Parker PF 600
Cell Culture Tray Pump
Operating Manual
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The Parker PF 600 Cell Culture Tray Pump is designed for use with the Quasi Vivo® QV900 Cell Culture Trays. Quasi Vivo is a registered trademark of Kirkstall Limited
1. Unpacking

Remove the packing materials, unpack the pump controller and the power supply unit.

Make sure that you have got all the components as specified in 14. List of components/ last page of this manual.

Please contact your supplier if you notice any one of the components is missing or damaged.

Note: Do not attempt to assemble a unit using damaged components.

Retain the packaging so it can be used for future shipping.

The plug-in power supply unit is Switch Mode and automatically adjusts itself to the mains power supply characteristics. It will work with any mains voltage supply from 100V to 240V.

2. General information on peristaltic pumps

Peristaltic tube pumps are ideal for fluid transfer, metering and dispensing. In contrary to centrifugal and gear pumps, peristaltic pumps handle fluids of various viscosities, are self priming and can operate in either flow direction.

With no valves, seals or packing to come in direct contact with the pumped fluid, they are ideal for pumping high purity & corrosive fluids and for contamination free dosing.

The principle of the peristaltic pump is based on a tube which is occluded by a series of rollers. The bigger the tube diameter—the higher the flow. The larger the angular distance between the rollers—the larger the flow.

The unit is based on a precision peristaltic pump with 4 needle rollers and a max total of eight channels.

The speed of the rotor can be regulated using the speed control dial then set with the locking lever.

The pump unit is delivered standard with ID 0.5mm Silicone tube. Calibrating one channel using the speed control dial will set all channels to the same speed, and flowrate.
3. **Familiarise yourself with the pump dispense tubes cassette**

The supplied pump unit allows for two tube sets of 4 channel each—8 in total. The cell culture tray is designed for 6 channels. Please leave 2 channels unconnected. These will be used for calibration.

To remove the tube set, press the lever on the fixed-tube-clamp and pull out of the guide slot.

### 3.1 Clamping the peristaltic tube

A set consists of 4 tubes held together on each side of the pump with fixed-tube-clamps.

To unclamp the tubes from the pump head, slide one of the fixed-tube-clamps off the unit and then the second clamp until you have the tube set freely in your hand.
3.2 Releasing the peristaltic tube when you have finished

We recommend to remove the tube sets from the pump unit if the pump remains idle for periods longer than 3 days. By preventing pressure points on the tubes this will help to maintain pump dispensing accuracy.

3.3 Replacing the tube

It is recommended to change the tubing after 30 days continuous use (720 hours). Otherwise tubing should be replaced when worn out or wherever you intend to change the tube diameter for different dispense volume range in which you work. After 30 days change the tubing on every pump tube cassette. The tubes should all be the same length before connection.

Slide out the tube clamps and replace the tube, making sure that you have installed the tube centrally and that the tube is fully engaged by the tube guides.

![Photo 1](image-url)
4. Preparing the unit for run

Slide the reservoir bottle tray onto the pump unit.
Connect the reservoir bottles to the pump head using the supplied silicone tubes.
Connect the pump head to the tray using the supplied silicone tubes.

IMPORTANT: The assembled culture tray system must be lifted by the white pump unit section. The culture tray sections are only loosely attached to the pump unit. (see photo #)

The unit should look like this:

Connect the cable from power supply to the unit and plug the power supply into the mains. The power supply will accept any voltage from 100V to 240V.

The 3 toggle switches on the unit are:

1. On/Off
2. Direction—forward or backwards
3. Run/Prime

The Prime switch is a momentary action switch. The switch is designed to accelerate the filling or emptying of the tubes from the bottle reservoirs, through the plate and from there back to the reservoir bottles. Pull the switch towards ‘Prime’ to run the pump at 12.5 times the calibrated speed setting.
5. The speed control dial

The Speed Control Dial is in effect a multi turn potentiometer equipped with a revolution counter. The potentiometer allows for 10 full turns.

The dial can be fixed at any position to avoid accidental change in setting. Use the brake lever to fix the dial.

The control is not completely linear.

Min speed setting 0.0 = 1 rotor rev. each 6.30 minutes.
Speed setting 0:10 = 1 rotor rev. each 50 seconds

Flow rate depends on tube diameter and rotor speed.
The unit is delivered with an IDØ 0.5mm tube. Other tube diameters are available on request.

The flow of the IDØ 0.5mm tube is 10µl per rotor rev.

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<th>µl/min</th>
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</tbody>
</table>

Table 1
6. The support tray

Each support tray can be fitted with either 6 reservoir bottles and one tray, two trays or 12 reservoir bottles. The unit can be extended to fit more than one tray and the trays do not have to be mounted onto the pump unit but can stand independently in the pump’s proximity.

To fix a tray onto the pump unit slide it top to bottom along the back edge of the pump unit until the tray is fully engaged with the pump unit.

Set up Options

**Tubing options**

All the different set ups described can use silicone tube or other materials such as Teflon to connect the chambers to each other and to the pump and reservoir bottle. A 2mm ID silicone tube can be used on its own or as a sleeve connector for other narrower silicone or tubing from other materials like Teflon.

**Single Chamber tests with recirculation**

6 chambers individually linked to a reservoir bottle and a pump cassette. The smaller 30 ml reservoir bottles will normally be used for this test.

**Single Chamber tests with flow through set up**

6 chambers individually linked to a reservoir bottle and a pump cassette with an option to have a flow through to waste. The larger 125 ml reservoir bottles are normally used for this test, and a large waste bottle would need to be connected.

A 6 to 1 manifold connector can be supplied on request. This can be connected to any waste bottle large enough for the purpose of the test.

**6 different tests with three chamber replicates**

Three cell culture trays are set up with three individual chambers linked in series. The inlet of the first of these chambers is connected to a pump cassette and the outlet from the third chamber is connected to the inlet of the reservoir bottle as shown in photo 3. This means that each cell culture tray can have two separate test conditions.

**Other options**

Many other options will be possible such as 1 tray with 3 times 2 replicates and so on. The only limitation is the number of pump heads.

Photo 3
7. Calibrating the flowrate

The Tray Pump kit is supplied with 1 pump tube cassette, 2 reservoir bottles, 1 QV900 cell culture tray and a selection of tubing and connectors.

Set up the QV 900 tray as you would for the experiment you want to run. Connect the inlet of the first test chamber to the outlet connector of the pump cassette with tubing similar to what will be used in the test.

Connect a full reservoir bottle to the inlet connector end of the same pump cassette.

Connect the outlet of the last chamber in the series to the second empty reservoir bottle.

Start the pump and fill the complete circuit with liquid. Stop the pump then empty the receiving bottle and weigh it (without the lid). Now attach the bottle to the lid which should be connected to the test circuit and the flow system should be complete.

Set the speed control dial to the correct desired speed setting using Table 1 on page 8 as a guide. Run the pump for a fixed time (5 or 10 Minutes), but the longer the pump is run the more accurate will be the calculated flowrate).

Unscrew the lid from the return reservoir bottle and weigh the bottle with the fluid. The difference between the empty weight and the full weight divided by the time will be the flowrate in grams per minute. Grams per minute can be converted into ml/min by dividing by the specific gravity of the medium. Most media will have a Specific Gravity close to 1.00, so gm/min will = ml/min). If the flowrate does not match the test requirements, change the speed setting and run the calibration test again.
8. What parameters influence the flowrate

8.1 General
As previously stated, the principle of the peristaltic pump is based on a tube which is occluded by a series of rollers. There are a number of operator controlled parameters that can affect the flowrate.

8.2 Peristaltic Tube material type and diameter
The bigger the tube diameter—the higher the flow. The type of tubing used can affect the flowrate for a given dial setting. PTFE tubing has smoother walls which reduce the drag on the liquid being pumped compared with Silicone.

8.3 Connecting tube total length and diameter
Although peristaltic pumps are generally known as positive displacement pumps, the flowrate is affected by the pressure drop over the flow circuit. This simply means that the longer the tube and the narrower the diameter of the tube the greater the pressure drop from the pump to the return in the reservoir bottle. This can be measured by measuring the pressure just after the pump cassette. To achieve the same flowrate at a higher pressure drop requires a faster pump speed. At flowrates up to 1 ml/min there is almost zero pressure drop over the QV900 chamber under normal set up.

8.4 Number of chambers in series
Similar to point 8.3, the more chambers that are connected in series the higher the pressure drop will be, and the higher the speed will need to be to obtain the correct flowrate.

8.5 Density and viscosity of the media
More viscous materials (syrups, and gels are more viscous than water) require more energy to pump them round a circuit. Therefore the flowrate will be reduced for the same pump speed setting.

8.6 Speed of pump and electrical supply
Obviously the speed of the pump as controlled by the speed control dial will alter the flowrate of the pump. Some pumps work on a fixed AC to DC converter and changing the voltage supply can change the speed of the pump. The PF 600 is supplied with a Switch Mode power supply unit, so should not be affected by a change in voltage supply.
9. Handling sterile parts

The calibration process can and should be carried out with unsterile parts. The calibration can then be carried out on a normal laboratory bench. The system is designed to run in a sterile mode. A Quasi Vivo® 900 cell culture tray kit can be purchased to run experiments on the PF 600 Tray Pump. This will be supplied bagged and sterilised. Experiments should be set up in a laminar airflow sterile cabinet. The pump cassettes, tubing, and bottle caps can all be reused after they have been steam sterilised in an autoclave. The external surfaces of the Pump and Tray units can be sprayed with a suitable sterilising liquid. The sterile bagged items should only be opened, and the experiment set up inside the sterile cabinet. Once the flow circuit has been completed, and the reservoir bottles filled with medium the complete assembly is sealed can be used to run a sterile experiment, and the equipment can be moved to an incubator.
10. Connecting the circuit

For an experiment with 6 different circuits, it is important to have a system for connecting all the individual components together. Some examples that can be used are:

1. Colour code the tube sleeves with a marker pen or tape on the inlet and outlet of the pump cassette and the inlet to the cell culture chamber and the reservoir bottle. Connectors should also be colour coded if used.

2. Connect the inside reservoir bottle to the outside cell chamber and chamber 1 to the lowest pump cassette, followed by chamber 2 on the second lowest cassette and so on.

3. Number the reservoir bottles to match the numbers on the culture chambers.

4. Using tube connectors can simplify the set up of the experiment. The tubing used to connect the chambers to each other and to the pump and reservoir bottle is up to the user. 2 mm ID silicone tube is the simplest option. A very good alternative is a Teflon tube with ID 1.5 mm and OD of 2.3 mm. Parker part number TFS 15 NT. This can be connected using 2mm silicone tube sleeves as shown in photo 4.

Photo 4
11. Running an experiment

11.1 Set Up
The first step is to design and set up the cell culture circuit as described above. Everything should be sterile and ready to run. Make sure that the tubing is free from tight bends that can kink the tube and cause a flow restriction. It is recommended that ALL the following set up procedures are carried out inside the sterile cabinet.

11.2 Filling the reservoir bottles
The reservoir bottles must be filled with sterile medium inside the sterile cabinet. Care should be taken to make sure the lids are securely fitted to avoid a breach of sterility. Depending on the set up it is possible that the reservoir bottles might need topping up when the circuit is filled up with medium. This should also be done in the sterile hood.

11.3 Adding the cells or tissue to be cultured
Before completing the set up, the cells should already have been fixed to a growing surface. This can be a scaffold, alginate beads, a gel system, microscope slide coverslips, or directly on the base of the QV 900 chambers.
They can then be inserted into the QV 900 chambers and the chambers sealed. Make sure the chamber lids are pressed down securely and then turned and locked in place. Cells can also be fixed directly onto the base inside the QV 900 Cell Chambers.
It is possible to fill the system with medium, reverse the flow to empty the headspace in the chambers and then add the cells fixed to their growth support. The circuit can then be filled as normal. Alternatively 2 mls of medium can be pipetted manually into each chamber to stop the cells drying out during the priming process.

11.4 Priming the system
Having added the cells, set the speed control to the desired flowrate as previously calibrated (see section 7). Push the On/Off switch to On, make sure the flow/reverse switch is in the right direction and hold down the prime switch. The pump will rapidly fill up the circuit. If there is no fluid movement visible after 2 minutes release the prime switch and check that the cassette pumps are connected to the outlet from the reservoir bottle with the long tubing inside the bottle. Then check the flow is in the right direction.
Once the medium is flowing hold the prime switch down until the circuit is completely full. All the air bubbles and pockets in the chambers and tubing should automatically disappear. If some remain, tapping and tilting the chambers and tapping or squeezing the tube can help remove the air. Once the circuit is completely full release the prime switch.
At any time the prime switch can be used with the reverse switch to empty the surface headspace in the chambers.

11.5 Running conditions
Once the pump has been successfully used to fill up the system and everything seems to be working correctly the complete unit can be transferred to a heated incubator. The only connection outside the incubator will be the power connection. It is recommended that the AC/DC adaptor is left outside the incubator to prevent heat generation.
The pump will now run at the calibrated speed and flowrate as long as required. Depending on the system it may be necessary to replace some of the medium in the reservoir bottles every 2-3 days.
11.6 Different types of handling

11.6.1 Sampling the medium
Medium can be sampled in many ways. A number of sampling ports with Luer connector fittings are commercially available. These can be fitted anywhere in the circuit, including between two chambers.
Medium can also be sampled from the reservoir bottle. An example of a sampling connector is shown.

![Photo 5](image)

Valved needle-free syringe connection, with the female inlet connection activated by the male side of the syringe (F1 Luer Connectors 30526-10)

11.6.2 Opening the chambers
Anytime a chamber is opened even under the sterile cabinet, there is a chance of cell infection. Nevertheless, it is possible to open the chambers during an experiment.
Put the complete PF 600 unit inside a sterile cabinet. With the pump off reverse the flow, then start the pump again and hold down the prime switch. The medium will quickly be pumped back in to the reservoir bottle and leave the headspace in each chamber empty. The chamber lid can then be removed with minimal loss of medium.
When resealing the chamber make sure the lid is pushed firmly on to the base and the turned and locked in place.

![Photo 6](image)

11.6.3 Putting the trays on a microscope stage
The base of each cell culture tray is transparent and can be placed on a microscope stage. There are two main options for moving the trays.
A) Inside a sterile cabinet, empty the headspace in the chambers by reversing the flow. Disconnect the chambers from the pump cassette and the reservoir bottle and seal the open tubes with connectors. The trays can now be moved and place on a microscope stage. Reverse the procedure when finished and prime the chambers again.
B) Use tubing that is long enough to move the tray without disconnecting it. Then the pump can sit next to a microscope and the tray moved on to the microscope stage.
The choice of option is up to the user.
12. Care and Maintenance

12.1 Control Unit
The control unit is maintenance free. The peristaltic tubes however require replacement as soon as excessive wear or a large variation in dispense volumes are noticed.

The operational life of the tubes is a function of the rotor speed and load.

Avoid running the tubes dry for longer than a few minutes.

Check the peristaltic tubes weekly for signs of excessive wear and replace if required.

Pump tubes which remain stretched over the rotor rollers for longer period of time in idle state will deteriorate. Therefore, remove the tubes from the rollers if the pump is not in use for more than 3 days.

Unplug the power supply from the unit when not in use for more than 2 days.

12.2 Reusing tubing and pump tube sets
Teflon (PTFE) tubing and Silicone tubing and the polycarbonate pump cassettes can be steam sterilised in an autoclave. They should be bagged and sterilised then handled like any sterile supplied part. However if a long experiment has been run complete replacement of all the tubing is recommended. Silicone tube is permeable and proteins can bind to the surface potentially compromising future experiments. Teflon tubing has a very low incidence of non specific binding.

12.3 Reusing reservoir bottles
The reservoir bottles for the Parker pumps are supplied separately in a kit together with the QV 900 cell culture chamber plates.

Bottle caps
The Parker bottle caps are made from polycarbonate and can be steam sterilised in an Autoclave.

Bottles
Please follow the instructions for sterilising the bottle as shown on the packaging. Some bottles can be steam sterilised others are made from High Density Polyethylene and will not survive autoclaving.
General cleaning
It is important for all equipment in a sterile cabinet to be clean. The pump unit and the support trays should be cleaned after each experiment, and kept clean during the experiment. The units can be sprayed with appropriate sterilising fluid before being placed in the sterile cabinet. Tubing, connectors and reservoir bottles should be changed when necessary. These components are low cost disposable items and using a damaged or worn parts could compromise the results of an experiment.

Photo 8
13. Exclusion

If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment might be impaired.
This instrument is NOT suitable for use in explosion hazard environments.
This equipment is not suitable and should not be used for medical applications.

14. List of components

- Pump Unit with 8 headed pump, on/off switch, lockable vernier speed control, priming switch and reverse flow switch. One tube set with clips and connectors preinstalled.
- 2 Tray units that can be clipped together with the pump unit. Note that the attachment to the pump unit is not fixed. When picking up the assembled units the pump unit must be picked up first.
- 2 Reservoir bottles in sterile bags, complete with caps, filters and tube inserts
- 1 Sterile bagged pump tube cassette set with clips and connectors.
- Tubing to connect the system
- 1 unsterile Quasi Vivo cell culture tray for pump calibration

A separate Quasi Vivo 900 kit can be purchased to run experiments using the pump. Part number QV900-TPK-1
Appendix

Component ordering numbers
Pump unit (with 110V-240V PSU and power cord) ........................................ PF660
Power Supply Unit (spare) ................................................................. TBA
Power cord—UK ........................................................................... TBA
Power cord—EU ........................................................................ TBA
Power cord—USA ........................................................................ TBA
Tray Support unit ............................................................... PF670
1 off silicone pump tube cassette set with connectors. ......................... PF-TS-B4
1 30 ml reservoir bottle with cap. ..................................................... PF-RES-30S
1 off bottle 125 ml ............................................................. PF-RESB-125
Silicone tubing 0.5mm ID x 2.5mm OD. ........................................... SI 0.5x2.5
Operating Instructions .......................................................... TBA