2.2.9. Cells for Flow-Through Measurements

general remarks concerning flow-through cells

Connections

All cells shown in this section are available with the following inlet/outlet connectors:

- glass or quartz tubes
- plastic tubing with screw connectors
- glued-in stainless steel or plastic tubes

Bubble Formation

Air bubbles in the measuring chamber during measurements can lead to erroneous measurements. This problem is most prominent in cells with long light paths and small apertures. In the design of all Hellma flow- through cells, one or all of the following steps are taken to combat the problem:

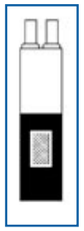
- A pyramid-shaped cavity, into which bubbles can rise and thus cannot interfere with the measurement, is introduced above the measuring chamber (cell series 176 for example).
- Flow-through cells are subjected to a special treatment which reduces the adhesion of bubbles to the surfaces within the measuring chamber.
- The channel that runs from the inlet tube to the outlet tube is designed to have minimal changes in cross section (cell series 178 for example).

Pressure Load

Every single flow-through cell is pressure tested at 3 bar during final inspection. Due to their design, many cells can withstand much higher pressures. However, the maximum sustainable pressure is also dependent on the type of connectors used. For example, compact cells with screw connectors can sustain higher pressures than cells with glass inlet/outlet tubes, and are pressure tested at 5 bars. For even higher pressures we offer cells with glued-in stainless steel or PEEK tubes. The patented Hellma gluing process results in joints that are resistant to chemicals and can withstand as much pressure as the cell windows themselves.

Flow Rate

The flow rate is dependent on the cross-sectional area of the inlet/outlet tubing, the smallest cross-sectional area within the cell, the power of the pump being used, and the physical properties of the sample (viscosity). Because of the many factors influencing the flow rate, we are unable to offer details for specific cell types.



Light Beam Cross Section

It is important for cells with apertures that are similar in size to the dimensions of the light beam to ensure that the light beam lies in the centre of the measuring chamber. The cross-sectional area of the light beam should be chosen smaller than the cell aperture so that it does not come into contact with the side walls or the base, as is shown here.

Measuring Chamber

Flow-through cells have measuring chambers that are either rectangular or circular in shape. Black quartz or black glass is used in the boundary of the aperture to ensure that no external or stray radiation influences the measurements, thus acting as a mask.

Cleaning

These cells should not be submerged in a cleaning bath, but rather the cleaning solution should be pumped through them. Connect the inlet tubing, via a pump, to a container holding the cleaning solution. Both the inlet and outlet tubings should lead into the cleaning fluid container. As a cleaning solution for this closed circulatory system, we recommend water to which 2% Hellmanex® II (cat. no. 320.001) has been added. The cells should be rinsed with distilled water. Once the water has passed through the cell it should be disposed off at the outlet.

Caution When Using Ultrasound

The cells should under no circumstances be put in a cleaning bath. Such baths will destroy compact cells relatively quickly, especially if heat and/or ultrasound are used to increase the effectiveness of the cleaning process.

Dirt on the outer surfaces of the cell can be removed with a damp cloth. Use Hellmanex® II or another solvent (e.g. ethanol).

Carry-Over

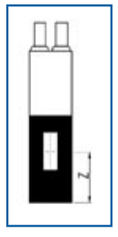
Special caution is necessary so that the exchange of fluids does not lead to false measurements due to “carry-over”. “Carry-over” occurs when, during the process of changing samples, residual fluids of one sample become mixed with the next sample or the cleaning solution. This phenomenon can lead to inaccurate results.

Carry-over is influenced by the following factors:

- design of the cell
- method used for filling / emptying the cell
- physical properties of the sample, such as viscosity and surface tension

Volume

In the tables, where the flow-through cells are listed, we have specified in the column “volume” the measuring volume, i.e. the volume of liquid which is actually irradiated. Please note that depending on the cell type the needed volume can be significantly larger.



Centre Height

A very important dimension for flow-through cells is the height of the centre of the light beam. This distance must be quoted when ordering these cells. Should you not know the light beam centre height, please specify the instrument in which the cell is to be used.

We additionally recommend taking the following points into consideration:

- Selecting the proper inlet/outlet tubing (recommended material: tubing made of PTFE or FEP) with regard to the diameter of the cell tubes.
- When working with a sipper system one should make sure that negative pressure does not become too strong in the cell in order to avoid degassing.
- Every cell should be thoroughly rinsed and cleaned after it has been used for a certain period of time. Please refer to our general remarks concerning cleaning procedures in the section “Materials and Technical Information”. We recommend our concentrated cleaning solution Hellmanex®II which is described in chapter 2.5.1.

Handling Instructions for Compact Cells with Screw Fittings

Design

A compact cell is a flow-through cell to which the tubings are connected by means of screw fittings.

The cell consists of two parts, the actual quartz or glass cell body and a U-shaped frame made of black anodised aluminium. The aluminium frame has threaded holes for the screw fittings and is glued to the cell body. The glue is only applied to the side surfaces of the cell.

Each fitting consists of a plastic tubing the end of which has been flanged, a washer, an O-ring, and a screw connector. The screw connector ensures a watertight seal by pressing the flange via O-ring and washer onto the top of the cell, which has been polished flat. The tubings are made of fluorinated ethylene propylene (FEP), a material which has resistance to corrosion and solvents that set it apart from other plastics. Should there be doubt about FEP's resistance to a particular medium, we can supply samples of tubing material for testing.

Tubings with screw fittings on both ends can also be ordered. A coupling link which joins two screw fittings is also available.

Apart from the above-mentioned Hellma screw connector with FEP tubing, modified fittings can also be supplied on request. The changes may involve the dimensions (outer/inner diameter and length) and the material of the tubing (FEP, PTFE, ETFE, PEEK, etc) as well as the kind of seal (with or without flange).

Connecting the Fittings

Before screwing in the fitting, make sure that its component parts are in the right order: flange, washer, O-ring, and finally the screw connector. Screw the fittings into place hand tight, starting with the fitting with the short screw connector. Do not use any tools such as pliers to tighten the fittings. Every connector of this type is able to withstand pressure of 5 bar.

Should a leak between the cell body and the flange occur, it may be caused by one of the following:

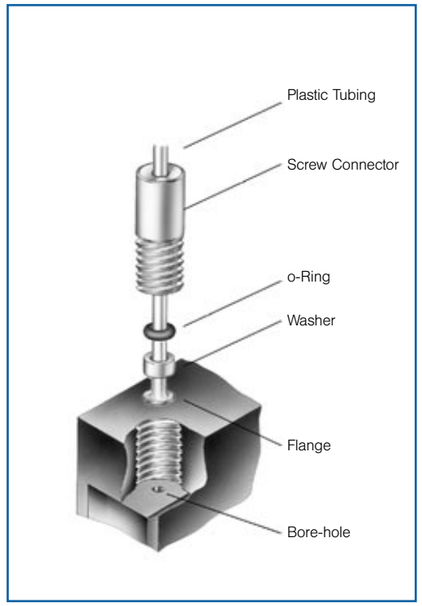
1. The screw connectors were not tightened adequately or have become loose. Check the tightness of the screw connectors periodically, especially after long periods of use, and tighten the connectors if necessary.

2. The flange at the end of the tubing is broken or damaged.

3. The holes on the top of the glass body are damaged or chipped, thus preventing the flange from creating a proper seal. For this reason, no hard or sharp tools should be used for cleaning.

4. There are dirt particles present between the flange and the top of the cell.

5. Component parts of the Hellma screw fitting were replaced with parts not having the proper dimensions (such as a screw connector with too short a thread).



Screw fitting

Please check for all of the above causes before sending in a claim for a leaking cell.

Cells for Continuous Flow

These cells usually have two connectors and are used for measurements in which the sample is continually forced through the cell by a pump. Continuous flow measurements are used in industry to monitor chemical reactions or such processes as mixing. These measurements are usually only carried out at one wavelength. Peristaltic and membrane pumps are examples of pumps that can be used to operate these cells.

Cells for Discontinuous Flow

These cells are filled with the aid of a pump but measurements do not take place during the through-flow but rather while the fluid is stationary. After the measurement the samples/liquids are pumped out and the cell is filled again.

Please note the following modes of operation:

- Unidirectional peristaltic or membrane pump (cell model 178). These pumps operate in only one direction.
- Bi-directional peristaltic pump (cell models 170-176 and 178)
- Syringe, downstroke for filling, upstroke for emptying (cell models 170-176, 178)
- Cell model 178 with cylindrical aperture:
  If a simple peristaltic or membrane pump is used, this cell can only be operated in one direction. It can also be operated with a bi-directional peristaltic pump and with a syringe.
- Cell models 170 -176 with rectangular aperture:
  These cells are filled and emptied from the base of the measuring chamber. The tube that leads to the bottom of the cell is marked with an arrow. Suitable pumps include bi-directional peristaltic pumps and syringes.

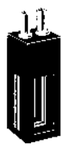
2.2.9. Cells for Flow-Through Measurements

macro | semi-micro | with in/outlet tubes

Catalogue Number	Window Material	Light Path mm	Centre Height mm	Outside Dim. H x W x D mm	Aperture H x W mm	Volume µl	Number of Windows	Remarks
130-QS	Quartz SUPRASIL	10		45 x 12.5 x 12.5	33 x 9.5	3200	2	
137-QS	Quartz SUPRASIL	1 2 5 10		45 x 12.5 x 3.5 45 x 12.5 x 4.5 45 x 12.5 x 7.5 45 x 12.5 x 12.5	20 x 9 20 x 9 20 x 9 20 x 9	260 520 1300 2600	2 2 2 2	
170-OS	Special Optical Glass	1 2		35 x 12.5 x 12.5 35 x 12.5 x 12.5	17.5 x 6.5 17.5 x 6.5	120 240	2 2	
170-QS	Quartz SUPRASIL	0.1 0.2 0.5 1 2		35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5	17.5 x 3.5 17.5 x 3.5 17.5 x 3.5 17.5 x 6.5 17.5 x 6.5	6.2 12.4 31 120 240	2 2 2 2 2	
175.000-OS	Special Optical Glass	10 10	15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5	11 x 6.5 11 x 6.5	750 750	2 2	
175.000-QS	Quartz SUPRASIL	5 5 10 10 20 20 50 50 100 100	15 8.5 15 8.5 15 8.5 15 8.5 15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5 45 x 12.5 x 12.5 38.5 x 12.5 x 12.5 45 x 12.5 x 22.5 38.5 x 12.5 x 22.5 45 x 12.5 x 52.5 38.5 x 12.5 x 52.5 45 x 12.5 x 102.5 38.5 x 12.5 x 102.5	11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5 11 x 6.5	375 375 750 750 1500 1500 3750 3750 7500 7500	2 2 2 2 2 2 2 2 2 2	


130


137


170


175.000-OS


175.000-QS

2.2.9 Cells for Flow-Through Measurements

compact | with 2 screw connectors M 6 X 1 and FEP tubes
outside Ø 1.9 mm, inside Ø 1.1 mm, 500 mm long

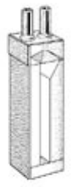
Catalogue Number	Window Material	Light Path mm	Centre Height mm	Outside Dim. H x W x D mm	Apertur H x W mm	Volume µl	Number of Windows	Remarks
170.700-QS	Quartz SUPRASIL	0.01 0.05 0.1 0.2 0.5 1 2	both heights	35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5	17.5 x 3.5 17.5 x 3.5 17.5 x 3.5 17.5 x 3.5 17.5 x 3.5 17.5 x 3.5 17.5 x 3.5	0.6 3 6.2 12.4 31 62 124	2 2 2 2 2 2 2	


170.700

2.2.9. Cells for Flow-Through Measurements

semi-micro | micro | with in/outlet tubes

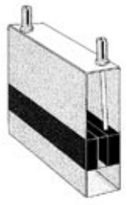
Catalogue Number	Window Material	Light Path mm	Centre Height mm	Outside Dim. H x W x D mm	Aperture H x W mm	Volume µl	Number of Windows	Remarks
174-OS	Special Optical Glass	10		48 x 12.5 x 12.5	36 x 4	1500	2	
174-QS	Quartz SUPRASIL	10		48 x 12.5 x 12.5	36 x 4	1500	2	
176.000-OS	Special Optical Glass	10 10	15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5	11 x 4 11 x 4	450 450	2 2	
176.000-QS	Quartz SUPRASIL	5 5 10 10 20 20 50 50 100 100	15 8.5 15 8.5 15 8.5 15 8.5 15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5 45 x 12.5 x 12.5 38.5 x 12.5 x 12.5 45 x 12.5 x 22.5 38.5 x 12.5 x 22.5 45 x 12.5 x 52.5 38.5 x 12.5 x 52.5 45 x 12.5 x 102.5 38.5 x 12.5 x 102.5	11 x 4 11 x 4 11 x 4 11 x 4 11 x 4 11 x 4 11 x 4 11 x 4 11 x 4 11 x 4	230 230 450 450 900 900 2250 2250 4500 4500	2 2 2 2 2 2 2 2 2 2	



174

176.000-OS

176.000-QS



176.000-QS
50 mm

2.2.9 Cells for Flow-Through Measurements

compact | with 2 screw connectors M 6 X 1 and FEP tubes
outside Ø 1.9 mm, inside Ø 1.1 mm, 500 mm long

Catalogue Number	Window Material	Light Path mm	Centre Height mm	Outside Dim. H x W x D mm	Aperture H x W mm	Volume µl	Number of Windows	Remarks
176.700-QS	Quartz SUPRASIL	5 5 10 10 20 20 50 50 100 100	15 8.5 15 8.5 15 8.5 15 8.5 15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 12.5 35 x 12.5 x 22.5 35 x 12.5 x 22.5 35 x 12.5 x 52.5 35 x 12.5 x 52.5 35 x 12.5 x 102.5 35 x 12.5 x 102.5	11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5 11 x 3.5	195 195 390 390 780 780 1950 1950 3900 3900	2 2 2 2 2 2 2 2 2 2	
176.703-QS	Quartz SUPRASIL	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	8 x 2 8 x 2	160 160	2 2	

176.700

176.703

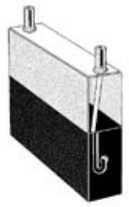
2.2.9. Cells for Flow-Through Measurements

micro | ultra-micro | with in/outlet tubes

Catalogue Number	Window Material	Light Path mm	Centre Height mm	Outside Dim. H x W x D mm	Aperture H x W mm	Volume µl	Number of Windows	Remarks
178.010-OS	Special Optical Glass	10 10 50 50	15 8.5 15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5 45 x 12.5 x 52.5 38.5 x 12.5 x 52.5	Ø 3 Ø 3 Ø 3 Ø 3	80 80 370 370	2 2 2 2	
178.010-QS	Quartz SUPRASIL	10 10 20 20 40 40 50 50	15 8.5 15 8.5 15 8.5 15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5 45 x 12.5 x 22.5 38.5 x 12.5 x 22.5 45 x 12.5 x 42.5 38.5 x 12.5 x 42.5 45 x 12.5 x 52.5 38.5 x 12.5 x 52.5	Ø 3 Ø 3 Ø 3 Ø 3 Ø 3 Ø 3 Ø 3 Ø 3	80 80 150 150 300 300 370 370	2 2 2 2 2 2 2 2	
178.011-OS	Special Optical Glass	10 10	15 8.5	45 x 12.5 x 12.5 38.5 x 12.5 x 12.5	Ø 2 Ø 2	30 30	2 2	

178.010-OS

178.010-QS



178.010-QS
50 mm

178.011-OS

2.2.9 Cells for Flow-Through Measurements

compact | with 2 screw connectors M 6 X 1 and FEP tubes
outside Ø 1.9 mm, inside Ø 1.1 mm, 500 mm long

Catalogue Number	Window Material	Light Path mm	Centre Height mm	Outside Dim. H x W x D mm	Aperture H x W mm	Volume µl	Number of Windows	Remarks
178.710-OS	Special Optical Glass	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 3 Ø 3	80 80	2 2	
178.710-QS	Quartz SUPRASIL	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 3 Ø 3	80 80	2 2	
178.711-OS	Special Optical Glass	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 2 Ø 2	30 30	2 2	
178.711-QS	Quartz SUPRASIL	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 2 Ø 2	30 30	2 2	
178.712-OS	Special Optical Glass	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 1.5 Ø 1.5	18 18	2 2	
178.712-QS	Quartz SUPRASIL	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 1.5 Ø 1.5	18 18	2 2	
178.713-QS	Quartz SUPRASIL	10 10	15 8.5	35 x 12.5 x 12.5 35 x 12.5 x 12.5	Ø 1 Ø 1	8 8	2 2	

178.710

178.711

178.712

178.713