ActiPix D100

Cartridge Manual
Version 1.1

ActiPix D100

Cartridge Manual v.1.1

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parallel array technology

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Read this first!

The ActiPix® D100 is a high performance UV area imaging system with high precision electronic and sensitive optical components. Please read Chapter 1 of this User Manual and Quick Start guide in the Software Manual before attempting any assembly or operation.

Please also familiarise yourself with all hazards which are highlighted in this manual before commencing operation. The following symbols represent key areas where you will need to pay extra attention:

CAUTION: Is used to indicate correct operating or maintenance procedures that prevent damage to or destruction of the equipment or other property.

WARNING: Is used to indicate a potential danger that requires correct procedures or practices to prevent personal injury.

Installation Date:
Warranty End Date:
Service Engineer:
Control Box Serial Number:
Sensor Serial Number:

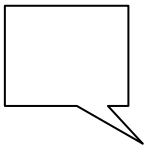
SECTION 1.0
SAFETY

This section must be carefully read before unpacking, installing, using, maintaining or repairing the instrument and/or its accessories.

1.1. Symbol Convention

CAUTION: Is used to indicate correct operating or maintenance procedures that prevent damage to or destruction of the equipment or other property.

WARNING: Is used to indicate a potential danger that requires correct procedures or practices to prevent personal injury.



HINT: Notice that user tips are shown in the dialog box.
These HINTS often contain important basic information and apply to all users.

1.2. Safety Precautions

1.2.1. The safety statements in this manual comply with the requirements of the UK Health and Safety at Work Act of 1974. You must read this section to ensure the safe operation of your instrument.

1.2.2. UV detection involves the use of high voltage power supplies and xenon flash lamps. The instrument and accessories described in this manual must be used, maintained and repaired by properly trained personnel only.

1.2.3. The standard safety procedures in your laboratory should always be adhered to, in addition to the advice given in this manual.

1.2.4. Removal of any fixed covers may expose live electrical mains. If this becomes necessary, the instrument must be disconnected from the electrical mains and at least three minutes allowed for capacitors to discharge.

1.2.5. Replace fuses only with approved high breaking current type of the specified rating (Operating manual Section 8.0).

1.2.6. In the event of breakage of any fragile components such as the fused silica capillary or the protective cover slip (Operating manual Figure 8), only handle using protective gloves and eyewear. If the protective cover slip over the sensor is damaged, do not operate the equipment. Unplug the sensor cable to avoid any possible damage to the sensitive electronics inside, and notify your supplier immediately.

1.2.7. Solvents used in applications can be corrosive, poisonous or flammable and suitable care should be taken in handling them. In the UK it is a requirement to comply with the Control of Substances Hazardous to Health Act 1989 (COSHH).

1.2.8. During operation warm air is vented from the rear side of the ActiPix® control box (Operating manual Fig 5). All cables and pipework must be clear of this airstream and items adversely affected by heat should not be placed in close proximity.

1.2.9. When hazardous chemicals are being analysed, care must be taken to provide the necessary level of ventilation.

1.2.10. Do not stack any items on any of the components of the ActiPix® unit.

1.3. Impaired Safety Protection

Whenever it is likely that safety protection has been impaired, the instrument and/or accessory must be made inoperative and secured against operation. The matter should then be referred to the appropriate servicing authority for remedial action.

1.4. CE Notice

Marking with the symbol CE indicates compliance of the ActiPix™ D100 UV detector to the following European Directives:

89/336/EEC Electromagnetic Compatibility Directive (EMC)
2006/95/EC Electrical Equipment designed for use within certain voltage limits (Low Voltage Directive)

Such marking indicates that the system meets or exceeds the technical standards listed in the Declaration of Conformance.

Declaration of Conformity according to ISO/IEC Guide 22 and EN 45014

Manufacturer: Paraytec Ltd

Address: 1a St George's Place, Tadcaster Road, York, YO24 1GN

The above manufacturer declares that the ActiPix D100 UV detector conforms to the following standards:

Safety: IEC61010-1:2001
UL 61010-1:2004

EMC: EN61326-1:1997 + A1: 1998 + A2:2001 + A3:2003 Electromagnetic compatibility (EMC) equipment for measurement, control and laboratory use

FCC: ANSI C63.4 2003 and CFR47 Part 15:2003 Code of Federal Regulations

Notices: 1) Use only Paraytec Ltd approved parts

2) Use shielded cables supplied by Paraytec Ltd when connecting the ActiPix D100 UV detector to other equipment.

Compliance with the above two notices is necessary to ensure that the appropriate radio frequency emissions will be maintained within the limits of the specifications referred to in this declaration.

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be rendered ineffective.

1.5. Solvents and Electricity

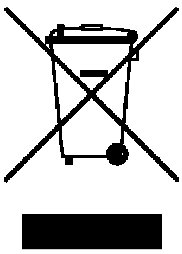
No solvents are required inside the control box. Solvents should NEVER be placed, applied or spilled inside the control box. The only user serviceable part is the filter holder which can be removed for cleaning.

For optimum performance and care of your instrument, ensure that the D100 and corresponding PC have a stable, clean and uninterrupted source of mains power. It is highly recommended to use a surge protection device; however, a primary level of protection is provided by specialised components inside the control box.

1.6. Recycling Information

Paraytec recommends that customers dispose of their used cartridges, capillaries connectors, cables, sensor head assemblies and control boxes in an environmentally sound manner. Potential methods include reuse of parts or whole products and recycling of products, components and/or materials.

1.6.1. Waste Electrical and Electronic Equipment (WEEE) Directive



In the European Union, this label indicates that this product should not be disposed of with household waste. It should be deposited at an appropriate facility to enable recovery and recycling. For information on how to recycle this product responsibly in your country, please contact Paraytec at info@paraytec.com

SECTION 2.0 Introduction

2.1. Overview

The ActiPix® D100 opens up many new exciting possibilities for researchers. This revolutionary instrument is a smart, sensitive imaging system that has been designed for use in a variety of applications in research, development and quality control.

In order for the D100 to perform all of its unique capabilities, a cartridge is required for proper use. The cartridge serves many functions, for example (i) excluding ambient light from the imaging area and (ii) accurate positioning of the capillaries or cells with good repeatability. No proper imaging can be accomplished without the use of the specially designed cartridges.

Cartridges have been designed to make them easy to assemble and practical to use. Most of the cartridges can be used fully assembled in other instruments such as inverted microscopes. Careful choice of the cartridge for the desired application is required for optimal performance of the system. Whilst all have been designed to enhance performance in one particular application, many cartridges offer flexibility in use. To discuss the viability of using cartridges for novel applications, do not hesitate to contact Paraytec staff (sales@paraytec.com).

SECTION 3.0
Choosing a Cartridge

3.1. Basic Information

The ActiPix D100 has many versatile applications. Because of this, it is important to use the correct cartridge to get the best results for that application.

Choosing the correct type of cartridge depends on the application and the final data format: absorbance plot or imaging movies.

For capillary (absorbance) cartridges there are several styles and each is available for capillaries with outer diameter (OD) either 200 or 360 µm. The style and OD of the capillary selected generally depends on the application. Typical applications are in measurement of time dependent absorbance of analyte peaks after or during a liquid phase separation, e.g. liquid chromatography (LC) or capillary electrophoresis (CE).

All cartridges for imaging use a quartz cell or plate. Such cartridges are not designed for use with a capillary, and typically have a sample imaging area 5 or 10 times larger than that used with capillaries. Imaging applications include monitoring bulk solution or surface processes and reactions.

Descriptions of all cartridges and the applications for which they have been designed are given in the following section. The applications mentioned in section 3.2 are far from exhaustive. In addition to the cartridges shown here, Paraytec has the ability to custom design cartridges tailored to your needs. For more advice on possible uses of the ActiPix system, contact the sales team at sales@paraytec.com.

3.2. Cartridge Types and Descriptions

3.2.1. Table of Cartridge Types and Part Numbers

	Type of Cartridge	Part Number	Description	Capillary size	# of capillaries
Capillaries	Multi-application cartridge	C102MA200	Multiple applications using single cartridge	200 µm	1 or 2
		C102MA360	Multiple applications using single cartridge	360 µm	1 or 2
	Sizing application	C102SIZE200	For sizing only	200 µm	1
	nanoLC cartridge	C101NANO200F	6/32 female fitting for nanoLC separations	200 µm	1
		C101NANO200M	10/32 male fitting for nanoLC separations	200 µm	1
	CE cartridge	C102CE200	For CE separations	200 µm	1 or 2
	Bioreactor	CBIOR200075-1	Looped bioreactor for pre and post reaction	200 µm	1 or 2
Imaging	Dissolution cartridge	CDISSA-1	Tablet dissolution area imaging with integrated holder	n/a	n/a
	Dissolution extras	DISSFT-1 MEMFT-1 VISQ-1 MEMST1-1 VISSTQ-1	Spare holders and visualization chambers	n/a	n/a
	Large area imager	CVIVO-1	500 uL flat area imaging plate	n/a	
	Custom cartridge	C100CUST	For specialist applications, two iterations	n/a	

Table 1: Overview of types of cartridges and part numbers

3.2.2. Quick Guide to Cartridge Types and Applications

Multi-application cartridge: **C102MA200** **C102MA360**	**Description** **ActiPix multi-application cartridge**
	*Reusable. Can be used for applications requiring up to 2 capillaries, e.g. sizing of pure species, 2 capillary CE, bioreactor studies. Contains spacing combs for even mounting.* *C102MA200 for use with 200 µm OD capillaries.* *C102MA360 for use with 360 µm OD capillaries.*

Figure 1: Multi-application cartridge

Cartridge for sizing applications: **C102SIZE200**	**Description** **ActiPix cartridge for sizing application**
	*Reusable. Allows easy assembly of cartridge for sizing application. Contains spacing combs for even mounting.* *For use with 200 µm OD capillaries.*

Figure 2: Cartridge for sizing applications

NanoLC cartridge: **C101NANO200F**	**Description** **ActiPix nanoLC cartridge for 6/32 female fitting** *Reusable. Comes pre-loaded with 200 µm OD, 75 µm ID capillary for UV with nanoLC systems.* *C101NANO200F for 6/32 female fitting.* *C101NANO200M for10/32 male fitting.*

Figure 3: NanoLC cartridge, female

NanoLC cartridge: **C101NANO200M**	**Description** **ActiPix nanoLC cartridge for *for10/32 male fitting*** *Reusable. Comes pre-loaded with 200 µm OD, 75 µm ID capillary for UV with nanoLC systems.* C101NANO200M for10/32 male fitting

Figure 4: NanoLC cartridge, male

CE cartridge for use with 200 µm OD capillaries: **C102CE200** **C102CE360**   	**Description** **ActiPix cartridge for use with 200 µm OD or 360 OD capillaries** *Reusable. For use with 200 µm OD, 75 µm ID capillary or 360 µm OD, 100 µm ID capillary or UV detection with CE or capLC systems. Contains spacing combs for even mounting.*

Figure 5: CE cartridge

Part Number C106MP200 or CE106MP360 	**Description** **ActiPix 6 capillary multiplex cartridge for use with 200 µm OD or 360 OD capillaries** *Reusable. For use with 200 µm OD, 75 µm ID capillary or 360 µm OD, 100 µm ID capillary or UV detection with CE or capLC systems. Contains spacing combs for even mounting.*

Figure 6: 6 capillary multiplexed cartridge

Fused silica capillaries, 10m lengths	
FSA375075	fused silica capillary, 360 um OD, 75 um ID
FSA375100	fused silica capillary, 360 um OD, 100 um ID
FSA375150	fused silica capillary, 360 um OD, 150 um ID
FSA375200	fused silica capillary, 360 um OD, 200 um ID
FSA350250	fused silica capillary, 350 um OD, 250 um ID
FSA350200	fused silica capillary, 350 um OD, 200 um ID
FSA200075	fused silica capillary, 200 um OD, 75 um ID
FSA200050	fused silica capillary, 200 um OD, 50 um ID
FSA360100C	transparent fused silica capillary, 363um OD, 100um ID
FSA360075C	transparent fused silica capillary, 363um OD, 75um ID

Table 2: Fused silica capillaries, 10m lengths

Cartridges for area imaging applications

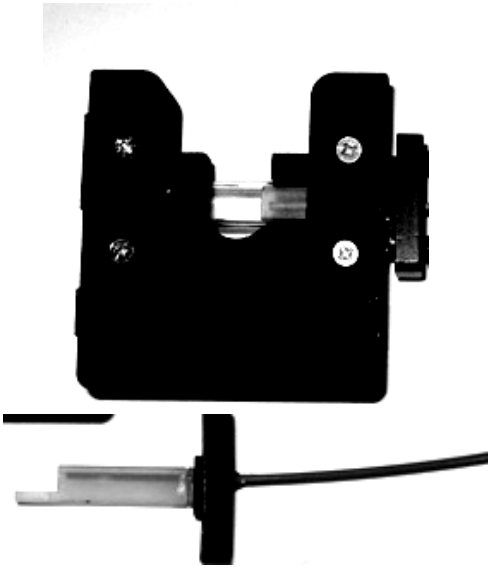
Part Number CAMEMST-1	**Description** **ActiPix cartridge for monitoring diffusion processes, static flow**
	*ActiPix cartridge for imaging diffusion processes with static flow. Comes complete with:* *MEMST1-1, Inline membrane diffusion holder (static version shown)* VISSTQ-1, replacement quartz visualisation chamber (static) *(spares can be ordered separately)*

Figure 7: ActiPix cartridge for monitoring diffusion processes, static flow

Part Number CAVIVO-1	**Description** **ActiPix large area imaging cartridge**
	ActiPix cartridge for imaging processes on a large viewing area

Figure 8: Large area imaging cartridge

Part Number C100CUST-1	Description **Custom cartridge holders for specialist applications, 2 iterations. Contact Sales** *Paraytec offer a custom cartridge design service for specialist applications not listed. Please contact sales@paraytec.com for more details*

Figure 9: Custom cartridge holders

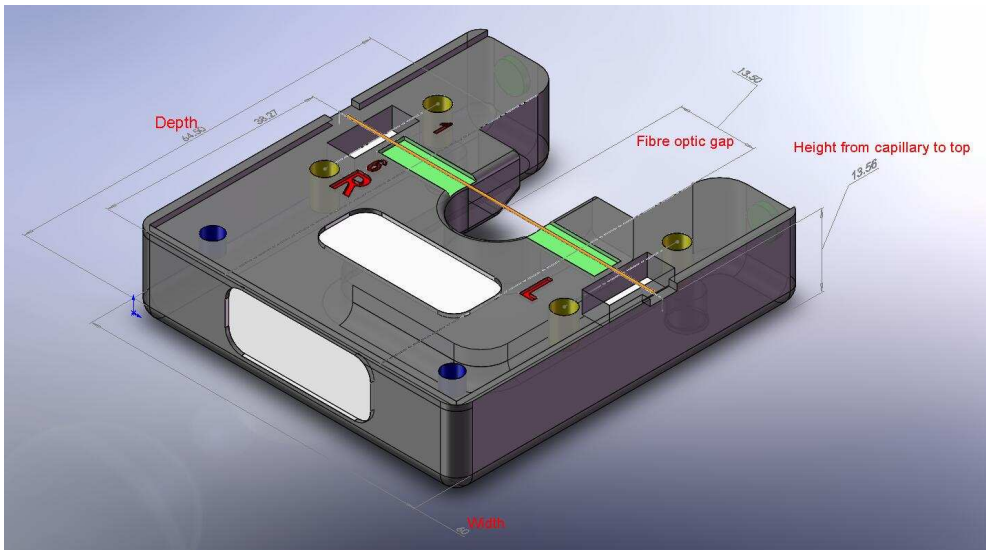


Figure 10: Diagram of cartridges with dimensions

SECTION 4.0
Cartridge Preparation

4.1. Basic Information

Proper assembly of a cartridge is vital for connecting to other equipment and to avoid breaking capillaries.

NOTE: Capillary cartridges are designed for two sizes of capillary 360 µm or 200 µm OD. Forcing 360 µm capillaries into the 200 µm cartridge combs can cause breakages and fluid leakages that may damage the ActiPix sensor head. Inserting 200 µm into 360 µm will increase the probability of capillary movement and lead to poor data.

To begin, **ALWAYS** orient the cartridge as shown in Figure 11 below for assembly. To do this, removed the cartridge from the D100 and rotate 180 degrees toward you. This will position the cartridge upside down for ease of access to the bottom plate screws and more importantly to maintain the capillaries respective to the sides they will have when replaced into the cartridge. This becomes very important when making delicate fluid connections that need to flow in from the left or right as the case may be.

⚠ **If the cartridge is not assembled in the proper manner, when it is returned to the normal position in the D100 the fluid directions will be reversed and the inlet side of the capillary possibly too short.**

Figure 11: Correct orientation for assembly of cartridges

Once the capillary has been placed in the cartridge it is highly advised to apply tension to the capillary such that it remains in a straight line parallel to the face of the sensor. If the capillary is allowed to curve several errors might occur in the absorbance: 1) for upward curvature, part of the capillary window will be further away from the cover plate surface and hence give a lower signal; 2) the capillary might move with vibrations or just with time, thereby falling out of the pixel map assigned in the cartridge file with the result being a dramatic rise or fall in signal; 3) the capillary might break, resulting in a lost experiment or damage to the cartridge (for information on leaks leading to presence of liquid inside the sensor please refer to the User Manual)

To properly tighten the capillary inside the cartridge, begin by placing the capillary in the required location, then place the bottom plate in place with the four (4) screws ready to be tightened, begin to tighten the right side of the cartridge only*, now apply a straight, constant outward pulling tension to the capillary on the left side, once tension is applied tighten the screws on the left side.* In summary, the right side of the capillary is held in place with the clamping action of the right screws then tension is applied to straighten the capillary while simultaneously tightening the left side screws.

For confirmation of a correctly tensioned capillary, in On-line mode open an imaging method to view the capillaries. If they appear curved repeat the process above.

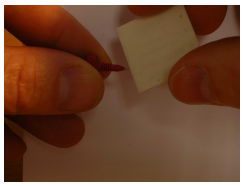
4.2. Making a Window in a Capillary

All capillaries come with a protective polymer coating on the outside. Whilst this coating is in place the capillaries enjoy enormous flexibility and resilience. However, the polyimide coating (brown or TSP type) does not transmit light and must be removed prior to installation. PTFE coated or TSU type capillaries do not require their coatings to be removed, but suffer from loss of signal and increase in stray light through scattering by the polymer.

To remove the outer polymer coating to make a viewing window the following tools are required:

- Lighter or open flame such as a candle
- Disposable soft wiping cloth such as a lab wipe
- An alcohol solvent, e.g. ethanol, methanol, 2-propanol (isopropanol), or an alcohol gel
- Ruler
- Black marker

- Flat, smooth surface
- White paper for visualization
- Eye glass



After the overall length of capillary has been cut, determine the location of the window. This can be measured from either end, but preferably from the flow inlet end. If the length of capillary is important, as is the case in CE and for sizing, measure from the grub screw in the centre of the sensor head shown below. This point represents the centre of the sensor, with the actual sensor imaging area being 9 mm in width.

Figure 12: Close-up view of Sensor Head

The minimum window width is 10 mm and maximum 25 mm, with the preferred width being 15 mm. Using the ruler and the marker, completely mark black a 15 mm section where the window is to go.

Next, hold the capillary in one hand in front of you parallel to the body. With the flame on the lowest setting move the flame towards and away from you (not left to right along the capillary) until the polymer coating is completely black and charred. Do not allow the flame to remain in contact with the capillary after the polymer coating has completely charred.

Caution: if the flame is applied too long the capillary will melt.

Figure 13: Creating a detection window

After the capillary has been charred, apply a small enough amount of alcohol to the lab wipe such that it is wet but not dripping. Now place the capillary on a flat surface and with the wet wipe, wipe the charred area with a smooth, firm swipe **away** from the holding position **ONLY**. The capillary is quite strong still, but a motion of wiping back and forth will certainly cause the window to break. As long as the surface is flat there should be little danger of breaking the capillary from pressing down. Rotate the capillary if required, and wipe to remove char from the back.

After the entire charred polymer has been removed inspect the new window with the eye glass from the tool kit. If any small pieces remain they must be removed with further wiping action. This can also be done on the white paper background.

⚠ **NEVER apply the flame a second time to the capillary as this will cause permanent damage to the new window.**

Once the polymer coating has been removed the window is extremely fragile and must be kept flat at all times, including while installing in the cartridge.

⚠ **ANY TORQUE APPLIED TO THE CAPILLARY WILL CAUSE IT TO BREAK AT THIS POINT.**

4.3. Installation of Capillary in CE or LC Cartridge

The well-established separation techniques of capillary electrophoresis (CE) and nano liquid chromatography (nanoLC) normally use fused silica capillaries. Use of the ActiPix D100 detector with CE or nanoLC typically requires insertion of a detection capillary in the flow line that must have a window ‘burned’ in.

The location of the window from either end of the capillary should first be measured and the polymer coating removed as directed in section 2.4 above.

Helpful HINT: read how to properly tension capillary in section 4.1

The window size should be between 10 and 25 mm (see section 4.2). It is essential that the window be positioned directly in the centre of the viewing area.

For further information on installing the nanoLC capillary refer to Tech Note # 3: *Installing a window in nanoLC.*

4.4. Inserting a Dissolution Cassette

Dissolution cartridges do not use capillaries but are connected with PEEK tubing of various ID dimensions. The quartz cells are rectangular tubes that are inserted by pressing in from either side of the cartridge.

The PEEK tubing is connected to both the tablet or membrane holder and the receiver cassette. These in turn insert into the quartz cell located inside the cartridge.

Once the holder and receiver are inserted, they should be secured by tightening the two M3 screws (refer to figure below) gently until a seal is made. Label the screws and put textboxes in Fig below, which also needs a label. At the base of the holder and receiver are O-rings that form the leak proof seal on the quartz cell. If the holder or receiver are not tightened enough a leak will occur. Should this happen, simply tighten further. With time the O-rings will fail naturally due to material degradation and will have to be replaced.

The holder and receiver are interchangeable to accommodate ease of assembly in the lab. This has no effect on data or performance. Flow originating from the left side of the cartridge is seen on the left side of the image.

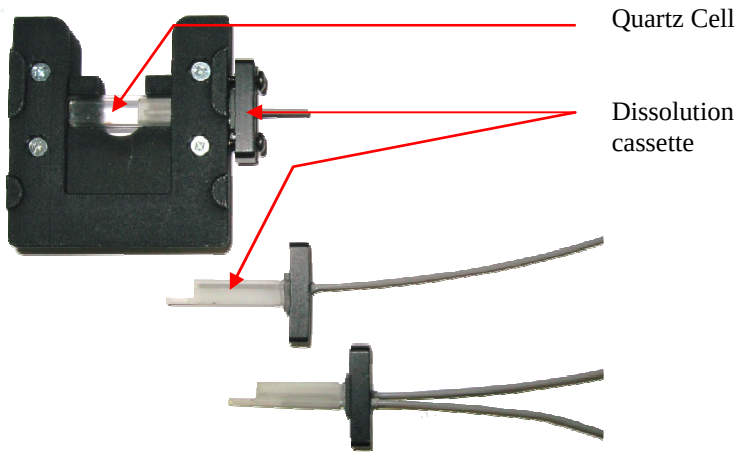


Figure 14: Holder and receiver

The dissolution holders have been engineered to shape the bulk flow to make the flow parallel to the exposed surface of the tablet section. The flow profile will work for any tablet section, provided it is mounted with its exposed surface 0 - 1.5 mm above the top surface of the holder Above 1.5 mm the flow profile will likely cause turbulence and disruption of the flow profile.

A gap exists between the holder and receiver so that there is no pressure against them when the seal is made against the quartz.

SECTION 5.0
Tubing and Connections

5.1. Types of Tubing

There are two types or tubing available to make connections to a cartridge: polymer or fused silica.

Polymers come in many varieties. The application will determine which is the best material. For use with connectors, a critical variable is the outer diameter (OD). Since the detection zone is typically fused silica for most cartridges, all tubing will have to be reduced down to either 200 or 360 µm OD. Matching of the ID is also extremely important, in order to minimize turbulent zones at discontinuities in the flow profiles.

5.2. Basic Types of Connectors

Connectors come in two general sizes based on the thread size. All fittings use American thread gauges. These are 6-32 (or 6 UNC) and 10-32 (or 10 UNC). The 6-32 fitting connectors typically, but not always, require a sleeve that has an outer dimension of 1/32" OD (0.75 mm) whereas the 10-32 always use a sleeve that measures 1/16" OD.

Sleeves come in the two outer sizes listed above but have a variety of inner diameters based on capillary or tubing used. The optimum sleeve material is Teflon or PTFE.

All connectors use a ferrule locking system. It is important that this system be fully understood before assembling.

5.3. Sources for Connectors

www.upchurch.com

www.vici.com

5.4. Troubleshooting Connections

Most tubing connections work using the principle of ferrules. A ferrule is either a replaceable wedge or a one-piece wedge that when connected into a female receiver causes the wedge tip to drive inward, in this case into the sleeve or tubing, and create a seal. Almost every ferrule will reseal. However, an over tightened ferrule will become too small and leak; it may also pinch too far in on the tubing and pinch it closed. Some ferrules are reusable from tube to tube, but only a handful of times. Whenever possible, a ferrule that has been 'set' should be left sealed. A fact about ferrules that is not well understood is that they are made oversized and have to be shrunk down through a wedging action to 'activate' them. This activation process might actually take up to three lots of tightening to wedge the ferrule enough that it constricts around the tubing. Once a ferrule has been wedged it can not return to any other position. Ferrules that have been over tightened will appear rounded or 'squished' and are probably unusable.

SECTION 6.0
Large Area Imager: Using the quartz plate

The large area imager allows visualization of almost any substance and can be used complementarily with an inverted microscope.

To remove the quartz plate, simply remove the bottom plate of the cartridge and gently push the quartz plate out of the cartridge.

To install the quartz plate, reverse the steps above.

The quartz plates have an internal lip that is approximately 200 µm high, but can be ordered in larger heights if more volume is required.

Because quartz is very inert, the quartz slide can be sterilized or cleaned with any reagents. The inner surface can be coated with a variety of materials for cell adhesion or particle interaction.

The cartridge comes with two 45 degree entrance holes for syringe needles for injecting reagents or solutions.

SECTION 7.0
Cleaning Cartridges

All cartridges are made from a black polymer composite. A lint free, slightly damp, wipe will remove most substances. Since most organic solvents will damage at least one of the plastics in the composite, only water should be used for cleaning.