

# Integrated Systems for High Performance GPC/SEC for Polymer Characterization and High Throughput Screening from 30-220°C



**Polymer Laboratories**

Now a part of Varian, Inc.



**VARIAN**

# State of the Art, Flexible, Integrated GPC/SEC Systems

## Ambient to High Temperature

Gel permeation chromatography/size exclusion chromatography (GPC/SEC) is the technique of choice for rapid and reliable characterization of polymer molecular weight and molecular weight distribution. However, advances in polymer science and technology mean that a more diverse range of solvents and temperatures is required in modern GPC analysis.

Polymer Laboratories (PL, now a part of Varian, Inc.), has been the leader in the development of elevated temperature GPC/SEC for many years, expanding useability, capabilities and safety features. PL can supply regular integrated GPC systems with RI detection, through triple detector systems incorporating viscosity and/or light scattering, to fully customized systems featuring, for example, gradient HPLC or high throughput. Contact PL to discuss your requirements.



### PL-GPC 50 *Plus*

Polymer Laboratories has introduced a new version of its PL-GPC 50 system for high resolution, cost effective GPC between ambient and 50. The PL-GPC 50 Plus platform includes refractive index detector and allows optional UV, viscosity (PL-BV400Ri) and light scattering detectors for multiple detector systems.



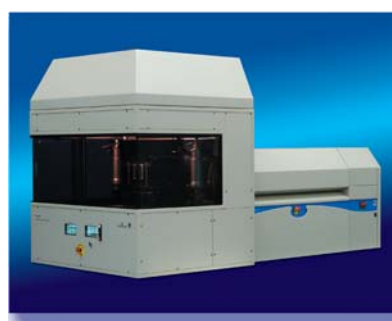
### PL-GPC 220

Polymer Laboratories' PL-GPC 220 integrated GPC/SEC system features unbeatable reproducibility for any GPC/SEC application, across the entire operating range. The PL-GPC 220 is an extremely flexible system, designed to run almost all polymer, solvent and temperature combinations, with full automation, from 30 to 220°C.



### PL-GPC 120

PL has designed the PL-GPC 120 system specifically for GPC/SEC analyses between 30-120°C, where elevated temperature is required to reduce the eluent viscosity rather than to dissolve the sample. Offering either manual injection as standard or an external autosampler option (PL-AS MT), the PL-GPC 120 gives improved resolution and reproducibility compared to conventional modular systems.



### PL-XT 220

The PL-XT 220 is a sophisticated, fully featured robotic high temperature GPC analysis system for rapidly obtaining data for polymeric samples of all types in combinatorial materials discovery. The PL-XT 220 incorporates sample preparation, injection and analysis with fully automated, instrument control.

Page	Contents
2	GPC/SEC Systems
3	PL-GPC 50 Plus
5	PL-GPC 120 PL-GPC 220
8	GPC/SEC Sample Handling
9	PL-XT 220 Rapid Analysis GPC System
10	GPC-FTIR Characterization
11	Integrated Viscosity and Light Scattering
12	Ordering Information

# PL-GPC 50 *Plus* Integrated GPC/SEC System

## System Design & Performance

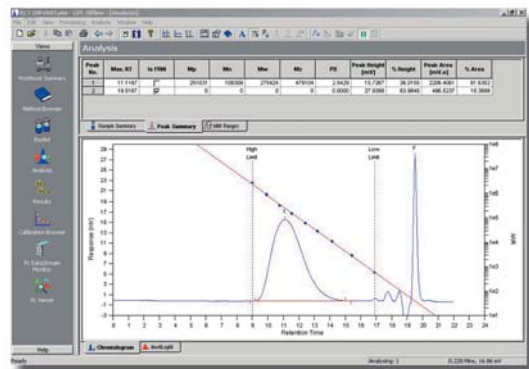
Polymer Laboratories has introduced a new version of its PL-GPC 50 integrated GPC system for polymer characterization and analysis.

**The PL-GPC 50 Plus is a high resolution, cost effective integrated GPC system designed for operation from ambient to 50°C. The system comprises a precision solvent delivery system, an automatic injection valve, a high performance differential refractive index detector and a column oven as standard.**

The enhanced PL-GPC 50 Plus platform enables fully integrated triple detection. For maximum flexibility and applicability, a choice of system enhancements is available. Additional modules such as

- Viscosity
- Light Scattering
- UV (fixed and variable)
- ELSD
- Autosampler
- Degasser
- Fraction collector

...can also be incorporated.



## Designed for Ease of Use

The PL-GPC 50 Plus features onboard PC based system control and Cirrus™ data acquisition and analysis software with 4 channels of data collection - everything you need to get up and running in one integrated package.

The new PL-GPC 50 Plus enables network control for convenient and easy connection of Polymer Laboratories' instrumentation across a company's network to obtain instant access for remote monitoring, control and data collection.

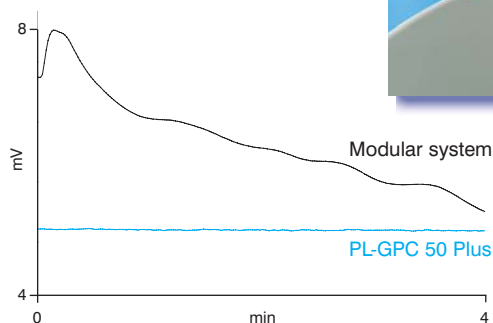
The simplicity of the PL-GPC 50 Plus design and the intuitive interface makes it extremely easy to operate. This, combined with high performance and reliability, makes the PL-GPC 50 Plus the ideal choice for any laboratory.

## Versatility and Performance

For optimized performance, the system is designed to significantly reduce extra column dispersion and band broadening effects, thereby maximizing resolution and accuracy for the GPC separation. The PL-GPC 50 Plus can accommodate up to four regular 300mm GPC columns with easy access for column exchange via the hinged front panel.

The injection valve, columns and detector heads are all situated within the oven, giving excellent thermal stability regardless of conditions within the laboratory. To show the performance of the system, a comparison was made between the baseline drift of the PL-GPC 50 Plus at 40°C and a typical modular system at room temperature. Minimal drift is visible with the PL-GPC 50 Plus, which was less than 1mV in 4 minutes compared to a significant drift of nearly 3mV on the modular system resulting from changes in the ambient temperature of the laboratory.

Columns: 2xPLgel 5µm MIXED-C, 300x7.5mm (PL1110-6500)  
Eluent: THF (stabilized)  
Flow Rate: 1.0ml/min  
Temp: 40°C



The PL-GPC 50 Plus includes a fully integrated software platform for managing all areas of instrument operation. Control of the pump, detector, injection valve, autosampler etc could be performed simply through an intuitive graphical interface making the instrument truly user-friendly.

This package also includes a new, full automation option via an instrument scheduler function.

Using the scheduler, instrument control via the software can be fully automated and sequenced, allowing a pre-defined series of routine operations, such as those used to ready the instrument for sample injection, to be performed with just a single click of the mouse. Combining the simplicity of manual control through the graphical interface with the automated features of the scheduler makes the PL-GPC 50 Plus control software both powerful and versatile.

# PL-GPC 50 Plus Integrated GPC/SEC System

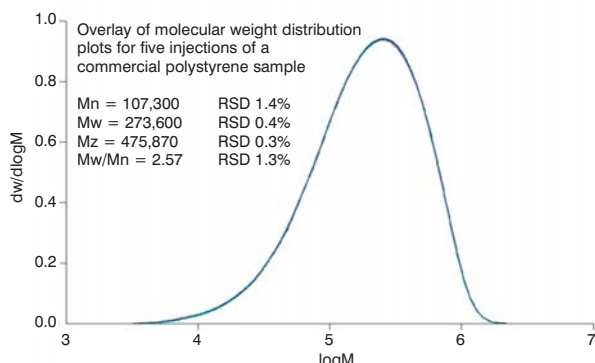
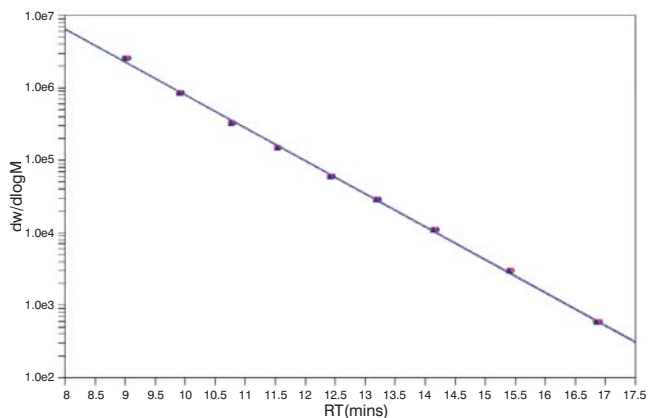
## System Design & Performance

### Excellent Reproducibility

The flow rate precision of the solvent delivery system is fundamental to achieving the most reliable GPC data. The PL-GPC 50 Plus delivers flow reproducibility of better than 0.1%, resulting in repeatable calibration curves and accurately calculated polymer molecular weight data.

Columns: 2xPLgel 5 $\mu$ m MIXED-C, 300x7.5mm (PL1110-6500)  
Eluent: THF  
Flow Rate: 1.0ml/min

Overlay of five GPC calibration curves generated from five separate injections of each polystyrene standard (EasiCal PS-1 calibrants)



### New Autosampler for the PL-GPC 50 Plus



The PL-AS RT Autosampler is designed for use with the PL-GPC 50 Plus. This X-Y style autosampler has a 156 vial capacity and operates at ambient temperature.

Sample injection is with a flushed fixed loop giving a reproducibility (RSD) of  $\leq 0.5\%$ .

Programming through the PL-GPC 50 Plus control interface provides the flexibility of automated wash cycles, and up to 9 injections per vial.

### GPC-FTIR Characterization

The combination of GPC-FTIR enables rapid determination of compositional heterogeneity and its relationship to molecular weight from a single measurement.

PL manufactures the innovative PL RTGPC-FTIR interface to couple the PL-GPC 50 Plus to an FTIR system. The flow cell, which is supplied with a specific mounting bracket for individual FTIR instruments, fits directly onto the optical bench of the spectrometer. The flow cell features low dispersion for minimum band broadening and is available with a choice of window materials for a variety of applications.

### Conventional GPC Calculations from FTIR

PL has introduced the GPC-FTIR Data Import Module for its Cirrus suite of GPC software, which allows time-resolved FTIR data to be imported into Cirrus for conventional molecular weight calculations using either narrow or broad standard calibrations.

Using the GPC-FTIR Data Import software with the PL RTGPC-FTIR Interface permits the powerful combination of compositional analysis by FTIR with the determination of molecular weight by GPC.

For further information on coupling GPC to FTIR, see page 10.

### Technical Specifications

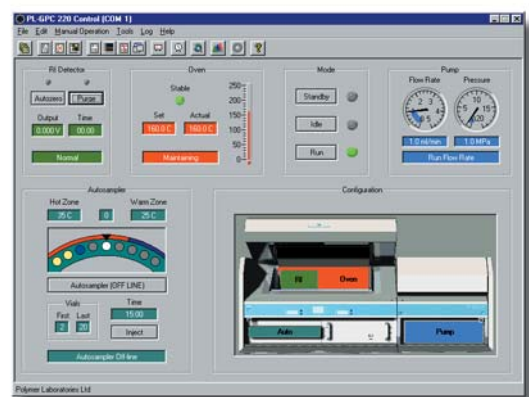
<b>Pump</b>	Flow Range Flow Rate Precision	0.01-9.99ml/min <0.09%
<b>Oven</b>	Temperature Range Temperature Stability	Ambient - 50°C $\pm 2^\circ\text{C}$
<b>Refractive Index Detector</b>	Differential Refractometer Cell Volume Sensitivity Noise Wavelength	Deflection 6 $\mu$ l 2.5x10 <sup>-7</sup> RIU/mV $\leq 80\mu\text{V}$ ( $\leq 2 \times 10^{-8}$ RIU) 880 $\pm 30$ nm
<b>Injector</b>		Manual injector via integrated Valco 6 port 2 position valve
<b>Instrument Control</b>		Windows® 2000 or XP based Advanced PC Control
<b>General</b>	Power Requirements	100-125 or 210-250V AC, Line frequency 50/60 Hz
<b>Size (wxdxh)</b>		420x600x394mm (max height of 610mm with integrated solvent containers)
<b>Packaged Size (wxdxh)</b>		813x743x630mm
<b>Weight</b>		40kg; 88lbs

For full specifications, see PL's website at [www.polymerlabs.com/gpc](http://www.polymerlabs.com/gpc)

## System Design & Performance

**PC Control - Easy to Program, Easy to Use**  
Polymer Laboratories' PL-GPC 120 and PL-GPC 220 systems for polymer characterization up to 120°C and 220°C respectively feature intuitive, comprehensive PC software control for full and flexible system management. With safety a pre-requisite, PL's instrument control uniquely allows you the choice to locate your PC outside of the laboratory.

An interactive color-coded graphics approach is employed for ease of use. Simply click on the modules via the main screen to alter any run parameters. Flow rate, temperature and autosampler sequence are quickly and easily updated, and on-screen help is always available, if required.



The time estimator calculates the amount of solvent you will need to run your samples. Input the day and time you want the system to start, then load your samples into the autosampler and let the PL-GPC 220 take care of the analysis for you.

PL has designed the PL-GPC 220 for truly unattended operation. The system gradually heats to the analysis temperature while the pump maintains a low flow of solvent through the column. Once set temperature is reached and stable, the pump ramps gradually to the flow rate required to run your sample. The PL-GPC 220 then automatically purges the RI detector and autozeros the baseline. Detector output is monitored and when stable, the autosampler loads and injects the first sample. Once the run sequence is complete, the flow rate can be automatically reduced to conserve solvent.

## Integrated Solvent Delivery - Safety by Design

The solvent module integrated within the PL-GPC 220 provides a safe, controlled environment in which to manage solvent and waste. Solvent handling is fully integrated and vented for operator safety, and the system does not require location within a fume hood.



The PL-GPC 220 includes an integral solvent degasser with a choice of solvent reservoir from 2 liter bottles up to a 13 liter stainless steel tank. The solvent delivery module is thermostated to 30°C, which ensures efficient, continuous and reproducible solvent delivery, even if the solvent is viscous or may be solid at near ambient temperature.

## Autosampler Options

### PL-GPC 220's Dual Zone Heated Autosampler - No Degradation of Samples Before Injection

PL's innovative autosampler accommodates 40 samples in industry-standard 2ml vials. Injection precision is better than 1% RSD with no cross contamination between samples, and without the need for rinse vials. The PL-GPC 220 autosampler design features dual zone heating to minimize thermal degradation. The Hot and Warm zones are independently programmable from ambient to 220°C, therefore the samples in the carousel waiting for injection are maintained at a lower holding temperature, then heated to analysis temperature immediately prior to injection.

The vial is transferred to the column oven where the sample thermally equilibrates prior to injection. This minimizes baseline disturbance and completely eliminates the risk of sample precipitation.

### New Autosampler for the PL-GPC 120



The PL-AS MT Autosampler is designed for use with the PL-GPC 120. This X-Y style autosampler has a 156 vial capacity and operates from 30 to 120°C.

Sample injection is with a flushed fixed loop giving a reproducibility (RSD) of  $\leq 0.5\%$ .

Programming through the PL-GPC 120 control interface provides the flexibility of automated wash cycles, sample agitation prior to injection and up to 9 injections per vial.

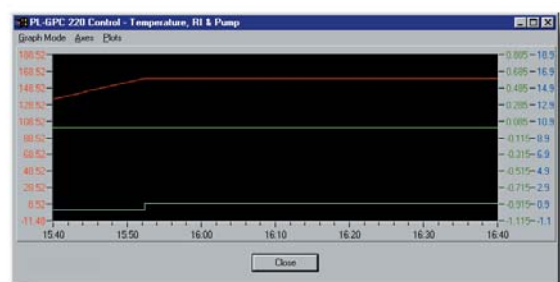
## System Design and Performance

### Widest Temperature Range

The PL-GPC 120 operates across the temperature range 30-120°C for analyses in routine solvents such as THF and polar solvents such as DMF, DMSO and NMP, etc, where elevated and constant temperature of operation can significantly improve resolution and detector performance.

The PL-GPC 220 features the widest temperature operating range available - 30-220°C, permitting the analysis of virtually any polymer in any solvent.

The multi heater forced air oven within the PL-GPC 120 and PL-GPC 220 systems is extremely stable, and accurately controls the temperature to less than 0.05°C per hour. This minimizes detector baseline drift, ensuring the reproducible retention times so important in GPC.



Real time plot of temperature, RI output and pump pressure.

All detectors situated within the oven environment benefit from the temperature range and stability of PL's oven.

### Easy Access Oven - Changing Columns and Routine Maintenance Made Simple

The column oven in the PL-GPC 120 and PL-GPC 220 can comfortably hold six 30cm GPC columns.

The oven opens at a convenient angle to allow for easy access for changing columns and the injector loop, providing comfortable, safe operation.



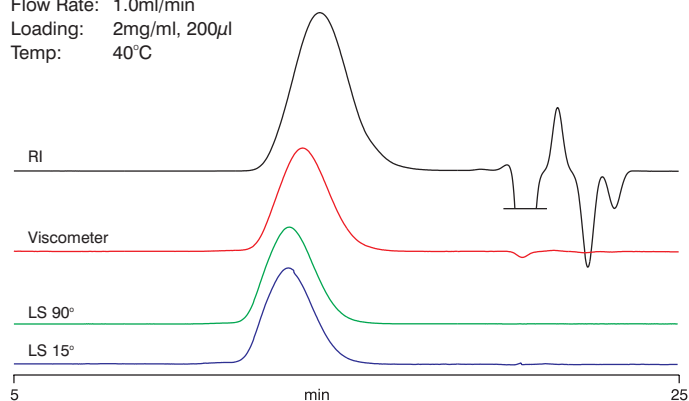
### Customized Solution

The oven uniquely permits easy expandability and lends itself to multiple detector upgrading, with detectors such as LALLS, MALLS, Viscometry, FT-IR and ELSD, and through coupling to other techniques such as TREF. PL's ovens allow a combination of up to four detectors, for example, integrated RI, viscometry and light scattering coupled to FTIR, for complete polymer characterization.

Contact PL to discuss your individual requirements.

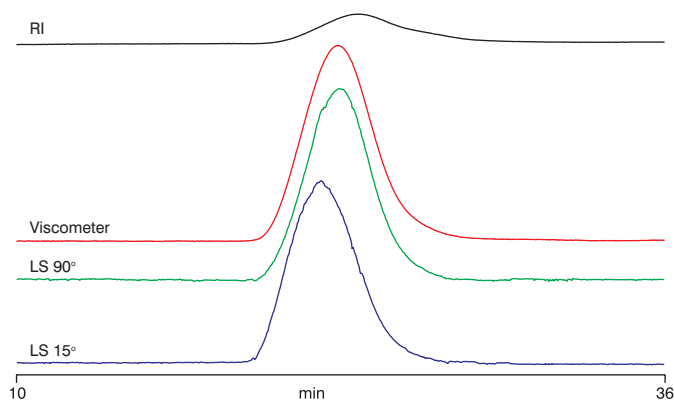
### Polystyrene at 40°C

Columns: 2xPLgel 10 $\mu$ m MIXED-B, 300x7.5mm (PL1110-6100)  
Eluent: THF  
Flow Rate: 1.0ml/min  
Loading: 2mg/ml, 200 $\mu$ l  
Temp: 40°C



### High Molecular Weight Polyethylene at 160°C

Columns: 4xPLgel 20 $\mu$ m MIXED-A LS, 300x7.5mm (PL1110-6200LS)  
Eluent: TCB  
Flow Rate: 1.0ml/min  
Loading: 1mg/ml, 200 $\mu$ l  
Temp: 160°C



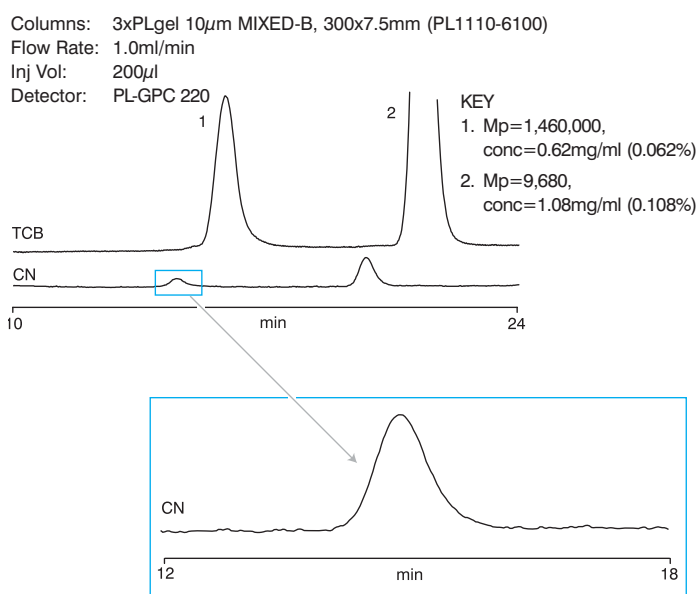
## System Design and Performance

### Enhanced RI Sensitivity and Stability

The improved Refractive Index detector includes a new photodiode and uses fiber optic technology to maximize sensitivity while minimizing baseline drift and noise, vital for good GPC/SEC. This RI ensures outstanding signal/noise ratio, even at 220°C!

### Polystyrene Standards

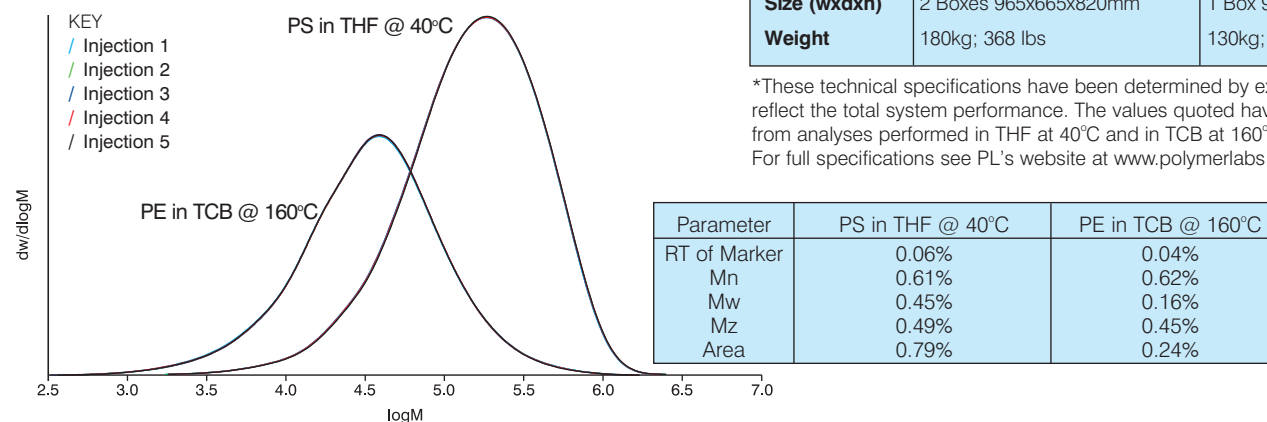
These chromatograms illustrate excellent signal to noise for polystyrene in TCB at 160°C ( $dn/dc=0.050\text{ml/g}$ ) and a very distinct signal for polystyrene in CN at 210°C ( $dn/dc=0.003\text{ml/g}$ )!



### High Precision Isocratic Pump - Unrivalled Reproducibility for Precise Results

The high performance PL-GPC 120 and PL-GPC 220 integrated GPC/SEC systems from PL incorporate a high precision pump for the best pump performance available. Unbeatable flow reproducibility of 0.07% is achieved, not only in THF at near ambient temperature, but also in TCB at temperatures above 140°C.

### Repeatability Data from 5 Consecutive Injections



### Safety First - Solvent Leak Detection and Automated Shutdown

PL's systems incorporate integral sensors which constantly monitor the system. Vapor sensors are fitted in both the solvent module and column oven. The sensors can be programmed for sensitivity according to the solvent in use.

In the case of an unattended error, the system selects and activates the appropriate shutdown sequence depending on the nature of the error. Low solvent flow will be maintained, where possible, to avoid damage to valuable GPC columns.

An audit trail feature offers full status and error logging facility for system traceability.

### Technical Specifications

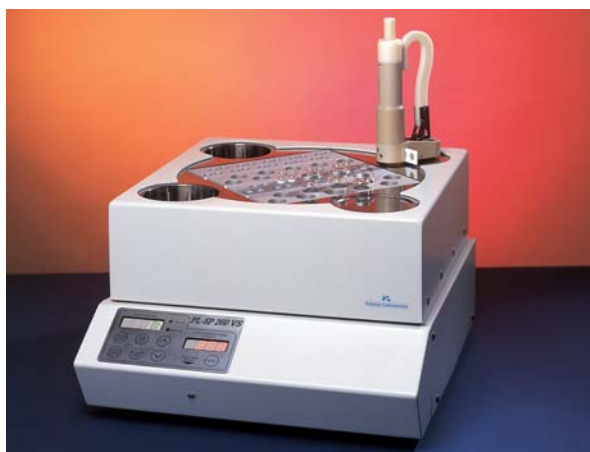
<b>Pump</b>	Flow Range Flow Rate Reproducibility	0.1-5.0ml/min ≤0.07%
<b>Oven</b>	Temperature Range PL-GPC 220 PL-GPC 120 Temperature Stability Column Capacity	30-220°C 30-120°C <0.05°C/hour 6x30cm columns
<b>Detector</b>	Differential Refractometer Cell Volume Sensitivity* Noise* Drift* Wavelength	Deflection 8 $\mu\text{l}$ 2x10 <sup>-7</sup> RIU/mV ≤80 $\mu\text{V}$ (≤1.6x10 <sup>-8</sup> RIU) ≤10mV/hour (≤3x10 <sup>-8</sup> RIU/hr) 890±50nm
<b>Autosampler</b>	Carousel Capacity (PL-GPC 220) (PL-GPC 120 supplied with PL-AS MT Autosampler option) Injection Volume PL-GPC 220 PL-GPC 120 Precision*	40x2ml vials  Flushed fixed loop, 5-500 $\mu\text{l}$ Flushed fixed loop, 5-500 $\mu\text{l}$ ≤1%
<b>Instrument Control</b>		Microprocessor
<b>Instrument Interface</b>		Windows 2000 based Advanced PC Control
<b>General</b>	Power Requirements	210-250V AC Line frequency 50/60 Hz
<b>Size (wxdxh)</b>	<b>PL-GPC 220</b> 1260x540x580mm	<b>PL-GPC 120</b> 810x540x580mm
<b>Packaged Size (wxdxh)</b>	2 Boxes 965x665x820mm	1 Box 965x665x820mm
<b>Weight</b>	180kg; 368 lbs	130kg; 286 lbs

\*These technical specifications have been determined by experimentation and reflect the total system performance. The values quoted have been calculated from analyses performed in THF at 40°C and in TCB at 160°C. For full specifications see PL's website at [www.polymerlabs.com/gpc](http://www.polymerlabs.com/gpc).

# Sample Handling for the PL-GPC 120 / PL-GPC 220

## PL-SP 260VS Sample Preparation System

The PL-SP 260VS is a new Sample Preparation System designed for the dissolution and filtration of samples prior to GPC analysis. The unit combines controlled heating across a temperature range of 30-260°C\*, with gentle agitation, user-selectable from speeds of between 85-230\*\* rpm. With its temperature range and speed capabilities, the new PL-SP 260VS is ideal for a wide range of polymer types.



### Choice of Vial Types

The removable aluminium blocks for the heated compartment are available in several formats to accommodate a variety of vial types. The Standard Accessory Kit is designed to be used with standard sample preparation vials (supplied) and either PL-GPC 220 2ml autosampler vials or Waters' 4ml autosampler vials. The Custom Accessory Kits permit alternative vials to be specified by the customer. For further details, see PL's Chromatography Catalog or visit our website.

### Efficient Dispensing

A unique pipettor device efficiently dispenses hot filtered sample solution from the sample preparation vial directly into destination (autosampler) vials, with minimal handling.

### Choice of Filtration Media

Two filtration media are available:

#### Glass fiber

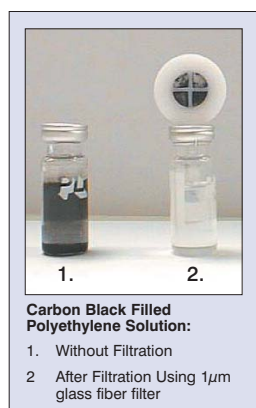
(nominal porosity 1µm) -  
the preferred system for general applications

#### Porous stainless steel

(nominal porosity 0.5µm, 2µm,  
5µm or 10µm)

\* +/- 2°C

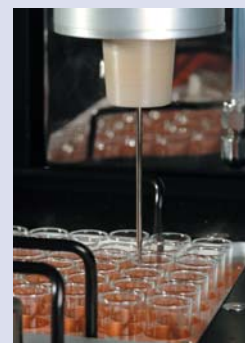
\*\* +/- 10%



## PL-XTR Robotic Sample Handling System

The PL-XTR is an advanced, fully automated, sample handling system designed to be interfaced with any GPC system, providing increased efficiency and high throughput. A two arm robot performs both sample dilution and injection functions from ambient up to 220°C.

- Software controlled robotic functions
- Designed for operator safety

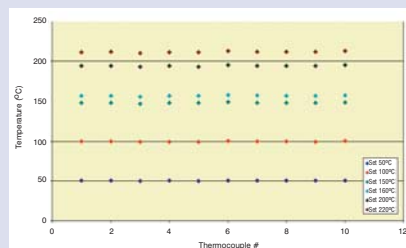


Sample filled vials are loaded into 48 capacity sample blocks in an X-Y array. The robotic arm dispenses a defined volume of solvent into the vials, which are then subjected to controlled heating and optional stirring for a programmed dissolution time. Once dissolution is complete, the solution is delivered to the GPC chromatograph via an on-board heated injection valve and compact heated transfer line.

The injection system incorporates heated needle assemblies which can be rinsed to avoid cross contamination of samples.

### Temperature Control

The PL-XTR features precise and uniform temperature control across the sample blocks. The graphs indicate temperature profiles monitored in solvent filled vials at 10 different positions (indicated in red) in 2x48 sample blocks for 6 different set temperatures.



Manufactured by PL under exclusive licence from Symyx® US Patent No. 6,260,407. Use of this instrument may also be covered by one or more of US Patent Numbers 6,406,632, 6,475,391, 6,265,226, and 6,454,947. Additional US and foreign patents pending.

For specifications, see PL's website at [www.polymerlabs.com/gpc](http://www.polymerlabs.com/gpc)

[www.polymerlabs.com/gpc](http://www.polymerlabs.com/gpc)



# PL-XT 220 Rapid Analysis GPC/SEC System

## High Throughput Screening of Polymers

Recent developments in combinatorial materials discovery and the growing need to rapidly obtain data for polymeric samples of all types has required a completely different approach to performing GPC analysis.

The PL-XT 220 from Polymer Laboratories (PL) is a sophisticated, fully featured, totally automated rapid high temperature GPC analysis system incorporating:

- Sample Preparation
- Sample Analysis
- Sample Injection
- Fully Automated Instrument Control



The PL-XT 220 consists of:

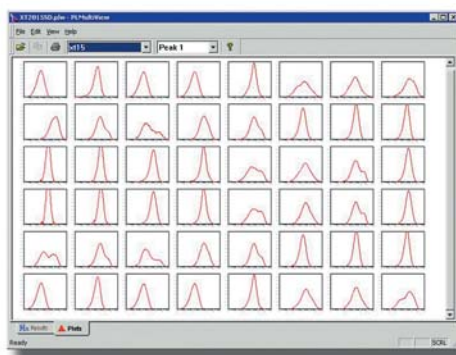
- Dual arm robotic sample preparation platform with two x 96 well autosampler capability for continuous operation
- Temperature controlled oven (30-220°C) containing columns and a range of optional detectors
- A precision solvent delivery system
- A specifically designed high temperature evaporative light scattering detector (ELSD)
- Sophisticated, flexible and intuitive system control software for complete automation
- Powerful and comprehensive data collection, analysis and 'rapid data review' software



Manufactured by PL under exclusive licence from Symyx® US Patent No. 6,260,407. Use of this instrument may also be covered by one or more of US Patent Numbers 6,406,632, 6,475,391, 6,265,226, and 6,454,947. Additional US and foreign patents pending.

### Rapid GPC

The PL-XT 220 is capable of performing rapid, reproducible, automated GPC analysis in under 10 minutes. Purpose designed single columns or conventional multi column formats can be employed. To ensure maximum baseline stability and sample throughput, ELSD is standard in the chromatography system. However, the PL-XT 220 is compatible with all traditional GPC concentration and molecular weight sensitive detectors.



Automatic calibration of the system followed by sample data analysis can be achieved using PL's powerful Cirrus™ GPC software. Large sample data arrays can be reviewed through a flexible graphics package, allowing for visual assessment and detailed comparison of molecular weight properties.

### Technical Specifications

<b>Pump</b>	Flow Range Flow Rate Reproducibility	0.1-5.0ml/min ≤0.07%
<b>Oven</b>	Temperature Range Temperature Stability Column Capacity	30-220°C <0.05°C/hour 6x30cm columns
<b>Detector</b>	PL-ELSD Nebulizer Temp Evaporator Temp Gas Flow Pressure Operating Range Maximum Pressure	30-220°C 30-300°C 0-2 SLM @ 60psi @ 25°C 60-100psi (4-6.7 bar) 150psi (10 bar)
<b>Sample Preparation And Injection</b>	2 Arm Robot  Five Independently Controlled Heated Zones Heated Needles Sample Capacity  Injection Volume Inline Filter	30-220°C  500µl capacity 4x48 Vials (4, 8 and 15ml max volume) Flushed fixed loop, 5-500µl
<b>Instrument Control</b>		Microprocessor
<b>Instrument Interface</b>		Windows 2000 based Advanced PC Control
<b>General</b>	Power Requirements	210-250V AC Line frequency 50/60 Hz
<b>Size (wxdxh)</b>		1770x836x1011mm
<b>Packaged Size (wxdxh)</b>		1. 1070x940x1090mm 2. 1320x760x9100mm 3. 1000x880x600mm
<b>Weight</b>		~200kg; 429 lbs

To order please contact Polymer Laboratories, or your local distributor

US 800 767 3963 UK / International (+44) 01694 723581 Germany (+49) 06151 / 7030 Benelux (+31) 118 671500 France (+33) 04 91 17 64 00

# Specialist GPC/SEC Detectors

## GPC-FTIR Characterization of Polymers from PL

For use with:

- PL-GPC 50 Plus
- PL-GPC 120
- PL-GPC 220

Interfacing chromatographic methods with other analytical techniques can significantly increase the amount of information available for polymer characterization. Polymer Laboratories manufactures two innovative interfaces to couple gel permeation chromatography (GPC) with fourier transform infrared spectroscopy (FTIR), enabling rapid determination of compositional heterogeneity and its relationship to molecular weight from a single measurement.

The flow cell, which is supplied with a specific mounting bracket for individual FTIR instruments, fits directly onto the optical bench of the spectrometer and interfaces with any GPC system. The flow cell features low dispersion for minimum band broadening and is available with a choice of window materials for a variety of applications.

For room temperature applications using the PL-GPC 50 Plus, Polymer Laboratories supplies the PL RTGPC-FTIR Interface.

For elevated temperature applications, the PL HTGPC-FTIR Interface is supplied with a temperature control module to enable the heated cell assembly and heated transfer line to be controlled up to 175°C.

The GPC-FTIR combination provides spectral information for the polymer as a function of elution time from the GPC system. The spectrometer-based software records multiple spectra which can be used to derive both molecular weight distribution using PL's Cirrus™ GPC software and composition distribution information.

### Conventional GPC Calculations from FTIR

PL has introduced the GPC-FTIR Data Import Module for its Cirrus suite of GPC software which allows time-resolved FTIR data to be imported into Cirrus for conventional GPC calculations. Compatible with the PerkinElmer Spectrum Timebase, Thermo Nicolet OMNIC and Bruker OPUS™ FTIR data acquisition packages, the GPC-FTIR Data Import software easily converts time-resolved spectral profiles into standard Cirrus data files. Once converted, these files can be manipulated in Cirrus to allow calculations of molecular weight averages using either narrow or broad standard calibrations.

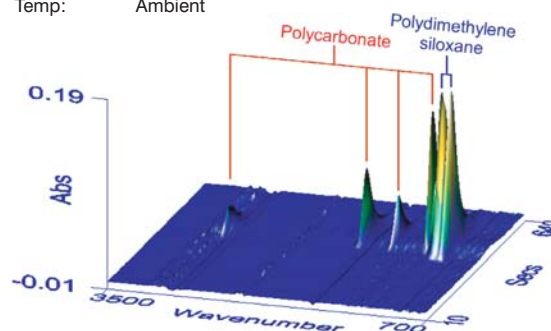


The PL-GPC 220 coupled to the PerkinElmer Spectrum One FTIR.

### Applications:

#### Analysis of Copolymers and Polymer Blends

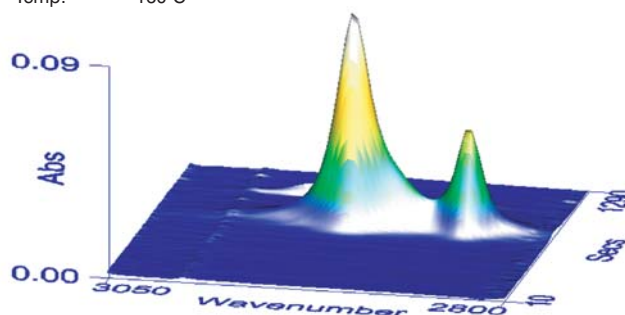
Sample: Polycarbonate/polydimethylsiloxane blend  
Column: PLgel 5µm MIXED-C, 300x7.5mm (PL1110-6500)  
Eluent: Dichloromethane  
Flow Rate: 1.0ml/min  
Temp: Ambient



#### Determination of Short Chain Branching in Polyolefins using the PL-GPC 220

For FTIR users, the PL HTGPC-FTIR Interface is ideal for the study of short chain branching in polyethylene. Using PL's Cirrus™ GPC-FTIR SCB software in conjunction with the FTIR control and acquisition software, the short chain branching distribution can be mapped as a function of molecular weight distribution. The software incorporates a novel chemometrics approach which permits determination of the SCB/1000 carbon atoms as a function of molecular weight, as well as an error bar for each point.

Sample: Polyethylene  
Columns: 2xPLgel 10µm MIXED-B, 300x7.5mm (PL1110-6100)  
Eluent: Trichlorobenzene  
Flow Rate: 1.0ml/min  
Temp: 160°C



Images produced from the PerkinElmer Timebase FTIR Software.

# Specialist GPC/SEC Detectors

## Integrated Viscosity and Light Scattering

For use with:

- PL-GPC 50 Plus
- PL-GPC 120
- PL-GPC 220
- PL-XT 220

State of the art polymer characterization requires the User to extract the maximum information from the experiment. PL's integrated GPC/SEC systems are designed to accommodate integrated triple detection. Specialist detectors such as viscometers and light scattering detectors can be factory installed or retrofitted for maximum convenience. In addition, PL's GPC/SEC systems have been engineered to easily interface to other instrumentation.

### High Sensitivity Viscosity Detection

The combination of refractive index (RI) and viscosity detection provides accurate molecular weight determination for all polymer types based on the Universal Calibration principle, as well as valuable branching information not otherwise accessible from a concentration detector alone.

The PL-BV 400RT (for use with the PL-GPC 50 Plus) and PL-BV 400HT (for use with the PL-GPC 120, PL-GPC 220 and PL-XT 220) are new detectors from Polymer Laboratories for the online measurement of viscosity, featuring:

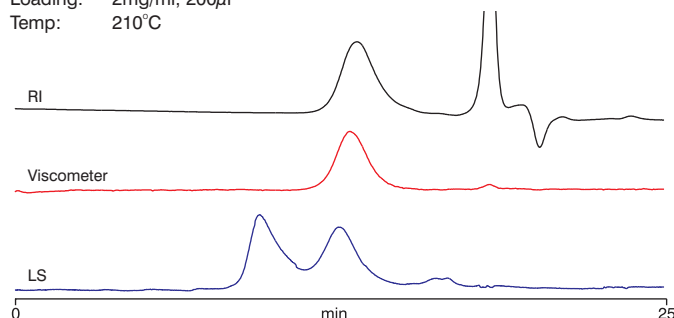
- High sensitivity
- Stable baselines
- Compatibility with all solvents
- Operation over the temperature range:  
PL-BV 400RT Ambient-50°C  
PL-BV 400HT 30-220°C
- Inlet pressure (IP); differential pressure (DP)

...with the benefit of:

- Precision engineered 4-capillary bridge
- High sensitivity pressure transducers
- State of the art low noise electronics

### Poly(phenylene sulfide)

Columns: 2xPLgel 10 $\mu$ m MIXED-B, 300x7.5mm (PL1110-6100)  
Eluent: o-chloronaphthalene  
Flow Rate: 1.0ml/min  
Loading: 2mg/ml, 200 $\mu$ l  
Temp: 210°C



### High Accuracy Light Scattering Detection

Absolute molecular weight light scattering capabilities are provided for Polymer Laboratories' range of GPC/SEC systems, for

- Absolute MW distributions (Mw, Mn, Mz, etc)
- Radius of gyration (Rg)
- Branching data for polymers

For light scattering capabilities with the PL-GPC 50 Plus integrated GPC/SEC system, Polymer Laboratories supplies the PL-LS series of light scattering detectors.

For high temperature integrated light scattering, PL's new PL-HTLS 15/90 laser light scattering detector is located within the oven compartment of the PL-GPC 120/PL-GPC 220/PL-XT 220 systems, and can be factory fitted or retrofitted. The detector operates between 30-250°C, and is compatible with typical GPC solvents for high temperature applications. The system provides absolute MW distributions from less than 10<sup>3</sup> to over 10<sup>7</sup> daltons and Rg in the 12-150nm range.

### Cirrus™ GPC/Multi Detector Polymer Characterization Software

PL's easy to use, fully featured Cirrus GPC/Multi Detector software enables GPC/Viscometry, GPC/Light Scattering and Triple Detection calculations to be performed, supporting PL's and other manufacturers' viscometry and light scattering detectors.

# Integrated Systems for High Performance GPC/SEC

## System Design and Ordering Information

### Safety

The instruments were designed and built to comply with the current European electrical safety regulations (EN 61010, Parts 1 and 11), and are certified to be EMC (EN55022) compatible. All instruments are CE marked.

### Ordering Information

Description	Part No.
PL-GPC 50 Plus Integrated GPC/SEC System	PL0870-8000
PL-GPC 120 Integrated GPC/SEC System	PL0830-0000
PL-GPC 220 Integrated GPC/SEC System	PL0820-0000
PL-AS RT Autosampler	PL0870-8150
PL-AS MT Autosampler	PL0870-8180
PL-XT 220 Rapid Analysis GPC/SEC System	PL0840-0000
PL-XTR Robotic Sample Handling System for Automated GPC/SEC	PL0840-1000
Heated Transfer Line	PL0810-1001
PL-SP 260VS Sample Preparation System	PL0810-4050
PL-SP 260VS Standard Accessory Kit	PL0810-4100
PL-BV 400RT Viscometer	PL0810-3060
PL-BV 400HT Viscometer	PL0810-3050
PL-HTLS 15/90 Light Scattering Detector	PL0640-1200
Cirrus™ Multi Detector Software	PL0570-2020
Cirrus™ GPC-FTIR SCB Software	PL0570-2400
GPC-FTIR Data Import Module	PL0570-2300
PL RTGPC-FTIR Interface / PL HTGPC-FTIR Interface Contact your local sales office or distributor to discuss interface options	
Degasser	PL0870-0100
Fixed Wavelength UV Detector	PL0870-1000
Variable Wavelength UV Detector	PL0870-1500
PL-ELS 1000 Evaporative Light Scattering Detector	PL091/24797
PL Network Interface	PL0870-0200

### Contact the UK office for details of your local distributor

Your local distributor is:

Polymer Laboratories manufactures market leading organic and aqueous GPC/SEC columns and standards, including:

- PlusPore - New High Resolution GPC Columns
- PLgel - Advanced Organic GPC Columns
- PL EnviroPrep - New Columns for Sample Clean-up
- PL Rapide - Rapid GPC/SEC Columns
- PL aquagel-OH - Aqueous SEC Columns
- PL Polymer Standards for GPC/SEC
- EasiVial - Pre-weighed Polymer Standards Kits
- EasiCal - Pre-prepared Calibration Kits



## Polymer Laboratories

[www.polymerlabs.com/gpc](http://www.polymerlabs.com/gpc)

### North America

Polymer Laboratories  
Varian, Inc.  
Amherst Fields Research Park  
160 Old Farm Road  
Amherst, MA 01002  
Tel, toll free: 800 767 3963  
or tel: 413 253 9554  
Fax: 413 253 2476  
Email: SalesUS@polymerlabs.com  
Email: SupportUS@polymerlabs.com  
Credit Cards Accepted.

### Germany

Polymer Laboratories  
Varian Deutschland GmbH  
Alsfelder Strasse 6  
64289 Darmstadt, Germany  
Tel: (+49) 6151 / 7030  
Fax: (+49) 6151 / 703237  
Email: PLdeutsch@polymerlabs.com

### Benelux

Polymer Laboratories  
Varian B.V.  
Postbus 8005  
4330 EA Middelburg  
The Netherlands  
Tel: (+31) 118 671500  
Fax: (+31) 118 671502  
Email: PLbenelux@polymerlabs.com

### UK

Polymer Laboratories Ltd  
Now a part of Varian, Inc.  
Essex Road, Church Stretton  
Shropshire SY6 6AX, UK  
Tel: (+44) 1694 723581  
Fax: (+44) 1694 722171  
Email: Sales@polymerlabs.com  
Email: Support@polymerlabs.com

### France

Polymer Laboratories  
Varian SA  
GVIO Parc de Marseille Sud  
Impasse du Paradou  
Batiment D5  
BP 159, 13276 Marseille Cedex 09  
France  
Tel: (+33) 04 91 17 64 00  
Fax: (+33) 04 91 17 64 01  
Email: support@polymerlabs.fr  
Website: www.polymerlabs.fr

*All Trademarks Acknowledged  
Varian, Inc. reserves the right  
to change specifications without notice.*



**VARIAN**

CS665/F/1.06