

# **Overview of Consumables for Atomic and Molecular Spectroscopy**

From Insight to Outcome

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# Overview: Our large SPSD Portfolio



7800 ICP-MS



7900 ICP-MS



8900 ICP-MSQQQ



4210 MP-AES



55 AA & 240/280 AA



5110 ICP-OES



4100 ExoScan,  
4200 Flex Scan  
Handheld FTIR



Cary 630 FTIR



Cary Eclipse Fluorescence



Cary 100/300 UV-Vis



Cary 60 UV-Vis



4300 TopScan



Cary 610/620 FTIR Microscopy Imaging



8454 DAD UV-Vis



Cary 7000 UMS



Cary 4000/5000/6000i UV-Vis NIR



4500 Portable FTIR

5500 Compact  
in Lab FTIR



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# Consumables Required by Instrument Type

	Flame AA	GFAA	MP-AES	ICP-OES	ICP-MS
<b>Source Lamps</b>					
Hollow cathode lamps	●	●			
Deuterium lamp (background corrector)	●	●			
<b>Sample Atomizer Components</b>					
Burners/torches	●		●	●	●
Graphite tubes, electrodes and shrouds		●			
Quartz atomization cells (VGA)	●				
<b>Sample Introduction Components</b>					
Nebulizers/spray chambers	●		●	●	●
Capillaries, peristaltic pump tubing, etc.	●	●	●	●	●
Autosampler vials, racks and probes	●	●	●	●	●
<b>Other Supplies</b>					
Interface cones and ion lenses					●
Vacuum system supplies					●
<b>Chemical Standards</b>					
Calibration standards	●	●	●	●	●
Ionization suppressant and matrix modifiers	●	●	●	●	●
Tuning/wavelength calibration solutions			●	●	●



# Summary – Key Consumables for AA

## All instruments:

- HC lamps
- **AA and ICP/MS standard solutions**

## Flame AA systems:

- Glass impact beads, burner cleaning strips, nebulizer components, capillary tubing, burners etc
- Ionization suppressant / buffer solutions
- With the SIPS dilution system – SIPS pump tubing and transfer tubing
- With an autosampler - sample tubes, racks, probes and transfer tubing

## Graphite furnace AA systems:

- Graphite tubes, guaranteed performance and all batch tested
- Sample vials, dispensing capillary and syringe for autosampler
- Matrix modifiers

## Vapor generation AA systems:

- Quartz atomization cells
- Peristaltic pump tubing
- Connecting tubing

# Exclusive OneNeb Inert Nebulizer

- Robust PFA and PEEK construction
  - Inert - resistant to strong acids such as HF & organics
  - Resistant to breakage
- Moulded plastic design provides improved nebulizer to nebulizer reproducibility
- Constant diameter narrow bore tubing through to nebulizer tip
  - Ideal for high solids/particulates
  - Improved tolerance to high TDS samples
- Narrow aerosol size distribution provides improved precision
- Compatible with a wide flow range from 0.1 to 2 mL/min.
  - No sensitivity loss at low flow rates
- Not self aspirating – must be pumped



# Summary – Key Consumables for MP-AES

## Sample preparation/presentation:

- Spray chambers
- Nebulizers, **Exclusive OneNeb**
- Peristaltic pump tubing
- Drain tubing
- Torches
- MP-AES standard solutions
- Ionization suppressant / buffer solutions

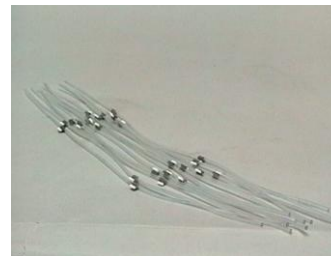


## Autosampling:

- Sample tubes, racks, probes and transfer tubing

## Miscellaneous Spares:

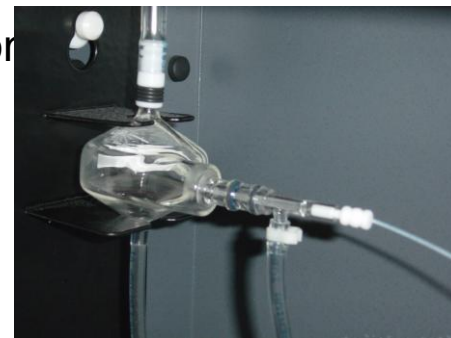
- Pre-optics window
- On-board argon bottle
- Replacement argon bottle and air filters (for instrument and nitrogen generator)



# Summary – Key Consumables for ICP-OES

## Sample preparation/presentation:

- Spray chambers
- Nebulizers, **Exclusive OneNeb**
- Peristaltic pump tubing
- Transfer and drain tubing
- Torches
- Application kits (adapt your instrument to a new application)
- ICP standard solutions
- Ionization suppressant / buffer solutions

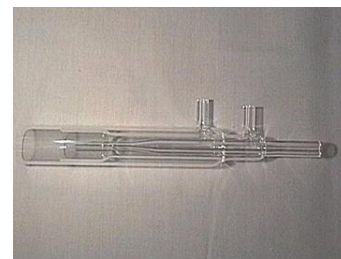
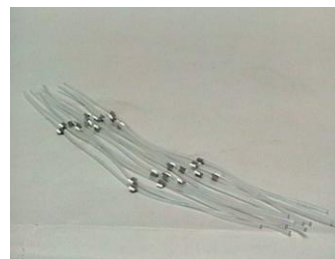


## Autosampling:

- Sample tubes, racks, probes and transfer tubing

## Vapor generation systems:

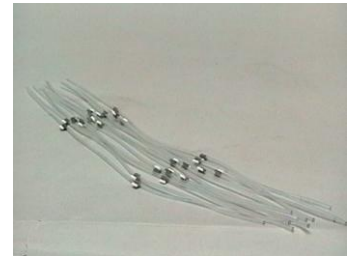
- Peristaltic pump tubing
- Connecting tubing



# Summary – Key Consumables for ICP-MS

## Sample preparation/presentation:

- Spray chambers
- Nebulizers
- Peristaltic pump tubing
- Transfer and drain tubing
- Torches
- ICP-MS standard solutions
- Internal Standard solutions



## Ion Extraction:

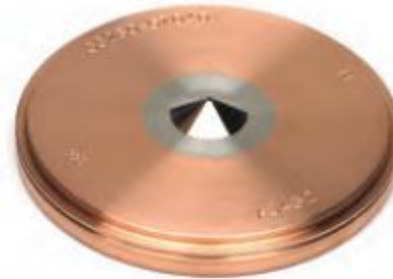
- Sampler and skimmer cones

## Autosampling:

- Sample tubes, racks, probes and transfer

## ISIS:

- Peristaltic pump tubing, ferrules & fittings





# Types of Hollow Cathode (HC) Lamps Available

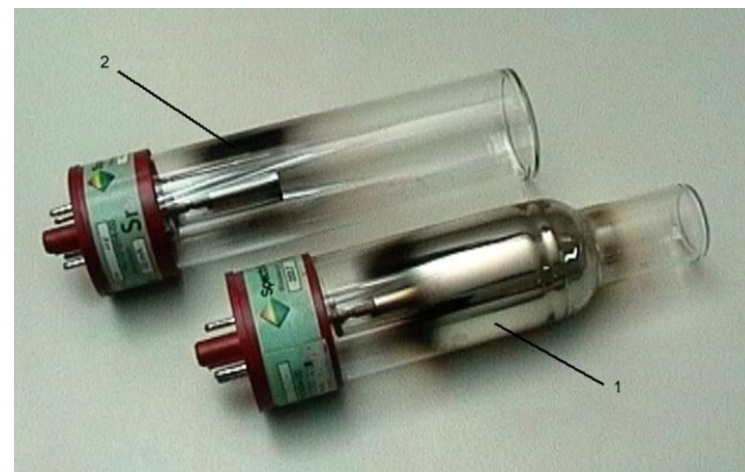
Single and multi-element lamps

Coded lamps

- Lamps for each element have “unique” codes built in
- Instrument software uses this code to automatically identify the lamp  
Reduces operator errors
- Compatible with Agilent/Varian and Thermo instruments  
(coding not recognised on other makes)

Uncoded lamps

- Simplest lamp type available
- Has no coding at all
- Compatible with most instruments **EXCEPT Perkin Elmer and Shimadzu** using Self Reversal Correction



High intensity UltrAA lamps

- Unique lamp design **exclusive to Agilent/Varian** instruments
- Produces higher emission intensity and lower noise

# Why Should PE Users Choose Agilent Supplies?



AGILENT SPECTROSCOPY  
SUPPLIES & SERVICES ARE  
**THE BEST CHOICE**  
FOR PERKINELMER SYSTEMS



Supports your instrument choice

Can help to achieve the best possible performance and productivity

Guaranteed to be compatible

- Fully qualified on genuine PE systems
- Backed by our Stand Behind Warranty
- Users can be confident the parts will not cause failure or downtime
- Agilent's best-in-class technical support team ready to assist

It's a comprehensive portfolio of supplies, services and expertise

For users working with PerkinElmer  
AA / ICP-OES / ICP-MS systems



# PE Instrument Platforms Supported

Oldest = Less Support

AAAnalyst 200/400/600/800



Optima 2x00/5x00 Series



Elan 6000/9000/DRC Series



AS-90 Series autosampler



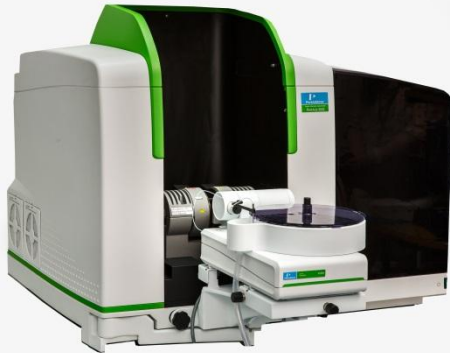
FIAS/FIMS-100/400



Optima 7x00 Series



PinAAcle 900 Series



Optima 8x00 Series



NexION 300/350 Series



Atomic Absorption

ICP-OES

ICP-MS

Current = Most Support



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# Introducing the OneNeb Series 2 for PE Optima

- New, updated version of the inert OneNeb universal Nebulizer
  - Features a user replaceable capillary
  - ETFE body for improved robustness
  - Different quick release gas connector
  - Sample capillary has a thicker wall
    - Reduces kinking
    - Less chance of damage when connecting the peristaltic pump tubing
  - Supplied with connectors to enable easy connection to the PE Optima ICP-OES
  - Retains all the other performance features and benefits of the “original” OneNeb

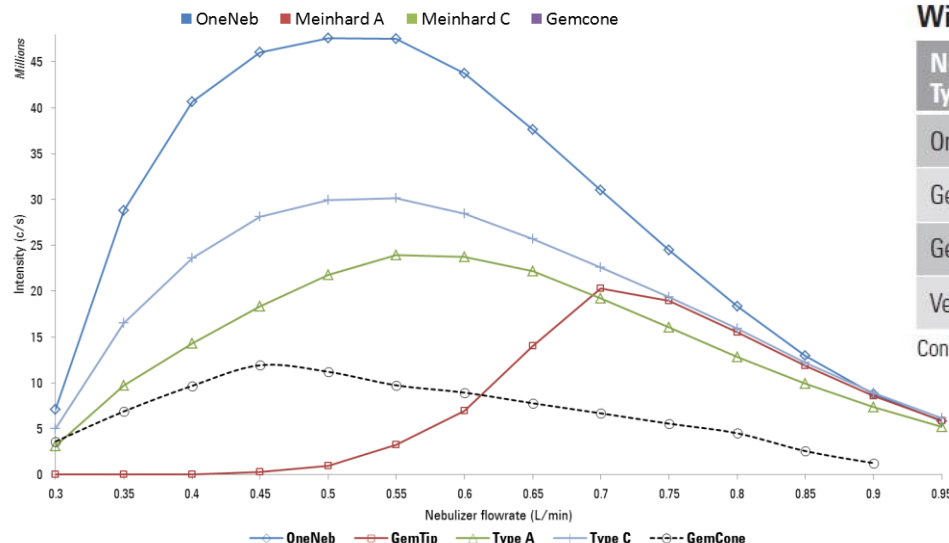
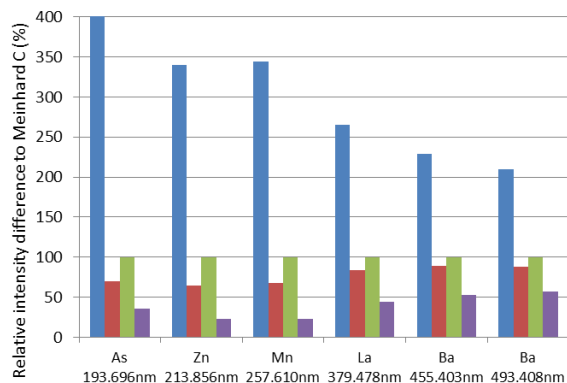


# Performance of OneNeb Nebulizer with PE Optima

Increased sensitivity. Reach lower detection limits. Less rework. Improved productivity

## Sensitivity comparison

Sensitivity test in Axial view - 2% HNO<sub>3</sub> matrix  
(Relative to Meinhard C)



## Detection limit comparison

### With Axial View

Nebulizer Type	Tl 190.800 (nm)	As 193.696 (nm)	Se 196.026 (nm)	Pb 220.353 (nm)
OneNeb	4.3	1.4	5.7	2.8
GemCone	14.4	14.3	25.4	7.7
GemTip	14.0	13.8	22.3	4.5
VeeSpray	9.8	19.6	21.2	3.2

Concentrations in µg/L

### With Radial View

Nebulizer Type	Mn 257.610 (nm)	La 379.478 (nm)	Ba 455.403 (nm)	Zn 213.856 (nm)
OneNeb	0.6	1.8	0.2	1.6
GemCone	0.9	5.5	0.6	7.5
GemTip	0.8	2.7	0.2	6.2
VeeSpray	1.3	4.7	0.4	4.2

Concentrations in µg/L



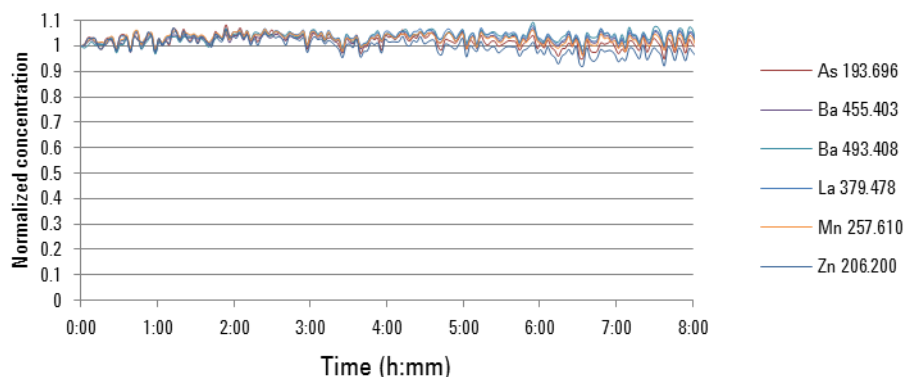
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# Long Term Stability of OneNeb with PE Optima

Able to withstand the most difficult samples. Less frequent replacing. Reduced downtime

Demonstrates performance of the nebulizer during prolonged analysis with high dissolved solids samples.  
For samples with high TDS and/or suspended solids PE recommends their GemCone nebulizer

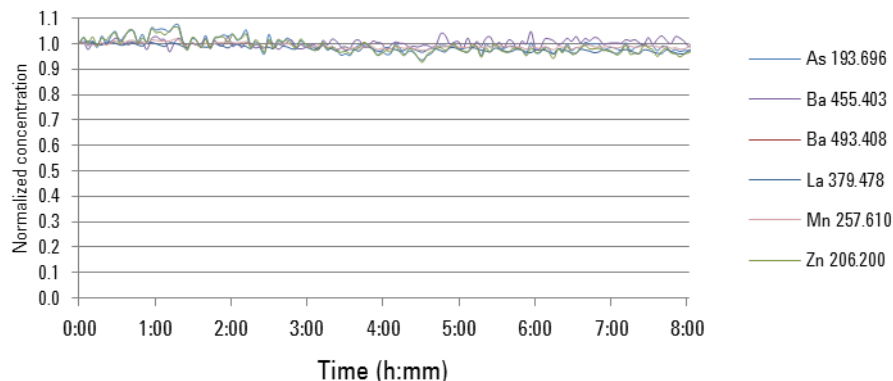
**PE's GemCone long-term Stability**  
(5%NaCl / 2% HNO<sub>3</sub>)



**PE Optima 7300**

Plasma/aux flow	15/1 L/min
Neb flow	0.55L/min
Sample flow	1.5mL/min
Tubing	blk-blk (sample)
Spray chamber	Glass DPSC
Sample matrix	5% NaCl /2% HNO <sub>3</sub>
Rinse time	120s (@ 0.8mL/min)
Replicates	5 x (1-5s)
Internal Std	Y 5mg/L

**Agilent's OneNeb Long-term stability**  
(5%NaCl/2%HNO<sub>3</sub>)



**PE Optima 7300**

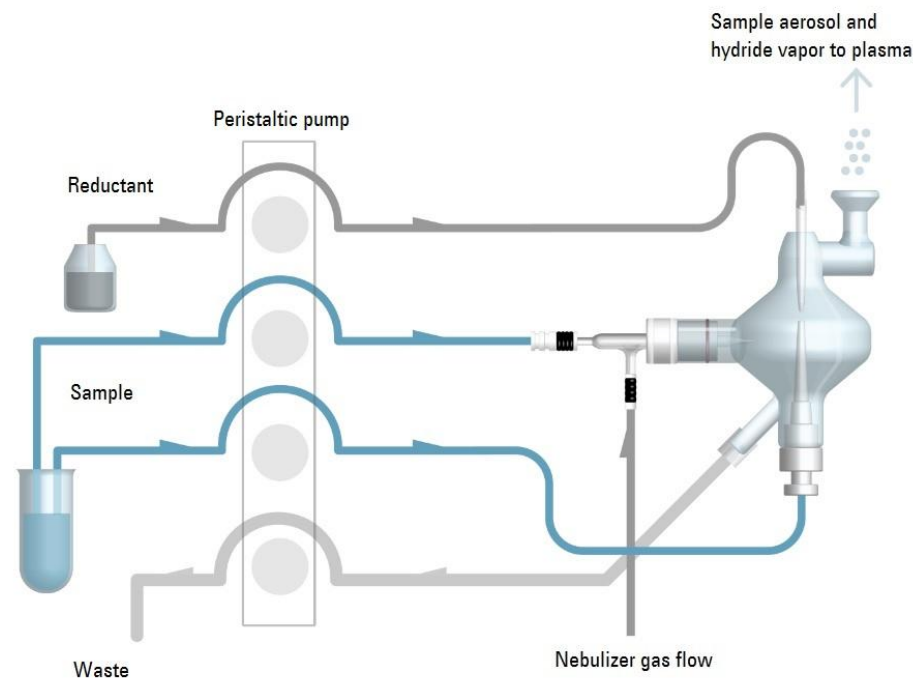
Plasma/aux flow	15/1 L/min
Neb flow	0.20L/min
Sample flow	1.5mL/min
Tubing	blk-blk (sample)
Spray chamber	Glass DPSC
Sample matrix	5% NaCl /2% HNO <sub>3</sub>
Rinse time	120s (@0.8mL/min)
Replicates	5 x (1-5s)
Internal Std	Y 5mg/L





# What's the MSIS?

- A unique spray chamber design for ICP-OES
  - Provides better sensitivity for elements determined using hydride generation e.g. As, Se and Hg
  - Improves detection limit performance for these relatively insensitive elements
  - Provides capability to nebulize a liquid sample and measure volatile hydrides simultaneously
  - Can also be used in 3 modes
  - Eliminates manual change-over to conventional hydride analysis
  - Enables simultaneous determination of routine and hydride elements using the same setup
  - May eliminate the need for a dedicated hydride generation system
  - Exclusive to Agilent!



# Performance of MSIS with PE Optima

One system for analysis of even the most difficult elements.  
 Prep and run your entire analysis on one system.  
 Eliminates the need for multiple systems & batch testing of As, Hg, Se and others  
 Improved productivity and cost/ labor savings

Element/Wavelength (nm)	Measured with glass concentric nebulizer in nebulization mode	Measured with glass concentric nebulizer in simultaneous mode
Al 394.401		5.0
As 193.696	11.0	1.5* ←
Ca 317.933		2.6
Cd 226.502		0.4
Co 230.786		0.8
Cr 267.716		0.6
Cu 327.393		1.4
Fe 259.939		0.4
Hg 194.168	1.3	0.2* ←
Li 670.784		0.04
Mg 280.271		0.3
Mn 257.610		0.05
Mo 204.597		2.4
Ni 231.604		1.4
Pb 220.353		3.3
Se 196.026	12.0	0.5* ←
V 292.402		0.9
Zn 213.857		0.4

\*Measured using hydride determination  
 Concentrations in µg/L



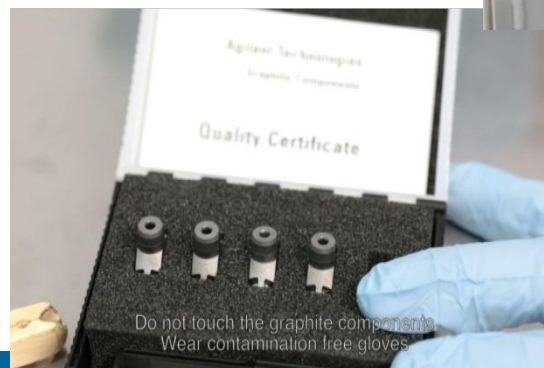
Detection limit performance for other analytes  
 measured in conventional nebulization mode unaffected



# Instructional Videos to Support PE Users

7 instructional videos will be available at launch:

1. Torch maintenance & set-up on PE Optima ICP-OES
2. Sample introduction maintenance & set-up on PE Optima ICP-OES
3. Maintenance of windows/filters on PE Optima ICP-OES
4. Graphite tube replacement & furnace set-up on PE THGA/HGA Graphite Furnace AA systems
5. Sample introduction maintenance & set-up on PE NexION ICP-MS
6. Interface cone maintenance & set-up on PE NexION ICP-MS
7. Maintenance of the water chiller



# Agilent Molecular Spectroscopy Portfolio



## Routine UV-Vis

Cary 60

8454



## Mid Range UV-Vis

Cary 100

Cary 300



## Fluorescence

Cary Eclipse



## High Perf. UV-Vis-NIR

Cary 4000

Cary 5000

Cary 6000i

Cary 7000 UMS



## High Perf. FTIR and Imaging

Cary 610

Cary 620

Cary 660

Cary 670

Cary 680



## Routine FTIR

5500

Cary 630



## Portable FTIR

4500

4100 Exoscan

4200 Flex Scan

4300 Handheld

# Consumables Required by Instrument Type

	Routine UV/Vis	High Perf. UV/Vis	Fluor. Systems	Portable FTIR FTIR	High Perf.
Sample Measurement Components					
Cuvettes	●	●	●		
Cell/Sample holders	●	●	●	●	●
Sipper pump tubing & joining tubing	●	●	●		●
Well or micro plates			●		
Source Lamps					
Deuterium lamp	●	●			●
Visible (QH) lamp	●	●			●
Other source lamps	●		●	●	●
Certification Standards					
OQ/PQ standards	●	●	●		●

# Agilent Commonly Used Consumables

## UV Cuvettes:

- Cell holders
- Fibre optic probes

## Source Lamps:

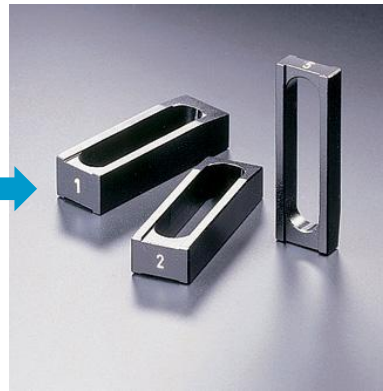
- Deuterium lamps
  - Visible lamps
  - Xenon lamps
  - Other source lamps
- 
- Standards & reference materials



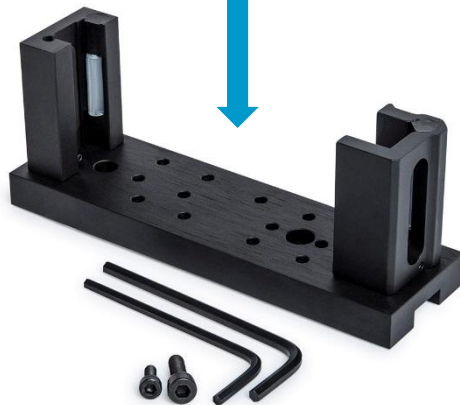
# Rectangular Cells

## Most common type of cell used

- Can be open (with PTFE lid) or stoppered
- Usually standard 10mm pathlength
  - Smaller pathlengths available
  - May require a spacer to be used
  - Long pathlength versions also available
    - Does require a special cell holder



Disposable cells  
(polystyrene)



# Micro Cells

Used for limited sample volume or for high absorbance samples

## Semi micro cells

- Smaller volume due to reduced internal
- Should have black walls to reduce stray
- Sized to fit a standard cell holder



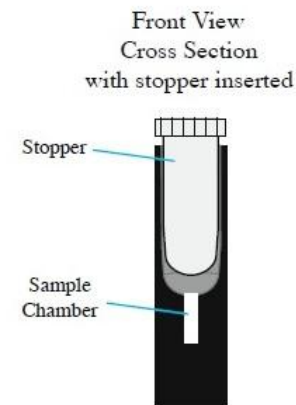
## Ultra micro cells

- Specially designed for use with small uL volumes
- Sample usually held in a small chamber
- Should have black walls to reduce stray light
- Sized to fit a standard cell holder

### Caution!

Instrument used influences cell compatibility

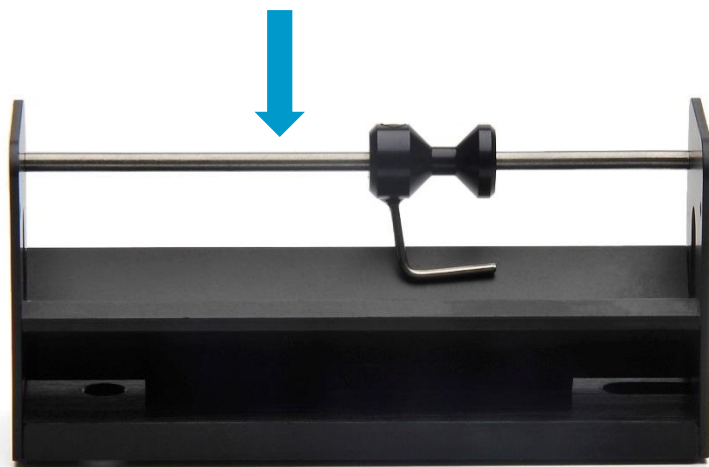
e.g. Cary 50/60 has smaller beam size and higher light throughput – can be used with smallest volume cells  
min. 5uL, 10mm pathlength p/n 6610013700



# Cylindrical Cells

Used when larger sample volume available for analysis  
(or for dilute samples (low absorbance))

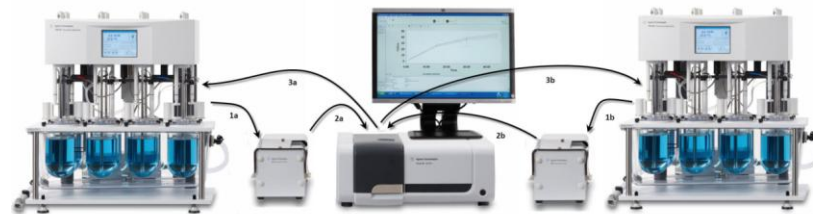
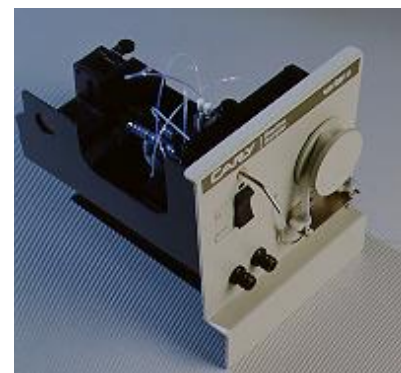
- Can use 1 or 2 ports for sample filling
- Available in different pathlengths
  - Usually 50mm or 100mm pathlength
  - Does require a special “cylindrical cell” holder





# Flow Cells

- Used with a “sipper” accessory to pump sample into and out of the cell
- Improves productivity by reducing sample transfers
  - Caution! – May introduce other errors
    - Bubbles from filling process – reduced by chamber shape and suitable pump speed
    - Carryover between solutions – rinsing can help
- Some specifically designed for use with dissolution testers for pharmaceutical analysis
  - Measures rate at which a tablet dissolves
  - QC check for faults in formulation / production
  - Solution pumped from the “bath” to the cell for measurement and return



1 a/b - 708-D5 to Peristaltic Pump  
2 a/b - Peristaltic Pump to Cary 60 (flowcells)  
3 a/b - Cary 60 (flowcells) to 708-D5

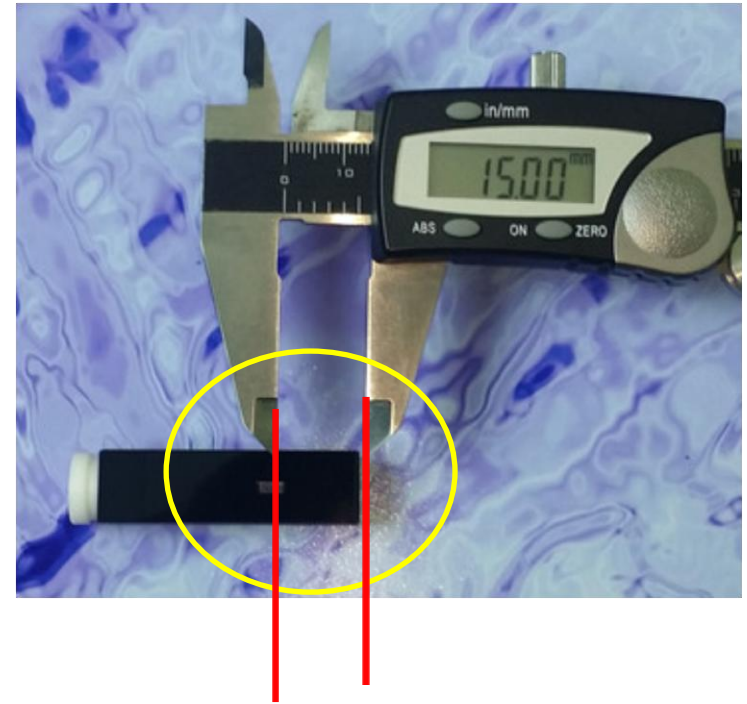




# Differentiating Factors for UV Cuvettes

- **Z Height**

- Each manufacturer's UV instrument has a different "Z height"
- This determines where the centre of the light beam passes through the cell
- Especially critical with small aperture cells
  - Micro cells are NOT interchangeable between different instruments
  - Be sure they order the right cell
- Comparison of Z heights:
  - Agilent 8453/8454 = 15 mm
  - Agilent Cary range = 20 mm
  - Competitive systems = 8.5 / 11 / 15 mm
- Who else uses Z height of 15 mm?
  - Perkin Elmer, Thermo, Shimadzu, GBC & Pharmacia



Measured as distance from base of cell to the centre of the aperture

# Cheap Alternatives to UV Cuvettes (1)

- Use a conventional 16mm OD test tube or other vessel
- Suitable for the Cary 50/60 with the Test Tube Holder (pn 7910033500)



# Alternatives to UV Cuvettes (2)

## Fibre optics

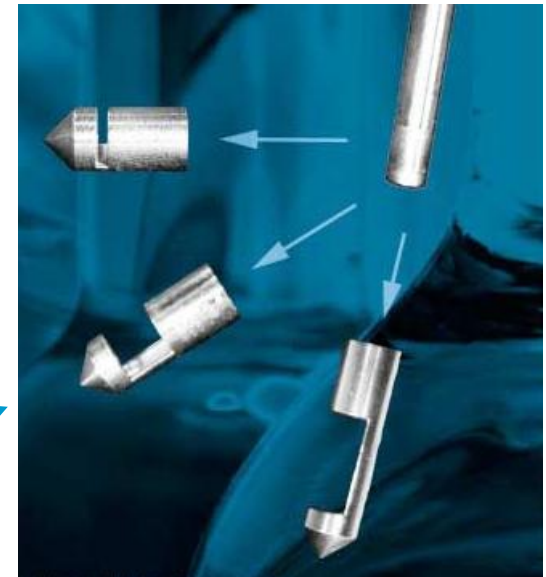
- The fiber optic probe takes the light from the instrument via a fiber – to the sample – and back to the instrument
- Performance depends on:
  - Efficiency of coupling the light from the instrument to the fiber
  - Shielding of the fiber tip from stray light effects e.g. ambient (room) light
- Why use Fibre Optics?
  - Eliminates need for cuvettes!
  - Improve workflow and increase productivity
  - Measure cold, hot, toxic/radioactive or odd-shaped samples
  - Measure samples *in situ*





# Consumables for Fibre Optics

- Wide range of probes available – most for specific applications e.g. reflection, transmission
- Some probes have variable pathlengths – user simply changes the probe tip
- Tips can be removed for cleaning and re-used
- Stainless steel trans-reflectance probe body (probe body only - pn 7910035700) used with interchangeable tips



- 10mm pathlength tip pn 7910035800
- 5mm pathlength tip pn 7910035900
- 2mm pathlength tip pn 7910036000
- 40mm pathlength tip pn 7910036100



- Torlon trans-reflectance probe body (probe body only - pn 7910032600) used with interchangeable tips



- 2mm pathlength tip pn 7910032800
- 5mm pathlength tip pn 7910032900
- 10mm pathlength tip pn 7910033000
- 20mm pathlength tip pn 7910034600
- 40mm pathlength tip pn 7910034500



- Versa immersion transmission probe body (probe body only - pn 190055700) used with interchangeable tips

- 10mm pathlength tip pn 190055900

	Selection Matrix:					Applications		Modes		
	Multiple Pathlengths	Chemically Resistant	Low Volume	Very high Concentrations	Long path length	UV-Vis ABS	Vis-NIR ABS	Fluorescence		
Immersion	2	1	1	1	2	●	●			
Torlon	2	2	1	1	2	●	●			
Quartz	1	3	–	1	1	●	●			
Micro	1	1	3	1	1	●	●			
Reflectance	–	1	–	2	–			●		
U Probe	3	3	–	3	3	●	●			
Fluorescence	–	1	–	–	–			●		
ATR	–	2	–	3	–	●	●			

1 : Good  
2 : Better  
3 : Best



# UV Standards for Instrument Certification



- Validation and regulatory controls demand system validation
  - Certified standards are required to enable validation of instrument performance
  - Different standards are used – depends on the regulatory tests the user needs to comply with
- The certified standards kit (pn 9910085200) is the most important
  - This “certified standards kit” contains all the solutions required to enable validation or performance testing to ASTM/EP/BP and TGA standards, including :
    - Photometric accuracy - potassium dichromate
    - Wavelength Accuracy - holmium oxide
    - Stray Light - potassium chloride, sodium iodide and potassium iodide
    - Resolution - toluene in hexane
  - Depending on the regulatory authority, may need to supplement with additional kits e.g.
    - Neutral density glass filters pn 190032100
    - Didymium standard pn G6860-80001
    - Acetone standard pn G6860-80002

Parameter Tested	Wavelength Region	EP	DAB	USP	ASTM	TGA	BP	Material
Photometric Accuracy	UV	•	•	•	•	•	•	Potassium Dichromate solution
	Visible	•						Potassium Dichromate solution
	Visible			•	•	•	•	Neutral Density Glass filters
Wavelength Calibration	UV/Visible	•	•	•	•	•	•	Holmium Oxide solution
	UV/Visible			•	•	•	•	Holmium Oxide glass filter
	Visible			•	•	•	•	Didymium Glass filter
	Visible			•				Didymium Oxide solution
	Far UV	•	•	•	•	•	•	Rare Earth Oxide solution
	UV/Visible			•	•	•	•	Samarium Oxide solution
	Stray light	•	•	•	•	•	•	Stray Light Cut-off filters
Resolution/ Bandwidth	UV/Visible	•	•	•	•	•	•	Toluene in Hexane
	UV	•						Benzene Vapour



**THANK YOU**  
**СПАСИБО**

**QUESTIONS?**  
**ВОПРОСОВ?**

