

# 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 120 °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)	230 V Oven Heating (°C/min)
50-70	66-80	120
70-120	60	105
120-175	45	85
175-300	30	55
300-450	20	35

#### 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

<b>Volume (HxWxD)</b>	9 in. (229 mm) x 9 in. (229 mm) x 9.8 in. (249 mm) = 794 cubic in. Maximum usable depth = 6.3 in.
<b>Columns</b>	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

<b>Range</b>	Ambient + 3.5 °C to 450 °C. (Preliminary specifications. Potential improvement under evaluation)
<b>Settings</b>	Temperature is directly selectable in 0.1 °C steps throughout the temperature range
<b>High-temp Protection</b>	Firmware protection (prevents safety hazard)

### Oven Temperature Programming

<b>Max Temperature Ramp rate</b>	The ramp rate temperature is under validation
<b>Temperature Settings</b>	Initial, final temperature, selectable within 0.1 °C increments
<b>Time Settings</b>	0.01 min increments
<b>Programming Rate</b>	Settable from 0.0 °C/min to 120.0 °C/min in 0.1 °C increments
<b>Program Steps</b>	100 total steps of any ramp and plateau combinations
<b>Maximum Run Time</b>	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, H<sub>2</sub>, N<sub>2</sub> and argon/methane as each system is calibrated for all gases during manufacturing

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

**Total flow setting range:**

- 0-120 mL/min Ar/CH<sub>4</sub>
- 0-200 mL/min N<sub>2</sub>
- 0-200 mL/min H<sub>2</sub> or He

**Split/Splitless Capillary Injector**

- Split ratio easily adjustable for a wide range of analytical conditions up to 12500:1

**Total flow setting range:**

- 0-1200 mL/min N<sub>2</sub>
- 0-1000 mL/min Ar/CH<sub>4</sub>
- 0-1500 mL/min H<sub>2</sub> 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 to 12500:1

**Total flow setting range:**

- 0-1200 mL/min N<sub>2</sub>
- 0-1000 mL/min Ar/CH<sub>4</sub>
- 0-1500 mL/min H<sub>2</sub> 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**

<b>Operating Temperature</b>	100 °C to 450 °C in 1 °C increments
<b>Minimum Detectable Quantity</b>	< 1.2 pg C/s of tridecane
<b>Linearity</b>	> 10 <sup>7</sup>
<b>Data Collection Rate</b>	2, 5, 10, 20, 50, 100, 200, 500, 1000 Hz
<b>Data Rates</b>	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)**

<b>Source</b>	15 mCi <sup>63</sup> Ni
<b>Temperature Protect</b>	470 °C by software
<b>Makeup Gas</b>	Either Ar/CH <sub>4</sub> or N <sub>2</sub>
<b>Operating Temperature</b>	100 °C to 450 °C in 1 °C increments
<b>Minimum Detectable Quantity</b>	< 5 fg lindane with argon/methane or nitrogen. (Preliminary specifications. Potential improvement under evaluation)
<b>Linearity</b>	> 10 <sup>4</sup>
<b>Data Acquisition</b>	Up to 1,000 Hz accommodate peaks as narrow as 5 msec at half height
<b>Physical Details</b>	
<b>Power Consumption</b>	2400 VA (volt-amps) for the GC 120 VA (volt-amps) for the GC
<b>GC with Fast Heating</b>	Fast ramp rates require power >210 volts at >15 amps
<b>Power Specifications</b>	120 VAC +- 10% @ 50/60 Hz +- 1% 1,000 VA, 230 VAC +- 10% @ 50/60 Hz +- 1% 1,000 VA
<b>Power Outlets</b>	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.
<b>Electrical Requirements</b>	
<b>Laboratory Environment</b>	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.
<b>Storage</b>	Ambient temperature: -20 °C to +60 °C (-4 °F to +140 °F) Relative humidity: 20% to 80%, without condensation
<b>Altitude Operating</b>	Operating: 0-2000 m; Non-operating: 0-12,000 m (sea level to 39,370 feet).
<b>Pollution Degree</b>	Will operate safely in environments that contain nonconductive foreign matter up to Pollution Degree 2 as defined in EN/IEC 61010-1.
<b>European Union Industrial</b>	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.
<b>BTU Output</b>	6,553 BTU/hour for the 120V (1920VA) 11,604 BTU/hour for 230V (3400VA)
<b>Weight with AS Tower and Large Capacity Tray</b>	64 kg (142 lb)
<b>Dimensions</b>	(HxWxD)

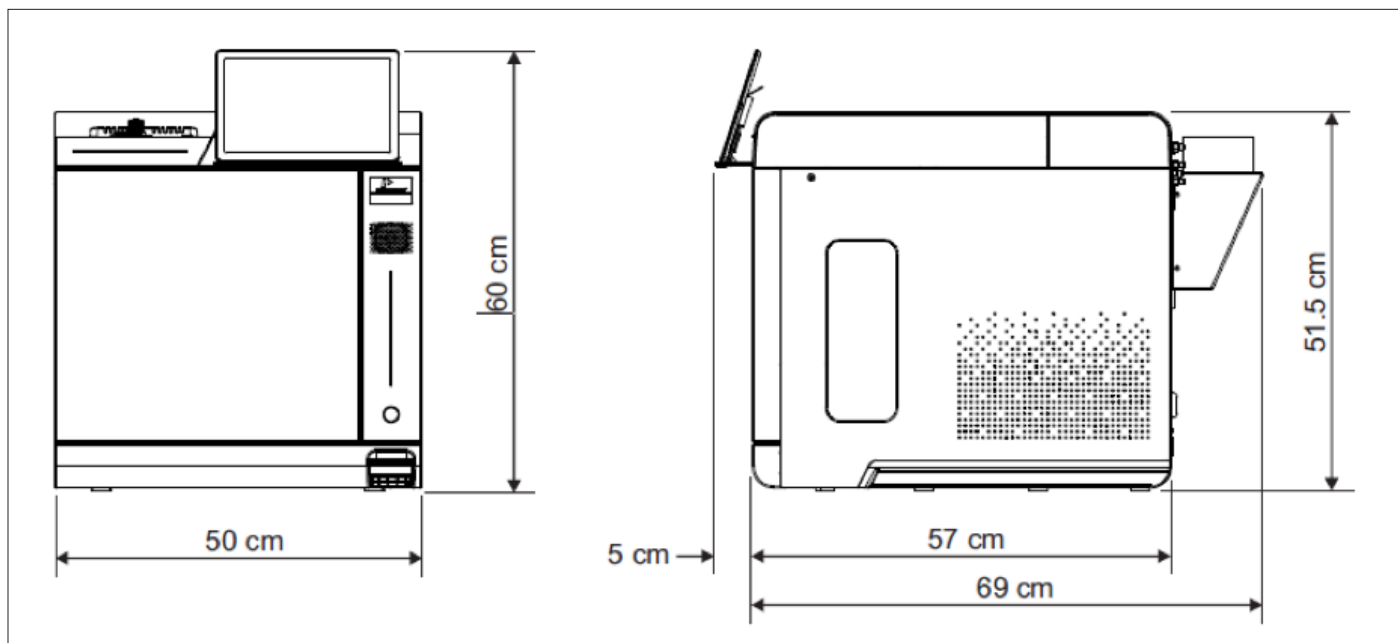


Figure 1: Without autosampler.

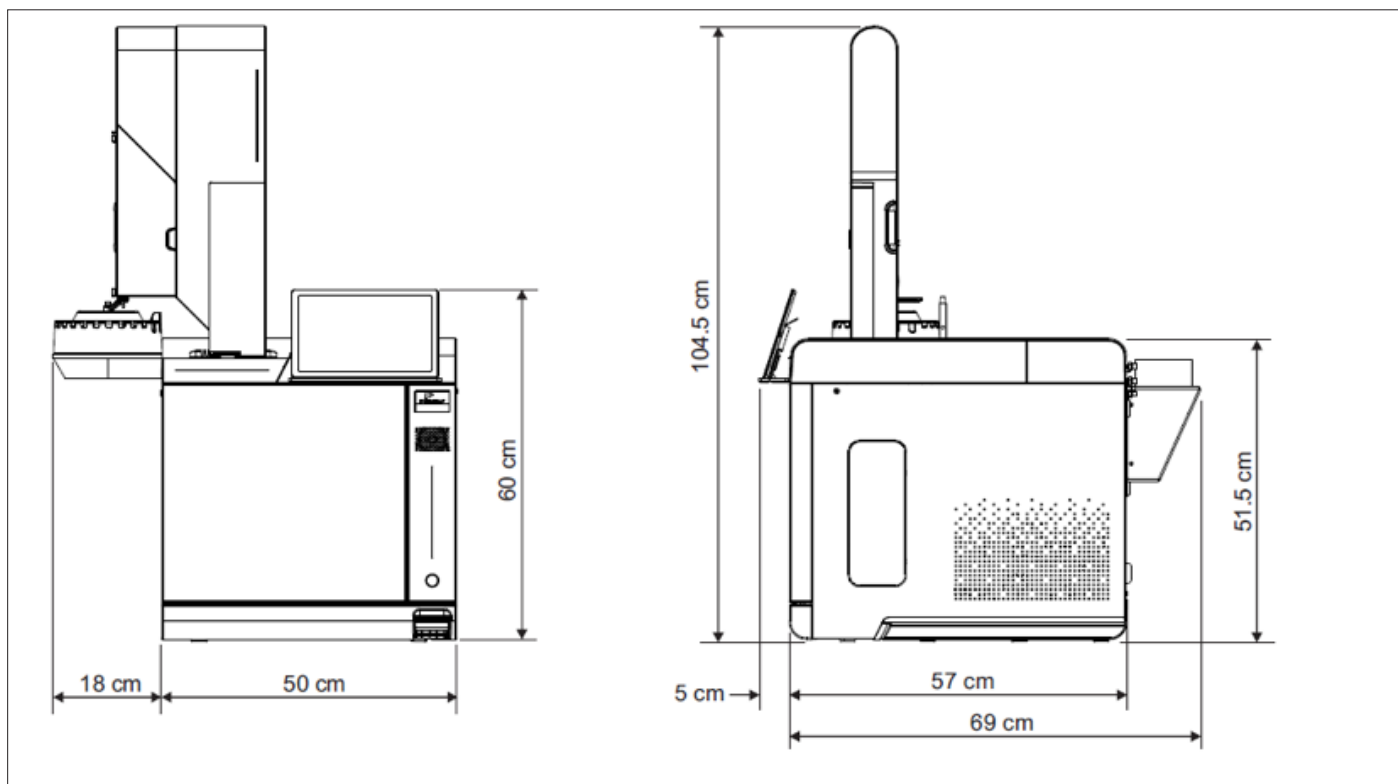


Figure 2: With autosampler tower and low-capacity samples tray.

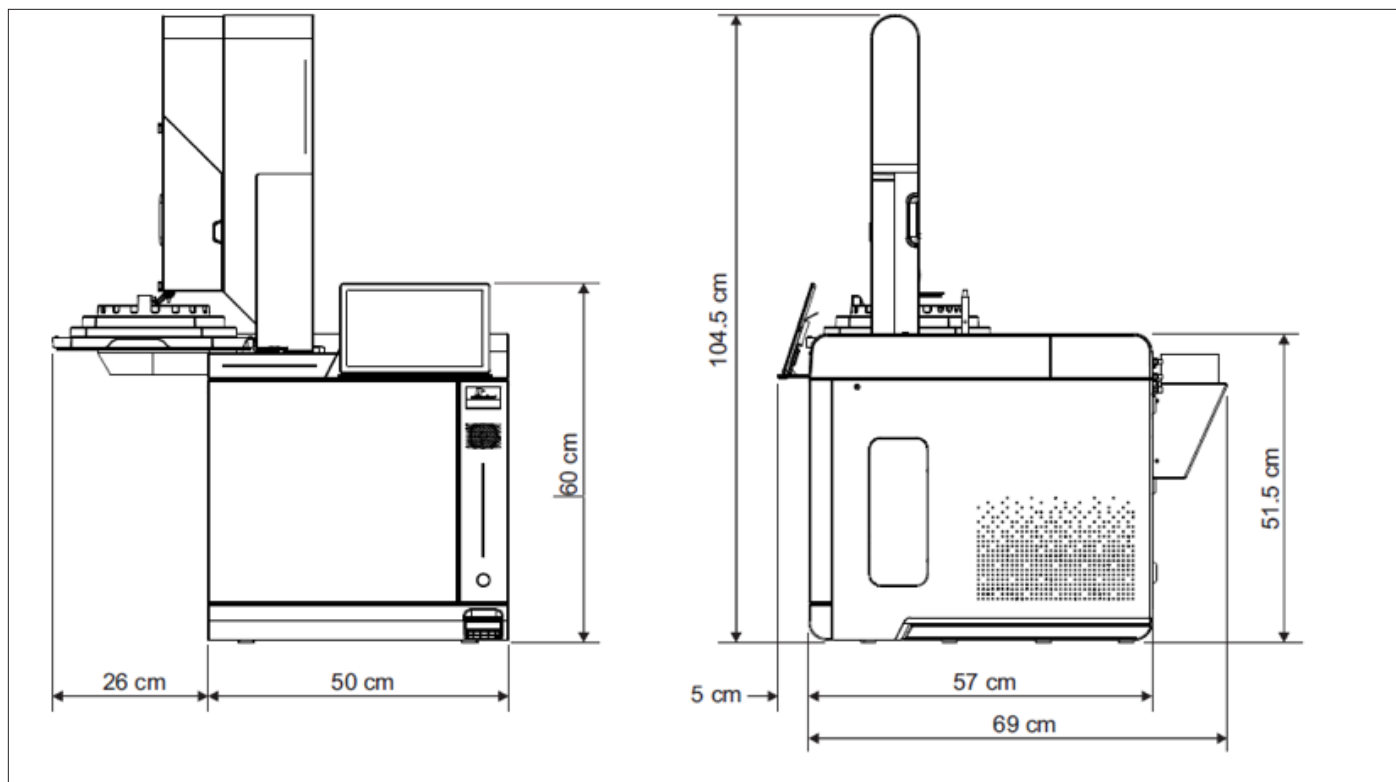


Figure 3: With autosampler tower and high-capacity samples tray.

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