Contents

1. Introduction

This manual covers the operation and maintenance of the Sheffield Lfc flow-through cell.

This manual should be considered a permanent part of the Sheffield Lfc flow-through cell and should remain with it if it is sold.

If a problem should arise, or if you have any questions, please contact Waterra UK Ltd.

Waterra UK Limited reserves the right to make changes at any time without notice and without incurring any obligation.

2. Why use the Sheffield Lfc Flow-Through Cell?

The Sheffield Lfc flow-through cell is an easy to use and inexpensive solution for measuring dissolved oxygen and other probe measurements in the field or laboratory.

The Sheffield Lfc flow-through cell design features include:

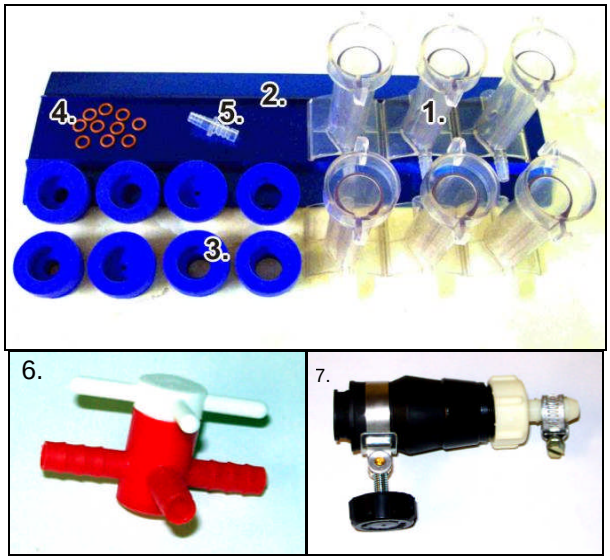
- Modular design.
- Push-fit bungs to accommodate most standard probes.
- Low cell volumes.
- Engineered laminar flow path.
- Low-flow functionality – up to 1.5 litres/minute.
- Rapid flow-through time.
- Simple connection to pumping systems.
- Lightweight.

3. Component Identification

Check the packing list enclosed with your Sheffield Lfc cell for an itinerary of goods ordered.

Components described elsewhere in this manual are referred to in the following diagrams.

3.1. Standard Components



6 Cell Kit

	Description	Product Code
1.	Sheffield Lfc Cell	SLF-Cell
2.	Sheffield Lfc Base Stand (holds up to 6 cells)	SLF-Base
3.	Sheffield Lfc Bungs	SLF-BSet8
4.	Silicone O-Rings	SLFo-RingPk
5.	Sheffield Lfc Cell Inlet Adaptor	SLF-Cad
6.	Sheffield Lfc 3-Way valve	SLF-3WV
7.	Sheffield Lfc Tubing conector assembly including 1-way valve	SLF-TC1

3.2. Optional Components

Additional components, bung sets and spare parts are available from Waterra. Please contact us for additional information.

4. Assembly and Probe Insertion

Prior to use for the first time, assemble as follows.

4.1. Fit O-Rings

The Sheffield Lfc flow-through cell comprises of a number of connected individual cells. Connections between cells are made water tight with o-rings.

- For each cell, fit a single o-ring into the seat (groove) found on the barbed outflow. Ensure the ring is seated correctly.
- Initially, fit a single o-ring to the middle groove of the cell inlet adaptor, check it is well seated. Up to 2 further o-rings may be added if needed.

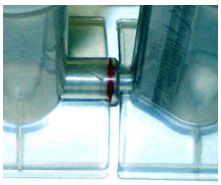
Spare silicone o-rings are available from Waterra.

4.2. Cell Connection

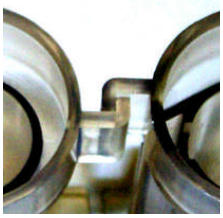
Connect the individual cells together on a flat surface before attaching to the base stand.

- Gently rotate and push-fit the cell inlet adaptor into the sample inlet (marked by a triangle indicating the direction of flow) of one cell.
  Ensure the o-ring is still seated correctly after insertion.

The cell with the cell inlet adaptor is always the first cell in sequence.



- To connect additional cells, gently rotate and push-fit the barbed outlet with o-ring fitting of the preceding cell into the inlet of the next.
  HINT: Rotating during connection will prevent the o-ring from twisting.
  HINT: Moisten the o-ring to aid insertion.



- Lock the tops of the cells loosely together by interlocking the right-angle claws.

4.3. Fit to Base Stand

Up to six connected Sheffield Lfc cells may be fitted to a base stand.

WARNING: The base stand has sharp edges. Care should be taken in handling.

- Slide the base of each cell in turn between the rails on the base stand.

- Check that the tops of connected cells remain interlocked after insertion.
- Check that o-rings are still sealed.

Where more than six cells are required, additional base stands are available from Waterra.

4.4. Bungs

Five bung apertures sizes are available for probe insertion covering most common probe sizes: 3.0, 11.7, 15.8, 17.3, and 19.5 mm. Aperture sizes are labelled on the top of each bung. Additional bung sets are available from Waterra.

It is possible for users to make other aperture sizes (up to 20mm) by using a laboratory cork-borer.

4.5. Inserting Probes

All probes should be calibrated before insertion into the Sheffield Lfc flow-through cell.

WARNING: Water quality probes are delicate instruments. Take care when inserting and withdrawing probes from bungs. Only hold by the main probe body and not by the cable connection or tip of probe.

HINT: Some probes do not have integral temperature sensors. Accurate measurements require temperature compensation. Temperature probes must be inserted into separate cells.

HINT: Wetting the bung will aid insertion of probes.

- Remove any protective caps from the probe.
- Select the most appropriate sized bung aperture for the probe.
- Holding the probe body only, gently push-fit the probe into the bung aperture. If necessary, moisten the bung to help insertion and pull the probe from beneath the bung by holding the probe body.
- Tapered probes should be inserted to sufficient depth to form an adequate seal.

  HINT: Temperature sensors, flow venting holes etc. must be inserted below the base of bung to allow correct operation within the cell.

  HINT: Probes with embossed logos should be aligned where the bung can seal either above or below the design.

- Push-fit the bung containing the probe into the cell. Ensure all 3 ribs of the bung are in contact with the cell wall and the probe is clear of the base of the cell.

  HINT: Hold the probe and bung by the sides of the bung and gently push into the cell.

  WARNING: The maximum depth of insertion is 85 mm. Probes should be set at a height at least 5 mm above the base of the cell to obtain reliable readings and to avoid damage by striking the base of the cell.

4.6. Use with Waterra Supplied Probes

4.6.1. Environmental Monitoring Kit

The following table summarises the recommended bung apertures for use with probes commonly supplied with the Waterra Environmental Monitoring Kit (HI-EMK).

Bung Aperture	Suggested Water Quality Probe	
19.5 mm	HI-76302	Electrical Conductivity
17.3 mm	HI-76407/4	Dissolved Oxygen
11.7 mm	HI-1230B	pH
	HI-3430B	ORP / EH
3.0 mm	HI-7669/2	Temperature

HINT: HI-76302 EC probe: The sheath must remain on the probe. Vent holes in the sheath must protrude below the bung by at least 10mm to allow water to flow freely past sensors.

HINT: HI-1230B pH probe: The bung will not seal fully around the raised logo stamped onto the probe body. The probe should only be inserted into the bung to below this logo.

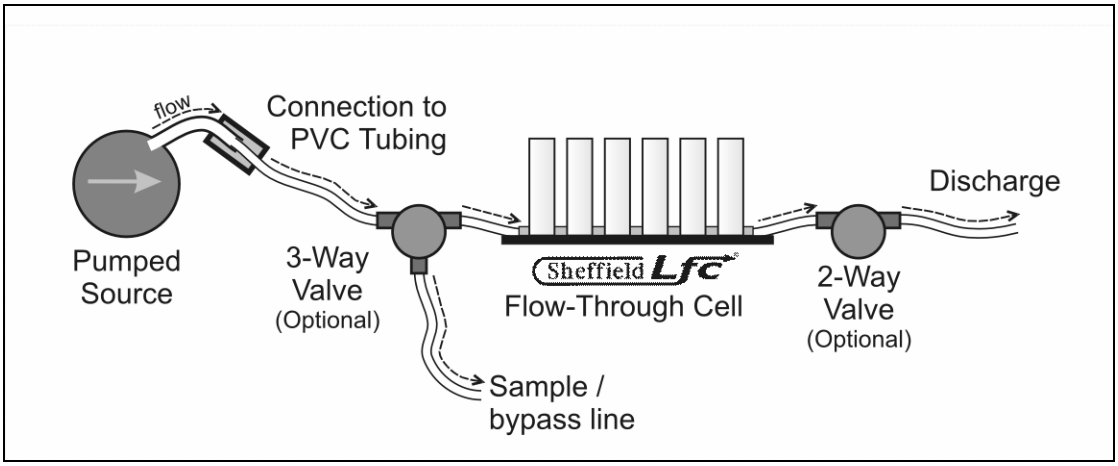
WARNING: HI-7669/2 T probe: The probe must be pushed or pulled through the bung by holding the metal part of the probe only. To avoid damage to the probe do not push or pull the probe into or out of the bung by holding any part of the connecting cable.

4.6.2. Multi-Parameter Meter

The 17.3 mm aperture bung is suitable for use with the probe supplied with the HI-991300/991301 Multi-parameter meter.

17.3 mm	HI-1288	Multi-parameter

5. Pump Connection to Sheffield Lfc Flow-Through Cell



The Sheffield Lfc cell has been designed for use with low-flow pumping rates optimised between 0.5 and 1.0 litre/minute and a maximum flow rate of 1.5 litres/minute.

5.1. Tubing Connections to Cell

The barbed inlet and outlet of the assembled cells are suitable for tubing with an internal diameter of between 7 and 9 mm. Waterra supply PVC tubing for this purpose (SLF-T11mm).

- Push-fit flexible tubing to the barbed inlet and outlet of the assembled cells.

5.2. Use of Valves to Control Flow

A 3-way valve (SLF-3WV) can be attached to the inlet tubing in advance of the Sheffield Lfc flow-through cell. This enables:

- diversion of flow to reduce the flow rate of water to below 1.5 litres/minute into the Sheffield Lfc flow-through cell.
- diversion of flow for sampling (sample line).

A second (optional) 2-way or 3-way valve fitted to the outlet tubing will help to control discharge from the cell in situations where it is important to preserve water or to control the rate of discharge (for example where pumping yields are very small or for laboratory use).

WARNING: The use of the 3-way valve (SLF-3WV) is not recommended for use with the connector kit (SLF-TC1) as it introduces air into the system.

5.3. Customised Pump Connections

The following sections describe the fittings needed to connect the Sheffield Lfc flow-through cell to Waterra inertial pumps and peristaltic pumps. Other pumps can be readily connected using similar types of fittings, though sizes will need to be customised by the user depending on the size of the pump discharge hose and the pumping rate.

5.3.1. Connecting to Waterra Inertial Pumps

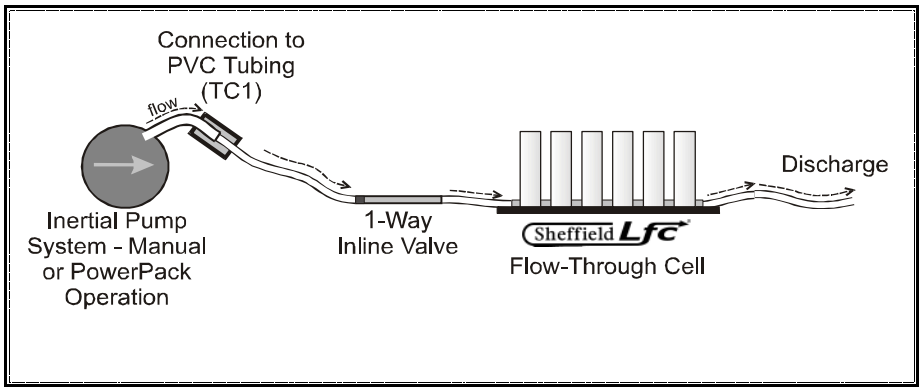
The Sheffield Lfc flow-through cell may be operated with Standard or smaller size Waterra inertial pumps. The following section describes the connections needed for Waterra Standard inertial pump tubing.

When connecting the Sheffield Lfc flow-through cell to any Waterra inertial pump system the SLF-TC1 connector kit is required to remove movement from the action of the inertial pump and to prevent surging of water inside the cells.

Inertial pumps can be operated manually or, to obtain more consistent and sustainable flow rates, by using a Waterra PowerPack.

WARNING: Turn off the Waterra PowerPack during all connection procedures.

1.) Inertial pump system connected to Sheffield Lfc flow-through cell.



The SLF-TC1 Kit is supplied pre-assembled. For use follow the instructions below:

- Tightly clamp the tubing connector (SLF-TC1) to the inertial pump tubing.
- Connect the short length of PVC tubing over valve to the **inlet** of the Sheffield Lfc cell. This should be secured using the supplied worm-drive clip.
- A length of PVC tubing should be push-fitted over the Sheffield Lfc barbed **outlet** to allow control of discharge water.

HINT: Allow 1-2 minutes for water to pass through all cells until all traces of bubbles are removed. This also allows time for the removal of air trapped in the PVC tubing.

WARNING: The use of the 3-way valve (SLF-3WV) is not recommended for use with the connector kit (SLF-TC1) as it introduces air into the system.

REMEMBER: The Sheffield Lfc flow-through cell is designed for low flow rate of around 1 litre/minute (maximum 1.5litres/minute). The cell should be disconnected from the inertial pump if higher pumping rates are used.

REMEMBER: When using the Waterra PowerPack ensure the throttle is set to the lowest speed.

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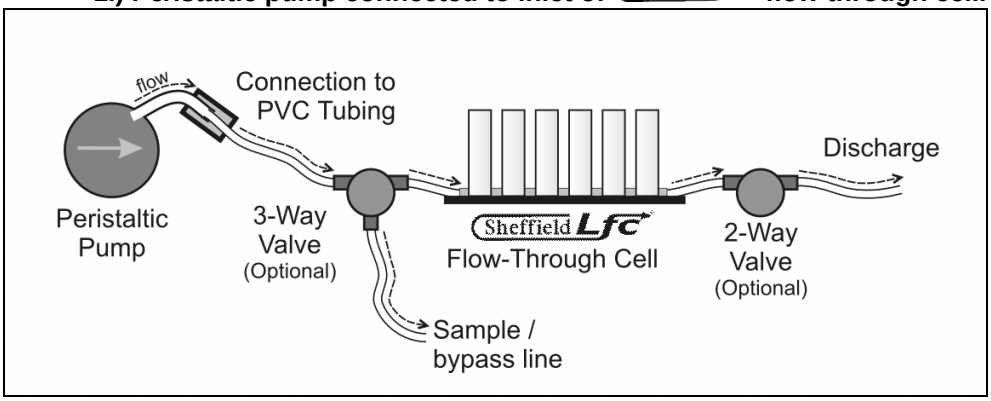
5.3.2. Connecting to Peristaltic Pump

Peristaltic pumps (such as the Solinst S410 peristaltic pump, which is available from Waterra) can be connected to either the inlet or outlet sides of the Sheffield Lfc flow-through cell as described below. Both methods use the SLF-T11mm PVC tubing and SLF-3WV 3-way valve.

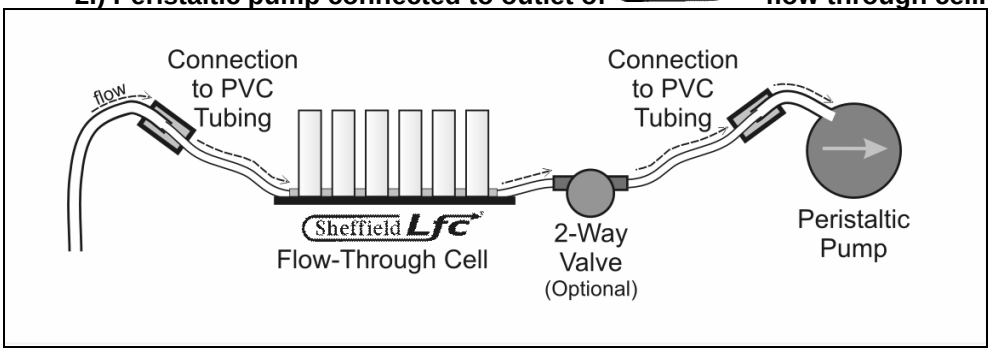
1.) Peristaltic pump connected to inlet of Sheffield Lfc flow-through cell.



In this configuration, the sample is drawn under suction then delivered under positive pressure to the Sheffield Lfc flow-through cell.

- Push-fit the silicone discharge tubing from peristaltic pump to a length of PVC tubing. The tubing should be of sufficient length to reach the Sheffield Lfc flow-through cell.
- Push-fit the PVC tubing outlet to the 3-way valve.
- Connect a short length of tubing from the 3-way valve to the inlet of the Sheffield Lfc flow-through cell.
- Connect a length of tubing to the unused outlet of the 3-way valve to create a sample/bypass line.
- Tubing should be push-fitted to the Sheffield Lfc flow-through cell barbed outlet to provide a directable discharge.

2.) Peristaltic pump connected to outlet of Sheffield Lfc flow-through cell.



In this configuration, the sample is drawn entirely under suction through the Sheffield Lfc flow-through cell.

- Push-fit the sample tubing outlet to a length of PVC tubing of sufficient length to reach the Sheffield Lfc flow-through cell.
- Push-fit the PVC tubing outlet directly onto the Sheffield Lfc flow-through cell inlet. It is not possible to use a 3-way valve to create a sample line.
- Push-fit a length of PVC tubing from the Sheffield Lfc flow-through cell barbed outlet to the silicone inlet tubing of the peristaltic pump.

6. Using Your Sheffield Lfc Flow-Through Cell

WARNING: Though the assembled cells are water tight under normal operating conditions, precautions must be maintained to avoid contact between users and potentially contaminative or harmful liquids during operation. If cells become contaminated and beyond the point of being cleaned, they should be disposed of safely and replaced with new cells.

6.1. Flow rate

The Sheffield Lfc flow-through cell has been designed to operate at flow rates of between 0.5 and 1.0 litres/minute (maximum 1.5 litres/minute). If higher pumping rates are used, the cell bungs are designed to release.

6.2. Expelling air bubbles

Air bubbles may collect in the cells and around probes, particularly when the cells are first filled with liquid.

HINT: Ensure that air bubbles are not entering the assembled cells from the sample pump or badly seated o-ring joints.

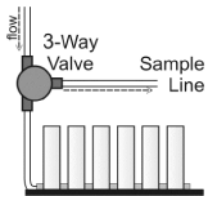
Air bubbles may be expelled by various methods including:

- Temporarily increase the flow rate (to no greater than 1.5 litres/minute). This will force air bubbles around the flow channels and out of the discharge.
- Gently tap cell assembly on a hard surface. The jolt should dislodge any large air bubbles.
- Invert or move the assembled cells to guide air bubbles around through the cells to exit through the discharge outlet.

6.3. Taking Measurements

Once air bubbles are expelled and the sample is flowing through the assembled cells, water quality measurements can be reliably recorded.

6.4. Taking Samples



Samples for other purposes can be taken whilst the Sheffield Lfc flow-through cell is in use. The 3-way valve inserted before the cell inlet can be used to divert a portion of flow away from the sample and into sample bottles or other measurement apparatus.

7. Storage and Maintenance

7.1. Cleaning & Storage

When not in use, the Sheffield Lfc flow-through cell should be cleaned and dried prior to storage.

The Sheffield Lfc flow-through cell may be cleaned by:

- Rinsing cells with (de-ionised) water or a mild acid.
  HINT: The assembled Sheffield Lfc flow-through cell may be connected to a domestic tap using the SLF-TC1 connector.
- Wiping base stand with a damp cloth.

WARNING: Abrasive cleaners and solvents should not be used.

7.2. Maintenance checks

The following should be undertaken in order to maintain the performance of the Sheffield Lfc flow-through cell.

- O-rings should be regularly checked for signs of wear and replaced as necessary.
- Bungs should be replaced if they become loose or damaged.
- Cracked or damaged cells should be replaced.

8. Trouble Shooting

Before contacting Waterra please use the following trouble shooting guide to resolve common difficulties.

Problem	**Possible cause / Remedy**
O-ring not seated correctly onto inlet adaptor or cell outflow.	Stretched, worn or previously used o-ring - replace with new o-rings.
O-ring pulled out of seat during cell connection.	Wet o-rings before connection. Rotate cells slightly during connection to avoid twisting and sideways movement of the o-ring. Stretched, worn or previously used o-ring - replace with new rings.
Cells do not interlock fully when on flat surface.	The cells will interlock when attached to the base stand.
Unable to slide connected cells onto base stand.	Ensure rails on base stand are clean and clear of debris. Ensure cell tops are interlocked fully and cells lie straight.

Probes do not fit tightly into bung apertures.	Check protective cap has first been removed from probe. Bungs are designed to work with certain probe sizes only. Probes sometimes fit more than one bung size - try using different bungs. Wetting a bung will sometimes aid insertion where probes are very tight-fitting. But do not use excessive force to push probes into bungs as this may lead to damage of the probe. Core-out a customised aperture size using laboratory cork-borers using a smaller aperture bung. Additional bung sets may be purchased from Waterra.
Damage to probe tip during insertion	Incorrect insertion procedure - probe pushed in too far. Refer to instruction manual.
Damage to probe connecting cable during insertion or withdrawal	Incorrect procedure - probe should not be gripped by cable connections at any time. Refer to instruction manual.
Air or liquid leak at cell connection.	Worn or badly seated o-ring. Replace or re-seat o-ring. Reduce flow rate. Ensure the top of cells are interlocked.
Air or liquid leak at inlet adaptor.	Check fitted o-ring(s) Try fitting a second o-ring. (3 should only be used in exceptional circumstances)
Air or liquid leak between probe and bung.	Probe not inserted correctly, re-insert. Wrong bung for probe - reassemble with correct bung aperture size. Reduce flow rate.
Inconsistent water quality readings.	Ensure meter is working correctly and is calibrated. Check protective cap has been removed from probe. Ensure all air bubbles are expelled from assembled cells. Fluctuations may be real.

9. Spare Parts and Accessories

A comprehensive range of spares and accessories are available for your Sheffield Lfc flow-through cell. Please contact Waterra or your supplier.

Spares	
SLFo-RingPk	Silicone o-rings (Pack of 10)
SLF-BSet8	8 Sheffield Lfc cell bungs (19.5 mm x2, 17.3 mm, 15.8 mm, 11.7 mm x2, 3.0 mm x2)
SLF-B003	Single 3mm Bung

SLF-B117	Single 11.7mm Bung
SLF-B158	Single 15.8mm Bung
SLF-B173	Single 17.3mm Bung
SLF-B195	Single 19.5mm Bung
SLF-Base	Sheffield Lfc cell base stand (holds up to 6 cells)
SLF-Cad	Sheffield Lfc cell inlet adaptor
SLF-Cell	Sheffield Lfc cell (single cell)
Accessories	
SLF-T11mm	PVC Tubing (11 mm OD x 8 mm ID) per metre
SLF-3WV	3-way polyethylene valve (for 7-9 mm ID tubing)
SLF-TC1 Kit	Connector for Standard Waterra Inertial Pump Tubing, 1-Way Inline Valve and 2m PVC SLF tubing

For details of Waterra Inertial Pumps, peristaltic pumps and other groundwater monitoring products, please view our web site at www.WaterraUK.com.

10. Specifications

It is the policy of Waterra to continually review and update product design, therefore some details may differ from the actual product sold.

All dimensions are approximate and include protrusions.

Cell	
Material	ABS (Acrylonitrile Butadiene Styrene)
Dimensions	110 x 76 x 58 mm
Volume	40 ml
Outlet fitting	7-9 mm ID tubing
Bung	
Material	Silicone
Available apertures	19.5 mm, 17.3 mm, 15.8 mm, 11.7 mm, 3.0 mm
Base Stand	
Material	Anodised Aluminium
Dimensions	400.0 x 11.9 x 1.3 mm
O-Rings	
Material	Silicone
Inlet Adaptor	
Material	ABS
Outlet fitting	7-9 mm ID tubing
Three-Way Valve	
Material	Polyethylene
Inlet / outlet fittings	7-9 mm ID tubing