

**Publication PB 0175  
Issue 2**

**IP55 ingress protection, variable speed high-flow pump  
Installation and operating instruction**

<b>Drive/s:</b>	<b>Issue 4</b>
<b>EPROM:</b>	<b>N/A</b>
<b>Pumphead/s:</b>	<b>603R Issue 1</b>

***604S/R***

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**Declarations**



When the 604S/R pump is used as a stand alone pump it complies with:

Machinery Directive 89/392/EEC and EN60204-1

Low Voltage directive 73/23/EEC and EN61010-1

EMC Directive 89/336/EEC and EN50081-1/50082-1

Responsible person: A S Balding, Managing Director, Watson-Marlow Limited, Falmouth, Cornwall TR11 4RU, England.

Telephone 01326 370370 Fax 01326 376009

**Declaration of incorporation**

When the 604S/R 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 provisions of the Machinery Directive 91/368/EEC EN60204-1.

Responsible person: A S Balding, Managing Director, Watson-Marlow Limited, Falmouth, Cornwall TR11 4RU, England.

Telephone 01326 370370 Fax 01326 376009

## Safety

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.



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 dangerous voltages (at mains potential) inside the unit. If access is required, isolate the pump from the mains before removing the cover.

## Information for returning pumps

Any 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 (a suitable blank form is 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. 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.

## Two year warranty

Watson-Marlow Limited warrants, subject to the conditions below, through either Watson-Marlow Limited, its subsidiaries, or its authorised distributors, to repair or replace free of charge, including labour, any part of this product which fails within two years of delivery of the product to the end user. 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 accordance with the instructions given in this manual.

Conditions of and specific exceptions to the above warranty are:

- Consumable items such as **tubing and rollers** are excluded.
- Products must be returned by pre-arrangement carriage paid to Watson-Marlow Limited, its subsidiaries, or its authorised distributor.
- All repairs or modifications must have been made by Watson-Marlow Limited, its subsidiaries, or its authorised distributors or with the express permission of Watson-Marlow Limited, its subsidiaries, or its authorised distributors.
- Products which have been abused, misused, or subjected to malicious or accidental damage or electrical surge are excluded.

Warranties purporting to be on behalf of Watson-Marlow Limited made by any person, including representatives of Watson-Marlow Limited, its subsidiaries, or its distributors, which do not accord with the terms of this warranty shall not be binding upon Watson-Marlow Limited unless expressly approved in writing by a Director or Manager of Watson-Marlow Limited.

## **Recommended operating procedures**

**DO** keep delivery and suction lines as short as possible.

**DO** use the minimum number of bends in rigid pipe runs. If there must be a bend, use a swept bend and not a tight elbow.

**DO** run at a slow speed when pumping viscous fluids. 9.6 or 12.7mm bore tube with a 3.2mm wall will give best results. Tube smaller than this will generate a high friction pressure loss which reduces the flow. Tube with a larger bore will not have sufficient strength to reconstitute. Flooded delivery will enhance pumping performance. Some tube materials are available with a 4mm wall for speeds up to 100rpm. (The rotor will require re-setting to a roller track gap of 6.6mm.)

**DO** use suction and delivery pipelines with a bore equal to or larger than the bore of the tube fitted in the pumphead. When pumping **viscous** fluids, the losses caused by increased friction can be overcome by using pipe runs with a cross sectional area several times greater than the pumping element.

**DO** use the largest possible bore tube running at slow speed for the longest tube life.

**DO** fit an extra length of pump tube in the system so that you can move the tube through the pumphead occasionally, without needing to break the pumping circuit. This is particularly useful for extending tube life in long running sterile applications.

**DO** keep the track and rollers clean, and ensure that the rollers are free.

**DO NOT** fit valves in the suction or delivery line without considering that peristaltic pumps are self priming and will hold their prime up to several metres, so there may be no need for non-return or foot valves, nor for the loading valves required on many other kinds of pumps.

Any valves fitted must cause no restriction. If electrically actuated valves are fitted, they should be interlocked so that the pump will only run when the valves are open. Fit an automatic by-pass if manual valves are installed.

**When using Marprene or Bioprene tubing**, after the first 30 minutes of running, re-tension the tube in the pumphead by releasing the tube clamp on the delivery side a little and pulling the tube tight. This is to counteract the normal stretching that occurs with Marprene and Bioprene, which can go unnoticed and result in poor tube life.

**Tube selection** The chemical compatibility list published in the Watson-Marlow catalogue is only a guide. If in doubt about the compatibility of a tube material and the duty fluid, request a tube sample card for immersion trials. Remember the sample will be fully immersed, but the fluid when in use will only be in contact with the inside of the tube. If the material swells but does not lose its strength it could be worth considering.

**Viscous dispensing** To overcome the common problems of reduced accuracy and dripping delivery pipes, the suction and delivery lines should be kept as short as possible. Use larger bore transmission tubing than that in the pumphead to keep the friction losses to a minimum. Improved accuracy will be noticed if rigid or semi-rigid pipe is used on the delivery side. The rigid tube is effective in reducing over-run because it does not expand during pumping.

## Part 1: Drive

### Siting

To ensure correct lubrication of the gear box it is important to run the pump only while its feet are standing on a horizontal surface.

It should be situated where there is free air to circulate around the pump and where the tubing is allowed to enter the tube clamps without kinking.

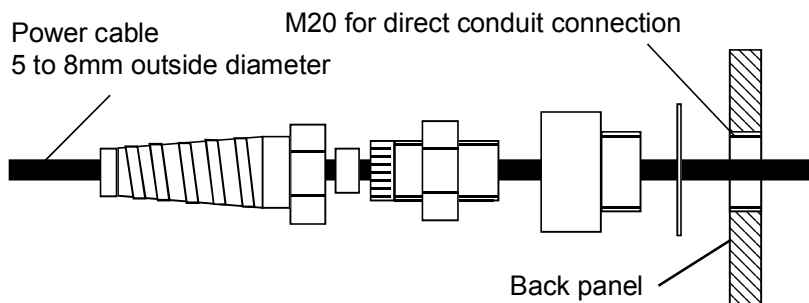
The 604S/R can be operated at ambient temperatures from 5C to 40C. Storage temperatures from -40C to 70C are permissible, but allow time for acclimatisation before use.

### Electrical connection

The 604S/R operates on single-phase mains electricity supplies only. It will accept without modification or switching any voltage from 100V to 240V either 50Hz or 60Hz.

Remove the small transparent plate on the rear panel to gain access to the terminal block. Route the mains supply cable through the entry point to the right of the recess, and couple the cable to the terminal block in accordance with the instructions printed prominently on the rear panel.

Alternative connectors are supplied to screw into the entry point gland. One accepts 20mm rigid or flexible conduit, and the other accepts three core 0.75 square millimetre PVC smooth sheathed mains cable with a outside diameter of 4mm to 7mm (via the screwed adapter supplied) so that a flying lead can be used. When using a, flying lead, ensure that the lead is securely retained in the strain relief gland so that IP55 ingress protection is maintained.



**Securely replace the transparent plate and the gasket over the recess.**

**Ingress protection standard will be compromised if transparent plate is not properly replaced.**



Should the pump fail to operate, check that mains electricity is available at the unit, that the fuse is intact and that the pump is not stalled by incorrect fitting of tubing. If the pump is to be used under manual control and fails to operate, check that the manual mode has been selected.

**Failure to operate**

**There are dangerous voltages (at mains potential) inside the unit. If access is required, isolate the pump from the mains before removing the cover.**



## Part 2: Operation

### Overview

Start the pump by turning the forward/off/reverse switch on the left hand side of the front panel to the required direction of rotation. The preferred direction of rotation is clockwise (with fluid entering at the bottom right of the pumphead and exiting at the top right of the pumphead), which will ensure the longest possible tube life. To operate against higher pressures, use anticlockwise rotation. The pump can be primed rapidly at its maximum speed by depressing the max switch on the front panel. When released the switch will return to its normal position.

To stop the pump, turn the forward/off/reverse switch to its central off position. To change the direction of flow, turn the forward/off/reverse switch to its central off position until the pumphead rotor stops, and then turn it to the other direction of rotation.

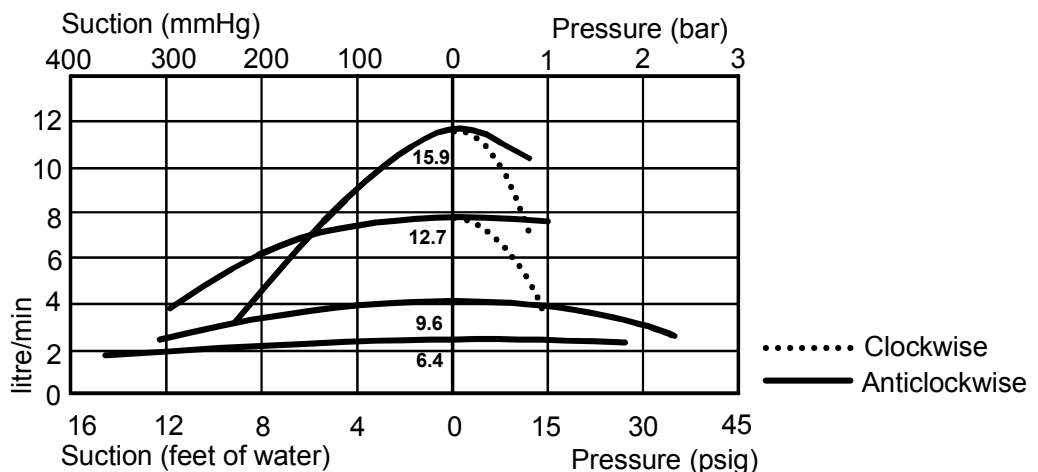
The speed control ratio of the 604S/R is 50:1 giving a speed range from approximately 4rpm to its rated maximum speed of 165rpm.

### Flow rates

The flow rates given below were obtained using Watson-Marlow 3.2mm wall thickness Marprene tubing pumping water at 20C with negligible suction and delivery pressures (unless otherwise stated). Where an application is critical, the flow rate should be determined under operating conditions. The important factors are suction and delivery pressures, temperature and fluid viscosity.

604S/R flow rates		Minimum flows 2 percent of rates given				
Tube #	25	17	122	82	184	
Tube Bore	4.8mm 3/16"	6.4mm 1/4"	9.6mm 3/8"	12.7mm 1/2"	15.9mm 5/8"	
Litre/min	<b>1.5</b>	<b>2.3</b>	<b>4.2</b>	<b>7.4</b>	<b>11</b>	
US gpm	<b>0.4</b>	<b>0.6</b>	<b>1.1</b>	<b>2.0</b>	<b>2.9</b>	

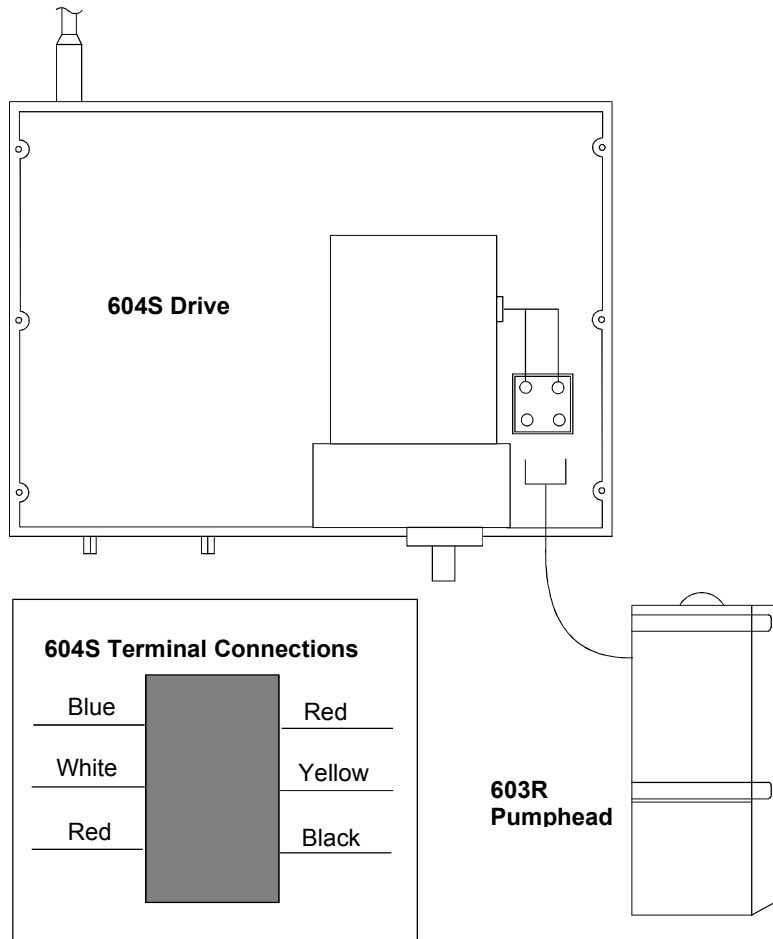
604S/R flow rates against suction lift and delivery pressure. Suction lift figures obtained with zero delivery pressure. Delivery pressure figures obtained with zero suction lift.



## Part 3: 603R Pumphead

### Installation

The 604S drives are fitted with pumpheads which incorporate an electrical "safe-guard" isolation switch which will disable the drive when the pumphead is opened or removed. To fit the pumphead first remove the cover from the cased drive. Pass the pumphead guard switch wires through the front panel of the drive and connect to the terminal block as shown below.



Fit the track over the drive spindle and locating boss. Tighten the track retaining screws. After checking that the drive spindle has been completely degreased, slide the rotor into position. The rotor is attached to the drive spindle via a split collet, and it is important that the rotor retaining screw is fully tightened a torque of 13Nm to prevent slipping when the pump is being used.

To remove the track, remove any tubing from the pumphead, and swing out the crank handle to expose the door retaining screw. Turn the screw counterclockwise one turn to release the collet, and withdraw the rotor from the shaft. Loosen the track locating screw and pull the track clear. Rotate the track to its new position and tighten the track locating screw.

**Ingress protection standard will be compromised if the gasket and seals are not properly replaced.**

Contact Watson-Marlow Technical Support and reference TB0006 if asking for advice concerning IP55 pump unit cover removal/replacement.





## Tube loading

Switch off the pump and isolate it from the mains supply before loading tubing. If the pump is not switched off before the pumphead guard is raised, a switch on the guard will cut off power to the motor. This switched guard is a safety back-up system and must not be used as the primary on/off switch for the pump.

The 604S/R is fitted with a spring loaded twin roller pumphead designed for tubing with a nominal wall thickness of 3.2mm and bore sizes of between 4.8mm and 15.9mm. The pumphead is fixed in one position. A length of 410mm of tubing is needed for the pumphead. Open the pumphead guard and fit one end of the tube into the bottom adjustable clamp. Tighten the lower serrated adjustment wheel. Then, whilst rotating the rotor clockwise (a spanner is provided for this purpose), feed the tube between the rollers and the track, ensuring that the tubing is not twisted or stretched. This is particularly important for the larger bore sizes of tubing. Fit the other end of the tube into the top adjustable clamp, ensuring that the tube is not slack in the pumphead. Clamp the tube very firmly by turning the upper serrated adjustment wheel. Remove the spanner and close the guard.

## Tubing range

Pump performance depends upon the accuracy and consistency of the tubing. All Watson-Marlow tubing is specifically formulated for peristaltic pumping, and is manufactured and quality controlled to our own specifications. We recommend Marprene tubing whenever it is chemically suitable. The Product Codes for the range of tubing suitable are listed below.

Tubing for 603R pumphead						
Bore mm	"	Tube #	Marprene	Bioprene	Silicone	Neoprene
4.8	3/16	25	902.0048.032	903.0048.032	910.0048.032	
6.4	1/4	24	902.0064.032	903.0064.032	910.0064.032	920.0064.032
9.6	3/8	122	902.0096.032	903.0096.032	910.0096.032	920.0096.032
12.	1/2	186	902.0127.032	903.0127.000	910.0127.032	920.0127.032
15.9	5/8	184	902.0159.032	903.0159.000	910.0159.032	920.0159.032
Bore mm	"	Tube #	Butyl	Tygon	Viton	
4.8	3/16	25	930.0048.032	950.0048.032	970.0048.032	
6.4	1/4	24	930.0064.032	950.0064.032	970.0064.032	
9.6	3/8	122	930.0096.032	950.0096.032	970.0096.032	
12.	1/2	186	930.0127.032	950.0127.032	970.0127.032	
15.9	5/8	184	930.0159.032		970.0159.032	

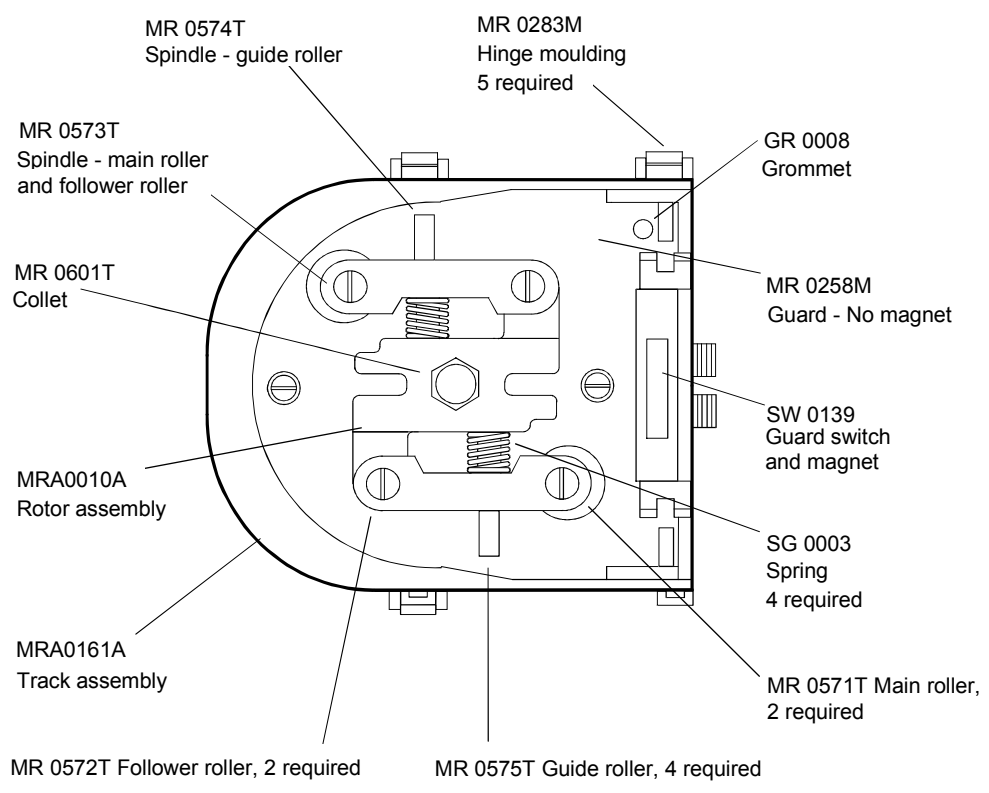
## Adjustment of the pumphead rollers

The two spring loaded rollers compensate for tolerance variations in the wall thickness of tubing, eliminating the manual adjustment normally required by peristaltic pumps, and, in general, there should be no need for the gap setting between the rollers and track to be adjusted.

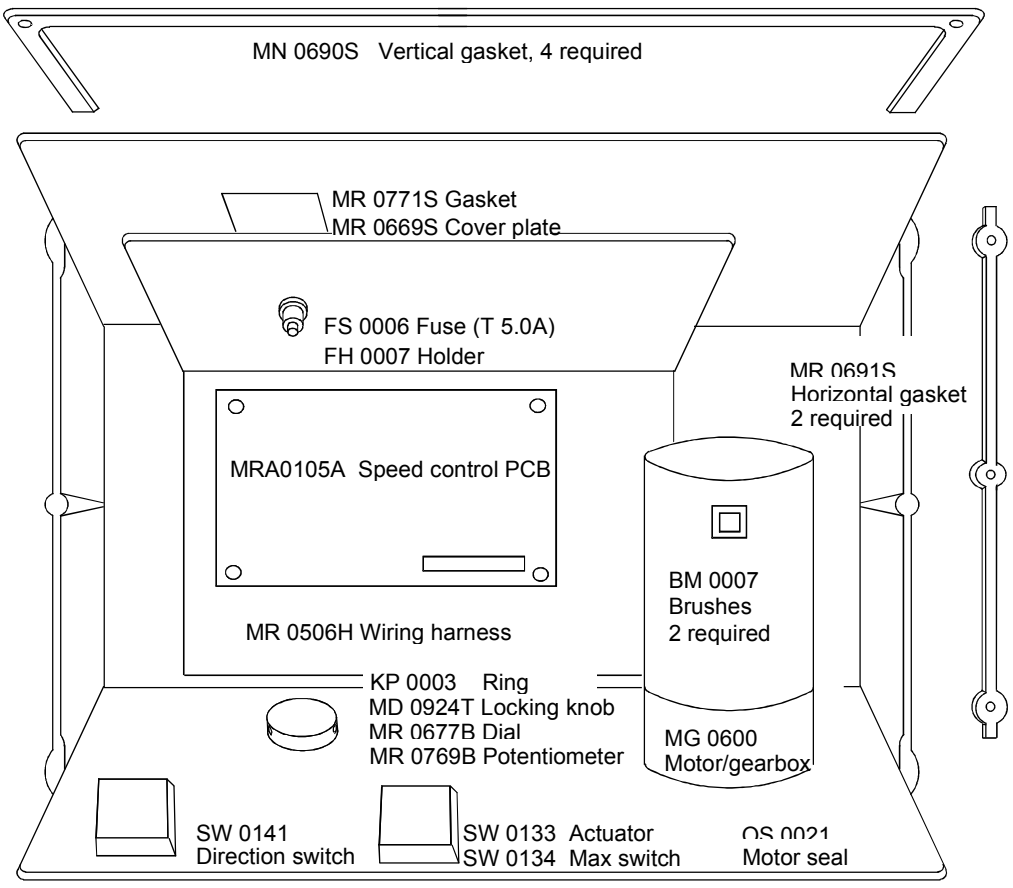
Should it ever appear that the roller arms are not equally adjusted, the original factory setting of 5.2mm can easily be restored. There is an adjustment screw on each of the two roller arms. Turn each screw anticlockwise until both rollers are just in contact with the track, and then turn each screw clockwise by five turns. Correct and equal adjustment is important. Over-occlusion will reduce tube life. Under-occlusion will reduce pumping efficiency.



# Pumphead spares



# Drive spares



## Part 4: Appendices

### Specification

Nominal maximum rotor speed	165rpm
Speed control range	2 percent to 100 percent
Operating voltages/frequencies	100-240V 50/60Hz single phase
Maximum power consumption	250VA
Fuse rating	Type T (anti-surge) 5A
Operating temperature range	5C to 40C
Storage temperature range	-40C to 70C
Standards	IEC335-1, EN60529 (IP55) Machinery Directive: 89/392/EEC and EN60204-1 Low Voltage Directive: 73/23/EEC and EN61010-1 EMC Directive: 89/336/EEC and EN50081-1/50082-1
Noise	<70dBA at 1m
Weight	21kg (46lbs)

### Care and maintenance

The 604S/R uses a permanent magnet direct current motor with a pulse-width-modulated speed controller which provides black commutation making brush wear very slight. All that is necessary is that the brushes be inspected every 3000 running hours and replaced when they are at or below 6mm in length.

All moving parts of the rotor should be checked from time to time for freedom of movement. Occasional lubrication of pivot points and rollers with light lubricating oil will help ensure trouble free operation. If the pump needs cleaning, use a cloth dampened with water and mild detergent. Do not use strong solvents.

If harmful liquids are spilled on to the pump, first switch off the pump and isolate it from the mains. To clean the pumphead remove any tubing. Then remove the rotor by unscrewing the retaining bolt one turn anticlockwise to release the collet and withdraw the rotor from the shaft. If the pumphead is to be removed and cleaned, remove the twelve screws securing the top cover and disconnect the two wires leading from the reed switch mounted on the pumphead from the terminal block to the right of the motor. Remove the track by unscrewing the two retaining screws and detaching the track from its spigot.

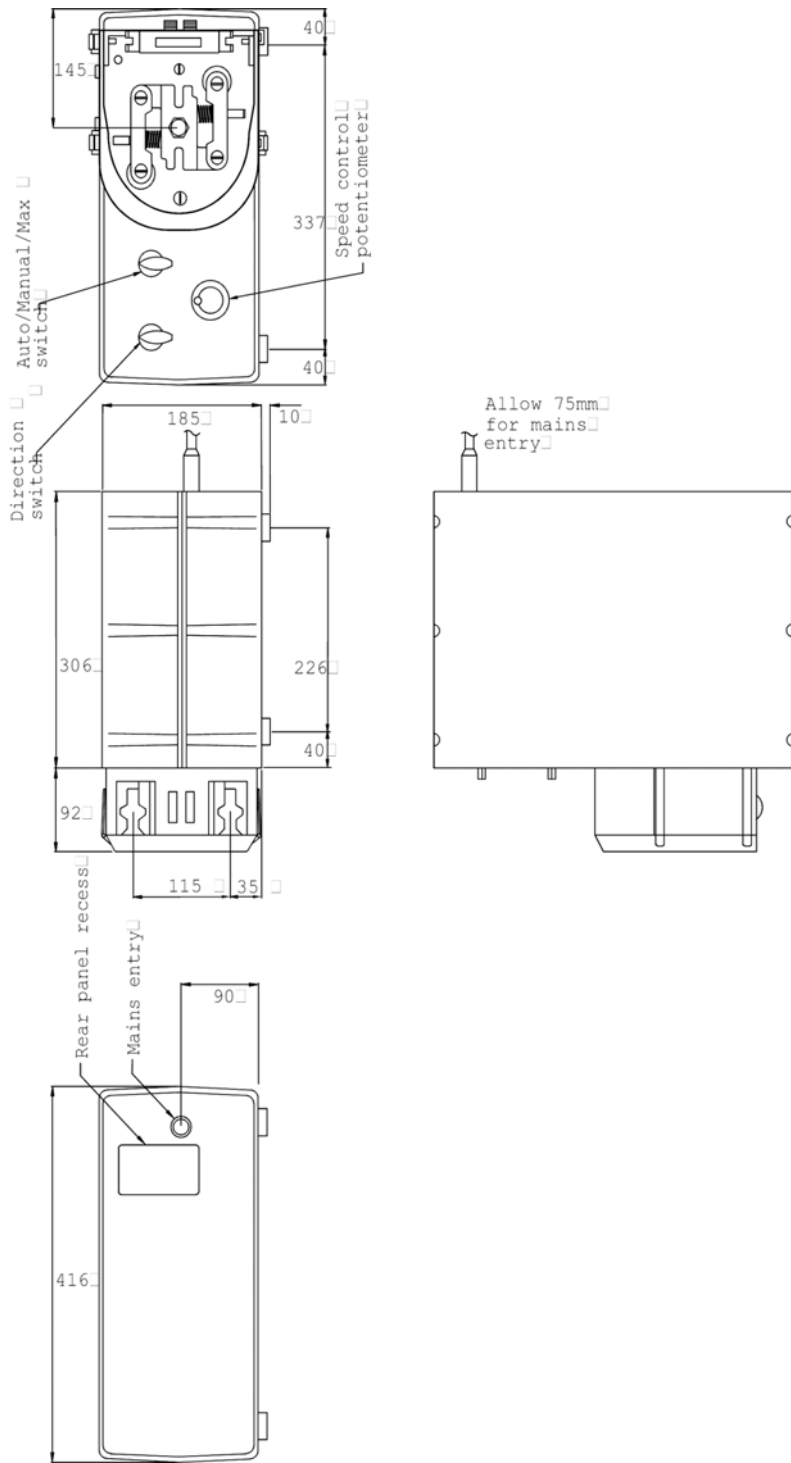
After cleaning the pumphead components, refit the pumphead ensuring the leads of the reed switch are connected to the terminal block and that the seal is effective. Check that the gaskets are in good condition, replace if they are damaged. Replace all of the case screws and tighten. Refit the rotor and ensure that the collet screw is tight.

Check for correct operation of the switched guard before putting the pump back into service.

**Ingress protection standard will be compromised if the gasket and seals is not properly replaced.**



# Outline drawing



# Decontamination certificate

## Watson-Marlow Limited Health and Safety Declaration

1.0 This procedure is a legal requirement in the UK and **must** be used when returning pumps and equipment for service at Watson-Marlow (or its distributor).

3.0 Either fax this form or send by first class post to Watson-Marlow (or its distributor) to **ensure** that we have the information **before** receipt of the equipment.

2.0 **Pumps returned for service must be cleaned. You are responsible for their decontamination.**

A further copy must be attached to the **outside** of the shipping case.

**Failure to complete the form or comply with the procedure will cause delays in servicing the equipment.**

4.0 Company .....  
 Address .....  
 Telephone .....  
 Post Code.....  
 Fax number.....

5.0 Please complete **all** the following sections

5.4 If substances are not hazardous nor toxic, please complete section 5.4.1. If substances are hazardous or toxic, please complete section 5.4.2.

5.1 Pump Type.....

5.2 Serial number.....

5.4.1 I hereby confirm that the equipment specified has not pumped nor come into contact with any toxic or hazardous substances.

5.3 Details of substances pumped

Signed.....  
 Name.....  
 Position.....  
 Date.....

5.3.1 Chemical names:

- (a) .....
- (b) .....
- (c) .....
- (d) .....

5.4.2 I hereby confirm that the only toxic or hazardous substance(s) that the equipment specified has pumped or come into contact with are those named, and that the information given is correct and the carrier has been informed if the consignment is of a hazardous nature.

5.3.2 Precautions to be taken in handling these substances:

- (a) .....
- (b) .....
- (c) .....
- (d) .....

Signed.....  
 Name.....  
 Position.....  
 Date.....

5.3.3 Action to be taken in the event of human contact:

- (a) .....
- (b) .....
- (c) .....
- (d) .....

5.5 Carrier to be used

.....  
 Delivery date

5.3.4 Cleaning fluid to be used if residue of chemicals is found during servicing:

- (a) .....
- (b) .....
- (c) .....
- (d) .....

5.6 Fault description or any other information

.....  
 .....  
 .....

**IMPORTANT**

Before returning any product for service, this form **must** be completed and sent to Watson-Marlow, or its subsidiary, or its official distributor undertaking the service