Union and is environment intended for the industrial environment. The instrument is to be connected to a main power network supplied from a high- or medium-voltage transformer dedicated to the supply of an installation feeding a manufacturing or similar plant.
BTU Output	6,553 BTU/hour for the 120V (1920VA) 11,604 BTU/hour for 230V (3400VA)
Weight with AS Tower and Large Capacity Tray	64 kg (142 lb)
Dimensions	(HxWxD)

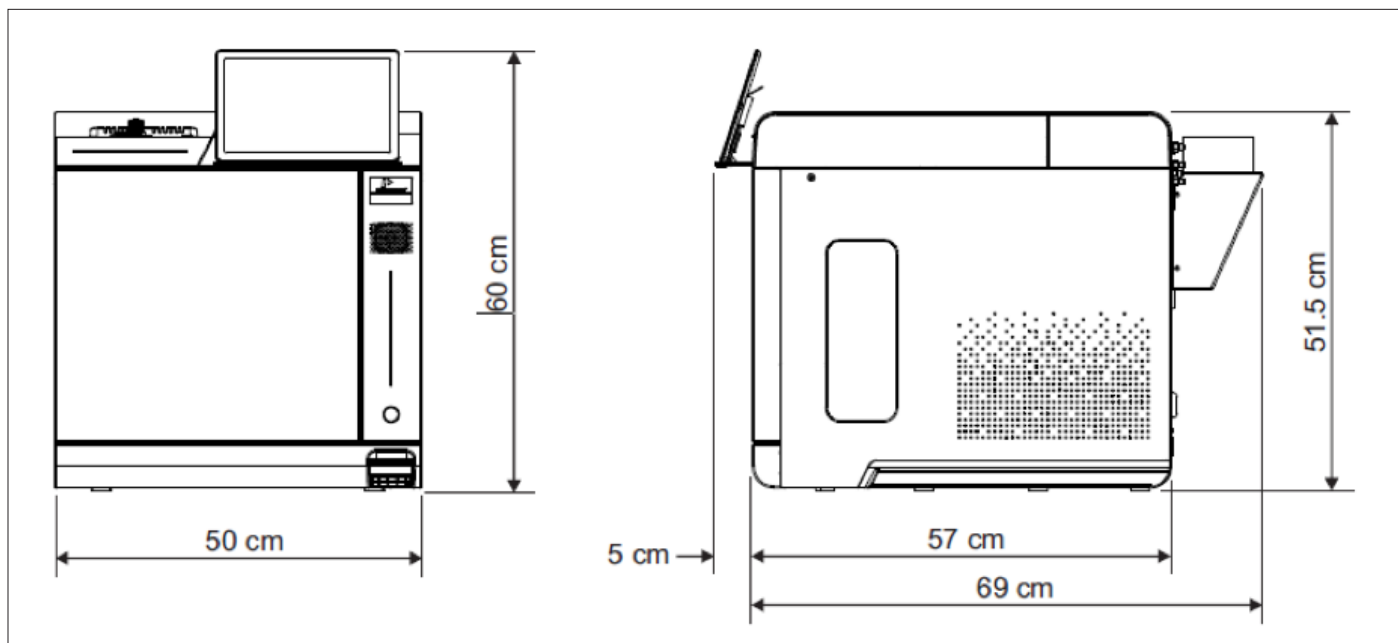


Figure 1: Without autosampler.

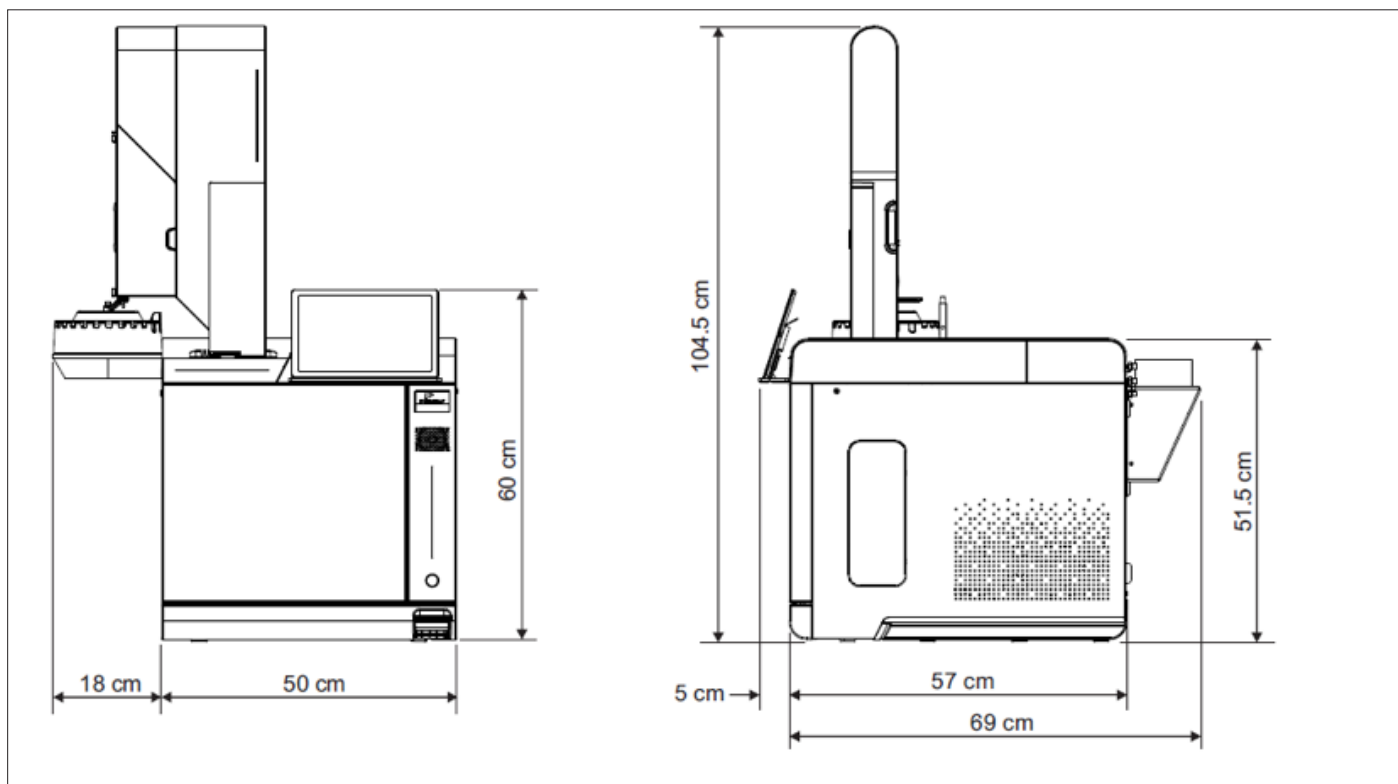


Figure 2: With autosampler tower and low-capacity samples tray.

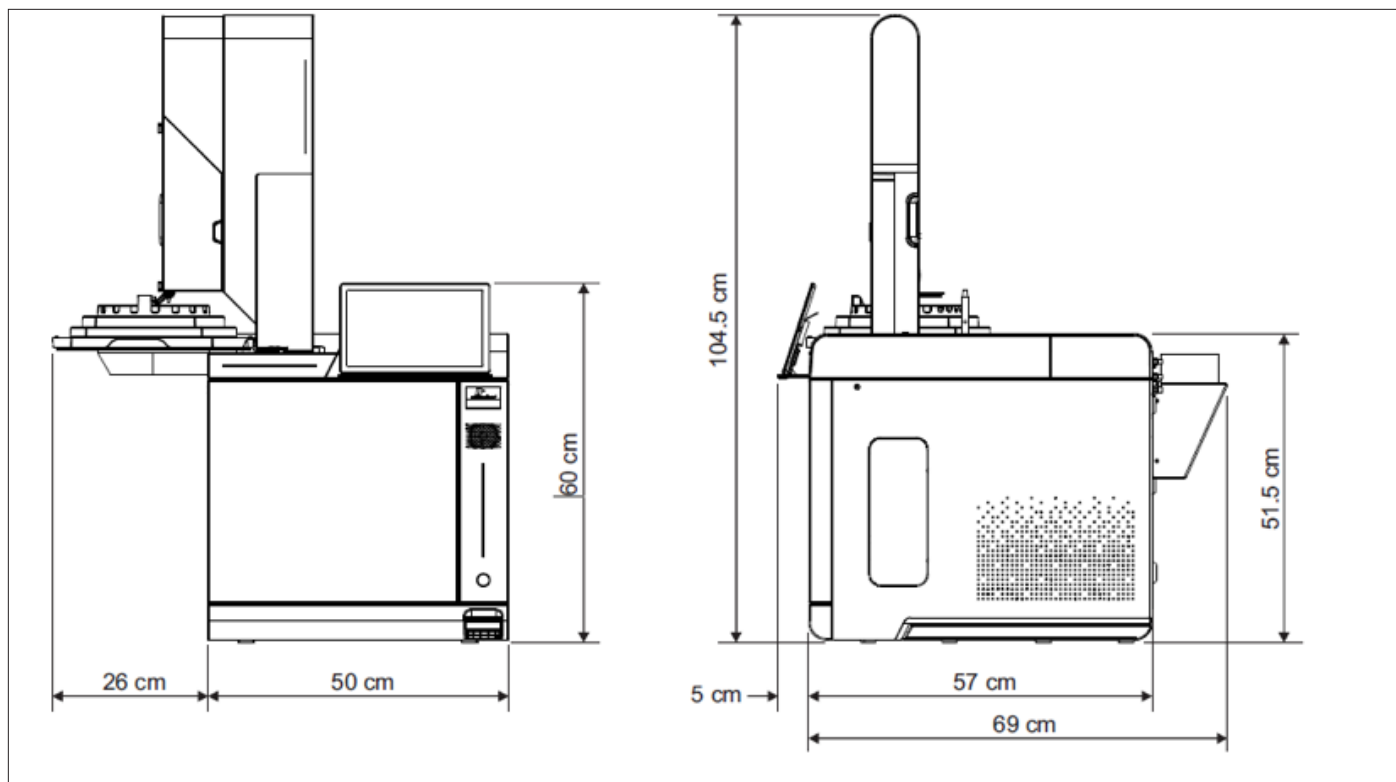


Figure 3: With autosampler tower and high-capacity samples tray.

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