



Polymer Source, Inc.

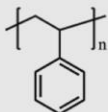


ISO CERTIFIED REFERENCE MATERIAL

POLYSTYRENE

Polymer Source is proud to announce our 25th anniversary in business of research grade polymers. We would like to acknowledge all our customers –researchers and scientists in the fields of chemistry, biochemistry, physics and chemical engineering throughout the world – for their input in research and innovation driving global change.

To celebrate our success in design of tailor-made polymers and worldwide recognition, we are excited to introduce our new products – Certified Reference Materials – **now with -75% OFF!**

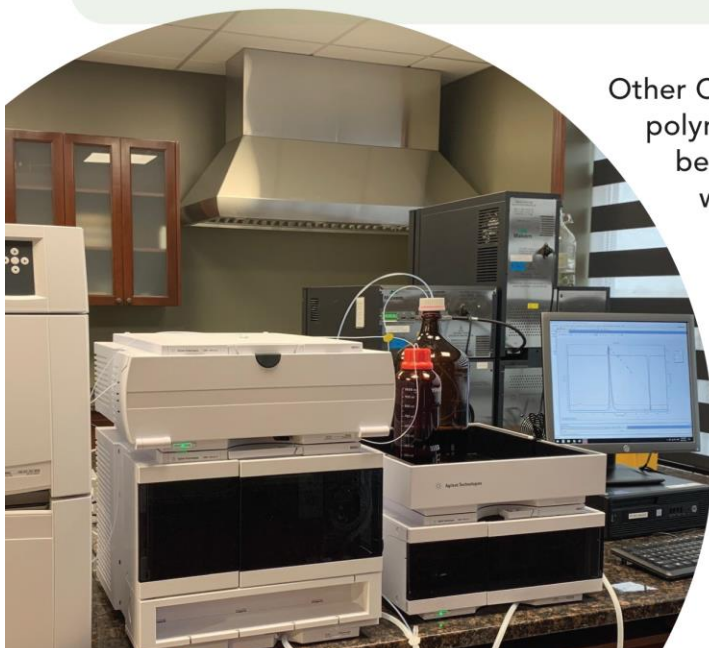


12 samples × 250 mg each
Special Price: 900 USD
(regular price: 3,600 USD)

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VALID FOR
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PERIOD
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Our POLYSTYRENE standards kit includes 12 samples with molecular weight ranging from **800 Da to 6,000,000 Da** and narrow polydispersity. All our PS samples are certified to comply with **ISO 17024 and ISO 9001:2015** standards, and are good for calibration and evaluation of analytical instruments, as well as for fundamental research.



Other Certified Reference Materials (polyethylene oxide, polymethacrylates, polypyridines, and polydienes) will be available in 2019! Please, check our website www.polymersource.ca for updates.

Thank you for choosing Polymer Source to supply polymers for your research.

It is our pleasure to continue serving you.

Sunil K. Varshney, Ph.D.
President and Company founder.

Tel.: (1)514-421-5517, Fax: (1)514-421-5518

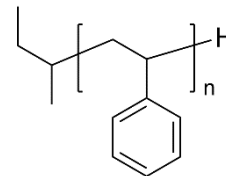
E-mail: info@polymersource.com

Web: www.polymersource.ca



CERTIFICATE OF ANALYSIS

Product name and structure: **POLYSTYRENE**
ISO Certified Reference Material



PS standards kit number: **R12-08k6m-PS**

Part numbers: 1-PS-0.8k_R8093-S, 5-PS-11k_R8575-S, 9-PS-250k_R5712-S,
2-PS-1.8k_R1772-S, 6-PS-25k_R1507-S, 10-PS-650k_R2814-S,
3-PS-2.5k_R2275-S, 7-PS-60k_R4249-S, 11-PS-900k_R5654-S,
4-PS-5.5k_R4246-S, 8-PS-105k_R10518-S, 12-PS-6M_R106p-S.

ISO Certified Reference Material:

Polymer: Polystyrene (PS)
Linear formula: $[\text{CH}_2\text{CH}(\text{C}_6\text{H}_5)]_n$
CAS number: 9003-53-6
Purity: 99.9 %
Appearance: White powder, solid, or fluffy material (except PS with MW<1,000: viscous material)
Production: Polystyrene was synthesized by living anionic technique, and regressively purified by column chromatography to remove inorganic side-products followed by freeze-drying of the obtained polymer solution from benzene.
Quality Control: Polymer Source is **ISO 9001:2015** certified company, and our Testing and Calibration Laboratory is complying with **ISO 17025** standards.

GPC/SEC Instrument Details and Analysis Conditions:

Instrument: Agilent Technologies 1260 Infinity II GPC/SEC System
Detectors: Triple detector (RI, Viscometer, LS 90° and LS 15°)
Columns: Three columns 300×7.5 mm, Agilent Technologies:

- PLgel 5µm 10E3Å (MW range: 500 to 60,000)
- PLgel 10µm 10E5Å (MW range: 60,000 to 2,000,000)
- PLgel 10µm 10E6Å (MW range: 600,000 to 10,000,000)

Solvent (mobile phase): THF (Tetrahydrofuran with 1% triethylamine)
Temperature: 30 °C
Flow rate: 1 mL/min
Injection volume: 100 µL
Column calibration: Polystyrene analytical standards (M_p : 580–6,035,000 g/mol)
System calibration: Polystyrene analytical standard (M_p : 217,000 g/mol)
Data acquisition software: Agilent GPC/SEC Software
Sample concentration: 0.5–2 mg/mL
dn/dc (mL/g): 0.185
*Abbreviations used in Results: M_p , M_n , M_w , M_z and M_v are the respective peak, number, weight, Z and viscosity molecular weight averages. M_w/M_n is the polydispersity ratio.
 $[\eta]$ is the intrinsic viscosity (THF, 30 °C).



¹H NMR Instrument Details and Analysis Conditions:

Instrument: Bruker Avance III 500 NMR spectrometer
Solvent: Chloroform-d₃

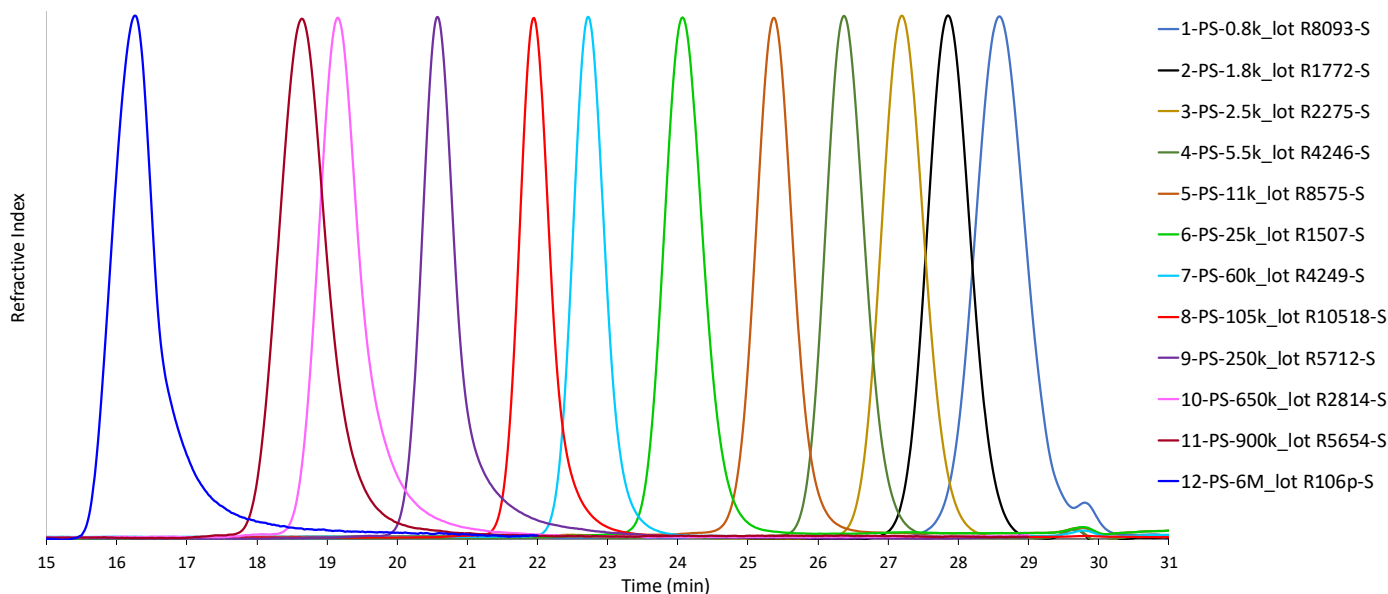
DSC Instrument Details and Analysis Conditions:

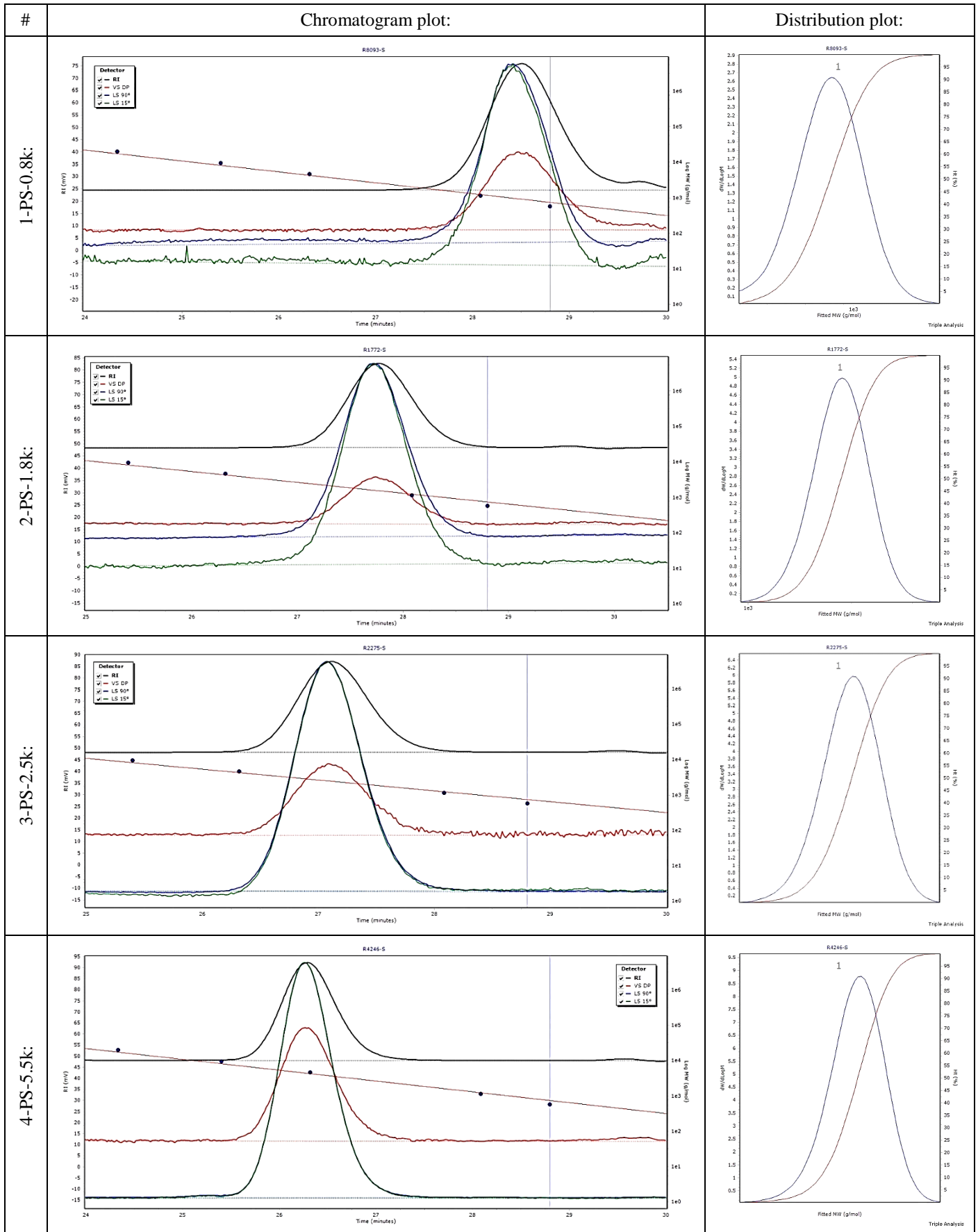
Instrument: TA Instruments DSC Q100
Gas: Nitrogen
Thermal analysis: Glass transition temperature (T_g) was measured at a scan rate of 10°C/min.

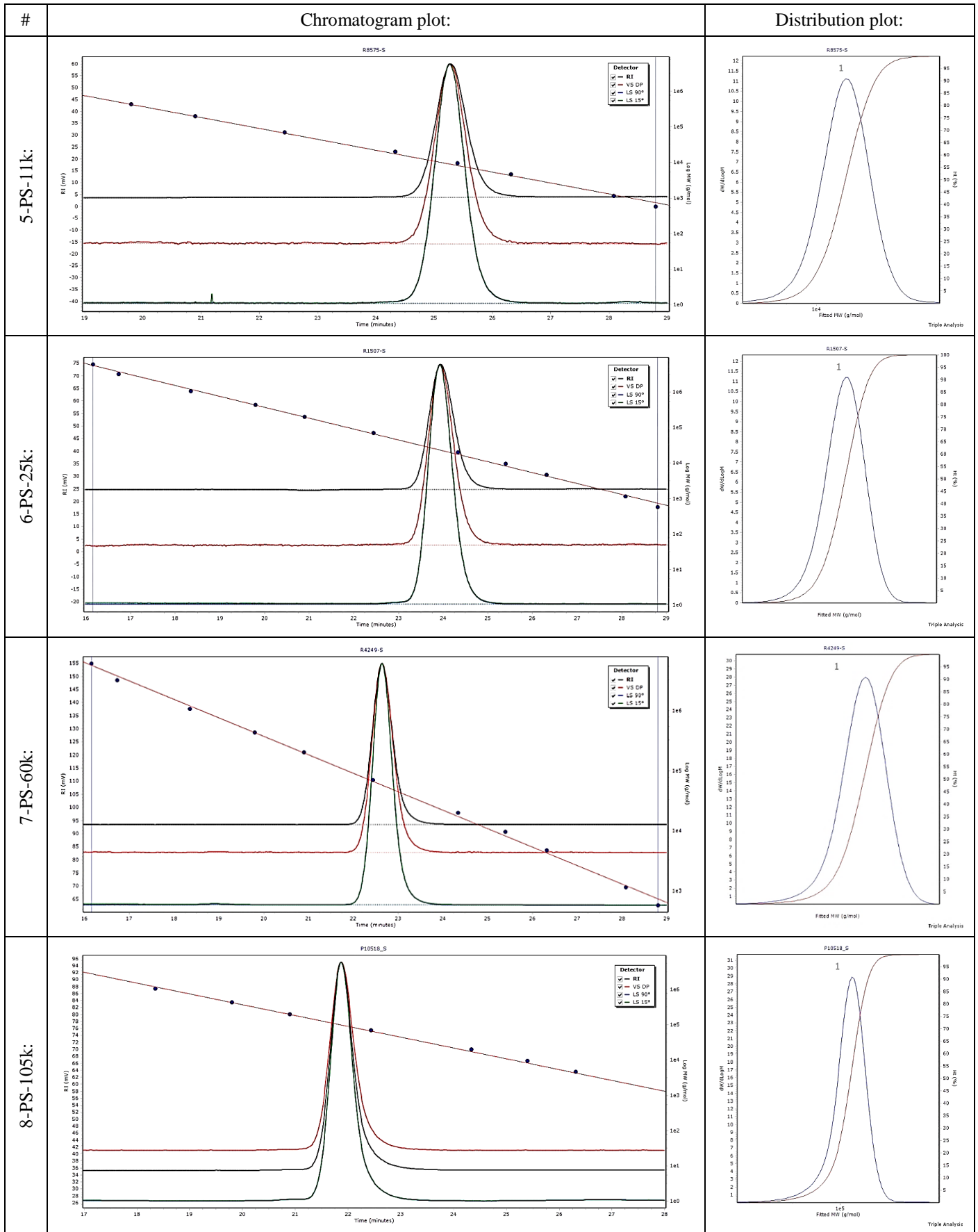
RESULTS:

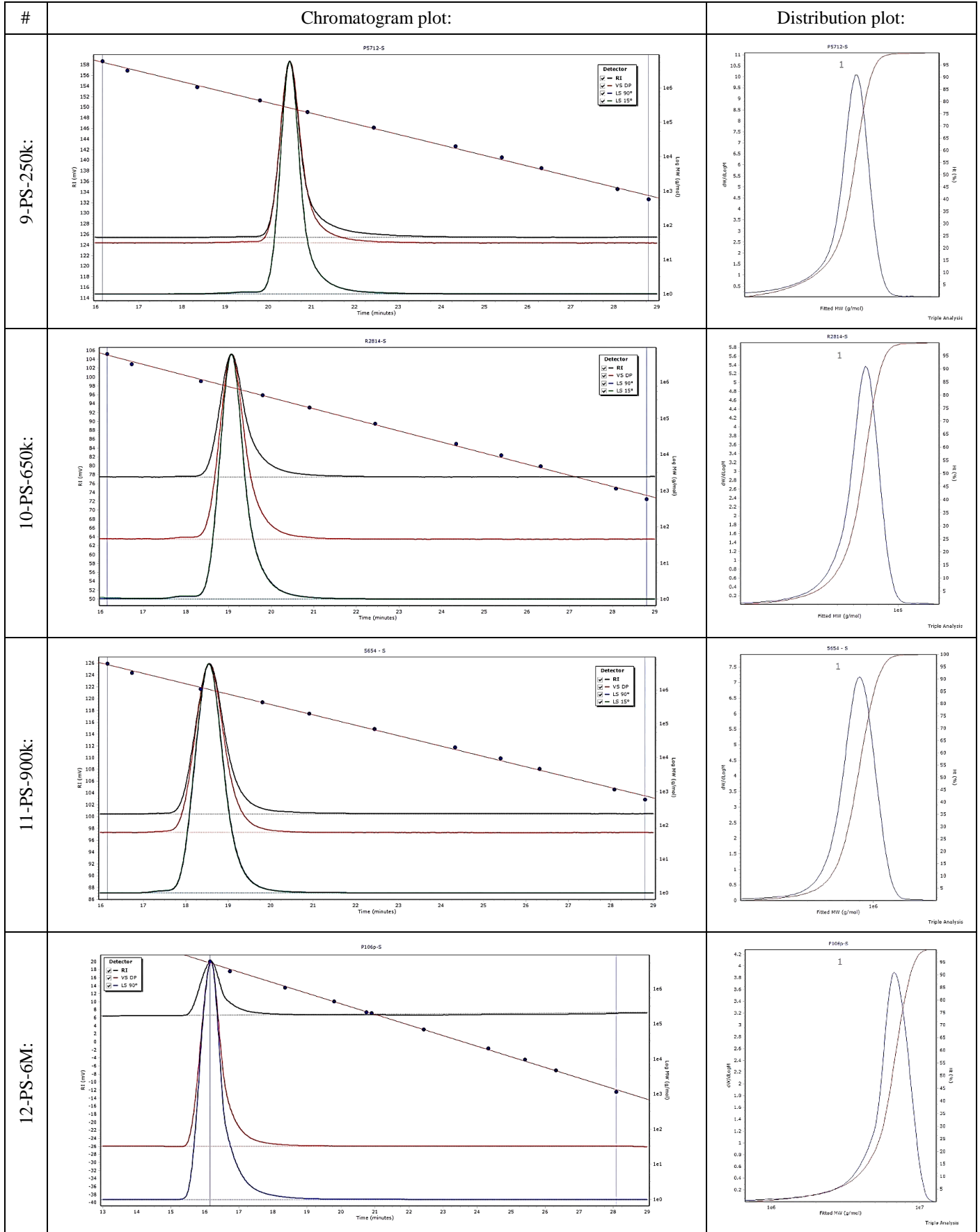
Sample #	GPC/SEC Results							Mol.Wt. calculated from ¹ H NMR	T _g (°C)
	Molecular weight averages (g/mol)					M _w /M _n	[η] _w (dL/g)		
	M _p	M _n	M _w	M _z	M _v				
1-PS-0.8k	790	725	820	930	880	1.13	0.03	790	-4
2-PS-1.8k	1,870	1,820	1,890	1,950	1,930	1.04	0.04	1,410	49
3-PS-2.5k	2,500	2,430	2,500	2,550	2,500	1.03	0.05	2,660	68
4-PS-5.5k	5,500	5,300	5,450	5,500	5,450	1.03	0.07	4,850	84
5-PS-11k	11,000	10,800	11,000	11,050	11,000	1.02	0.10		90
6-PS-25k	25,700	25,000	25,500	25,800	25,750	1.02	0.18		100
7-PS-60k	60,500	60,000	61,000	61,200	61,100	1.02	0.32		100
8-PS-105k	105,000	103,000	105,000	104,000	104,000	1.02	0.46		100
9-PS-250k	249,000	235,000	240,000	245,000	244,000	1.02	0.83		102
10-PS-650k	690,000	615,000	658,000	690,000	680,000	1.07	1.79		106
11-PS-900k	900,000	857,000	881,000	901,000	899,000	1.03	2.16		106
12-PS-6M	6,500,000	5,570,000	6,260,000	6,750,000	6,550,000	1.12	6.34		106

Chromatograms Overlay

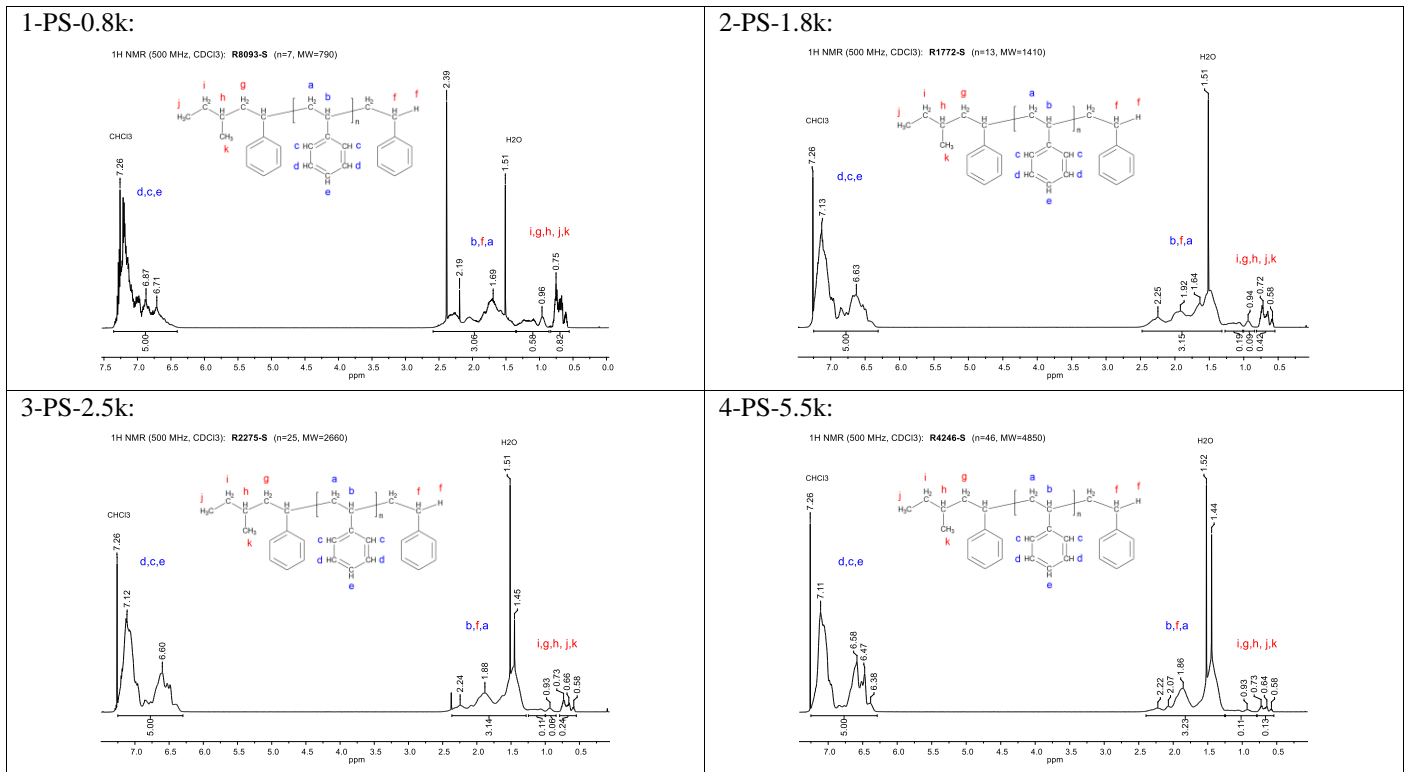




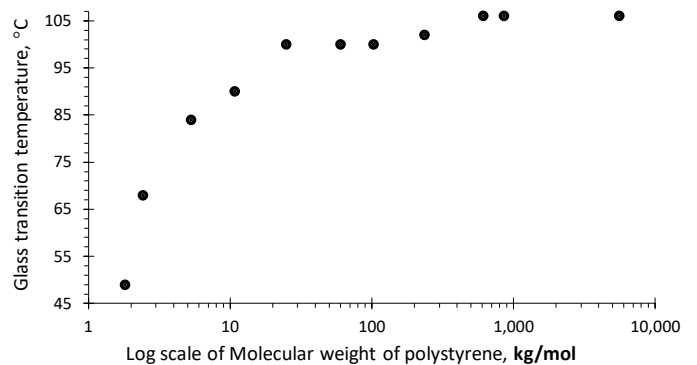
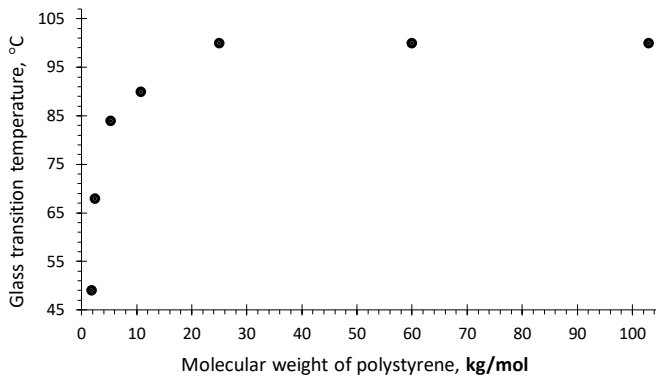




Polystyrene samples of low molecular weight were analyzed by proton NMR, and the calculated MW is in good correlation with GPC/SEC data. ¹H NMR spectra are presented below.



Dependence of glass transition temperature (T_g) of polystyrene from its molecular weight:



The above analyses run according to **ISO 9001:2015** and **ISO 17025** standards.
 Manufacture and control run according to *Polymer Source* methods of analysis.

Iryna I. Perepichka, Ph.D.
 Quality Assurance and Quality Control

Sunil K. Varshney, Ph.D.
 Production and Validation