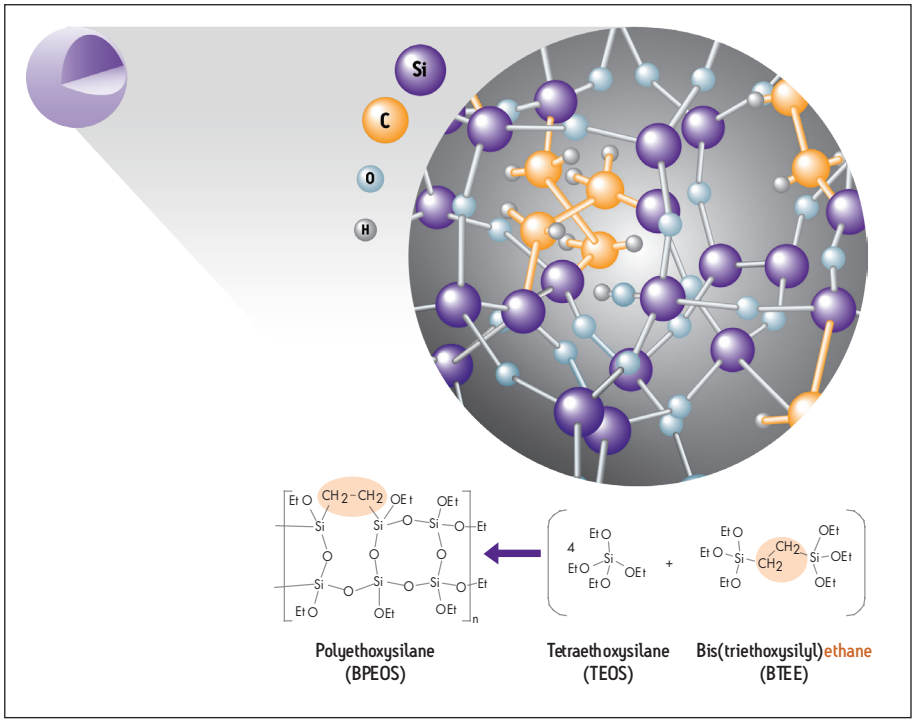
ACQUITY APC Columns

Increased Speed and Resolution for Aqueous and Organic Polymer Separations

ACQUITY® Advanced Polymer Chromatography® (APC™) Columns contain high-performance chemistries designed for rapid and accurate chromatographic characterization of synthetic polymer and macromolecular species. The innovative hybrid-polymer sub-3-µm particle technology outperforms conventional polymeric-based phases to provide unmatched chromatographic efficiency, stability and method flexibility compared to existing methods for polymer characterization. ACQUITY APC Columns deliver superior chromatographic performance for all polymer classes, including low molecular weight aqueous and organic soluble polymers up to a molecular weight of 2,000,000 g/mole.

BEH TECHNOLOGY

Ethylene Bridged Hybrid [BEH] Technology synthesis creates particles that ensure extreme column performance and long column lifetime under harsh operating conditions. The particle is prepared from two high purity monomers: tetraethoxysilane [TEOS] and bis(triethoxysilyl) ethane [BTEE], which results in a highly stable and mechanically strong particle.



BEH Technology™ Particle Synthesis.

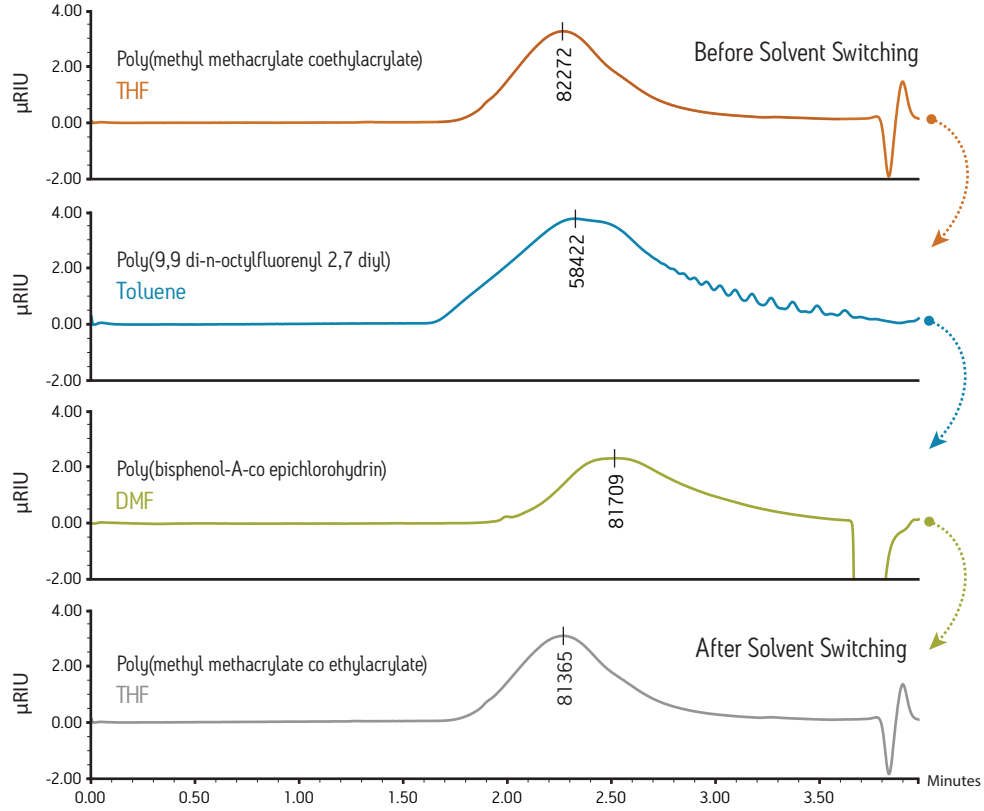
* US Patents 6,686,035; 7,223,473; 7,250,214

Compared to conventional polymer-based stationary phases, ACQUITY APC Columns deliver:

- **High Efficiency.** The optimized pore volume and particle size allow ACQUITY APC Columns to provide unmatched separation speed, resolution and chromatographic efficiency.
- **Bed Stability.** The rigid BEH particle used in ACQUITY APC Columns provides a stable bed that eliminates the shrinking and swelling that often occurs with polymeric stationary phases upon solvent switching.
- **Industry Leading Reproducibility.** Each step of our column manufacturing process, from raw material characterization to final batch analysis, is monitored and tightly controlled to deliver unmatched product reproducibility.

ONE SYSTEM. ONE BANK OF COLUMNS. ANY SOLVENT.

The rigid hybrid particles used for ACQUITY APC Columns provide an unprecedented capacity for rapid solvent switching allowing you to use multiple conditions for the same column bank. Conventional polymeric phases are often dedicated to single analysis conditions because the chromatographic bed is vulnerable to shrinking and swelling that can be potentially harmful to the column. By eliminating this constraint, ACQUITY APC Columns allow more freedom for method development and a higher capacity to provide characterization for a diverse range of polymer samples.



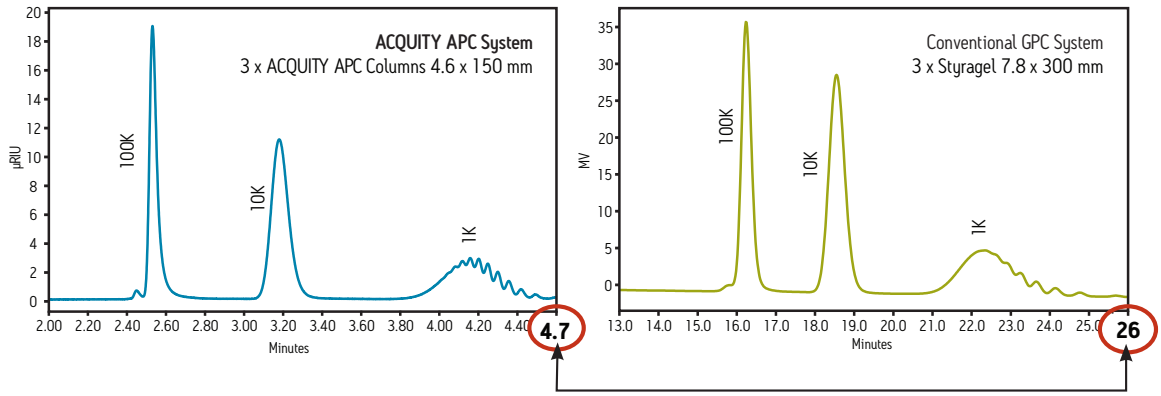
Poly (methyl methacrylate co ethyl acrylate) THF

	Before	After	% Change
Mp	82272	81365	1.1
Mw	78650	78953	0.4
Mn	49383	50110	1.5
PDI	1.59	1.58	0.6

The ability to rapidly switch chromatographic conditions allows you to run multiple methods for a diverse range of polymer species using the same bank of ACQUITY APC Columns. This example shows a repeatable analysis of poly(methylmethacrylate co-ethyl acrylate) using the same two ACQUITY APC XT 4.6 x 150 mm Columns (125Å and 450Å) in series after switching solvents from THF to toluene to DMF and back to THF.

SUPERIOR SEPARATION PERFORMANCE

ACQUITY APC Columns are designed for polymer scientists who require advanced polymer characterization and chromatographic analysis. Innovations developed for the ACQUITY APC Columns introduce new capabilities for chromatographic efficiency, speed and resolution that are unmatched using conventional methods. Using columns at the highest level of chromatographic performance gives you the ability to quantify and characterize polymer samples with confidence and accuracy while maximizing your productivity.



ACQUITY APC Columns provide faster analysis times and increase chromatographic resolution. Improving data quality enhances your ability and confidence for accurate polymer characterization. The conventional GPC separation of a set of polystryrene standards was performed using 3 Styragel® HR Columns (HR 0.5, HR 2, and HR 4E; all 7.8 x 300 mm). The same polystryene sample was analyzed using a 3 column bank of 4.6 x 150 mm ACQUITY APC Columns (XT 45, XT 45, and XT 200). The separation used THF at a flow rate of 1 mL/min.

REPRODUCIBLE COLUMN PERFORMANCE

One of the most important parameters in designing the BEH particle was to significantly improve the chromatographic performance of the base particle. Polymer characterization relies on reproducible column performance and it is one of the most critical factors for long-term method reliability. Each step of our column manufacturing process is monitored and tightly controlled to maintain unmatched product reproducibility. Every test, from raw material characterization to final batch analysis, is designed to ensure that the ACQUITY APC Column you use today will perform the same from column-to-column, batch-to-batch, and year-to-year.

ENGINEERING

- Ultra-low dispersion hardware
- Innovative frit technology

BULK SYNTHESIS

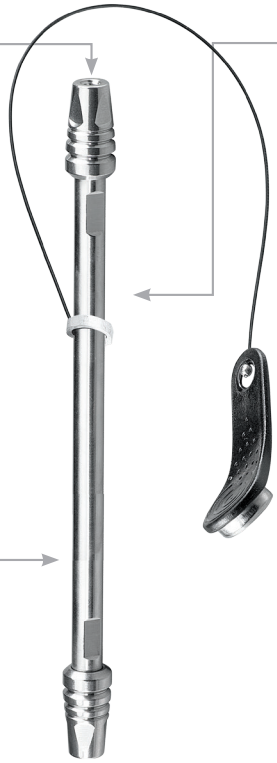
- Mechanically strong particles
- Advanced particle sizing technology
- Sustained batch-to-batch reproducibility and selectivity
- High efficiency, high mass transfer sub-3-µm particles

COLUMN MANUFACTURING

- Mechanically stable and pressure tolerant beds
- Advanced column packing technology and equipment
- Quality controlled testing for maximum separation efficiency

TRACEABILITY

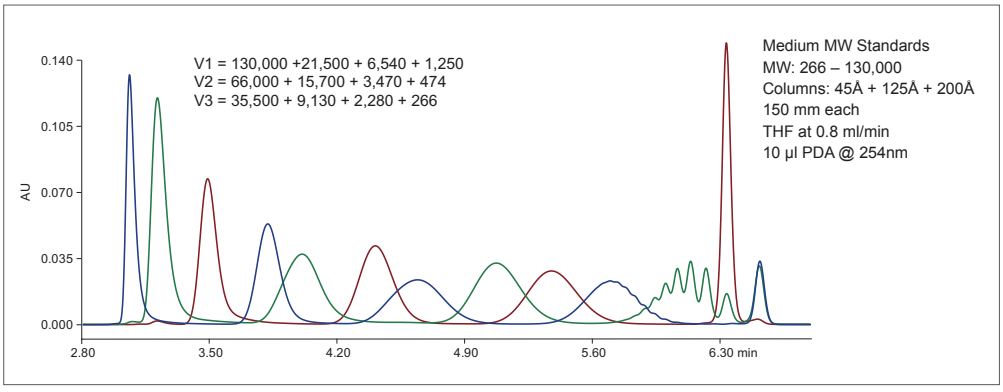
- Electronic column usage management via eCord™ Intelligent Chip Technology
- Tracks history of column's performance and usage over lifetime of the column
- Tethered to the column to ensure permanent accessibility to column history



ACQUITY APC CALIBRATION STANDARDS

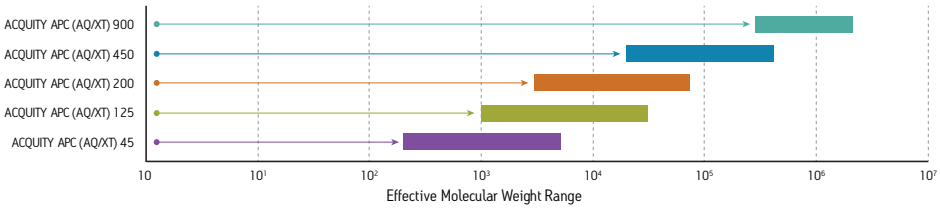
Waters revolutionized the polymer analysis industry with the introduction of the ACQUITY Advanced Polymer Chromatography (APC) System for the separation and characterization of complex polymers in solution. The system utilizes innovative hybrid silica/polymer sub-3-µm particle columns to enable higher chromatographic efficiency, improved column stability, and enhanced method flexibility. This provides users with higher throughput, increased resolution and ultimately, and more accurate information about their samples. Due to variances in LC system, sample preparation and laboratory environment, routine calibration is critical to achieving high accuracy in MW determination.

Representing an industry first, ACQUITY APC Calibration Standards were specifically designed to match the molecular weight range of the ACQUITY APC XT Columns. They eliminate the need to manually prepare custom calibration mixes, as ACQUITY APC Calibration Standards provide the right number of data points for the targeted MW range. In addition, calibration time on the ACQUITY APC System is reduced by a factor of 3–5x, enabling higher confidence in the accuracy of your results by performing more frequent calibrations.



TECHNICAL SPECIFICATIONS

The ACQUITY APC (AQ and XT) Columns Selection Guide will assist in choosing the right column that best fits your application.



ACQUITY APC AQ Columns for Aqueous-Based Separations

Column Dimension (i.d. x length)	Pore Size (Å)	Effective Molecular Weight Range*	Particle Size (µm)	Temperature Limit (°C)	Part Number
4.6 x 30 mm	45	200 – 5,000	1.7	45	186006972
4.6 x 75 mm	45	200 – 5,000	1.7	45	186006973
4.6 x 150 mm	45	200 – 5,000	1.7	45	186006975
4.6 x 30 mm	125	1,000 – 30,000	2.5	45	186006977
4.6 x 75 mm	125	1,000 – 30,000	2.5	45	186006978
4.6 x 150 mm	125	1,000 – 30,000	2.5	45	186006980
4.6 x 30 mm	200	3,000 – 70,000	2.5	45	186006982
4.6 x 75 mm	200	3,000 – 70,000	2.5	45	186006983
4.6 x 150 mm	200	3,000 – 70,000	2.5	45	186006985
4.6 x 30 mm	450	20,000 – 400,000	2.5	45	186006987
4.6 x 75 mm	450	20,000 – 400,000	2.5	45	186006988
4.6 x 150 mm	450	20,000 – 400,000	2.5	45	186006990
4.6 x 30 mm	900	300,000 – 2,000,000	2.5	45	186007249
4.6 x 75 mm	900	300,000 – 2,000,000	2.5	45	186007250
4.6 x 150 mm	900	300,000 – 2,000,000	2.5	45	186007251

ACQUITY APC XT Columns for Extended Temperature Organic-Based Separations

Column Dimension (i.d. x length)	Pore Size (Å)	Effective Molecular Weight Range*	Particle Size (µm)	Temperature Limit (°C)	Part Number
4.6 x 30 mm	45	200 – 5,000	1.7	90	186006992
4.6 x 75 mm	45	200 – 5,000	1.7	90	186006993
4.6 x 150 mm	45	200 – 5,000	1.7	90	186006995
4.6 x 30 mm	125	1,000 – 30,000	2.5	90	186006997
4.6 x 75 mm	125	1,000 – 30,000	2.5	90	186006998
4.6 x 150 mm	125	1,000 – 30,000	2.5	90	186007000
4.6 x 30 mm	200	3,000 – 70,000	2.5	90	186007002
4.6 x 75 mm	200	3,000 – 70,000	2.5	90	186007003
4.6 x 150 mm	200	3,000 – 70,000	2.5	90	186007005
4.6 x 30 mm	450	20,000 – 400,000	2.5	90	186007007
4.6 x 75 mm	450	20,000 – 400,000	2.5	90	186007008
4.6 x 150 mm	450	20,000 – 400,000	2.5	90	186007010
4.6 x 30 mm	900	300,000 – 2,000,000	2.5	90	186007252
4.6 x 75 mm	900	300,000 – 2,000,000	2.5	90	186007253
4.6 x 150 mm	900	300,000 – 2,000,000	2.5	90	186007254

**The calibration range is based on well-characterized polystyrene standards.*

ACQUITY APC COLUMN CONNECTOR KITS

The ACQUITY APC Column Connector kits contain all of the fittings and tubing needed to connect either 2, 3, or 4 columns of any length, serially within the CM-S module.

Description	Part Number
ACQUITY APC 2 Column Connector Kit	205001169
ACQUITY APC 3 Column Connector Kit	205001171
ACQUITY APC 4 Column Connector Kit	205001172

BENCHMARKING, METHOD DEVELOPMENT, AND TROUBLESHOOTING: ACQUITY APC STANDARDS

The ACQUITY APC Standards are available in both polystyrene and polymethyl methacrylate configured into Low, Middle, and High Molecular Weight Calibration Kits. They are also available in convenient Method Development Kits to include the full separation range of all three kits combined.

ACQUITY APC Standards

Description	MW Range	Part Number
ACQUITY APC Polystyrene Low MW Calibration Kit	266 – 15,000	186007539
3 Vials Containing Different MW Ranges		
Qty. 10 of each vial		
ACQUITY APC Polystyrene Middle MW Calibration Kit	266 – 130,000	186007540
3 Vials Containing Different MW Ranges		
Qty. 10 of each vial		
ACQUITY APC Polystyrene High MW Calibration Kit	266 – 2,500,000	186007541
3 Vials Containing Different MW Ranges		
Qty. 10 of each vial		
ACQUITY APC Polystyrene Method Development MW Calibration Kit	266 – 2,500,000	186007542
9 Vials, Containing 1 Vial each of the Low, Middle, and High Polystyrene Kits		
ACQUITY APC Polymethyl Methacrylate Low MW Calibration Kit	202 – 12,000	186007543
3 Vials Containing Different MW Ranges		
Qty. 10 of each vial		
ACQUITY APC Polymethyl Methacrylate Middle MW Calibration Kit	202 – 200,000	186007544
3 Vials Containing Different MW Ranges		
Qty. 10 of each vial		
ACQUITY APC Polymethyl Methacrylate High MW Calibration Kit	202 – 1,600,000	186007545
3 Vials Containing Different MW Ranges		
Qty. 10 of each vial		
ACQUITY APC Polymethyl Methacrylate Method Development MW Calibration Kit	202 – 1,600,000	186007546
9 Vials, Containing 1 Vial Each of the Low, Middle, and High Polymethyl Methacrylate Kits		

Waters

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