WATSON MARLOW Pumps

WATSON-MARLOW MANUALS

m-120coversheet-S-400-gb-01 Original instructions

Watson-Marlow 120 cased pumps 120S/D1, 120S/DM2, 120S/DM3

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WATSON MARLOW Pumps

WATSON-MARLOW MANUALS

m-120general-gb-01 Original instructions

Watson-Marlow 120 cased pumps Section 1 of 3: general information

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1.1 Declaration of conformity

This declaration was issued for Watson-Marlow 120 pumps on April 28, 2010. 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 61010-1. Conforms to UL 61010-1.

1.2 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: David Cole, 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 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.wmpg.com

1.3 Three-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 pump drive which fails within three 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.
- Tubing, a consumable item, is excluded.
- Products which, in the judgment of Watson-Marlow, have been abused, misused, or subjected to malicious or accidental damage or neglect are excluded.
- The 120F is excluded from all warranty when pumping above 1 bar. The 120U and the 120S are excluded from all warranty when pumping above 2 bar.
- Electrical surge as a cause of failure is excluded.
- Chemical attack is excluded
- All pumphead rollers are excluded.
- Ancillaries are excluded.

Pumpheads used with this pump drive carry their own warranty.

1.4 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.

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

- Dedicated 120F, 120S or 120U pump drive fitted with a 114DV pumphead, 102R pumphead, 400D1, 400DM2 or 400DM3 pumphead
- The designated external DC power supply unit for your pump with plug adaptors
- PC-readable CDROM containing these operating instructions
- Quick Start printed 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. 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.

1.5 Information for returning pumps

If you wish to return a pump for service or other reasons, contact Watson-Marlow or your distributor, quote your pump's serial number, and ask for a returns number. Include this number when you ship the pump.

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 1.14 *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.

1.6 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.

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.

1.7 Safety notes and standards

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.

There are moving parts inside the pumphead. Before opening the pumphead guard or 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 non-flammable 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.

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.

Fundamental work with regard to 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.

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

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 warm during operation. Do not take hold of the pump while it is running.

The exterior surfaces of the external DC power supply may get warm during operation. To be safe, let it cool after use before handling it.

For safety, the pump must not be run without a pumphead fitted.

Electrical safety

The power supply is Class II insulated: double insulated with no earth connection.

The pump is Class III: safety extra-low voltage (SELV).

Installation category (over-voltage category): II

Pump 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: IEC/EN/UL 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 Criteria C
	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
	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

Power supply standards

Safety standards	UL 60950-1 CSA-C22.2 TUV EN 60950-1
EMC	EN 55022 Class B, FCC part 15/CIS PR 22 Class B EN 61000-3-2, 3 EN61000-4-2, 3, 4, 5, 6, 8 and 11 Criteria A

Power supply specifications

Insulation category	Class II: double insulated, no earth
Mains voltage/frequency	90-264VAC, 47-63Hz, 1ph
Mains current	0.7A @ 100VAC; 0.4A @ 230VAC
Output voltage	24VDC
Output power	24W @ 30C; 18W @ 40C
Protection	Hiccup mode: recovers automatically after fault removed
Overload protection	110%-200% of rated output power
Working temperature	-10C to 50C, 14F to 122F
Operating humidity	20% to 90% RH, non-condensing
Over-voltage	115% to 135%

Note: Pump specifications are included in Section 2 of these instructions.

Emergency disconnection

The pump's external DC power supply is the disconnecting device, which must be readily identifiable and easily reached, for isolating the motor drive from the mains supply. **Note**: There may be a slight delay after isolating the pump before the pump stops.

1.8 Good pump installation practice

1.8.1 General recommendations

Position

The 120 pump must be mounted in the upright position and not inverted or placed on its rear face.

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 flow of air around the pump to ensure that heat can be dissipated. Ensure that the temperature around the pump does not exceed 40C.

It is possible to stack only one other 120 pump on top of this pump. The case's third row of feet ensure ventilation between pumps and allow the top pump to be set back a little to give clear access to the lower pump's keypad. You can place other equipment on the pump's upper surface as long as the ambient temperature does not exceed 40C.

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.

Pressure advice

In most circumstances, rotor and tube life are maximised if the pumphead is run slowly, particularly when pumping at high pressure. Do not exceed the pressures shown here.

120 pump RMS pressure ratings	
120F + any pumphead	0 bar
120S+102R **120S+400DM2** **120S+400DM3** **120U+114DV** **120U+400D1** **120U+400DM2** **120U+400DM3**	2 bar

1.8.2 Do's and do not's

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

Do not strap together the control and and external DC power supply cables.

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) 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 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 (though see Pressure advice in 1.8.1 *General recommendations*). Flooded suction will enhance pumping performance in all cases, particularly for materials of a viscous nature.

120 pumps may be wiped with a damp cloth, but should not be hosed or immersed. The front of the pump is further protected against light spillages.

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.

1.9 Power supply

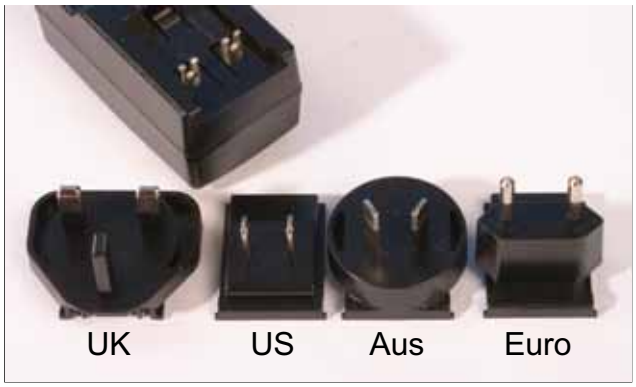
The 120 pump is suitable for single-phase mains electricity supplies only via the double-insulated (Class II) 90-264VAC-to-24VDC mains adaptor. Use only the approved 24VDC Meanwell type GE24I24-P1JK DC adaptor or the Powersolve ESA24-24 DC adaptor supplied with the pump.

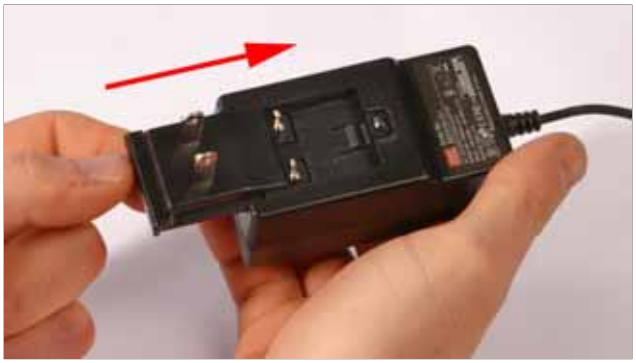
A well regulated electrical mains supply is required along with cable connections conforming to the best practice of noise immunity. It is not recommended to site these drives alongside "dirty" electrical mains supplies such as 3-phase contactors and inductive heaters without special attention being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

To prepare your power supply

- Select the mains input adapter appropriate to your region—UK, US, Australia or Europe—and slide it into position on the rear of the unit. Ensure it clicks into place.

Stop/start power cycles: Do not power up/power down for more than 100 starts per hour. A minimum interval of 3 seconds is required between power cycles.





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

1.10 Dimensions

Note: A 120U pump drive is shown here. All drives have the same dimensions and weight (apart from drive shaft dimensions).

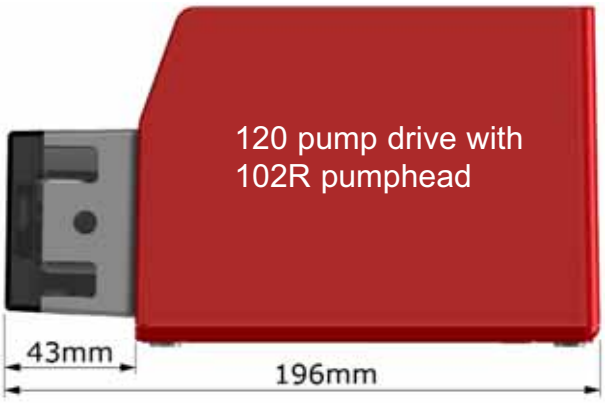
Unit weights

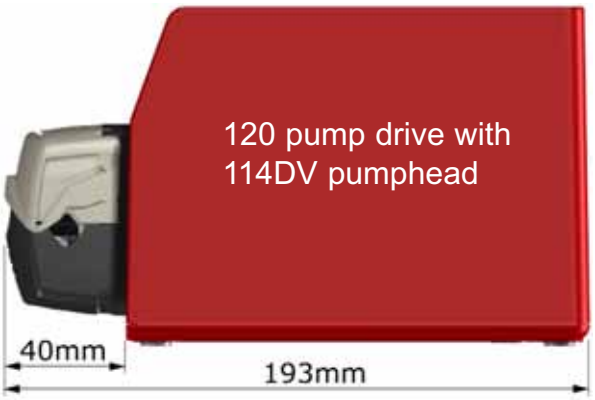
Drive only	+ 114DV	+ 102R	+ 400D1	+ 400DM2	+ 400DM3
1.4kg	1.5kg	1.55kg	1.65kg	1.7kg	1.7kg

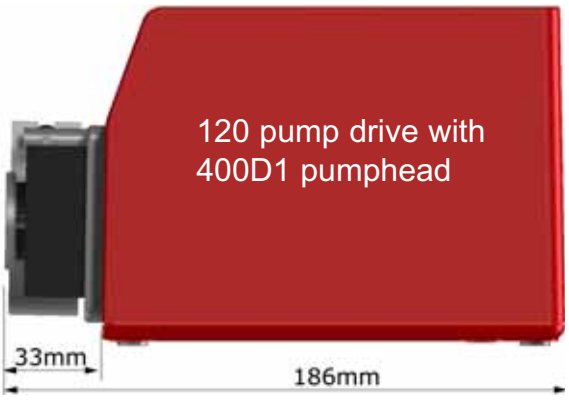
IP (ingress protection) definition

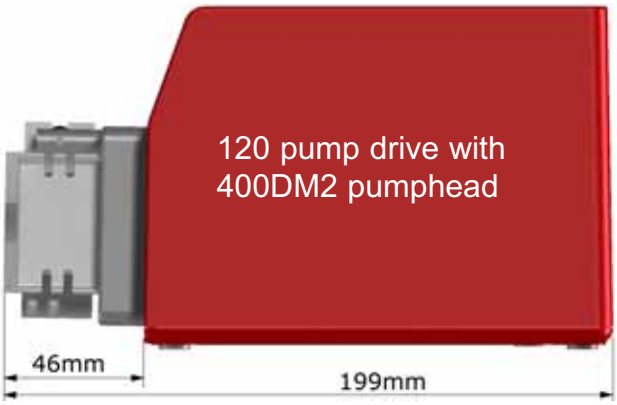
This pump's ingress protection is rated IP31.

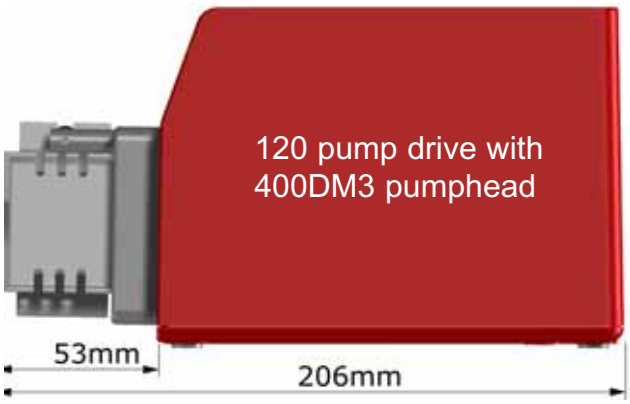
1st Digit: 3	2nd Digit: 1
Protected against ingress of solid objects with a diameter of more than 2.5mm. Tools, wires etc with a thickness of more than 2.5mm are prevented from approach	Protection against dripping water falling vertically. No harmful effect must be produced











1.11 Start-up check list

Note: See also section 2 (120F, 120S or 120U drives) and section 3 (102R, 114DV or 400 series pumpheads) of these instructions.

- Ensure that proper connections are achieved between the pump tube and suction and discharge piping.
- Ensure proper connection has been made to the external DC power supply unit, and to a suitable power supply.
- Ensure that the recommendations in the section 1.8 *Good pump installation practice* are followed.

1.12 Drive maintenance

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.

1.13 Drive spares

Dedicated external DC power supply unit and plug adaptors: MN2634B
Foot: FB0012

1.14 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.

WATSON MARLOW Pumps

WATSON-MARLOW MANUALS

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Watson-Marlow 120S cased pumps Section 2 of 3: Operating manual

Contents

2.1 Pump specifications

A nameplate is fixed to the rear of the pump. It _contains manufacturer and contact details, product reference number, serial number and model details.

120S
This pump is controlled from the keypad. It features:

Manual control
Speed adjustment; run and stop; direction control; “max” key for rapid priming; “auto start” for automatic power recovery

Pump specifications

Control range (turndown ratio)	With 102R: 1-32 rpm (32:1) With 114DV: 1-200 rpm (200:1) With 400D1: 1-200 rpm (200:1) With 400DM2: 1-100 rpm (100:1) With 400DM3: 1-100 rpm (100:1)
Power supply DC input	24V @ 1A
Software version	Accessible by combination keypress
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
Pumphead options	114DV, 102R, 400D1, 400DM2 and 400DM3
Operating temperature range	5C to 40C, 41F to 104F
Storage temperature range	-25C to 65C, -13F to 149F
Maximum altitude	2,000m, 6,560ft
Humidity (non-condensing)	80% up to 31C, 88F, decreasing linearly to 50% at 40C, 104F
Weight	See *Section 1, General information*
Noise	<60dB(A)

2.2 Good pump installation practice

The 120 pump must be mounted in the upright position and not inverted or placed on its rear face.

2.3 Switching the pump on

The pump is powered by a dedicated 24V external DC power supply unit which is supplied with the pump.

- Plug the power supply's output connector into the power socket on the rear of the pump.
- Plug the power supply unit into a mains power outlet and switch on. The pump performs a power-on test to confirm proper functioning of the memory and hardware. If a fault is found, an error message is displayed. See 2.5.1 *Error codes*.
- Load the pumphead with tube: see Section 3 of these instructions.

The pump is now ready to operate according to the default settings.

Operating parameters may be changed by means of key-presses. See 2.4 *Manual operation*.

To return the pump to its default settings, press and hold **DIRECTION** on power up.

120S First-time start-up defaults	
Set speed	32 rpm
Direction	Clockwise
Display	Speed in rpm
Display and LEDs	On
Pump status	Stopped
Keypad lock	Off
Auto-start	Off
Beeper	On
Max (prime)	Maximum possible speed
Scrolling increment	1 rpm

2.4 Manual operation

2.4.1 Keypad functions

All settings and functions of the pump are set and controlled by means of key-presses. Immediately after power-up, the currently selected rotation speed is indicated on the display. Start-stop status, auto-start status, automatic control status and direction of rotation are indicated by LEDs beside their keys; keypad lock status is indicated by an LED beside the padlock symbol.

2.4.2 Start and stop

To start the pump at the speed and in the direction indicated, press the green **START** key on the keypad. A beep sounds and the LED beside the **START** key illuminates to confirm that the pump is operating. We recommend that the speed is reduced to a minimum (1 rpm) before starting the pump.

To stop the pump, press the red **STOP** key on the keypad. A beep sounds, the pump stops and the LED beside the **START** key goes out to confirm that the pump is stopped. The display continues to show the previous speed and direction. The pump will return to this speed and direction when the **START** key is pressed again.

2.4.3 Increase and decrease pump speed

Press and hold **UP** to increase the speed shown on the display in minimum steps of 1 rpm (unless the speed displayed is already the maximum allowed speed). Beeps sound while the key is held. If the pump is then started by pressing the **START** key, it operates at the new speed. If the pump is running when **UP** is pressed, the change takes effect immediately.

Press and hold **DOWN** to decrease the speed shown on the display in minimum steps of 1 rpm. Beeps sound while the key is held. If the pump is then started by pressing the **START** key, it operates at the new speed. The minimum running speed possible is 1 rpm. If the pump is running when **DOWN** is pressed, the change takes effect immediately.

Note: You can reduce the pump speed from 1 rpm to 0 rpm by a further press on the **DOWN** key. The LED beside the **START** key goes out. The pump is still in the running state and you can press the **UP** key to return the pump to the minimum speed.

2.4.4 Change direction of rotation

Press **DIRECTION** to toggle the sense of rotation. A beep sounds and the LED beside the clockwise-pointing arrow to the key's right illuminates to indicate clockwise rotation; the LED beside the counter-clockwise-pointing arrow to the key's left illuminates to indicate counter-clockwise rotation. 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.

2.4.5 Prime the pump

While pressed, **MAX** operates the pump at the maximum allowed speed and in the direction indicated. Beeps sound while the key is held. When released, the pump returns to its previous status. 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.

2.4.6 Run the pump at maximum speed

Press **MAX** and **UP** together to set the pump to maximum allowed speed. Beeps sound while the keys are held. If the pump is then started by pressing the **START** key, it operates at the new speed. If the pump is running when **MAX** and **UP** are pressed, the change takes effect immediately.

2.4.7 Run the pump at minimum speed

Press **MAX** and **DOWN** together to set the pump to minimum speed. Beeps sound while the keys are held. If the pump is then started by pressing the **START** key, it operates at the new speed. If the pump is running when **MAX** and **DOWN** are pressed, the change takes effect immediately.

2.4.8 Auto-start

Press **AUTO START** to toggle the auto-start function on and off. A beep sounds and the LED beside the **AUTO START** key illuminates to indicate that the auto-start function is on. If auto-start is on, the pump starts in the last selected condition following a power supply interruption. If auto-start is off, the pump waits for a press on the **START** key before starting in the last selected condition following a power supply interruption.

2.4.9 Keypad beep

While the pump is stopped, press **DIRECTION** and **UP** together to toggle the keypad beep on and off.

2.4.10 ROM

While the pump is stopped, press **DIRECTION** and **DOWN** together to display the pump's ROM version. Beeps sound while the keys are held.

2.4.11 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.

To lock the keypad while the pump is running:

- Hold down the **START** key for more than one second. A beep sounds, the LED beside the padlock symbol flashes briefly then illuminates and the keypad is locked. Only the **START** and **STOP** keys function. If another key is pressed while the keypad is locked and the pump is running, a message is briefly displayed: **Hold Strt**. This tells the user to press and hold the **START** key for more than one second to unlock the keypad and make the required key available.

To lock the keypad while the pump is stopped:

- Hold down the **STOP** key for more than one second. A beep sounds, the LED beside the padlock symbol flashes briefly then illuminates and the keypad is locked. Only the **START** and **STOP** keys function. If another key is pressed while the keypad is locked and the pump is stopped, a message is briefly displayed: **Hold Stop**. This tells the user to press and hold the **STOP** key for more than one second to unlock the keypad and make the required key available.

To unlock the keypad while the pump is running:

- Hold down the **START** key for more than one second. A beep sounds, the LED beside the padlock symbol flashes briefly then goes out and the keypad is unlocked.

To unlock the keypad while the pump is stopped:

- Hold down the **STOP** key for more than one second. A beep sounds, the LED beside the padlock symbol flashes briefly then goes out and the keypad is unlocked.

2.4.12 Defaults

To return the pump to its default settings, press and hold **DIRECTION** on power up. See 2.3 *Switching the pump on*.

2.5 Troubleshooting

If the pump fails to operate, make the following checks:

- Check that the dedicated external DC power supply unit is plugged into a working mains power source which is switched on. Check that the power supply unit's LED is illuminated (if fitted).
- Check that the dedicated external DC power supply unit's output connector is plugged into the pump.

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

- Check that tubing is installed in the pumphead; check that it is the correct wall thickness: 1.6mm. See section 3 of these instructions.
- 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 rotor is in the pumphead, that it rotates and that the rollers are in good condition.
- Check that fluid is supplied to the pump.

2.5.1 Error codes

If an internal error occurs, an error screen is displayed.

Error code	Error condition	Suggested action
Er 0	FRAM write error	Attempt to reset by switching power OFF / ON. Or seek support
Er 1	FRAM corruption	Attempt to reset by switching power OFF / ON. Or seek support
Er 2	FLASH write error during drive update	Attempt to reset by switching power OFF / ON. Or seek support
Er 3	FLASH corruption	Attempt to reset by switching power OFF / ON. Or seek support
Er 4	FRAM shadow error	Attempt to reset by switching power OFF / ON. Or seek support
Er 9	Motor stalled	Stop pump immediately. Check pumphead and tube. Power OFF/ON may reset. Or seek support
Er10	Tacho fault	Stop pump immediately. Power OFF/ON may reset. Or seek support
Er14	Speed error	Stop pump immediately. Power OFF/ON may reset. Or seek support
Er15	Over current	Stop pump immediately. Check system. Power OFF/ON may reset. Or seek support
Er16	Over voltage	Stop pump immediately. Check mains voltage selector switch. Check supply. OFF/ON may reset. Or seek support
Er17	Under voltage	Stop pump immediately. Check mains voltage selector switch. Check supply. OFF/ON may reset. Or seek support
Er19	Over temperature	Stop pump immediately. Turn OFF. Seek support
Er30	Over power	Turn OFF. Check power supply. Check pumphead and tubing. Wait 30 minutes. Power ON may reset. Or seek support
Err	General error condition	Turn OFF. Seek support

WATSON MARLOW Pumps

WATSON-MARLOW MANUALS

m-400-gb-01 Original instructions

Watson-Marlow 120 cased pumps Section 3 of 3: 400D1, 400DM2, 400DM3 pumpheads

Contents

3.1 Pumphead specifications

The 400D1 pumphead is designed to accept 1.6mm wall thickness tubing in four different bore sizes. The 400DM2 and 400DM3 pumpheads are designed to accept three-bridge manifold tubing only.

3.2 400D1, 400DM2 and 400DM3 key safety information

There are moving parts inside the pumphead. Before opening the tool-unlockable pumphead 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.
- Protective clothing and eye protection must be worn if hazardous fluids are pumped.

3.3 400D1, 400DM2 and 400DM3 installation

A correctly engineered installation will promote the best possible tube life, so please ensure that the following guidelines are followed:

- Avoid tight pipeline bends, pipe reducers and excessive lengths of smaller bore tubing than that in the pumphead, particularly in pipelines on the suction side.
- Ensure that connecting pipework and fittings are suitably rated to handle the predicted pipeline pressure.
- If rigid pipework comes in close proximity to the pumphead, a drop-out section of pipework will simplify tube replacement.

3.4 400D1 tube loading and removal

- Release the track by disengaging the sprung track pin.
- Before tube loading, make sure that enough suction and delivery tubing is available to connect into the remaining pipeline or to reach the suction reservoir and delivery point.
- Locate the tubing into the suction side tube clamp. Feed the tubing in around the rotor, maintaining reasonable tube tension so that the tube sits around the rotor, and locate into the delivery side tube clamp. Make sure that there are no twists or kinks in the tubing after loading as this will reduce tube life.
- Ensure the tube is lined up centrally in the track and correctly secured at each clamp.
- Reposition the track over the rotor and fix by slotting the track pin back into the track slot.
- To remove the tube, reverse the sequence. **Note**: over-tightening the sprung track pin can damage the tube and the pumphead.

Tube re-tensioning

- When using Marprene tubing: After the first 30 minutes of running, re-tension the tube in the pumphead by releasing the sprung track pin and pulling the tubing on the delivery side a little. This is to counteract the normal stretching that occurs with Marprene which can go unnoticed and result in poor tube life.

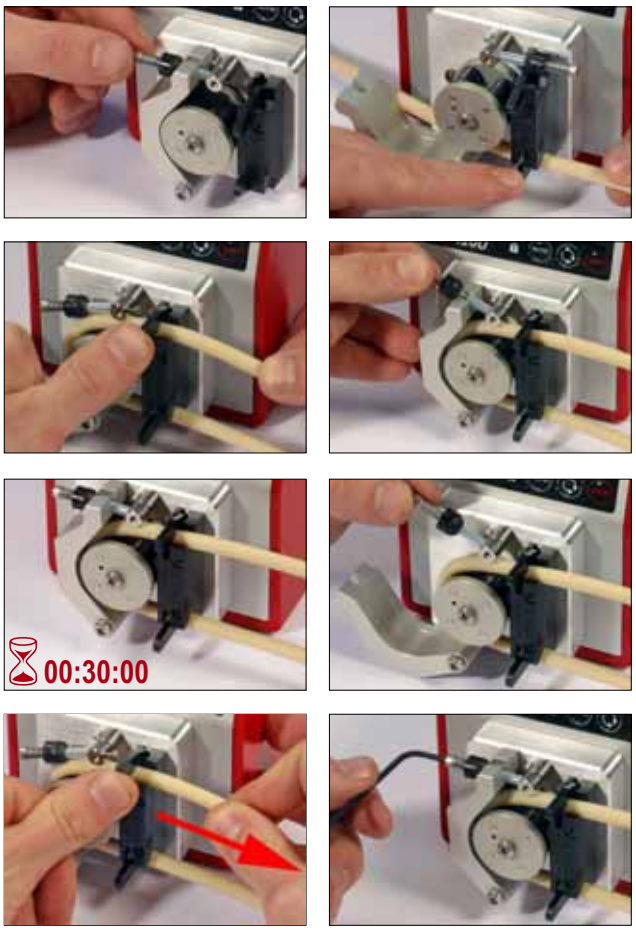
Tube removal

- Release the track by disengaging the sprung track pin and withdraw the tubing from the sprung clamps.

3.5 400DM2 and 400DM3 tube check

The 400DM2 and 400DM3 pumpheads are designed to accept three-bridge manifold tubing only. Each piece of three-bridge manifold tubing has two pumping sections. Reduced flow performance in one section is a sign of tube wear and should be used as an indicator to switch over to using the second section. When the switch to the second section is made, check the first section of tubing is not adversely affected by normal line pressure. If this is the case then the complete section of tubing will need to be replaced.

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



Over-tightening the sprung track pin can damage the tube and the pumphead.

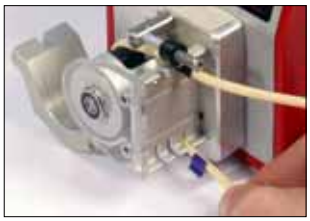
3.6 400DM2 and 400DM3 tube loading and removal

- Release the track by disengaging the sprung track pin.
- Locate the first tube bridge into the appropriate tube bridge holder slot. Feed the tubing in around the rotor. Locate the centre tube bridge into the bridge holder slot immediately opposite the first tube bridge. Repeat for the remaining one (400DM2) or two (400DM3) channels. Make sure that there are no twists or kinks in the tubing after loading as this will adversely affect tube life.
- Reposition the track over the rotor and fix by slotting the track pin back into the track slot. **Note**: over-tightening the sprung track pin can damage the tube and the pumphead.

Tube removal

- Release the track by disengaging the sprung track pin.
- Remove both tubing bridges from their location slots and remove the tubing from the pump-head.





Over-tightening the sprung track pin can damage the tube and the pumphead.

3.7 400D1, 400DM2 and 400DM3 pumphead spares

Description	Part code
400D1 pumphead	043.001D.D1C
400DM2 pumphead	043.001D.D2C
400DM3 pumphead	043.001D.D3C

3.8 400D1, 400DM2 and 400DM3 performance

Tube life and performance against pressure

The pressure and the suction height can be increased by compressing the spring in the sprung track pin. A smaller gap between the rollers and track will give better performance against pressure but will reduce tube life.

Other application factors that will influence tube life in peristaltic pumps are pump speed and number of rollers (roller impacts/minute), temperature, chemical compatibility of the duty fluid and viscosity of the duty fluid. Several tubing materials are available offering different levels of life expectancy. The tubing's dimensional tolerances from the manufacturing process will also influence the life of a tube.

This means that it is impossible to predict tube life in any particular application.

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

Marprene and Bioprene: less than 6,000 hours
Silicone: less than 250 hours
Others: less than 100 hours

The factors highlighted above will tend to reduce tube life. **For precise and repeatable performance it is important to determine flow rates under operating conditions for each new piece of tubing.**

Note: Flow rates quoted have been rounded for simplicity, but are accurate to within 5%—well within the normal tubing tolerance variation of flow rate. They should therefore be taken as a guide. Real flow rates in any application must be determined empirically.

Note: The 120S and the 120U must be run counter-clockwise to achieve pressures up to 2 bar.

400D1 Pumpsil (ml/min)						
Speed range	**0.5mm**	**0.8mm**	**1.6mm**	**2.4mm**	**3.2mm**	**4.0mm**
120U						
0.1-200 rpm	0.001-2.2	0.003-5.8	0.011-23	0.02-49	0.041-81	0.06-120
120S						
1-200 rpm	0.01-2.2	0.03-5.8	0.11-23	0.24-49	0.41-81	0.59-120

400DM2 and 400DM3 Pumpsil (ml/min)						
Speed range	**0.13mm**	**0.19mm**	**0.25mm**	**0.38mm**	**0.5mm**	**0.63mm**
120U						
0.1-100 rpm	0.0001-0.1	0.0002-0.2	0.0004-0.4	0.0008-0.8	0.001-1.4	0.002-2.2
120S						
1-100 rpm	0.001-0.1	0.002-0.2	0.004-0.4	0.008-0.8	0.014-1.4	0.022-2.2

400DM2 and 400DM3 Pumpsil (ml/min)						
Speed range	**0.76mm**	**0.88mm**	**1.02mm**	**1.14mm**	**1.29mm**	**1.42mm**
120U						
0.1-100 rpm	0.003-3.1	0.004-4.3	0.006-5.5	0.007-7.0	0.009-8.9	0.011-11
120S						
1-100 rpm	0.031-3.1	0.043-4.3	0.055-5.5	0.070-7.0	0.089-8.9	0.110-11

400DM2 and 400DM3 Pumpsil (ml/min)							
Speed range	**1.52mm**	**1.65mm**	**1.85mm**	**2.05mm**	**2.38mm**	**2.54mm**	**2.79mm**
120U							
0.1-100 rpm	0.012-12	0.014-14	0.018-18	0.021-21	0.026-26	0.031-31	0.036-36
120S							
1-100 rpm	0.120-12	0.14-14	0.180-18	0.210-21	0.260-26	0.310-31	0.360-36

3.9 Tubing product codes

400D1 continuous tubing product codes

mm	inch	#	Marprene	Bioprene	Pumpsil	GORE STA-PURE PCS
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	913.A016.016	960.0016.016
2.4			902.0024.016	903.0024.016	913.A024.016	
3.2	1/8	16	902.0032.016	903.0032.016	913.A032.016	960.0032.016
4.0			902.0040.016	903.0040.016	913.A040.016	

mm	inch	#	Neoprene	PVC	Fluorel	GORE STA-PURE PFL
0.8	1/32	13	920.0008.016			
1.6	1/16	14	920.0016.016	950.0016.016	970.0016.016	965.0016.016
3.2	1/8	16	920.0032.016	950.0032.016	970.0032.016	965.0032.016

400DM2 and 400DM3 segment tubing product codes

Colour code	wall mm	bore mm	Autoclavable Marprene	Marprene	PVC	Silicone
Orange/black	0.8	0.13			981.0013.000	
Orange/red	0.8	0.19			981.0019.000	
Orange/blue	0.8	0.25	979.0025.00+	979.0025.000	981.0025.000	
Orange/green	0.8	0.38	979.0038.00+	979.0038.000	981.0038.000	
Orange/yellow	0.8	0.50	979.0050.00+	979.0050.000	981.0050.000	
Orange/white	0.8	0.63	979.0063.00+	979.0063.000	981.0063.000	983.0063.000
Black/black	0.8	0.76	979.0076.00+	979.0076.000	981.0076.000	983.0076.000
Orange/orange	0.8	0.88	979.0088.00+	979.0088.000	981.0088.000	983.0088.000
White/white	0.8	1.02	979.0102.00+	979.0102.000	981.0102.000	983.0102.000
Red/red	0.8	1.14	979.0114.00+	979.0114.000	981.0114.000	983.0114.000
Grey/grey	0.8	1.29	979.0129.00+	979.0129.000	981.0129.000	983.0129.000
Yellow/yellow	0.8	1.42	979.0142.00+	979.0142.000	981.0142.000	983.0142.000
Yellow/blue	0.8	1.52	979.0152.00+	979.0152.000	981.0152.000	983.0152.000
Blue/blue	0.8	1.65	979.0165.00+	979.0165.000	981.0165.000	983.0165.000
Green/green	0.8	1.85	979.0185.00+	979.0185.000	981.0185.000	983.0185.000
Purple/purple	0.8	2.05	979.0205.00+	979.0205.000	981.0205.000	983.0205.000
Purple/black	0.8	2.29	979.0229.00+	979.0229.000	981.0229.000	983.0229.000
Purple/orange	0.8	2.54	979.0254.00+	979.0254.000	981.0254.000	983.0254.000
Purple/white	0.8	2.79	979.0279.00+	979.0279.000	981.0279.000	983.0279.000

3.10 Trademarks

Watson-Marlow Bioprene, Pumpsil and Marprene are trademarks of Watson-Marlow Limited.
Fluorel is a trademark of 3M.
GORE STA-PURE PCS and **GORE STA-PURE PFL** are trademarks of W.L.Gore and Associates.

3.11 Do not use pumps in patient-connected applications

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

3.12 Publication history

m-400-gb-01.qxp: Watson-Marlow 400 pumpheads

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