



UV-visible spectroscopy solutions

for pharmaceutical analysis



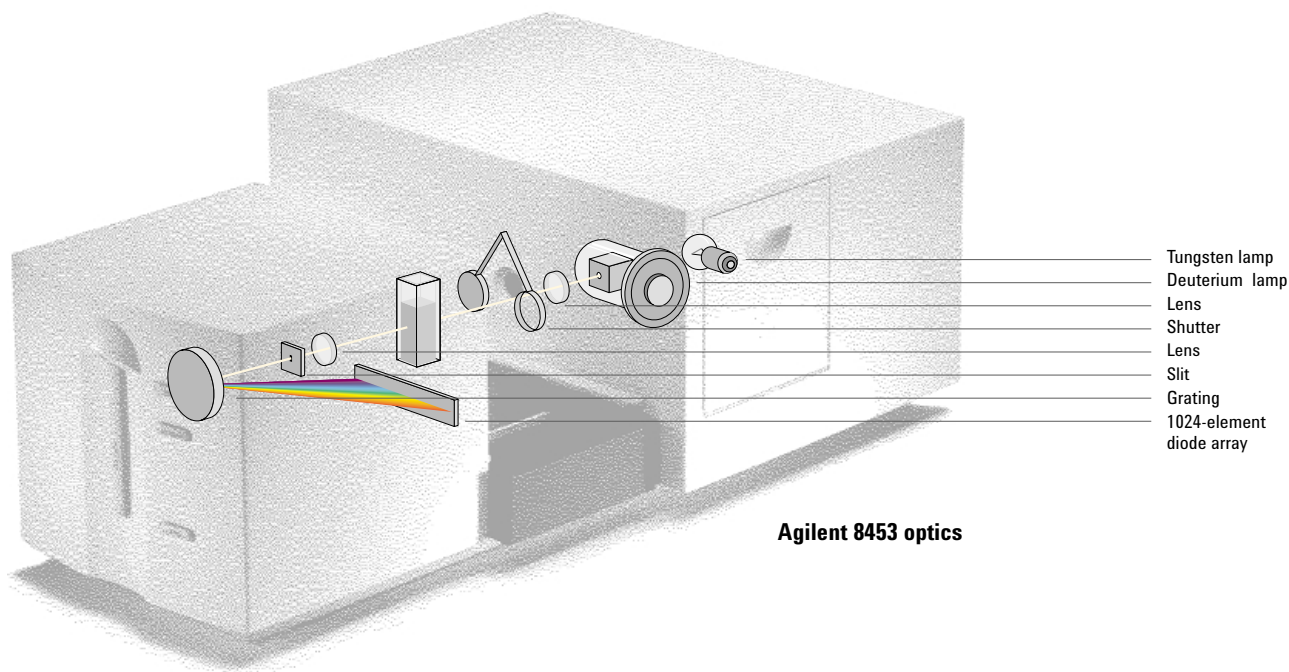
Agilent 8453 UV-visible spectrophotometer

Our measure is your success.



Agilent's UV-visible systems

UV-visible spectroscopy solutions that satisfy the diverse needs of analysts in routine QA/QC, research, and method development laboratories.



The Agilent 8453 UV-visible spectrophotometer offers the latest in diode-array technology:

- Small footprint to save bench space
- Prealigned deuterium and tungsten lamp light sources for trouble-free maintenance
- Built-in buttons to measure sample, standard, and blank for convenient measurements even when wearing gloves
- Thermally stable ceramic spectrograph for a wide operating temperature range
- Communication through GPIB or LAN for dedicated or networked PC control
- Firmware upgrade from PC for easy participation in future developments
- Built-in GPIO interface for control of accessories
- Compliance with all requirements of the European Pharmacopoeia (EP) and United States Pharmacopoeia (USP)

Good Laboratory Practice

The Agilent 8453 supports compliance with GLP regulations:

- Serial and firmware revision number held in firmware
- Own clock for time and date stamps of the spectra
- Extensive self-test procedures that check the electronics and key optical characteristics to ensure consistent performance between validation
- Built-in electronic logbooks, which contain the results of self-tests, notes in instrument maintenance, events and errors

Optical performance

The Agilent 8453 offers the advantages of a diode array plus significant improvements in optical performance:

- 190–1100 nm wavelength range
- 1 nm slit width
- < 0.03 % stray light

The diode-array advantages

Backed by over two decades of experience in the development and manufacture of diode-array spectrophotometers, the Agilent 8453 gives you clear advantages.

- Fast spectral scanning for complete spectral information useful for:
 - proof of identity and purity of the sample
 - additional information for “out of specification test result” investigation in a regulated environment
 - re-evaluation with different method
 - multi-wavelength applications such as user-defined equations
 - multicomponent analysis of mixtures
- Open sample area for convenient sample handling
- High throughput optics guarantees excellent signal-to-noise for high sensitivity
- Virtually absolute wavelength resettability allows selection of optimum wavelength and use of electronic standards
- Exceptional ruggedness and reliability

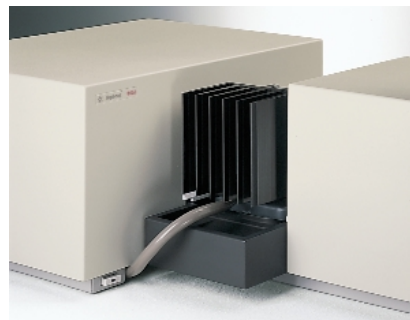
Sipper operation is easy with built-in measurement buttons



Side door for easy lamp change



Open sample area means large accessories are easy to use – here the Peltier cell holder



Specifications – Agilent 8453 UV-Visible spectrophotometer

Optical performance

Wavelength range	190–1100 nm	
Slit width	1 nm	
EP resolution test	> 1.6	toluene in hexane, ratio abs. at 269 nm/266 nm
Stray light	< 0.03 %	at 340 nm (NaNO ₂ , ASTM)
	< 0.05 %	at 220 nm (NaI, ASTM)
	< 1 %	at 198 nm (KCl, EP)
Wavelength accuracy	< ± 0.5 nm	0.5-second scan (NIST 2034)
	< ± 0.2 nm	at 486.0 and 656.1 nm
Wavelength reproducibility	< ± 0.02 nm	ten consecutive scans (NIST 2034)
Photometric accuracy	< ± 0.005 A	at 440.0, 465.0, 546.1, 590.0, and 635.0 nm, 1 A (NIST 930e)
	< ± 0.01 A	at 235, 257, 313, 350, 430 nm, (potassium dichromate, EP method)
Photometric noise	< 0.0002 A	sixty 0.5 second scans at 0 A, 500 nm, rms
Photometric stability	< 0.001 A/h	at 0 A, 340 nm, after 1-hour warm up, measured over 1 hour, every 5 seconds, constant ambient temp.
Baseline flatness	< 0.001 A	0.5-second blank, 0.5-second scan, rms
Typical scan time	1.5 second	full range
Shortest scan time	0.1 second	full range
Time until next scan	0.1 second	full range, 0.1-second scan, up to 150 consecutive scans

Physical dimensions

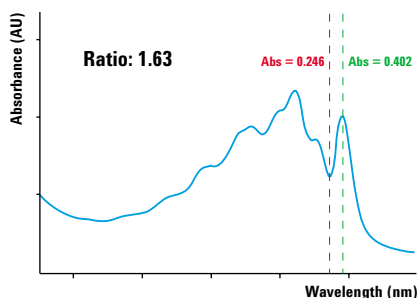
Height x width x depth	185 x 344 x 560 mm (7.3 x 13.5 x 22.0 inches)
Weight	16.5 kg (36.3 lb)

Power requirements

Line voltage	90–264 V AC
Line frequency	47–63 Hz
Power consumption	70 VA typical

Environmental conditions

Operating temperature	0–50 °C (32–122 °F)
Non-operating temperature	–40–70 °C (–4–158 °F)
Humidity	< 95 %, at 25–40 °C (77–104 °F)



Spectrum of a 0.02 % v/v solution of toluene in hexane

Good Laboratory Practice

Easy compliance to GLP for increased productivity

Agilent Technologies and GLP

Agilent plays a leading role in defining the GLP-related responsibilities of manufacturers and users. And, Agilent implements features in its products that enable users to comply with GLP regulations quickly, reliably, and productively.

Standards kit

OQ/PV is made even easier using Agilent standards kit, which meets the needs of both the United States and European Pharmacopoeias. The kit comprises standard solutions in snap-open glass ampules which are inexpensive, easy-to-use and traceable. The standards let you check for photometric accuracy, wavelength accuracy, stray light and resolution.



Validation begins with the manufacturer ...

Agilent designs and develops products according to documented procedures. Each product is validated before it leaves the factory. The Declaration of Conformity document is your assurance that the spectrophotometer meets specifications. The Declaration of System Validation describes procedures used in software and system development and is your assurance of software quality.

... and continues on site

All you need for Installation Qualification (IQ) and Operational Qualification/Performance Verification (OQ/PV) is provided for both the spectrophotometer and system software. Full documentation is included and, where appropriate, procedures are supported by software to save time. IQ and OQ/PV can be performed by the user or are available as services from Agilent.

Electronic records and signatures

The Agilent UV-visible ChemStation software in combination with Windows and the optional Security Pack can be configured to support the requirements for electronic records and signatures for a closed system as defined in FDA 21 CFR part 11. Tools and products for system installation and operational qualification also complete this solution.

Access Control

Two levels of permissions are defined and managed by the system administrator as user groups within Windows. All access control features of Windows can be applied such as password aging, uniqueness or account lock. The Agilent UV-visible ChemStation login is based on these user groups and checks the permission rights of the users. For example, at the manager level, you can develop, modify and save methods, at the operator level you only can load and run these methods but cannot save new methods or change existing ones. In the absence of the user, the running system can be locked for unattended operation.

Method integrity

The software saves all method parameters (meta data) in a single, checksum-protected binary file including method history. Existing method files cannot be overwritten.

Data integrity

Agilent systems measure and save full spectra, even if your current method only uses a single wavelength. Data is automatically annotated with date, time, instrument identifier, operator name, and sample information added by the user. Result files include all information to reprocess the results such as raw data, the complete method as well as logbooks on the run. Even in the case of the operator having deleted a spectrum from the set of spectra, the deleted spectrum and the operators comment are saved with the result file and are available for review.

Data security

The protection of electronic records is one of the most important aspects of data security. The Agilent UV-visible ChemStation software saves data in checksum-protected binary files. In combination with Windows file system permission settings, Agilent ChemStation operators can not modify, rename, delete or move any of the data or method files.

Audit trail

The run logbook is automatically generated by the Agilent UV-visible ChemStation and is part of the result file. It contains information such as, who and when the spectra were measured, saved, reprocessed, the calibration modified or method parameters changed.

Electronic signatures

Users can sign result files electronically with their user ID and password. The purpose of the signature as well as the user name, date and time are stored in the signature logbook that is integrated in the individual result file.

Agilent 8453 Instrument Performance Verification Setup

Instrument serial number: DE82702137

1. Wavelength Accuracy and Reproducibility

☒ Holmium oxide Setup ...

☐ Deuterium lamp emission lines

2. Photometric Accuracy

☒ Neutral density filter (NST 930E) Setup ...

☐ Potassium dichromate Setup ...

☐ Potassium dichromate (430 nm) Setup ...

3. Stray Light

☒ KCl solution at 198nm

☐ NaI solution at 228nm

☐ NaIO₂ solution at 340nm

4. Resolution

☒ Toluene in hexane

5. Noise

☒ No filter required

6. Baseline Flatness

☒ No filter required

7. Absorbance Stability (1 hour test)

☐ No filter required

OK Cancel Help

**Choose the test
you need**



**Agilent traceable
standards kits for
UV-visible instrument
operational
qualification (OQ)
and performance
verification (PV)
and optional OQ/PV
hardware kit saving
time and supporting
OQ/PV procedures.**

Solutions for general purpose tasks

Easy to learn and easy to use for increased productivity

Easy to use

The Agilent 8453 UV-visible spectroscopy system may well be the easiest UV-visible system you will ever use. Three steps are all you need to get results.

Graphical user interface

Usability tests performed with actual users in their own labs initiated a completely new approach to user interface design. The Agilent 8453 UV-visible spectroscopy system uses symbolic graphics to:

- make the system intuitive, easy to learn, and easy to use,
- provide confirmation of current status at a glance,
- provide visual confirmation of actions,
- provide fast access to frequently performed activities.

Automation

A single dialog box makes setup for automated analyses easy and quick. You can use automation to guide an operator through a series of manual measurements, or combine it with sampling accessories to provide semi- or fully automated analysis. The automation function controls

- the Agilent sipper system
- the Agilent XY autosampler
- the Agilent multicell transport

The optional control samples allow you to run an automatic system suitability test before quantitative analyses.

Compatibility

The Agilent UV-visible ChemStation uses the Microsoft® Windows environment so you can run other programs, such as word processors and spreadsheets, at the same time, and transfer data using copy-and-paste.

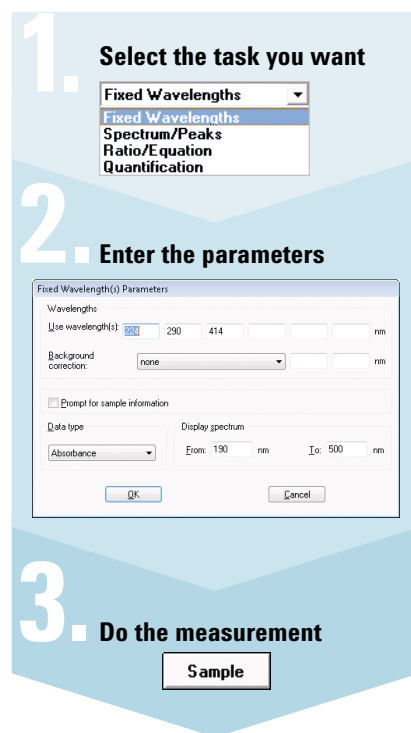
Clear and simple reports

Generating reports could not be easier. Simply click the printer icon in the toolbar and a standard report is printed. When possible this standard report is printed on a single sheet of paper. The report format depends upon the task in use but all reports include essential GLP information such as method and data file name, date, time, operator, overlay of sample spectra and result table.

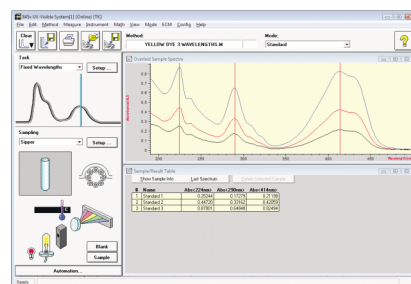
Productivity

The Agilent 8453 system is a highly productive UV-visible spectroscopy system. Its combination of ease of learning, ease of use, fast spectral acquisition, fast data evaluation, report generation, and automation lets you get results fast – even if you only use the system occasionally.

Add diagnostic tools such as performance verification, system documentation, and the extreme reliability of the system and you will spend the minimum time with administration or maintenance and repair.



Your results are automatically displayed



You may print a report



Solutions for biochemical analysis

Key biochemical applications in a single, easy-to-use system

Ease of use

The biochemical analysis software builds on the Agilent 8453 UV-visible spectroscopy system. It provides the additional tasks that the biochemist needs and uses the same easy-to-use graphical user interface. Preprogrammed methods for protein and nucleic acid analysis help you get up and running fast.

Proteins and nucleic acids

Standard methods are provided for the qualitative and quantitative analysis of nucleic acids and proteins:

- 260/280 nm ratios (with optional reference at 320 nm) for nucleic acid purity
- Warburg-Christian calculation of concentration of nucleic acid or protein in mixtures
- Biuret, Lowry, Modified Lowry, Bradford, Bicinchoninic acid, and Trinitrobenzene sulfonate protein quantification methods

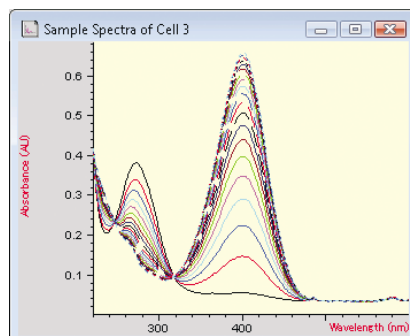
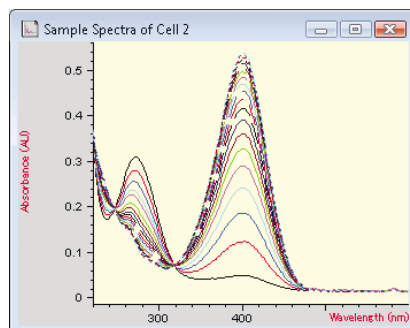
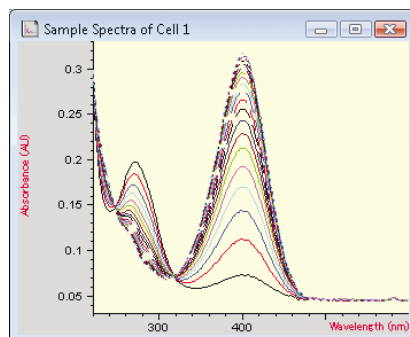
Microsampling

A frequent problem for the biochemist is the small sample volume available for analysis. With the Agilent 8453 spectrophotometer you can use microcells requiring as little as 15 μL of sample for qualitative and precise quantitative analysis.

Multicell kinetics

For productivity with enzyme kinetic measurements the optional eight-position multicell transport can be used. You can freely configure which positions contain samples and blanks and you can select to subtract the rate of one cell from the others.

You can evaluate kinetic rates at a single wavelength or subtract a reference wavelength. Rate calculation methods include initial rate, zero order, first order, and delta absorbance. For a single cell you can also display and calculate rates at up to six individual wavelengths.



Full spectra are always acquired, even in multicell kinetics, so you can reevaluate results at leisure

Solutions for research and development

The power and flexibility to develop the optimum method and solve the toughest problems

Powerful data analysis

The advanced software provides unprecedented interactive and programmable data analysis capability:

- 21 mathematical functions for processing spectra that you can combine in any sequence
- Flexible use of any number of single or multiple wavelengths, or average a range of values
- Evaluation using user-entered equations, single-component or multi-component analysis
- Up to four different types of data analysis performed on one set of data in parallel
- Comparison of data evaluation results using different analysis parameters
- Use confirmation analysis with quantitative methods to check the identity and purity of samples, and to detect if measurements are being made outside the linear range of the analysis

Enterprise content management

Agilent OpenLAB enterprise content manager (ECM) facilitates creation of a knowledge base of UV-visible ChemStation methods and data across larger entities based on web services.

Method development tools

Four special utilities are provided to assist the user in developing the best parameters for quantitative analysis:

- Evaluate Standards for linearity – performs a single component calibration at each wavelength over a user-specified wavelength. It determines the correlation coefficient and uncertainty at each wavelength.
- Compare Calibrations – puts the results from two independent calibrations side by side on the screen for comparison.
- Optimize Wavelength for selectivity and accuracy – quantifies a user-selected sample at all wavelengths and plots the quantification results against wavelength.
- Test Method for precision – calculates the average and standard deviation of multiple analyses of an identical sample.

Multicomponent analysis

Multicomponent UV-visible analysis can provide a real alternative to time-consuming separations. Fast electronic scanning, spectral curve fitting of standards to unknowns, excellent wavelength reproducibility, and maximum-likelihood statistics make sure that results are superior to those obtained with conventional mechanical-scanning spectrophotometers. Calibration is simple and fast using pure standards or mixtures of standards. Statistics for the fit of the standards to the sample spectra give you confidence in your results.

Customization

Virtually every aspect of the system can be customized through macro programming.

A series of predefined reports are available in the software. However, to fulfill specific needs, the user can define their own customized reports based on the predefined reports or user defined template.

Electronic records and signatures

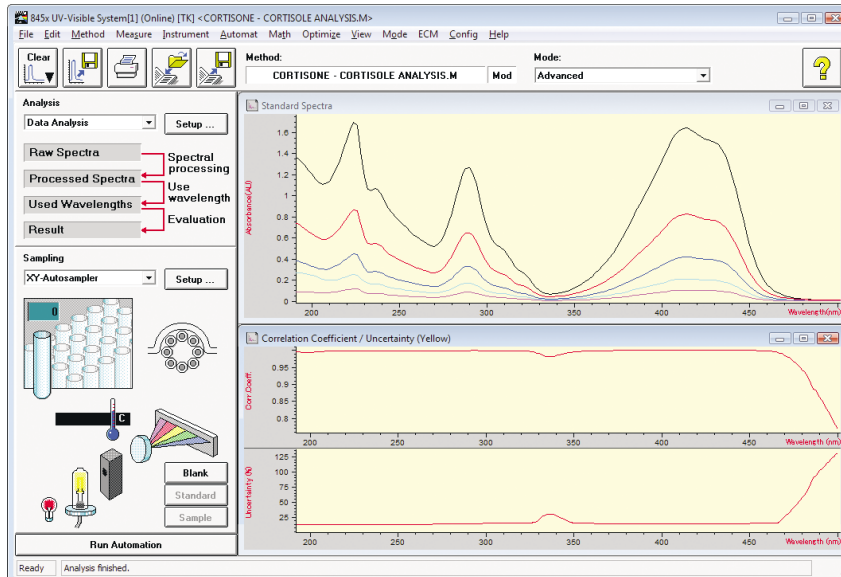
The advanced mode can be combined with the security pack to support 21 CFR part 11.

Advanced automation

With the advanced automation capability you can perform fully automatically complex measurement, data evaluation, and report generation sequences using single or multiple methods for different types of samples. It can also be used to guide an operator through a complex sequence of manual measurement operations. Complex methods or automation processes that you develop on the advanced system can be transferred to and executed on the general purpose system.



Multi-component analysis with diagnostic tools that show the quality of the results



The Optimize Standards function shows the wavelengths that give the best calibration

Solutions for dissolution testing

The most flexible and adaptable system for formulation development and routine testing

Ease of use

The dissolution testing software builds on the Agilent UV-visible ChemStation platform. It provides the additional tasks that are required for automated sampling, data evaluation and reporting, and applies the same easy-to-use pictorial user interface. All parameters necessary to perform a dissolution test are stored in a single method file. Methods include procedures that guide the operator through the specified tasks.

Real-time display

During the dissolution test you get full overview of the system and bath status and the progress of the dissolution process. The graphical profile display shows in real-time the progress in all vessels. A numeric display shows you the actual values for each vessel at the measurement time as well as the average and statistics. A spectral window always shows all spectra of the last cycle.

Integration of third-party equipment

The open architecture of the third-party interface allows integration of baths through Dynamic Data Exchange (DDE). Major bath manufacturers provide the necessary drivers to allow control and monitoring of the baths through Agilent UV-visible ChemStation. Data acquired from the baths become part of the common result file and can be integrated in the final report.

Calculations and reports

Dissolution results are calculated in real-time and reported based on different options. The software can compensate for volume changes caused, for example, by pH change, sampling or evaporation. This volume change function can be used to allow processing of dissolution data from the flow-through and "Biodiss" apparatuses (USP 3, 4). A variety of report templates for different purposes are provided, including all GLP relevant information. Report templates for method reports, calibration reports and dissolution test results are also available. To adapt the report to your specific needs the report layouter can be used to create custom report templates.

Good Laboratory Practice

The dissolution testing software features specific tools for dissolution testing to help to comply with GLP regulations such as user defined pre- and post-dissolution sequences:

- Users can load only those methods for which they have permission
- Flow rate check of pump
- Transfer of bath parameters to the bath
- Wash cycle to clean the tubing
- Remeasure standard
- Measure control for a system suitability test
- Medium test

Standards and samples are measured and stored in the result file as spectra that are useful for positive sample identification and for a purity check. In the rare case of something going wrong, the availability of all sample spectra is also very useful and can shorten an investigation dramatically. All method parameters (meta data) as well as different logbooks are also stored in the result file for complete documentation and reprocessing capabilities based on a single source. In addition, all features are available which are built in the verification and diagnostic software.

Enterprise content management

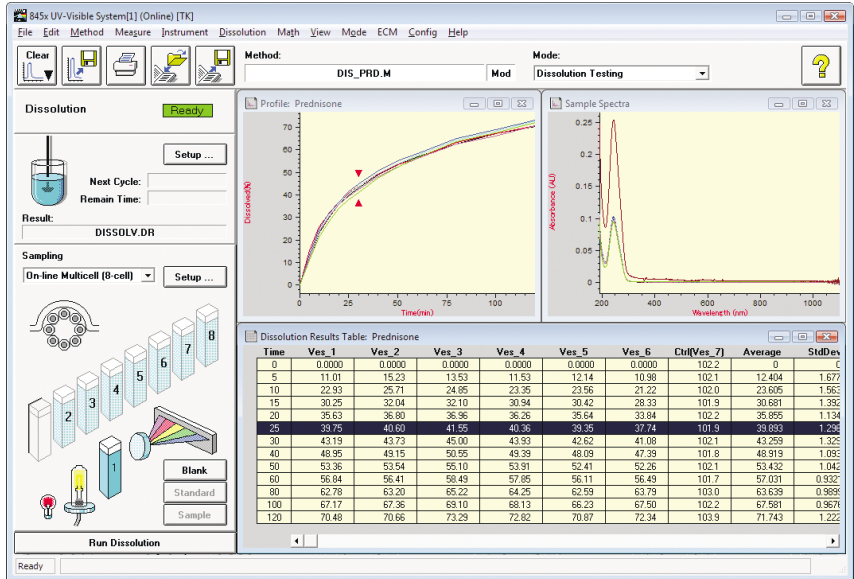
Agilent OpenLAB enterprise content manager (ECM) facilitates creation of a knowledge base of UV-visible ChemStation methods and data across larger entities based on web services.

Electronic records and signatures

The dissolution testing mode can be combined with the security pack to support 21 CFR part 11.

Offline dissolution testing

In offline dissolution testing the samples are collected independently from the analytical system. These samples are measured by the Agilent 8453 UV-visible dissolution testing system using standard cells or, for more convenience, with a sipper. In both cases the operator is prompted for the specific sample. For unattended operation an autosampler can be used. In all cases the sampling for blank, sample and control, is user-definable.



The run-time display shows profiles, actual values and the last spectra as well as the status of instrument at a glance

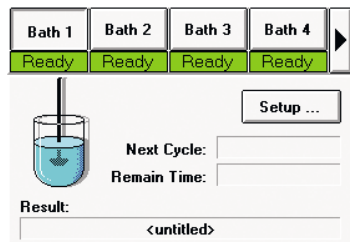
Dissolution Run Method Parameters

PreRun Seq | Dissolution Run | PostRun Seq

#	Action	Parameters
1	Wash Cycle	Duration: 30 sec
2	Flow Rate Test	Duration: 1 min
3	Measure Blank	Channel: 1
4	Medium Test	Limit: +/- 0.01 AU
5	ReMeasure Standard	Channel: 1, Replace
6	Measure Control	Channel: 1

OK Cancel Help

The user-defined sequence guides the operator through the tasks done before a dissolution run



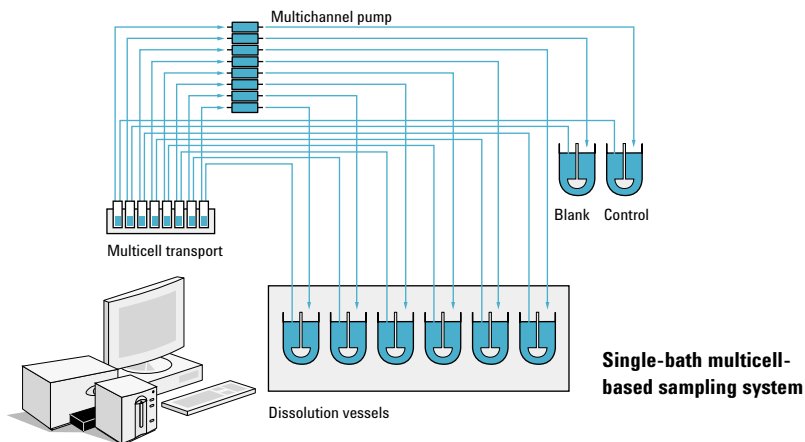
High-throughput QA/QC dissolution testing on up to four baths simultaneously

Online sampling systems

Automated systems with up to four dissolution baths

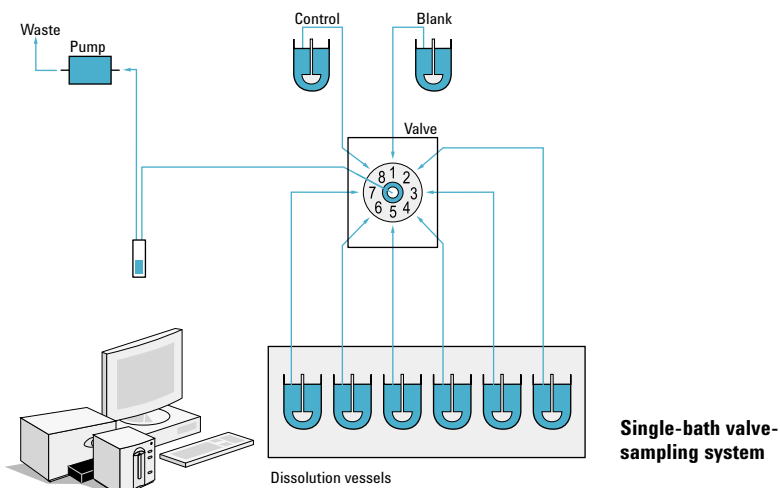
Multicell-based sampling system

The multicell system is the most commonly used sampling system with single bath testing. It uses a multicell transport with eight flow cells, one for the blank, up to six for the individual vessels and one for a control, and a multi-channel pump to sample all vessels simultaneously. A minimum cycle time of two minutes is possible. The dissolution medium is recycled so that there is no change in medium volume during the test. This system is the most versatile one and ideally suited for low volume QA testing as well as formulation development.



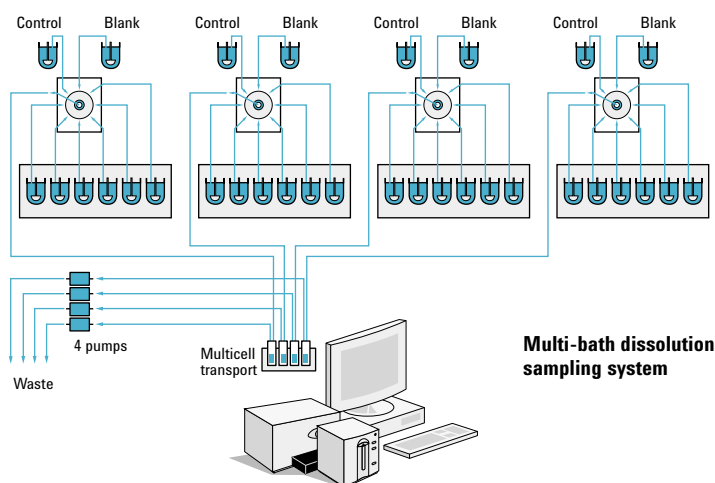
Valve-based sampling system

The valve-based system is the most cost-effective solution. It uses an eight-port valve to switch between blank, control and the six dissolution vessels, and has a single channel to transfer the sample. Because the sampling is sequential, the minimum cycle time is five minutes. At each sampling cycle a small volume (about 4 mL) of dissolution medium is lost but the software can correct for this loss during calculation of the results.



Multi-bath sampling for increased productivity

When you have large numbers of samples to analyze the Agilent 8453 dissolution testing system in combination with the valve-based, multi-bath sampling system gives you the highest productivity. The system can measure a blank, six vessels and a control in up to four baths all within five minutes. On each of the baths an individual method can be used. The methods and features are identical as with the single-bath, valve-based system.



Solutions for pharmaceutical analysis

At a glance

Selection of software modules

Adapt the 8453 spectroscopy system to your needs by adding different software modules to the general-purpose software. One or more modules can be added to at the same time to support different applications. Agilent OpenLAB ECM allows you to manage data and methods across large entities.

If you work in a regulated environment, add the security pack software for help with compliance to 21 CFR part 11. Please note that either the ECM module or Security pack can be installed on a UV-visible system.

Increasing productivity

The ChemStation software allows control of different sampling systems to increase throughput. A common feature of the general purpose, advanced and dissolution software is that the predefined methods work with different sampling systems – without changing parameters.

Therefore, a method developed for manual sampling can easily be used with a sipper or autosampler, depending on the actual demand.

Selecting the dissolution sampling system

For offline dissolution testing, you can add a sipper or autosampler for increased productivity. For online dissolution testing, two kinds of sampling systems are available, parallel sampling using a multicell transport or sequential sampling using a valve.

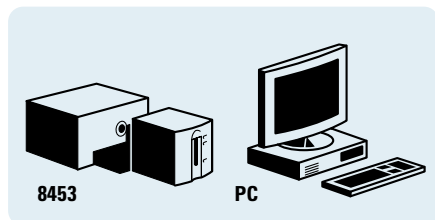
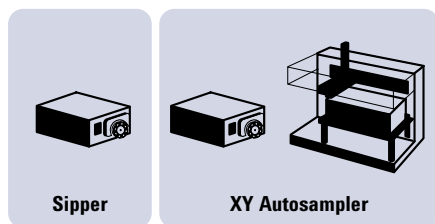
Select the valve system if:

- Upgrade to a multibath system is planned
- Only one flow cell should be used
- Staggered tablet drop is not a problem
- Budgets are tight

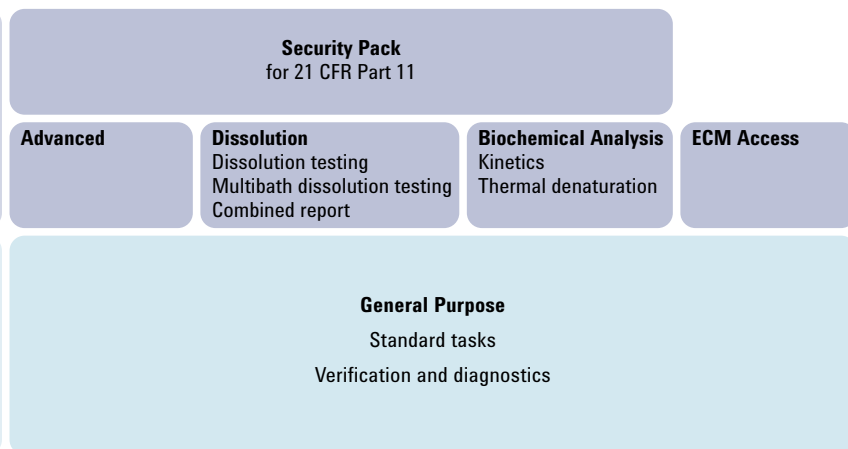
Select the multicell-based system, if

- A closed loop system is required
- Minimum cycle times must be achieved
- Parallel sampling is required for automated tablet drop or basket methods

Sampling systems



Add-on software modules



8453 spectroscopy system with general purpose UV-visible ChemStation software

Accessories

Cell holders

Agilent Technologies offers a range of single cell holders, providing you with the ability to analyze a wide variety of samples. Unless otherwise stated the holders accept cells with path lengths up to 10 mm.

Standard cell holder: Ensures quick and precise cell positioning for each measurement. Supplied standard with all Agilent spectrophotometers.

Thermostatable cell holder: When connected to a circulating-water bath, ensures constant sample temperature for temperature-sensitive analyses. An optional accessory provides water-driven stirring with magnetic stirring bar for 10-mm cells.

Long-path length cell holder: Holds rectangular and cylindrical cells with path lengths up to 100 mm.

Multicell transport

The multicell transport provides a significant increase in productivity when you need to do simple, repetitive measurements on a small number of samples, or when you want to follow changes in several samples (for example, enzyme kinetic studies). The multicell transport features:

- Full control through software
- Eight cell positions (for example, one blank and seven samples)

- Random access to all positions
- Water-thermostatable using external water bath, 5–90 °C temperature range and ± 0.3 degrees temperature difference between any two cells at 37 °C
- Less than 1 second to move between adjacent cells
- ± 0.1 mm position repeatability
- Optional water-driven magnetic stirring module

Sipper system

For repetitive measurement of liquid samples a sipper system improves productivity and eliminates errors caused by manual cell handling. The Agilent sipper system comprises a peristaltic pump and a quartz flow cell:

- Full control through software
- Variable pump, delay, and return time
- Flow cell with 10 mm path length, 3 mm diameter, and 80 μ L volume
- Constant-speed peristaltic pump with Tygon pump tubing
- Minimum sample volume of approximately 1 mL
- Typical sampling time of 20 seconds

Peltier thermostatted cell holder

Use the Peltier controller and cell holder when you require precise or variable temperature control:

- Built-in magnetic stirrer
- Heat exchanger for sample pre-heating when using sipper system
- Fully controlled through software and GPIB interface
- External sensor for precise sample temperature (optional)
- Typical range of 10–100 °C (–10 to +80 degrees relative to ambient) without need for water cooling
- Accuracy of ± 0.2 degrees at 20–40 °C, ± 0.3 degrees at 0–20 °C and 40–60 °C, ± 0.5 degrees at 60–100 °C
- Reproducibility of ± 0.1 degrees at 0–60 °C, ± 0.2 degrees at > 60 °C
- Stirring speed of 40–1000 rpm



Cell holders



Multicell transport



Peltier thermostatted cell holder

Autosampler

Combine an XY autosampler with a sipper system and you can measure large numbers of samples fully automatically in unattended mode. The XY autosampler features:

- Full control through software
- Capacity of up to 240 samples
- Wash station for optional rinsing between samples
- 10–13-mm diameter sample tubes with maximum height of 100 mm
- Typical transit time (adjacent samples) of approximately 6 seconds (including raising and lowering probe)
- Typical time per sample of 25 seconds (including sipper operation time)
- Minimum sample volume of 2 mL.

Cells

Agilent Technologies offers a range of quartz cells for standard and flow-through operation including:

- Regular rectangular cells with path lengths of 1, 2, and 10 mm
- Cylindrical cell with 100-mm path length
- Stopped cells to protect your sample from air and ideal for use with the external sensor of the Peltier temperature controller

- Flow cells of different designs with screw fittings and path lengths of 0.1, 0.2, 0.5, 1, 2, 5 and 10 mm
- Semi-micro and micro cells with path lengths of 2 and 10 mm for minimum sample volumes of 15 and 60 μL respectively

Third-party accessories

A wide range of accessories, designed for or compatible with Agilent spectrophotometers are available:

- **Custom Sensors & Technology** fiber optics coupler, fibers and sampling devices
- **DBS** Peltier devices for single cell and multicell transport
- **Gilson** autosamplers that are controlled directly from the Agilent UV-visible ChemStation software
- **Labsphere** diffuse reflectance accessories
- **Applied Photophysics** stopped-flow accessory for fast kinetics
- **Hi-Tech** stopped-flow accessory for fast kinetics
- **Distek** dissolution baths

Agilent support

Agilent has support centers in 85 countries supplying a wide range of support products that can be tailored to your needs.

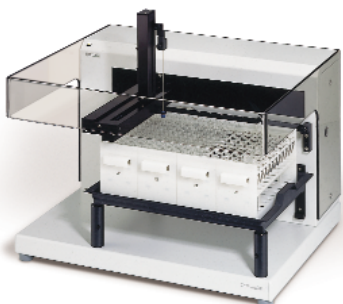
For example, the Agilent network of Analytical Response Centers provides direct access to support professionals who help you resolve operational difficulties, and offer assistance and advice on running Agilent chemical analysis software. They also help you to solve analytical problems, to keep your equipment up to date, and to maintain GLP standards.

All of us at Agilent are here to help you meet your pharmaceutical analysis goals, not just now but also long into the future.

Ask your Agilent representative for more details or see the Agilent Columns and Supplies Catalog. www.agilent.com/chem/supplies



Sipper system



Autosampler



Cells

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agilent_inquiries@agilent.com

Europe

info_agilent@agilent.com

Asia Pacific

adinquiry_aplsca@agilent.com

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