MANOMETRIC PUMP

ELECTRICALLY POWERED MODEL

OPERATING AND SERVICE MANUAL

FOR

REF		
	P1PIP44115SS	P1PIP44220SS
	P1PIP46115SS	P1PIP46220SS
	P1PIP48115SS	P1PIP48220SS
	P1PIP412115SS	P1PIP412220SS
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Manual P4-F-100, Revised January 22, 2021

READ ENTIRE MANUAL
BEFORE OPERATING MANOMETRIC PUMP

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1 Introduction

This Manometric Pump is part of the motility system used for intraluminal manometric studies of the gastrointestinal tract, such as pressure measurement of muscular contractions or resting tone inside the esophagus, stomach, bile duct, small intestine, colon, rectum, or anus. Other components of this system include a set of pressure transducers, a manometric catheter, and a computerized data processing system or a chart recorder.

The Electrically Powered Manometric Pump uses regulated compressed air to deliver distilled water through flow resistors (0.6ml/min at 15psi by default) called capillary tubing to each lumen of the manometric catheter. The pressurized water flows from each capillary tube to a pressure transducer and then passes through the respective lumen of the multi-lumen catheter to that lumen's single opening inside the organ under diagnosis of the patient. The pressure changes caused due to muscular movements of the respective part are transmitted through the fluid path back to the externally mounted transducers; i.e. the water serves as a pressure - transmission medium. Each lumen of the manometric catheter is connected to its own pressure transducer and all the pressure transducers are connected to a computerized recording system or a strip chart recorder. The pressure profile of the multi-channel tracing provides useful diagnostic data for evaluation of the normal or abnormal motor function of the patients' gastrointestinal tract.

This Manometric Pump is designed to operate at a constant pressure rather than at a constant flow rate. It maintains a pre-set hydraulic pressure (5-15 psi) at the water chamber regardless of the flow. At 15 psi (776 mmHg) the pump provides a high static hydraulic pressure background to ensure a high pressure rise rate as well as recording accuracy and repeatability. It can record fast pressure changes such as in the upper esophageal sphincter. The small bore of the capillary tube also ensures a very low infusion rate. During a motility study, the actual flow rate in the manometric catheter varies due to the fluctuation caused by muscle contractions.

The pressure rise rate of the pump, measured as pressure change per unit of time (i.e. mmHg/sec or cmH_2O/sec), is directly proportional to the water chamber pressure; which implies that higher water chamber pressure will result in higher pressure rise rate and higher flow rate. In order to achieve measurement accuracy, the pressure rise rate of the recording system must exceed the actual physiological rise rate of the organ. The upper esophageal sphincter has the highest muscular contraction rate in ~~of~~ the gastrointestinal tract. A study of this organ requires the highest pressure rise rate of the recording system, 400 mm Hg/sec. The recommended water chamber pressure of 15 psi (pounds per square inch) will achieve a pressure rise rate of 400 mm Hg/sec. The main purpose of reducing the water chamber pressure from 15 to 5 psi is to reduce the infusion rate from 0.6 to 0.3 mL/min. The lower water chamber pressure and lower pressure rise rate still permit reliable measurement accuracy for the organs with lower physiological contraction rate. The pump allows the operator to change the water chamber pressure for different physiological applications in order to optimize the pressure rise rate and flow rate. An infusion rate table (Table 1, Section 4.2) is provided to enable an estimate of the total volume of water infused into the patient in a given period of time.

a) Intended Use

The Manometric Pump is part of the motility system used for intraluminal manometric studies of the gastrointestinal tract, such as pressure measurement of muscular contractions or resting tone inside the esophagus, stomach, bile duct, small intestine, colon, rectum, or anus. Other components of this system include a set of pressure transducers, a manometric catheter, and a computerized data processing system or a chart recorder.

The pump should be used in a hospital setting under the supervision of a physician who has received professional training in gastrointestinal manometry.

b) Indication for Use

Use of the Manometric Pump together with a manometric catheter is indicated when measurements of gastro- intestinal tract pressures are judged to be useful for determining management of patients with proven or suspected gastro-intestinal motor disorders

The pressure profile of the multi-channel tracing provides useful diagnostic data for evaluation of the normal or abnormal motor function of the gastrointestinal tract. Similar applications include pressure measurements for oropharygeal, esophageal, stomach, intestinal, colonic, anorectal and biliary motility studies.

The data obtained will assist in the diagnosis and treatment of dysfunction in the GI tract.

c) Contraindication for use

The presence of any stenosis, structural deformity or disease within the gastrointestinal tract, that results in an unacceptably increased risk of distention, perforation, or any other adverse consequence arising from use of this assembly.

d) Warnings

The Manometric Pump must only be used in a hospital setting under the medical supervision of a physician who has received professional training in gastrointestinal manometry.

No electrical equipment should be located beneath the Manometric Pump. Some water from the motility catheter is likely to drip down during the procedure. A danger of electric shock could result.

Use only sterilized irrigation water in the water chamber. Never use tap water as it contains minerals which can cause blockages in tubing and/or can support bacterial growth.

Do not position the unit such that the equipment will be difficult to unplug or that ventilation openings are blocked.

To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth.

The Manometric Pump must not be alter or modify in any way. Mui Scientific is not liable for personal injury and damage to property if the original Mui Scientific parts are not being used, if the instruction for use in these operating instructions are not being observed, or if assembly, new settings, alterations, extensions and repairs have been carried out by qualified personnel.

The Manometric Pump has a prescribed lifetime of 10 years.

2 Description of the Manometric Pump

2.1 PHYSICAL DESCRIPTION

The Electrically Powered Manometric Pump consists of an air compressor and a pressure regulator inside a stainless steel case. The regulated air supply pressurizes the water chamber, which delivers pressurized water to a stopcock manifold, which further connects to a set of capillary tubes. A set of transducer holders is located on an adjustable support bar attached at the pump. The transducers and manometric catheters (which are not supplied with pump) are mounted on the transducer holders and connected to the capillary tubes.

Pressurized air is supplied by the air compressor, and it passes through the drying cylinder inside the electrical compartment, which removes all the moisture from the compressed air. The drying cylinder serves as a high pressure air reservoir (17-40 psi).This pressurized compressed air is supplied to the water chamber via manually adjustable regulator to obtain 5-15 psi of pressure inside the water chamber.

The compressor gauge (left side) shows the high pressure in the drying cylinder. The water chamber gauge (right side) shows the pressure in the water chamber. The POWER pilot light indicates the main power status, ON/OFF, and the COMPRESSOR pilot light indicates the compressor status, ON/OFF.

The water chamber is removable as it is simply resting inside the water chamber holder on the pump. It is equipped with Metal quick connect at the lid to receive compressed air from the drying cylinder, and with a connection outlet at the bottom to supply filtered water. The lid of the chamber is removable to facilitate filling and cleaning. A toggle valve is provided for quick release of the chamber pressure. The chamber float acts as a barrier to minimize air absorption into the water.

A master on-off valve controls the water flow from the water chamber to the stopcock manifold. The 4-way stopcocks on the manifolds provide individual on-off control of the water flow to each capillary tube. The outlet end of each capillary tube is equipped with a standard male luer connector for easy connection to the transducer. If required, a female-female luer adaptor is provided for conversion of the luer connections.

The transducer holders (various types are available) keep the transducers in place and level. The adjustable support permits proper positioning of the height of the transducers with respect to the patient.

2.2 GENERAL REQUIREMENTS

CAUTION:
The Electrically Powered Manometric Pump must only be used in a hospital setting under the medical supervision of a physician who has received professional training in gastrointestinal manometry.

The Manometric Pump should be mounted on a cart or shelf at approximately the same height as the patient's bed. The height of the transducers should be level with the height of the patient's stomach. This will reduce the hydrostatic pressure artifact on the transducer and on the recording.

The Manometric Pump is normally placed near the bedside close to the patient's head.

CAUTION:
No electrical equipment should be located beneath the Manometric Pump. Some water from the manometric catheter is likely to drip down during the procedure. A danger of electric shock could result.

CAUTION:
Only use distilled water in the water chamber. Never use tap water as it contains minerals which can cause blockages in tubing and/or can support bacterial growth.

WARNING:
Do not position the unit such that the equipment will be difficult to unplug or that ventilation openings are blocked.

WARNING:
To avoid risk of electric shock, this equipment must only be connected to a main supply with protective earth.

WARNING: The Manometric Pump must not be alter or modify in any way. Mui Scientific is not liable for personal injury and damage to property if the original Mui Scientific parts are not being used, if the instruction for use in these operating instructions are not being observed, or if assembly, new settings, alterations, extensions and repairs have been carried out by qualified personnel.

There are no contraindications for this device

There are no applied parts in this device as defined in IEC 60601-1:2005+C1+C2.

The equipment can be isolated from mains by turning power off or unplugging the unit.

The Mui Scientific Pump does not contain any hazardous goods; the material of the housing can be recycled completely. The component parts of the Mui Scientific Pump must be disposed of correctly and the materials are to be separated carefully, according to local regulations.

Electrical requirements:

(a) *115 Volt Model*: A grounded, hospital grade, 115 Volt, 60 Hz, 15A Electrical outlet is required. The pump is rated at 2A. Hospital grade power cord with IEC plug is included.

(b) *220 Volt Model*: A grounded, hospital grade, 220 Volt, 50 Hz Electrical outlet is required. The pump is rated at 2A.

Over-all dimensions:

Height (including water chamber) ----------	50 cm (20 inches)
Width (4, 6 and 8 channel models) ----------	56 cm (22 inches)
Width (12 channel model) ----------	69 cm (27 inches)
Depth (transducer holders attached) ----------	33 cm (13 inches)
Length of AC power cord (115v only) ----------	240 cm (94 inches)

Weight:

Net weight (4, 6 and 8 channel models) ----------	14 kg (30 pounds)
Net weight (12 channel models) ----------	15 kg (32 pounds)

Ambient Operation Conditions:

 (Ambient Temperature Range) ----------	+10°C To +40°C
 (Relative Humidity Range) ----------	30% To 75%
 (Atmospheric Pressure Range) ----------	86 kPa To 106 kPa

2.3 DIAGRAM OF FEATURES

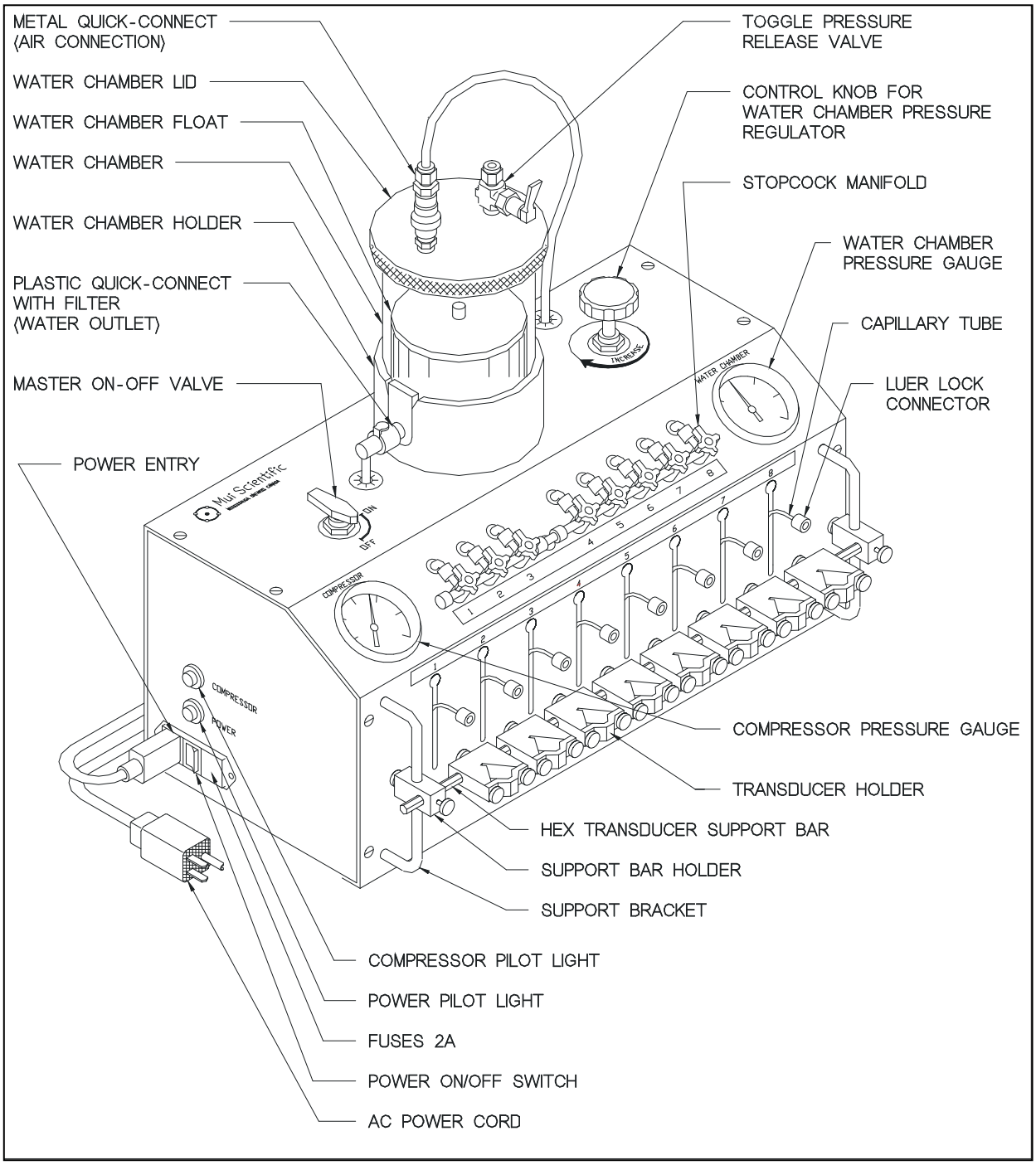


Figure 1: Diagram of Electric Pump (8-channel model shown)

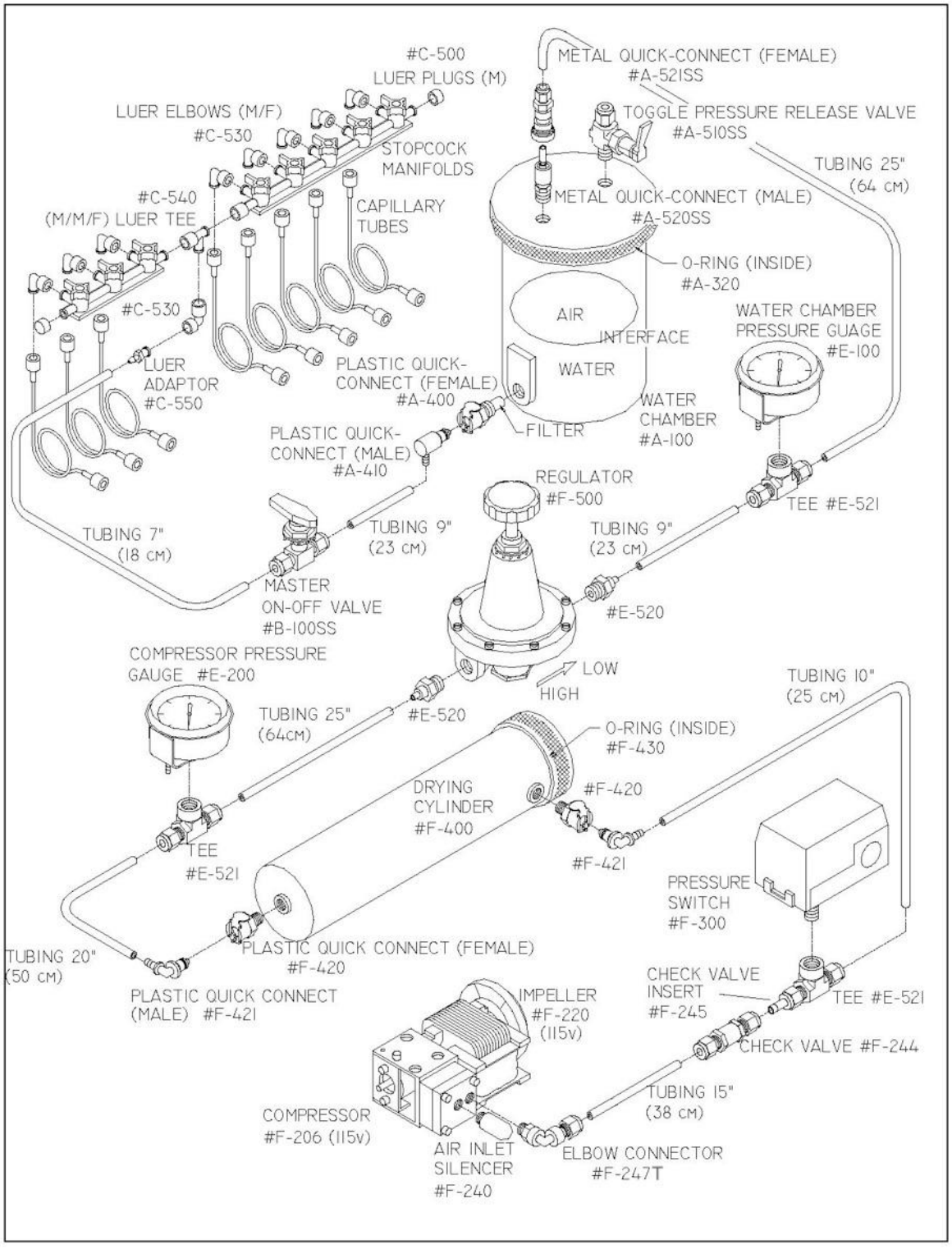


Figure 2: Air-Water System of Electric Pump

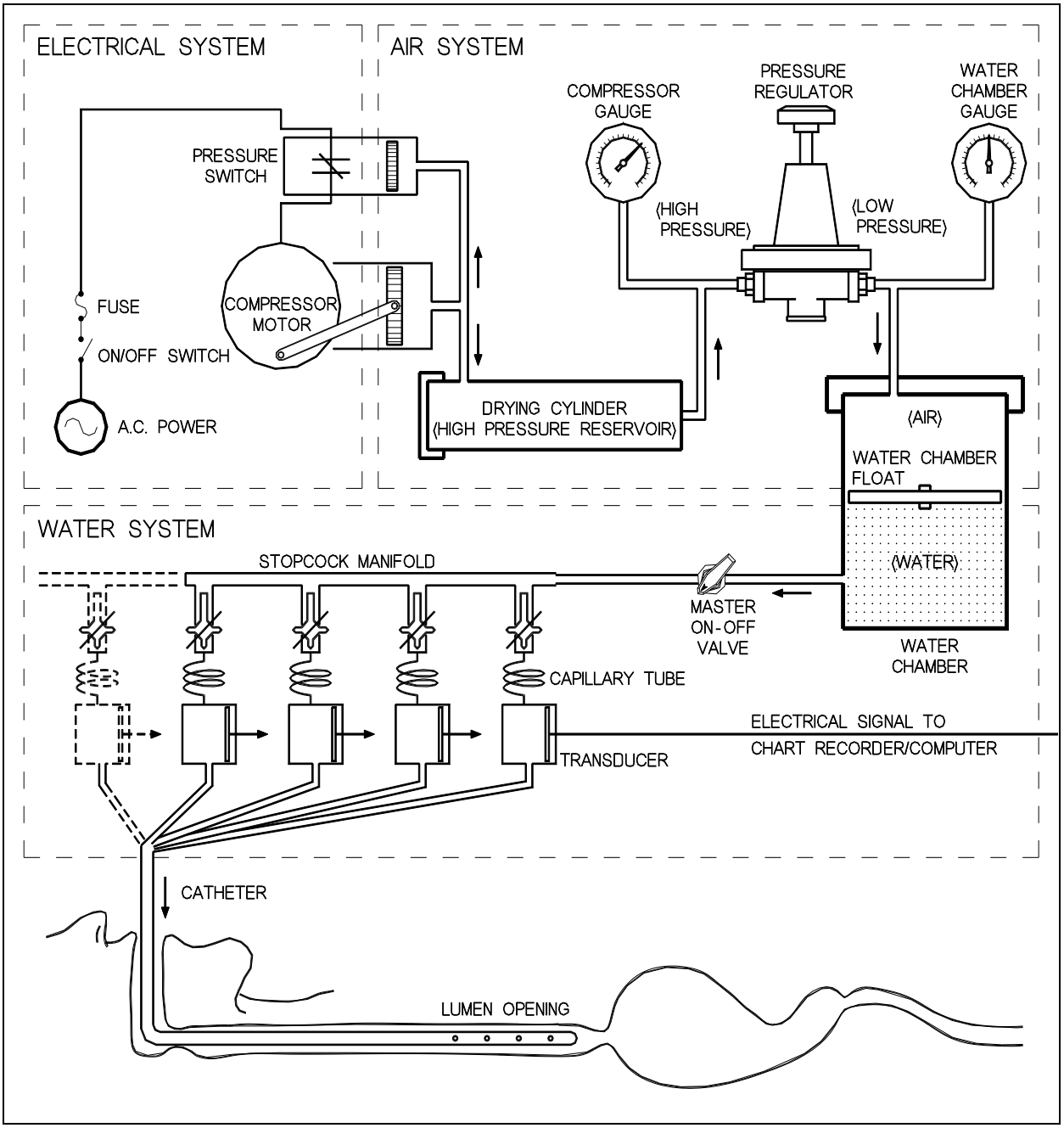


Figure 3: Block Diagram of Electric Pump

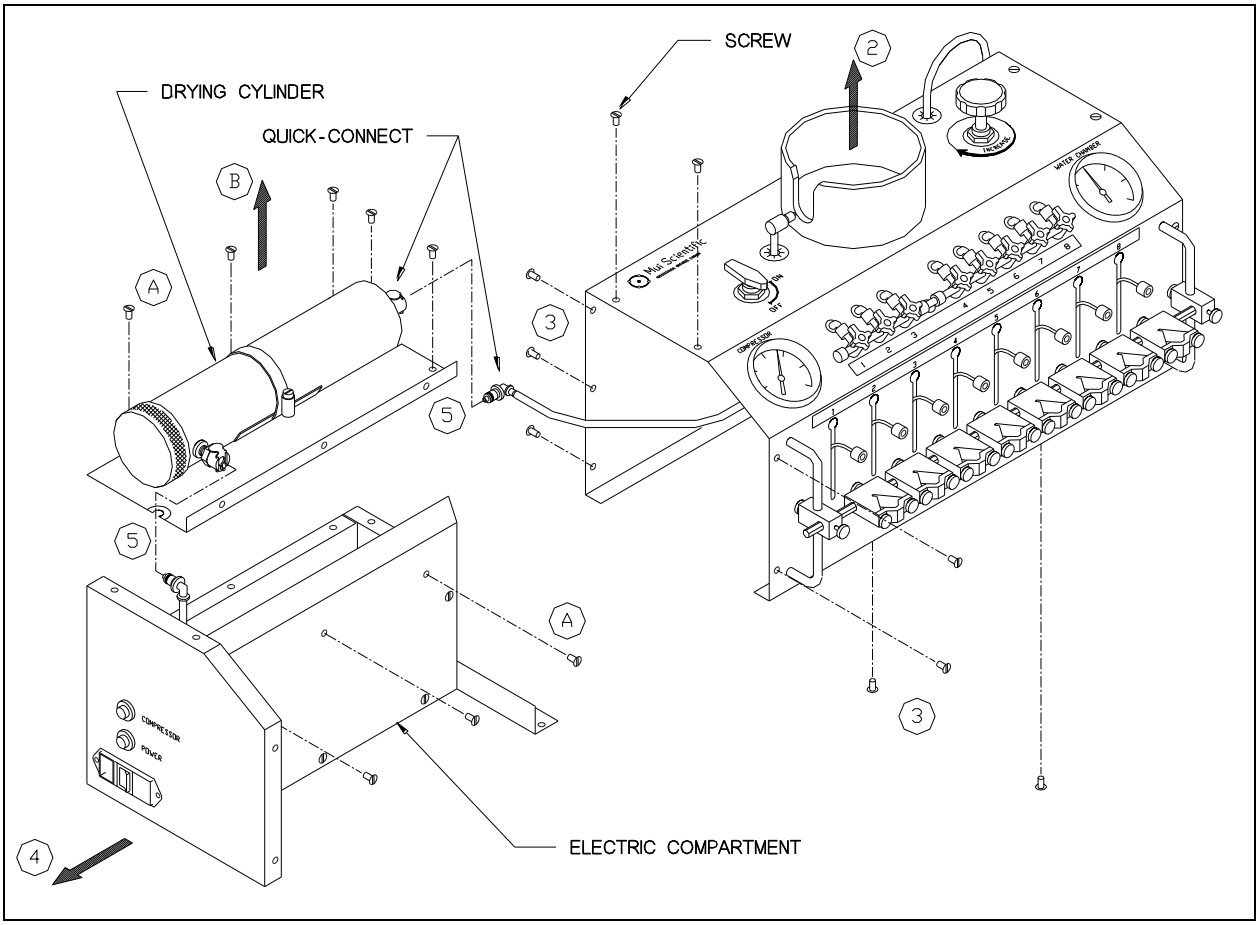


Figure 4: Electrical Compartment Removal

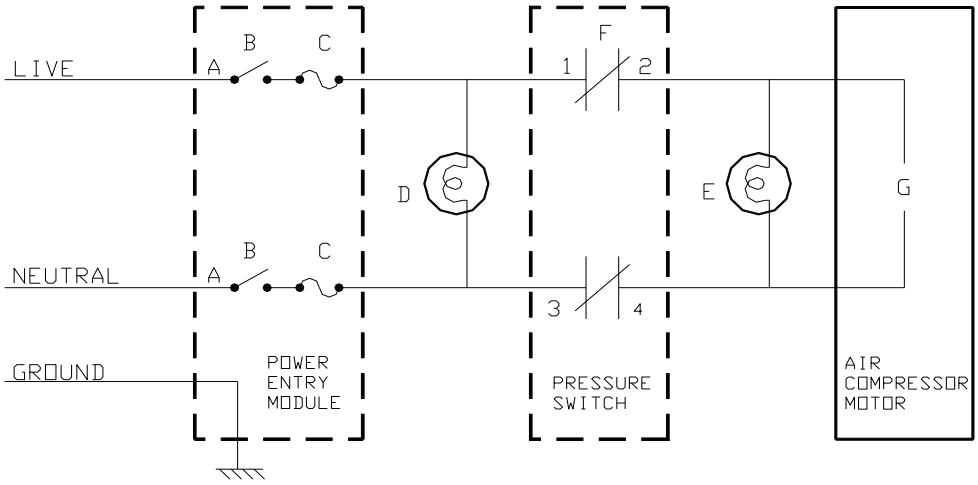
WARNING: DISCONNECT POWER CORD AND RELEASE ALL AIR PRESSURE BEFORE DISASSEMBLING THE MANOMETRIC PUMP.

ELECTRIC COMPARTMENT REMOVAL:

1. DISCONNECT POWER CORD AND RELEASE ALL AIR PRESSURE.
2. REMOVE THE WATER CHAMBER FROM THE MANOMETRIC PUMP.
3. REMOVE 7 SCREWS AT THE LEFT END OF THE PUMP HOUSING AND 2 SCREWS AT THE BOTTOM OF THE PUMP CASING AS SHOWN.
4. SLIDE THE ELECTRICAL COMPARTMENT OUT IN THE DIRECTION OF THE ARROW.
5. DISCONNECT THE AIR HOSES AT THE DRYING CYLINDER QUICK DISCONNECTS.

OPENING ELECTRIC COMPARTMENT:

A. REMOVE 3 SCREWS FROM THE FRONT PANEL AND 5 SCREWS FROM THE TOP PANEL OF THE ELECTRIC COMPARTMENT AS SHOWN.
B. LIFT THE TOP PANEL (WITH THE DRYING CYLINDER ATTACHED) TO EXPOSE THE INTERIOR OF THE ELECTRIC COMPARTMENT.



ITEM	DESCRIPTION
A	POWER ENTRY
B	DPST ON/OFF SWITCH
C	DOUBLE FUSE 5X20 mm 2A
D	POWER PILOT LIGHT
E	COMPRESSOR PILOT LIGHT
F	PRESSURE CONTROL SWITCH
G	AIR COMPRESSOR MOTOR
LIVE	BLACK (BROWN): 115V MODEL (220V MODEL)
NEUTRAL	WHITE (BLUE)
GROUND	GREEN/YELLOW

Figure 5: Electrical Schematic

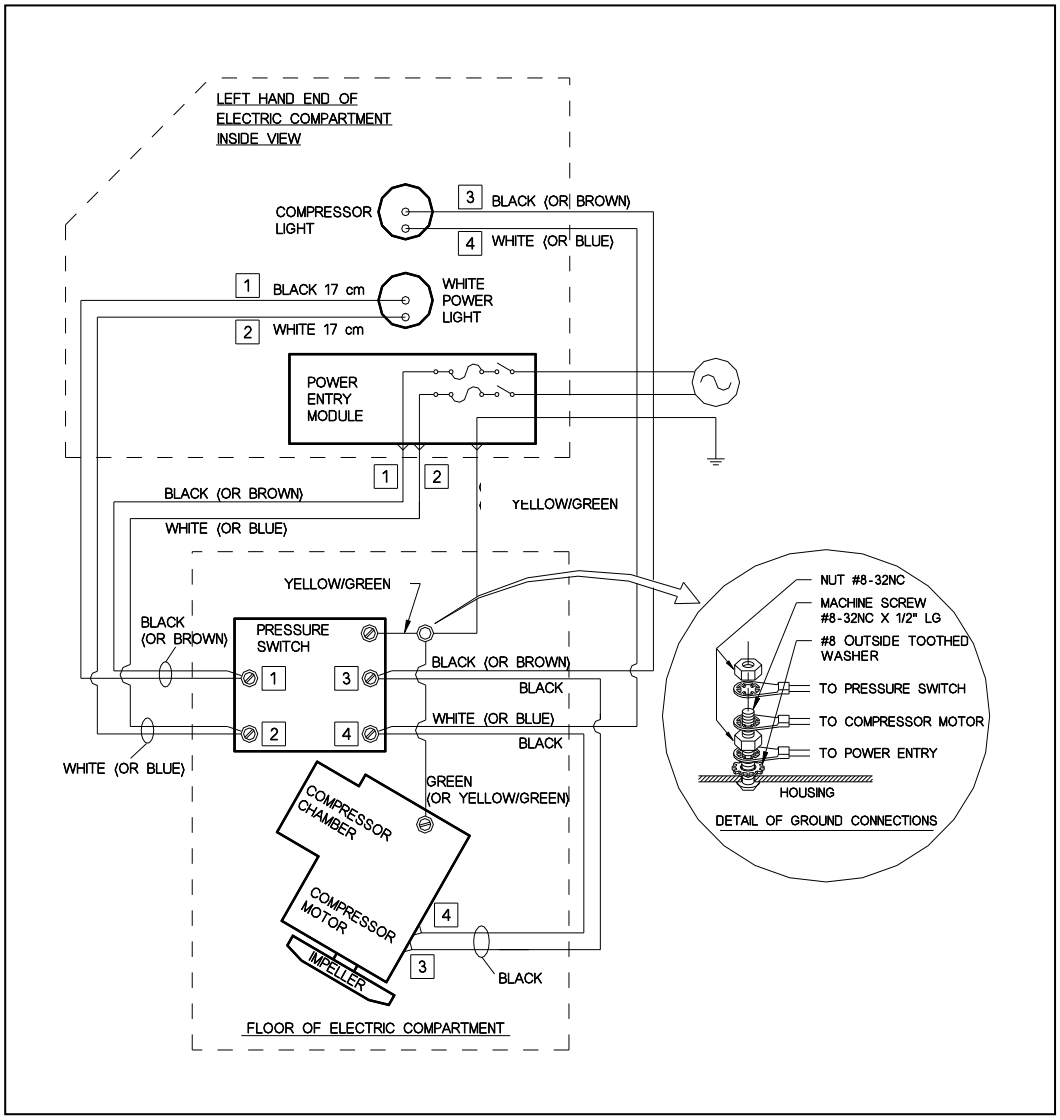


Figure 6: Electrical Compartment

2.4 APPLICABLE STANDARDS AND WARNING STATEMENTS

Standard/Document Name	Description
93/42/EEC	Council Directive concerning medical devices as amended by Directive 2007/47/EC
EN 1041:2008	Information supplied by the manufacturer of medical devices
EN ISO 13485:2016	Medical Devices – Quality Management Systems – Requirements for Regulatory Purposes
ISO 14971:2019*	Medical Devices – Application of Risk Management to Medical Devices
EN ISO 15223-1:2016	Medical Devices – Symbols to be used with medical device labels, labelling and information to be supplied – Part 1:General requirements
EN 1041:2008+A1:2013	Information supplied by the manufacturer of medical devices
EN 60601-1:2015/A1:2013	Medical electrical equipment — General requirements for basic safety and essential performance
EN 60601-1-2:2014	Electromagnetic disturbances requirements and tests (EMC)
IEC 60601-1-6: 2013	General requirements for basic safety and essential performance: Usability
ISO 17664:2017	Processing of health care products – Information to be provided by the medical device manufacturer for the processing of medical devices

Equipment Classification

Class I with respect to protection from electric shock.
Type BF with respect to degree of protection from electric shock.
Ordinary degree of protection against ingress of liquids.
Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with nitrous oxide.

Mode of Operation: Maximum 5 minutes ON per 2 hours.

Warning Statements and Warning Symbols

TYPE BF APPLIED PART

DANGER: EQUIPMENT NOT SUITABLE FOR USE IN THE PRESENCE OF A FLAMMABLE ANAESTHETIC MIXTURE

DO NOT PERFORM SERVICE OR MAINTENANCE WHILE EQUIPMENT IS IN USE

GROUND RELIABILITY CAN ONLY BE ACHIEVED WHEN THE EQUIPMENT IS CONNECTED TO A RECEPTACLE MARKED “HOSPITAL ONLY” OR “HOSPITAL GRADE”

REFER TO INSTRUCTION MANUAL/BOOKLET

ATTENTION; CONSULT ACOMPANYING OPERATING INSTRUCTIONS

CAUTION; TO REDUCE THE RISK OF ELECTRIC SHOCK DO NOT REMOVE COVERS. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL

REPLACE FUSE AS MARKED (250V, T2A)

Note: All models (115v, 220v) require 2 fuses:
5 x 20 mm, 250v, T2A, 35A breaking capacity.

SEE INSTRUCTION MANUAL

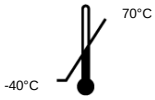
DO NOT USE IF PACKAGE IS DAMAGED

NON STERILE

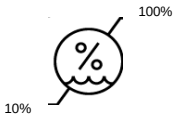
NON-DEHP

Environmental Conditions for Storage or Transport

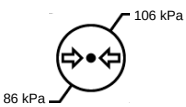
When packed for transport from factory, equipment will withstand



AMBIENT TEMPERATURE RANGE -40°C TO +70°C



RELATIVE HUMIDITY RANGE 10% TO 100%



ATMOSPHERIC PRESSURE RANGE 86 KPA TO 106 KPA

3 Initial Installation

3.1 INITIAL ASSEMBLY

Remove any remaining packing material. Place the pump main assembly on a table and make the following adjustments:

- Adjust the height of the hexagonal transducer support bar:
  Loosen the rear knurled screws on the support bar holder that mounts the hexagonal transducer support bar. Adjust the height of the support bar so that the transducers level with the approximate height of the patient's stomach during a study. Retighten the knurled screws.

- Adjust the orientation of the hexagonal bar:
  Loosen the front knurled screws on the holder that mounts the hexagonal transducer support bar on the front of the Manometric Pump. Rotate the bar until the transducer holders are in a horizontal position. Retighten the screws.

- Adjust the spacing of the transducer holders:
  Loosen the rear knurled screws on the transducer holders and space the transducer holders evenly along the hexagonal bar. Retighten the screws securely.

- If necessary, the transducer holders can be removed by sliding them off the end of the hexagonal bar.

- Check that the pointer in both gauges is at zero position.

CAUTION:
After shipment, pointer may not rest at zero due to internal case pressure buildup caused by temperature variations. Accuracy may be significantly reduced. To restore gauge to operating condition, move lever of fill plug to the "open" position.

3.2 PLACEMENT OF WATER CHAMBER

- Place the water chamber into the water chamber holder on top of the Manometric Pump, lining up the water quick-connect pointing to the left on the bottom of the water chamber with the slot in the holder (Figure 13, Section 4.1).

  The plastic holder enables a person to easily remove or tighten the lid of the water chamber.

- Unscrew the lid of the water chamber. Discard any packing material.

- Check that the O-ring is lightly greased (with petroleum jelly).

- Replace lid back onto water chamber.

3.3 CONNECTING ELECTRICAL SYSTEM

- Ensure that the main power switch (at the bottom of the left side panel of the Manometric Pump) is in the OFF position.

- Plug the grounded AC power cord (hospital grade) into the IEC power entry that is next to the main power switch. Connect the power cord to a grounded electrical outlet.

3.4 INSTALLATION OF TRANSDUCERS

A. Universal Transducer Holder Installation

If the pump is supplied with the Universal Transducer Holder Assembly, then use the following steps to install transducers (not supplied) on the Manometric Pump:

- Position the universal transducer holders horizontally.
- Loosen the 2 front knurled screws on the universal transducer holder.
- Slide the transducer between the front bracket and the V-shaped cutout in the holder as shown in Figure 7(a), 7(c).
- To hold a smaller diameter transducer, remove the 2 front knurled screws completely and reverse the front bracket of the transducer holder as shown in Figure 7(b).
- Clamp the transducer in the holder assembly by retightening the two knurled screws against the front bracket.

  CAUTION:
  Do not over-tighten the knurled screws against the front bracket.
  Damage to the transducer may result.

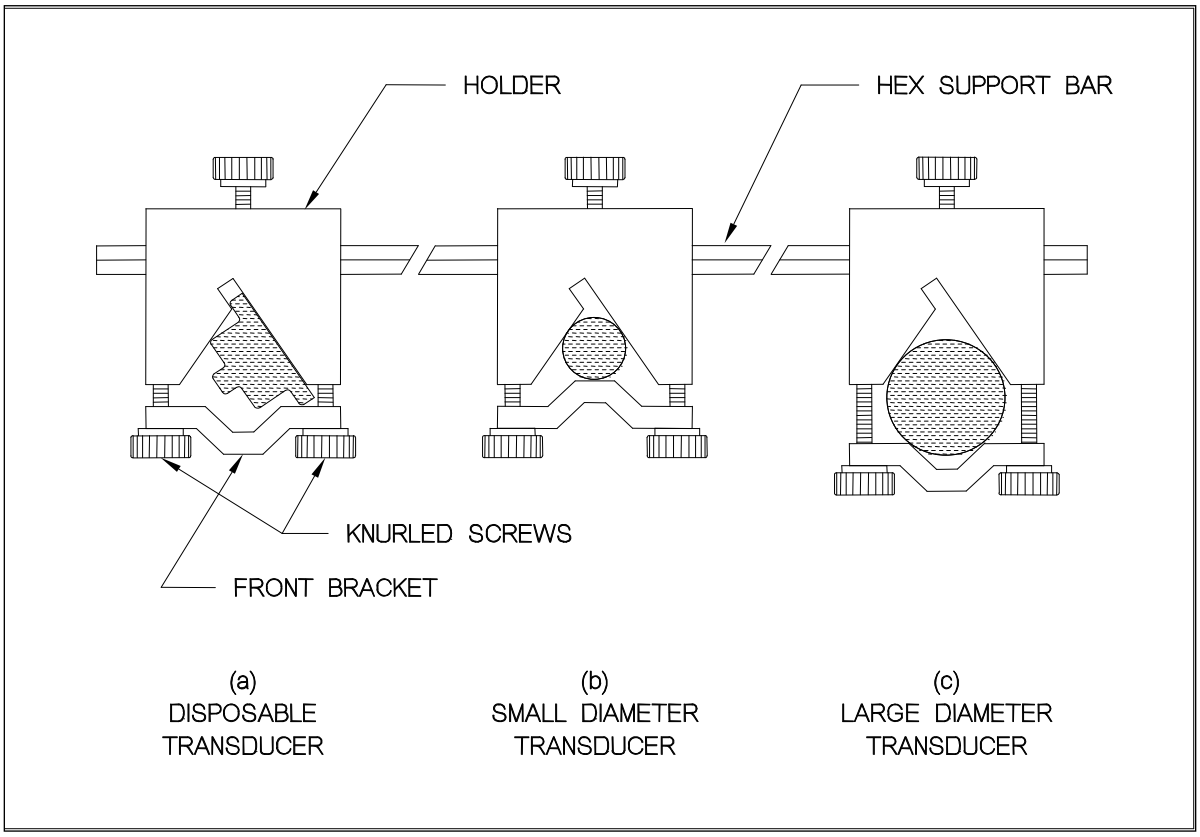


Figure 7: Universal Transducer Holder Assembly

B. Medex/pvb Transducer Holder Installation

If your pump is supplied with the Medex or PVB Transducer Holder Assembly, as shown in Figure 8, simply slide the transducer into the slot on the transducer holder plate from the top. The transducer holder plate can be repositioned by loosening and tightening the knurled thumbscrews at the back of the assembly.

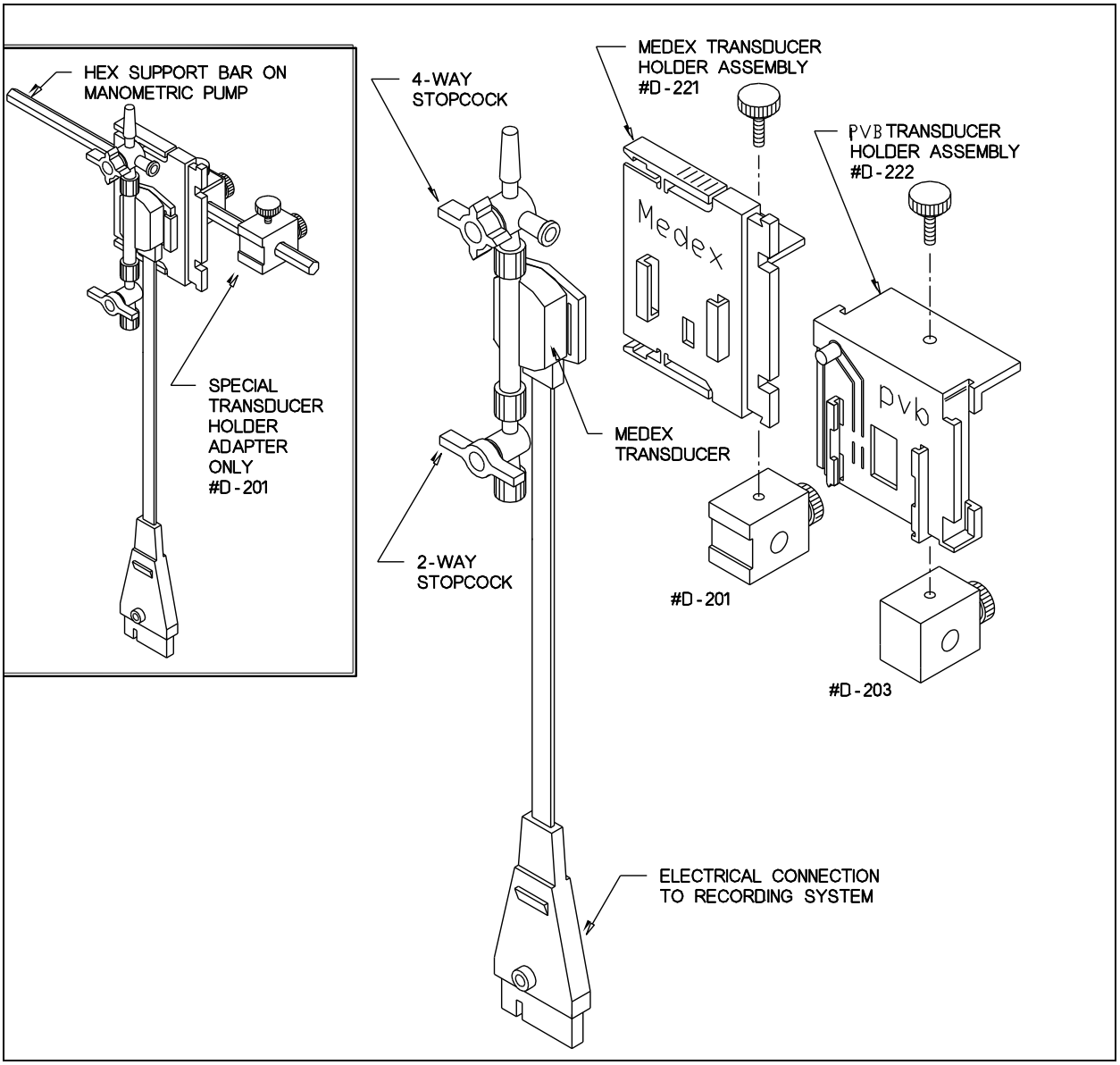


Figure 8: Medex/pvb Transducer Holder Assembly

3.5 INSTALLATION OF STOPCOCKS

Install plastic stopcocks (not supplied) to the input and output ports of the transducers and attach capillary tubes as shown in Figure 9, to aid in the purging of air bubbles.

The most common cause of loss of recording accuracy in a motility system is air bubbles trapped in the transducer or in the manometric catheter. Figure 9 shows the way to connect the transducers to the Manometric Pump and the catheter when using a large syringe. This setup requires additional 2-way and 4-way stopcocks for each transducer. Ample water under pressure can be flushed from the bottom to the transducer in order to push any air bubbles up and out the top of the transducer. This method ensures that the transducer and catheter are free of air bubbles in the shortest time possible.

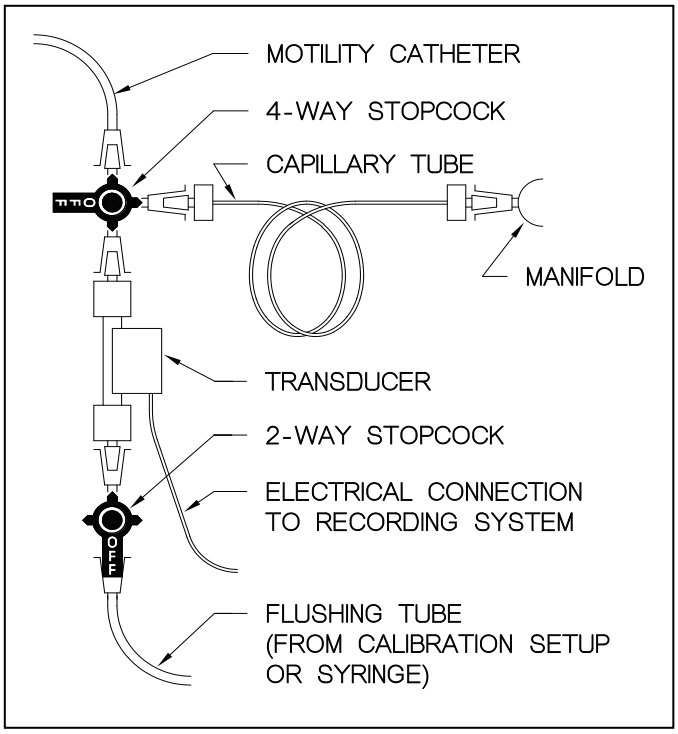


Figure 9: Installation of Stopcocks on Transducer

Another method of connection is shown in Figure 10. The small flow from the capillary tube will require more time to flush out all the small air bubbles, and may not be very efficient.

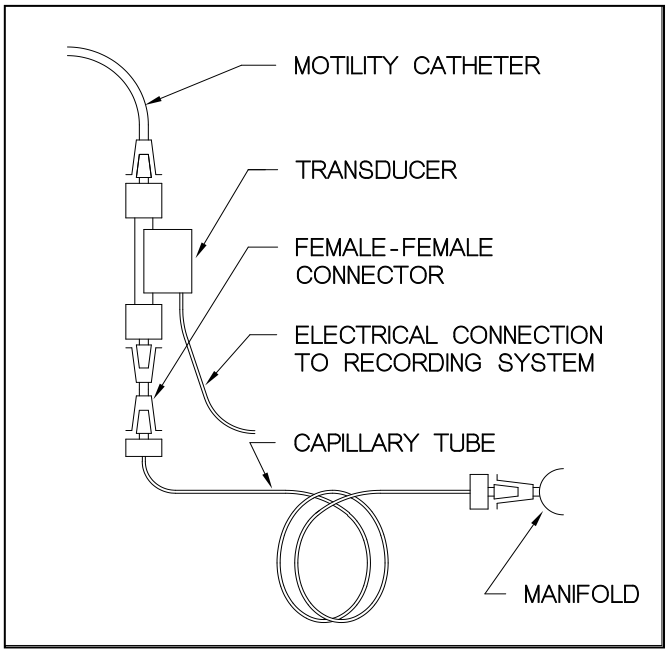


Figure 10: Alternate Connection to Transducer

3.6 INSTALLATION OF CALIBRATION SYSTEM

Installation of Hydrostatic Calibration System (0-50/68 cmH_2O)
0-50 cm H_2O System, Part #P4-H-610
0-68 cm H_2O System, Part #P4-H-620

- On the square calibration rod locate the two white plastic tube-holders. Slide a clear plastic 11-inch tube into the hole of each tube-holder as shown in Figure 11, below. Tighten the knurled screw to secure the clear plastic tube.

- Slide the square calibration rod into the two calibration rod holders on the right-hand round support bracket. The clear plastic tubes should be oriented perpendicular to the pump as shown in Figure 11. The lower clear plastic tube should be at the same level as the transducers for 0 cmH_2O or low calibration. The upper plastic tube is for 50 or 68 cmH_2O for high calibration (68 cmH_2O = 50 mm Hg).

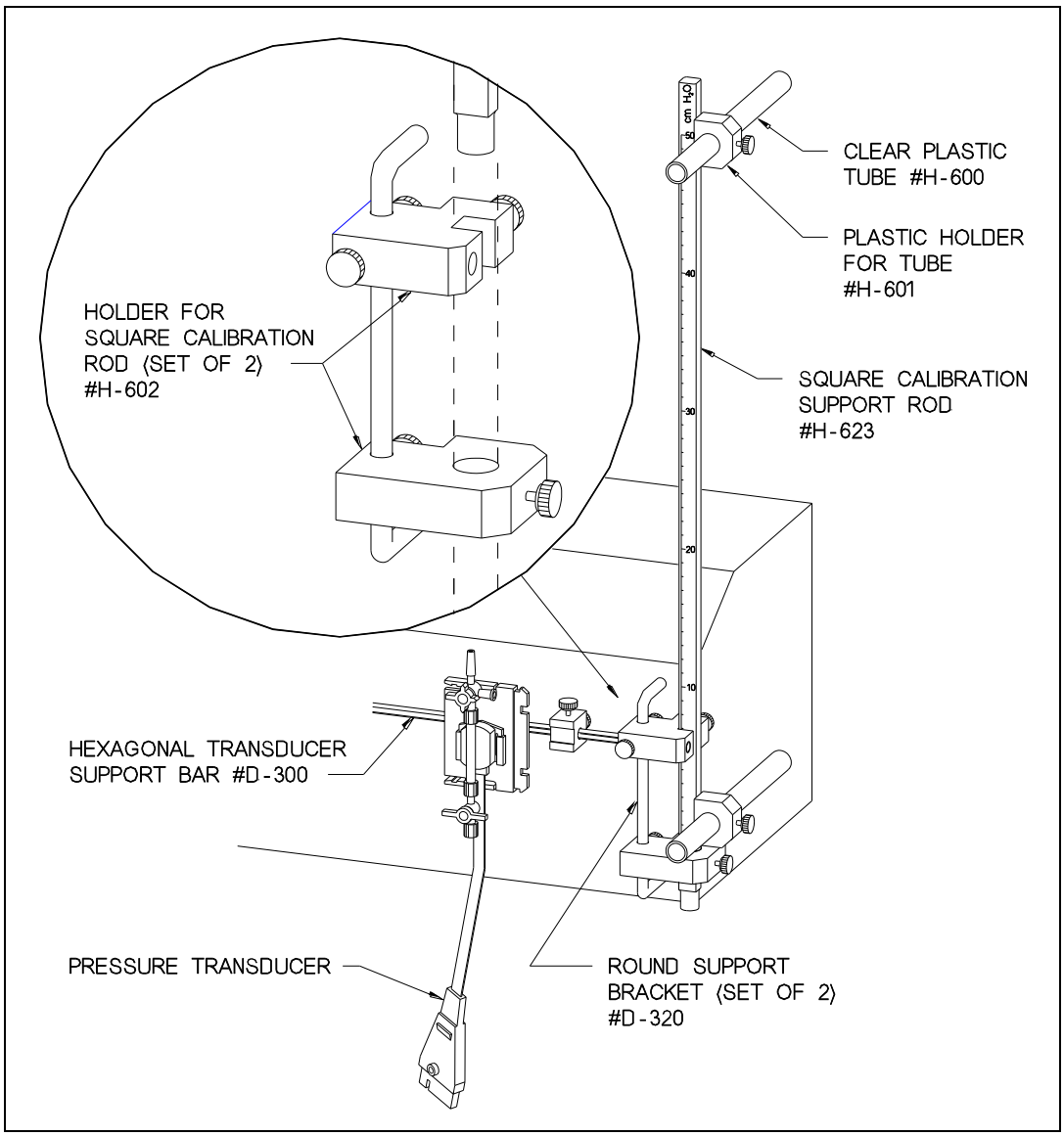


Figure 11: Hydrostatic Calibration System (0–50/68 cm H_2O)

4 Preparation Procedures

Section 4 describes all of the procedures required to prepare the pump for motility studies and routine maintenance.

4.1 FILLING THE WATER CHAMBER

- Turn the master on-off valve to the OFF position.
- Place the water chamber into the water chamber holder on top of the pump, lining up the bottom quick-connect on the water chamber pointing to the left with the slot in the holder.
- Unscrew the lid of the water chamber and remove the round float by grasping the knob.
- Ensure that the inside of the water chamber is clean. Fill three-quarters full with distilled water only.

  CAUTION:
  Never use tap water as it contains minerals which can cause blockages in tubing and/or support bacterial growth.

- Replace the float in the water chamber at an angle to avoid any bubbles being trapped under the float.

  CAUTION:
  Never use the pump without the float in the water chamber.
  Air bubbles will form at the transducer and will reduce the pressure response rate and the accuracy of measurement.

- Screw the lid back on and tighten securely.

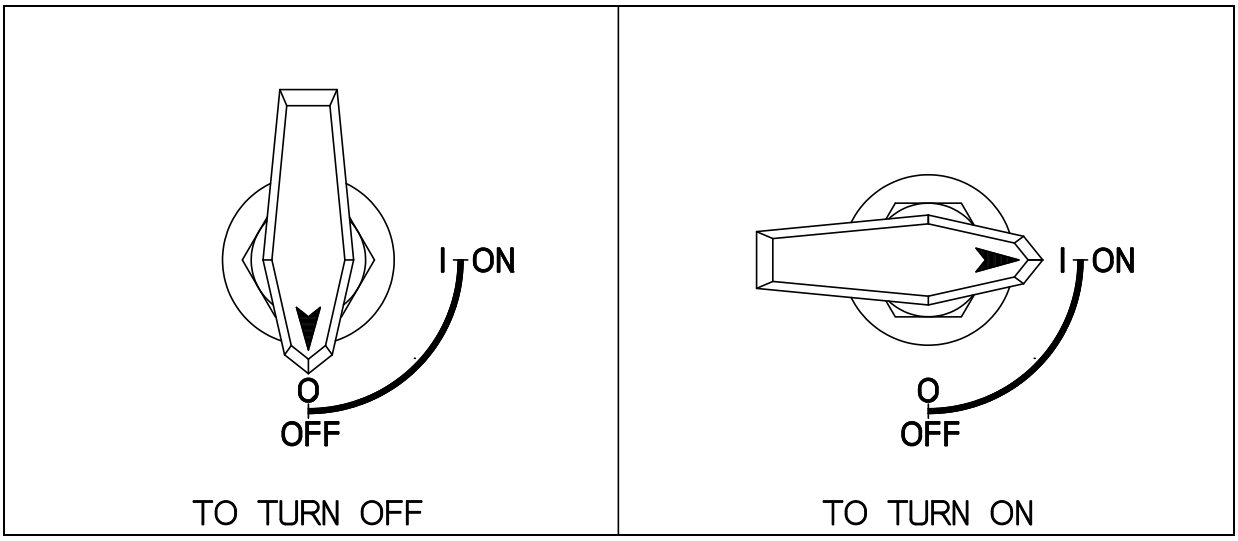


Figure 12: Master On-Off Valve

- Connect the plastic quick-connect near the base of water chamber by pressing the metal tab on the connector and push the elbow connector in until it snaps (Figure 13a below).

- This connection provides pathway to deliver pressurized water from the water chamber through the master on-off valve into the stopcock manifold; Hence, to the capillary tubes. A stainless steel filter on the quick-connect inside the water chamber filters all water before it is delivered to the capillary tubes.

- To disconnect the quick-connect, push down on the metal tab and pull the elbow connector out. The water flow will automatically shut off at both ends of the quick connect (Figure 13b below).

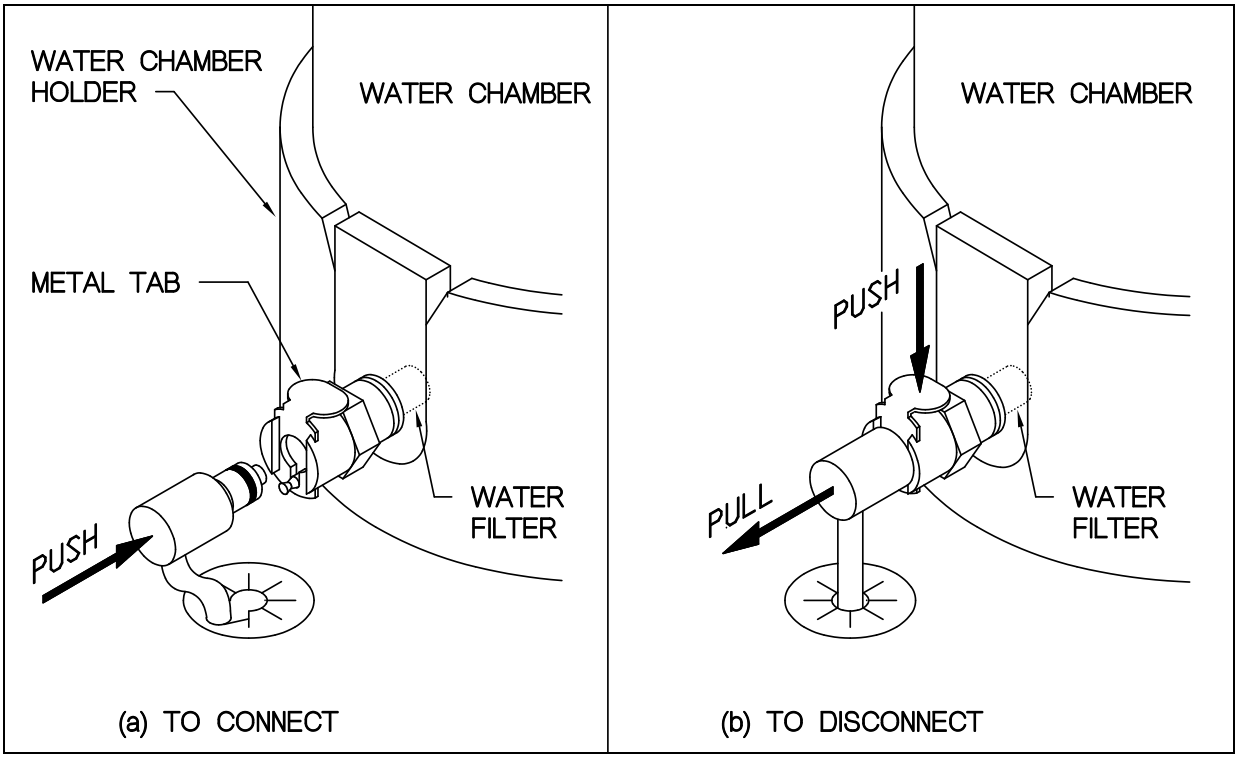


Figure 13: Bottom Quick-Connect and Filter on Water Chamber

TO CONNECT:
Make sure that the metal tab is down. Insert the elbow quick connect and push it in until the metal tab snaps up into the lock position.

TO DISCONNECT:
Push down on the metal tab and pull the elbow quick connect out.

- Connect the metal quick-connect located on the lid of the water chamber (Figure 14 below) to the female quick connect at air supply tubing by pushing the two metal fittings together until they snap into the latched position.

  This connection delivers compressed air from the pressure regulator to the water chamber.

- To release the quick-connect, push down on the flange. When disconnected, air pressure in the water chamber is released and air flow from the compressor is shut off at the female quick connect end.

  The toggle pressure release valve as shown in Figure 14 below is in the normal CLOSED position. To OPEN the valve squeeze the black handle towards the body of the valve. The valve opens momentarily to release pressure from the system (or Water chamber).

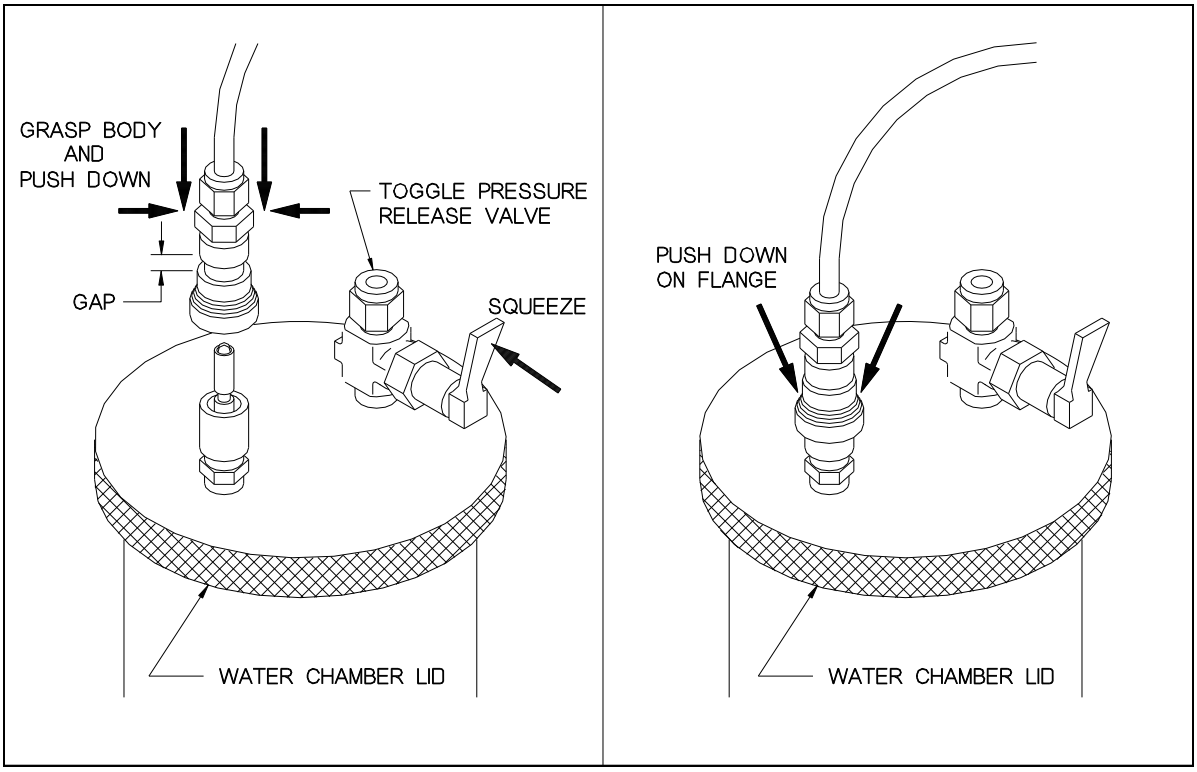


Figure 14: Air Quick-Connect on Top of Water Chamber

TO CONNECT:
Push down on the body
until connection snaps together.
The gap between the body
and the flange will disappear.

TO DISCONNECT:
Push down on the flange
until the body of the quick
connect pops up and
disconnects. Lift the connector
body off the post.

4.2 SELECTING WATER CHAMBER PRESSURE

To select water chamber pressure for optimal recording accuracy of pressure rise rate for your recording site or organ, refer to the table below and adjust the water chamber pressure accordingly. The associated infusion rate is provided in the table to enable a quick estimate of the total volume of water infused into the patient in a given period of time.

15 psi is the recommended pressure for esophageal and upper esophageal sphincter studies. For a small bowel study, the pressure should be set at 7 psi. For a colon study, the pressure can be as low as 5 psi.

CAUTION:
Do not set water chamber pressure higher than 20 psi.
Damage to system could result. Patient will receive excessive water.

Table 1: Water Chamber Pressure Selection vs. Infusion Rate (or Pressure Rise Rate)

RECORDING SITE (ORGAN)	APPROXIMATE INFUSION RATE WITH STANDARD CAPILLARY TUBE (ml/min)	RECOMMENDED WATER CHAMBER PRESSURE pound/square inch (kPa)	MINIMUM PRESSURE RISE RATE AT CATHETER OPENING (mm Hg/sec)
UES	0.6	15 (103)	400
Esophagus	0.6	15 (103)	400
Stomach	0.6	15 (103)	400
Small Bowel	0.4	7 (48)	120
Bile Duct	0.4	7 (48)	120
Colon	0.3	5 (35)	60

Table 2: Pressure Conversion Chart

Psi	cm of H_2O	mm of Hg	kPa
20	1408	1034	138
15	1056	776	103
7	493	362	48
5	352	259	35

4.3 ADJUSTING WATER CHAMBER PRESSURE

- Check that the master on-off valve is at the OFF position (Figure 12, Section 4.1).

- Turn the main power switch to the ON position.

  When the main power switch is turned on, both pilot lights (POWER and COMPRESSOR) will illuminate and the compressor will run. The pressure on both gauges will rise.

  After a few minutes the compressor should stop and the COMPRESSOR pilot light should turn off. The compressor pressure gauge (left side) should be set at minimum 35psi. The white power pilot light remains lit, indicating that the main power is still on.

  The compressor gauge indicates the pressure in the high pressure drying cylinder inside the pump. In normal operation, as water empties from the water chamber it is replaced by compressed air. The compressor pressure gauge will drop slowly from approximately 40 psi to 17 psi. When the pressure has fallen to 17 psi, the compressor will turn on for a few minutes until it reaches 40 psi again (to maintain a constant water chamber pressure).

  The water chamber gauge (right side) shows the regulated pressure delivered to the water chamber. This is normally set at 15 psi and remains constant. (For other pressure settings see Table 1, Section 4.2).

- Adjust the black regulator control knob until the water chamber gauge (on the right hand side of the pump) indicates 15 psi.

- The black regulator control knob is located on the top of the pump on the right hand side. It controls the pressure regulator that is mounted inside the case. The regulator reduces the high pressure compressed air received from the compressor and delivers it to the water chamber at lower pressure.

To Increase Pressure:

- Turn the regulator knob clockwise.

To Decrease Pressure:

As the pressure regulator is a non-relieving type, in order to decrease the pressure to a new setting, it is necessary to relieve the downstream pressure trapped inside the regulator and the water chamber to below the desired new setting. Then increase the pressure to the desired new setting. Follow the steps below:

- First turn the regulator knob counter-clockwise 2 complete turns.

- The needle on the water chamber gauge will not move because the existing pressure is still trapped in the water chamber and in the downstream side of the regulator.

- Then release the excess pressure using the toggle pressure release valve on top of the water chamber. Squeeze the black handle of the toggle valve toward the body of the valve momentarily (Figure 14, Section 4.1). The water chamber gauge needle will show a drop in pressure.

- Repeat the above two steps if necessary until the water chamber pressure falls to a level below the desired pressure.

- Turn the regulator knob clockwise to increase the pressure to the desired level.

The toggle valve can be locked in the open position if the black handle of the toggle valve is pulled backward into a fully extended position at 90º to the body of the valve.

CAUTION:
Do not leave the toggle pressure release valve locked in the fully open position.
The compressor motor will run continuously. This may cause overheating of the compressor motor.

4.4 PURGING AIR FROM PUMP AND TRANSDUCERS

During the following procedures, it is helpful to a place a towel under the transducers to absorb any water that may spill onto the pump.

- After the water chamber pressure has been adjusted to the desired level (usually 15 psi), open all 4-way stopcocks on top of the transducers as shown in Figure 9, Section 3.5.

- Turn the master on-off valve to ON.

- Partially unscrew each of the end plugs one at a time on the left and right ends of the stopcock manifold to purge any air from inside the manifold. Then re-tighten the end plugs.

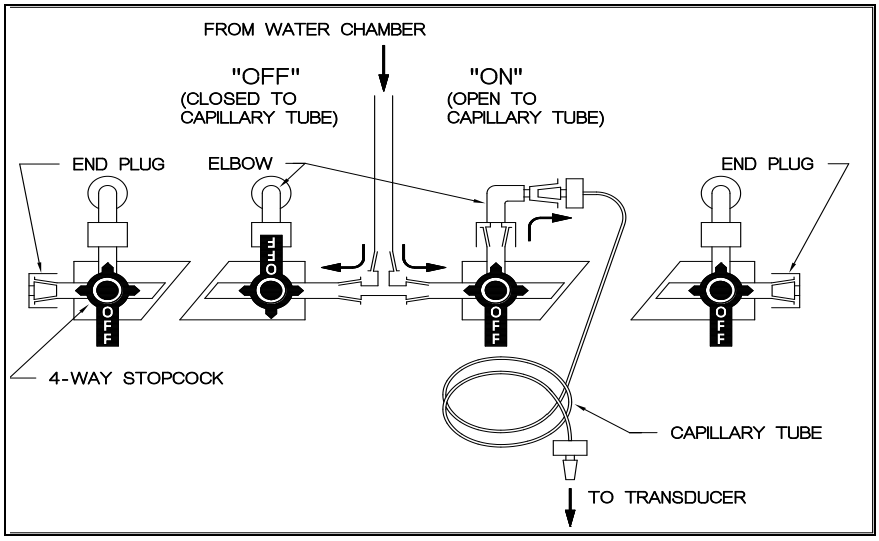


Figure 15: Stopcock Manifold

CAUTION:
Water will spray out as the end plug is unscrewed.
An extension tube with a male luer or a 2-way stopcock can be permanently attached in place of the end plug for routine purging.

- Turn ON all the manifold stopcocks. (The off-handle on each manifold stopcock should point downward as shown in Figure 15).

  The off-handle indicates the direction in which the flow is cut off. If the handle is <u>not</u> aligned perfectly the stopcock may be only partially open or partially closed.

- Tilt the front of the pump toward you and hold it for 1-2 minutes to allow air bubbles to be flushed from the elbows connecting the manifold to the capillary tubes. Check that no bubbles remain in these elbows before continuing.

- Allow 2-3 minutes for the water pressure to purge any air inside the capillary tubes.

- Open the 2-way stopcocks on the bottom of the transducers.

- Attach a large syringe filled with distilled water to the bottom stopcock (Figure 16).

- Push water from the syringe gently into the transducer. The large syringe and the gentle pushing reduce the pressure on the transducer, and hence, reduce the risk of damage to the transducer.

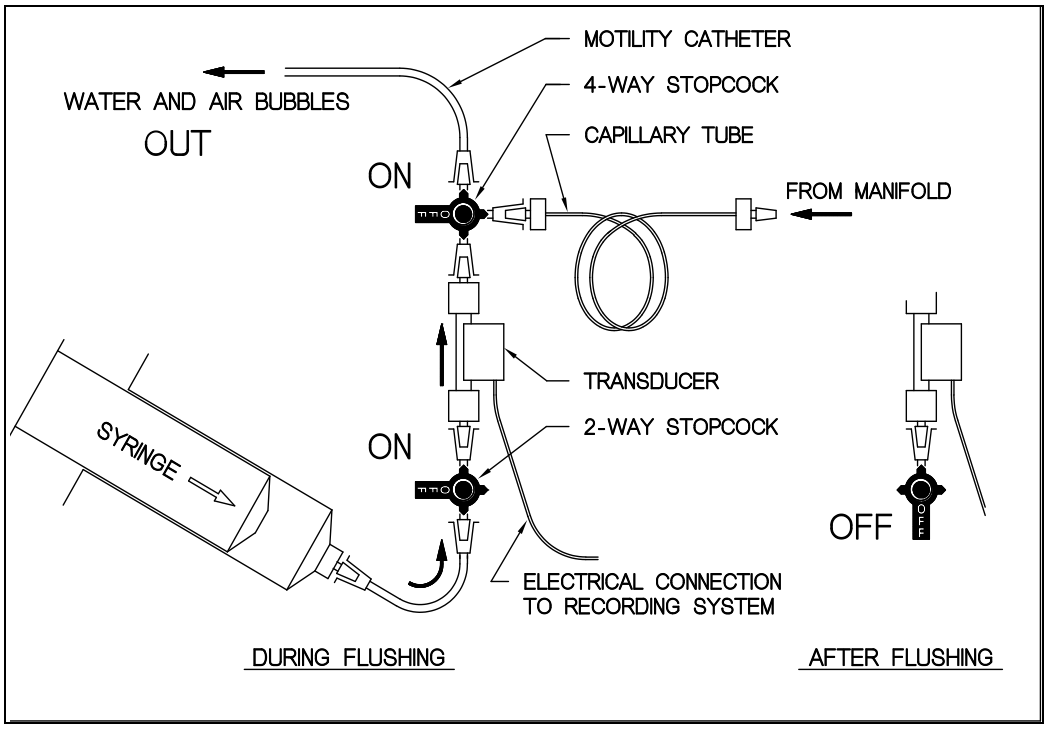


Figure 16: Purging Air from System Using a Syringe

If small bubbles persist in sticking to the wall, use rubbing alcohol instead of distilled water in the syringe. Alcohol has a lower surface tension, which allows bubbles to be released more easily.

CAUTION:
Never use a syringe smaller than 10 cc. Transducer damage may result due to excessive high pressure.

- Flush out any air remaining in the transducer or in the catheter. Turn the bottom 2-way stopcock to the off position and move to the next stopcock.

- After all air bubbles have been flushed out, turn the master on-off valve to the OFF position.

- The pump is now in standby mode ready to begin a study

4.5 CALIBRATION OF RECORDING SYSTEM

Refer to the manufacturer's instructions for your computerized data processing system or chart recorder. Follow the recommended calibration procedure.

Use of Hydrostatic Calibration System (0-50/68 cm H_2O)

- Attach manometric catheter to transducer.

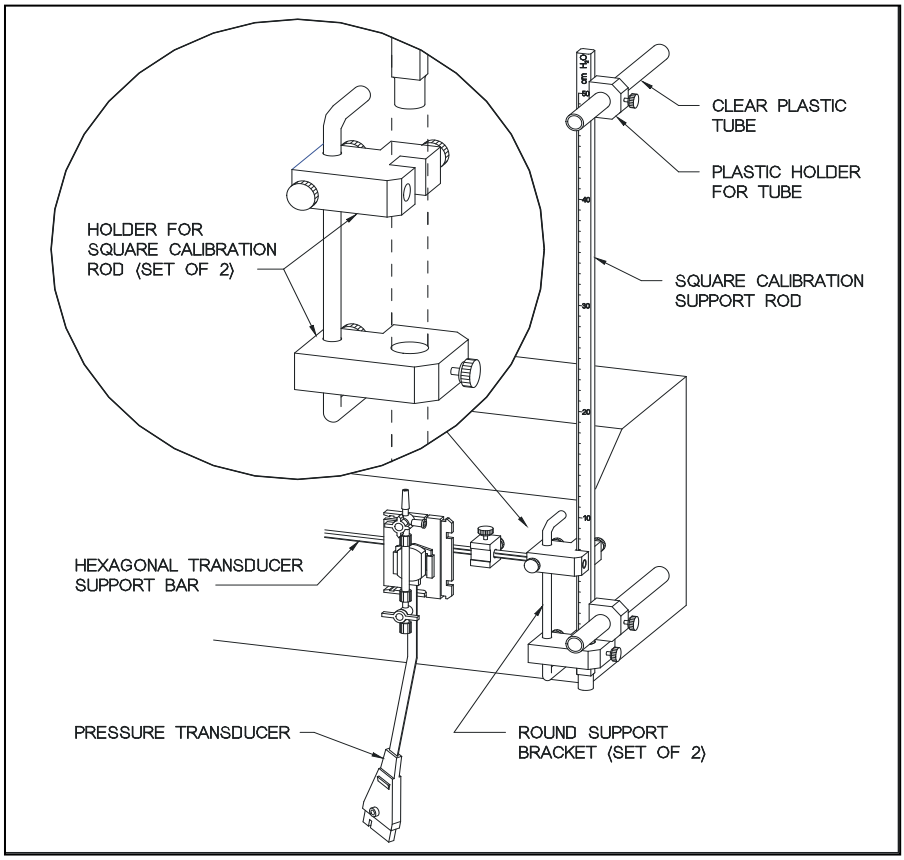


Figure 17: Hydrostatic Calibration System (0-50/68 cm H_2O)

- Turn on-off valve to ON. Fill and flush catheter

- Slide catheter into the bottom plastic tube. The bottom plastic tube should be adjusted to the same height as the transducers. This position simulates 0 cm H2O pressure. Select low calibration on computer or adjust baseline on recorder to 0 cm H2O position for each channel.

- Slide catheter into the top plastic tube. This position generates 50 or 68 cm H2O pressure. Select high calibration on computer, or adjust the recorder to 50 or 68 cm H2O for each channel.

- If the top plastic tube is located at 68 cm height, the value will be equivalent to 50 mm Hg pressure

- This completes the pressure calibration

4.6 FUNCTIONAL CHECK – PINCH TEST

1. Performing the Pinch Test

This test confirms that the entire system is functioning properly, including the pump, the transducers, and the recording system.

- For a computerized system, turn on the computer and run the recording program as you normally would for a motility study. Alternatively, run the chart recorders' speed as you normally would for a motility study (1, 2, 2.5 or 5 mm/sec).
- Set the recording system pressure amplitude as you would for a study (10 mm Hg/square or 100 mm full scale).

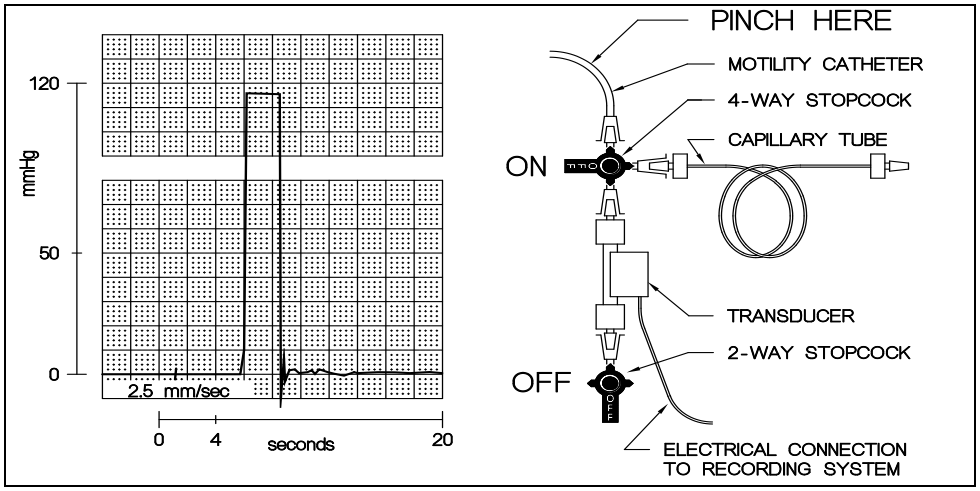


Figure 18: Pinch Test: Pinch Point and Output Graph

- Firmly pinch the manometric catheter for several seconds at a point immediately above the 4-way stopcock as shown in Figure 18 and release it. The pressure tracing should respond immediately with a virtually vertical rise to the full-scale pressure amplitude as set. See the graph in Figure 18. This response confirms that the entire system is functioning properly, with no leakage.

It is recommended to perform this pinch test routinely at the beginning of each motility study. Any corrections can be made before the study. It also provides a permanent record on the functional performance of the system.

This pinch test is also useful during a study, whenever the clinical tracing is abnormally inactive and the performance of the system is in question.

Refer to Functional Troubleshooting in Section 5.2 for detailed explanations of unsatisfactory pressure tracings, and to Section 5.3 for Pressure Rise Rate calculation.

- Repeat this test for all channels.

2. Turn the master on-off valve to the OFF position.

3. Check again that there is sufficient water in the chamber to complete the study. Refill if necessary.

4. The pump is now in standby mode ready to begin a study.

5 Operation

5.1 NORMAL OPERATION BEFORE AND DURING THE STUDY

1. Check that there is sufficient water in the chamber to complete the study. Refill the water chamber if necessary.

2. The power switch and the power pilot light should be on. The compressor gauge (left side) should indicate a pressure between 17 psi to 40 psi. The compressor is most likely not running at this time. (The compressor will turn on automatically when pressure drops below 17 psi; the COMPRESSOR pilot light will be on when the compressor is running.)

3. The water chamber gauge (right side) should be at 15 psi or at the specific pressure for your study. Readjust the water chamber pressure if necessary to your specific requirement (see Sections 4.2 and 4.3).

4. The manometric catheter should be firmly attached to the stopcocks on top of the transducers and all air bubbles should have been flushed out. Flush again if necessary in accordance with Section 4.4.

5. Calibrate the recording system if necessary (see instructions from the manufacturer of the chart recorder). Make sure that every tracing is at zero pressure (baseline position).

6. Run the computer or chart recorder same as for a motility study such that with the master on/off valve at the OFF position, baseline tracing is set to zero pressure (Figure 19).

This establishes the <u>static baseline</u>, i.e. the baseline with no infusion taking place

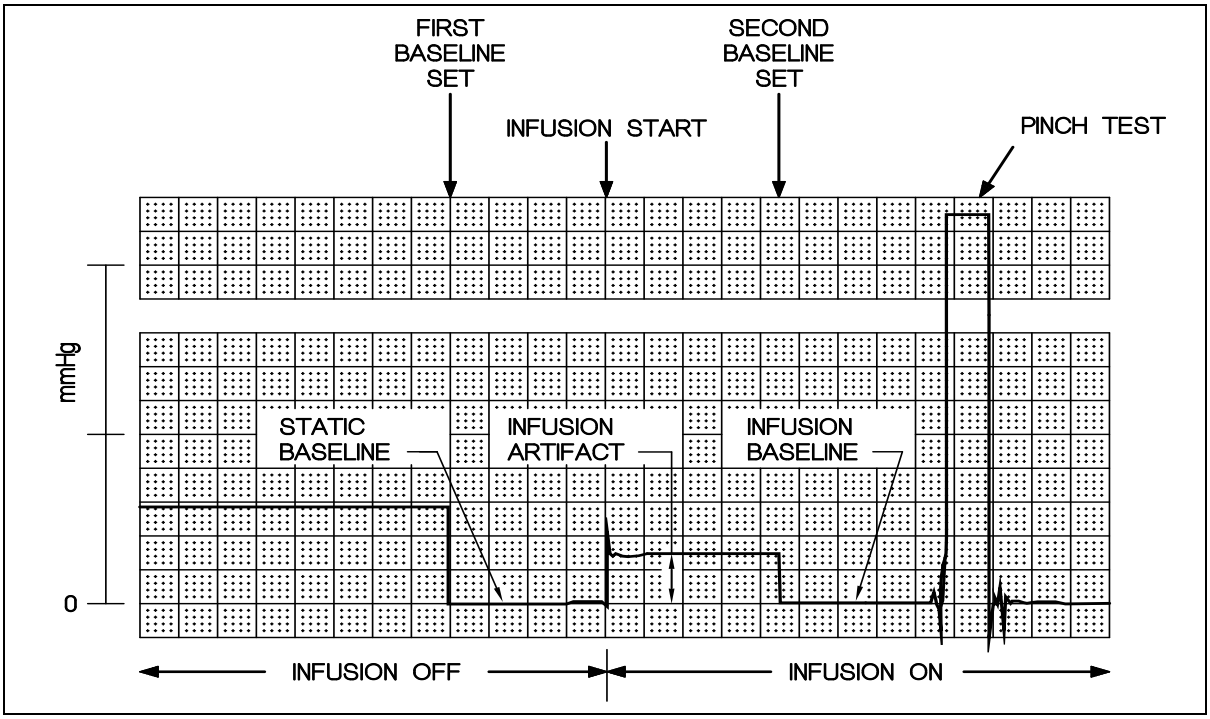


Figure 19: Infusion Artifact

8. Turn the master on-off valve to the ON position.

   All tracings should show an increase at baseline of 2-10 mm Hg. This is known as the infusion artifact. See Figure 19. It is caused by friction and restriction of the water flow passing through the catheter. If an abnormally high infusion artifact occurs, blockage or leakage may have occurred within the manometric catheter (see Section 5.2).

9. Set the baseline tracing back to 0.
   This is the infusion baseline, the baseline pressure with the infusion artifact removed. This is the baseline to be used for the study.

10. PINCH TEST: Pinch the plastic tube between the transducer and the catheter and observe a sharp rise in the chart recorder tracing. (The Pinch test is described in Section 4.6). Repeat the Pinch Test to all channels.

    If the tracing does not rise sharply at full-scale, the Manometric Pump and chart recording system are not functioning properly.

    Follow the Pinch Test Troubleshooting instructions in Section 5.2. Refer, if necessary, to Troubleshooting, Section 7.

11. Turn the master on-off valve to OFF position and insert the manometric catheter into the patient. Turn the master on-off valve to ON and repeat the pinch test again.

12. Start the motility procedure according to the protocol.

5.2 FUNCTIONAL TROUBLESHOOTING WITH THE PINCH TEST

When the tracing following the pinch test does not rise sharply to full-scale deflection, the system is not functioning properly. If only one tracing is affected, the problem is most likely to be in the individual capillary tube, the transducer and stopcock, or the manometric catheter. If all channels are affected, then the problem is probably with the water chamber, the master on-off valve, or recording system.

A. No pressure rise in recording - Possible causes:

- Water chamber pressure or air compressor pressure is zero:

  - If the left side compressor gauge is zero or less than 15 psi, make sure that the power is turned on to re-pressurize the system (Section 3.3). Check that the water chamber gauge reads 15 psi (or the desired setting).

- Top quick-connect to water chamber is disconnected or water chamber is not pressurized:

  - Squeeze the toggle valve on top of the water chamber. If there is no hiss of escaping air, the water chamber is not pressurized.

  - Make sure that the metal quick-connect on the lid of the water chamber is connected properly. Push the metal connector together hard, until it snaps. (Figure 14, Section 4.1)

- Bottom quick-connect to water chamber is disconnected:
  - Reconnect the bottom quick-connect (Figure 13, Section 4.1)

- Master on-off valve is at the OFF position:
  - Turn ON (Figure 12, Section 4.1).

- Stopcocks at manifold are at the OFF position:
  - Turn ON (Figure 15, Section 4.4).

- 4-way stopcock to transducer/catheter/capillary tubing is closed:
  - Open stopcock to correct the problem.

- Transducer malfunction:
  - Interchange transducers to confirm malfunction.

- Recording system malfunction:
  - Troubleshoot, following manufacturer's instructions.

B. Slow pressure rise in recording – Possible causes:

- Air bubbles in fluid path:
  - Carefully inspect for air bubbles in system. If not sure, flush the system thoroughly (Section 4.4).

- Leakage in fluid path:
  - Carefully inspect all luer connections for leakage of water. Tighten all connections; replace any component that leaks. A slow leak is difficult to detect. Wipe all luer connections dry and monitor again for any leaks.

- Water chamber pressure too low, i.e. 1-2 psi:
  - If the pressure on the left-hand compressor gauge is more than 17 psi, turn the pressure regulator control knob <u>clockwise</u> to increase the pressure output from the regulator to the water chamber.

  - If the pressure on the compressor gauge is less than 17 psi, make sure that the power is turned on to re-pressurize the system (Section 4.3)

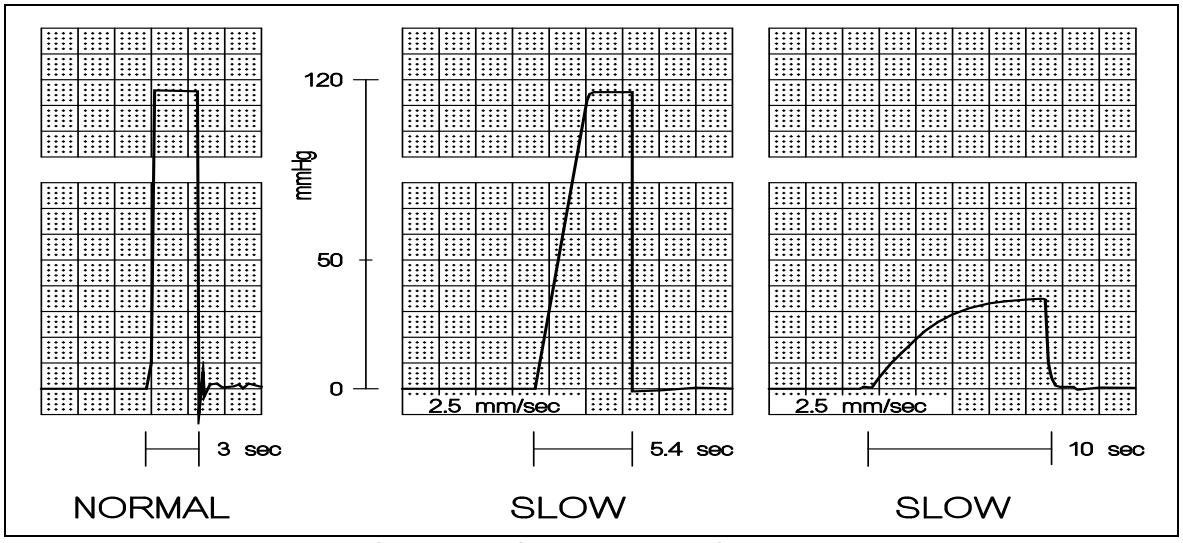


Figure 20: Slow Pressure Rise Rate

- Blocked capillary tube:

  - First, check that the 4-way stopcocks on the stopcock manifold and on top of the transducers such that they are in the fully open position (Figure 15, Section 4.4; Figure 9, Section 3.5).

  - Disconnect the catheter from the transducers. Observe water dripping from each transducer. Those with a slow flow rate are likely to be blocked at the capillary. At 15 psi the flow rate should be about 0.6 ml/min or about 10 drops/min (6-7 seconds between drops). If there is no flow or a slow flow rate, turn the master on-off valve OFF and replace the capillary tube.

- Leaking or blocked catheter:
  - A leaking catheter will produce a lower infusion artifact. A partially blocked catheter usually creates a higher resistance, which produces a higher infusion artifact.

  *- Connect the catheter to the transducer and lay it horizontally on top of the transducers. Flush thoroughly with water. With master on-off valve at **OFF** position, run the recording system and set baseline to "0" for the system. Then turn master on-off valve **ON**, and check the recording for the 2-10 mmHg rise of the infusion artifact (Figure 19, Section 5.1).*

  - The artifact should be similar for all channels. Any channel that has an unusually low infusion artifact is likely to have a leaking catheter or valve connection. Any channel that has an unusually high infusion artifact is likely to be blocked in that lumen of the catheter.

  - Remove the catheter, place it in a basin of hot water, and flush the channel with a small syringe filled with hot water until the channel is cleared.

5.3 CALCULATION OF PRESSURE RISE RATE

The pressure rise rate is defined as the pressure rise rate in mm Hg or cm H_2O per second.

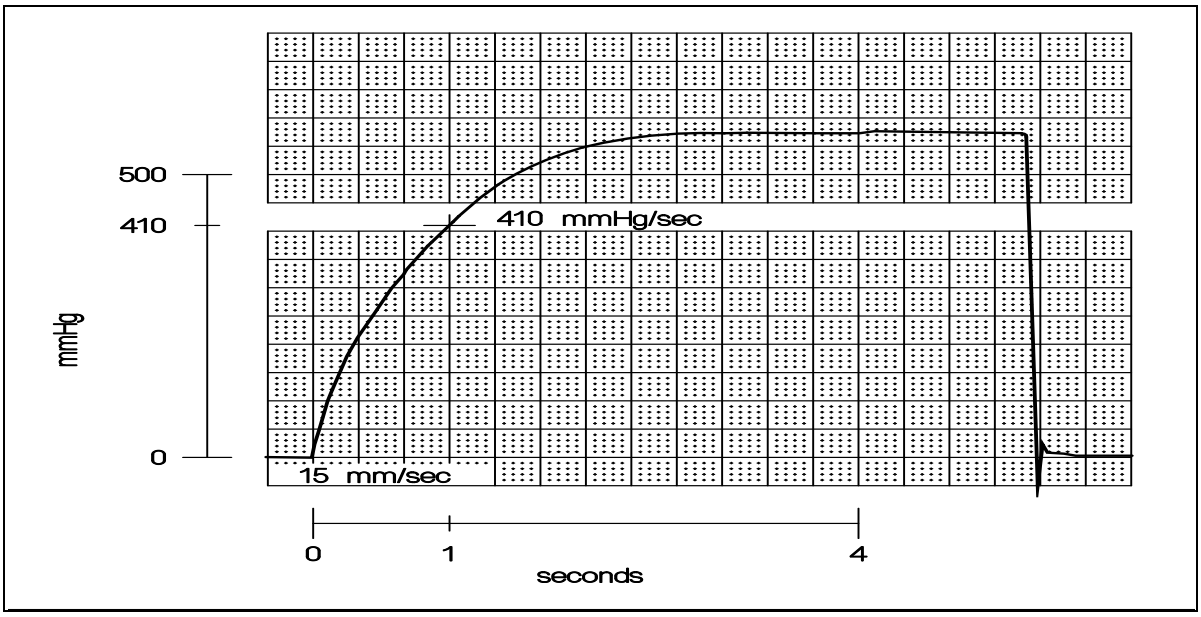


Figure 21: Calculation of Pressure Rise Rate

- Run the recording system at a high speed such as 15 mm/sec in order to capture a one second slope. With infusion on, block the opening of the manometric catheter with your finger to create a rise in pressure.

- In Figure 21, the pressure tracing rises from 0 mmHg at the beginning of the rise to 410 mmHg at the 1-second mark. The pressure rise rate is therefore (410)/(1) = 410 mmHg/sec.

  To ensure measurement accuracy of the physiological contractions, the pressure rise rate for esophageal study should be 400 mmHg/sec or better.

5.4 TERMINATION OF PROCEDURE

- Stop recording of motility software program

- Turn master on-off valve to OFF.

- Disconnect manometric catheter from transducers.

5.5 POST STUDY: DAILY BLOW-DRY SHUT-DOWN PROCEDURE

- Empty the water chamber.

- Reconnect the empty water chamber and pressurize.

- Turn the master on-off valve ON. Flush the whole system with air until no more water is dripping out of the capillaries.

- Turn master on-off valve to OFF. Release pressure using the pressure release toggle valve at top of water chamber. Turn power off.

- Remove empty water chamber. Store dry with lid off.

- Store pump system dry with all stopcocks and valves open

CAUTION:
Do not leave any water in the pump system or water chamber overnight. Retained water in the pump system may cause the growth of bacteria to unacceptable levels.

CAUTION:
Do not leave the water chamber pressurized overnight. Gases dissolved in water under pressure will form air bubbles in the transducer and will reduce the pressure rise rate.

6 Service: Maintenance

According to clinical standards, the water in the water chamber has to meet the acceptable levels of potable water. The proven method* to keep bacterial levels down is to store the pump tubing system dry when not in use. The daily drying protocol alone can maintain the distilled water within acceptable potable water levels.

6.1 DAILY BLOW-DRY SHUT-DOWN PROTOCOL

- First, empty the water chamber.
- Reconnect the empty water chamber and pressurize.
- Turn the master on-off valve ON. Open all valves and stopcocks. Flush the whole system with air for 5 minutes until no more water is dripping out of the capillaries.
- Turn master on-off valve to OFF. Turn power off. Release all pressure by squeezing toggle valve at top of water chamber.
- Remove empty water chamber. Store dry with lid off.

Daily Start-up Procedure

- At next time of operation, fill water chamber with distilled water and reconnect to pump system.
- Pressurize pump and turn master on-off valve to ON. Flush water through the system for 5-10 minutes ensuring that no air bubbles are trapped in the system.

Connect manometric catheter and perform pinch test (Section 4.6) to assure the recording fidelity is within the recommended rise rate. This confirms that no major bubbles are trapped in the system.

6.2 DISINFECTION

*Disinfection of the pump should be done at regular intervals – **monthly is recommended** – or prior to biliary motility test.*

CAUTION:
Do not use alcohol to clean the water chamber. Alcohol may cause cracks in the water chamber material.

Do not autoclave any of the components.

***** Alfa, M.J., Ilnyckyj, A., MacFarlane, N., Preece, V., Ailford, S. Fachnie, B. Microbial overgrowth in water perfusion equipment for esophageal/rectal motility. Gastrointestinal Endoscopy 2002:55:209-13.

Chemical Disinfectants:

For pumps containing STAINLESS STEEL components:

(Pumps shipped AFTER March 1, 2001) (S/N MS4-1946 or higher)

CAUTION: Do not use any disinfectant or chemical solution in the fluid path of the pump which is incompatible with the following materials: acetal, acrylic, Buna-N, epoxy adhesive, polycarbonate, high-density polypropylene, polyurethane, TFE, and stainless steel. Confirm compatibility of the disinfectant with the disinfectant manufacturer before use.
Mui Scientific is not liable for any damage to the pump, or harm to patients or personnel, caused by improper use of a disinfectant or procedure.

Clinical evaluations have verified the following disinfectants for use:

- Cidex OPA (manufactured by Johnson & Johnson; Irvine, CA, U.S.A.)
- Sporox II (Sultan Chemists Inc.; Englewood, NJ, U.S.A.)
- Korsolex Extra (Bode Chemie Hamburg; Hamburg, Germany)

A disinfectant which is compatible with flexible endoscopes will be compatible with the Stainless Steel pumps. For the Brass pumps, one must be assured that the disinfectant is compatible with brass.

6.3 DISINFECTING PROCEDURE

Step 1: Purge System with Air

(Skip Step 1 when starting with a dry pump)

- First, empty the water chamber. Reconnect the empty water chamber and pressurize. Turn the master on-off valve ON. Flush the whole system with air for 5-10 minutes, or until no more water is dripping out of the capillary tips.

- Turn master on-off valve to OFF. Remove empty water chamber.

- After drying the pump before filling with disinfectant, add line to stay disconnected from transducers.

Step 2: Fill System with Disinfectant

- Fill water chamber half with disinfectant and swirl within water chamber to rinse all surface area (including underside of lid).

- Reconnect water chamber to top and bottom quick connects.

- Pressurize the water chamber and turn the master on-off valve to ON.

- Perfuse the disinfectant at 20 psi through pump tubing system for for 20 minutes, allowing the disinfectant to drip out through capillary tips into a container.
** Please contact Mui Scientific directly for disinfection protocol of any capillaries with a flow rate other than 0.6 mL/min.*

- During perfusion, disconnect and reconnect the plastic quick connect at the base of the water chamber several times. Rotate master on/off valve and all stopcocks several times repeatedly to expose all inside surface areas to the disinfectant.

- Turn master on-off valve to OFF. Allow the disinfectant to stay in the system for the additional length of time recommended by the disinfectant manufacturer (30 minutes. or longer is common for disinfection).

Step 3: Rinse System with Distilled Water

- Disconnect the quick connects at the top and base of the water chamber (wrap towel around top quick connect, as contaminated pressurized air will shoot out). Remove water chamber.

- Fill water chamber 1/2 with distilled water. Swirl water within water chamber to rinse all surface area (including underside of lid).

- Reconnect water chamber to top and bottom quick connects.

- Perfuse at 20 psi for 20 minutes to rinse disinfectant.

- During perfusion, disconnect and reconnect the plastic quick connect at the base of the water chamber several times, Rotate master on/off valve and all stopcocks several times repeatedly to expose all inside surface areas to the water rinse.

Step 4: Repeat Step 3 (to ensure all disinfected has been raised out of the system)

Step 5: Purge System with Air (For storage or immediate use)

- Disconnect the quick connects at the top and base of the water chamber. Empty the water chamber.

- Reconnect empty water chamber to top and bottom quick connects. Purge tubing system with 20 psi compressed air for 20 minutes, or until no more water is dripping out of the capillary tubing tips.

- Replace used transducers with new transducers. Reconnect capillaries to new transducers.

- For Storage: Turn power switch OFF of the pump. Squeeze the toggle valve on the water chamber lid to release all the pressure. Remove empty water chamber and store dry without lid.

- For Immediate Use: Fill water chamber with distilled water and continue with start-up procedure.

6.4 CARE AND CLEANING OF YOUR MANOMETRIC PUMP

CAUTION:
Unplug the power cord from the pump when cleaning to avoid the danger of electric shock.

- Use a soft cloth, slightly moistened with water and mild soap to wipe down any spots that may accumulate on the outside of the pump. Wipe off any soap residue with water.

- Rinse out the water chamber with fresh clean water and wipe out using a soft cloth. (DO NOT USE ALCOHOL). Check the outlet screen filter in the bottom of the water chamber for signs of blockage and rinse clean with distilled water (if necessary).

- Inspect the fluid tubing on the pump for mineral deposit and replace tubing if necessary.

6.5 REPLACING THE CAPILLARY TUBING

During normal use, mineral deposits or dirt may partially or completely block the capillary tubing.

To replace the capillary tubing:

- Turn master on-off valve to OFF and remove water chamber.

- Disconnect the capillary tube from the transducer.

- To gain access to the underside, set the pump onto its back.

- Push the black plug out of the keyhole slot on the front of the pump. Pull the capillary tube inside, through the keyhole.

- From underneath, disconnect the other end of the capillary tube from the stopcock manifold.

- Install the new capillary tube in reverse order taking care to attach the end of the capillary tube to the stopcock manifold securely.

6.6 INSPECTING THE DRYING CYLINDER

Inspect the drying cylinder through the port on the back of the pump.

If the color of the drying cylinder is orange, the desiccant is in satisfactory condition.

If the color of the entire drying cylinder is dark green, the desiccant must be regenerated.

6.7 DRYING THE DESICCANT

If the entire desiccant has turned dark green, it indicates that the desiccant has absorbed excessive amounts of moisture from the air. It must be dried.

The length of time before the desiccant needs to be regenerated will vary, depending on the operating environment and the frequency of pump use. The desiccant may last several years before regeneration is needed.

- Remove the drying cylinder from the pump using the Electric Compartment Removal Drawing as a guide (Section 2.3).

- Remove the cylinder cap. CAUTION: The cap is spring loaded.

- Pour out the granules on a tray and spread evenly, one granule deep.

- Heat the granules for 5 hours at 125°C (250°F) in a conventional oven.

  When all the water has been driven out the granules will be orange again.

  To ensure maximum effectiveness of desiccant, do not regenerate more than five times.

- Cool the desiccant in a tight container before refilling the acrylic unit.

- Pre-dry the felt filters at 100 °C for 30 minutes before assembly of the drying cylinder.

- Reassemble the drying cylinder and connect to the pump. Pressurize the pump and check that the cap of the drying cylinder is on tightly, with no leakage.

- Reassemble the pump.

7 Service: Troubleshooting

7.1 POOR RESPONSE RATE OR NO SIGNAL RESPONSE ON THE RECORDING SYSTEM

To check that the Manometric Pump and recording system are functioning properly, pinch each of the tubes from the transducer to the catheter and observe a sharp rise in the recorder tracing (Pinch Test, Section 4.6; Section 5.2). If the tracing does not rise sharply, check the following:

- Check that the master on-off valve is fully on.
- Check that the water chamber gauge indicates the recommended pressure (15 psi recommended).
- Check for any air bubbles and flush the fluid system.
- Check for leaks at stopcock or transducer.
- Check for any blocked capillary tubes.
- Remove any blocked capillary tubes and flush them from both ends using a 1cc syringe filled with distilled water or rubbing alcohol. If any capillary tubes are still blocked, replace them.
- Check the transducers and recording system for any faults.

7.2 COMPRESSOR MOTOR DOES NOT RUN

- Check that power cord is plugged in.
- Check that power switch is turned ON (the white power light should be illuminated).
- Check that fuses are not blown. Two fuses (5 x 20 mm, 250v, T2A) are located next to the power on/off switch.
- If the motor has been running continuously, the thermal protection switch may have shut off the compressor. Turn off the power, let the motor cool off for half an hour or more, and then turn on the power again

7.3 COMPRESSOR MOTOR RUNS TOO OFTEN OR DOES NOT SHUT OFF

- Check that the toggle pressure release valve on the water chamber lid is closed.
- Check for leaks at water chamber lid:
  With the entire system pressurized, disconnect the water quick-connect on the bottom of the water chamber. Invert water chamber. If water seeps from lid, depressurize system and tighten lid.
- Check for any water leaking from connections at the stopcock manifold or at the transducers. Tighten connections if necessary.

- Check for air leaks.
- Pressurize the system.
- Turn the pressure regulator control knob counter clockwise until the knob detaches. This disconnects the high pressure air system from the low pressure air system at the regulator (Figure 3, Section 2.3).
- Disconnect the air quick connect on top of the water chamber.
- Record the pressure reading on both gauges.
- Turn the power OFF.
- Wait.

If the pressure drops only on the water chamber gauge, the leak exists in the low pressure air system.

- Invert the pump or remove the right-hand end to check the connections to the water chamber gauge and on the outlet of the regulator. Use soapy water to detect leaks.

If the pressure drops only on the compressor gauge, the leak exists in the high pressure air system.

- Disconnect the power cord.
- Remove the electric compartment (Figure 4, Section 2.3).
- Check using soapy water for any air leaks at the drying cylinder or at any other connections.

<u>If user unable to resolve problem with the Manometric Pump, they are to contact the manufacturer directly.</u>

8 Parts List

PARTS LIST: ELECTRICALLY POWERED MANOMETRIC PUMP

Models PIP-4-, S/N's MS4-1177 and higher (After September 1992)

Description	Part Number
WATER CHAMBER AND PARTS	
Water Chamber for electrically powered pump, w/o fittings (1 L)	P4-A-100
Water Chamber for electrically powered pump, with S.S. fittings (1 L)	P4A200SS
Water Chamber Holder	P4-A-300
O-Ring for water chamber lid (4 ½" OD)	P4-A-320
Plastic Female Quick Connect with filter (for water outlet on bottom of water chamber)	P4-A-400
Plastic Male Quick Connect, elbow (connects to bottom of water chamber)	P4-A-410
Toggle Pressure Release Valve SS (on lid of water chamber) (¼" end)	P4A513SS
Male Quick Connect SS (on lid of water chamber)	P4A520SS
Female Quick Connect SS (connects to lid of water chamber)	P4A521SS
MASTER ON-OFF VALVE, FITTINGS, TUBING	
Master On-Off Valve only, stainless steel	P4B101SS
Master On-Off Valve SS w/tubing	P4B200SS
Insert for tubing only, Brass	P4-B-300
Insert for tubing only, Stainless Steel	P4B300SS
Ferrule Set with Insert, Brass	P4-B-301
Ferrule Set with Insert, Stainless Steel	P4B301SS
Tubing, polyurethane, 1/8"ID - ¼"OD, price per foot	P4-B-400
O-Ring for plastic male quick connect (1/8" ID, Buna-N)	P4-B-520
MANIFOLDS, STOPCOCKS, LUER CONNECTORS	
Upgrade from 4-channel to 8-channel (8 ch stopcock manifold, 4 transducer holders, 4 capillary tubes) Please specify serial number & transducer type.	P4-C-100
4-Channel Stopcock Manifold Assembly (with elbows)	P4-C-200
6-Channel Stopcock Manifold Assembly (with elbows)	P4-C-201
8-Channel Stopcock Manifold Assembly (with elbows)	P4-C-202
12-Channel Stopcock Manifold Assembly (with elbows)	P4-C-203

MANIFOLDS, STOPCOCKS, LUER CONNECTORS, continued	
5-Gang Stopcock Manifold only	P4-C-300
3-Gang Stopcock Manifold, only, all female connections	P4-C-301
4-Way Stopcock	P4-C-400
2-Way Stopcock	P4-C-410
Luer Plug (male)	P4-C-500
Luer Plug (female)	P4-C-501
Luer Adaptor, Female-Female (Capillary Tube Adaptor to female luer)	P4-C-510
Luer Elbow (Male-Female)	P4-C-530
Luer Tee (Male-Male-Female)	P4-C-540
Luer Adaptor (Luer Female - Hose Barb)	P4-C-550
Luer Extension (Male-Female)	P4-C-511
TRANSDUCER HOLDERS AND ACCESSORIES	
Universal Transducer Holder	P4-D-100
Medex Transducer Holder (Face Plate only)	P4-D-101
PVB Transducer Holder (Face Plate only)	P4-D-102
Adaptor only (for Medex or PVB transducer holder/face plate to connect to hex. support bar)	P4-D-201
Medex Transducer Holder Assembly (face plate w/ adaptor) (P4-D-101 plus P4-D-201)	P4-D-221
PVB Transducer Holder Assembly (face plate w/ adaptor) (P4-D-102 plus P4-D-201)	P4-D-222
PVB Transducer	P4-D-222T
Hexagonal Transducer Support Bar, S.S., 20 inch	P4-D-300
Holder for Hexagonal Support Bar to support bracket, plastic	P4-D-310
Round Support Bracket, S.S.	P4-D-320
GAUGES	
Water Chamber Pressure Gauge (0-30psi)	P4-E-100
Compressor Pressure Gauge (0-60psi)	P4-E-200
Brass Tee, 1/4NPTF, to Swagelok, to Swagelok	P4-E-521
Plastic Male Connector (1/4” NPT to 1/8” tubing)	P4-E-520

PARTS SPECIFIC TO ELECTRICALLY POWERED MODEL	
Operating and Service Manual	P4-F-100
Compressor, 115V/60Hz and 220V/50Hz	P4-F-206
Impeller only, for 115/220volt compressor	P4-F-220
Air Inlet Silencer	P4-F-240
Elbow Connector (Teflon), 1/8”MNPT to tubing	P4-F-247T
Check Valve w/ Swagelok	P4-F-244
Check Valve Insert	P4-F-245
Pressure Switch	P4-F-300
Drying Cylinder only	P4-F-401
Drying Cylinder with Female Quick Connects (1/8” ID)	P4-F-411
Plastic Quick Connect only (female, 1/8” ID) for drying cylinder	P4-F-420
Plastic Quick Connect only (male elbow, 1/8” ID), connects to drying cylinder	P4-F-421
Desiccant (1 pack)	P4-F-435
Band Clamp to support drying cylinder	P4-P-500
Pressure Regulator for compressed air (0 - 30 psi)	P4-F-500
Control Knob only, for pressure regulator P4-F-500	P4-F-520
Power Entry Module 115V	P4-F-600
Power Entry Module 220V	P4-F-601
Fuse, T2A, 250V, 5 x 20mm (for all voltages)	P4-F-611
Power Cord (Hospital Grade), 115volts	P4-F-620
Power Pilot Light (white), 115volts	P4-F-630
Power Pilot Light (white), 220volts	P4-F-631

HYDROSTATIC CALIBRATION SYSTEM, 0 - 50/68 cm H_2O	
Calibration System (Scale 0 - 68 cm H_2O, or 0 - 50mm Hg)	P4-H-620
Square Calibration Support Rod only, 295cm length	P4-H-623
Clear Plastic Tube (11”)	P4-H-60011
Plastic Tube-Holder	P4-H-601
Holder Set for Square Calibration Rod (Set of 4)	P4-H-602
CAPILLARY INFUSION TUBES - PLASTIC	
Capillary Infusion Tube, plastic, flow rate: 0.6mL/min, with Male Luer Connectors	P4CMM648
Capillary Infusion Tube, plastic, flow rate: 0.6mL/min, 1 Male and 1 Female Luer Connector	P4CMM648F
Capillary Infusion Tube, plastic, flow rate: 0.6mL/min, Female Luer Connectors	P4CMM648FF