WATSON MARLOW Pumps

WATSON-MARLOW BREDEL MANUALS

m-323dz-gb-04

Watson-Marlow 323Dz pumps

Contents

1 Declaration of conformity

This declaration was issued for Watson-Marlow 323Dz pumps on November 1, 2007. When this pump unit is used as a stand-alone pump it complies with: Machinery Directive 2006/42/EC, EMC Directive 2004/108/EC.

This pump is ETL listed: ETL control number 3050250. Cert to CAN/CSAstd C22.2 No 61010-1. Conforms to UL std 61010A-1.

See 8 *Pump specifications*.

2 Declaration of incorporation

When this pump unit is to be installed into a machine or is to be assembled with other machines for installations, it must not be put into service until the relevant machinery has been declared in conformity with the Machinery Directive 2006/42/EC.

Responsible person: Christopher Gadsden, Managing Director, Watson-Marlow Limited, Falmouth, Cornwall TR11 4RU, England. Telephone +44 (0) 1326 370370 Fax +44 (0) 1326 376009.

The information in this user guide is believed to be correct at the time of publication. However, Watson-Marlow Limited accepts no liability for errors or omissions. Watson-Marlow Bredel has a policy of continuous product improvement, and reserves the right to alter specifications without notice. This manual is intended for use only with the pump it was issued with. Earlier or later models may differ. The most up-to-date manuals appear on the Watson-Marlow website: http://www.watson-marlow.com

3 Two-year warranty

Watson-Marlow Limited ("Watson-Marlow") warrants, subject to the conditions and exceptions below, through either Watson-Marlow, its subsidiaries, or its authorised distributors, to repair or replace free of charge, any part of the product which fails within two years of the day of manufacture of the product. Such failure must have occurred because of defect in material or workmanship and not as a result of operation of the product other than in normal operation as defined in this pump manual.

Watson-Marlow shall not be liable for any loss, damage, or expense directly or indirectly related to or arising out of the use of its products, including damage or injury caused to other products, machinery, buildings, or property, and Watson-Marlow shall not be liable for consequential damages, including, without limitation, lost profits, loss of time, inconvenience, loss of product being pumped, and loss of production. This warranty does not obligate Watson-Marlow to bear any costs of removal, installation, transportation, or other charges which may arise in connection with a warranty claim.

Conditions of and specific exceptions to the above warranty are:

Conditions

- Products must be returned by pre-arrangement, carriage-paid, to Watson-Marlow, or a Watson-Marlow approved service centre.
- All repairs or modifications must have been made by Watson-Marlow Limited, or a Watson-Marlow approved service centre or with the express permission of Watson-Marlow.
- Warranties purporting to be on behalf of Watson-Marlow made by any person, including representatives of Watson-Marlow, its subsidiaries, or its distributors, which do not accord with the terms of this warranty shall not be binding upon Watson-Marlow unless expressly approved in writing by a Director or Manager of Watson-Marlow.

Exceptions

- The warranty shall not apply to repairs or service necessitated by normal wear and tear or for lack of reasonable and proper maintenance.
- All tubing and pumping elements as consumable items are excluded.
- Products which, in the judgment of Watson-Marlow, have been abused, misused, or subjected to malicious or accidental damage or neglect are excluded.
- Electrical surge as a cause of failure is excluded.
- Chemical attack is excluded
- All pumphead rollers are excluded.
- Pumpheads from the 313/314 retain their one-year standard pumphead warranty. The drive they are attached to is subject to the two-year warranty as set out here.
- Ancillaries such as leak detectors are excluded.

4 When you unpack your pump

Unpack all parts carefully, retaining the packaging until you are sure all components are present and in good order. Check against the components supplied list, below.

Packaging disposal

Dispose of packaging materials safely, and in accordance with regulations in your area. The outer carton is made of corrugated cardboard and can be recycled.

Inspection

Check that all components are present. Inspect components for damage in transit. If anything is missing or damaged, contact your distributor immediately.

Components supplied

Watson-Marlow 323Dz pumps are supplied as:

- Dedicated 323Dz pump drive unit fitted with one or more 313 or 314 pump-heads or a 501RL pumphead (see 8 *Pump specifications*).
- The designated mains power lead for your pump
- PC-readable CDROM containing these operating instructions
- Quick Start manual

Note: Some versions of this product will include components different from those listed above. Check against your purchase order.

Storage

This product has an extended shelf life. However, care should be taken after storage to ensure that all parts function correctly. Users should be aware that the pump contains a battery with an unused life of seven years. Long-term storage is not recommended for peristaltic pump tubing. Please observe the storage recommendations and use-by dates which apply to tubing you may wish to bring into service after storage.

5 Information for returning pumps

Equipment which has been contaminated with, or exposed to, body fluids, toxic chemicals or any other substance hazardous to health must be decontaminated before it is returned to Watson-Marlow or its distributor.

A certificate included at the rear of these operating instructions, or signed statement, must be attached to the outside of the shipping carton. This certificate is required even if the pump is unused. See 25 *Decontamination certificate*.

If the pump has been used, the fluids that have been in contact with the pump and the cleaning procedure must be specified along with a statement that the equipment has been decontaminated.

6 Peristaltic pumps - an overview

Peristaltic pumps are the simplest pump, with no valves, seals or glands to clog or corrode. The fluid contacts only the bore of a tube, eliminating the risk of the pump contaminating the fluid, or the fluid contaminating the pump. Peristaltic pumps can run dry.

How they work

A compressible tube is squeezed between a roller and a track on an arc of a circle, creating a seal at the point of contact. As the roller advances along the tube, the seal also advances. After the roller has passed, the tube returns to its original shape, creating a partial vacuum which is filled by fluid drawn from the inlet port.

Before the roller reaches the end of the track, a second roller compresses the tube at the start of the track, isolating a packet of fluid between the compression points. As the first roller leaves the track, the second continues to advance, expelling the packet of fluid through the pump's discharge port. At the same time, a new partial vacuum is created behind the second roller into which more fluid is drawn from the inlet port.

Backflow and siphoning do not occur, and the pump effectively seals the tube when it is inactive. No valves are needed.

The principle may be demonstrated by squeezing a soft tube between thumb and finger and sliding it along: fluid is expelled from one end of the tube while more is drawn in at the other.

Animal digestive tracts function in a similar way.

Suitable applications

Peristaltic pumping is ideal for most fluids, including viscous, shear-sensitive, corrosive and abrasive fluids, and those containing suspended solids. They are especially useful for pumping operations where hygiene is important.

Peristaltic pumps operate on the positive displacement principle. They are particularly suitable for metering, dosing and dispensing applications. Pumps are easy to install, simple to operate and inexpensive to maintain.

7 Safety notes

In the interests of safety, this pump and the tubing selected should only be used by competent, suitably trained personnel after they have read and understood this manual, and considered any hazard involved. If the pump is used in a manner not specified by Watson-Marlow Limited, the protection provided by the pump may be impaired.

This symbol, used on the pump and in this manual, means: Caution, refer to accompanying documents.

This symbol, used on the pump and in this manual, means: Do not allow fingers to contact moving parts.

This symbol, used on the pump and in this manual, means: Recycle this product under the terms of the EU Waste Electrical and Electronic Equipment (WEEE) Directive.

There is a user-replaceable type T1.0AH 250V fuse in the fuse drawer of the IEC mains connector at the back of the pump, which also contains a spare fuse. In some countries, the mains power plug contains an additional replaceable fuse. There are no user-serviceable fuses or parts inside this pump.

Fundamental work with regard to lifting, transportation, installation, starting-up, maintenance and repair should be performed by qualified personnel only. The unit must be isolated from mains power while work is being carried out.

Any person who is involved in the installation or periodic maintenance of this equipment should be suitably skilled or instructed and supervised using a safe system of work. In the UK this person should also be familiar with the Health and Safety at Work Act 1974.

There are moving parts inside the pumphead. Before opening the track, ensure that the following safety directions are followed.

- Ensure that the pump is isolated from the mains power.
- Ensure that there is no pressure in the pipeline.
- If a tube failure has occurred, ensure that any fluid in the pumphead has been allowed to drain to a suitable vessel, container or drain.
- Ensure that protective clothing and eye protection are worn if hazardous fluids are pumped.
- Primary operator protection from rotating parts of the pump is provided by the pumphead track. See 21 *Pumpheads*.

This product does not comply with the ATEX directive and must not be used in explosive atmospheres.

This pump must be used only for its intended purpose. The pump must be accessible at all times to facilitate operation and maintenance. Access points must not be obstructed or blocked. The pump's mains plug is the disconnecting device (for isolating the motor drive from the mains supply in an emergency). Do not position the pump so that it is difficult to disconnect the mains plug. Do not fit any devices to the drive unit other than those tested and approved by Watson-Marlow. Doing so could lead to injury to persons or damage to property for which no liability can be accepted.

If hazardous fluids are to be pumped, safety procedures specific to the particular fluid and application must be put in place to protect against injury to persons.

The exterior surfaces of the pump may get hot during operation. Do not take hold of the pump while it is running. Let it cool after use before handling it.

No attempt should be made to run the drive without a pumphead fitted.

8 Pump specifications

Labels fixed to the rear of the pump contain manufacturer and contact details, product reference number, serial number and model details.

8.1 Pump features

This pump can be controlled from the keypad (or a footswitch for dosing). It features:

Manual control
Speed adjustment; run and stop; direction control.

Remote control
Dose starts can be controlled with a contact closure or logic input signal.

Dispensing
The pump dispenses measured volumes of fluid as single doses, batches or as a timed sequence of doses. Ramp and drip control.

High-speed model

323Dz with 313D three-roller flip-top pumphead: maximum speed 400 rpm; or 314D four-roller flip-top pumphead: maximum speed 300 rpm; for 1.6mm wall thickness tubing up to 8mm diameter.

Low-speed model

323Dz with 501RL 1.6mm wall tubing pumphead for tubing up to 8mm diameter: max speed 300 rpm. Note: It is possible to fit 313 and 314 pumpheads to a low-speed 323Dz drive by the use of an adaptor plate: part no 039.0031.000.

The 323Dz is available with a choice of gearboxes: a long-nosed gearbox, which offers 1-300 rpm and can be fitted with a 501RL or a 501RL2 pumphead, or a 313D/A or a 314D/A pumphead (which includes an adaptor plate)*; or a short-nosed gearbox, which offers 2-400 rpm and can be fitted with a 313 or 314 pumphead. See 21 *Pumpheads* for further information.

* 313D/A and 314D/A pumpheads should not be confused with 313DA and 314DA pumpheads, which are ATEX-compliant models for use in explosive atmospheres.

IP (Ingress Protection) and NEMA definitions

IP				NEMA	
1st Digit		2nd Digit			
3	Protected against ingress of solid objects with a diameter of more than 2.5mm. Tools, wires etc with a thickness of more than 2.5mm are prevented from approach	**1**	Protection against dripping water falling vertically. No harmful effect must be produced	**2**	Indoor use to provide a degree of protection against limited amounts of falling water and dirt
5	Protected against harmful dust deposits. Ingress of dust is not totally prevented but the dust must not enter in sufficient quantity to interfere with satisfactory operation of the equipment. Complete protection against contact	**5**	Protection against water projected from a nozzle against the equipment (enclosure) from any direction. There must be no harmful effect (water jet)	**12**	Indoor use to provide a degree of protection against dust, falling dirt and dripping, non-corrosive liquids
				13	Indoor use to provide a degree of protection against dust and spraying of water, oil and non-corrosive coolants
6	Protection against ingress of dust (dust-tight). Complete protection against contact	**6**	Protection against heavy seas or powerful water jets. Water must not enter the equipment (enclosure) in harmful quantities (splashing over)	**4X**	Indoor or outdoor use* to provide a degree of protection against splashing water, wind-blown dust and rain, hose-directed water; undamaged by the formation of ice on the enclosure. (Resist corrosion: 200-hour salt spray)

* Protect from prolonged UV exposure.

Pump specifications

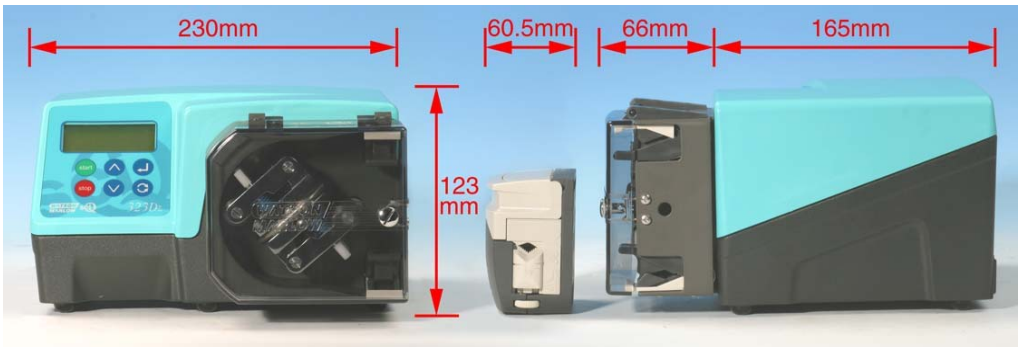
Supply voltage/frequency	100-120V/200-240V 50/60Hz 1ph
Maximum voltage fluctuation	±10% of nominal voltage. A well regulated electrical mains supply is required along with cable connections conforming to the best practice of noise immunity
Installation category (overvoltage category)	II
Power consumption	100VA
Full load current	<0.43A at 230V; <0.86A at 115V
Eprom version	Accessible through pump software
Enclosure rating	IP31 to BS EN 60529; Equivalent to NEMA 2. Suitable for indoor use. Protected against dripping water and falling dirt. May be wiped with a damp cloth but should not be immersed
Operating temperature range	4C to 40C, 40F to 104F
Storage temperature range	-40C to 70C, -40F to 158F
Maximum altitude	2,000m, 6,560ft
Humidity (non-condensing)	80% up to 31C, 88F, decreasing linearly to 50% at 40C, 104F
Weight	See 8.2 *Dimensions*
Noise	<70dB(A) at 1m

Absolute minimum dose size	Two revolutions
Recommended minimum dose size	Five revolutions
Maximum single dose size	9,999 litres
Minimum number of doses	1
Maximum number of doses	9,999
Minimum interval between doses	0.1 second
Maximum interval between doses	999 seconds

Standards

EC harmonised standards	Safety of machinery—electrical equipment of machines: BS EN 60204-1
	Safety requirements for electrical equipment for measurement, control and laboratory use: BS EN 61010-1 incorporating A2 Category 2, Pollution degree 2
	Degrees of protection provided by enclosures (IP code): BS EN 60529 amendments 1 and 2
	Conducted emissions: BS EN 55011 A1 and A2, Class A, called by BS EN 61000-6-4
	Radiated emissions: BS EN 55011 A1 and A2, Class A, called by BS EN 61000-6-4
	Electrostatic discharge: BS EN 61000-4-2
	Radiated RF immunity: BS EN 61000-4-3 A1 and A2, called by BS EN 61000-6-2
	Fast transient burst: BS EN 61000-4-4 A1 and A2, Level 3 (2kV), called by BS EN 61000-6-2
	Surge immunity: BS EN 61000-4-5 A1 and A2, called by BS EN 61000-6-2
	Conducted RF immunity: BS EN 61000-4-6, called by BS EN 61000-6-2
	Voltage dips and interruptions: BS EN 61000-4-11, called by BS EN 61000-6-2
	Mains harmonics: BS EN 61000-3-2 A2
	Pumps and pump units for liquids—common safety requirements: BS EN 809
Other standards	UL 61010A-1
	CAN/CSA-C22.2 No 61010-1
	Conducted emissions FCC 47CFR, Part 15.107
	Radiated emissions FCC 47CFR, Part 15
	NEMA 2

8.2 Dimensions



Unit weights

	Drive only	+ 313	+ 501RL
323Dz	4.5kg, 9lb 15oz	4.8kg, 10lb 9oz	5.5kg, 12lb 2oz

9 Good pump installation practice

9.1 General recommendations

Position

A correctly engineered installation will promote long tube life. Site the pump on a flat, horizontal, rigid surface, free from excessive vibration. Allow a flow of air around the pump to ensure that heat can be dissipated. Ensure that the temperature around the pump does not exceed 40C.

Emergency disconnection

The pump's mains plug is the disconnecting device (for isolating the motor drive from the mains supply in an emergency). Do not position the pump so that it is difficult to disconnect the mains plug. The **STOP** key on the keypad will always stop the pump. However, it is recommended that a suitable local emergency stop device is fitted into the mains supply to the pump.

Valves

Peristaltic pumps are self-priming and self-sealing against backflow. No valves are required in inlet or discharge lines. Valves in the process flow must be opened before the pump operates. Users are advised to fit a pressure relief device between the pump and any valve on the discharge side of the pump to protect against damage caused by accidental operation with the discharge valve closed.

The pump may be set up so that the direction of rotor rotation is clockwise or counter-clockwise, whichever is convenient. Please note, however, that with a 501RL pumphead tube life will be greater if the rotor rotates clockwise; and that performance against pressure will be maximised if the rotor rotates counter-clockwise.

Tubing materials: run-in advice

Sta-Pure and Marprene tubing are hard to compress when new. When using tubing made of these materials, the first 30 seconds should be at a speed of 10 rpm or greater. If the pump is run slower, the safety system built into pump drive's software may cause it to stop and display an over-current error message.

9.2 Do’s and do not’s

Do operate the pump on a flat horizontal surface. The pump requires a free flow of air for cooling. Do not block the air vents beneath the pump or at the rear.

Do not stack pumps more than three high.

Do use only single phase mains electricity supplies.

Do keep delivery and suction tubes as short and direct as possible - though ideally not shorter than 1m - and follow the straightest route. Use bends of large radius: at least four times the tubing diameter. Ensure that connecting pipework and fittings are suitably rated to handle the predicted pipeline pressure. Avoid pipe reducers and lengths of smaller bore tubing than the pumphead section, particularly in pipelines on the suction side. When pumping viscous fluids use pipe runs with a bore several times larger than the pump tube. Any valves in the pipeline (not usually needed) must not restrict the flow. Any valves in the flow line must be open when the pump is running.

Do ensure that on longer tube runs at least 1m of smooth bore flexible tubing is connected to the inlet and discharge port of the pumphead to help to minimize impulse losses and pulsation in the pipeline. This is especially important with viscous fluids and when connecting to rigid pipework.

Do site the pump at or just below the level of the fluid to be pumped if possible. This will ensure flooded suction.

Do keep the pumphead track and all moving parts clean and free from contamination and debris.

Do run at slow speed when pumping viscous fluids. Flooded suction will enhance pumping performance in all cases, particularly for materials of a viscous nature.

Do recalibrate after changing pump tubes, fluid, or any connecting pipework. It is also recommended that the pump is recalibrated periodically to maintain accuracy.

When using Marprene or Bioprene continuous tubing, do re-tension the tube after the first 30 minutes of running.

Tube selection: The chemical compatibility lists published in Watson-Marlow publications are guides. If in doubt about the compatibility of a tube material and the duty fluid, request a Watson-Marlow tube sample card for immersion trials.

10 Connecting this product to a power supply

A well regulated electrical mains supply is required along with cable connections conforming to the best practice of noise immunity. It is not recommended to site these drives alongside "dirty" electrical mains supplies such as 3-phase contactors and inductive heaters without special attention being paid to unacceptable mains-borne noise.

The voltage selector is mounted in the switchplate at the rear of the pump. Set the voltage selector to 115V for 100-120V 50/60Hz supplies or 230V for 200-240V 50/60Hz supplies. Always check the voltage selector switch before connecting the mains supply. Make suitable connection to an earthed, single-phase mains electricity supply. To comply with Safety Standards, the mains plug must be a separable plug (not a locking type).

We recommend using commercially available supply voltage surge suppression where there is excessive electrical noise.

Input line fusing: type T1.0AH 250V 20mm time-delayed cartridge fuse, located in the combined mains IEC inlet socket and fuse drawer at the rear of the pump.

Note: A spare fuse is also provided in the drawer.

Conductor coding

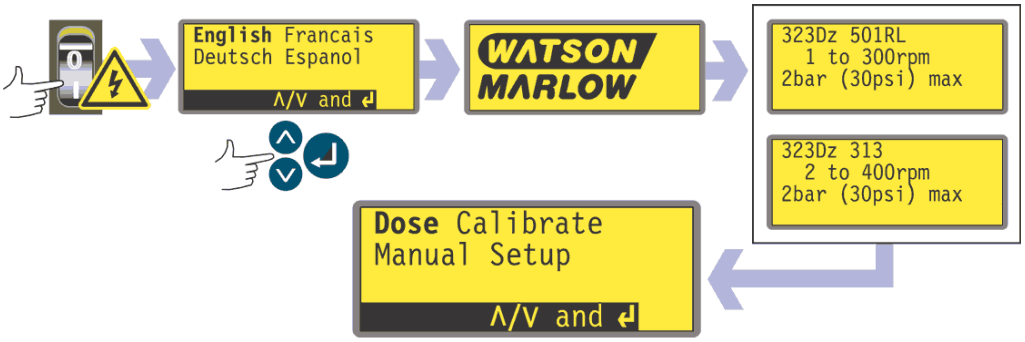
	European	North American
live	brown	black
neutral	blue	white
ground	green/yellow	green

11 Start-up check list

- Ensure that proper connections are achieved between the pump tube and suction and discharge piping.
- Ensure proper connection has been made to a suitable power supply.
- Ensure that the recommendations in section 9 Good pump installation practice are followed.
- Check the position of the voltage selector switch
- Check the mains power switch at the rear of the pump
- Check the fuse in the mains inlet socket at the rear of the pump
- Ensure that the mains IEC plug is correctly fitted in the mains IEC inlet socket

12 Switching the pump on for the first time

Note: This manual uses **bold** type to highlight the active option in menu screens: E**nglish**" in the first screen represented here. The active option appears on the pump display in inverse text.



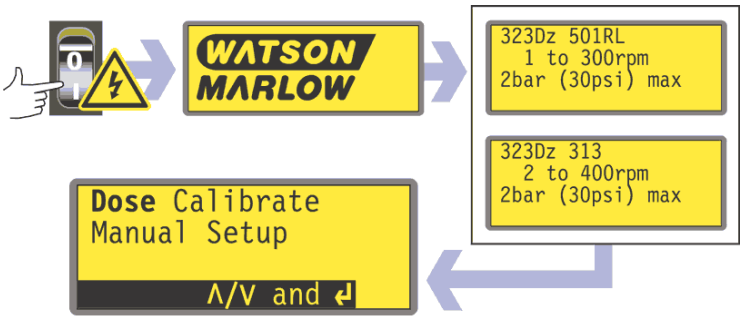
- Switch on the power supply at the rear of the pump. The pump runs a power-on test to confirm proper functioning of the memory and hardware. If a fault is found, an error message is displayed. See 16.1 *Error messages*.
- The pump displays a language menu. Use the **UP** and **DOWN** keys to select your language. Press the **ENTER** key to confirm your choice.
- **The information which follows assumes that your choice was English.**
- When the language is chosen this menu will not appear again and all menus will appear in the language you chose. (Language can be reset as described later. See 15.1.4 *Language*.)
- The pump displays the Watson-Marlow start-up screen for four seconds, followed by the pump model identity screen for four seconds (examples are shown here), and then the main menu.
- The rotation symbol on the display indicates clockwise rotation. The speed of rotation is the pump's maximum. Other initial start-up operational parameters are listed in the table below.

First-time start-up defaults			
Language	Not set	**Backlight**	On
Speed	Maximum	**Auto-restart**	Off
Direction	Clockwise	**Pump status**	Stopped
Calibration	**400 rpm**: 313, 8mm tube **300 rpm**: 501RL, 8mm tube	**Beeper**	On

The pump is now ready to operate according to the defaults listed above.

All operating parameters may be changed by means of key-presses. See 14 Manual operation.

13 Switching the pump on in subsequent power cycles (if not in auto-restart mode)



- Switch on the power supply at the rear of the pump. The pump runs a power-on test to confirm proper functioning of the memory and hardware. If a fault is found, an error message is displayed. See 16.1 *Error messages*.
- The pump displays the Watson-Marlow start-up screen for four seconds, followed by the pump model identity screen for four seconds (examples are shown here), and then the main menu.
- **Note**: If *any* key is pressed during the display of any of the preliminary screens, the display jumps to the next screen. Quickly pressing any two keys or any key twice immediately after switch-on causes the display to jump to the main menu. In the main menu, keys assume their normal functions - see 15.2 *Manual control*.
- Start-up defaults are those in place when the pump was switched off last. Check that the pump is set to operate as you require it.

The pump is now ready to operate. If the pump starts immediately, look for the **!** symbol on the display. This symbol indicates that the pump is set for auto-restart. Press the **STOP** key to stop the pump. See 14 *Auto-restart*.

All operating parameters may be changed by means of key-presses. See 15.2 *Manual control*.

14 Auto-restart facility

Auto-restart will re-start the pump after mains power interruptions.

In auto-restart mode, if the pump was previously dispensing a dose, it returns to the dose start screen and waits for the **START** key (or remote dose start switch) to be pressed.

If the pump was previously under manual control, auto-restart returns the pump to the last manual setting; stopped if the pump was previously stopped, or running if the pump was previously running.

The default setting is auto-restart off. Without auto-restart the pump displays the main menu and waits for a control mode to be selected.

To install auto-restart:

- Mains power must be available to the pump to engage auto-restart.
- Stop the pump. Turn off the mains power switch at the rear of the pump.
- Hold down the **START** key and turn the mains power switch on. The **!** symbol shows on the display.
- Start the pump. If the mains supply is interrupted the pump will automatically restart when the mains power returns.
- Auto-restart is retained while the pump is switched off.
- To remove auto-restart switch off the mains power at the rear of the pump. Hold down the **STOP** key and turn the mains power switch on. The **!** symbol will go out.

Do not use auto-restart for more than 10 starts per hour. We recommend remote control where a high number of starts is required.

15 The main menu

In addition to their functions in other operations (see 15.2 *Manual control*), the following keys have specific actions in menu screens:

- **STOP**: In general, **STOP** functions as a "go back" key, taking the user up one menu level without making a change. In a numeric entry screen, **STOP** resets the pump to the previous value.
- **UP**: The **UP** key is used in menu item selection: it moves a highlight up the menu. When a numerical entry screen is displayed, pressing **UP** increases the number displayed.
- **DOWN**: The **DOWN** key is used in menu item selection: it moves a highlight down a menu. When a numerical entry screen is displayed, pressing **DOWN** decreases the number displayed.
- **START**: During Dose setup, press the **START** key to leave setup and begin the dose batch via the priming screen. When the priming screen is displayed, press and hold the **START** key to operate the pump at full speed and prime the pump.
- **DIRECTION**: During Dose setup, the **DIRECTION** key reverses the direction of pump rotation instantly.
- **RETURN**: The **RETURN** key functions in a similar way to the "enter" key of a personal computer: it confirms key-presses made immediately before. In menu item selection, it triggers the action or display selected from a menu using the **UP** and **DOWN** keys.

The options are **Dose, Calibrate, Manual, Setup**.

- **Dose** programs the pump for dispensing.
- **Calibrate** sets the pump for accurate flow. The flow rate of the pump is governed by the tubing. Factory default is for the 501 pumphead with 8mm bore tubing or the 313/314 pumphead with 8mm bore tubing.
- **Manual** for keypad control of continuous fluid transfer.
- **Setup** prepares the pump for operation.

Use the **UP** and **DOWN** keys to move between the menu options. Press the **RETURN** key to select the option.

Press the **STOP** key to exit a sub-menu and move back up to the previous menu. Or press the **STOP** key when changing values on the display to revert to the original value.

15.1 Setup

Use the **UP** and **DOWN** keys to select **Setup** from the main menu. Press **RETURN**. The pump displays the setup menu: **ROM, Backlight, Defaults, Language** and **Menu**.

Scroll through the menu using the **UP** and **DOWN** keys. Press **RETURN** to select the option you wish to change.

15.1.1 ROM version

Use the **UP** and **DOWN** keys to select **ROM**. Press **RETURN**. The pump displays the software version, the pump type and drive speed for four seconds.

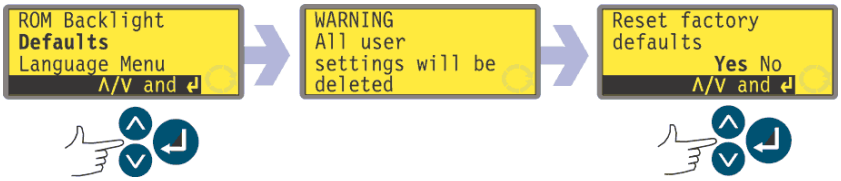
15.1.2 Display backlight

Use the **UP** and **DOWN** keys to select **Backlight**. Press **RETURN**. Use the **UP** and **DOWN** keys to select backlight **On** or **Off**. Press **RETURN**.

Alternatively ...

When *not* in the Setup menu, hold down the **STOP** and **UP** keys to switch the backlight on; hold down the **STOP** and **DOWN** keys to switch the backlight off.

15.1.3 Restore factory defaults



This clears any programmed settings and restores the pump to the original factory settings. Use the **UP** and **DOWN** keys to select **Defaults**. Press **RETURN**. The pump displays a brief warning message that all settings will be deleted, and offers a choice: Restore defaults: **Yes** or **No**. Use the **UP** and **DOWN** keys to select **Yes**. Press **RETURN**. The pump displays the Setup menu.

15.1.4 Language

Use the **UP** and **DOWN** keys to select **Language** from the setup menu. Press **RETURN**. Use the **UP** and **DOWN** keys to select **English, Français, Deutsch** or **Español**. Press **RETURN**. The pump displays the setup menu in your chosen language. It is assumed for the rest of this manual that your choice was **English**.

15.1.5 Menu

To exit the Setup menu, and return to the main menu, use the **UP** and **DOWN** keys to select **Menu**. Press **RETURN**.

Alternatively ...

Press **STOP**.

15.2 Manual control

All settings and functions of the pump in manual mode are set and controlled by means of key-presses. The currently selected rotation direction is indicated on the display by a clockwise or counter-clockwise segmented arrow. If an exclamation mark (**!**) shows, it indicates that Auto-restart is on.

Note: A number of the controls listed below are shortcuts to commands which are also available through the main menu. See 15 *Main menu*.

A brief single press on each key triggers a beep sound (if enabled - see *Keypress combinations*, below) and causes the pump to function as follows:

- **START**: starts the pump at the speed and in the direction shown on the display. The rotation symbol will become animated to confirm that the pump is operating. We recommend that the speed is reduced to a minimum before starting the pump.
- **STOP**: has no effect if the pump is not running. If the pump is running, pressing **STOP** stops the pump. The display continues to show the previous speed and direction. The pump returns to this speed and direction when the **START** key is pressed again.
- **UP**: increases the speed shown on the display in minimum steps of 1 rpm (unless the speed displayed is already the maximum speed). If the pump is then started by pressing the **START** key, it operates at the new speed. If the pump is running when **UP** in pressed, the change takes effect immediately.
- **DOWN**: decreases the speed shown on the display in minimum steps of 1 rpm. If the pump is then started by pressing the **START** key, it operates at the new speed. The minimum speed possible is 1 rpm (low speed model) or 2 rpm (high speed model). If the pump is running when **DOWN** is pressed, the change takes effect immediately.
  Note: You can reduce the pump speed to 0 rpm by a further press on the **DOWN** key. The pump is still in the running state and the rotation symbol will continue to move. Press the **UP** key to return the pump to the minimum speed.
- **DIRECTION**: toggles the direction of rotation shown on the display. If the pump is then started by pressing the **START** key, it rotates in the new direction. If the pump is running when **DIRECTION** is pressed, the change takes effect immediately.
- **RETURN**: stops the pump (if it is running) and displays the main menu.

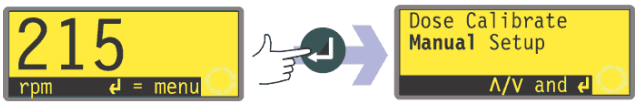
Keypress combinations ...

cause the pump to function as follows:

- **UP** and **DIRECTION** on power-up: toggles the keypad beep on and off.
- **START** on power-up: switches on the Auto-restart facility. See 14 *Auto-restart*.
- **STOP** on power-up: switches off the Auto-restart facility. See 14 *Auto-restart*.
- **STOP** and **UP**: turns the display backlight on.
- **STOP** and **DOWN**: turns the display backlight off.
- **DIRECTION** and **DOWN**: interrupts the display to show the pump's ROM version for four seconds.

Use the **UP** and **DOWN** keys to select **Manual** from the main menu. Press **RETURN**. The display shows the last set speed. (An example is shown here.)

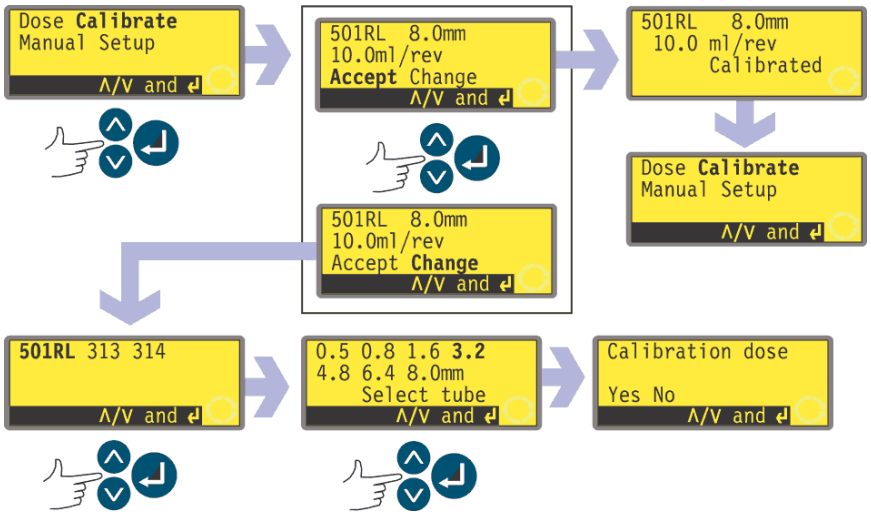
- Use the **UP** key to increase the set speed. Use the **DOWN** key to reduce the set speed. We recommend that the speed is reduced to a minimum before starting the pump.
- Press the **DIRECTION** key to reverse the direction of rotation.
- The direction is shown by the rotation symbol. The direction may be changed while the pump is stopped or running.
- Start the pump with the **START** key.
- The rotation symbol moves to confirm that the pump is operating. The symbol is static when the pump is stopped.
- Stop the pump with the **STOP** key. The pump stops immediately.
- The display continues to show the previous speed and direction. The pump returns to this speed when the **START** key is pressed again.
- You can reduce the pump speed to 0 rpm with the **DOWN** key. The pump is still in the running state and the rotation symbol continues to move. Press the **UP** key to return the pump to the minimum speed.



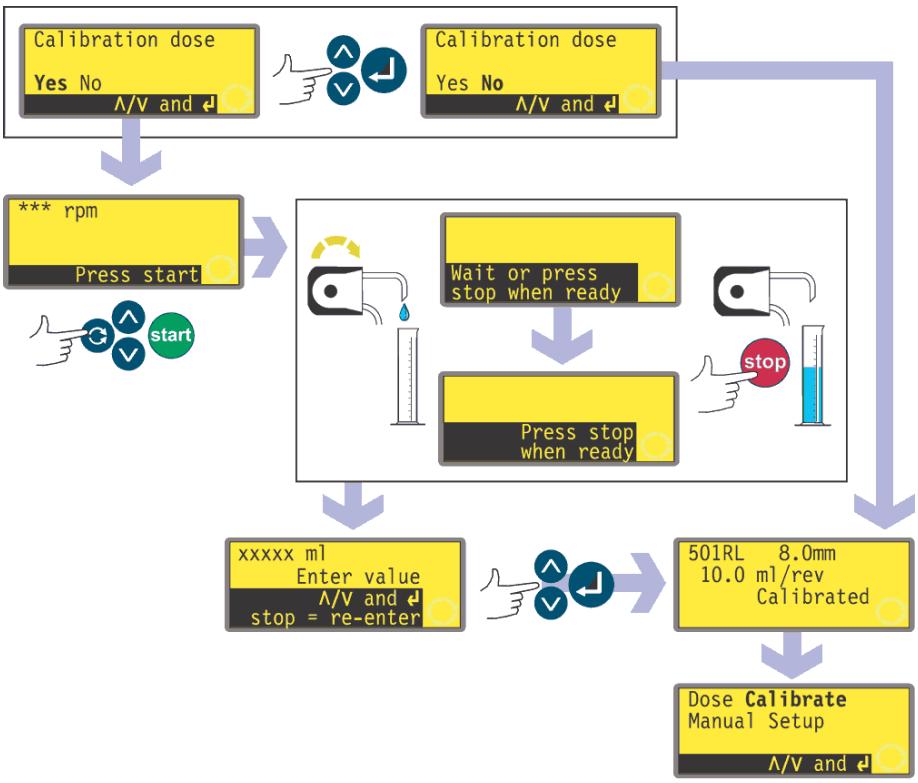
Press the **RETURN** key to return to the main menu. If the pump is operating it stops, and the main menu is displayed.

15.3 Calibration

To dispense the correct amount of fluid the pump must know which pumphead is fitted and the tube size in the pumphead. You may also measure the flow from the pump and enter this value for the most accurate calibration.



- Use the **UP** and **DOWN** keys to select **Calibrate** from the main menu. Press **RETURN**.
- The pump shows the stored values of pumphead, tube size, and present flow rate in ml per minute. Example figures are shown here.
- If the pumphead and tube information is correct, select **Accept** and press **RETURN**. The pump briefly displays a summary of the current speed and flow settings, and the main menu.
- If the pumphead and tube information is wrong use the **UP** and **DOWN** keys to select **Change** and press **RETURN**.
  - The display lists pumphead options. Use the **UP** and **DOWN** keys to select the correct one and press **RETURN**.
  - The display lists the tube sizes. Use the **UP** and **DOWN** keys to select the cor rect size and press **RETURN**. The display asks the user if he wishes to run a calibration dose.



- The display asks the user if he wishes to run a calibration dose. To obtain the most precise calibration, select **Yes**. Select **No** if you wish to use the pre-programmed flow data and return to the main menu via a summary of the current speed and flow settings. Press **RETURN**.
- If you choose to run a calibration dose, the pump displays its current direction and rotation speed. You may change pump rotation direction and speed using the **DIRECTION** and **UP** and **DOWN** keys.
- Put a measuring container at the pump outlet. Press **START**. The pump runs for 4 minutes, displaying an information screen for 15 seconds and a further information screen for the rest of the 4 minutes. You may stop the calibration dose at any time with the **STOP** key—but allow the pump to run as long as possible to obtain the most accurate calibration. A minimum of 15 seconds is recommended.
- Measure the quantity of fluid dispensed. The measurements must be in millilitres for calibration and dosing. The pump displays its calculated dose volume, based on previous calibration data. Use the **UP** and **DOWN** keys to adjust this reading to match the measured volume. Press **RETURN**. The pump displays the new head, tube and flow settings, and redisplays the main menu. Example figures are shown here.

It is also possible to re-calibrate the pump during a batch run. (See 15.4 *Dose*.) Re-calibration allows fine tuning of basic calibration.

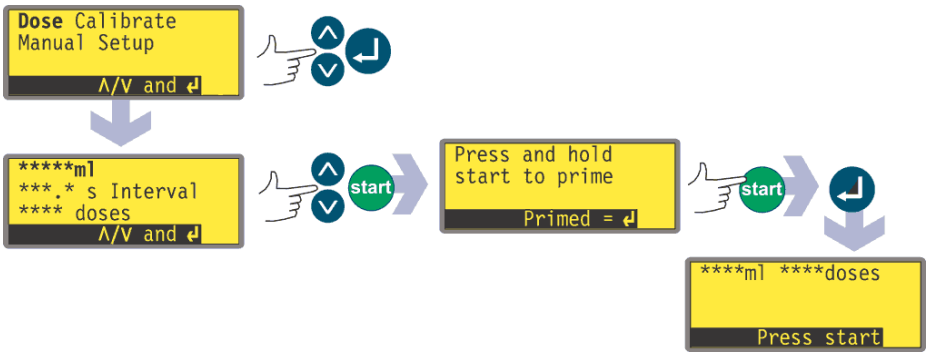
If a re-calibration differs by more than 25% from the original calibration, the re-calibration value will be ignored. Another full calibration is required to change a dose size by more than 25%.

15.4 Dose

The **Dose** facility programs the pump to dispense measured volumes of fluid. These can be individual doses, a batch of doses delivered singly, or a batch of doses delivered at timed intervals. A dose, or batch of doses, can be controlled by the pump, by pressing the **START** key, or by pressing an optional remote-control foot or hand switch or by an external logic signal.

You can start pumping immediately using the settings chosen for the previous batch; or you can alter one or more of the settings before starting to pump.

To start pumping immediately:

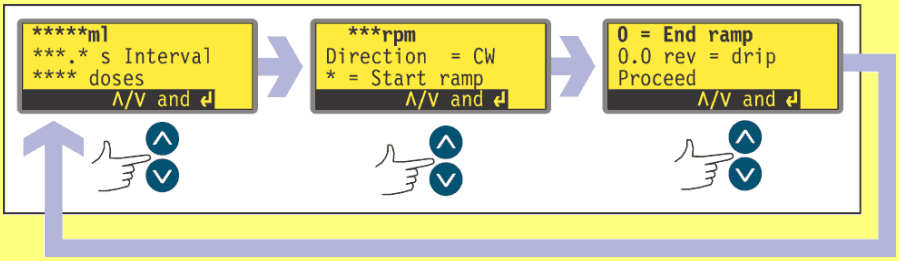


- Use the **UP** and **DOWN** keys to select **Dose** from the main menu. Press **RETURN**. The pump displays the dose size, dosing interval and the number of doses and waits for the **START** key to be pressed.
- When the **START** key is pressed, the pump offers the user the opportunity to prime the pump. To do so, **press and hold** the **START** key. The pump operates continuously at maximum speed until the **START** key is released.
- When priming is complete, or if no priming is required, press **RETURN**. The pump displays the dose size and the number of doses and waits for the **START** key to be pressed to start the batch.

To alter the batch settings before starting pumping:

- Use the **UP** and **DOWN** keys to select **Dose** from the main menu. Press **RETURN**.
- The pump displays the first three of the eight parameters which may be set for the next dosing session: dose volume, dosing interval and number of doses.

The Dose menu occupies three screens.



To move from one screen to subsequent screens, repeatedly press DOWN. Each item is highlighted in turn until the last item on the screen is highlighted. A further press on the DOWN key displays the next screen of the menu, with the first item highlighted.

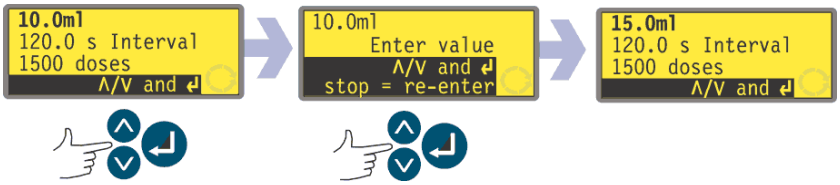
Follow the reverse procedure using the UP key to move to an item on a previous screen of the menu.

Make a selection using the **UP** or **DOWN** keys and press **RETURN** to confirm your choice. The values shown are those set for the last dosing session. As each parameter of the eight is highlighted, you may accept or change its value.

- If it is correct, do nothing. **UP** and **DOWN** will highlight the next parameter.
- If you wish to change it, press **RETURN**. Use the **UP** and **DOWN** keys to alter the value. When the value is correct, press **RETURN**.
- **At any time during the dose setup sequence described below the user may press START and the pump displays the priming screen and may be operated according to the parameters in force. If the next batch requires only the dose size to be changed from the last batch, for example, change it and press START, ignoring the other seven parameters.**

In this programming area, pressing STOP while setting up dosing parameters returns the value being changed to its original setting, allowing the user to start again.

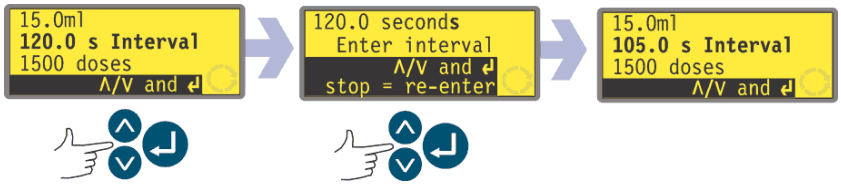
15.4.1 Dose volume



- Use the **UP** and **DOWN** keys to highlight the volume line of the display (the top line, first screen).
- If the dose volume displayed is correct, do nothing. **UP** and **DOWN** highlight the next or previous parameter.
- If you wish to change the dose volume, press **RETURN** and use the **UP** and **DOWN** keys to scroll the display to the required dose volume. Example figures are shown here. To quickly return to the starting value, press **STOP**. When the dose volume is correct, press **RETURN**. The first screen of the dose menu is re-displayed with the new dose size. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

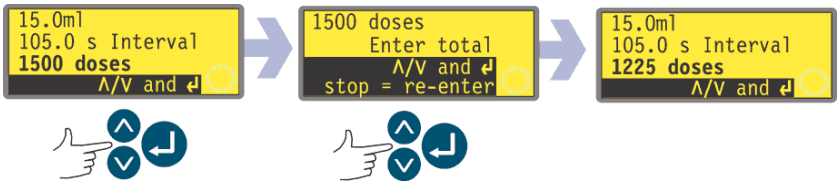
Note: The dose size must use more than two complete revolutions of the pumphead. To obtain best accuracy the dose size should use more than five revolutions. Where the dose size uses less than five revolutions, the pump may warn that a smaller tube size is required. If you do not change the tube size, the pump may proceed with your selected dose size but accuracy may be reduced. If the dose is smaller than the two revolution minimum, the pump displays a warning and does not allow you to proceed. If you wish to proceed with the dose size, you must perform a new pump calibration using a smaller tube size. (See 15.3 *Calibration*).

15.4.2 Dose interval



- Use the **UP** and **DOWN** keys to highlight the dose interval line of the display (the second line, first screen). The display shows the previously set time interval between doses in seconds.
  Note: If the time is set to zero, the pump waits for a start signal from the START key, or from an optional external control switch or logic signal, before proceeding with each dose. If the time interval is greater than zero, the pump proceeds through the sequence of doses at the programmed time interval.
- If the interval displayed is correct, do nothing. **UP** and **DOWN** highlight the next or previous parameter.
- If you wish to change the interval between doses, press **RETURN** and use the **UP** and **DOWN** keys to scroll the display to the required interval. Example figures are shown here. To quickly return to the starting value, press **STOP**. When the dose interval is correct, press **RETURN**. The first screen of the dose menu is redisplayed with the new dose interval. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

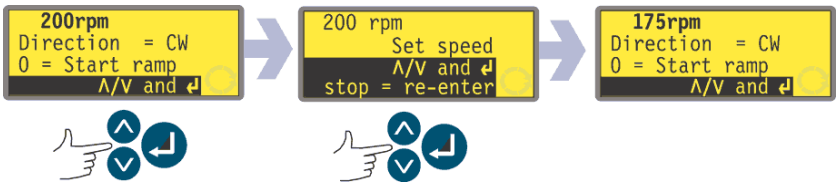
15.4.3 Number of doses



- Use the **UP** and **DOWN** keys to highlight the dose number line of the display (the third line, first screen). The display shows the previously set number of doses.
- If the number displayed is correct, do nothing. **UP** and **DOWN** highlight the next or previous parameter.
- If you wish to change the number of doses, press **RETURN** and use the **UP** and **DOWN** keys to scroll the display to the required number. Example figures are shown here. To quickly return to the starting value, press **STOP**. When the number is correct, press **RETURN**. The first screen of the dose menu is redisplayed with the new number of doses. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.
  Note: If the number of doses is set to 1, the pump waits for a press on **START** for each dose, and the display during dosing increments with each dose. If the number of doses is set to greater than 1, the display decrements with each dose until it reads zero and the batch is complete

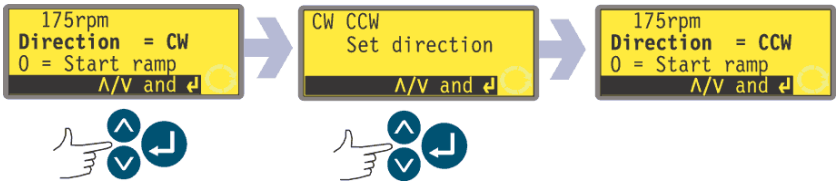
.

15.4.4 Pump speed



- Use the **UP** and **DOWN** keys to highlight the speed line of the display (the first line, second screen). The display shows the previously set pump speed.
- If the speed displayed is correct, do nothing. **UP** and **DOWN** will highlight the next or previous parameter.
- If you wish to change the speed, press **RETURN** and use the **UP** and **DOWN** keys to scroll the display to the required speed, up to a maximum of 300 rpm (low-speed model or highspeed model fitted with a 314 pumphead) or 400 rpm (high-speed model fitted with a 313 pumphead). Example figures are shown here. To quickly return to the starting value, press **STOP**. When the speed is correct, press **RETURN**. The second screen of the dose menu is redisplayed with the new pump speed. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

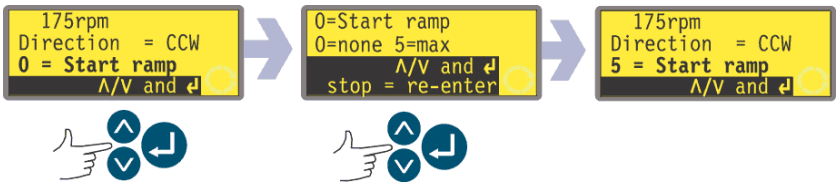
15.4.5 Pump direction



- Use the **UP** and **DOWN** keys to highlight the direction line of the display (the second line, second screen). The display shows the previously set direction of rotation.
- If the direction displayed is correct, do nothing. **UP** and **DOWN** will highlight the next or previous parameter.
- If you wish to change the direction, press **RETURN** and use the **UP** or **DOWN** keys to highlight the desired direction. An example is shown here. Press **RETURN**. The second screen of the dose menu is redisplayed with the new pump direction. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

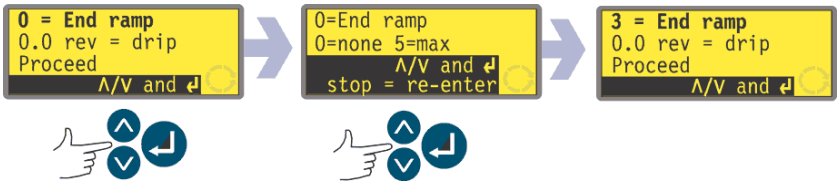
Alternatively ...
Press the **DIRECTION** key at any point in the menu sequence.

15.4.6 Start ramp



- Use the **UP** and **DOWN** keys to highlight the start ramp line of the display (the third line, second screen). The display shows the start ramp setting of the last dosing session. When set to '0' the pump starts abruptly at full speed. When set to '5' the pump accelerates softly to full speed.
- If the setting displayed is correct, do nothing. **UP** and **DOWN** will highlight the next or previous parameter.
- If you wish to change the setting, press **RETURN** and use the **UP** or D**OWN** keys to highlight the desired setting: 0, 1, 2, 3, 4 or 5. An example is shown here. To quickly return to the starting value, press **STOP**. Press **RETURN** when correct. The second screen of the dose menu is redisplayed with the new start ramp setting. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

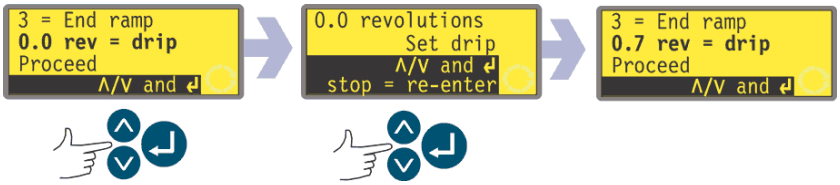
15.4.7 End ramp



- Use the **UP** and **DOWN** keys to highlight the end ramp line of the display (the first line, third screen). The display shows the end ramp setting of the last dosing session. When set to '0' the pump stops abruptly. When set to '5' the pump decelerates softly to a stop.
- If the setting displayed is correct, do nothing. **UP** and **DOWN** will highlight the next or previous parameter.
- If you wish to change the setting, press RETURN and use the UP and DOWN keys to highlight the desired setting: 0, 1, 2, 3, 4 or 5. An example is shown here. To quickly return to the starting value, press **STOP**. Press **RETURN** when correct. The third screen of the dose menu is redisplayed with the new end ramp setting. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

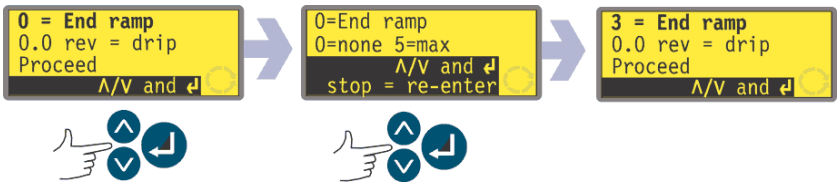
15.4.8 Drip

The pump can be set to reverse briefly at the end of each dose to prevent drips.



- Use the **UP** and **DOWN** keys to highlight the drip line of the display (the second line, third screen). The display shows the drip setting of the last dosing session: from 0 to 1.0: zero to one revolution at one-tenth of a revolution intervals.
- If the setting displayed is correct, do nothing. **UP** and **DOWN** will highlight the next or previous parameter.
- If you wish to change the setting, press **RETURN** and use the **UP** and **DOWN** keys to increase or decrease drip reversal: zero revolutions to 1 revolution at 0.1 revolution intervals. An example is shown here. To quickly return to the starting value, press **STOP**. Press **RETURN** when correct. The third screen of the dose menu is redisplayed with the new drip setting. If you wish to change other parameters, use the **UP** and **DOWN** keys to highlight each as required.

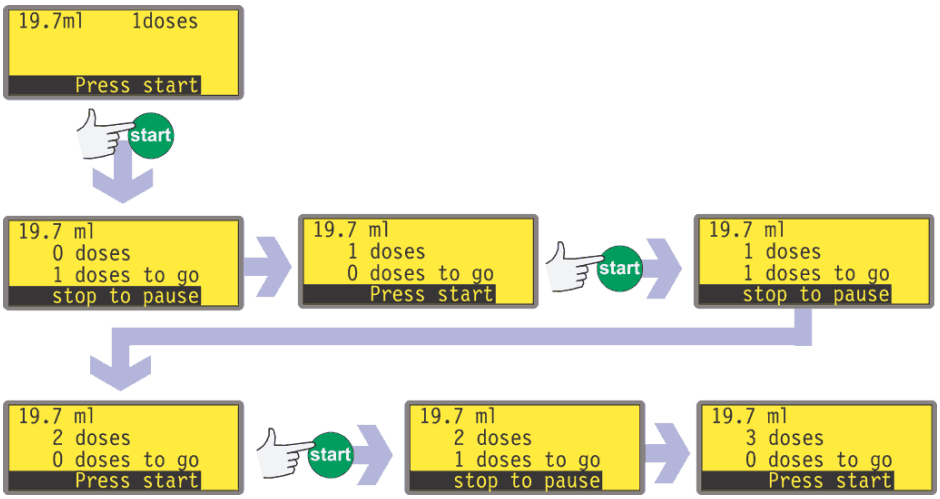
15.4.9 Proceed



- If you wish to begin the dosing session, use the **UP** or **DOWN** keys to highlight **Proceed** and press **RETURN**. The pump offers the user the opportunity to prime the pump. To do so, **press and hold** the **START** key. The pump operates continuously at maximum speed until the **START** key is released. When priming is complete, or if no priming is required, press **RETURN**. The pump displays the dose size and the number of doses and waits for the **START** key to be pressed.
- If you wish to review or change the parameters for the next batch, press **STOP** twice and use the **UP** and **DOWN** keys to move back up through the list of parameters.

15.4.10 Single dose dispensing

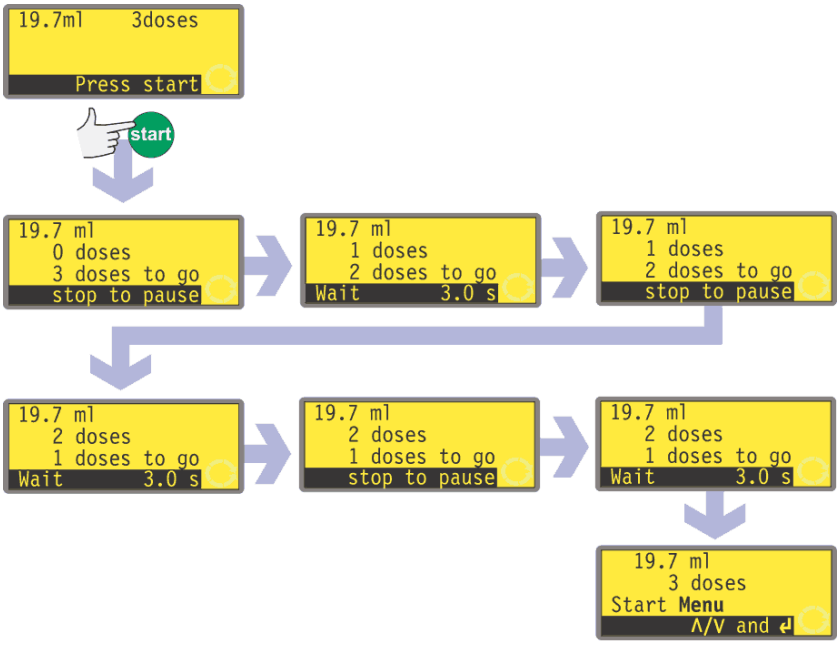
When **START** is pressed, the pump performs a dosing batch according to the parameters set.



If the batch is set to perform one dose, as in the example shown here, the pump stops when that dose has been dispensed and waits for a further press on the **START** key. As each dose is dispensed, the display increments, recording the number of doses dispensed so far.

Note: To dispense a batch of one dose and set the pump to count the doses/batches, check that the dose interval is set to zero seconds. If an interval is set, the pump will still dispense batches of one dose, but will not increment its display to show how many doses/batches have been dispensed.

15.4.11 Batch dispensing



If the batch is set to perform more than one dose with a set interval between doses, the pump operates until all the batch's doses have been dispensed. The display decrements as each dose is dispensed, showing the number of doses still to be dispensed. During the intervals between doses - 3 seconds in the example shown - the time elapsing is counted down to show how much time is left before the next dose will start.

If the interval is set to zero seconds, the batch can be dispensed in individually triggered doses by repeated presses on the **START** key. The display decrements as each dose is dispensed, showing the number of doses still to be dispensed.

When the batch is complete, the pump displays a screen summarising the batch, and offering two choices: start the batch again or return to the menu screen, where batch setting changes can be made.

- Use the **UP** and **DOWN** keys to highlight **Start** or **Menu** and press **RETURN**.

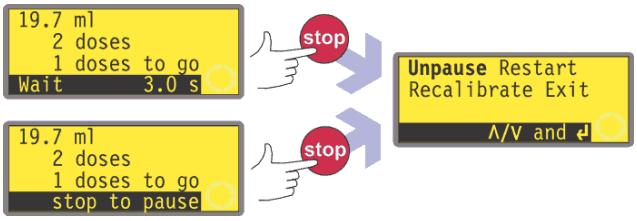
- If you select **Start**, the pump displays the dose size and the number of doses and waits for the **START** key to be pressed to begin a repeat batch.

Alternatively ...
Just press **START**.

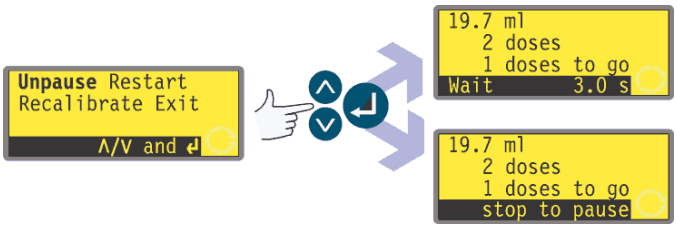
Note: When a batch is repeated, no opportunity is offered to prime the pump. If you wish to re-prime the pump, return to the main menu and re-enter the dosing menu as if it were a new batch.

- If you select **Menu**, the pump displays the main menu. See 15 *Main menu*.

Batch pause



You can interrupt a batch at any time by pressing **STOP**. The pump stops and offers four choices: **Unpause**: continue the dose sequence from where it was stopped; **Restart**: start the dose or the batch from the beginning; **Re-calibrate**: re-calibrate the pump; and **Exit**: abandon the batch and return to the main menu.



- Use the **UP** and **DOWN** keys to make a selection. Press **RETURN** to confirm.
- **Unpause**: If you choose **Unpause** the pump finishes dispensing the current dose and completes the batch.

- **Restart**: If you choose **Restart** the pump displays the number of doses in the batch and the number which have been completed. It offers two choices: restart the interrupted dose or restart the batch. Use the **UP** and **DOWN** keys to make a selection. Press **RETURN** to confirm.

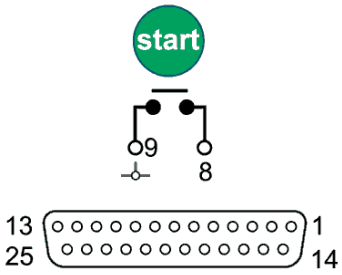
  - Select **Restart dose** and the pump re-dispenses the interrupted dose and resumes the batch where it was interrupted - as in the example shown above.

- Select **Restart batch** to command the pump to display the size and number of doses in he batch, as in the example above, and wait for the **START** key to be pressed to restart the batch.

- **Re-calibrate**: (**Note**: In this manual, re-calibrate means **adjust the full calibration previously performed**. It is not possible at this point to perform a fresh full calibration. To do so return to the main menu. See 15.3 *Calibration*.) If you choose **re-calibrate** you can check a recent dose and adjust the dose size (within a range of ±25%) for the remainder of the batch.
- The display shows the volume of fluid it believes it has dispensed in each dose.
- Measure the volume of fluid dispensed in a recent dose.
  - If the pump's display is correct, press **RETURN**.
  - If the pump's display is incorrect, use the **UP** and **DOWN** keys to adjust the volume displayed to match the measured quantity of fluid. Press **RETURN** to leave the recalibration sequence.
  - If the volume adjustment needed is greater than 25%, it is likely that the original calibration is incorrect. The pump displays a warning and resets to the original calibration value. You must perform a new pump calibration. Press **RETURN** to leave the recalibration sequence.
  - The pump redisplays the four choices: **Unpause; Restart; re-calibrate;** and **Exit**.
  - Use the **UP** and **DOWN** keys to make a selection. Press **RETURN** to confirm.
  - If you choose **Unpause** or **Restart** the pump operates as described above, but using a dose adjusted as a result of any changes you made during the re-calibration sequence. If you choose **Re-calibrate**, you can repeat the re-calibration. If the pump did not allow recalibration because the adjustment required was greater than 25%, choose **Exit**. The pump displays the main menu, from which you can perform a fresh complete calibration of the pump.

- Exit: If you choose **Exit**, the pump redisplays the main menu.

15.5 Remote control



A Watson-Marlow remote control footswitch or handswitch may be used to start the dose or batch. The dose will proceed once the switch is pressed. In an emergency press the **STOP** key to halt the dose.

The switch should be connected as shown. Or a TTL-compatible logic signal may be applied to pin 8. (Low 0V, High 5V maximum. Ground to pin 9).

Never apply mains voltage to the 25-way D socket. Up to 5V TTL may be applied across pins 8 and 9, but do not apply voltage across any other pins. It may result in permanent damage not covered by warranty.

16 Troubleshooting

If the pump display remains blank when the pump is on, make the following checks:

- Check the position of the voltage selector switch at the rear of the pump.
- Check the mains power switch at the rear of the pump.
- Check that mains power is available to the pump.
- Check the fuse in the fuse drawer of the IEC mains power connector at the rear of the pump.
- Check the fuse in the mains power plug if one is present.

If the pump runs but there is little or no flow, make the following checks:

- Check that the tube and rotor are in the pumphead.
- Check that fluid is supplied to the pump.
- Check that the tube is not split or burst.
- Check for any kinks or blockages in the lines.
- Check that any valves in the lines are open.
- Check that the correct wall-thickness tube is being used.
- Check direction of rotation.
- Check that the rotor is not slipping on the drive shaft.

If trouble persists, technical assistance for this product is available from your distributor or Watson-Marlow Ltd, Falmouth TR11 4RU, United Kingdom.

16.1 Error messages

Error	Error condition	Suggested action
0	RAM write error	Attempt to reset by switching power OFF / ON. Or seek support
1	RAM corruption	Attempt to reset by switching power OFF / ON. Or seek support
2	OTP ROM error / corruption	Attempt to reset by switching power OFF / ON. Or seek support
3	OTP ROM read error	Attempt to reset by switching power OFF / ON. Or seek support
5	Unknown pump type	Check the interface card and cables. Attempt to reset by switching power OFF / ON. Or seek support
7	Display failure	Seek support
8	Wrong key-press	Attempt key-press again. Attempt to reset by switching OFF / ON
9	Motor stalled	Stop pump immediately. Check pumphead and tube. Power OFF/ON may reset. Or seek support
10	Tacho fault	Stop pump immediately. Power OFF/ON may reset. Or seek support
14	Over speed	Stop pump immediately. Power OFF/ON may reset. Or seek support
15	Over current	Stop pump immediately. Check system. Power OFF/ON may reset. Or seek support
16	Over voltage	Stop pump immediately. Check mains voltage selector switch. Check supply. Power OFF/ON may reset. Or seek support
17	Under voltage	Stop pump immediately. Check mains voltage selector switch. Check supply. ON/OFF may reset. Or seek support
18	Watchdog error	Attempt to reset by switching power OFF / ON. Or seek support
19	Over temperature	Stop pump immediately. Turn OFF. Seek support
20	Signal out of range	Check analogue control signal range. Trim signal as required. Or seek support
21	Over signal	Reduce the analogue control signal
22	No signal	Connect analogue control signal or return to manual control
25	Network not detected	Turn OFF. Check network and connections. Or seek support
26	RS232 fault	Turn OFF. Check network and connections. Or seek support
27	RS232 lost	Turn OFF. Check network and connections. Or seek support
33	Unrecognised keypress	Attempt keypress again. Attempt to reset by switching power OFF/ON. Otherwise seek support.
35	Work overload	Turn OFF. Check power supply. Check pumphead and tubing. Wait 30 minutes. Power ON may reset. Otherwise seek support.
ERR	General error condition	Turn OFF. Seek support

17 Drive maintenance

The pump is sealed to IP31 and is suitable for wipe-down cleaning. Do not use solvents, mechanical scourers, strong organic acids, or alkali-based cleaning solutions.

Remove any tubing, detach the pumphead, and wash the pumphead thoroughly with a mild solution of detergent in water.

Check moving parts of the rotor from time to time for freedom of movement. Lubricate pivot points and rollers occasionally with Teflon lubricating oil.

The pump has a good, broad chemical resistance to inorganic acids, saline solutions, alkalis, some hydrocarbons and a large number of oils and greases. It is suitable for wipe-down but not for long-term contact with alcohols. The case may be damaged by contact with strong acids or strong solvents.

There are no user serviceable parts inside the pump. The unit should be returned to Watson-Marlow or its appointed agents or distributors for service.

18 Drive part numbers

Drives only

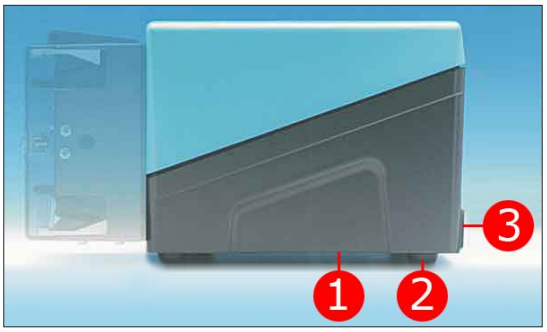
Part number	Drive type	Drive speed	Pumphead	Mains lead type
036.3183.00U	323Dz	300	-	UK
036.3184.00U	323Dz	400	-	UK

Complete pump assemblies

Part number	Drive type	Drive speed	Pumphead	Mains lead type
030.3183.RLU	323Dz	300	501RL	UK
030.3184.3DU	323Dz	400	313D	UK
030.3184.4DU	32Dz	400	314D	UK

For US mains lead, replace 'U' with 'A' at end of part number.
For European mains lead, replace 'U' with 'E'.

19 Drive spares



	Spare	Description
1	MN2094T	Interface card cover
2	FB0009	Foot
3	FS0003	Fuse

20 Accessories

520AF	Footswitch	059.3002.000
520AH	Handswitch	059.3022.000
505AS	Filling stand	059.5001.000
505AL	Dispensing lance	059.5052.000

21 Pumpheads

21.1 Pumpheads: key safety information

Before opening the pumphead track please ensure that the following safety directions are followed.

- Ensure that the pump is isolated from mains voltage.
- Ensure that there is no pressure in the pipeline.
- If a tube failure has occurred, ensure that any product in the pumphead has been allowed to drain to a suitable drain.
- Ensure that protective clothing and eye protection are worn if hazardous products are being pumped.

21.2 313D and 314D pumpheads

314D pumpheads should run no faster than 300 rpm when in continuous use. Speeds up to 400 rpm are permissible for intermittent use.

The 313D pumphead has three rollers and is designed to provide higher flow rates. The 314D pumphead has four rollers to provide greater pumping precision with less pulsation in the flow. Both designs are available for 1.6mm and 2.4mm wall tubes.

New tubing can be loaded easily into the flip top design. The top closes with a "clamp and stretch" action to locate the tube in the correct position and with the correct tension.

Standard and extension pumpheads are bayonet mounted. This ensures easy cleaning and fast set up.

Tube selection

The chemical compatibility list published in the Watson-Marlow web site is only a guide. If in doubt request a tube sample card for immersion trials.

Installation

323 400 rpm drives (shown) have an integral mounting plate to attach a 313 or 314 pumphead.



Engage the pumphead drive slot with the end of the pump drive shaft. Continue to align the pumphead until the bayonet engages with the mounting plate. Turn the pumphead clockwise until it locks into an upright position.

Removal

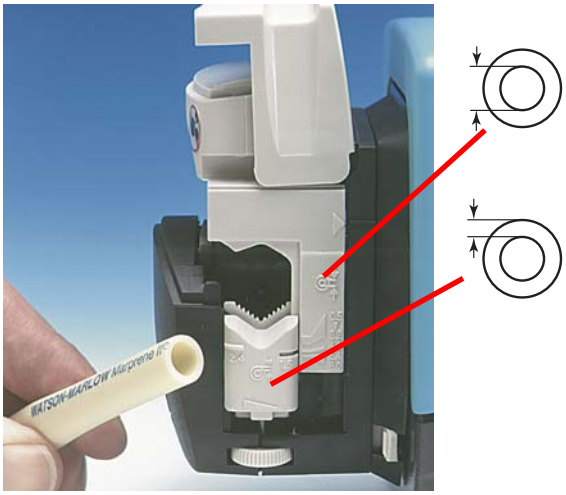


Push the locking lever back and turn the pumphead anti-clockwise until it is free from the mounting plate.

Tube loading

Switch off the pump before tube loading. Lift the "flip top" track until fully open.





Set the tube clamps to the correct tube size. The track must be fully open. Align the scale on both sides of the pumphead.

If the tube is dirty, or there is a high suction lift, the tube clamps may need a smaller setting to secure the tube.



- Select enough tube length for the curve of the pump track. Slide the tube into the open pumphead. The tube must not be twisted or stretched against the rollers.
- Ensure the tubing locates in the centre of the tube clamps. Carefully lower the track. Check that the tube is not crushed in the clamps or over stretched.

When using Marprene tubing

Re-tension new tube after the first 30 minutes of running. Stop the pump. Release the flip top. Allow the tube to resettle naturally across the rollers. Re-clamp the tube. Re-start the pump. This will correct the normal stretching that occurs with new Marprene tube. The correct tension is essential for good tube life.

21.3 313D and 314D pumphead spares

	Spare	Description
1	033.3411.000	313D three-roller pumphead
2	033.3431.000	313X extension three-roller pumphead
1	033.4411.000	314D four-roller pumphead
2	033.4431.000	314X extension four-roller pumphead
1	033.3511.000	313D2 three-roller pumphead for 2.4mm tube
2	033.3531.000	313X2 extension three-roller pumphead for 2.4mm tube
1	033.4511.000	314D2 four-roller pumphead for 2.4mm tube
2	033.4531.000	314X2 extension four-roller pumphead for 2.4mm tube

21.4 313D and 314D flow rates

Flow rates were obtained using silicone tubing with the pumphead rotating clockwise, pumping water at 20°C with zero suction and delivery pressures. For critical applications determine flow rates under operating conditions.

Flow rates, 313D, 1.6mm wall (ml/min)								
bore	mm	0.5	0.8	1.6	3.2	4.8	6.4	8.0
	in	1/50	1/32	1/16	1/8	3/16	1/14	5/16
#		112	13	14	16	25	17	18
2-400 rpm		0.06-12	0.14-28	0.54-110	2-400	404-880	7.2-1400	10-2000

Flow rates, 314D, 1.6mm wall (ml/min)								
bore	mm	0.5	0.8	1.6	3.2	4.8	6.4	8.0
	in	1/50	1/32	1/16	1/8	3/16	1/14	5/16
#		112	13	14	16	25	17	18
2-400 rpm		0.06-12	0.12-24	0.50-100	1.7-340	3.8-760	6.0-1200	8.0-1600

Note: 314D pumpheads should run no faster than 300 rpm when in continuous use. Speeds up to 400 rpm are permissible for intermittent use.

21.5 313D and 314D: maximum number of pumpheads

313D, 314D Pumpsil, to 400 rpm

bore	mm	0.5	0.8	1.6	3.2	4.8	6.4	8.0
	in	1/50	1/32	1/16	1/8	3/16	1/14	5/16
#		112	13	14	16	25	17	18
0-0.5 bar		6	6	5	3	2	2	1
0.5-2 bar		6	6	5	3	2	1	1

313D, 314D Marprene, Bioprene, Tygon, Neoprene, Fluorel, to 400 rpm

bore	mm	0.5	0.8	1.6	3.2	4.8	6.4	8.0
	in	1/50	1/32	1/16	1/8	3/16	1/14	5/16
#		112	13	14	16	25	17	18
0-2 bar		6	6	4	2	2	1	1

313D, 314D STA-PURE, CHEM-SURE, to 400 rpm

bore	mm	1.6	3.2	4.8	6.4	8.0
	in	1/16	1/8	3/16	1/14	5/16
#		14	16	25	17	18
0-2 bar		1	1	1	1	1

313D2, 314D2 Pumpsil, Marprene, Bioprene, Tygon, Neoprene, Fluorel, STA-PURE, CHEM-SURE, to 400 rpm

bore	mm	0.5	0.8	1.6	3.2	4.8	6.4	8.0
	in	1/50	1/32	1/16	1/8	3/16	1/14	5/16
#		112	13	14	16	25	17	18
0-2 bar		1	1	1	1	1	1	1

Note: 314D pumpheads should run no faster than 300 rpm when in continuous use. Speeds up to 400 rpm are permissible for intermittent use.

21.6 313D and 314D: tubing part numbers

1.6mm tube						
mm	**in**	**#**	**Marprene**	**Bioprene**	**CHEM-SURE**	**Pumpsil**
0.5	**1/50**	**112**	902.0005.016	903.0005.016		913.A005.016
0.8	**1/32**	**13**	902.0008.016	903.0008.016		913.A008.016
1.6	**1/16**	**14**	902.0016.016	903.0016.016	965.0016.016	913.A016.016
3.2	**1/8**	**16**	902.0032.016	903.0032.016	965.0032.016	913.A032.016
4.8	**3/16**	**25**	902.0048.016	903.0048.016	965.0048.016	913.A048.016
6.4	**1/4**	**17**	902.0064.016	903.0064.016	965.0064.016	913.A064.016
8.0	**5/16**	**18**	902.0080.016	903.0080.016	965.0080.016	913.A080.016

1.6mm tube						
mm	**in**	**#**	**PVC**	**Fluorel**	**Neoprene**	**STA-PURE**
0.8	**1/32**	**13**			920.0008.016	
1.6	**1/16**	**14**	950.0016.016	970.0016.016	920.0016.016	960.A016.016
3.2	**1/8**	**16**	950.0032.016	970.0032.016	920.0032.016	960.A032.016
4.8	**3/16**	**25**	950.0048.016	970.0048.016	920.0048.016	960.A048.016
6.4	**1/4**	**17**	950.0064.016	970.0064.016	920.0064.016	960.A064.016
8.0	**5/16**	**18**	950.0080.016	970.0080.016	920.0080.016	960.A080.016

2.4mm tube					
mm	**in**	**#**	**Marprene**	**Bioprene**	**Pumpsil**
0.5	**1/50**	**105**			913.0005.024
0.8	**1/32**	**108**			913.0008.024
1.6	**1/16**	**119**	902.0016.024	903.0016.024	913.0016.024
3.2	**1/8**	**120**	902.0032.024	903.0032.024	913.0032.024
4.8	**3/16**	**15**	902.0048.024	903.0048.024	913.0048.024
6.4	**1/4**	**24**	902.0064.024	903.0064.024	913.0064.024

2.4mm tube				
mm	**in**	**#**	**CHEM-SURE**	**STA-PURE**
1.6	**1/16**	**119**	965.0016.024	960.0016.024
3.2	**1/8**	**120**	965.0032.024	960.0032.024
4.8	**3/16**	**15**	965.0048.024	960.0048.024
6.4	**1/4**	**24**	965.0064.024	960.0064.024

Note: 1.6mm wall CHEM-SURE and STA-PURE tubing are supplied in 305mm lengths. 2.4mm wall CHEM-SURE and STA-PURE tubing are supplied in 355mm lengths.

21.7 501RL pumphead

The 501RL and 501RL2 pumpheads are suitable for tubing with internal diameters up to 8.0mm. The 501RL is set during manufacture for use with 1.6mm wall tubing and 501RL2 is set for 2.4mm wall tubing.

The spring-loaded rollers give extended tube life. The pumphead can be run clockwise, for best tube life, or anticlockwise for higher pressures. The "tool lockable" guard should be locked shut while the pump is in use.

21.8 501RL and 501RL2 installation

The 501RL track will fit on the drive in three orientations. Secure the track with the locating screw.

The rotor grips the drive shaft via a split collet. Ensure the drive shaft is degreased before fitting the rotor. This will prevent the rotor slipping on the drive shaft during operation. Tighten the rotor screw to a torque of 3Nm.

The track and rotor may be removed from the pump for cleaning or to reposition the track on the pump.

There is a drive pin inside the rotor collet to engage with the end of the drive shaft. To keep this pin correctly engaged on the drive shaft, we recommend that the collet remains on the shaft, while the rotor is removed. Hold the rotor firmly and remove the rotor retaining screw. Pull the rotor from the drive shaft leaving the collet on the drive shaft. Remove the track locating screw. You may remove the track or rotate to the new position. Align the track and refit the track locating screw. Refit the rotor.

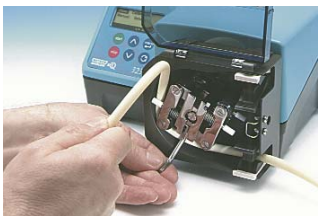
21.9 501RL and 501RL2 tube loading

Switch off the mains supply. Unlock and open the pumphead guard.

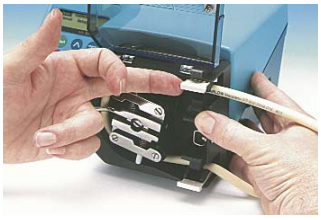
Select a minimum length of 240mm of tubing. Fit one end of the tubing into a clamp.



The rotor has tube guide rollers that pull the tube into the pumphead during loading. Turn the rotor carefully until the tube guides pick up the tube. Continue to turn the rotor, and feed the tubing in between the guides.




When the tube has gone round the pump track fit the other end of the tubing into the clamp. Check that the tubing has fitted naturally against the track for best tube life. Release the clamps and adjust the tubing if it is slack, twisted, or stretched.



The tube clamps can accommodate various tube diameters by pushing in, or pulling out, the grip bars within the clamp. Set the clamps to apply the minimum necessary pressure to the tubing.

Restart the pump. Free the downstream clamp for a short time, while the pump is running, so that the tube can find its natural length. Please keep fingers clear of the moving rotor. Shut and lock the guard after adjusting the tube.

When using Marprene tubing

Re-tension new tube after the first 30 minutes of running. Stop the pump and release the tube clamp at the outlet of the pump. Pull any slack tube from the pumphead and re-clamp the tube. Re-start the pump. This will correct the normal stretching that occurs with new Marprene tube. The correct tension is essential for good tube life.

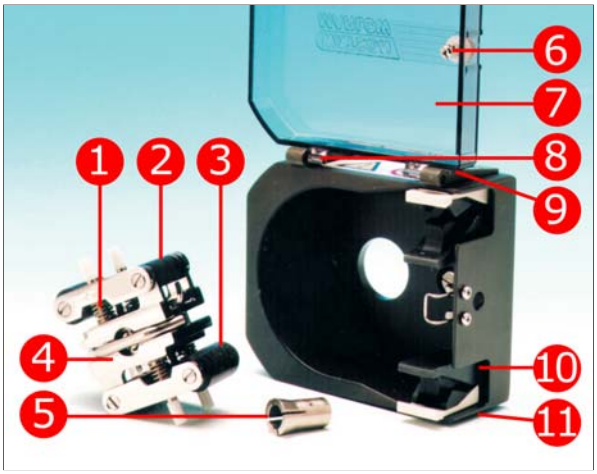
21.10 501RL and 501RL2 rotor settings

The 501RL and 501RL2 pumpheads are factory set to give optimum tube life with Watson-Marlow tubing. We recommend that the rotors are not adjusted or that other types of tubing are not used.

If the rotor needs re-aligning we recommend the rotor is returned to Watson-Marlow for correct adjustment. Or contact our technical department for further information.

Check moving parts of the rotor from time to time for freedom of movement. Lubricate pivot points and rollers occasionally with Teflon lubricating oil.

21.11 501RL and 501RL2 pumphead spares



	Spare	Description
	053.0001.L00	501RL complete pumphead
	053.0001.L20	501RL2 complete pumphead
1	SG001 SG002	Springs for 501RL (blue) Springs for 501RL2 (red)
2	MN0012T	Follower roller
3	MN0011T	Main roller
4	MNA0143A	501RL rotor assembly
5	CL0656T	Collet
6	FN4502	Lock
7	MN0377M	Lockable guard
8	MN0266M	Hinge
9	FN2341	Hinge screw
10	MNA0114A	Tube clamp assembly
11	FN2332	Screw
-	XX0095	Teflon lubricant

21.12 501RL and 501RL2 flow rates

Flow rates were obtained using silicone tubing with the pumphead rotating clockwise, pumping water at 20°C with zero suction and delivery pressures. For critical applications determine flow rates under operating conditions. The important factors are suction and delivery pressure, temperature and fluid viscosity. Tube life will be reduced when pumping against pressure.

Flow rates, 501RL, 1.6mm wall, 501RL2, 2.4mm wall (ml/min)								
bore	mm	0.5	0.8	1.6	3.2	4.8	6.4	8.0
	in	1/50	1/32	1/16	1/8	3/16	1/14	5/16
#		112	13	14	16	25	17	18
1-300 rpm		0.04-13	0.12-37	0.43-130	1.9-560	4.0-1200	6.4-1900	10-3000

21.13 501RL and 501RL2: tubing part numbers

1.6mm tube for 501RL pumpheads						
mm	in	#	Marprene	Bioprene	CHEM-SURE	Pumpsil
0.5	1/50	112	902.0005.016	903.0005.016		913.A005.016
0.8	1/32	13	902.0008.016	903.0008.016		913.A008.016
1.6	1/16	14	902.0016.016	903.0016.016	965.0016.016	913.A016.016
3.2	1/8	16	902.0032.016	903.0032.016	965.0032.016	913.A032.016
4.8	3/16	25	902.0048.016	903.0048.016	965.0048.016	913.A048.016
6.4	1/4	17	902.0064.016	903.0064.016	965.0064.016	913.A064.016
8.0	5/16	18	902.0080.016	903.0080.016	965.0080.016	913.A080.016

1.6mm tube for 501RL pumpheads						
mm	in	#	PVC	Fluorel	Neoprene	STA-PURE
0.8	1/32	13			920.0008.016	
1.6	1/16	14	950.0016.016	970.0016.016	920.0016.016	960.0016.016
3.2	1/8	16	950.0032.016	970.0032.016	920.0032.016	960.0032.016
4.8	3/16	25	950.0048.016	970.0048.016	920.0048.016	960.0048.016
6.4	1/4	17	950.0064.016	970.0064.016	920.0064.016	960.0064.016
8.0	5/16	18	950.0080.016	970.0080.016	920.0080.016	960.0080.016

Note: CHEM-SURE and STA-PURE are supplied in 305mm lengths.

2.4mm tube for 501RL2 pumpheads					
mm	in	#	Marprene	Bioprene	Pumpsil
0.5	1/50	105			913.A005.024
0.8	1/32	108			913.A008.024
1.6	1/16	119	902.0016.024	903.0016.024	913.A016.024
3.2	1/8	120	902.0032.024	903.0032.024	913.A032.024
4.8	3/16	15	902.0048.024	903.0048.024	913.A048.024
6.4	1/4	24	902.0064.024	903.0064.024	913.A064.024
8.0	5/16	121	902.0080.024	903.0080.024	913.A080.024

22 Trademarks

Watson-Marlow, Bioprene, Pumpsil and Marprene are trademarks of Watson-Marlow Limited.

Fluorel is a trademark of 3M.

Sta-Pure and Chem-Sure are trademarks of W.L.Gore and Associates.

23 Warning not to use pumps in patient-connected applications

Warning: These products are not designed for use in, and should not be used for patient-connected applications.

24 Publication history

m-323dz-gb-04.qxp: Watson-Marlow 323Dz.

First published 01 02. Revised 01 08.

25 Decontamination certificate

In compliance with the UK Health and Safety at Work Act and the Control of Substances Hazardous to Health Regulations, you are required to declare the substances which have been in contact with product(s) you return to Watson-Marlow or its subsidiaries or distributors. Failure to do so will cause delays. Please ensure that you fax us this form and receive an RGA (Returned Goods Authorisation) before you despatch the product(s). A copy of this form must be attached to the outside of the packaging containing the product(s). Please complete a separate decontamination certificate for each product. You are responsible for cleaning and decontaminating the product(s) before return.

Your name		**Company**	
Address			
Postcode/zip		**Country**	
Telephone		**Fax**	
Product type		**Serial number**	
To speed the repair, please describe all known faults			

The product has ... ☐ Been used ☐ Not been used

If the product has been used, please complete all the following sections.
If the product has not been used, please just sign this form.

Names of chemicals handled with product(s)	
Precautions to be taken in handling these chemicals	
Action to be taken in the event of human contact	

I understand that the personal data collected will be kept confidentially in accordance with the UK Data Protection Act 1998.

Signature	**RGA number**	
	Your position	
	Date	

Please print out, sign and fax to Watson-Marlow Pumps at +44 1326 376009.