

Watson-Marlow 520SN IP66 /NEMA 4X pumps



Contents

1	Declaration of conformity	2	17	520N module removal and replacement	33
2	Declaration of incorporation	2	18	Troubleshooting	34
3	Warranty	3	18.1	Error codes	35
4	When you unpack your pump	4	19	Drive maintenance	36
5	Information for returning pumps	5	20	Drive spares	36
6	Peristaltic pumps - an overview	6	21	The 520R, 520R2 and 520RE pumpheads	37
7	Safety	7	21.1	Pumphead position, removal and replacement	38
8	Pump specifications	9	22	520R, 520R2 and 520RE installation	40
8.1	Dimensions	13	22.1	Opening the pumphead guard	40
9	Good pump installation practice	14	22.2	520R and 520R2 tube loading	41
9.1	General recommendations	14	22.3	520RE: fitting the drain port	42
9.2	Do's and do not's	15	22.4	520RE Element loading	43
10	Connecting this product to a power supply	16	22.5	520RE Element connection	45
11	Start-up check list	19	23	520R, 520R2 and 520RE maintenance	46
12	Switching the pump on for the first time	19	24	520R, 520R2 and 520RE rotor settings	47
13	Switching the pump on in subsequent power cycles	21	25	Pumphead spares	48
14	Operation	22	26	Flow rates	49
14.1	Keypad functions	22	27	Tubing and element part numbers	57
14.2	Keypad lock	24	28	520 series pumping accessories	60
14.3	Keypad beep	24	29	Trademarks and disclaimer	61
14.4	To reset defaults	25	30	Patient-connected use: warning	61
14.5	To reset language	25	31	Publication history	61
14.6	Backlight	25	32	Decontamination certificate	62
14.7	Auto-restart	26			
14.8	Maximum allowed speed	27			
14.9	Speed	27			
14.10	Direction	27			
15	MemoDose	28			
15.1	Changing dosing speed	30			
16	Flow calibration	31			
16.1	Exit from flow calibration	32			

1 Declaration of conformity



This declaration was issued for Watson-Marlow 520SN pumps on February 1, 2004. 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/CSA std C22.2 No 1010-92. Conforms to UL std 61010A-1 April 30, 2002.

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. See 8 *Pump specifications*.

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

A handwritten signature in black ink, appearing to read 'C. Gadsden', written in a cursive style.

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 Five year warranty

520 cased pumps, 620 cased pumps and 720 cased pumps

For any 520, 620 or 720 cased pump purchased after 1 January 2007, 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 five 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.
- The 620R family of pumpheads are excluded from all warranty when pumping above 2 bar while above 165rpm.
- Pumpheads from the 313/314 and the Microcassette ranges and any 701 extension pumpheads are excluded and retain their one-year standard pumphead warranty. The drive they are attached to is subject to the five-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 lists, below.

Packaging disposal

Dispose of packaging materials safely, and in accordance with regulations in your area. Pay particular attention to the expanded polystyrene shockproof shells. 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 (520SN pump, IP66 / NEMA 4X)



- The 520SN pump drive unit fitted with:
 - 520R2 or other pumphead (see 8 *Pump specifications*) if specified as a pump
 - A 520N watertight module providing pump ingress protection to IP66, NEMA 4X.
Note: the module is attached for transit, but must be removed for voltage selection and fuse inspection and then re-affixed before the pump is operated.
 - 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 32 *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 possible 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 operate dry without risk.

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 Ltd, the protection provided by the pump may be impaired.

Any person who is involved in the installation or maintenance of this equipment should be fully competent to carry out the work. In the UK this person should also be familiar with the Health and Safety at Work Act 1974.



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.



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. The motor must be secured against accidental start-up.



There is a user-replaceable type T2,5A H 250V fuse in the fuseholder in the centre of the switchplate at the back of the pump. In some countries, the mains power plug contains an additional replaceable fuse. There is a fuse on the interface card which self-resets after five seconds. There are no user-serviceable fuses or parts inside this pump.

There are moving parts inside the pumphead. Before opening the tool-unlockable pumphead guard, 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.
- Protective clothing and eye protection must be worn if hazardous fluids are pumped.
- Primary operator protection from rotating parts of the pump is provided by the pumphead safeguard. Note that safeguards differ, depending on the type of pumphead. See the *pumphead* section of this manual.

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. 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.

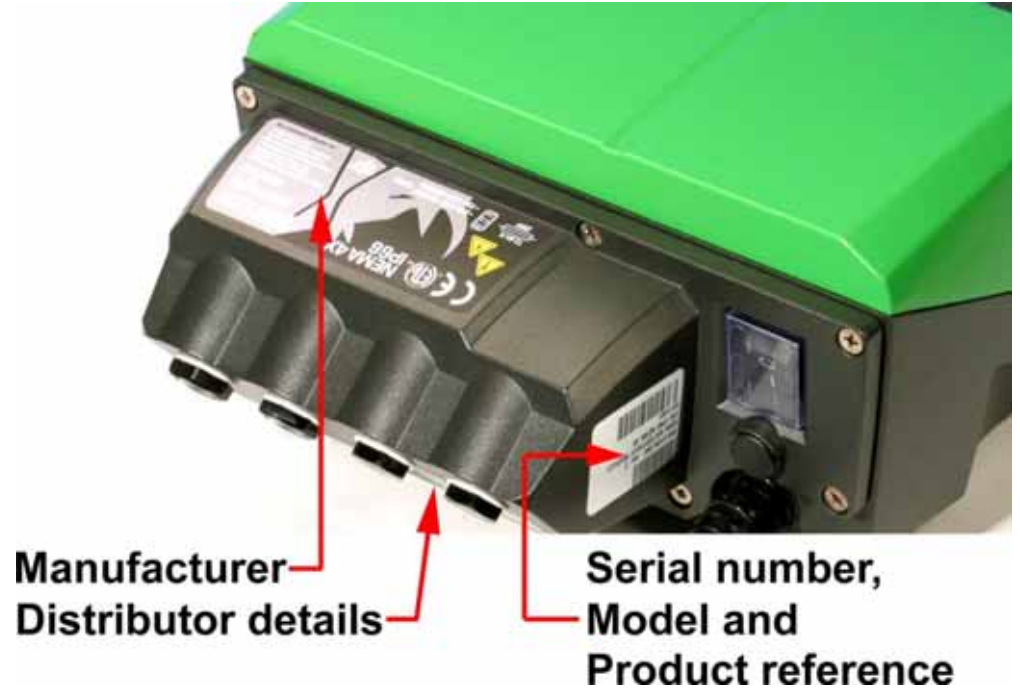
The exterior surfaces of the pump may get hot during operation. Do not take hold of the pump while it is running. Let it cool after use before handling it. The drive unit must not be run without a pumphead fitted.



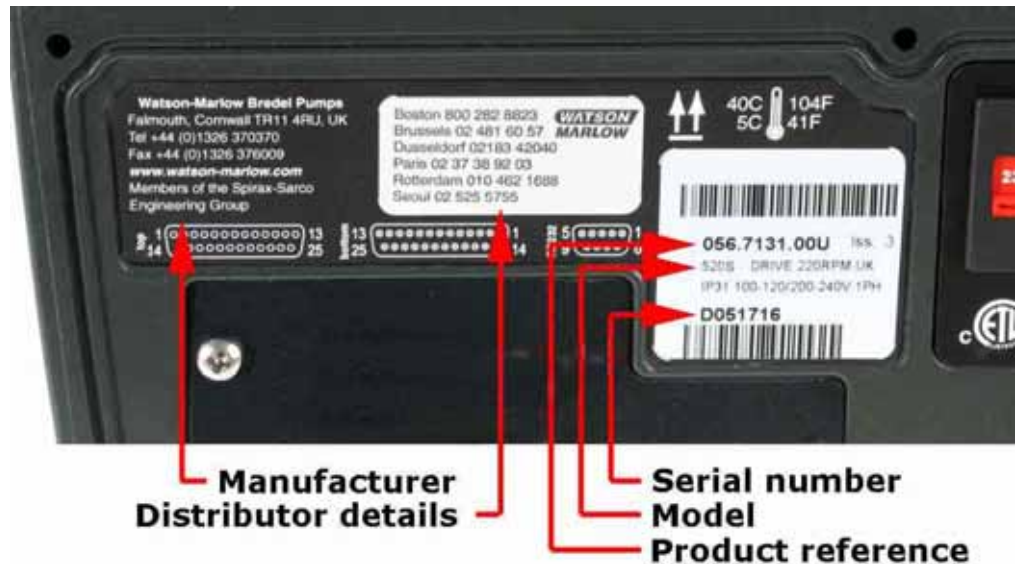
This product does not comply with the ATEX directive and must not be used in explosive atmospheres.

8 Pump specifications

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



The same information is carried on the drive's backplate, accessible when the 520N module is removed.



520SN, IP66 / NEMA 4X model

This pump operates by manual control only. There are no external control connections. All pump functions are controlled from the keypad. It features:

Manual control

Speed adjustment; run and stop; direction control; "max" key for rapid priming.

MemoDose

Allows precise repeat dosing. Stores in memory a pulse count from the motor. This count is repeated each time **START** is pressed to provide a single-shot dose.

Calibration dose

Uses the same pulse count as MemoDose. The corresponding pumped volume can be entered to calibrate the flow of the pump.

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 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)

* 520N cased pumps are rated to NEMA 4X (indoor use) only.

Pump specifications

Control range (turndown ratio)	0.1-220rpm (2200:1)
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 to the best practice of noise immunity
Installation category (overvoltage category)	II
Power consumption	135VA
Full load current	<0.6A at 230V; <1.25A at 115V
Eprom version	Accessible through pump software
Enclosure rating	IP66 to BS EN 60529; NEMA 4X to NEMA 250 *
Pumphead options	520R, 501RL, 313, 314, 505L, 505BA, 505CA, 314MC, 318MC
Operating temperature range	5C to 40C, 41F 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
Pollution degree	2
Noise	<70dB(A) at 1m

Note: 520 drive models are C ETL US listed. Cert to std CAN/CSA C22.2 No 1010-92. Conforms to std UL 61010A-1 April 30, 2002.

Note: 520 drive models have been tested in accordance with BS EN 61000-6-2:2001 (EN 61000-4-4) Fast Transient and Burst Tests to Industrial limits - ie: Level 3 : 2kV.

* Protect from prolonged UV exposure.

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 EN61000-6-4
	Radiated emissions: BS EN 55011 A1 and A2 Class A, called by BS EN61000-6-4
	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
CAN/CSA-C22.2 No 61010-1	
Conducted emissions FCC 47CFR, Part 15.107	
Radiated emissions FCC 47CFR, Part 15	
NEMA 4X to NEMA 250 (indoor use) for IP66 products only	

8.1 Dimensions

520SN IP66 / NEMA 4X model



Unit weights

	Drive only	+ 520R, 520R2	+ 520REL, 520REM, 520REH	+ 505L
IP66, NEMA 4X	9.52kg 20lb 15oz	10.42kg 22lb 15oz	10.34kg 22lb 13oz	12.00kg 26lb 7oz

9 Good pump installation practice

9.1 General recommendations

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

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.

Do not stack pumps more than three high. When pumps are stacked, ensure that the ambient temperature around all the pumps in the stack does not exceed 40C.

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 for the 520R and 501RL pumpheads tube life will be greater if the rotor rotates clockwise; and that performance against pressure will be maximised if the rotor rotates counter-clockwise. To achieve 4 bar and 7 bar pressures using a 520RE pump and the appropriate rotor and element, the pump **must** rotate counter-clockwise.

Peristaltic pumps are self-priming and self-sealing against backflow. No valves are required in inlet or discharge lines, except as described below. 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. Users of 520RE pumps at pressures up to 4 bar and 7 bar are advised to fit a non-return valve between the pump and the discharge pipework to avoid the sudden release of pressurised fluid in the unlikely event of element failure.

9.2 Do's and do not's

Do not build a pump into a tight location without adequate airflow around the pump.

Do ensure that whenever the 520N watertight module is fitted the seals are intact and properly located.

Do ensure that the holes for cable glands are properly sealed to maintain the IP66 / NEMA 4X rating.

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. Any valves in the pipeline (not usually needed with a self-priming peristaltic pump) must not restrict the flow. Any valves in the flow line must be open when the pump is running.

Do use suction and delivery pipes equal to or larger than the bore of the tube in the pumphead. When pumping viscous fluids use pipe runs with a bore several times larger than the pump tube.

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 minimise 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 and maximum pumping efficiency.

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. When using the 520R pumphead, a 6.4mm or 4.8mm bore tube with a 2.4mm wall will give best results. Tube smaller than this will generate a high friction loss, so reducing the flow. Tube with a larger bore may not have sufficient strength to reconstitute fully. 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.

IP66 / NEMA 4X models may be hosed down, but should not be immersed. Protect from prolonged UV exposure.

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



The voltage selector is mounted in the switchplate at the rear of the pump, protected from water by the 520N module. The module must be removed to allow access to the switchplate. See 17 *520N module removal and replacement*. 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.



The voltage selector switch is not visible while the 520N module is in place. Do not switch the pump on unless you have checked that it is set to suit your power supply by removing the module and inspecting the switch, and then refitting the module. See 17 *520N module removal and replacement*.

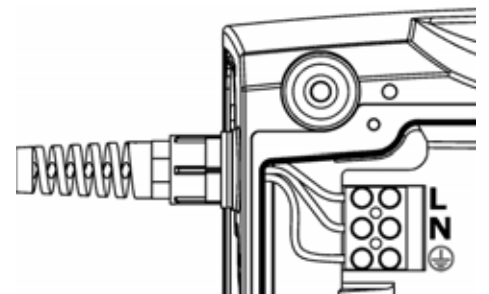


We recommend using commercially available supply voltage surge suppression where there is excessive electrical noise.

Power cable: The pump is supplied fitted with a cable gland and approximately 2.8m of power cable. Recommended cable: H05RN-F3G0.75; SJTW 105C 3-18AWG; max OD 8mm ($\frac{5}{16}$ in).

This drawing shows the cable connections from below with the interface card cover removed.

Power cables of NEMA 4X specification pumps are fitted with a standard US mains power plug. IP66 specification pumps are supplied with no plug. The colour code for the power cable is: brown - live; blue - neutral; green and yellow - earth.



If the mains power cable is inappropriate for your installation, it can be changed. This operation can be carried out with the 520N module in place, or after it has been removed, as shown here for clarity.



- Remove the six screws from the interface card cover underneath the pump. Lift off the interface card cover. You may find it convenient to remove the cover completely; if so, remove the cover earth lead.
- Undo the terminal block connectors. Remove the restraining clip by sliding its jaws sideways in opposite directions.
- Loosen the cable gland using a 19mm wrench and remove the gland and the cable.
- Thread a replacement cable through the three parts of the gland, the pump case and the restraining clip. Connect the new cable to the block connectors, following the drawing above.
- Tighten the restraining clip, and the gland to 2.5Nm. Check that the card cover earth link is secure. Replace the card cover, checking that the earth wire is not pinched beneath the cover lip. Take care that the sealing strip is properly seated to ensure a seal.



Input line fusing: type T2,5A H, 250V, 20mm time-delayed fuse, located in a fuseholder in the centre of the switchplate at the rear of the pump.

Power interruption: This pump has an auto-restart feature which, when active, will restore the pump to the operating state it was in when power was lost. See 14.7 *Auto-restart*.

Stop / start power cycles: Do not power up/power down for more than 100 starts per hour, whether manually or by means of the auto-restart facility. We recommend remote control where a high frequency of power cycles is required.

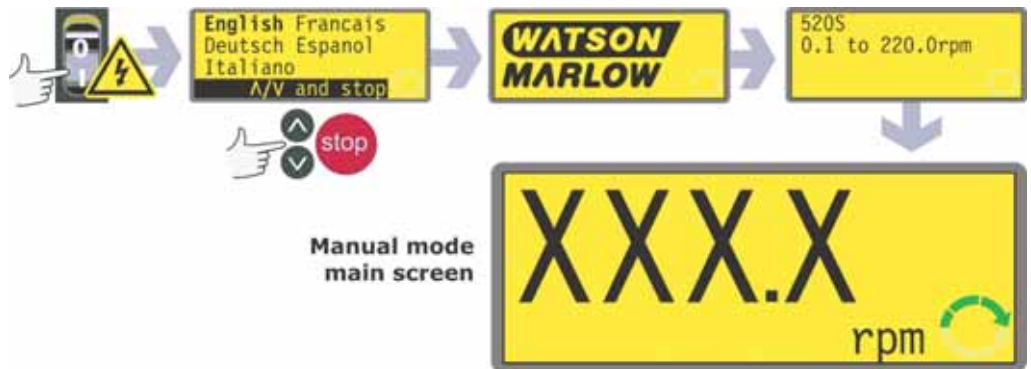
11 Start-up check list

Note: See also 22.2 *Tube loading*.

- 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 the section 9 *Good pump installation practice* are followed.

12 Switching the pump on for the first time

Note: This manual uses **bold** type to highlight the active option in menu screens: “**English**” 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 code is displayed. See 18.1 *Error codes*.
- The pump displays a language menu. Use the **UP** and **DOWN** keys to select your language. Press the **STOP** 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 screens will appear in the language you chose. (Language can be reset as described later. See 14.5 *To reset language*.)

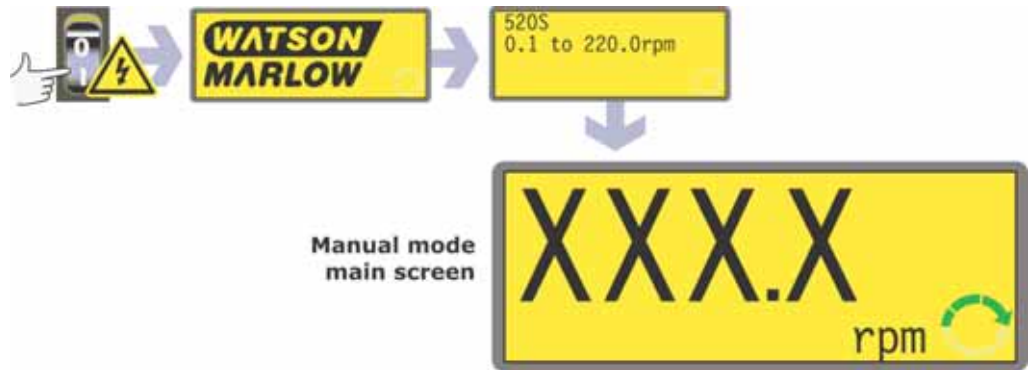
- The pump displays the Watson-Marlow start-up screen for four seconds, followed by the pump model identity screen for four seconds, and then the manual mode main screen.
- The rotation symbol on the display indicates clockwise rotation. The speed of rotation is the pump's maximum. Other initial start-up operational parameters are listed in the table below.

First-time start-up defaults			
Language	Not set	Keypad lock	Off
Speed	Maximum	Auto-restart	Off
Direction	Clockwise	Pump status	Stopped
Calibration	520R 9.6mm tube	Beeper	On
Backlight	On	Manual screen	rpm

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 *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 code is displayed. See 18.1 *Error codes*.
- The pump displays the Watson-Marlow start-up screen for four seconds followed by the pump model identity screen for four seconds, and then the manual mode main screen.
 - **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 manual mode main screen. Once in the manual mode main screen, keys assume their normal functions - see 14.1 *Keypad functions* below. A subsequent press on **START** causes the pump to operate.
- 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.

All operating parameters may be changed by means of key-presses. See 14 *Operation*.

14 Operation

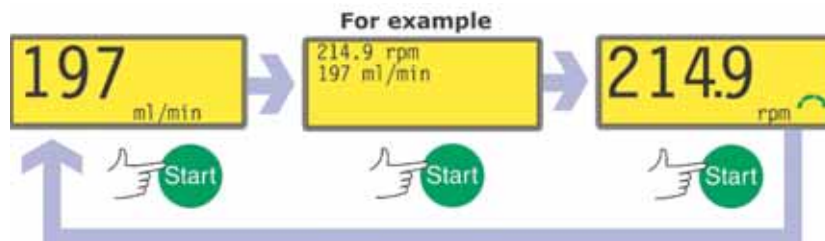
14.1 Keypad functions

All settings and functions of the pump in manual mode are set and controlled by means of key-presses. Immediately after the start-up display sequence detailed above, the manual mode main screen will be displayed. 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 (see 14.7 *Auto-restart*). If a padlock icon (🔒) shows, it indicates that Keypad lock is on (see 14.2 *Keypad lock*).



A brief single press on each key triggers a beep sound (if enabled - see 14.3 *Keypad beep*) 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 (0.1 rpm) before starting the pump.



If the pump is running when **START** is pressed, it causes the information shown on the manual mode main screen to cycle from revolutions per minute, to flowrate in millilitres per minute (via a warning screen if flowrate has not been calibrated and if this is the first cycle since power-up) to both rpm and flowrate. See 16 *Calibration*.

- **MAX**: while pressed, **MAX** operates the pump at the maximum allowed speed and in the direction shown on the display. When released, the pump returns to its previous status.
Note: Priming can be achieved by pressing the **MAX** key until fluid flows through the pump and reaches the point of discharge, and then releasing the **MAX** key.
- **STOP**: has no effect if the pump is not running. If the pump is running, pressing **STOP** stops the pump. The display will continue to show the previous speed and direction. The pump will return to this speed and direction when the **START** key is pressed again.
STOP is also used in the MemoDose facility, while calibrating the pump, setting the maximum speed and as an "enter" key - similar to the Return key on a personal computer.
- **UP**: increases the speed shown on the display in minimum steps of 0.1 rpm (unless the speed displayed is already the maximum allowed speed). If the pump is then started by pressing the **START** key, it will operate at the new speed. If the pump is running when **UP** is pressed, the change takes effect immediately.
Note: After a speed change, a screen showing the new rpm figure **and** the new flowrate is displayed for four seconds before returning the user to the previously set manual mode main screen: rpm **or** flowrate.
- **DOWN**: decreases the speed shown on the display in minimum steps of 0.1 rpm. If the pump is then started by pressing the **START** key, it operates at the new speed. The minimum speed possible is 0.1 rpm. If the pump is running when **DOWN** is pressed, the change takes effect immediately.
Note: After a speed change, a screen showing the new rpm figure **and** the new flowrate is displayed for four seconds before returning the user to the previously set manual mode main screen: rpm **or** flowrate.
Note: You can reduce the pump speed from 0.1 rpm 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.

Key-press combinations cause the pump to function as follows:

- **DIRECTION** on power-up: resets defaults.
- **DIRECTION** and **UP** on power-up: toggles the keypad beep on and off.
- **START** on power-up: switches on the Auto-restart facility. See 14.7 *Auto-restart*.
- **STOP** on power-up: switches off the Auto-restart facility. See 14.7 *Auto-restart*.
- **STOP** and **UP** while the pump is stopped: turns the display backlight on.
- **STOP** and **DOWN** while the pump is stopped: turns the display backlight off.
- **STOP** and **DIRECTION**: set the maximum allowed speed.
- **DIRECTION** and **DOWN**: interrupts the display to show the pump's ROM version for four seconds.

- **MAX** and **UP**: sets the pump to maximum allowed speed.
- **MAX** and **DOWN**: sets the pump to minimum speed.
- **START** pressed and held for two seconds: toggles the keypad lock on and off. Only the **START** and **STOP** keys are active when keypad lock is on. The padlock icon is displayed.
- **STOP** pressed and held for two seconds: toggles the keypad lock on and off. Only the **START** and **STOP** keys are active when keypad lock is on. The padlock icon is displayed.
- **STOP STOP** within half a second: shortcut entry to the MemoDose menu; when in MemoDose, shortcut return to manual mode main screen. See 15 *MemoDose*.

Note: The maximum allowed speed of the drive defaults to 220 rpm. It is possible to set this limit at any speed up to this value. See 14.8 *Set maximum speed*.

Note: Confirmation screens are displayed for 4 seconds. While they are displayed, a single press on any key removes them.

14.2 Keypad lock

The keypad can be locked to prevent changes to pump speed or other settings, and make it possible only to start or stop the pump. The padlock symbol shows on the display.

- While the pump is running, hold down the **START** key for two seconds. The padlock symbol shows and only the **START** and **STOP** keys function.
- The keypad may also be locked while the pump is stopped. Hold down the **STOP** key for two seconds. The padlock symbol shows and only the **START** and **STOP** keys function.
- To unlock the keypad while the pump is running hold down the **START** key for two seconds. The padlock symbol is removed. If the pump is stopped hold down the **STOP** key until the padlock symbol is removed.

14.3 Keypad beep

The pump keypad can operate silently or indicate a positive key-press with a beep sound.

- To toggle the sound on and off, stop the pump. Turn off the mains power switch at the rear of the pump.
- Depress the **UP** and **DIRECTION** keys while switching on the mains power switch at the rear of the pump.

14.4 To reset defaults

All settings can be re-set to factory defaults.

- Turn off the mains power switch at the rear of the pump.
- Depress the **DIRECTION** key while switching on the mains power switch at the rear of the pump. A warning screen is displayed briefly, followed by a screen asking the user to confirm that factory defaults are to be reset.
- Select **Yes** or **No** using the **UP** and **DOWN** keys. Confirm by pressing **STOP**. If **Yes** was confirmed, the pump resets all user-settable data to default values and displays the manual mode main screen. If **No** was confirmed, no change is made and the manual mode main screen is displayed.

The language of display screens may be reset only by resetting defaults.

14.5 To reset language

The language of display screens is set on initial start-up. To reset language, reset all defaults (see 14.4 *To reset defaults*).

14.6 Backlight

To turn the display backlight on:

- Depress the **STOP** and **UP** keys together.

To turn the display backlight off:

- Depress the **STOP** and **DOWN** keys together.

14.7 Auto-restart

This pump offers an auto-restart feature. When active on power loss, it will restore the pump when power returns to the operating state it was in when power was lost. It does not operate when powering down in the middle of a dose; when the pump is restarted, it will await a press on the **START** key to begin the interrupted dose again. Auto-restart is retained while the pump is switched off. When the pump starts running look for the ! symbol on the display. This ! symbol indicates that the pump is set for auto-restart.

To turn the auto-restart facility on:

- Turn off the mains power switch at the rear of the pump.
- Depress the **START** key while switching on the mains power switch at the rear of the pump.

To turn the auto-restart facility off:

- Turn off the mains power switch at the rear of the pump.
- Depress the **STOP** key while switching on the mains power switch at the rear of the pump.



Do not use auto-restart for more than 100 starts per hour. We recommend remote control where a high number of starts is required.

14.8 Maximum allowed speed

To set the maximum allowed speed:



- Depress the **STOP** and **DIRECTION** keys together.
- The display shows the currently chosen maximum allowed speed.
- Use the **UP** and **DOWN** keys to change the maximum allowed speed.
- Press **STOP** to confirm.
- The pump redisplay the manual mode main screen showing the new maximum allowed speed.

14.9 Speed

To change the running speed:

- Use the **UP** and **DOWN** keys to change the pump's running speed within limits of 0.1 rpm and the maximum allowed speed.
Note: You can reduce the pump speed from 0.1 rpm 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.

14.10 Direction

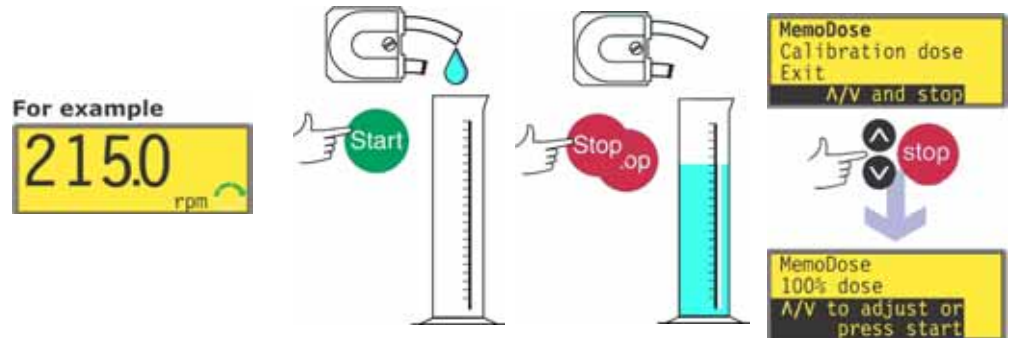
To toggle the pump's rotation sense:

- Press the **DIRECTION** key to toggle the pump between clockwise and counter-clockwise rotation.

15 MemoDose

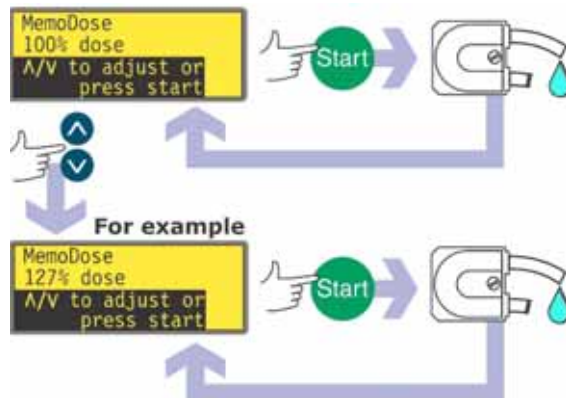
Each time the pump is started by pressing **START**, it records the number of pump-head revolutions which occur until **STOP** is pressed. The number of revolutions is proportional to the volume of fluid which has been dispensed: the dose. The MemoDose facility allows the user to repeat-dose a precise volume of fluid. To do so, a quantity of fluid must be dispensed as the master dose which the MemoDose facility can repeat exactly or proportionately.

To dispense a master dose



- In the manual mode main screen, set the appropriate pump speed and direction using the **UP** or **DOWN** keys and the **DIRECTION** key. A slower speed may make it easier for the user to measure accurately (though a slower speed may not represent the duty condition).
- Place a suitable measuring vessel under the pump delivery tube.
- Press **START**. The pump runs and fluid is pumped into the vessel.
- When the required volume of fluid has been dispensed, it is necessary to stop the pump and display the MemoDose screen. This can be achieved in two ways.
 1. Press the **STOP** key twice within half a second. The pump stops and immediately displays the MemoDose/Calibration screen. Use the **UP** or **DOWN** keys to select **MemoDose**. Press **STOP** to confirm.
OR...
 2. Press the **STOP** key once. The pump stops. (This may make it easier to ensure that the quantity of fluid that has been dispensed is sufficiently precise.) Then press the **STOP** key twice within half a second. The pump displays the MemoDose/Calibration screen. Use the **UP** or **DOWN** keys to select **MemoDose**. Press **STOP** to confirm.

To repeat the dose

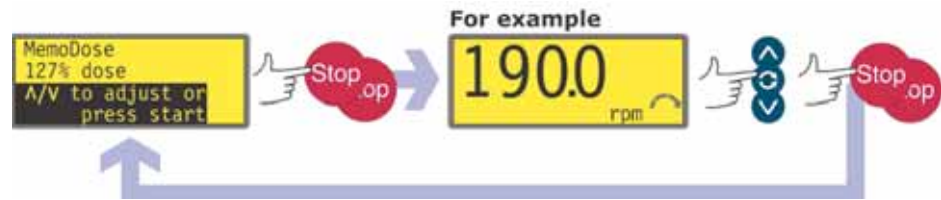


- The pump has recorded the number of pumphead revolutions required to dispense the master dose. If the volume of fluid in the measuring vessel is the volume required, press **START** to repeat the dose.
- If the volume in the measuring vessel differs from the volume required, the percentage setting may be adjusted within the limits 1% to 999% of the master dose. Use the **UP** or **DOWN** keys to alter the percentage. Press **START** to dispense the new dose.
- The display counts down as the dose proceeds and stops when the dose is complete.
- If **STOP** is pressed during dosing, the pump stops and returns the user to the MemoDose percentage screen.

Press the **STOP** key twice within half a second if you wish to exit MemoDose and return to manual operation.

15.1 Changing dosing speed

The user must exit MemoDose in order to change pump speed (and direction). After returning to MemoDose, the pump dispenses the previous dose size at the new speed.

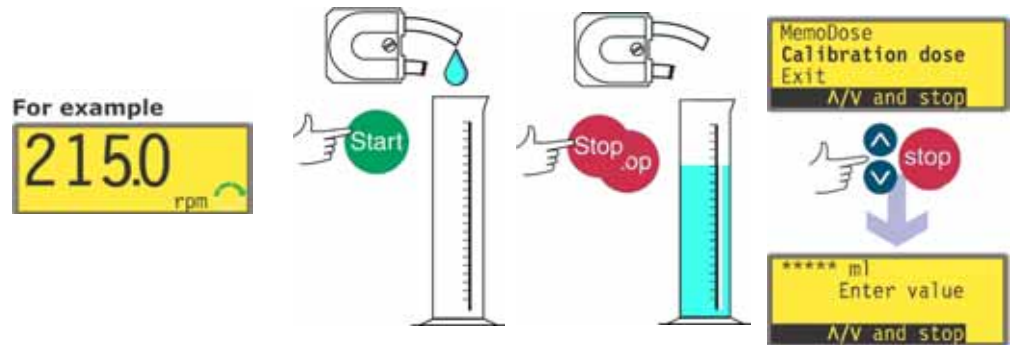


- Press the **STOP** key twice within half a second. The pump displays the manual mode main screen.
- **Do not start the pump. Doing so erases the previously recorded master dose and replaces it in the pump's memory with the current, unmeasured dose.** Adjust the speed showing on the display using the **UP** or **DOWN** keys.
- Press the **STOP** key twice within half a second to return to MemoDose. The display shows the previous percentage dose size. The pump will dose at the new speed.

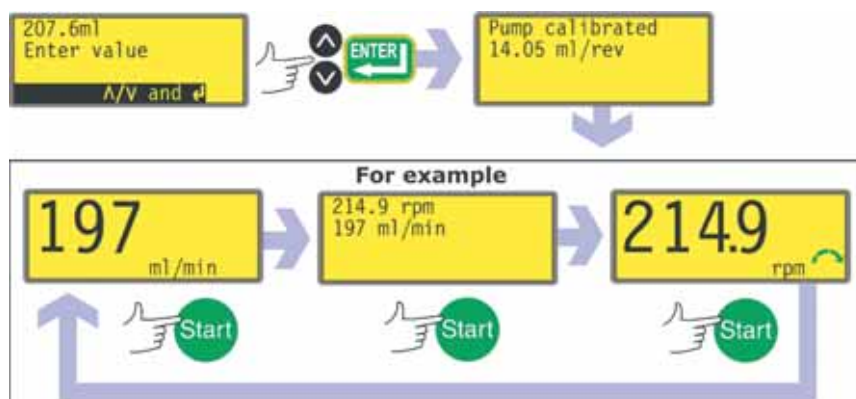
Note: To retain the MemoDose value through a power interruption the pump must be in auto-restart mode. The dosing cycle will resume at the start of a dose and wait for **START** to be pressed, with the MemoDose percentage screen displayed. See 14.7 *Auto-restart*.

16 Flow calibration

The pump can display flowrate in millilitres per minute as well as speed in revolutions per minute.



- In the manual mode main screen, set the appropriate pump speed and direction using the **UP** or **DOWN** keys and the **DIRECTION** key. A slower speed may make it easier for the user to measure accurately (though a slower speed may not represent the duty condition).
- Place a suitable measuring vessel under the pump delivery tube.
- Press **START**. The pump runs and fluid is pumped into the vessel. The volume pumped is not important; but the greater the volume, the more accurate the flow-per-revolution calculation will be. We suggest that the pumphead be run for at least 10 revolutions, and at least 20 when small-bore pumping tube is used.
- When a volume of fluid has been dispensed, it is necessary to stop the pump and display the Calibration dose screen. This can be achieved in two ways.
 1. Press the **STOP** key twice within half a second. The pump stops and immediately displays the MemoDose/Calibration screen. Use the **UP** or **DOWN** keys to select **Calibration dose**. Press **STOP** to confirm. OR...
 2. Press the **STOP** key once. The pump stops. (This may make it easier to ensure that the quantity of fluid that has been dispensed is sufficiently precise.) Then press the **STOP** key twice within half a second. The pump displays the MemoDose/Calibration screen. Use the **UP** or **DOWN** keys to select **Calibration dose**. Press **STOP** to confirm.
- Measure the volume of fluid pumped. Make a note of the volume.
- The pump has recorded the number of pumphead revolutions required to pump the volume of fluid measured.
- The calibration dose screen is displayed. It shows a four-digit number of millilitres, and the instruction: "Enter dose value". The number displayed is the number which was entered the previous time the pump was calibrated (or the default figure).



- Use the **UP** and **DOWN** keys to enter the measured volume of fluid pumped. Press **STOP** to confirm.
- The pump calculates the volume of fluid pumped for each pumphead revolution. The value from this calculation is saved for use in manual mode displays.
- The pump displays a confirmation screen for four seconds, and returns the user to the manual mode main screen, with millilitres per minute shown.
- The pump can now display millilitres per minute, revolutions per minute, or both. Press the **START** key while the pump is running to cycle through the three display options.

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

Note: If the pump power is cycled while flow rate is displayed, calibration is lost and a warning is displayed.

16.1 Exit

To return to the manual mode main screen select **Exit** using the **UP** and **DOWN** keys. Confirm by pressing **STOP**.



It is important to check the pump's voltage setting to ensure that it matches the supply. The voltage selection switch is on the rear panel of the drive. The module must be removed (and replaced) to allow it to be checked.

17 520N module removal and replacement

To remove the 520N watertight module:

The module is secured to the back of the drive unit by six M5x12 Pozidriv counter-sunk stainless steel screws.



- Remove the six screws using a suitable crosspoint screwdriver, leaving the top centre screw till last. Even when all screws have been removed, the sealing strip may cause the module to adhere to the drive. If so, a gentle tap will free it. Do not use a tool to lever it off.
- The sealing strip should be retained within its channel on the face of the module. The transparent on/off switch cover should be retained on its flange on the face of the module. Check the integrity of the seal and the transparent on/off switch cover. If either is damaged, it must be renewed to maintain ingress protection.
- If necessary, remove the module's earth link from the back of the drive. However, the link is long enough to allow the module to fold back to give access to the back of the drive.

To replace the 520N watertight module:



- Check that the fuse in the fuseholder (ringed) in the centre of the switchplate does not need to be replaced. Check that the voltage selector switch is correctly positioned for your power supply.

- Check that the sealing strip is fully in its channel on the face of the module.
- Attach the module's earth link wire. Replace and tighten its screw to 2Nm.
- Hold the module in place, taking care not to disturb the seal or pinch the earth link wire, and screw in the six retaining screws (top centre screw first). Tighten to 2.5Nm.

Note: Ensure that the 520N module is properly fitted at all times using all six screws. Without the module and the screws, the screw holes may corrode and IP66 (NEMA4X) protection will be compromised.

18 Troubleshooting

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

- Check the position of the voltage selector switch.
- 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 fuseholder in the centre of the switchplate 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.

18.1 Error codes

If an internal error occurs, a flashing error screen is displayed. **Note: Signal out of range, Over signal, No signal and Leak detected** error screens report the nature of an external signal. They do not flash.

Error condition	Suggested action
RAM write error	Attempt to reset by switching power OFF / ON. Or seek support
RAM corruption	Attempt to reset by switching power OFF / ON. Or seek support
OTP ROM error / corruption	Attempt to reset by switching power OFF / ON. Or seek support
OTP ROM read error	Attempt to reset by switching power OFF / ON. Or seek support
Unknown pump type	Check the interface card and cables. Attempt to reset by switching power OFF / ON. Or seek support
Display failure	Seek support
Wrong key-press	Attempt key-press again. Attempt to reset by switching OFF / ON
Motor stalled	Stop pump immediately. Check pumphead and tube. Power OFF/ON may reset. Or seek support
Tacho fault	Stop pump immediately. Power OFF/ON may reset. Or seek support
Speed error	Stop pump immediately. Power OFF/ON may reset. Or seek support
Over current	Stop pump immediately. Check system. Power OFF/ON may reset. Or seek support
Over voltage	Stop pump immediately. Check mains voltage selector switch. Check supply. Power OFF/ON may reset. Or seek support
Under voltage	Stop pump immediately. Check mains voltage selector switch. Check supply. ON/OFF may reset. Or seek support
Watchdog error	Attempt to reset by switching power OFF / ON. Or seek support
Over temperature	Stop pump immediately. Turn OFF. Seek support
Unrecognised key-press	Attempt key-press again. Attempt to reset by switching power OFF/ON. Or seek support
Work overload	Turn OFF. Check power supply. Check pumphead and tubing. Wait 30 minutes. Power ON may reset. Or seek support
General error condition	Turn OFF. Seek support

19 Drive maintenance

There are no user serviceable parts inside the pump (except the power cable: see 10 *Connecting this product to a power supply*). The unit should be returned to Watson-Marlow or its appointed agents or distributors for service.

20 Drive spares

Replaceable main fuse, type T2,5A H 250V
20mm: FS0064

Foot: MN2507M

21 The 520R, 520R2 and 520RE pumpheads

Identification of parts



520R/520R2		520REL/520REM/520REH			
1	Guard latch	5	Rotor cap	9	Pumping roller
2	Guard (520R, 520R2)	6	Tube guide roller	10	Tube clamp slider (520R, 520R2)
3	Track	7	Rotor	11	Tube clamp (520R, 520R2)
4	Clutch button cover	8	Follower roller	12	Guard with seal (520RE)
				13	Drain port (520RE)

21.1 Pumphead position, removal and replacement



Always isolate the pump from the mains power supply before opening the guard or performing any positioning, removal or maintenance activity.

The pumphead track can be fitted in one of three orientations to provide right, up or down input/output port positions, whichever is convenient. Position the pumphead so that the tube ports face up or down only where the drive is placed on the bench edge - otherwise the pump tube or the hinged guard will impact the bench. Do not position the pumphead so that the tube ports face the keypad. Doing so may result in a safety risk.

The pump can be configured for clockwise or counter-clockwise rotor rotation. Please note, however, that tube life will be greater if the rotor rotates clockwise; and that performance against pressure will be maximised if the rotor rotates counter-clockwise.

To reposition the track

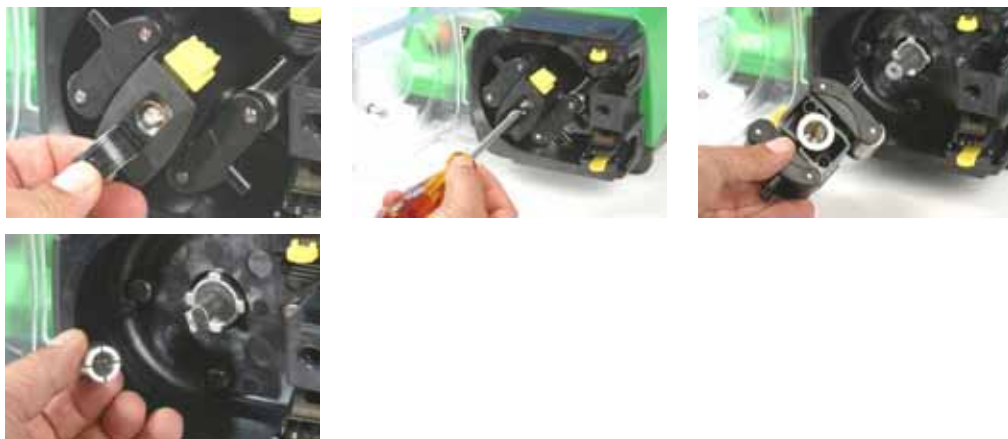
- Open the pumphead guard as described under 22.1 *Opening the pumphead guard*, below.
- Remove the rotor as described under *Rotor removal*, below.



- Undo and withdraw the four track-retaining screws using a slotted screwdriver.
- Remove the track.
- Relocate the track in the desired position. Replace and tighten the track-retaining screws.
- Replace the rotor as described under *Rotor replacement* below.
- Close the guard, pushing it fully home until the latch engages.

Rotor removal

- Remove any tubing from the pumphead.



- Open the flexible rotor cap in the centre of the rotor.
- Undo and withdraw the central locating screw using a slotted screwdriver.
- Pull the rotor hub off its dogged shaft.
- Between the hub and the shaft is a split collet. If the collet is retained by the shaft, pull it off, loosening it if necessary by tapping it lightly. Avoid levering it off using a screwdriver or other tool. If the collet is retained within the hub, remove it, loosening it if necessary by reinserting the central locating screw a turn or two and tapping the screw head lightly.

Rotor replacement



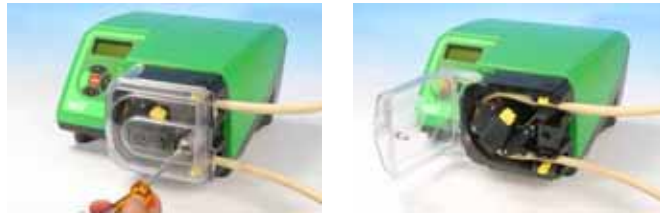
- Re-locate the split collet onto the drive shaft, rotating it until it fully engages the dog. Fit the rotor body over the drive shaft.
- Open the flexible rotor cap in the centre of the rotor. Use a slotted screwdriver to tighten the central locating screw to a torque of 3Nm (2.2 lb-ft) to prevent collet slip during operation. When fitted correctly, the tube guide rollers should align with the outer face of the track. Close the flexible rotor cap.
- Close the guard and ensure that the rotor is clear of the guard by observing the first few rotor rotations.

22 520R, 520R2 and 520RE installation



Always isolate the pump from the mains power supply before opening the guard or performing any positioning, removal or maintenance activity.

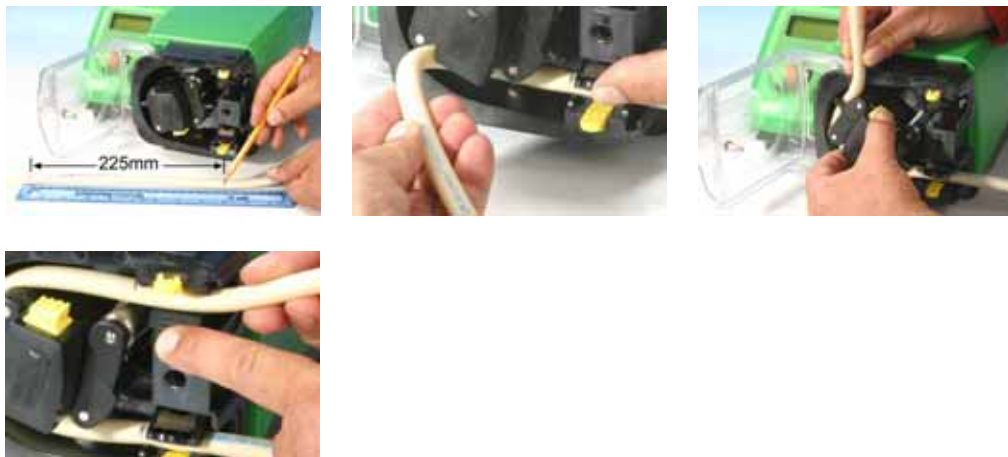
22.1 Opening the pumphead guard



- Unlock the pumphead guard by turning the guard fastener $\frac{1}{4}$ turn anticlockwise with a slotted screwdriver.
- Open the guard to its full extent to create maximum clearance for the tube ports.
- Ensure that the rollers rotate freely and that the tube clamps are clean.

22.2 520R and 520R2 tube loading

520R continuous tubing pumpheads are factory-set to accept Watson-Marlow 1.6mm-wall tubing. 520R2 continuous tubing pumpheads are factory set to accept Watson-Marlow 2.4mm-wall tubing. Pumping performance may be adversely affected if Watson-Marlow tubing is not used.



- Mark a 225mm (8 ⁷/₈in) length onto the section of the tubing which is to be located into the pumphead.
- Open the lower spring-loaded tube clamp and locate the tubing, with the first 225mm (8 ⁷/₈in) length mark aligned to the inside face of the spring-loaded part of the tube clamp. Release the clamp.
- Disengage the rotor clutch by fully depressing the yellow clutch button on the side of the rotor hub and turning the hub a few degrees while the clutch button is still depressed. The rotor can now rotate independently of the gearbox and motor for one full revolution. If the clutch re-engages before tube fitting is complete, depress the clutch button again and turn the rotor a few degrees.
- Feed the tubing around the pumphead track, turning the rotor as necessary. Make sure the tubing is not twisted or pinched between the guide rollers and the track. Ensure that the second 225mm (8 ⁷/₈in) mark is adjacent to the inner edge of the upper tube clamp.
- Open the upper spring-loaded tube clamp and locate the tubing into it, making sure there is no residual twist in the tubing, and that the tube sits centrally between the tube guide rollers. Release the clamp.



- The spring-loaded tube clamps must grip the tubing tightly enough to stop it moving in and out of the pumphead but must not over-squeeze the tube and throttle fluid flow. The tubing clamps are fitted with yellow sliders which can be clicked into two positions while the clamps are held open: the outer position will allow the clamps to grip the tube tightly; the inner will grip the tube loosely. Adjust the sliders to prevent tube movement during a few trial rotations of the rotor.
- Close the guard, pushing it fully home until the latch engages.
- Connect suitable pipework to the pumphead tubing using appropriate connectors.
- Remember, when using Marprene or Bioprene tubing, re-tension the tubing after 30 minutes of running, as it may grow in length as it beds in. Re-tension so that 225mm (8 7/8in) of tubing sits between the inside faces of the spring-loaded parts of the tube clamps.

22.3 520RE: fitting the drain port

The drain port is an optional extra, supplied with the pumphead. It is strongly recommended that users fit it before the pump is operated. It may be done with the rotor in position or removed.






- Remove the drain plug from the bottom of the pumphead. The drain plug is flexible. It may be removed using finger pressure from within the pumphead, or by accessing its flange from outside with a fingernail.
- Drop the port into position from inside the pumphead.
- Fit the supplied port retaining nut (3/8in BSP) and finger-tighten.
- Fit drainage pipework as required (not supplied).

22.4 520RE Element loading

520RE tubing element pumpheads are factory-set to accept Watson-Marlow 2.4mm-wall tubing elements. Elements fitted with either quick-release industrial connectors or Tri-clamp sanitary connectors may be used; however, **it is vital to match the pressure rating of the element with the pressure rating of the pumphead** so that the correct roller-spring rate and occlusion settings are used. The pressure rating of the pumphead appears on the flexible rotor cap in the centre of the rotor. The pressure rating of the element appears on the connector sleeve.

Note that the rotor cap and the element connector sleeve are colour-coded.

Note: To achieve 4 bar and 7 bar pressures using a 520RE pump and the appropriate rotor and element, the pump **must** rotate counter-clockwise.

Element and rotor pressure ratings					
Colour of flexible rotor cap and element connector sleeve					
Grey		Beige		Blue	
					
520REL Pressures up to 2 bar (30 psi) Bore sizes 3.2mm, 6.4mm and 9.6mm		520REM Pressures up to 4 bar (60 psi) Bore sizes 3.2mm and 6.4mm		520REH Pressures up to 7 bar (100 psi) Bore size 3.2mm	
Industrial Marprene TL Pumpsil Neoprene Chem-Sure	Sanitary Bioprene TL Pumpsil Sta-Pure Chem-Sure	Industrial Marprene TM Chem-Sure	Sanitary Bioprene TM Sta-Pure	Industrial Marprene TH Sta-Pure	Sanitary Bioprene TH Sta-Pure

Element connectors for industrial and sanitary use	
Industrial	Sanitary
	



Check that the conical connector sleeve of the element to be fitted is the same colour as the pumphead rotor cap

520RE element loading procedure

Note: The element loading procedure is the same for industrial (pictured) and sanitary elements.



- Select an appropriate Watson-Marlow 520RE tubing element, paying attention to pressure capability, bore size, tubing material and type of connector. See the table above for pressure ratings. **Check that the connector sleeve of the element to be fitted is the same colour as the pumphead rotor cap.**
- Slide the connector D-flange at one end of the element into the lower connector D-slot.
- Disengage the rotor clutch by fully depressing the yellow clutch button on the side of the rotor hub and turning the hub a few degrees while the clutch button is still depressed. The rotor can now rotate independently of the gearbox and motor for one full revolution. If the clutch re-engages before tube fitting is complete, depress the clutch button again and turn the rotor a few degrees.
- Feed the tubing element around the pumphead track, turning the rotor as necessary. Make sure the tubing is not twisted or pinched between the guide rollers and the track.
- Slide the second connector D-flange into the upper connector D-slot.
- Check that the element lies in the middle of the track and that the connector flanges are pushed fully home.
- Close the guard, pushing it fully home until the latch engages.
- Connect suitable pipework to the pumphead tubing using appropriate connectors. See below.

22.5 520RE Element connection

Select suitable tubing to connect to the tubing element supply and discharge connectors. Check that its pressure rating is appropriate to the application.

Sanitary $\frac{3}{4}$ in mini-Tri-clamp connectors

Sanitary connectors are connected to a tubing system using mini-Tri-clamps and gaskets.



- Hold the connector end of the supply or discharge tube against the element connector, with a gasket between them.
- Use a Tri-clamp to engage both flanges squarely, close it and tighten.

Industrial quick-release connectors

Industrial connectors are connected to a tubing system using quick-release fittings.



- Hold the pump securely and push the female fitting (available from Watson-Marlow Bredel) over the element until it clicks into place.



- To disconnect, hold the pump securely and pull the connector outer sleeve and twist counter-clockwise while pulling the female connector away.

23 520R, 520R2 and 520RE maintenance



Always isolate the pump from the mains power supply before opening the guard or performing any positioning, removal or maintenance activity.

- As part of regular cleaning and maintenance (and at least every three months), lubricate the pivot points, the follower rollers and the tube guide rollers with Ultra Lube (PA 1240), which is a non-toxic perfluoroether-based grease.
- The stainless steel pumping rollers run on externally-sealed bearings and are lubricated for life.
- Check that the pumphead track, rotor, rollers and spring-loaded tube clamps are clean and operating properly.
- If fluid is spilled inside the pumphead it should be cleaned as soon as possible, as reducing exposure time to contamination will prolong pumphead service life.
- To clean the pumphead, remove the rotor as described under *Rotor removal*, above. Flush the pumphead out with water and mild detergent, or suitable cleaning agent. Clean the rotor and rollers in the same way. If specific cleaning agents are required to clean the spillage, consult the general guide to cleaning with solvents below or Watson-Marlow technical support office before proceeding, in order to confirm chemical compatibility. **Note:** the pumphead guard, rotor cap and clutch boot should be removed in advance of some cleaning regimes. See the table below. These components are available as spares if damaged.
- Replace the rotor as described under *Rotor replacement*, above.

General guide to cleaning with solvents

Chemical	Cleaning precautions
Aliphatic hydrocarbons	Remove guard. Minimize rotor cap and clutch boot exposure to less than one minute (risk of attack). Re-lubricate follower and tube guide rollers.
Aromatic hydrocarbons	Remove guard. Minimize rotor cap and clutch boot exposure to less than one minute (risk of attack). Re-lubricate follower and tube guide rollers.
Ketone solvents	Remove guard. Minimize rotor cap and clutch boot exposure to less than one minute (risk of attack). Re-lubricate follower and tube guide rollers.
Halogenated/chlorinated solvents	Not recommended: possible risk to polycarbonate tube clamp adjusters and polypropylene tube clamp locators.
Alcohols, general	No precaution necessary. Re-lubricate follower and tube guide rollers.
Glycols	Minimize rotor cap and clutch boot exposure to less than one minute (risk of attack). Re-lubricate follower and tube guide rollers.
Ester solvents	Remove guard. Minimize rotor cap and tube clamp location cap exposure to less than one minute (risk of attack). Re-lubricate follower and tube guide rollers.
Ether solvents	Not recommended: possible risk to polycarbonate tube clamp adjusters and polypropylene tube clamp locators.

24 520R, 520R2 and 520RE rotor settings

520R, 520R2 and 520RE pumpheads are factory-set to give optimum tube life with Watson-Marlow tubing and elements. Radial roller positions should not be adjusted in any circumstances as this will adversely affect pumphead performance and invalidate warranty. Tamper-proof rotor arm occlusion setting screws are fitted to warn operators from occlusion adjustment. Tubing with a wall thickness other than 1.6mm or 2.4mm can be used only with a pumphead set up for that purpose during manufacture. Contact Watson-Marlow after-sales.

25 Pumphead spares



520R/520R2	520REL/520REM/520REH
053.1011.100	520R
053.1011.2L0	520R2
053.1011.ELO	520REL
053.1011.EM0	520REM
053.1011.EH0	520REH
1 MNA2050A (520R, 520R2)	Pumphead guard complete with tool-unlockable latch
2 MNA2045A (520R, 520R2)	Track assembly for cased pumps complete with spring-loaded tube clamps
3 MNA2076A (520R - 1.6mm wall tube) MNA2077A (520R2 - 2.4mm wall tube) MNA2148A (grey) (520REL) MNA2149A (beige) (520REM) MNA2150A (blue) (520REH)	Rotor cover, rotor cap and clutch button
4 MN2011M S60022	Clutch Clutch spring
5 MNA2043A (520R - 1.6mm wall tube) MNA2001A (520R2 - 2.4mm wall tube) MNA2138A (520REL - 0-2 bar, 0-30 psi) MNA2139A (520REM - 2-4 bar, 30-60 psi) MNA2140A (520REH - 4-7 bar, 60-100 psi)	Rotor assembly complete with pumping rollers, follower rollers and tube guide rollers
6 MNA2006A (520R, 520R2) MN2002M (520R, 520R2) MN2131M (520RE)	Bottom (LH) tube clamp Tube clamp location plug Drain plug
7 MNA2005A (520R, 520R2) MN2002M (520R, 520R2)	Top (RH) tube clamp Tube clamp location plug
8 MN2034B MN2005M	Guard latch spring Guard latch spring cartridge
9 MNA2147A (520RE)	Pumphead guard complete with seal and tool-unlockable latch
10 MNA2144A (520RE)	Track assembly for cased pumps
11 MN2023T and MN2003T (520RE)	Drain port and nut

Parts may be ordered individually.

26 Flow rates

Pumping conditions

For precise and repeatable performance it is important to determine flow rates under operating conditions for each new piece of tubing.

When rotating counter-clockwise, 520R, 520R2 and 520RE pumpheads' flow rates are directly proportional to rotor speed. When rotating clockwise, 520R, 520R2 and 520RE pumpheads' flow rates are directly proportional to rotor speed up to 1.5 bar; their performance above 1.5 bar should be determined empirically.

Note: 520RE pumpheads should be used rotating counter-clockwise if pressures above 1.5 bar are required.

If you wish to run the pump at a speed not shown in the tables below, flow figures can be reached by dividing the maximum flow shown in the tables below by the maximum rpm figure, and multiplying the result by your required speed in rpm.

Actual flow rates achieved may vary because of changes in temperature, viscosity, inlet and discharge pressures, system configuration and tubing performance against time. Flow rates may also vary due to normal manufacturing tolerances of the tubing. These tolerances will make flow rate variance more pronounced at smaller bore sizes.

520R and 520R2

All performance figures for the 520R and 520R2 pumpheads have been recorded against peak pipeline pressures.

Although rated to 2bar (30psi) peak pressure, this pump will generate in excess of 2bar (30psi) peak pressure if the pipeline is restricted. Where it is important that 2bar (30psi) is not exceeded, pressure relief valves should be installed in the pipeline.

Viscosity handling is maximised by using 2.4mm wall tubing with the 520R2 pump-head.

Flow rates are normalised test values obtained using 225mm (8 ⁷/₈) of new tubing (measured from the inside faces of the tube clamps), and the pumphead rotating clockwise pumping water at 20C with negligible inlet and discharge pressures.

Note: Flow rates quoted are for 1.6mm and 2.4mm wall tubes. Tubes of 0.5mm and 0.8mm bore are only available in 1.6mm wall thickness except for platinum-cured silicone. Tubes of 9.6mm bore are only available in 2.4mm wall thickness.

520RE

Performance figures for the 520REL and 520REM have been recorded against 2bar peak pressure and 4bar peak pressure respectively.

Performance figures for the 520REH have been recorded against 7bar constant pressure.

Although the 520REL is rated to 2bar (30psi) peak pressure, the 520REM is rated to 4bar (60psi) peak pressure and the 520REH is rated to 7bar (100psi) constant pressure, the pumps will generate in excess of these pressures if the system pressures exceed this. Where it is important that these rated pressures are not exceeded, pressure relief valves should be installed in the pipeline.

Flow rates are normalised test values obtained using 520 elements and the pump-head rotating anticlockwise pumping water at 20C with negligible inlet and discharge pressures.

Tube life

Application factors that influence tube life in peristaltic pumps are pump speed and number of rollers (roller impacts/minute), chemical compatibility and viscosity of the duty fluid and suction and discharge pressure. Several tubing materials are available with different levels of life expectancy. In addition, tubing's dimensional tolerances from the manufacturing process affect its life.

In perfect conditions of no suction or discharge pressure, pumping water in a clean environment at normal room temperature, the following nominal tube life may be experienced:

	520R and 520R2
Marprene, Bioprene, StaPure and Chem-Sure	less than 10,000 hours
Silicone	less than 250 hours
Others	less than 100 hours

Note: This is a guide only. It is not possible to make an accurate assessment of tube life except by trial of a real application.

Continuous tubing

520R Neoprene, Sta-Pure, Chem-Sure, PVC, Pumpsil (ml/min)								
Speed range	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm	9.6mm
520SN/R, 520SN/R2								
0.1-220rpm	0.004-9.5	0.01-24	0.04-97	0.18-390	0.40-870	0.70-1500	1.1-2400	1.6-3500

520R Marprene / Bioprene 64 shore tubing (ml/min)								
Speed range	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm	9.6mm
520SN/R, 520SN/R2								
0.1-220rpm	0.004-9.0	0.01-23	0.04-92	0.17-370	0.38-830	0.67-1500	1.1-2300	1.5-3300

520R Fluorel (ml/min)					
Speed range	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
520SN/R, 520SN/R2					
0.1-220rpm	0.03-70	0.13-280	0.29-630	0.51-1100	0.80-1800

520R Neoprene, Sta-Pure, Chem-Sure, PVC, Pumpsil (USGPH)								
Speed range	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm	9.6mm
520SN/R, 520SN/R2								
0.1-220rpm	0.0001-0.14	0.0002-0.35	0.001-1.4	0.003-5.6	0.006-13	0.01-22	0.02-35	0.03-50

520R Marprene / Bioprene 64 shore tubing (USGPH)								
Speed range	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm	9.6mm
520SN/R, 520SN/R2								
0.1-220rpm	0.0001-0.14	0.0002-0.37	0.001-1.5	0.003-5.9	0.01-13	0.01-23	0.02-37	0.02-53

520R Fluorel (USGPH)					
Speed range	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
520SN/R, 520SN/R2					
0.1-220rpm	0.0005-1.1	0.002-4.5	0.005-10	0.01-18	0.01-28

Elements

520REL Neoprene, Sta-Pure, Chem-Sure, Pumpsil (ml/min)				520REL Marprene / Bioprene TL (ml/min)		
Speed range	3.2mm	6.4mm	9.6mm	3.2mm	6.4mm	9.6mm
520SN/REL						
0.1-220rpm	0.18-390	0.70-1500	1.6-3500	0.17-370	0.67-1500	1.5-3300

520REL Neoprene, Sta-Pure, Chem-Sure, Pumpsil (USGPH)				520REL Marprene / Bioprene TL (USGPH)		
Speed range	3.2mm	6.4mm	9.6mm	3.2mm	6.4mm	9.6mm
520SN/REL						
0.1-220rpm	0.003-6.1	0.01-25	0.03-55	0.003-5.9	0.01-23	0.02-53

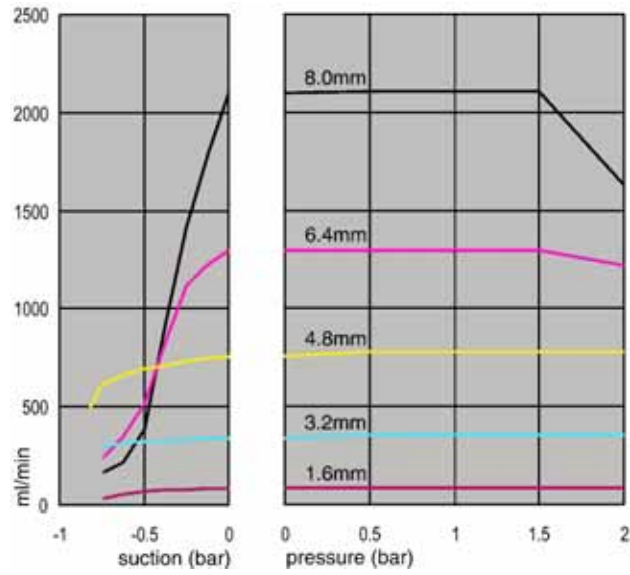
520REM Sta-Pure, Chem-Sure (ml/min)			520REM Marprene / Bioprene TM (ml/min)	
Speed range	3.2mm	6.4mm	3.2mm	6.4mm
520SN/REM				
0.1-220rpm	0.18-390	0.70-1500	0.17-370	0.67-1500

520REM Sta-Pure, Chem-Sure (USGPH)			520REM Marprene / Bioprene TM (USGPH)	
Speed range	3.2mm	6.4mm	3.2mm	6.4mm
520SN/REM				
0.1-220rpm	0.003-6.1	0.01-25	0.003-5.9	0.01-23

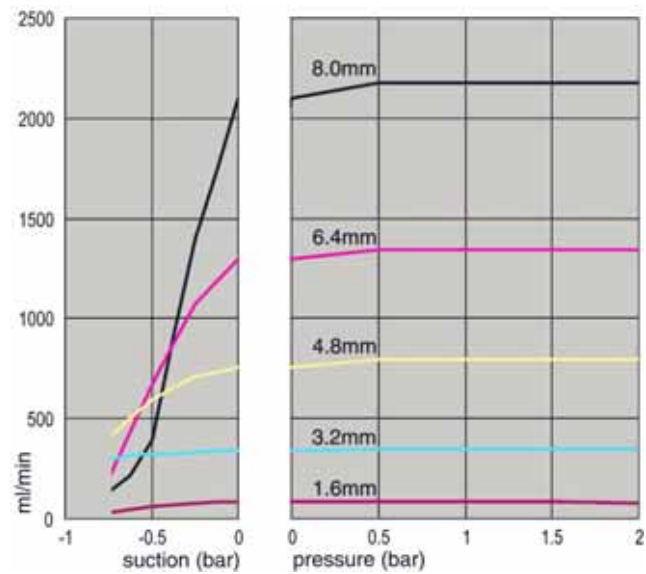
520REH Marprene / Bioprene TH, Sta-Pure (ml/min)		520REH Marprene / Bioprene TH, Sta-Pure (USGPH)
Speed range	3.2mm	3.2mm
520SN/REH		
0.1-220rpm	0.20-450	0.003-7.1

Performance curves

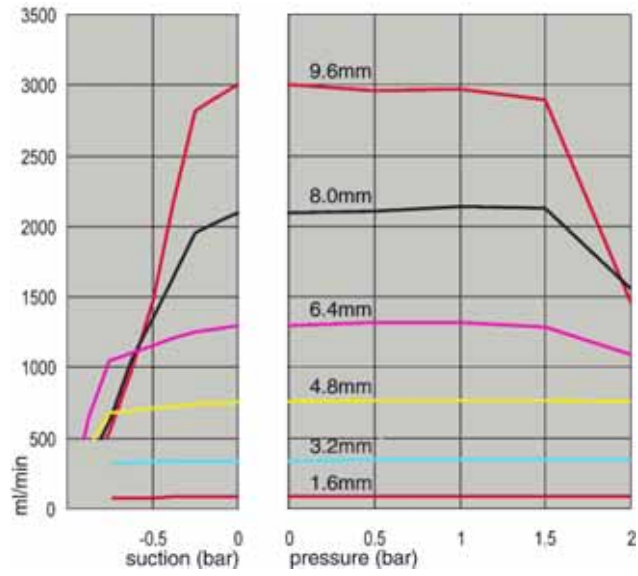
Marprene continuous tubing, 1.6mm wall, 200rpm, clockwise rotation



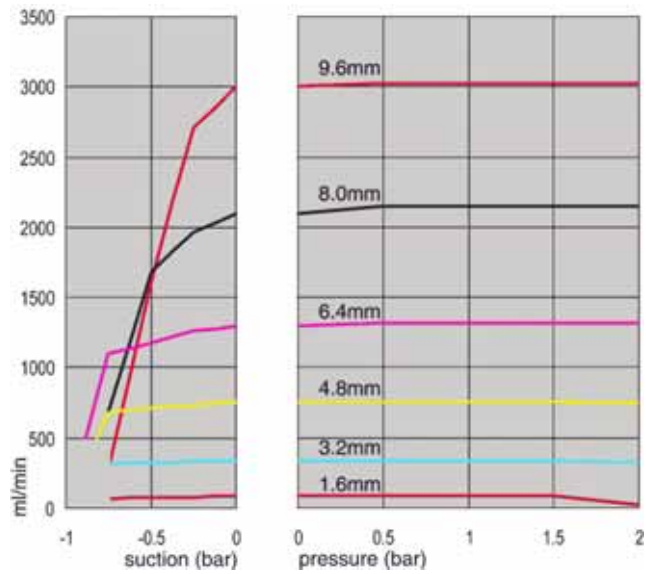
Marprene continuous tubing, 1.6mm wall, 200rpm, counter-clockwise rotation



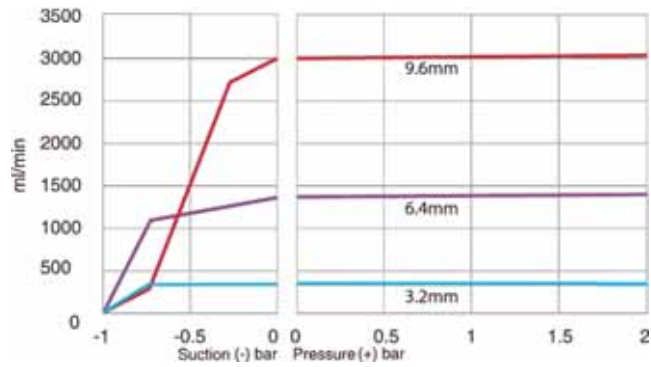
Marprene continuous tubing, 2.4mm wall, 200rpm, clockwise rotation



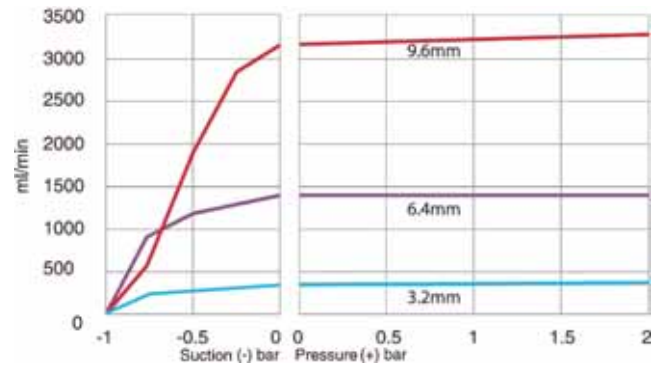
Marprene continuous tubing, 2.4mm wall, 200rpm, counter-clockwise rotation



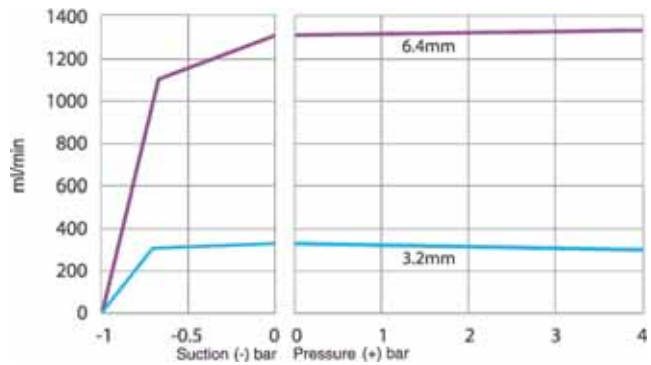
Marprene TL element, 0-2 bar (0-30psi), 200rpm, counter-clockwise rotation



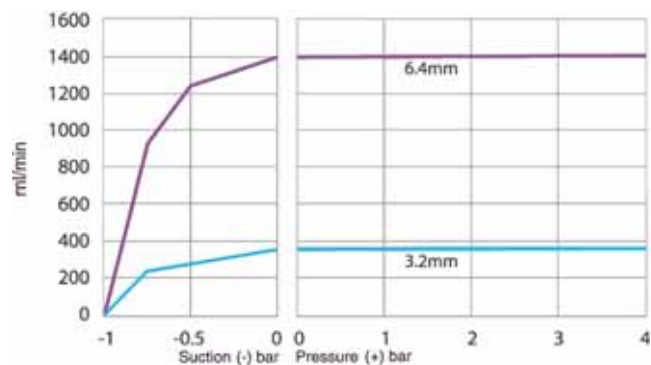
Sta-Pure element, 0-2 bar (0-30psi), 200rpm, counter-clockwise rotation



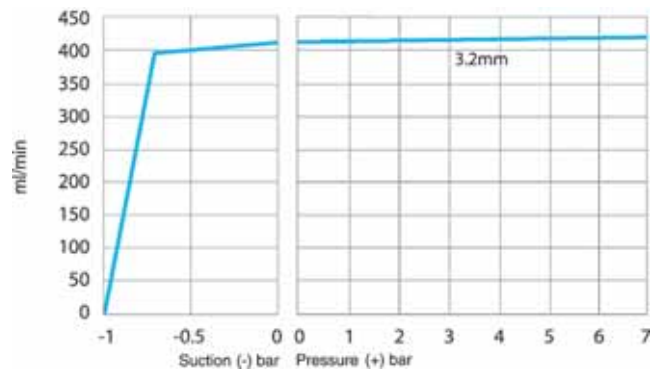
Marprene TM element, 2-4 bar (30-60psi), 200rpm, counter-clockwise rotation



Sta-Pure element, 2-4 bar (30-60psi), 200rpm, counter-clockwise rotation





Marprene TH element, 4-7 bar (60-100psi), 200rpm, counter-clockwise rotation





27 Tubing and element part numbers

1.6mm wall tubing for 520R pumpheads

					
mm	inch	#	Marprene	Bioprene	Chem-Sure
0.5	1/50	112	902.0005.016	903.0005.016	
0.8	1/32	13	902.0008.016	903.0008.016	
1.6	1/16	14	902.0016.016	903.0016.016	965.0016.016
3.2	1/8	16	902.0032.016	903.0032.016	965.0032.016
4.8	3/16	25	902.0048.016	903.0048.016	965.0048.016
6.4	1/4	17	902.0064.016	903.0064.016	965.0064.016
8.0	5/16	18	902.0080.016	903.0080.016	965.0080.016
mm	inch	#	PVC	Fluorel	Neoprene
0.8	1/32	13			920.0008.016
1.6	1/16	14	950.0016.016	970.0016.016	920.0016.016
3.2	1/8	16	950.0032.016	970.0032.016	920.0032.016
4.8	3/16	25	950.0048.016	970.0048.016	920.0048.016
6.4	1/4	17	950.0064.016	970.0064.016	920.0064.016
8.0	5/16	18	950.0080.016	970.0080.016	920.0080.016
mm	inch	#	Pumpsil	Sta-Pure	
0.5	1/50	112	913.A005.016		
0.8	1/32	13	913.A008.016		
1.6	1/16	14	913.A016.016	960.0016.016	
3.2	1/8	16	913.A032.016	960.0032.016	
4.8	3/16	25	913.A048.016	960.0048.016	
6.4	1/4	17	913.A064.016	960.0064.016	
8.0	5/16	18	913.A080.016	960.0080.016	

L16Note: 1.6mm wall Chem-Sure and Sta-Pure tubing are supplied in 305mm lengths.

2.4mm wall tubing for 520R2 pumpheads

					
mm	inch	#	Marprene	Bioprene	Pumpsil
0.5	$1/50$				913.A005.024
0.8	$1/32$				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
9.6	$3/8$	122	902.0096.024	903.0096.024	913.A096.024
mm	inch	#	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	
8.0	$5/16$	121	965.0080.024	960.0080.024	

Note: 2.4mm wall Chem-Sure and Sta-Pure tubing are supplied in 355mm lengths.

2.4mm wall elements for 520RE pumpheads

0-2 bar (0-30 psi) pressure rated elements



Industrial

mm	inch	#	Marpren TL	Pumpsil	Neoprene	Chem-Sure
3.2	1/8	16	902.0032.PFQ	913.A032.PFQ	920.0032.PFQ	965.0032.PFQ
6.4	1/4	17	902.0064.PFQ	913.A064.PFQ	920.0064.PFQ	965.0064.PFQ
9.6	3/8	122	902.0096.PFQ	913.A096.PFQ	920.0096.PFQ	965.0096.PFQ

Sanitary

mm	inch	#	Bioprene TL	Pumpsil	Sta-Pure	Chem-Sure
3.2	1/8	16	903.0032.PFT	913.A032.PFT	960.0032.PFT	965.0032.PFT
6.4	1/4	17	903.0064.PFT	913.A064.PFT	960.0064.PFT	965.0064.PFT
9.6	3/8	122	903.0096.PFT	913.A096.PFT	960.0096.PFT	965.0096.PFT

2-4 bar (30-60 psi) pressure rated elements



Industrial

mm	inch	#	Marpren TM	Chem-Sure
3.2	1/8	16	902.P032.PFQ	965.M032.PFQ
6.4	1/4	17	902.P064.PFQ	965.M064.PFQ

Sanitary

mm	inch	#	Biopren TM	Sta-Pure
3.2	1/8	16	903.P032.PFT	960.M032.PFT
6.4	1/4	17	903.P064.PFT	960.M064.PFT

4-7 bar (60-100 psi) pressure rated elements



Industrial

mm	inch	#	Marpren TM	Sta-Pure
3.2	1/8	16	902.H032.PFQ	960.H032.PFQ

Sanitary

mm	inch	#	Biopren TM	Sta-Pure
3.2	1/8	16	903.H032.PFT	960.H032.PFT

28 520 series pumping accessories

Accessory	Description	Part code	Pump compatibility
520ANC	Network cable, RS232, with 9-pin D-connectors	059.3121.000	520Du, 520Di
520ANX	Network extension cable with 9-pin D-connectors	059.3122.000	520Du, 520Di
520ANA	Network adaptor, 25-pin to 9-pin D-connectors	059.3123.000	
520AB	Batch records cable with 9-pin D-connectors	059.3125.000	520Di
520AF	Footswitch with 25-pin D-connector	059.3002.000	520U, 520Du, 520Di
520AH	Handswitch with 25-pin D-connector	059.3022.000	520U, 520Du, 520Di
520AV	Proximity switch	059.5072.000	520Di
520AVN	Proximity switch	059.507N.000	520DiN
505LTC	Tube clamp set for 505L pumphead	059.4001.000	520Di
505AS	Filling stand	059.5001.000	All models
520AL	Dispensing lance for use with 520AFN filling needles	059.5052.000	All models
505AFN	Filling needle set	059.5101.000	All models
	Filling needle 1.6mm bore	059.5100.016	All models
	Filling needle 3.2mm bore	059.5100.032	All models
	Filling needle 4.8mm bore	059.5100.048	All models
	Filling needle 6.4mm bore	059.5100.064	All models
	Filling needle 8.0mm bore	059.5100.080	All models
	Tube monitor with 25-pin D-connector	059.4501.520	520U, 520Du, 520Di
	Tube monitor, bare lead	059.450N.520	520UN, 520DuN, 520DiN
520AD	Leak detector kit	059.8121.000	520U, 520Du, 520Di
520AD	Leak detector kit	059.8131.000	520UN, 520DuN, 520DiN

29 Trademarks

Watson-Marlow, Bioprene, Pumpsil, LoadSure 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.

30 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.

31 Publication history

m-520sn-ip66-gb-05.htm: Watson-Marlow 520SN IP66 / NEMA 4X

First published 02 04. Revised 03 06. Revised 01 08.

32 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	<input type="text"/>	Company	<input type="text"/>
Address	<input type="text"/>		
Postcode/zip	<input type="text"/>	Country	<input type="text"/>
Telephone	<input type="text"/>	Fax	<input type="text"/>
Product type	<input type="text"/>	Serial number	<input type="text"/>
To speed the repair, please describe all known faults	<input type="text"/>		
The product has ...	<input type="checkbox"/> Been used <input type="checkbox"/> Not been used		
	<i>If the product has been used, please complete all the following sections. If the product has not been used, please just sign this form.</i>		
Names of chemicals handled with product(s)	<input type="text"/>		
Precautions to be taken in handling these chemicals	<input type="text"/>		
Action to be taken in the event of human contact	<input type="text"/>		
	<i>I understand that the personal data collected will be kept confidentially in accordance with the UK Data Protection Act 1998.</i>		
Signature	<input type="text"/>	RGA number	<input type="text"/>
		Your position	<input type="text"/>
		Date	<input type="text"/>
<i>Please print out, sign and fax to Watson-Marlow Pumps at +44 1326 376009.</i>			