

# Watson-Marlow 120 cased pumps

Installation, operating, and maintenance manual

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# 1 General information

## 1.1 EU declaration of conformity



### EU declaration of conformity

1. Manufacturer: Watson-Marlow Limited, Bickland Water Road, Falmouth, TR11 4RU, UK
2. This declaration of conformity is issued under the sole responsibility of the manufacturer.
3. Object of the Declaration: 120 Cased Pump. (Models: S, F, U), with all approved pumpheads, tubing and accessories..
4. The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

*Machinery Directive 2006/42/EC, EMC Directive 2014/30/EU, RoHS Directive 2011/65/EU*

5. The Object of this Declaration conforms with the applicable requirements of the following standards and technical specifications:

*BS EN 61010-1:2010+A1:2019  
IEC 60529:1989+A2:2013 (IP31)*

6. Certified standards:

*UL 61010-1:2012 3rd Edition  
CAN/CSA C22.2#61010-1-12:2012 3rd Edition*




Signed for on behalf of:  
Watson-Marlow Limited  
Falmouth, 24th April 2024

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## 1.2 UK declaration of conformity

 <b>Fluid Technology Solutions</b>	
<b>UK declaration of conformity</b>	
<ol style="list-style-type: none"><li>1. Manufacturer: Watson-Marlow Limited, Bickland Water Road, Falmouth, TR11 4RU, UK</li><li>2. This declaration of conformity is issued under the sole responsibility of the manufacturer.</li><li>3. Object of the Declaration: 120 Cased Pump. (Models: S, F, U), with all approved pumpheads, tubing and accessories..</li><li>4. The object of the declaration described above is in conformity with the relevant statutory requirements:  <i>Supply of Machinery (Safety) Regulations 2008, Electromagnetic Compatibility Regulations 2016, The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012</i></li><li>5. The Object of this Declaration conforms with the applicable requirements of the following standards and technical specifications:  <i>BS EN 61010-1:2010+A1:2019 IEC 60529:1989+A2:2013 (IP31)</i></li><li>6. Certified standards:  <i>UL 61010-1:2012 3rd Edition CAN/CSA C22.2#61010-1-12:2012 3rd Edition</i></li></ol>	
Signed for on behalf of: Watson-Marlow Limited Falmouth, 24th April 2024	
	
Nancy Ashburn, Head of Design & Engineering, Watson-Marlow Limited Watson-Marlow Fluid Technology Solutions Telephone: +44 (0) 1326 370370 A Spirax-Sarco Engineering plc company	

## 1.3 Warranty

Watson-Marlow Ltd ("Watson-Marlow") warrants this product to be free from defects in materials and workmanship for three years from the date of shipment, under normal use and service.

Watson-Marlow's sole responsibility and the customer's exclusive remedy for any claim arising out of the purchase of any product from Watson-Marlow is, at Watson-Marlow's option: repair, replacement or credit, where applicable. Unless otherwise agreed in writing, the foregoing warranty is limited to the country in which the product is sold.

No employee, agent or representative of Watson-Marlow has the authority to bind Watson-Marlow to any warranty other than the foregoing unless in writing and signed by a director of Watson-Marlow. Watson-Marlow makes no warranty of the fitness of its products for a particular purpose.

In no event:

- i. shall the cost of the customer's exclusive remedy exceed the purchase price of the product;
- ii. shall Watson-Marlow be liable for any special, indirect, incidental, consequential, or exemplary damages, however arising, even if Watson-Marlow has been advised of the possibility of such damages.

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. Watson-Marlow shall not be liable for consequential damages, including without limitation, lost profits, loss of time, inconvenience, loss of product 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.

Watson-Marlow shall not be responsible for shipping damage of returned items.

### Conditions

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

### Exceptions

- Consumable items including tubing and pumping elements are excluded.
- Pumphead rollers are excluded.
- Repairs or service necessitated by normal wear and tear or by lack of reasonable and proper maintenance are excluded.
- Products which, in the judgement of Watson-Marlow, have been abused, misused, or subject to malicious or accidental damage or neglect are excluded.
- Failure caused by electrical surge is excluded.
- Failure caused by incorrect or sub-standard system wiring is excluded.
- Damage by chemical attack is excluded.
- Ancillaries such as leak detectors are excluded.
- Failure caused by UV light or direct sunlight.
- Any attempt to disassemble a Watson-Marlow product will invalidate the product warranty.
- The 120F is excluded from all warranty when pumping above 1bar. The 120U and the 120S are excluded from all warranty when pumping above 2 bar.

Pumpheads used with this pump drive carry their own warranty.

## 1.4 Introduction

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

These operating instructions are for the following pump models:

### 120F

This pump is started and stopped from the keypad.

### 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

### 120U

This pump can be controlled from the keypad or remotely. It features:

#### Manual control

- Speed adjustment
- Run and stop
- Direction control
- **max** key for rapid priming
- **auto start** for automatic power recovery
- **auto** key for changing between manual and auto control

#### Remote digital control

- The pump can be digitally controlled with a contact closure or logic input signal

#### Analogue control

- The pump speed can be controlled through an analogue signal input of 4-20mA or 0-10V

#### Outputs

- Logic output designated for an alarm only DC Tacho output

## 1.5 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. Please observe the storage recommendations and use-by dates which apply to tubing you may wish to bring into service after storage.

## 1.6 Information for returning pumps

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

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.

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 WMFTS or its subsidiaries or distributors. Failure to do so will cause delays. Please ensure that you email us this information and receive a RGA (Returned Goods Authorisation) before you despatch the product (s). A copy of the RGA form must be attached to the outside of the packaging containing the product(s).

Please complete a separate decontamination certificate for each product and attach it to the outside of the packaging containing the product (s). A copy of the appropriate decontamination certificate can be downloaded from the WMFTS website at [www.wmfts.com](http://www.wmfts.com).

You are responsible for cleaning and decontaminating the product(s) before return.

## 1.7 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.

## 1.8 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 WMFTS, 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 WMFTS. Doing so could lead to injury to persons or damage to property for which no liability can be accepted.

## Safety symbols


The following symbols may be used on the product, packaging and/or in these instructions:

	Either symbol indicates a safety instruction must be followed or potential hazard exists.		Rotating Parts
		(either symbol)	

The instruction documentation must be consulted in all cases where any safety symbol is shown to find details of potential hazards and actions to avoid.

## Compliance symbols

The following symbols may be used on the product, packaging and/or in these instructions:

	Complies with the applicable EC directives		Complies with the applicable UK regulations
	Complies to the applicable requirements of ACMA (Australian Communications and Media Authority)		China RoHS - products contain substances above RoHS limits, and with the Environment Use Period of 10 years
	The pump or packaging cannot be handled as domestic waste. Dispose of the pump and packaging at an appropriate recycling centre for the recovery of electrical and electronic equipment.		Certified by TUV to:  Safety requirements for electrical equipment for measurement, control, and laboratory Use – Part 1: General requirements <ul style="list-style-type: none"><li>• IEC 61010-1:2010/AMD1:2016</li><li>• EN 61010-1:2010/A1:2019</li><li>• UL 61010-1:2012/R:2019-07</li><li>• CSA C22.2 No. 61010-1-12/AMD1:2018-11</li></ul>



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.



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



**WARNING:** There are moving parts inside the pumphead. Before opening the guard or track, ensure that the following safety directions are followed:



- Ensure 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 appropriate Personal Protective Equipment (PPE) is worn.



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



**WARNING:** If fluids hazardous to health are used, applicable safety procedures must be followed to prevent injury.



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

<b>EC harmonised standards</b>	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	
<b>Other standards</b>	CAN/CSA-C22.2 No 61010-1
	Conducted emissions FCC 47CFR, Part 15.107
	Radiated emissions FCC 47CFR, Part 15

## Power supply standards

<b>Safety standards</b>	UL 60950-1
	CSA-C22.2
	TUV EN 60950-1
<b>EMC</b>	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

## 1.9 Good pump installation practice

### Position

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

It is recommended that the pump is sited on a flat, horizontal, rigid surface, free from excessive vibration, to ensure the correct lubrication of the gearbox and correct pumphead operation.

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 40 °C.

Do not stack more than 2 pumps on top of each other. 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. When the pumps are stacked, ensure that the ambient temperature around all the pumps in the stack does not exceed 40 C.



### 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.

### 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	2 bar
120U+400D1	
120U+400DM2	
120U+400DM3	

## 120F cased pumps

Two models are available, fitted with either a 114DV pumphead or a 102R pumphead, in either case pumping with Pumpsil silicone tubing only. The 120F is designed for fluid transfer only. It cannot be run at pressure.

### 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 external DC power supply cables.

**Do** keep delivery and suction tubes as short and direct as possible - though ideally not shorter than one metre - 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 must not restrict the flow. Any valves in the flow line must be open when the pump is running.

**Do** ensure that on longer tube runs at least one metre 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** use suction and delivery pipes equal to or larger than the tubing diameter bore. 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. Flooded suction will enhance pumping performance, particularly for materials of a viscous nature.

**Do not** pump any chemical not compatible with the tube or pumphead.

**Do not** run the pump with no tube or element fitted to the pumphead.

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.

## 1.10 Power supply

### Pump power supply requirements

Item	Pump requirements
Voltage from power supply unit	+24 VDC input
Maximum voltage fluctuation	±10 % of nominal voltage
Overvoltage category	II
Insulation class pump	III
Rated power	15 W

### Power supply unit

The 120 pump is suitable for single-phase mains electricity power supply, using the following power supply units:

Power supply unit	Pump model suitability
GE24I24-EC2	Supplied with all models to May 2026
NGE18I24-EC	Supplied with all models from May 2026
GST18A24-P1J	Supplied with pump product code 010.6141.DAE only
WR9QI750CCPNAIMR6B	Supplied with Argentina models only

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.

## Power supply unit specification

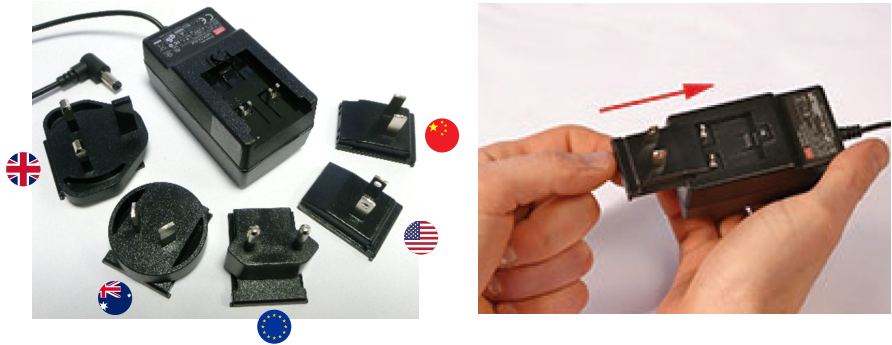
Item	Power supply unit			
	GE24I24-EC2	NGE18I24-EC	WR9QI750CCPNAIMR6B	GST18A24-P1J
<b>Power plug</b>	US European Australia UK China		Argentina	European
<b>Power cable (Power supply unit to power plug)</b>		Wall mount power adapter		2.5 m (8.2 Ft), (IEC C13 power cable)
<b>Power cable (Power supply unit to pump)</b>	Integrated, 1.5 m (4.9 Ft), male connector, 2.1 mm centre positive,			
<b>Insulation category</b>	Class II: double insulated, no earth		Class I: no earth	
<b>Mains voltage/frequency</b>	100 to 240 VAC 50/60 Hz			
<b>Mains current</b>	0.7A @ 100 VAC; 0.4A @ 230 VAC		0.6A @ 100 VAC - 240 VAC	0.5A @ 100 VAC; 0.3A @ 230 VAC
<b>Output voltage</b>	24 VDC, 18 W			
<b>Working temperature</b>	5° C to 40° C (41° F to 104° F)			
<b>Operating humidity</b>	20% to 90% RH, non-condensing			

### 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.

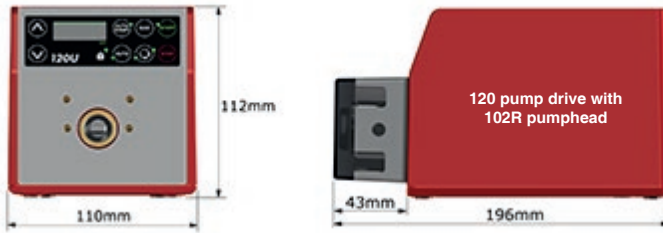
### To prepare your power supply

Select the mains input adapter appropriate to your region and slide it into position on the rear of the unit. Ensure it clicks into place. Example using : GE24124-EC2

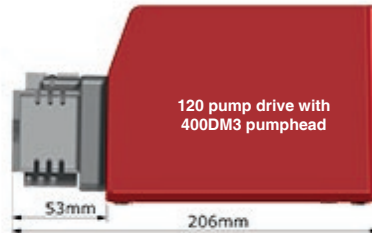
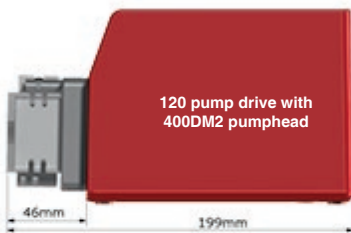
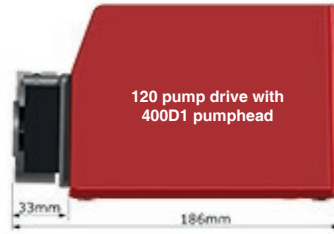
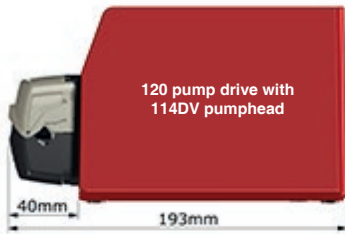


*Figure 1 - External AC/DC power supply unit power plug arrangement*

## 1.11 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

## 1.12 Start-up check list

Note: See also Refer to "102R pumpheads" on page 45 Refer to "114DV pumpheads" on page 40 or Refer to "400D1, 400DM2 and 400DM3 pumpheads" on page 50 for additional installation instructions specific to your pumphead.

- 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 Refer to "Good pump installation practice" on page 12 are followed.

## 1.13 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.

## 1.14 Drive spares

Foot: FB0012

## 1.15 Manufacturer and technical support

This product is manufactured by Watson-Marlow.

Watson-Marlow Limited  
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United Kingdom

Phone: +44 1326 370370

Website: <https://www.wmfts.com/>

For guidance or support of this product please contact your local WMFTS representative:  
<https://www.wmfts.com/en/about/locations/>

## 1.16 Authorised EU representative

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## 2 Operation

### 2.1 Specifications

#### 120F specifications

<b>Control range (turndown ratio)</b>	<b>Fixed speed:</b> With 102R: 10 rpm; 17 rpm; 31 rpm With 114DV: 10 rpm; 17 rpm; 31 rpm; 52 rpm; 220 rpm
<b>Power supply DC input</b>	24 V
<b>Ingress protection rating</b>	IP31 to BS EN 60529, NEMA 2, excluding mains leads and power supply
<b>Environment</b>	Suitable for indoor use (dry or wet location) up to ingress protection rating
<b>Pumphead options</b>	114DV and 102R
<b>Tubing options</b>	Pumpsil silicone tubing only
<b>Operating temperature range</b>	5C to 40C, 41F to 104F
<b>Storage temperature range</b>	-25C to 65C, -13F to 149F
<b>Maximum altitude</b>	2,000m, 6,560ft
<b>Humidity (non-condensing)</b>	80% up to 31C, 88F, decreasing linearly to 50% at 40C, 104F
<b>Weight</b>	See Refer to "Dimensions" on page 17
<b>Noise</b>	<60dB(A)

#### 120F performance data

This pump is available in five standard versions, each offering a fixed speed. For performance information, see Refer to "102R pumpheads" on page 45 or Refer to "114DV pumpheads" on page 40.

Fixed speeds available with pumphead options		
	102R	114DV
10 rpm	●	●
17 rpm	●	●
31 rpm	●	●
52 rpm	N/A	●
220 rpm	N/A	●

## 120S specifications

<b>Control range (turndown ratio)</b>	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)
<b>Power supply DC input</b>	24 V
<b>Ingress protection rating</b>	IP31 to BS EN 60529, NEMA 2, excluding mains leads and power supply
<b>Environment</b>	Suitable for indoor use (dry or wet location) up to ingress protection rating
<b>Pumphead options</b>	114DV, 102R, 400D1, 400DM2 and 400DM3
<b>Operating temperature range</b>	5C to 40C, 41F to 104F
<b>Storage temperature range</b>	-25C to 65C, -13F to 149F
<b>Maximum altitude</b>	2,000m, 6,560ft
<b>Humidity (non-condensing)</b>	80% up to 31C, 88F, decreasing linearly to 50% at 40C, 104F
<b>Weight</b>	See Refer to "Dimensions" on page 17
<b>Noise</b>	<60dB(A)

## 120U specifications

<b>Control range (turndown ratio)</b>	Manual control: With 102R: 0.1-32 rpm (320:1) With 114DV: 0.1-200 rpm (2,000:1) With 400D1: 0.1-200 rpm (2,000:1) With 400DM2: 0.1-100 rpm (1,000:1) With 400DM3: 0.1-100 rpm (1,000:1)
	Auto control: With 102R: 0.01-32 rpm (3,200:1) With 114DV: 0.05-200 rpm (4,000:1) With 400D1: 0.05-200 rpm (4,000:1) With 400DM2: 0.03-100 rpm (4,000:1) With 400DM3: 0.03-100 rpm (4,000:1)
<b>Power supply DC input</b>	24 V
<b>Ingress protection rating</b>	IP31 to BS EN 60529, NEMA 2, excluding mains leads and power supply
<b>Environment</b>	Suitable for indoor use (dry or wet location) up to ingress protection rating
<b>Pumphead options</b>	114DV, 102R, 400D1, 400DM2 and 400DM3
<b>Operating temperature range</b>	5C to 40C, 41F to 104F
<b>Storage temperature range</b>	-25C to 65C, -13F to 149F
<b>Maximum altitude</b>	2,000m, 6,560ft
<b>Humidity (non-condensing)</b>	80% up to 31C, 88F, decreasing linearly to 50% at 40C, 104F
<b>Weight</b>	See Refer to "Dimensions" on page 17
<b>Noise</b>	<60dB(A)

## 2.2 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.

### 120F

- Plug the power supply unit into a mains power outlet and switch on.
- Load the pumphead with tube.

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

### 120S

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 Refer to "Error codes" on page 38.

Load the pumphead with tube.

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

Operating parameters may be changed by means of key-presses. See Refer to "Manual operation — 120S and 120U" on page 26.

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

### 120U

**Note: If you plan to operate the pump by controls external to the pump, the 15-way D-connector must be connected before power is supplied to the pump. (see 2.5 Automatic control wiring and 2.6 Remote/automatic control and operation). If any change is made later to the 15-way D-connector, it must be reconnected before power is supplied to 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 Refer to "Error codes" on page 38.

Load the pumphead with tube.

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

Operating parameters may be changed by means of key-presses. See Refer to "Manual operation — 120S and 120U" on page 26.

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

## Default settings

First-time start-up defaults	120F	120S	120U
<b>Speed</b>	Fixed: see keypad	32 rpm	32 rpm
<b>Maximum speed</b>	Fixed: see keypad	N/A	Maximum possible speed depending on pumphead
<b>Direction</b>	Fixed: clockwise	Clockwise	Clockwise
<b>Mode</b>	N/A	N/A	Manual
<b>Display</b>	N/A	Speed in rpm	Speed in rpm
<b>Display and LEDs</b>	N/A	On	On
<b>Keypad lock</b>	N/A	Off	Off
<b>Beeper</b>	Fixed: on	On	On
<b>Auto-start</b>	Fixed: on *	Off	Off
<b>Max (prime)</b>	N/A	Maximum possible speed	Maximum possible speed
<b>Pump status</b>	Stopped	Stopped	Stopped
<b>Scrolling increment</b>	N/A	1 rpm	0.1 rpm
<b>Remote stop</b>	N/A	N/A	Open=run
<b>Output 1</b>	N/A	N/A	General alarm

\* If the **120F** is isolated from mains power while it is running, it will start when power is re-connected: it is not necessary to press **START**.

## 2.3 Remote control wiring



Terminals must only be connected to external circuits that are also separated from mains voltage by double or reinforced insulation.



Never apply mains power to the D-connector.

Do not apply voltages greater than 5 V DC for Digital inputs or 10 V DC for Analogue inputs to the relevant control cable connector pin. Greater voltage will cause permanent damage not covered by warranty.

Interfacing the 120U pump with other devices is by means of a female 15-pin D-connector at the rear of the pump.

A mating male connector, screened for EMC compatibility, must be connected to a screened control cable.

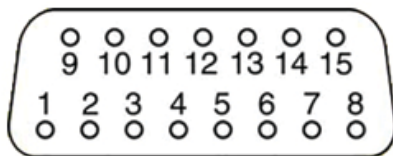
Recommended control cable: 7 strands 0.2mm, 24AWG, screened, circular, up to 15-core.

**The 15-way D-connector must be connected before power is supplied to the pump. If any change is made later to the 15-way D-connector, it must be re-connected before power is supplied to the pump.**

This pump passes all EMC compatibility requirements with up to 3m (10ft) of the cable type specified above. Beyond this distance it is the user's responsibility to ensure the pump is safe and reliable under remote and automatic control.

To minimise EMC interference the wiring to the 15-pin D-connector must be screened. The screen must be earthed at the signal end of the wiring. To further reduce EMC the screened cable must be threaded once or twice through a ferrite tubular cable shield or a hinged clamp core.

The signal ground and DC supply ground lines on this pump are isolated from ground by the external DC supply unit. It can be connected to isolated 0V or grounded 0V interfaces. The TTL (transistor transistor logic) output is composed of two states: nominally 0V and 5V; but in practice <0.4V (<16mA) and 2.4-5V (<0.4mA). They are not suitable for driving relays.



Pin no	Input or output	Function	Referenced to
1	Digital input	Analogue Voltage or Current Signal Input Select (0 - 5V input range)	Connect to Digital Ground for Current
2	Analogue input	Analogue Voltage or Current Signal Input (+) (0-10V / 4-20 mA range)	Referenced to Analogue Ground
3	Ground	Analogue Ground (0V)	
4	Digital input	Remote Direction Enable (0 - 5V input range)	Connect to Digital Ground to enable
5	Digital input	Remote Direction (0 - 5V input range)	Connect to 5VDC for counter-clockwise operation
6	N/A	For future use	N/A
7	Digital input	Manual or Auto Mode Select (0 - 5V input range)	Connect to 5VDC Supply for Auto Mode
8	Digital input	Remote Start/Stop (0 - 5V input range)	Connect to 5VDC Supply to stop
9	Analogue output	Analogue Tacho Output (0 - 5VDC signal)	Referenced to Analogue Ground
10	Ground	Analogue Ground (0V)	
11	Ground	Digital Ground (0V)	
12	Ground	Digital Ground (0V)	
13	DC output	5 V DC (+), 50 mA max	Referenced to Ground
14	Digital output	Alarm Output (5V TTL) Low = (0 - 0.4V < 16 mA) High = 2.4 - 5V (<0.4 mA) -> 5V	Referenced to Digital Ground. Not suitable for driving relays
15	DC output	12 V DC (+), 50 mA max	Referenced to Ground

## 2.4 Manual operation — 120F



### Start and stop

To start the pump, press the green **START** key on the keypad. The pump rotates clockwise at its fixed speed, a beep sounds and an LED beside the **START** key illuminates.

To stop the pump, press the red **STOP** key on the keypad. The pump stops, a beep sounds and the LED beside the **START** key goes out.

## 2.5 Manual operation — 120S and 120U



**The pump can be stopped at all times by pressing STOP on the keypad, whether it is in manual or auto mode. Auto mode is available on the 120U only.**



Note: Beeps sound to confirm the function of control keys only if keypad beep has not been turned off (see Refer to "Keypad beep" on page 28).

Note: Remote stop/start, direction, DC tachometer output and digital alarm output are active in both manual and auto modes (**120U only**).

## 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.

### 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 the minimum speed 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.

### Increase and decrease pump speed

Press and hold **UP** to increase the speed shown on the display in minimum steps (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. Beeps sound while the key is held. If the pump is then started by pressing the **START** key, it operates at the new speed. For the minimum running speed see Refer to "Specifications" on page 19. If the pump is running when **DOWN** is pressed, the change takes effect immediately.

Note: You can reduce the pump speed from the minimum speed 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.

### 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.

### 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.

### 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.

### 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.

## 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.

## Keypad beep

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

## 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.

## 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.

## Defaults

To return the pump to its default settings, press and hold **DIRECTION** on power up. See Refer to "Switching the pump on" on page 22.

## Set maximum allowed speed (120U only)

While the pump is stopped, press **AUTO** and **UP** together to put the pump into Setup mode. The display shows the current maximum allowed speed, and flashes to indicate that the pump is in Setup mode. Use the **UP** and **DOWN** keys to select a new maximum allowed speed. Press **AUTO** to confirm the new maximum allowed speed. Press **STOP** to escape from the the change sequence and revert to the previous maximum allowed speed. The minimum maximum speed is 2 rpm.

### Switch to automatic control (120U only)

Press **AUTO** to toggle the pump into and out of analogue control. A beep sounds and the LED beside the **AUTO** key illuminates to confirm that the pump is under analogue control, and will respond to any remote/auto signal. When started, the pump runs at the speed set by any analogue signal applied to the pump, and in the direction indicated.

When toggled from automatic control to manual control, the pump retains its speed setting.

## 2.6 Remote and automatic control and operation

The 120U pump can be operated by controls external to the pump: manually by a switch or potentiometer; or by an automatic control station. **You need not press the AUTO key unless you wish to control speed remotely: remote stop/start, direction, DC tachometer output and digital alarm output are active in both manual and auto modes.**

Check that the pump is ready to run before remote/automatic operation. Signals may start the pump without warning.



**Terminals must only be connected to external circuits that are also separated from mains voltage by double or reinforced insulation.**



**Never apply mains power to the D-connector.**

**Do not apply voltages greater than 5 V DC for Digital inputs or 10 V DC for Analogue inputs to the relevant control cable connector pin. Greater voltage will cause permanent damage not covered by warranty.**



**The pump can be stopped at all times by pressing STOP on the keypad, whether it is in manual or auto mode. Auto mode is available on the 120U only.**

### Remote stop/start when AUTO has not been pressed

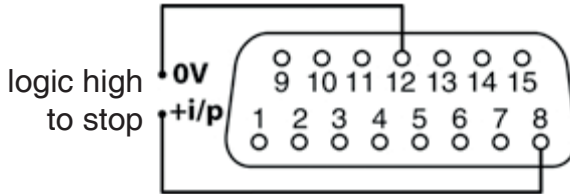
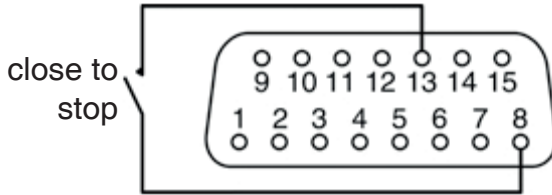
Fit a switch between pins 8 and 13.

OR:

Apply a TTL logic signal to pin 8, ground to pin 12.

Press **START** on the keypad to enable remote stop/start.

See 2.6.6 Remote stop/start for remote stop/start instructions after **AUTO** has been pressed



## Direction

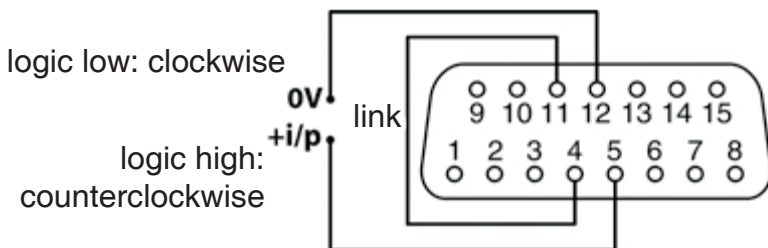
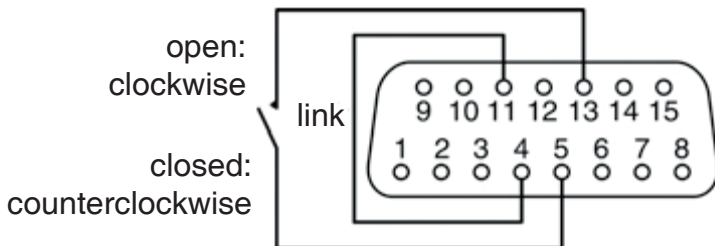
For remote direction change:

Enable remote direction control and disable the **DIRECTION** key on the keypad by fitting a link between pins 4 and 11.

Fit a switch between pins 5 and 13.

OR:

Apply a TTL logic signal to pin 5, ground to pin 12.

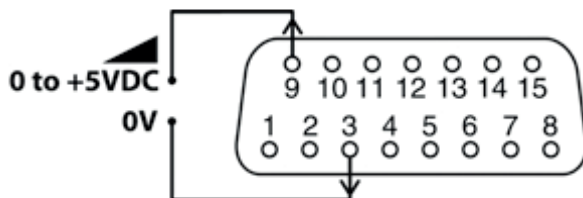


## DC tacho output

For DC tacho output:

Connect external instrumentation: positive terminal to pin 9; negative terminal to pin 3.

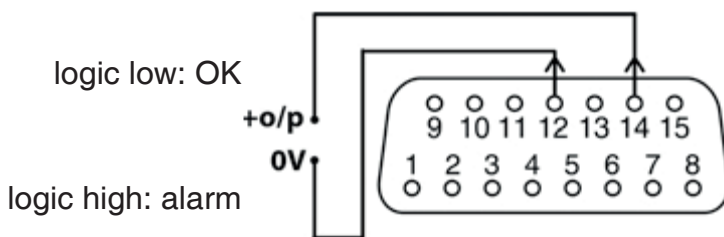
Note: This output is designed for low-resistance equipment inputs of nominally 1k $\Omega$ .



### Digital alarm output

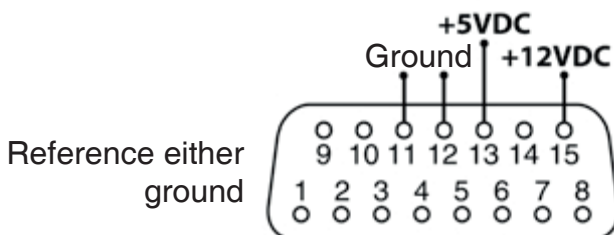
For digital alarm output (system errors only):

Connect an external TTL device: positive terminal to pin 14; negative terminal to pin 12.



### Supply voltages

+5VDC is available on pin 13. +12VDC is available on pin 15. Tolerances better than 10%. Both supplies are stabilised. Ground to pin 11 or pin 12.



DC Voltage	Max load	Pin	Typical use
+5V	10mA	13	Voltage supply for inputs using remote switch.
+12V	10mA	15	Possibly voltage supply for inputs using remote switch

### How to get into auto speed operation

Check that the pump is ready to run before remote/automatic operation. Signals may start the pump without warning.

- Press the **AUTO** key to select automatic operation. A beep sounds and the LED beside the **AUTO** key illuminates to indicate that the pump is under automatic speed control.
- The pump responds to the analogue signal as soon as this is done. Auto-start is automatically switched on. The only keys active are **STOP**, **AUTO** and **DIRECTION**.
- If remote direction input is active and the direction-enable link is applied, the **DIRECTION** key is disabled. If keypad lock is set, only **STOP** and **START** are active. **STOP** stops the pump and switches it to manual control (or, if the pump was put into auto mode by remote switching, to the auto-stop state—see Alternatively, below). **START** pressed for more than 1 second toggles the keypad lock on or off.

- The pump displays the speed at which the pump will rotate after receiving a high signal (20mA or 10V).

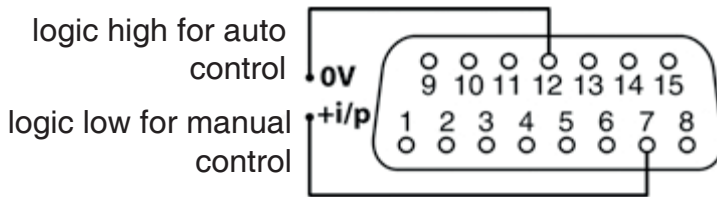
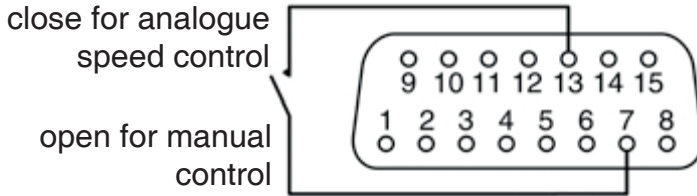
**Alternatively ...**

A remote signal can select auto or manual control, overriding the keypad AUTO key setting.

Fit a switch or link between pins 7 and 13.

OR:

Apply a TTL logic signal to pin 7, ground to pin 12.



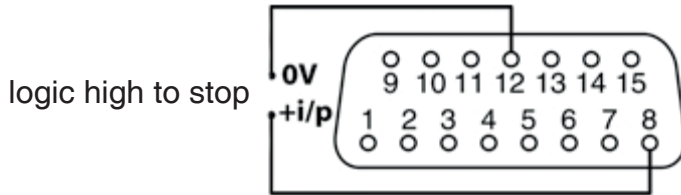
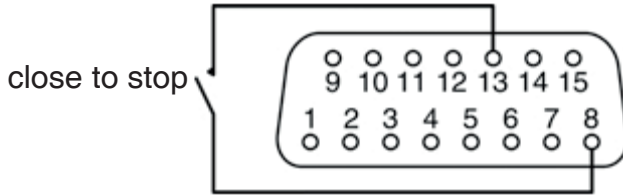
### Remote stop/start when AUTO has been pressed

Fit a switch between pins 8 and 13.

OR:

Apply a TTL logic signal to pin 8, ground to pin 12.

See 2.6.1 Remote stop/start for remote stop/start instructions if **AUTO** has not been pressed.



### Speed: analogue input

When **AUTO** has been pressed, pump speed can be controlled remotely by an analogue process signal within the range 0-10V; or 4-20mA. The pump provides an increasing flow rate for a rising control signal.

#### Voltage signal

0-10VDC. Input impedance: 24k $\Omega$ .

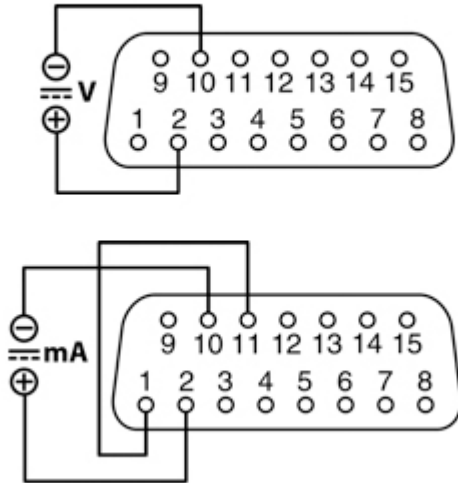
Connect a voltage source: negative terminal to pin 10; positive terminal to pin 2.

#### Current signal

4-20mA. Input resistance: 250 $\Omega$ .

Fit a link between pins 1 and 11.

Connect a current source: negative terminal to pin 10; positive terminal to pin 2.



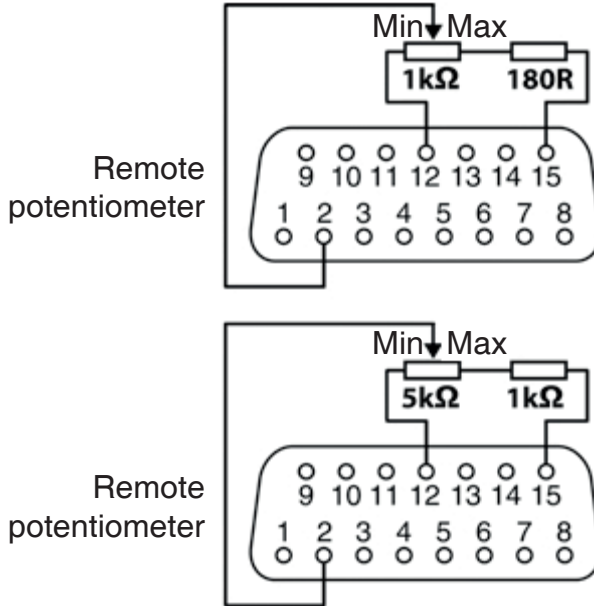
### Speed: remote potentiometer input

For remote potentiometer speed input, when **AUTO** has been pressed:

Connect a potentiometer ( $\pm 5\%$  tolerance recommended) between pins 12 and 15, with a resistor in series on the Max side of the potentiometer. Typical potentiometer value is  $1\text{k}\Omega$ - $5\text{k}\Omega$ . The resistor value should be  $180\text{R}$  when a  $1\text{k}\Omega$  potentiometer is used; the resistor value should be  $1\text{k}\Omega$  when a  $5\text{k}\Omega$  potentiometer is used.

Note: The resistor value may have to be adjusted higher or lower to achieve the full pump speed range. Connect the potentiometer wiper to pin 2.

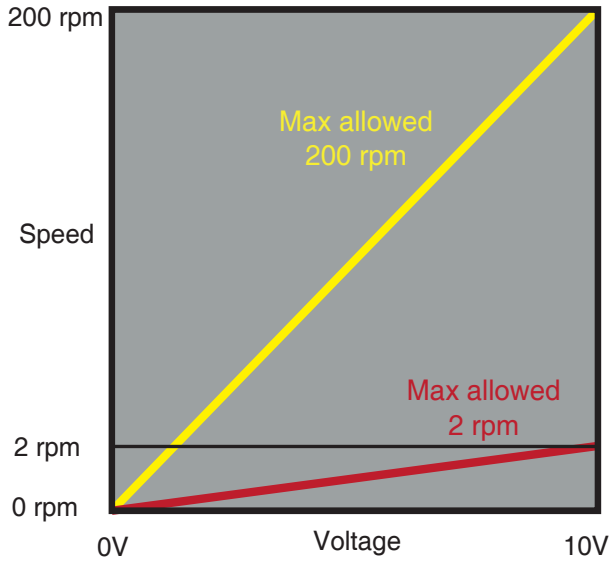
Note: Set the pump to analogue control. Do not apply a voltage or current control input signal at the same time. Performance will depend on the tolerances of components used.



### Set maximum allowed speed

While the pump is stopped, press **AUTO** and **UP** together to put the pump into Setup mode. The display shows the current maximum allowed speed, and flashes to indicate that the pump is in Setup mode. Use the **UP** and **DOWN** keys to select a new maximum allowed speed. Press **AUTO** to confirm the new maximum allowed speed. Press **STOP** to escape from the change sequence and revert to the previous maximum allowed speed. The minimum maximum speed is 2 rpm.

Note: To increase the control resolution when the maximum speed of the pump is not required, decrease the the maximum allowed speed. This is particularly useful if you are replacing a 101U/R 2 rpm pump with a higher-speed 120U/R pump.



## 2.7 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 fluid is supplied to the pump.
- Check for any kinks or blockages in the lines.
- Check that any valves in the line are open.
- Check that the tube and rotor are in the pumphead.
- Check that the tube is not split or burst.
- Check that the correct wall-thickness tube is being used.
- Check the direction of rotation.
- Check that the rotor is not slipping on the drive shaft.
- Check that tubing is installed in the pumphead; for 120F pumps, check that it is Pumpsil—other tubing materials are not suitable for use in a 120F pump; check that the tubing is the correct wall thickness: 1.6mm.

### Error codes

#### 120F

The LED beside the **START** key flashes to indicate a fault. Fast flashing— $\frac{1}{4}$  second on,  $\frac{1}{4}$  second off — indicates an error which may be resolved by cycling the power; if the fault is not resolved, contact your local service centre. Slow flashing—  $\frac{1}{2}$  second on,  $\frac{1}{2}$  second off—indicates a fault which requires the pump to be returned to your local service centre.

#### 120S and 120U

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

Note: **Signal out of range** and **Over signal** report the nature of an external signal.

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

<b>Error code</b>	<b>Error condition</b>	<b>Suggested action</b>
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
Er20	Signal out of range (120U only)	Check analogue control signal range. Trim signal as required. Or seek support
Er21	Over signal (120U only)	Reduce the analogue control signal
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

## 3 Pumpheads

3.1 114DV pumpheads .....	40
3.2 102R pumpheads .....	45
3.3 400D1, 400DM2 and 400DM3 pumpheads .....	50

### 3.1 114DV pumpheads

The 114DV pumphead has four rollers and accepts 1.6mm wall thickness tubing only. New tubing can be easily loaded into the flip top design. The top closes with a “clamp and stretch” action to locate the tube in the correct position and with the correct tension.

#### 114DV pumping conditions: pressure and viscosity

- All pressure values in this operating instruction, from which performance life figures have been calculated, relate to root mean square (RMS) pressure, giving a more relevant pressure value than figures quoted in terms of peak pressure. The RMS pressure is similar to the value you would read on a damped analogue gauge.
- Ensure that on longer tube runs at least one metre 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.

#### Safety information

**There are moving parts inside the pumphead. Before opening the 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.



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



**WARNING: There are moving parts inside the pumphead. Before opening the guard or track, ensure that the following safety directions are followed:**

- Ensure 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 appropriate Personal Protective Equipment (PPE) is worn.

## Pumphead installation

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

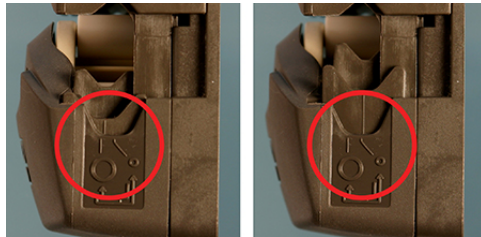
- Avoid tight pipeline bends, pipe reducers and excessive lengths of smaller bore tubing than that in the pumphead, particularly in pipelines on the suction side.
- Ensure that connecting pipework and fittings are suitably rated to handle the predicted pipeline pressure.
- If rigid pipework comes in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

### 114DV tube holder positioning

The pumphead can be adjusted to accommodate 1.6mm wall tubing in sizes from 0.5mm bore to 4.8mm bore.

#### Tube holder position

Tube bore size	0.5mm	0.8mm	1.6mm	2.4mm	3.2mm	4.0mm	4.8mm
Inner	✓	✓	✓	✓	✓	x	x
Outer	x	x	x	✓	✓	✓	✓



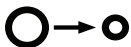
With the smaller bore tubes of 0.5mm, 0.8mm and 1.6mm the inner position must be used to prevent the risk of tube slipping through the clamps and wandering across the rollers causing premature tube rupture.

With the larger bore tubes of 4.0mm and 4.8mm the outer position must be used to prevent the flow rate being excessively reduced.

For tubing bores of 2.4mm and 3.2mm either setting may be used, as appropriate for the application. The inner setting will clamp the tube harder, reducing tube slip but has the potential to marginally reduce flow rate. The outer setting will optimise flow rate but the risk of tube slip is increased.

The tube holder is factory pre-set to the outer position.

### 114DV tube holder repositioning

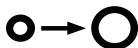


**To change from the large tube to the small tube setting**

Switch off the pump before changing the tube holder position. Use a pointed device such as a ball-point pen to reposition the lower tube holders on both sides of the pumphead.

- Lift the flip top until fully open.
- Place the pointed device pointing down into the small depression pictured here.

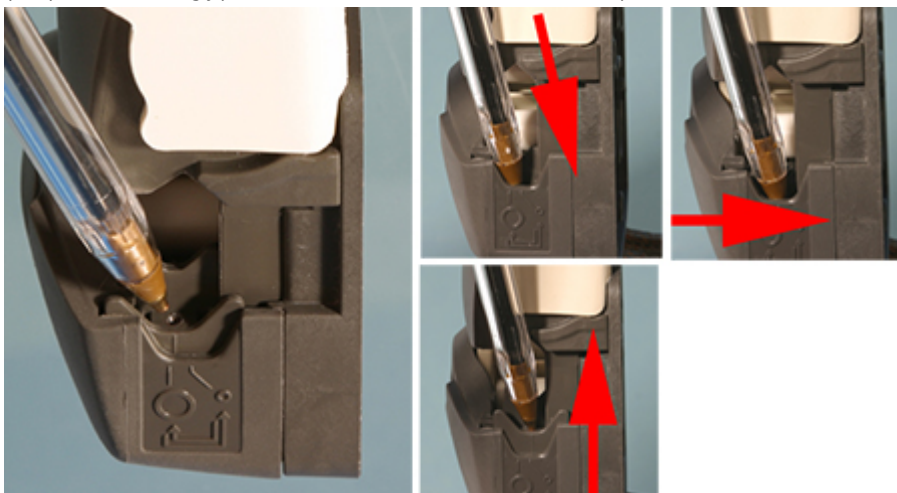
- Press down and slightly away from the front of the pumphead, as shown in the first picture above.
- Maintain the angled downward pressure and push away from the front of the pumphead. The jaw clicks into a new position.
- Release the pressure. The jaw rises into its correct alignment. If it does not rise, repeat the procedure, being sure to maintain downward pressure until release.
- Adjust the tube holder on the other side of the pumphead in the same way.



### To change from the small tube to the large tube setting

Carry out the procedure described above, but pushing towards the front of the pumphead.

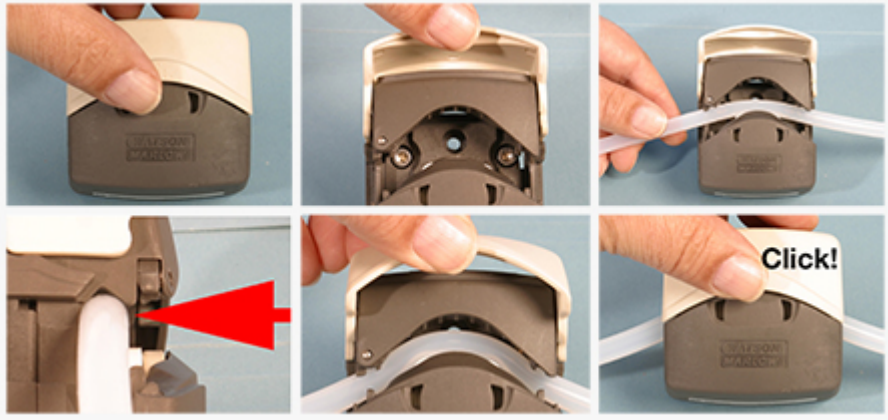
Note: The pictures in Refer to "114DV tube holder positioning" on the previous page show the tube holders' correct positions for small and large tubing. If a tube holder is not vertical relative to the body of the pumphead, it is wrongly positioned. Follow the instructions above to reposition it.



### 114DV tube loading and removal

Check that the tube holders on both sides of the pumphead are correctly set for the size of tube you are using.

- Lift the flip top until fully open.
- Select enough tube length for the curve of the pump track. Place the tube between the rotor rollers and the track, pressed against the pumphead inner wall. The tube must not be twisted or stretched against the rollers.
- Lower the flip top until it clicks into its fully closed position. The track closes automatically and the tube is stretched correctly as it does so.
- To remove the tube, reverse the sequence.



### 114DV pumphead spares

013.6000.00A

114DV pumphead with tube holder pre-set into larger bore setting

### 114DV performance data

Flow rates are normalised test values obtained using new tubing with the pumphead rotating clockwise pumping water at 20C with negligible inlet and discharge pressure. Actual flow rate 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.

**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.

#### 120F: All tubing materials (ml/min)

Fixed speed	0.5mm	0.8mm	1.6mm	2.4mm	3.2mm	4.0mm	4.8mm
10 rpm	0.2	0.4	1.4	2.9	4.7	6.7	8.5
17 rpm	0.3	0.7	2.4	4.9	8.0	11.0	14.0
31 rpm	0.6	1.2	4.3	9.0	15.0	21.0	26.0
52 rpm	1.0	2.1	7.3	15.0	25.0	35.0	44.0
220 rpm	4.4	8.8	31.0	64.0	100.0	150.0	190.0

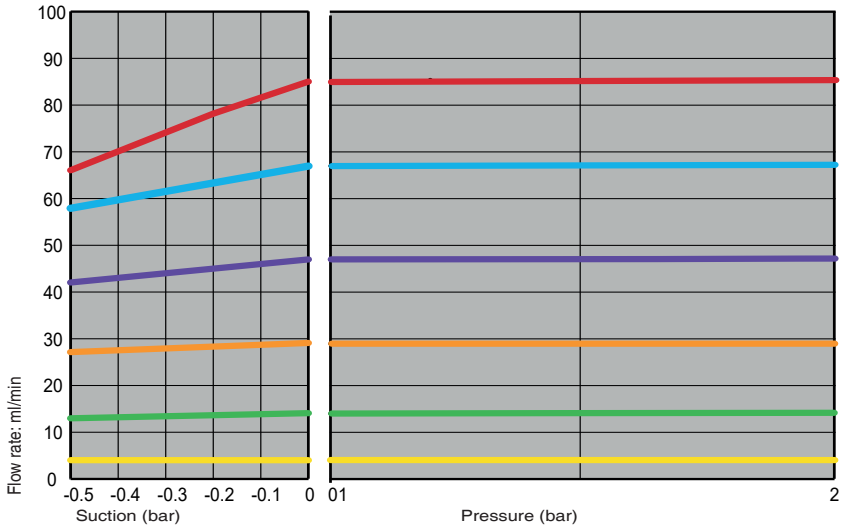
#### 120U: All tubing materials (ml/min)

Speed	0.5mm	0.8mm	1.6mm	2.4mm	3.2mm	4.0mm	4.8mm
0.1-200 rpm	0.002-4	0.004-8	0.01-28	0.03-58	0.05-94	0.07-130	0.09-170

**120S: All tubing materials (ml/min)**

Speed	0.5mm	0.8mm	1.6mm	2.4mm	3.2mm	4.0mm	4.8mm
0.1-200 rpm	0.02-4	0.04-8	0.14-28	0.29-58	0.47-94	0.67-130	0.85-170

**Pressure and flow performance curve**



Marpene tubing, 1.6mm wall, 100 rpm, CCW rotation.

Note: The 120S and the 120U must be run counter-clockwise to achieve pressures up to 2 bar. The 120F is a transfer-only, 0 bar pump.

## 114DV continuous tubing product codes

### 1.6mm wall thickness tubing for the 114DV pumphead

mm	#	Marprene	Bioprene	Pumpsil
0.5	112	902.0005.016	903.0005.016	913.A005.016
0.8	13	902.0008.016	903.0008.016	913.A008.016
1.6	14	902.0016.016	903.0016.016	913.A016.016
2.4		902.0024.016	903.0024.016	913.A024.016
3.2	16	902.0032.016	903.0032.016	913.A032.016
4.0		902.0040.016	903.0040.016	
4.8	25	902.0048.016	903.0048.016	913.A048.016
mm	#	STA-PURE PCS	STA-PURE PFL	
1.6	14	961.0016.016	966.0016.016	
3.2	16	961.0032.016	966.0032.016	
4.8	25	961.0048.016	966.0048.016	

## 3.2 102R pumpheads

The 102R is a twin roller pumphead for high precision flow rates, which can be used with Pumpsil platinum-cured silicone tubing only.

### 102R pumping conditions: pressure and viscosity

- The 120F, 120S and 120U pumps fitted with a 102R pumphead are rated for Pumpsil tubing only
- The 120S and the 120U must be run counterclockwise to achieve pressures up to 2 bar. The 120F is a transfer-only, 0 bar pump.
- All pressure values in this operating instruction, from which performance life figures have been calculated, relate to root mean square (RMS) pressure, giving a more relevant pressure value than figures quoted in terms of peak pressure. The RMS pressure is similar to the value you would read on a damped analogue gauge.
- Ensure that on longer tube runs at least one metre 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.

### Safety information

**There are moving parts inside the pumphead. Before opening the 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.



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



**WARNING:** There are moving parts inside the pumphead. Before opening the guard or track, ensure that the following safety directions are followed:



- Ensure 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 appropriate Personal Protective Equipment (PPE) is worn.

### **Pumphead installation**

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

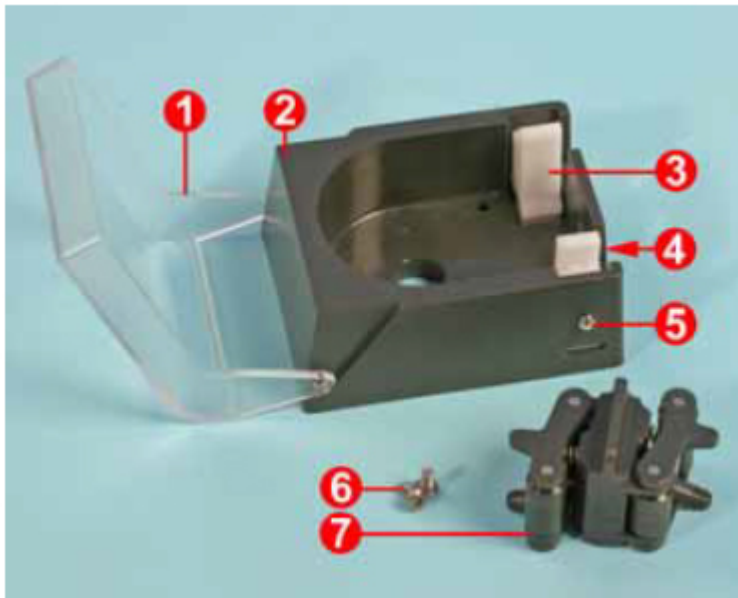
- Avoid tight pipeline bends, pipe reducers and excessive lengths of smaller bore tubing than that in the pumphead, particularly in pipelines on the suction side.
- Ensure that connecting pipework and fittings are suitably rated to handle the predicted pipeline pressure.
- If rigid pipework comes in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

## 102R tube loading and removal



- Fit one end of the tubing into one of the spring-loaded clamps. Rotate the rotor by hand and feed the tubing around the track.
- Fit the other end of the tubing into the second spring-loaded clamp, ensuring that the tubing is not slack in the pumphead since this can reduce tube life.
- To remove the tube, reverse the sequence.

## 102R pumphead spares



	013.7101.000	102R pumphead
1	MN2645M	Pumphead guard
2	MN0534M	Track
3	MNA0480A	Tube clamp
4	MN0119S	Spring to hold tube clamps in position
5	FN2313	Screw to secure tube clamps to pumphead track
6	FN0076	Screw fasteners to secure pumphead to drive
7	MNA0381A	Rotor assembly, 8mm shaft

### 102R performance data

Flow rates are normalised test values obtained using new tubing with the pumphead rotating clockwise pumping water at 20C with negligible inlet and discharge pressure. Actual flow rate 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.

**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.

**120U: Pumpsil (ml/min)**

Speed range	0.5 mm	0.8 mm	1.6 mm	3.2 mm	4.8 mm
0.1-32 rpm	0.003-0.9	0.005-1.6	0.02-6.7	0.09-27	0.17-54

**120S: Pumpsil (ml/min)**

Speed range	0.5 mm	0.8 mm	1.6 mm	3.2 mm	4.8 mm
1-32 rpm	0.003-0.9	0.005-1.6	0.21-6.7	0.85-27	1.7-54

**120F: Pumpsil (ml/min)**

Fixed flow rate					
Fixed speed	0.5 mm	0.8 mm	1.6 mm	3.2 mm	4.8 mm
10 rpm	0.3	0.5	2.1	8.5	17
17 rpm	0.5	0.9	3.6	14	29
31 rpm	0.9	1.6	6.5	26	52

**Continuous tubing product codes**

1.6mm wall tubing			Pumpsil
mm	inch	#	
0.5	1/50	112	913.A005.016
0.8	1/32	13	913.A008.016
1.6	1/16	14	913.A016.016
3.2	1/8	16	913.A032.016
4.8	3/16	25	913.A048.016

### 3.3 400D1, 400DM2 and 400DM3 pumpheads

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.

#### Safety information

**There are moving parts inside the pumphead. Before opening the 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.



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



**WARNING: There are moving parts inside the pumphead. Before opening the guard or track, ensure that the following safety directions are followed:**

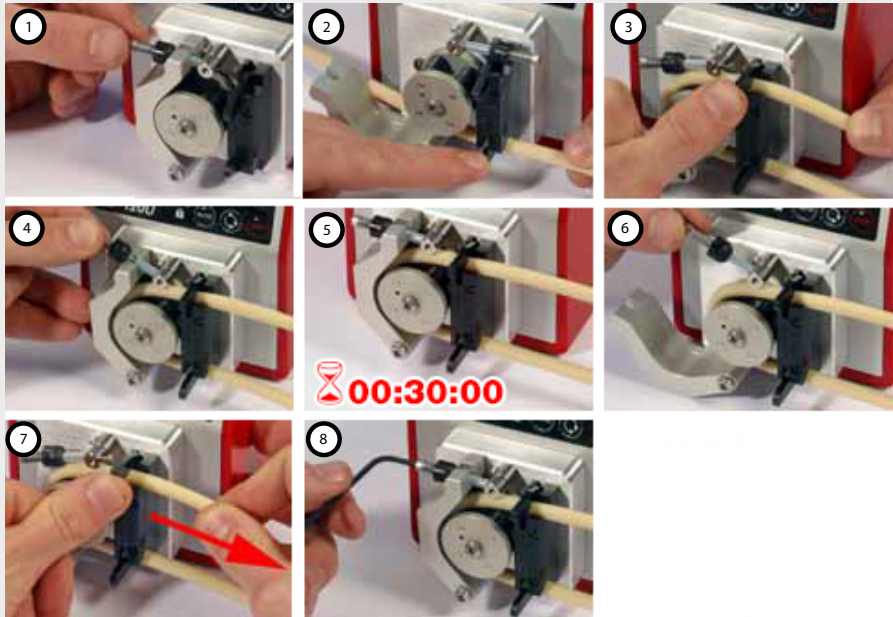
- Ensure the pump is isolated from the mains power.
- Ensure that there is no pressure in the pipeline.
- If a tube failure has occurred, ensure that any fluid in the pumphead has been allowed to drain to a suitable vessel, container or drain.
- Ensure that appropriate Personal Protective Equipment (PPE) is worn.

#### Pumphead 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.

## 400D1 tube loading and removal



1. Release the track by disengaging the sprung track pin.
2. 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.
3. Ensure the tube is lined up centrally in the track and correctly secured at each clamp.
4. 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.

### Tube re-tensioning

5. When using Marprene tubing: After the first 30 minutes of running
6. Re-tension the tube in the pumphead by releasing the sprung track pin.  
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.
7. Reposition the track over the rotor and fix by slotting the track pin back into the track slot.
8. Reposition the track over the rotor and fix by slotting the track pin back into the track slot.

### Tube removal

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

## 400DM2 and 400DM3 tube check

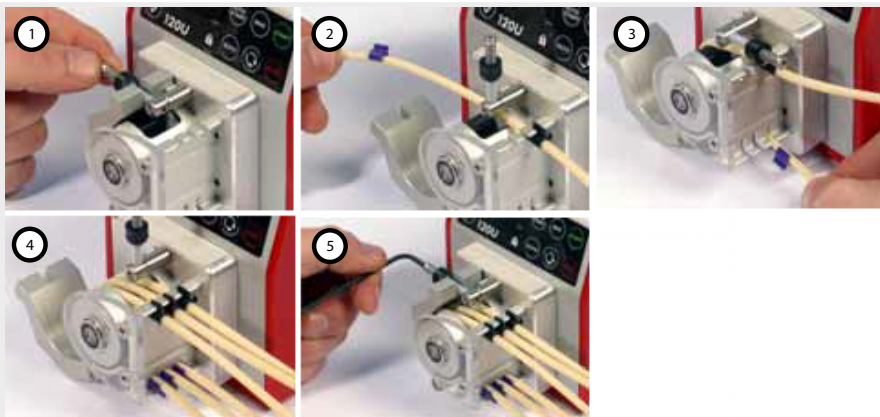
The 400DM2 and 400DM3 pumpheads are designed to accept three-bridge manifold tubing only. Each piece of three-bridge manifold tubing has two pumping sections. Reduced flow performance in one section is a sign of tube wear and should be used as an indicator to switch over to using the second section. 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.

## 400DM2 and 400DM3 tube loading and removal



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

### 400DM2 and 400DM3 tube loading and removal



1. Release the track by disengaging the sprung track pin.
2. Locate the first tube bridge into the appropriate tube bridge holder slot.
3. Feed the tubing in around the rotor. Locate the centre tube bridge into the bridge holder slot immediately opposite the first tube bridge.
4. 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.
5. Reposition the track over the rotor and fix by slotting the track pin back into the track slot.

### Tube removal

To remove the tube, reverse the sequence.

### 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 pumphead.

## 400D1, 400DM2 and 400DM3 pumphead spares

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

## 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:

Marpene 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 counterclockwise 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
<b>120U</b>						
0.1-200 rpm	0.001-2.2	0.003-5.8	0.011-23	0.02-49	0.041-81	0.06-120
<b>120S</b>						
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
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**120U**

<b>0.1-100 rpm</b>	0.0001-0.1	0.0002-0.2	0.0004-0.4	0.0008-0.8	0.001-1.4	0.002-2.2
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**120S**

<b>1-100 rpm</b>	0.001-0.1	0.002-0.2	0.004-0.4	0.008-0.8	0.014-1.4	0.022-2.2
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**400DM2 and 400DM3 Pumpsil (ml/min)**

Speed range	0.76mm	0.88mm	1.02mm	1.14mm	1.29mm	1.42mm
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**120U**

<b>0.1-100 rpm</b>	0.003-3.1	0.004-4.3	0.006-5.5	0.007-7.0	0.009-8.9	0.011-11
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**120S**

<b>1-100 rpm</b>	0.031-3.1	0.043-4.3	0.055-5.5	0.070-7.0	0.089-8.9	0.110-11
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**400DM2 and 400DM3 Pumpsil (ml/min)**

Speed range	1.52mm	1.65mm	1.85mm	2.05mm	2.38mm	2.54mm	2.79mm
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**120U**

<b>0.1-100 rpm</b>	0.012-12	0.014-14	0.018-18	0.021-21	0.026-26	0.031-31	0.036-36
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**120S**

<b>1-100 rpm</b>	0.120-12	0.14-14	0.180-18	0.210-21	0.260-26	0.310-31	0.360-36
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**Tubing product codes****400D1 continuous tubing product codes**

mm	inch	#	Marprene	Bioprene	Pumpsil	GORE STA-PURE Series PCS
<b>0.5</b>	1/50	112	902.0005.016	903.0005.016	913.A005.016	
<b>0.8</b>	1/32	13	902.0008.016	903.0008.016	913.A008.016	
<b>1.6</b>	1/16	14	902.0016.016	903.0016.016	913.A016.016	961.0016.016
<b>2.4</b>			902.0024.016	903.0024.016	913.A024.016	
<b>3.2</b>	1/8	16	902.0032.016	903.0032.016	913.A032.016	961.0032.016
<b>4.0</b>			902.0040.016			

mm	inch	#	Neoprene	PVC	GORE STA-PURE Series PFL
0.8	1/32	13	920.0008.016		
1.6	1/16	14	920.0016.016	950.0016.016	966.0016.016
3.2	1/8	16	920.0032.016	950.0032.016	966.0032.016

#### 400DM2 and 400DM3 segment tubing product codes

Colour code	wall mm	bore mm	Pharmed® BPT	Tygon® E3603	Tygon® E-LFL
Orange/black	0.8	0.13		981.A013.072	
Orange/blue	0.8	0.25	979.A025.072	981.A025.072	988.A025.072
Orange/green	0.8	0.38	979.A038.072	981.A038.072	988.A038.072
Green/yellow	0.8	0.44		981.A044.072	
Orange/yellow	0.8	0.51	979.A051.072	981.A051.072	988.A051.072
White/yellow	0.8	0.57		981.A057.072	
Orange/white	0.8	0.64	979.A064.072	981.A064.072	988.A064.072
Black/black	0.8	0.76	979.A076.072	981.A076.072	988.A076.072
Orange/orange	0.8	0.89	979.A089.072	981.A089.072	988.A089.072
White/black	0.8	0.95		981.A095.072	
White/white	0.8	1.02	979.A102.072	981.A102.072	988.A102.072
White/red	0.8	1.09		981.A109.072	
Red/red	0.8	1.14	979.A114.072	981.A114.072	988.A114.072
Red/grey	0.8	1.22		981.A122.072	
Grey/grey	0.8	1.30		981.A130.072	988.A130.072
Yellow/yellow	0.8	1.42	979.A142.072	981.A142.072	988.A142.072
Yellow/blue	0.8	1.52	979.A152.072	981.A152.072	988.A152.072
Blue/blue	0.8	1.65	979.A165.072	981.A165.072	988.A165.072
Blue/green	0.8	1.75		981.A175.072	
Green/green	0.8	1.85	979.A185.072	981.A185.072	988.A185.072
Purple/purple	0.8	2.06	979.A206.072	981.A206.072	988.A206.072
Purple/black	0.8	2.29	979.A229.072	981.A229.072	988.A229.072
Purple/orange	0.8	2.54	979.A254.072	981.A254.072	988.A254.072
Purple/white	0.8	2.74	979.A279.072	981.A279.072	988.A279.072

## 4 Trademarks

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GORE STA-PURE PCS and GORE STA-PURE PFL are trademarks of W.L.Gore and Associates.

## 5 Disclaimer

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