HPLC Detectors

CLARITY WITHOUT COMPROMISE

Waters™

ENSURE YOU GET THE ANSWERS TO THE QUESTIONS YOU ARE ASKING

Every lab works towards a different set of goals and faces a unique set of challenges. To successfully meet these challenges, it is important to have the right tools available in your toolbox.

Whether you are developing new methods or performing routine analyses, Waters™ and Wyatt™ HPLC detectors are designed to meet a variety of application needs. They help you achieve your company's goals by reducing time to results while improving the quality of information about your samples.

Liquid chromatography (LC) is one of the most important tools in an analytical laboratory; it is often referred to as the gold standard for quantification. Whether you are expanding into new applications or replacing aging technology, our wide range of detectors will reliably generate the data you need to support your business decisions and scientific goals.

- Optical, electrochemical, conductivity, light scattering, charged aerosol, mass, and viscosity detectors
- Optional flow cells to match the scale of your LC needs
- Compatibility with Empower™ and MassLynx™ Software
- Compatibility with the Alliance™ HPLC, Arc™ HPLC, Arc Premier, and ACQUITY™ Arc Systems

FLEXIBILITY AND COMPATIBILITY TO MEET ALL YOUR HPLC DETECTION NEEDS

DETECTOR OPTIONS TO MEET YOUR NEEDS

Waters and Wyatt offer more than 15 detectors for HPLC systems, providing the versatility needed to meet the needs of every laboratory.

INNOVATIVE TECHNOLOGY ENSURES RELIABILITY

Waters detectors feature innovative technologies that minimize baseline drift, detector-to-detector variability, and increase data reproducibility, collectively enhancing data accuracy and operational efficiency.

ADVANCED COMPOUND IDENTIFICATION FEATURES

Waters detectors combined with Empower Software offer advanced peak purity, spectral contrast, and library matching features, for sophisticated compound identification.

FULLY INTEGRATED WATERS AND WYATT SOLUTION

Single software control when coupling Wyatt detectors with Waters HPLC Systems provides a seamless workflow experience.

COMPLEMENTARY INFORMATION FROM MASS DETECTION

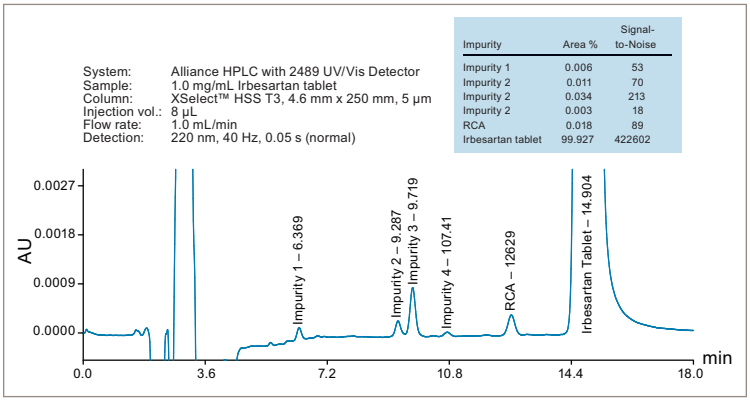
Waters mass detectors provide complementary information to optical detectors. The ACQUITY QDa™ II Mass Detector ensures confidence in your LC analysis by providing mass confirmation of all peaks in your separation.

WATERS AND WYATT HPLC DETECTORS

HPLC Detector Type	Waters and Wyatt HPLC Detector	Description	Type of Analytes	Destructive
Ultraviolet/Visible (UV/Vis) Detector	2489 UV/Vis Detector Arc Premier 2489 UV/Vis Detector	One of the most commonly used HPLC optical detectors due to its reliability and ease-of-use. A UV/Vis detector provide high sensitivity detection for compounds with chromophores, operating under single or dual wavelength modes. It is often used for quantitative analysis where the analytes of interest share the specific wavelength(s).	Analytes with chromophores that absorb UV/Vis light between 190 – 700 nm	No
Photodiode Array (PDA) Detector	2998 PDA Detector Arc Premier 2998 PDA Detector	A PDA detector captures absorbance across a range of wavelengths simultaneously. This allows for compound identification, quantification, and peak purity analysis, providing more detailed spectral information than a UV/Vis detector.	Analytes with chromophores that absorb UV/Vis light between 190 – 700 nm	No
Fluorescence (FLR) Detector	2475 FLR Detector Arc Premier 2475 FLR Detector	An FLR detector provides the highest sensitivity for quantification of fluorescent analytes at low concentrations and can be used for method development due to its spectral scanning capability. It is more sensitive and selective than a UV/Vis or PDA detector but not suitable for analytes lacking fluorescent properties. *Common uses: amino acids, aflatoxins, vitamins, polyaromatics*	Analytes that are naturally fluorescent or can be derivatized with a fluorescent tag	No
Refractive Index (RI) Detector	2414 RI Detector Optilab™ differential RI (dRI) Detector	An RI detector is often used to detect analytes with low or no chromophores. It is dependent on the fact that samples can change the refractive index of the solvent, thus it can detect any compound. The sensitivity is generally lower than other optical detectors because it is a universal bulk property detector. The Optilab also has the unique capability of measuring both absolute and differential RI. *Common uses: 2414 RI Detector - sugars, polymers, fatty acids Optilab dRI Detector – macromolecules*	Non-volatile analytes lacking chromophores	No
Evaporative Light Scattering (ELS) Detector	2424 ELS Detector	An ELS detector offers near-universal detection for non-volatile or semi-volatile compounds without UV/Vis absorption that do not ionize well for mass spectrometric detection. It is generally more sensitive than an RI detector and compatible with both isocratic and gradient separation. However, ELS detection is a destructive technique and does not work well when the sample volatility is similar to that of the mobile phase, and the ELS detector does not have a large linear range. *Common uses: triglycerides, lipids, natural products, sugars, oils*	Non-volatile or semi-volatile analytes, including those without chromophores	Yes
Electrochemical (EC) Detector	3465 EC Detector	An EC detector is versatile, allowing the analysis of electroactive compounds. It provides unique selectivity and high sensitivity because the detection is based on the oxidation-reduction properties of analytes. *Common uses: aminoglycosides, catecholamines, carbohydrates, phenols*	Electroactive compounds that can undergo oxidation or reduction reactions	No
Conductivity Detector	2432 Conductivity Detector	A conductivity detector is typically used for the quantification of ions and charged compounds in ion chromatography. It provides reliable detection for applications where ions are the primary analytes of interest, even at low concentrations. It is non-selective for individual ions, measuring the total ionic content, which can be advantageous for applications where overall ionic strength is relevant. *Common uses: organic acids, bases, salts*	Ions or charged compounds	No
Charged Aerosol Detector (CAD)	Charged Aerosol Detector	Featuring a wide dynamic range, Waters CAD is a sensitive, near-universal detector, enabling simultaneous quantitation of low-level, non-UV active compounds, and associated impurities and excipients – regardless of chemical structure - for confident, consistent results.	Non-volatile and semi-volatile analytes	Yes
Mass Detector	ACQUITY QDa II Mass Detector	The ACQUITY QDa II Mass Detector is designed to work in harmony with your chromatography system providing mass confirmation and identification. Built for ease of use, this modular detector can be operated by users with minimal mass spectrometry experience. This compact mass detector is more selective and sensitive than a UV/VIS detector and can be used in combination with other detectors to provide complimentary information in a single injection.	Volatile and semi-volatile ionizable analytes	Yes
	Single Quadrupole (SQ) Detector 2	A benchtop single quadrupole mass detector with a wide mass range, enabling uncompromised analysis of both low and high molecular weight compounds. It features automated system setup for non-expert users and supports various ionization techniques, making it suitable for a wide range of applications.		
Multi-Angle Light Scattering (MALS) Detector	DAWN, miniDAWN™ microDAWN™	MALS detectors provide precise characterization of the molar mass, size, and amounts of macromolecules and nanoparticles in solution. Widely used for characterizing proteins, nucleic acids, conjugates, polymers, nanoparticles, aggregates, and complex formulations of small molecules and macromolecules, with broad applications in biopharmaceutical analysis and polymer research. *Common uses: proteins, polymers, nanoparticles, nucleic acids*	Analytes with 200 Da - 1 GDa molar mass or 0.5 nm radius	No
Viscometer	ViscoStar™	A highly sensitive, on-line differential viscometer typically used in conjunction with a concentration detector such as the Optilab and a MALS detector to determine the intrinsic viscosity, size and conformation of all types of biopolymers, synthetic polymers and even proteins and peptides. *Common uses: polymers, carbohydrates, proteins, nanoparticles*	Biopolymers and synthetic polymers, including strongly fluorescent polymers and polymers with weak light scattering signals and low dn/dc values	No

SENSITIVITY AND SELECTIVITY

The 2489 UV/Visible (UV/Vis) and Arc Premier 2489 UV/Vis Detectors are ultraviolet/visible detectors that provide superior sensitivity and linear dynamic range, which are needed for the detection of the lowest-level impurities. The design for the most sensitive and versatile dual wavelength absorbance detectors combines a high energy Deuterium source, a precise optical design, and low noise, high speed electronics to ensure performance, reliability and usability.



The 2489 UV/Vis Detector provides excellent signal-to-noise response for methods which require low levels of sensitivity, as demonstrated by this example of Irbesartan and its related impurities.

2489 UV/Vis Detector Specifications

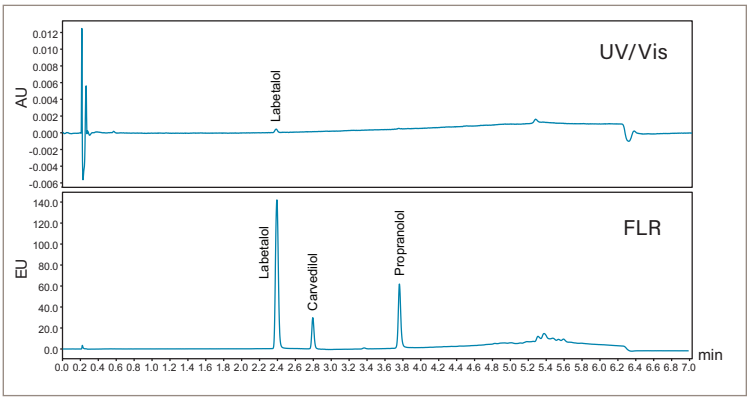
Arc Premier 2489 UV/Vis Detector Specifications

The 2475 Fluorescence (FLR) and Arc Premier 2475 FLR Detectors offer unsurpassed flexibility whether you are doing routine analysis or method development. They are the ideal tools for high sensitivity methods due to their low limits of repeatable quantification coupled with their high selectivity for analytes in complex matrices. Waters unique axially illuminated flow cell minimizes unwanted light scatter and dispersion compared to a traditional cubic flow cell. The 2475's unique calibration procedure for the photomultiplier tube and the ability to report detector signal in emission units (EU) help reduce the variability traditionally observed from detector to detector.

2475 FLR Detector Specifications

The complementary nature of our HPLC Detectors provides you with all the tools needed to ensure the right answers to your analysis.

Arc Premier 2475 Detector Specifications



The 2475 FLR Detector improves selectivity and sensitivity for analytes with low or no UV response, such as the beta blockers shown here, making the 2475 the perfect detector choice for analysis of the sample.

ENHANCED SAMPLE CHARACTERIZATION

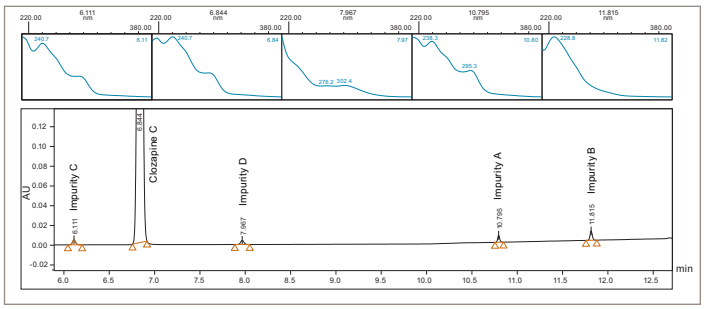
The 2998 Photodiode Array (PDA) and Arc Premier 2998 PDA Detectors uniquely integrate software and optics innovation to deliver no-compromise chromatographic and spectral sensitivity. The exceptional signal-to-noise ratios, high-sensitivity library matching, and high optical and digital resolution enable the 2998 PDA Detectors to map low level compounds, detecting and quantifying trace levels of impurities co-eluting within a chromatographic peak. Additionally, these detectors have a wide linear dynamic range that allows for simultaneous quantification of high- and low-level components within a single chromatographic separation.

2998 PDA Detector Specifications

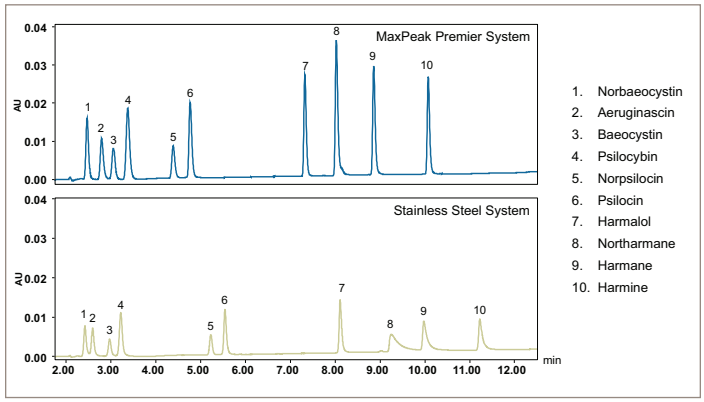
While most commercially available PDA detectors can only distinguish between compounds possessing relatively large spectral differences, Waters 2998 PDA Detectors can differentiate between the spectra of very closely related compounds. The spectral contrast analysis algorithm within the Empower software determines whether a chromatographic peak is comprised of a single component or is spectrally homogenous by comparing spectra from each data point across the entire peak against the reference spectrum at the apex. Changes in UV spectra across the peak indicate potential coelution with other components.

Arc Premier 2998 PDA Detector Specifications

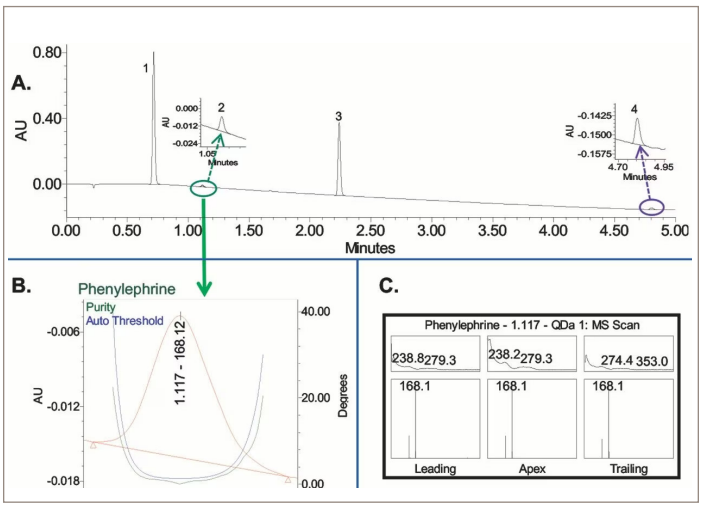
Ideal for routine analyses, the 2998 PDA Detectors are reliable, easy-to-use and have enhanced software control to provide flexibility for simultaneous 2D and 3D operation within Empower.



Spectral analysis algorithms can distinguish closely related compounds, as shown in this Clozapine and related impurities example, providing reliable library matching.



The Arc Premier System with 2998 PDA Detector provides substantial improvements in peak shape and sensitivity compared to the ACQUITY Arc System with 2998 PDA Detector in stainless steel hardware.



Use of the 2998 PDA Detector on Empower Software to determine the purity of the peak, complemented by mass information from the ACQUITY QDa Mass Detector. Chromatographic separation of Mucinex syrup (A). UV peak purity plot of the phenylephrine API (B). Empower Software Mass Analysis window with peak purity spectra for phenylephrine at the leading edge, apex, and trailing edge of the peak (C).

ARC PREMIER DETECTORS

The **Arc Premier 2489 UV/Vis, the Arc Premier 2475 FLR, and the Arc Premier 2998 PDA Detectors** are designed for Arc Premier LC Systems, which feature innovative MaxPeak High Performance Surfaces (HPS) Technology that effectively minimizes non-specific adsorption due to metal interactions. These detectors help ensure exceptional sensitivity and deliver clear, unambiguous results for even the most challenging analyses.

Arc Premier 2489
UV/Visible Detector

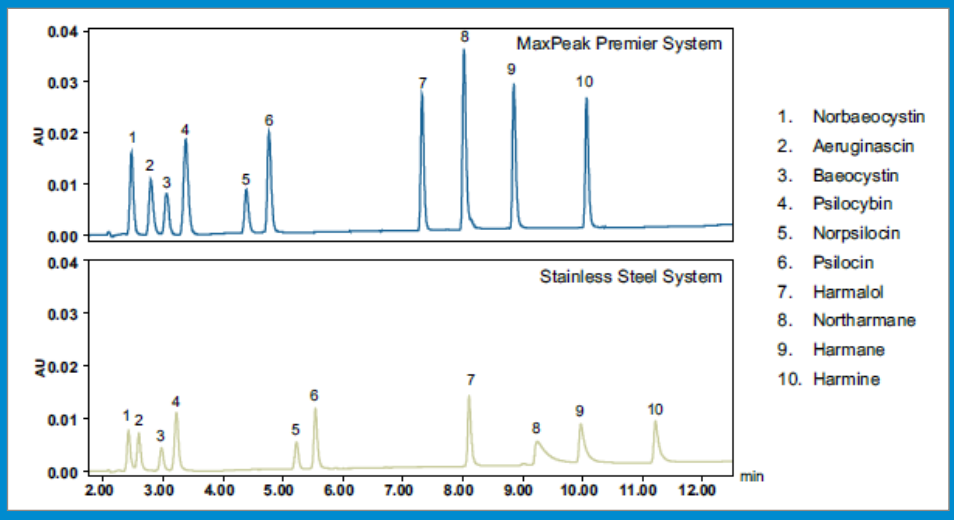
Arc Premier 2475
Fluorescence Detector

Arc Premier 2998
PDA Detector

Key Benefits:

- Improved analyte recovery
- Better peak shape
- Increased sensitivity
- Consistent reproducibility

Whitepaper:
MaxPeak Premier Solutions



The Arc Premier System with 2998 PDA Detector provides substantial improvements in peak shape and sensitivity compared to the ACQUITY Arc System with 2998 PDA Detector in stainless steel hardware.

COMPLEMENTARY MASS INFORMATION

Co-eluting components with no or low chromophore may not be identified through the peak purity tool. Complementary information, such as mass spectra from the ACQUITY QDa II Mass Detector or the SQ Detector 2, proves invaluable in the identification of unexpected co-eluting components, allowing for cross-verification and more confident identification.

The ACQUITY QDa II Mass Detector is purposefully designed for analytical scientists who need mass spectral data without the complexity of a mass spectrometer, to confirm compound identity and quantify compounds with no UV response or at levels not accessible by optical detection. Operating as intuitively as an optical detector, its simplicity not only streamlines the analytical process but also instills confidence in the certainty of your results during routine testing.

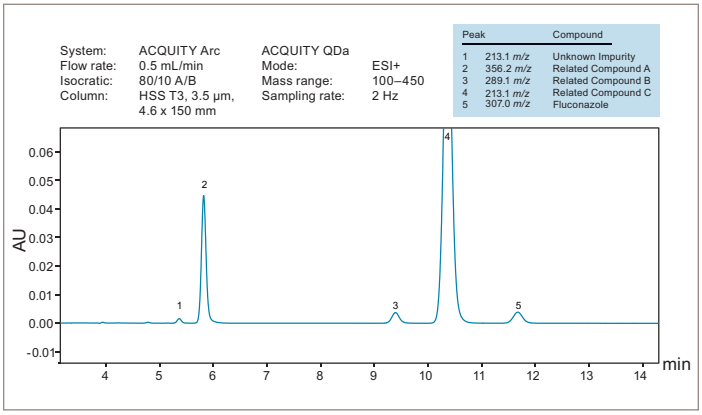
ACQUITY QDa II Instrument Capabilities

The SQ Detector 2 is a simple, robust, and versatile single quadrupole mass detector compatible with the broadest range of chromatography platforms and ionization modes covering the widest range of analytes. With a mass range of 3000 *m/z*, the SQ Detector 2 makes mass confirmation of large molecules easier.

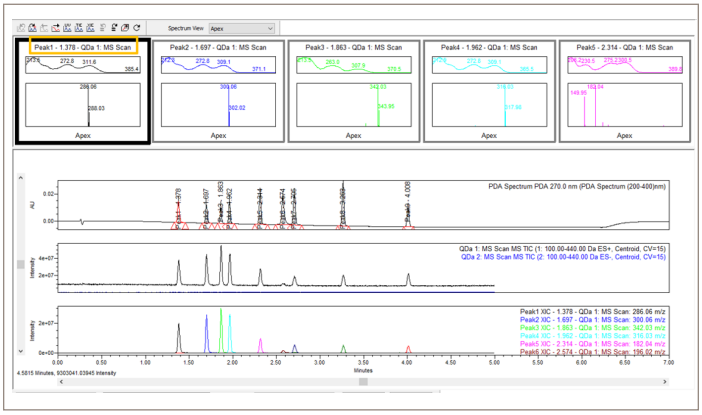
SQ Detector 2 Instrument Capabilities

The addition of a mass detector to your workflows provides information-rich mass spectral data to complement your current Waters UV/Vis, PDA, ELS, and Conductivity Detectors and give you a more complete separation.

	ACQUITY QDa II Mass Detector	SQ Detector 2
Mass Range	30-1500 *m/z*	2-3072 *m/z*
Scan Speed	12,500 Da/sec	15,000 Da/sec
Ionisation Mode	ESI	ESI, APCI, ESCi, ASAP
Size	Stackable	Bench top
Software	MassLynx/Empower	MassLynx/Empower
Compliance-Ready Solution	√	√



Use of the 2998 PDA Detector with the ACQUITY QDa Mass Detector allows for confidence in information about your sample, by providing mass confirmation of each peak, in example: Fluconazole USP Method.



Empower Software takes the Apex spectra (both UV and MS) from the retention times of the peaks in the UV chromatogram (Top). MS Scan data from 100-440 Da at ESI+ and ESI- modes (middle). MS extracted ion chromatograms at different m/z (bottom).

THE RIGHT TOOL FOR THE RIGHT JOB

Achieving accurate and reliable detection of analytes with poor or no chromophores demands the right detector. Waters and Wyatt offer solutions designed specifically for these challenging analytes, including the 2414 Refractive Index (RI) Detector, the 2424 Evaporative Light Scattering (ELS) Detector and the Charged Aerosol Detector (CAD). These detectors provide robust analysis for compounds that lack a UV/Vis response or are not easily ionized for mass detection, ensuring dependable results across a wide range of applications.

The 2414 RI Detector delivers high sensitivity, stability and reproducibility across a wide range of analyes. Waters innovative counter-current heat exchanger rapidly equilibrates temperature differences between the solvent stream entering and exiting the flow cell. This unique temperature control minimizes fluctuations in viscosity and refractive index, allowing for repeatable measurements even at lower concentrations. Its robust design ensures compatibility with diverse sample types and challenging analytical conditions.

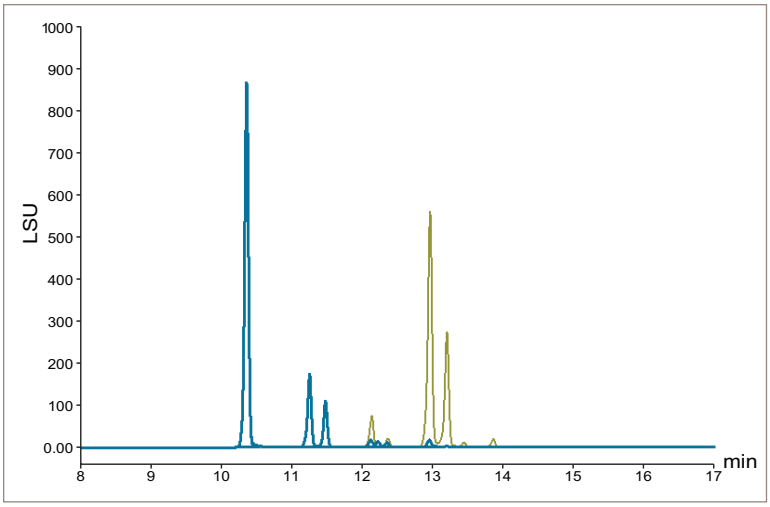
The balanced design of the 2424 ELS Detector delivers reproducible quantification for semi-volatile components without adding high dispersion to fast LC separations. It has been designed with active nebulizer heating and cooling, auto-optimize gain function and optional external column heater control to maximize your method performance. The detector's compatibility with gradient analysis allows for a wider separation range of your samples.

The Charged Aerosol Detector (CAD) provides near-universal, structure-independent detection with a dynamic range spanning more than four orders of magnitude, ideal for quantifying low-level, non-UV active compounds such as excipients, lipids, sugars and polymers. Purpose-built for Empower Software and Waters chromatography systems, the CAD facilitates seamless method transfer from existing charged aerosol solutions, reducing revalidation risks and productivity loss. Designed for usability, it features tool-free maintenance, automated flow diversion on error, and enhanced leak detection, making it the most accessible and supportable CAD solution for LC applications.

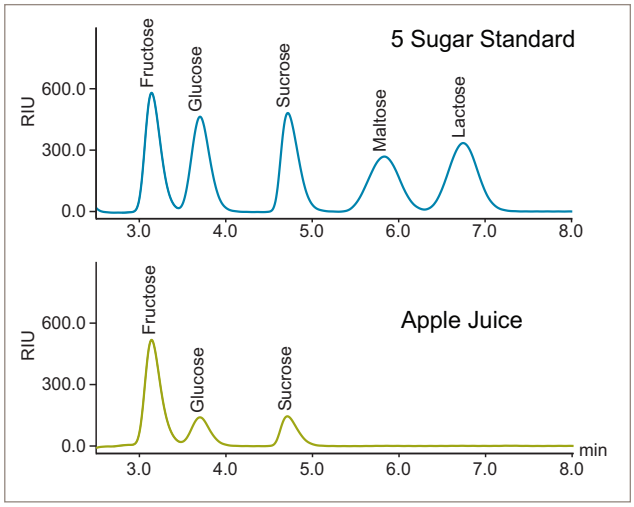
2414 RI Detector Specifications

2424 ELS Detector Specifications

Charged Aerosol Detector Specifications



The gradient analysis of triglycerides in edible oils using the 2424 ELS Detector, showing safflower oil (blue) and olive oil (green) overlaid on the same chromatogram.



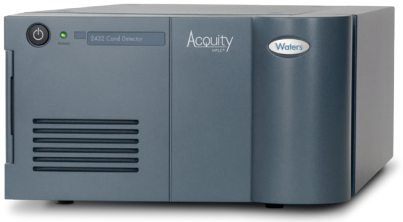
Of the five recognized food sugars (fructose, glucose, sucrose, maltose, and lactose), the first three are the most important in fruit juice analysis. These sugars are quickly and easily analyzed using an XBridge™ Amide XP Column on the Alliance HPLC System with the 2414 RI Detector.

FOR YOUR MOST CHALLENGING SEPARATIONS

The 3465 Electrochemical (EC) Detector offers sensitivity for ultra-trace analysis, reliability, and simplicity for superior electrochemical detection. It is available in two configurations: one that supports a single flow cell and another that accommodates up to two flow cells, each independently controlled. The detector is compatible with three types of flow cell and provides a wide selection of working and reference electrodes, all within a temperature-controlled environment. It supports multiple detection modes, including direct current, pulsed amperometric and scanning, delivering a fully automated, reliable electrochemical system with detection sensitivity suitable for a broad variety of application needs.

3465 EC Detector Specification

The 2432 Conductivity Detector features exceptional sensitivity and stability for single-column or suppressor-based ion chromatography. The 2432 cell design diminishes apparent void volume disturbances for more reliable peak quantitation. With the combination of the 2432 Conductivity Detector's temperature control and autozero capabilities you can be assured of maintained baseline stability during your analysis.



2432 Conductibility Detector Specifications

TRUSTED TOOLS FOR MACROMOLECULAR ANALYSIS

Wyatt Technology is a pioneer in commercial light scattering instruments that incorporate lasers as a light source, specializing in detectors commonly used to analyze the properties of novel therapeutics, including nano-drug carriers, vaccines, biopolymers, and proteins, as well as synthetic polymers and nanoparticles.

The Optilab differential Refractive Index (dRI) Detector provides excellent sensitivity, a wide dynamic range, and low detection limits for a variety of macromolecular characterization techniques, including HPLC and size exclusion chromatography (SEC) with MALS. It features precise temperature control, which effectively minimizes baseline drift and improves stability. Uniquely, the Optilab measures the absolute refractive index of a solution, setting it apart from conventional detectors. In addition, it can measure the dn/dc of a solvent at the same wavelength as the light scattering instrument, and its replaceable light source supports measurements at various wavelengths. The Optilab dRI is widely used for accurate concentration measurements of proteins, polymers, peptides, oligonucleotides and other macromolecules, making it a valuable addition to any MALS setups.

Optilab dRI Detector Specifications

The DAWN, miniDAWN, and microDAWN Multi-Angle Light Scattering (MALS) Detectors provide accurate determination of molar mass, size, conformation, and conjugation of peptides, proteins, nucleic acids, polymers, vesicles, and nanoparticles, without the need for column calibration. These detectors enable non-destructive, in-solution measurement without solvent or buffer limitations, making them ideal for aggregation studies. Each of these detectors is designed for different molar mass range and column dimensions, allowing you to achieve optimal results.

DAWN, miniDAWN, and microDAWN Detectors Specifications

The ViscoStar is an on-line differential viscometer designed with multiple novel technologies to provide highly sensitive measurement of intrinsic viscosity (IV) of macromolecules such as biopolymers and synthetic polymers, and even proteins and peptides. When coupled with size-exclusion chromatography, an RI or UV concentration detector and a MALS detector, it enables comprehensive characterization of hydrodynamic radius, conformation, and branching ratio of a macromolecule in solution.

ViscoStar Detector Specification

Wyatt's dRI Detector, MALS Detectors and Viscometer are digitally integrated with the Arc HPLC and Arc Premier Systems, which are controlled by the ASTRA™ software through HPLC CONNECT™. This integration provides a seamless experience for controlling Waters HPLC systems, importing digital UV signals, managing fraction collectors, and monitoring the HPLC status, all directly from within the ASTRA platform.

LC SYSTEMS AND SOFTWARE COMPATIBILITY

Detector	HPLC System				Software		
	Arc Premier	ACQUITY Arc	Arc HPLC	Alliance HPLC	Empower	MassLynx	HPLC CONNECT with ASTRA
2489 UV/Vis		√	√	√	√	√	√*
Arc Premier 2489 UV/Vis	√				√	√	√*
2475 FLR		√	√	√	√	√	√*^
Arc Premier 2475 FLR	√				√	√	√*^
2998 PDA		√	√	√	√	√	√*
Arc Premier 2998 PDA	√				√	√	√*
2414 RI	√	√	√	√	√	√	√*
Optilab dRI	√	Contact closure	√	Contact closure			√*
2424 ELS	√	√	√	√	√	√	
3465 EC	√	√	√	√	√		
2432 Conductivity	√	√	√	√	√	√	
Charged Aerosol	√	√	√	√	√	√	
ACQUITY QDa II Mass Detector	√	√	√	√	√	√	
SQD2	√	√	√	√	√	√	
DAWN, miniDAWN, and microDAWN	√	Contact closure	√	Contact closure			√*
ViscoStar	√	Contact closure	√	Contact closure			√*

√ Full (2-way) software compatibility
**When connected with the Arc Premier or Arc HPLC Systems in ASTRA*
^Data can be acquired but not processed in ASTRA

waters.com/Detectors

For your local sales office, please visit
waters.com/contact

Waters Corporation
34 Maple Street
Milford, MA 01757 U.S.A.
T: 1 508 478 2000
F: 1 508 872 1990
waters.com

Waters™

Waters, Wyatt, Empower, MassLynx, Alliance, ACQUITY, UPLC, XBridge, Arc, ASTRA, HPLC CONNECT, DAWN, miniDAWN, microDAWN, MaxPeak, XSelect, OptiLab, ViscoStar, and QDa are trademarks of Waters Technologies Corporation. All other trademarks are the property of their respective owners.

©2025 Waters Corporation. November 25-14700 720005629EN REV. B