MYOGRAPH SYSTEM - 112PP/114P

USER MANUAL, VOL. 3.1

TRADEMARKS

DMT reserves the right to alter specifications as required.
This document was, as far as possible, accurate at the time of printing.
Changes may have been made to the software and hardware it describes since then.
New information may be supplied separately.

This documentation is provided with the DMT Pressure Myograph System – Model 112PP / 114P

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SAFETY

The Pressure Myograph System has been designed for use only in teaching and research applications. It is not intended for clinical or critical life-care use and should never be used for these purposes. Nor for the prevention, diagnosis, curing, treatment, or alleviation of disease, injury, or handicap.

CAUTION:

- *DO NOT USE THE APPARATUS: THE ELECTRONICS POSE A RISK OF ELECTRICAL SHOCK.*
- *DO NOT USE THIS APPARATUS NEAR WATER.*
- *TO REDUCE THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THIS APPARATUS TO RAIN OR MOISTURE. OBJECTS FILLED WITH LIQUIDS SHOULD BE PLACED ON THE APPARATUS.*
- *DO NOT BLOCK ANY VENTILATION OPENINGS. INSTALL IN ACCORDANCE WITH THEM MANUFACTURER'S INSTRUCTIONS.*
- *ONLY USE SECURE INDUSTRY STANDARD CONNECTORS AND TUBING FOR PRESSURE CONNECTIONS. FAULTS, DEFECTS, AND MISTAKES DUE TO WRONG CONNECTIONS VOID WARRANTY. WE ARE NOT ACCOUNTABLE FOR RESULTS AND MISTAKES DUE TO INAPPOSITE PRESSURE HOOKUP.*
- *DO NOT INSTALL NEAR ANY HEAT SOURCE SUCH AS RADIATORS, HEAT REGISTERS, STOVES, OR OTHER APPARATUS THAT PRODUCE HEAT.*

The Pressure Myograph System is delivered with an external 100-240VAC to 24VDC adapter.

Protect the power adapter and cord from being walked on or pinched. Particularly at power plugs and the point where they connect to the apparatus.

Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way; such as, the power-supply cord or plug is damaged, liquid has spilled onto or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

EC DECLARATION OF CONFORMITY

DMT A/S
Certify and declare that the following apparatus:

Pressure Myograph System - DMT114P, DMT112PP

Restrictive use: Only for laboratory use.

Manufactured by:
DMT A/S
Rho 14
8382Hinnerup
Denmark

Conforms with the essential requirements of the EMC Directive 2004/108/EC.
Based on the following specifications applied by:
EN 61326-1:2006
EN 61326-2-6:2006 EN
61326-2-6/Corr.:2007

And with the LVD Directive 2006/95/EC.
Based on the following specifications applied by:
EN 61010-1:2010
EN 61010-2-030:2010

General warnings regarding EMC:
Do not use this device in close proximity to sources of strong electromagnetic radiation (e.g. 5nshielded intentional RF sources), as these may interfere with the proper operation.

CHAPTER 1 - SYSTEM OVERVIEW

1.1 INTERFACE

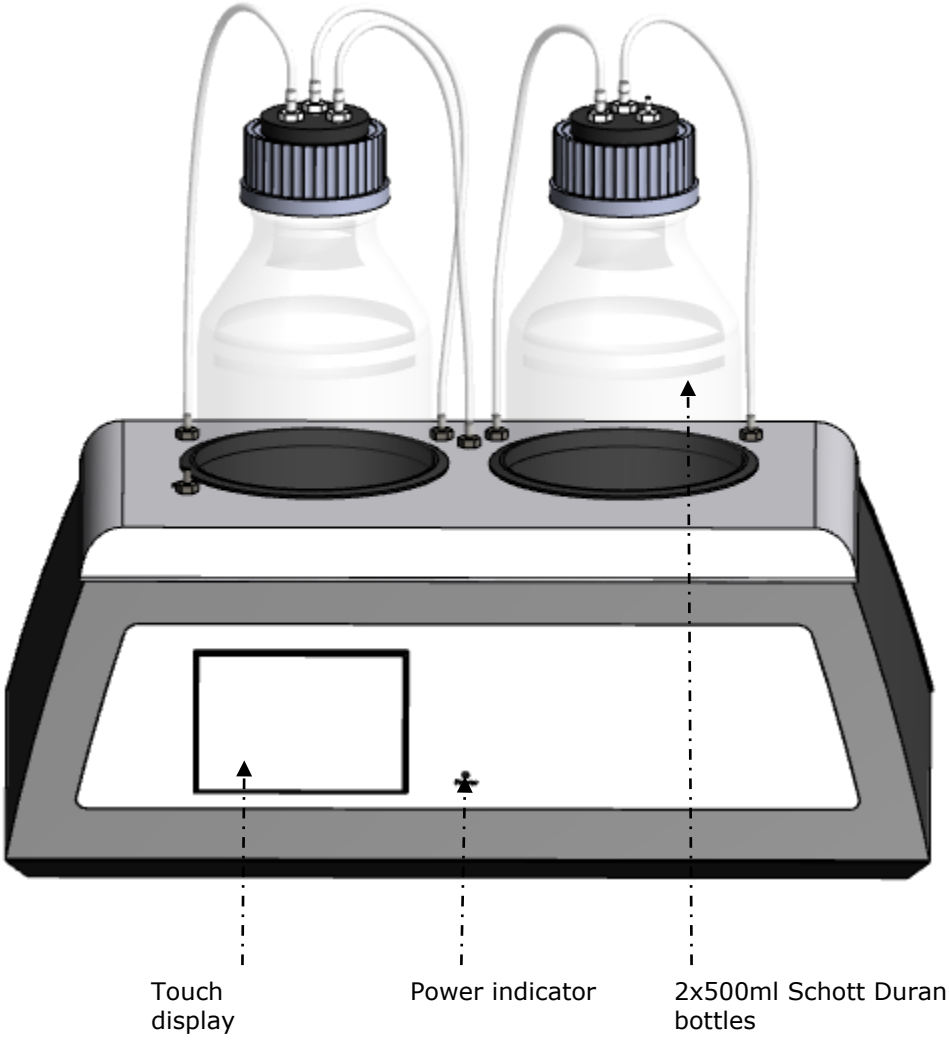


Figure 1.1 Pressure Interface - front

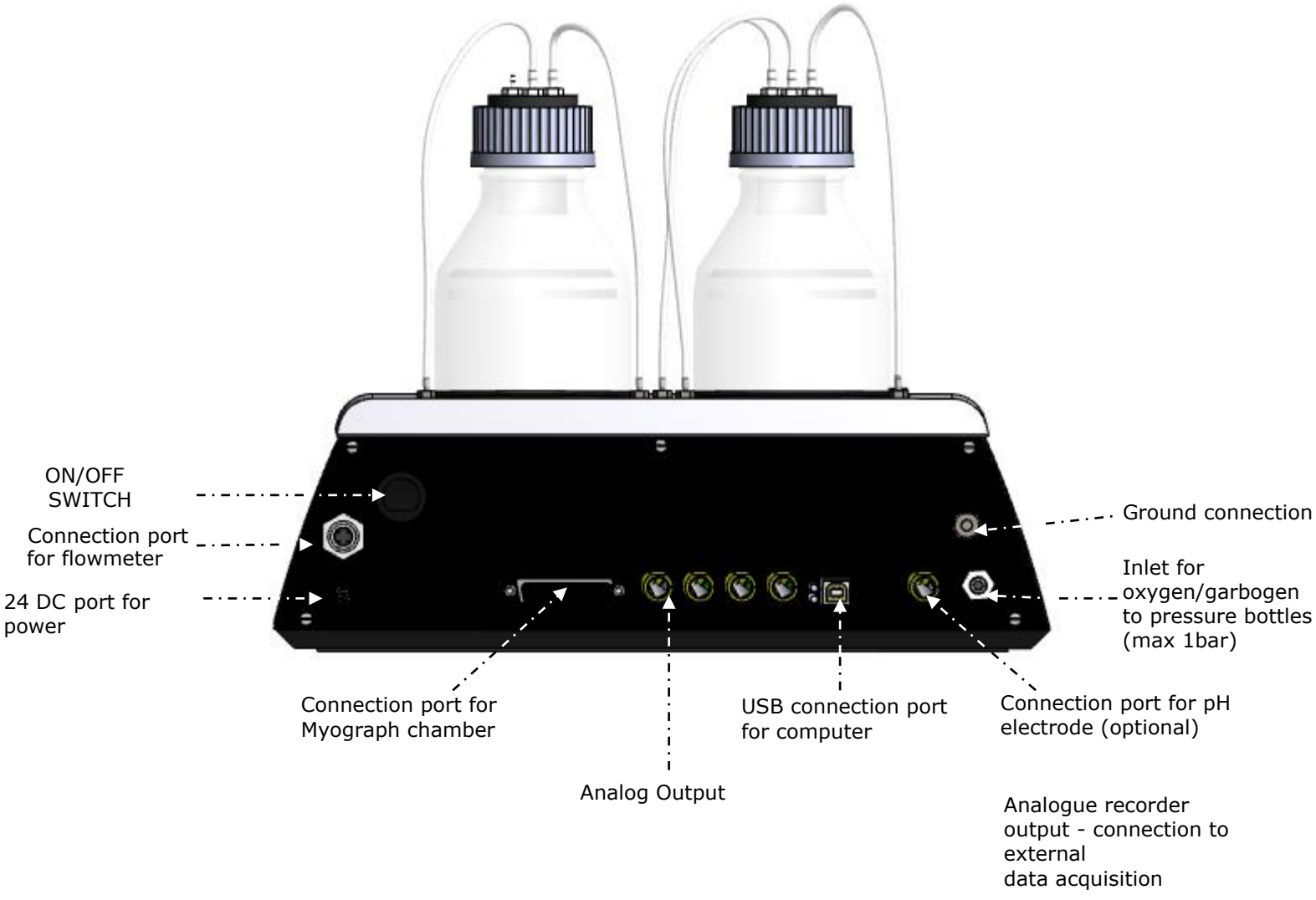


Figure 1.2 Pressure Interface - rear

1.2 PRESSURE MYOGRAPHS

1.2.1 PRESSURE MYOGRAPH - 114P

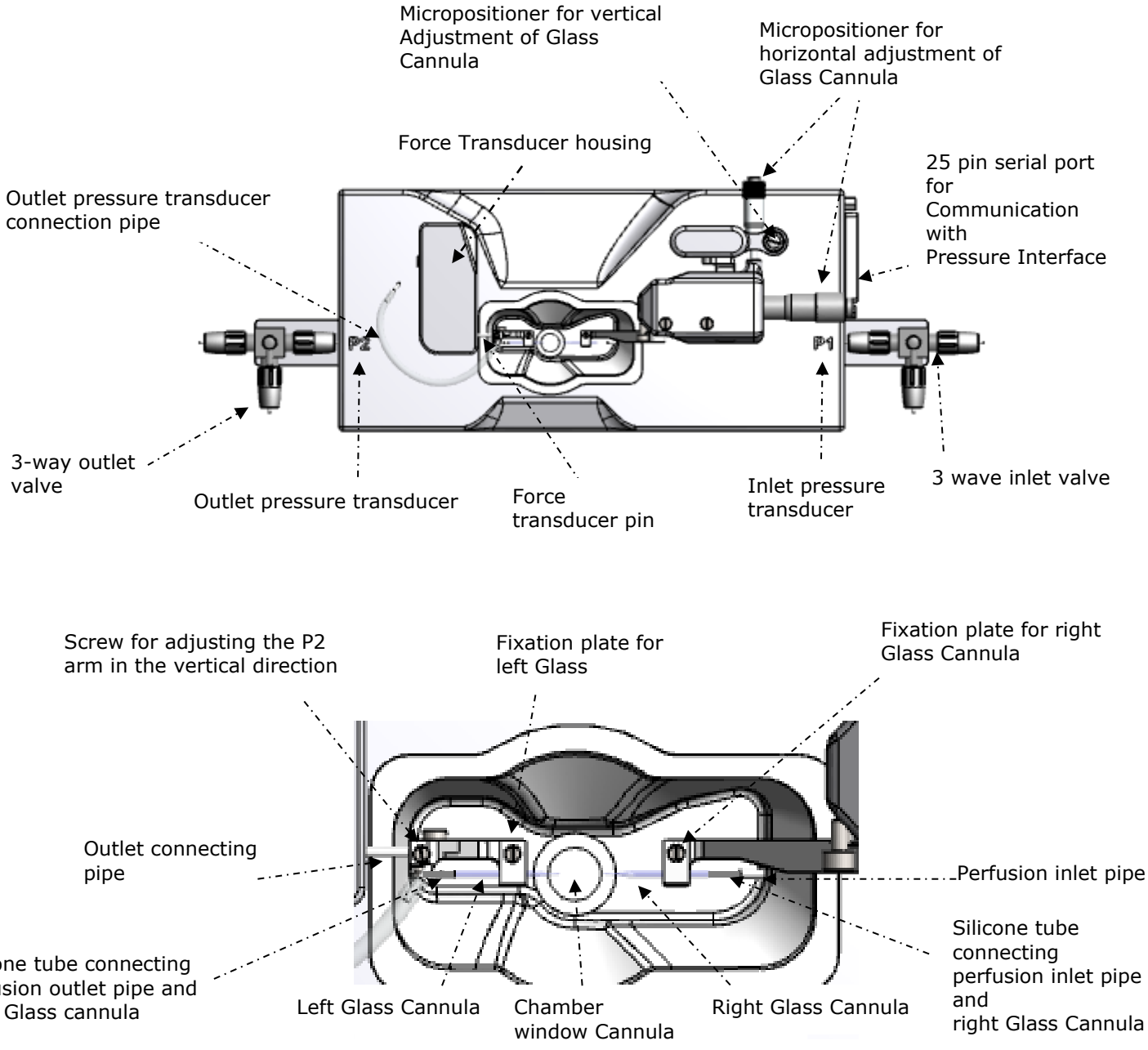


Figure 1.3 Pressure Myograph – 114P with close-up detail of the chamber

1.2.2 PULSATILE PRESSURE MYOGRAPH - 112PP

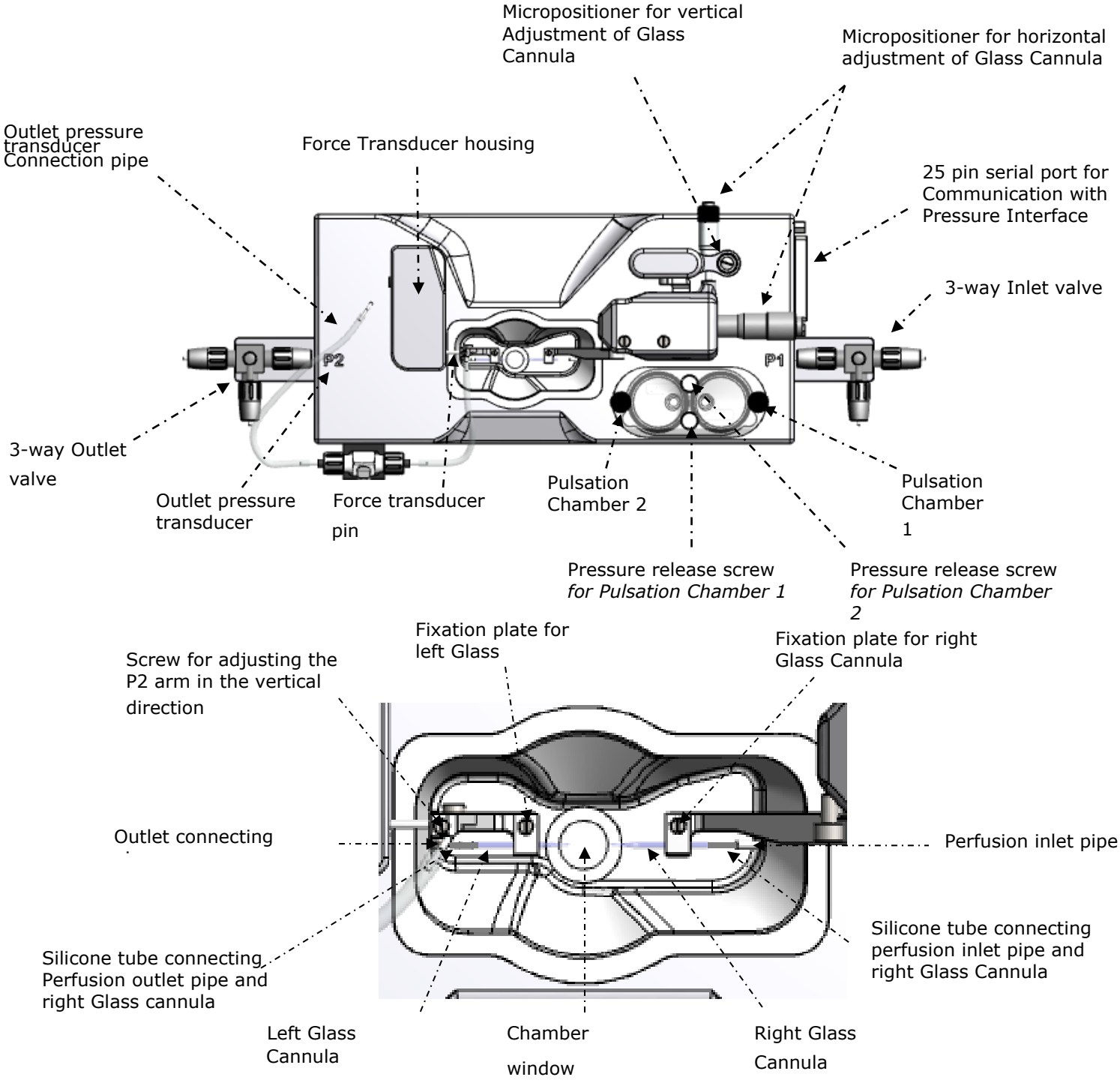


Figure 1.4 Pressure Myograph – 112PP with close-up detail of the chamber

2.1 SETTING UP THE COMPLETE PRESSURE MYOGRAPH SYSTEM

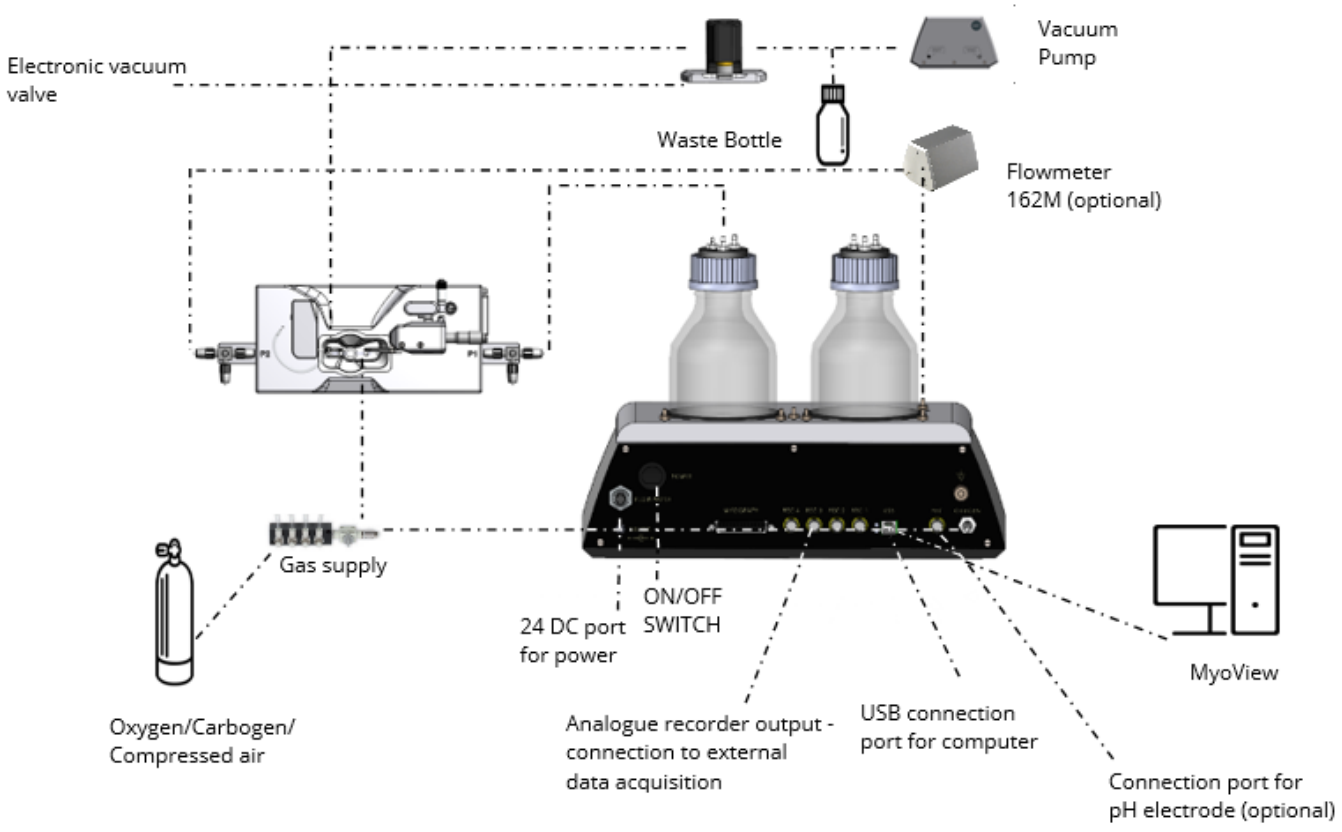


Figure 2.1 Pressure Myograph – 112PP with close-up detail of the chamber

Figure 2.1 is an example of a complete set-up for the Pressure Myograph System. The overview includes optional equipment such as a peristaltic pump to enable superfusion flow and pH probes for measuring pH in the superfusion buffer. In addition, the overview also includes the DMT Flowmeter - 162FM. The Flowmeter enables flow measurements in the range of 15-4000µl/min. A detailed step-by-step description is provided in the remaining sections of chapter 2.

The Pressure Myograph System will work with a range of different microscopes: the DMT Microscope,

NOTE: THE MICROSCOPE IS ESSENTIAL FOR THE DIMENSIONAL ANALYSIS OF THE MOUNTED VESSELS.

The DMT Microscope is a standard inverted microscope with a built-in digital CCD USB camera. The DMT Microscope is very effective and recommended in setups requiring standard image analysis.

The Zeiss Axio vert A1 is an inverted microscope that provides the highest degree of flexibility in image analysis. The Zeiss Axio vert A1, a Nikon TS-100F and Motic AE 2000 enable the use of a wide range of objectives and facilitate sophisticated fluorescence techniques. A camera mount is needed for the DMT USB camera.

Contact the DMT Sales Department for further product information and price on any optional equipment, including microscopes.

2.2 SETTING UP STEP-BY-STEP

This section describes how to connect the cables in the Pressure Myograph System as illustrated in figure 2.1.

NOTE: BEFORE PROCEEDING SETTING UP STEP-BY STEP MAKE SURE THAT THE PRESSURE INTERFACE, THE MICROSCOPE AND THE COMPUTER ARE SWITCHED OFF.

1. Pressure Myograph chamber to Pressure Interface connection: Connect the Pressure Myograph chamber to the Pressure Interface by using the grey 25/44-pin connection cable. Then connect the cable with the temperature probe to the Pressure Myograph.
2. Pressure Interface to computer connection: Connect the Pressure Interface to the computer with the USB cable, from the back panel of the Pressure Interface to the USB port on the computer.
3. Pressure Interface and oxygen supply connection: Connect the “Oxygen” inlet on the back of the Pressure Interface to an adjustable oxygen supply using the “Atlas Copco Cablair hose” delivered with the Pressure Myograph System.

IMPORTANT: MAKE SURE THAT THE HOSE IS SECURELY FASTENED TO THE “OXYGEN” INLET USING THE HOSE CLIP. THE PRESSURE FROM THE OXYGEN SUPPLY MUST NOT EXCEED 1.0 BAR.

4. Microscope/camera to computer connection:
   A. DMT Inverted Microscope: Inside the DMT Microscope there is a USB camera wired to a USB cable and one USB cable to power the microscope light. Connect the two USB cables from the DMT Microscope to the computer USB ports.
   B. Another microscope: Zeiss Axio vert A1, Nikon TS-100F, Motic AE 2000 etc. Connect the USB cable from the USB camera mounted on the microscope to the computer USB port.

NOTE: IF YOU HAVE PURCHASED A COMPUTER FROM DMT WITH YOUR PRESSURE MYOGRAPH SYSTEM THEN MYOVIEW DATA ACQUISITION SOFTWARE HAS ALREADY BEEN INSTALLED WITH DRIVERS FOR THE DIGITAL USB CAMERA. FOLLOW THE NEXT PROCEDURE TO SETUP THE PRESSURE MYOGRAPH SYSTEM.

NOTE: IF YOU HAVE NOT PURCHASED A COMPUTER FROM DMT FOLLOW THE MYOVIEW QUICK INSTALLATION GUIDE TO INSTALL MYOVIEW ON YOUR OWN COMPUTER. PLEASE MAKE SURE THE COMPUTER HAS THE REQUIRED SPECIFICATIONS.

5. Pressure Interface to external Data Acquisition System connection (optional): If you have not obtained the MyoVIEW software the four BNC ports on the rear of the Pressure Interface enables connection of an external data acquisition system for recording inlet pressure P1, outlet pressure P2, longitudinal force, probe temperature, chamber temperature, flow ON/OFF, pressure ON/OFF, pH1 value.

6. Turn on the power: Turn the main power to the Pressure Interface on at the power switch. Then turn on the computer and the Pressure Myograph System is now ready to for use with MyoVIEW Data Acquisition Software.

2.3 THE FIRST FORCE AND PRESSURE CALIBRATIONS

Prior to shipping the Pressure Myograph System has gone through two days of continuous testing, including final force and pressure calibrations. However, in order to ensure that the Pressure Myograph System is working at highest performance, DMT recommends that new force and pressure calibrations are performed before the first use. The force and pressure calibration procedures are described in detail in chapter 3.7.1.

2.4 EXTERNAL PRESSURE MYOGRAPH CONNECTIONS

This section illustrates how to connect the perfusion circuit, the superfusion circuit, oxygen supply, pressure supply and suction device on to the Pressure Myograph.

2.4.1 CONNECTING PERFUSION FLOW AND PURGING THE SYSTEM WITH BUFFER

The Pressure Interface controls the perfusion flow. Instructions on how to control the perfusion flow are provided in chapter 3.4. To connect the Pressure Interface to the Pressure Myograph, use the silicone tube (internal diameter 1mm) delivered with the Pressure Myograph System.

- Connect the “perfusion inlet” at P1 on the Pressure Myograph (see figure 2.2 and 2.3 for Pressure Myograph - 114P and Pulsatile Pressure Myograph – 112PP, respectively) to the P1 outlet on the cap of the Pressure Interface bottle (see figure 2.4).
- Connect the “perfusion outlet” at P2 on the Pressure Myograph (see figure 2.2 and 2.3 for Pressure Myograph - 114P and Pulsatile Pressure Myograph – 112PP, respectively) to the P2 inlet on the Pressure Interface (see figure 2.4).

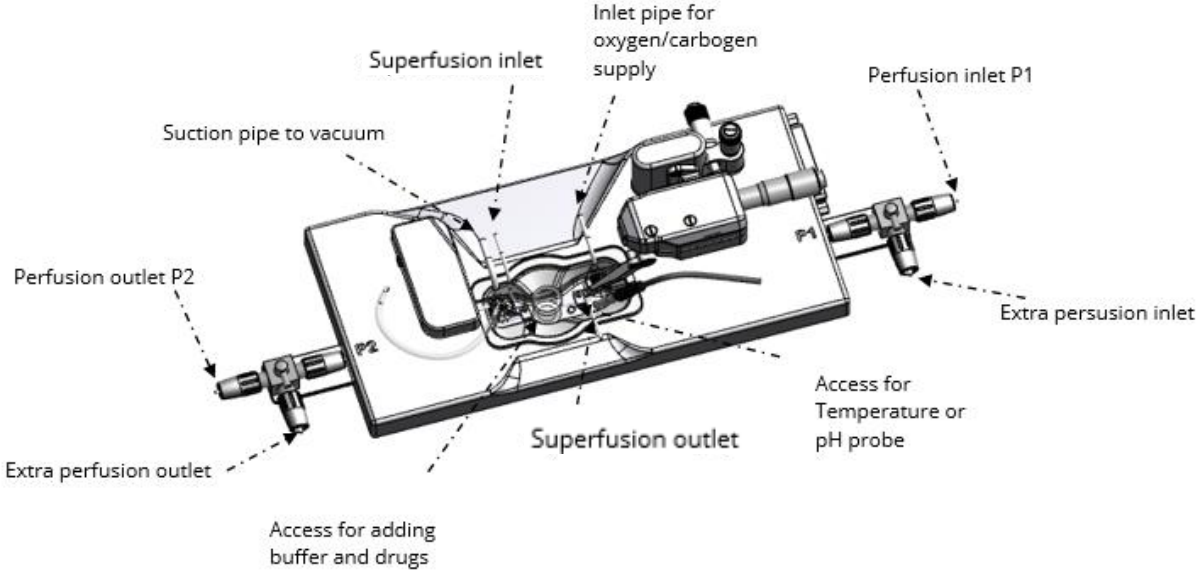


Figure 2.2 External connections for Pressure Myograph 114P

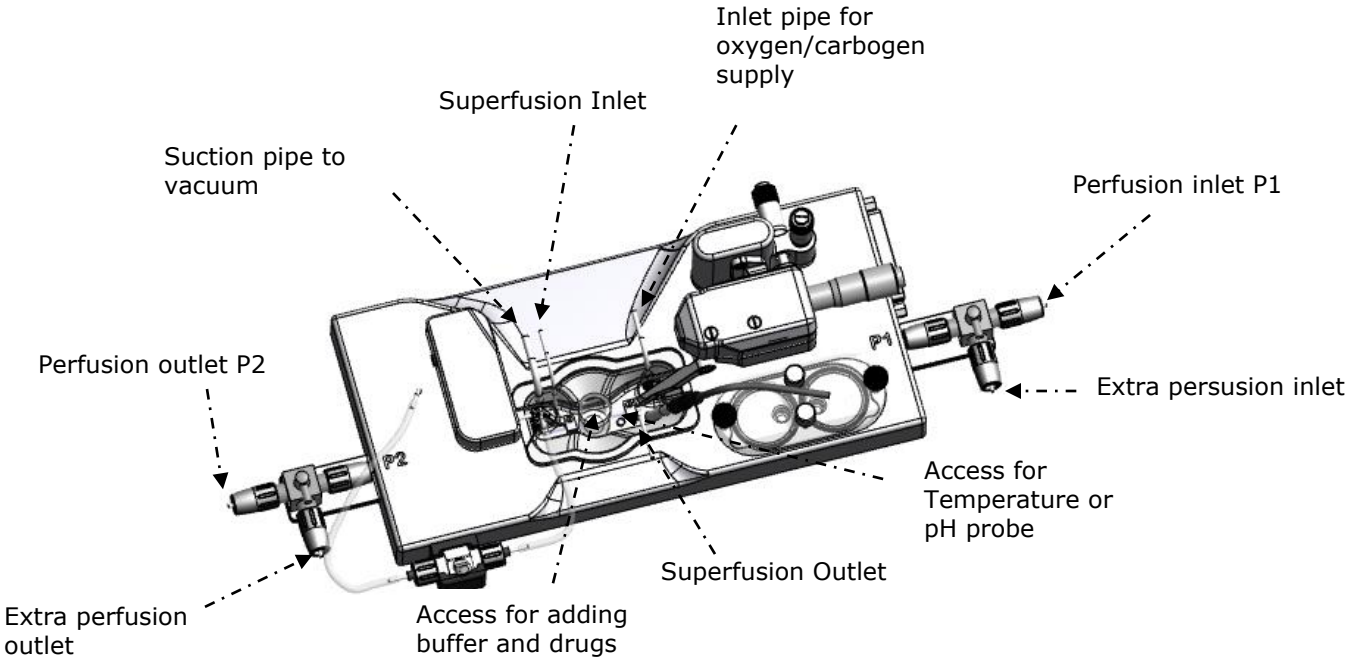


Figure 2.3 External connections for Pressure Myograph 112PP

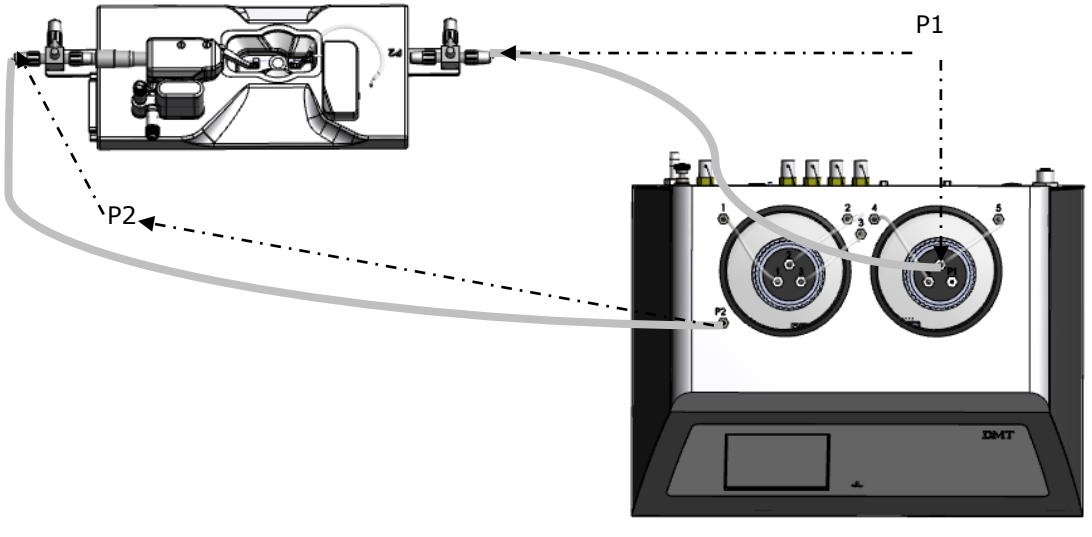


Figure 2.4 External connections for Pressure Myograph - 114P

NOTE: TO FILL THE TUBING AND AVOID AIR BUBBLES, MOUNT THE CALIBRATION SHUNT (RESISTANCE TUBE) AS SHOWN BELOW AND DESCRIBED IN CHAPTER 3.7.2.1.

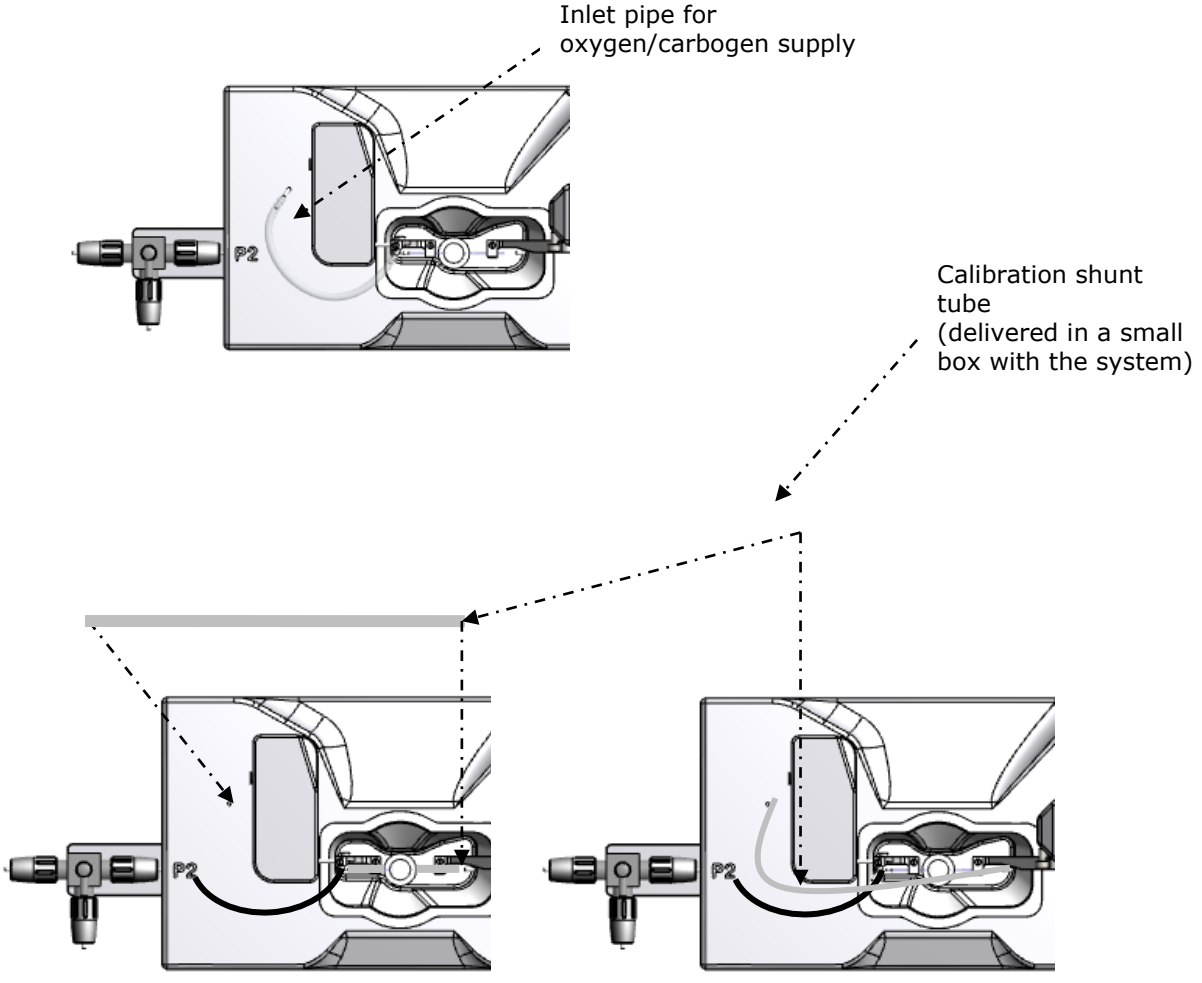


Figure 2.5 Mounting of the Calibration Shunt tube in the 114P and 112PP chamber

Fill the p1 Schott bottle with a maximum of 300 ml pre-warmed buffer aerated with carbogen.

NOTE: It is very important that the buffer is prewarmed to 37^0C and aerated with carbogen to avoid air bubbles in the silicone tubing during an experiment.

In the pressure interface menu set the pressure p1 and p2 as follow:

P1 = 150mm Hg
P2 = 70mm Hg
Set the Pressure ON
Set Flow ON

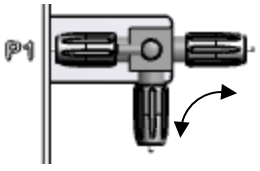
FOR 114P USERS CONTINUE AS BELOW AND FOR 112PP USERS GO TO SECTION 12

IMPORTANT:

- *FOR 114P USERS CONTINUE AS BELOW AND FOR 112PP, USERS GO TO SECTION 12*
- *LET THE PRESSURE REGULATOR RUN UNTIL NO AIR BUBBLES ARE VISIBLE IN THE PERFUSION CIRCUIT.*
- *NEVER RUN AIR BUBBLES THROUGH A VESSEL AS THIS MAY DAMAGE IT.*

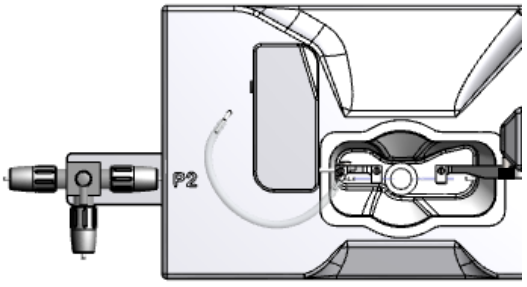
NOTE: NEVER FILL THE BUFFER BOTTLE WITH MORE THAN 300 ML AS HIGHER VOLUMES MAKES PRECISE CONTROL OF THE PRESSURE MORE DIFFICULT.

1. When no air is seen in the tubing turn of the flow and close the P1 3-way valve to the chamber as shown below.



Connected to P1 reservoir Bottle

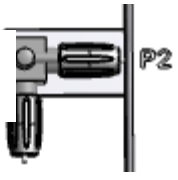
2. Fill the 114P chamber with 6ml pre-heated buffer.
3. Detach the short silicone tubing from the short steel pipe connecting the P1 glass cannula to the steel pipe inside the chamber.



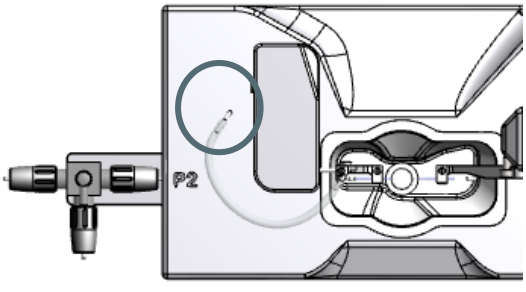
Detach the silicone from the short steel pipe here and attach a 5ml syringe with an 18-gauge needle

4. Attach a 5ml syringe with an 18-gauge needle to the short silicone tubing on the P1 glass cannula and use the syringe to drag buffer into the P1 glass cannula and silicone tube. When all air is removed, re-connect the short silicone tube to the steel pipe inside the chamber again.
5. Close the P2 3-valve towards the chamber as shown below

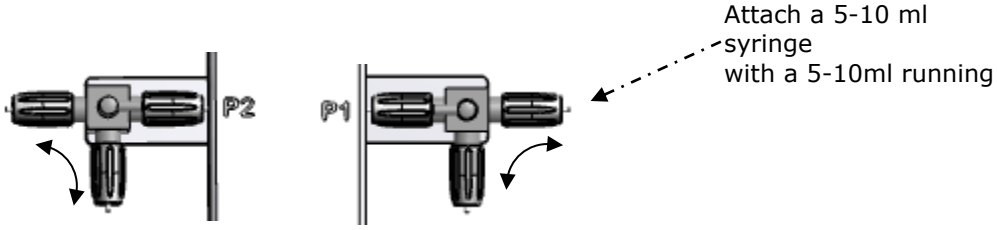
Connected port to marked P2 on the pressure interface



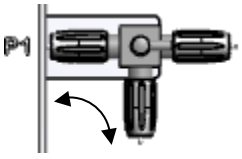
6. Detach the silicone tube on the top of the chamber at the P2 side as the position shown in the figure with a circle below. Attach a 5ml syringe with an 18-gauge needle to the silicone tube and use the syringe to drag buffer into the P2 glass cannula and silicone tube. When all air is removed, re-connect the silicone tube to the steel pipe on the 114P chamber, see figure below.



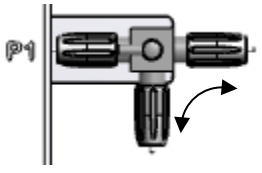
7. Inspect the glass cannulas and the silicone tubing in the chamber for air bubbles using a dissection microscope. If no air bubbles are visible, then continue with the mounting of the artery (See USER GUIDE). If not then try to repeat the above until all air bubbles are removed. If an air bubble is located on the P1 side, then try to remove it as described in step 8-10, otherwise skip these steps.
8. Close the 3-way valves toward the chamber at the P1 and P2 side. Detach the silicone tubing to the P1 and P2 reservoir bottles at the 3-way valves.



9. Attach a 5-10ml syringe at the extra P1 perfusion Inlet and push a small volume of buffer through the 3-way valve to remove air in the valve. Then close the 3-way valve toward the P1 buffer flask as shown below.



10. Now very gently with the syringe push buffer into the chamber (MONITOR the P1 Pressure on the Pressure Interface screen and DO NOT exceed 200mmHg). Make sure the chamber is connected to the interface with the myograph cable. Push minimum1ml into the chamber and P1 cannula to remove air. Close the 3-way valve toward the chamber as shown below.



11. The 114P chamber can now be moved to a dissection microscope for mounting of the vessel in the chamber.

NOTE: ARTERY MOUNTING PROCEDURE SEE "PRESSURE MYOGRAPH -114P/112PP – USER GUIDE PAGE 6-8".

FOR 112PP USERS CONTINUE AS FOLLOWS

12. Let the pressure regulator run and open the valve into the P1 Pulsation Chamber. As soon as the bottom part of P1 pulsation chamber is filled with buffer, quickly close the valve again. Open the valve into P2 Pulsation chamber. As soon as the bottom part of the P2 Pulsation chamber is filled with buffer, quickly close the valve.

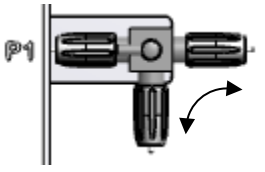
    NOTE: DO NOT DISCONNECT THE CHAMBER AND INTERFACE AT ANY TIME DURING SETPOINT 12-24. IF THE CHAMBER AND INTERFACE IS DISCONNECTED A VALVE INSIDE THE CHAMBER WILL CLOSE AND IT WOULD BE IMPOSSIBLE TO FLUSH BUFFER FROM P1 3-VALVE TO P1 CANNULA.

13. Let the pressure regulator run until no air bubbles are visible in the perfusion circuit.

    IMPORTANT:
    NEVER RUN AIR BUBBLES THROUGH A VESSEL AS THIS MAY DAMAGE THE ENDOTHELIUM.

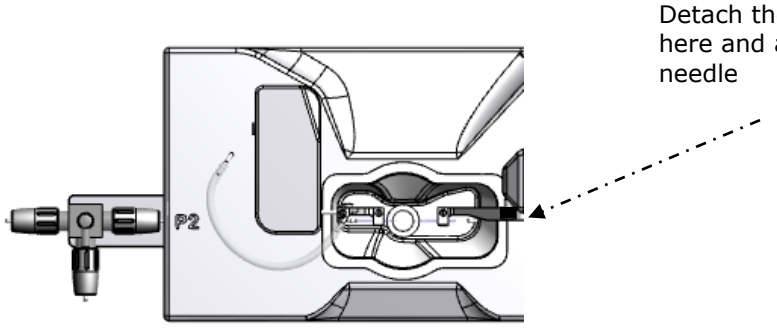
    NOTE: NEVER FILL THE BUFFER BOTTLE WITH MORE THAN 300 ML AS HIGHER VOLUMES MAKES PRECISE CONTROL OF THE PRESSURE MORE DIFFICULT.

14. When no air is seen in, the tubing turn of the flow and close the P1 3-way valve to the chamber as shown below.

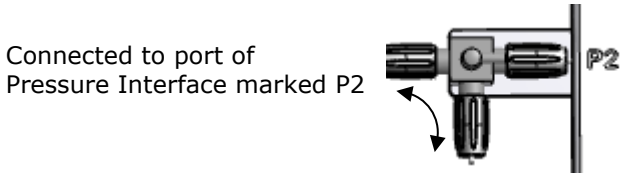


Connected to P1 reservoir

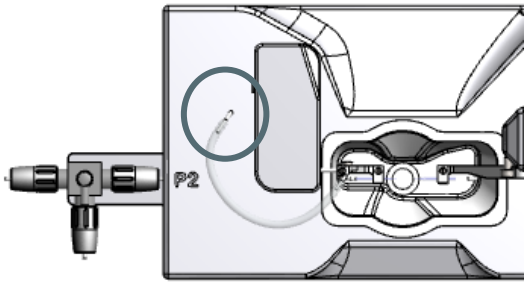
15. Fill the 114P chamber with 6ml pre-heated buffer.
16. Detach the short silicone tubing from the short steel pipe connecting the P1 glass cannula to the steel pipe inside the chamber.



17. Attach a 5ml syringe with an 18-gauge needle to the short silicone tubing on the P1 glass cannula and use the syringe to drag buffer into the P1 glass cannula and silicone tube. When all air is removed, re-connect the short silicone tube to the steel pipe inside the chamber again.
18. Close the P2 3-valve towards the chamber as shown below.

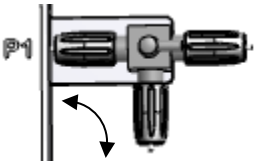


19. Detach the silicone tube on the top of the chamber at the P2 side at the position shown in the figure below with a red circle. Attach a 5ml syringe with an 18-gauge needle to the silicone tube and use the syringe to drag buffer into the P2 glass cannula and silicone tube. When all air is removed, re-connect the silicone tube to the steel pipe on the 114P chamber (red circle on the picture below).

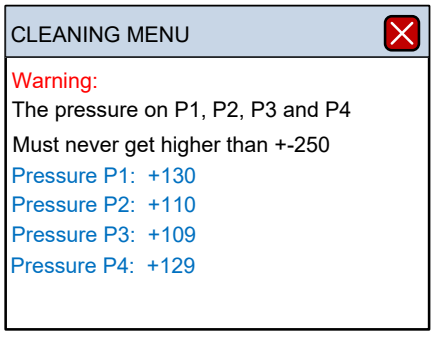


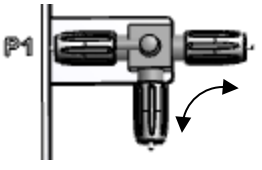
20. Inspect the glass cannulas and the silicone tubing in the chamber for air bubbles using a dissection microscope. If no air bubbles are visible, then continue mounting the artery. If not, then try to repeat the above until all air bubbles are removed. If an air bubble is located on the P1 side, then try to remove it as described in step 8-10, otherwise skip these steps.
21. Close the 3-way valves toward the chamber at the P1 and P2 side. Detach the silicone tubing to the P1 and P2 reservoir bottles at the 3-way valves.

22. Attach a 5-10ml syringe at the extra P1 perfusion Inlet and push a small volume of buffer through the 3-way valve to remove air in the valve. Then close the 3-way valve toward the P1 buffer flask as shown below.



23. Now very gently with the syringe push buffer into the chamber (MONITOR the P1, P2 and P4 Pressure on the Pressure Interface screen and DO NOT exceed 200mmHg in the CLEANING MENU). Push 1ml into the chamber and P1 cannula to remove air. Close the 3-way valve toward the chamber as shown below.





24. The 114P chamber can now be moved to a dissection microscope for mounting of the vessel in the chamber by detaching the silicone tubes connected to the P1 and P2 3-way valves.
25. The 114P/112PP chamber can now be moved to a dissection microscope for mounting an artery in the chamber.

NOTE: ARTERY MOUNTING PROCEDURE SEE "PRESSURE MYOGRAPH -114P/112PP – USER GUIDE PAGE 6-8".

2.4.2 EXTRA PERFUSION INLET/OUTLET

The extra perfusion inlet/outlet 3-way valves on the Pressure Myograph allow the introduction of special agents or reagents to the perfusion circuit during an experiment. They are placed at P1 and P2 on the Pressure Myograph and the small handle on top of the valves controls the flow direction. See figure 2.6.

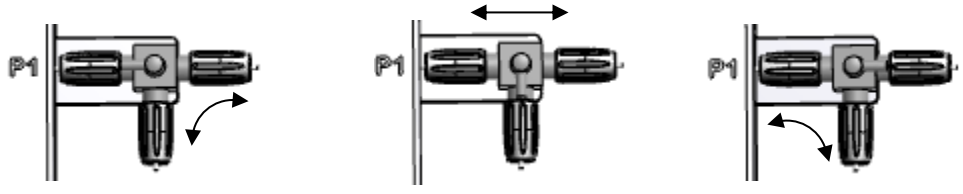


Figure 2.6 3-way valve flow settings at P1.
The arrow indicate the flow directions.

2.4.3 CONNECTING SUPERFUSION FLOW (OPTIONAL)

Creating a superfusion flow in the Pressure Myograph chamber requires an external peristaltic pump, which is not part of the basic Pressure Myograph System. Contact DMT for further information about recommended perfusion pump models, specifications, and prices. The superfusion circuit is connected to the Pressure Myograph cover lid steel pipes as illustrated in figure 2.7.

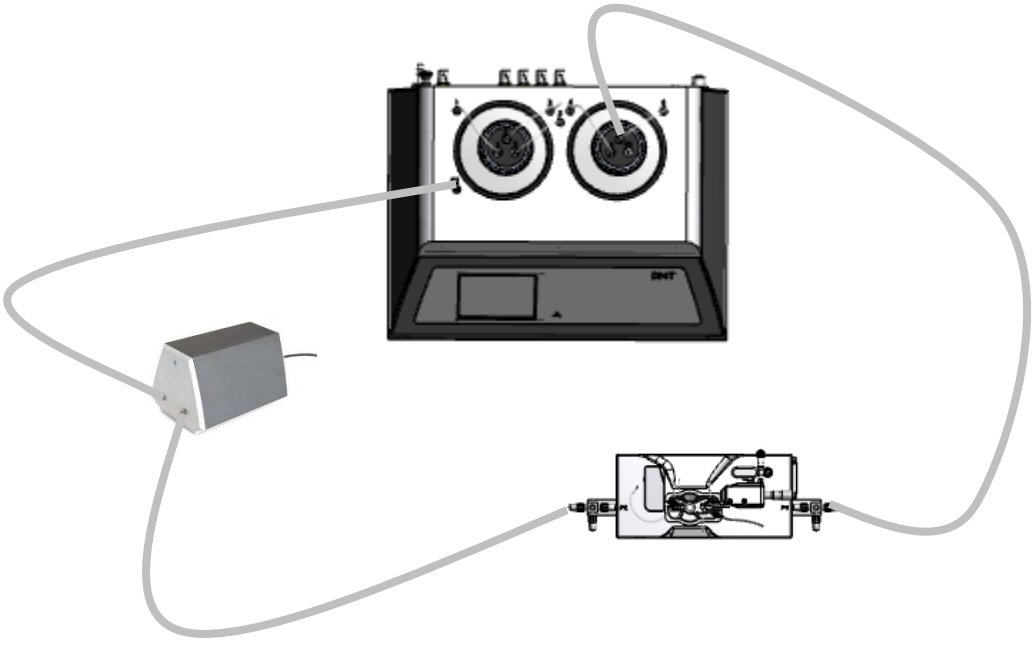
2.4.4 CONNECTING THE FLOWMETER – 162FM (OPTIONAL)

The FlowMeter – 162FM is optional for flow measurements in the range of 15 – 4000µl/min. The FlowMeter is easily combined with any Pressure Myograph System as illustrated in figure below. The 162FM Flowmeter can be obtained as a stand-alone Flowmeter or build into the Pressure Interface.

Use of the FlowMeter permits control of intravascular pressure, pressure gradient and flow conditions with high accuracy. This enables in vitro studies on vessel segments under conditions very close to those found in vivo. Adding the FlowMeter to the Pressure Myograph System also enables measurement of flow rate as a parameter. The FlowMeter data will make it possible to record live traces of the flow dependent parameters as shear stress and vascular resistance due to changes in vessel structure and function in various physiological and pharmacological studies.

To add the stand-alone FlowMeter to the Pressure Myograph System the cable from the flowmeter is attached to the flowmeter port marked on the backside of the Pressure Interface. MyoVIEW will recognize the FlowMeter as soon as it is connected to the Pressure Interface and will be ready for use immediately. If the flowmeter is purchased later than the pressure system, a new license code for MyoVIEW is supplied when opening the flow parameters.

The External DMT 162FM Flowmeter is connected at the P2 side of the 114P/112PP chamber using the applied silicone tubing with the internal diameter of 1mm. Connect the P2 outlet from the 114P/112PP chamber with the DMT 162FM Flowmeter Inlet and then connect the DMT 162FM Flowmeter outlet with The P2 connection on the Pressure Interface (see figure below).



*NOTE: THE DMT 162FM FLOWMETER WILL NOT GIVE CORRECT VALUE FOR THE 112PP SYSTEM DURING PULSATION. 112PP USERES CAN **ONLY** USE THE FLOWMETER IN THE NON-PULSATILE MODE.*

2.4.6 CONNECTING A SUCTION DEVICE

Connect the “large” pipe on the Pressure Myograph chamber cover (see figure 2.7) to a vacuum pump via a suction bottle and a vacuum valve as illustrated in figure 2.1. The internal diameter of the silicone tube used for this connection must be 2 mm. (a 2 mm tube is not included with the Pressure Myograph System).
The Vacuum Package (#101018/#101052) contain the electronic valve, waste bottle, vacuum pump and all the tubing and fittings.

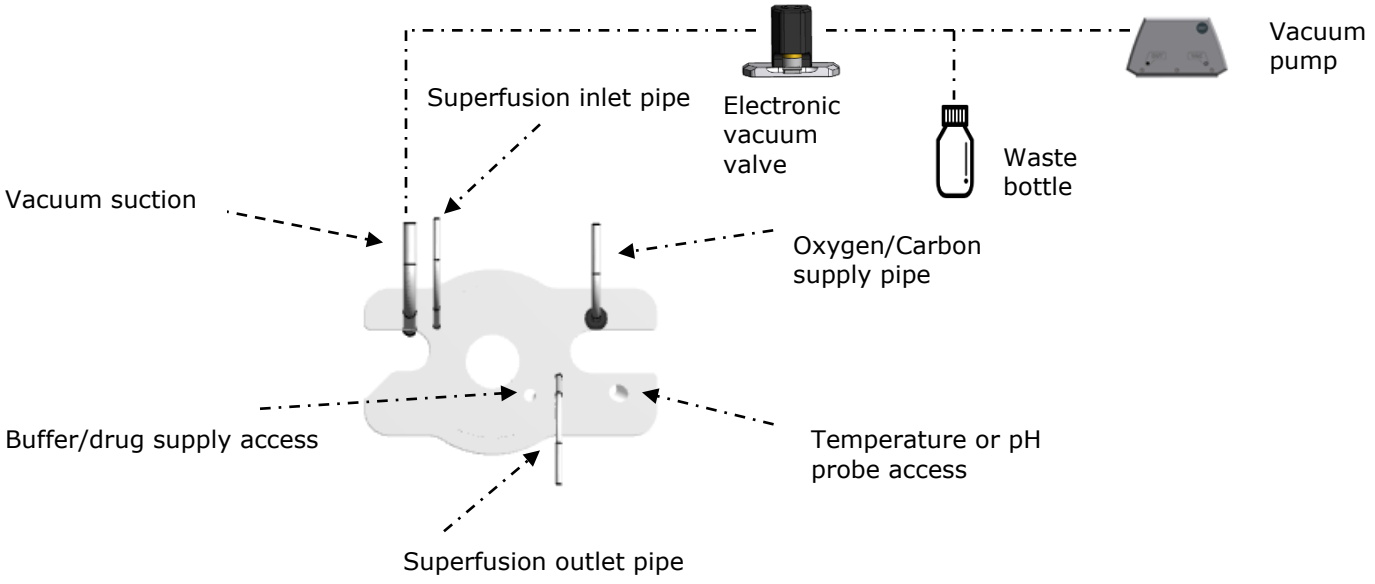


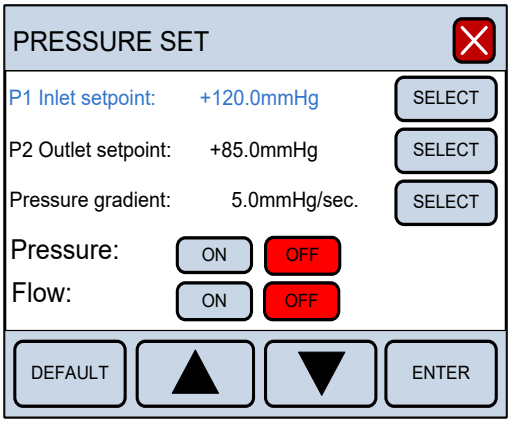
Figure 2.7 Description of coverlid functions for the 114P and 112PP chamber

CHAPTER 3 - PRESSURE INTERFACE MENUS

This chapter contains a detailed description of how to navigate the touch screen menus and how to use the special features of the Pressure Interface.

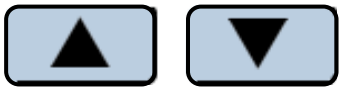
3.1 GENERAL DESCRIPTION OF HOW TO NAVIGATE THE TOUCH SCREEN

Menus on the Pressure Interface are all accessible by a touch screen. To access a menu, simply touch the screen. When a setting needs to be changed, press SELECT beside the line to be changed.



The line selected will turn blue, indicating that the Pressure Interface is in edit mode and waiting for input. When DEFAULT is chosen, a default value will be displayed.

To change the numeric value for the selected parameter, touch the UP or DOWN arrows.



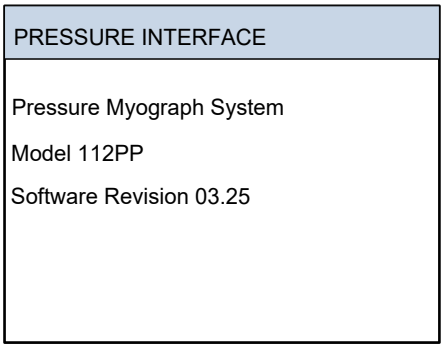
Once the desired setting has been chosen, pressing ENTER will save the selection, and the new value will be stored in memory. The selected line will turn black.

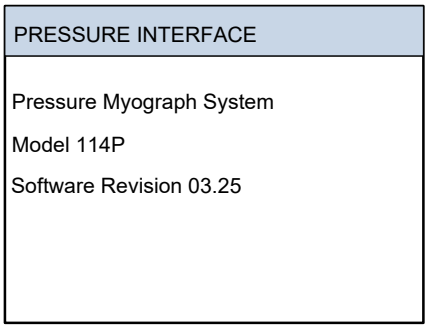
Pressing the white X in the red box will exit the menu and take you automatically to the Main Menu.

3.2 POWER-UP SCREEN

After turning on the Pressure Interface, an introduction screen appears. It displays the software version number. While this screen is displayed the system is auto-initializing.

After a few seconds, the Main Menu display will appear, showing the firmware version of the system.

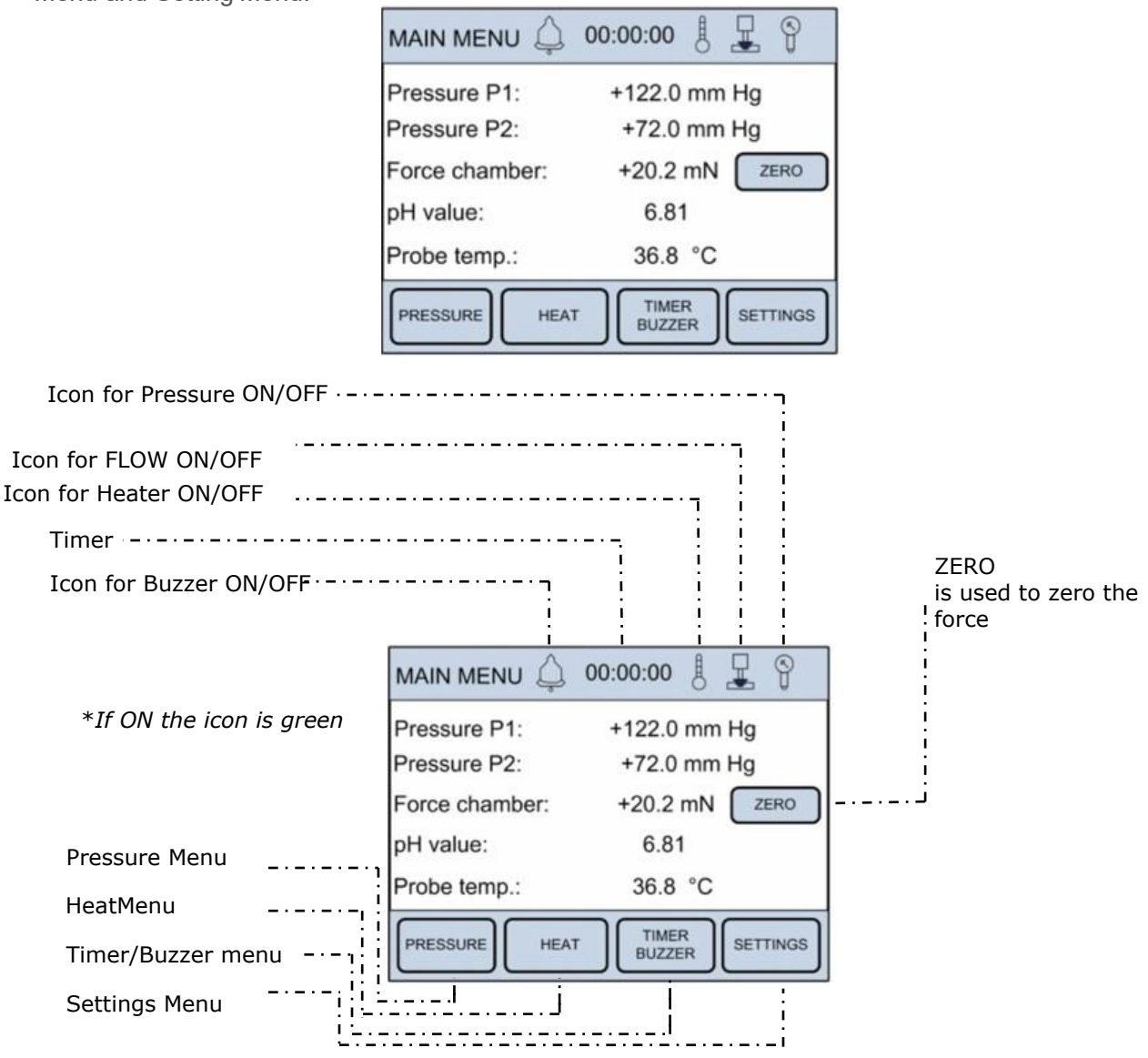




3.3 MAIN MENU

The Main Menu gives a good overall picture of how the Pressure Interface is working. It displays values for the input pressure, output pressure, force, pH (Optional), probe temperature and time, and the status of systems including the time, heat, flow and pressure. See next page for a description of the Main Menu.

Four sub-menus are accessible from the Main Menu screen: Pressure Menu, Heat Menu, Timer Buzzer Menu and Setting Menu.



Buzzer icon:
This icon indicates the status on the buzzer. If the icon is grey the buzzer is OFF.
If the icon is green the buzzer is ON (active) and will make a sound when the timer reaches zero.

OFF **ON**

Timer:
The Timer is a countdown timer that can be set to maximum 24 hours. If the Buzzer is activated, it will buzz when the timer reaches zero.

00:00:00

Heat icon:
This icon indicates the status of the chamber heat. If the icon is grey the heat is OFF.
If the icon is green the heat is ON (active).

OFF **ON**

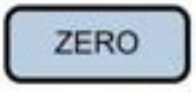
Flow valve icon:
This icon indicates the status on the flow valve.
If the icon is grey the flow valve is OFF (NO flow). If the icon is green the flow valve is ON (active).

OFF **ON**

Pressure icon:
This icon indicates the status of the pressure regulation. If the icon is grey the pressure regulation is OFF.
If the icon is green the pressure regulation is ON (active).

OFF **ON**

Zero:
Is used to zero the output from the force transducer. Pressing ZERO will reset the baseline of the chart traces without affecting the calibrations.

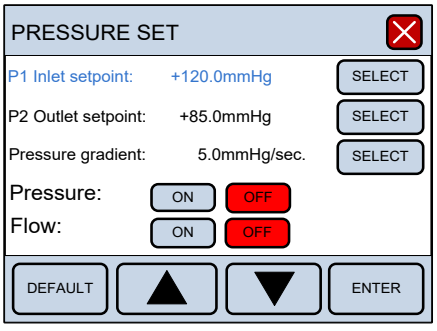


3.4 PRESSURE MENU

The pressure is controlled from this menu. Use SELECT to select the line to be changed. When selected the line changes to blue (edit mode). Use DEFAULT or UP and DOWN arrows to change the setpoint value. Pressing ENTER will save the new setpoint.

P1 Inlet setpoint is the pressure value that the regulator is setting on the inlet side of the Pressure Myograph. Pressure range is 0-250mmHg.
P2 Outlet setpoint is the pressure value that the regulator is setting on the outlet side of the Pressure Myograph. Pressure range is 0-250mmHg.

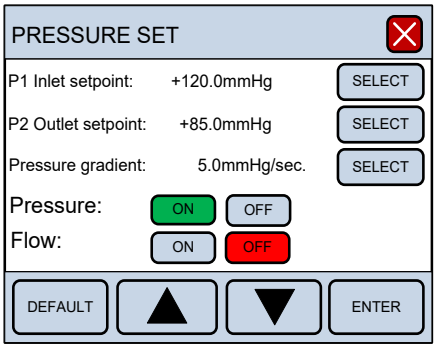
Pressure gradient set the speed at which the regulator modifies the pressure. The pressure change range is 1-10mmHg/sec.



IMPORTANT:

- *P1 INLET SETPOINT SHOULD BE HIGHER THAN P2 OUTLET SETPOINT TO CREATE FLOW.*
- *P1 INLET SET POINT CANNOT BE LOWER THAN P2 OUTLET SET POINT. THIS IS TO PREVENT BACKFLOW IN THE SYSTEM.*
- *IF FLOW IS ON, P1 INLET SET POINT HAS TO BE HGHER THAN P2 OUTLET SET POINT. THE SYSTEM WILL AUTOMATICALLY MAKE THE CORRECTION IF A SMALLER DIFFERENCE IS ENTERED.*
- *IF NO-FLOW IS WANTED, TURN FLOW OFF. SETTING P1 EQUAL P2 IS NOT POSSIBLE WITH FLOW ON. (SEE NEXT PAGE)*

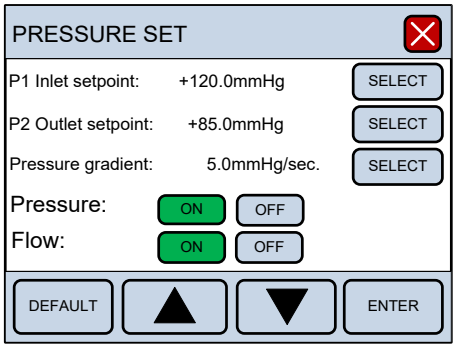
The pressure regulator and the flow are also controlled from this menu. To turn the pressure regulator on press ON outside the line for Pressure. When activated it turns green.



In Main Menu the pressure icon also turns green when pressure regulation is on.

ON

To turn the flow on press ON outside the line for Flow. When activated it changes green.

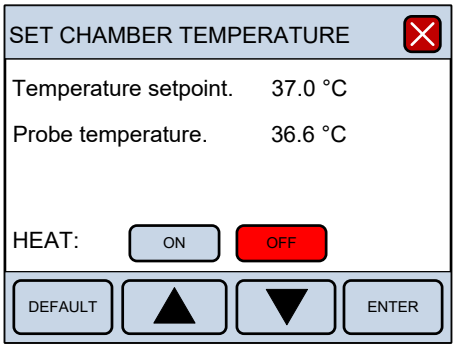


In Main Menu the flow icon also turns green when flow is on. Turning flow on will demand that the P1 is equal or higher than P2 pressure set point. The pressure interface will automatically make the correction when P1 is set to the same value as P2 if P1 is lower than P2. Turn flow OFF to simulate a “blind sac” experiment. Do not set P1 equal P2 because risk of backflow.

ON

3.5 HEAT MENU

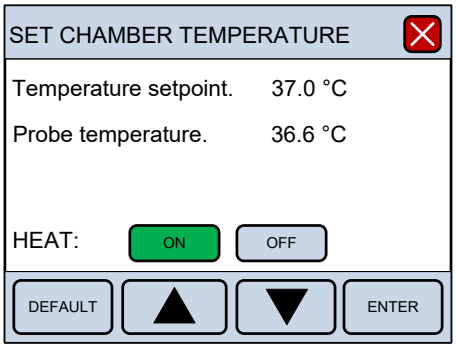
The chamber and bottle heating temperature are controlled from this menu. To turn the heat on, or to change the temperature for the system, press the HEAT in the Main Menu. The display will enter the Heat Menu and allow the user to change the system temperature, as well as turn heat on or off. Pressing DEFAULT will automatically reset the temperature setpoint to 37°C. Manually change the temperature by pressing the UP or DOWN arrows. Pressing ENTER will save the new temperature setpoint.



To turn the heat on, press ON and it will turn green. The system will heat to the desired temperature setpoint.

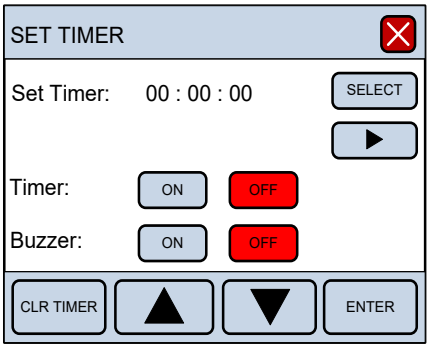
In Main Menu the thermometer icon turns green when the heat is on.

ON



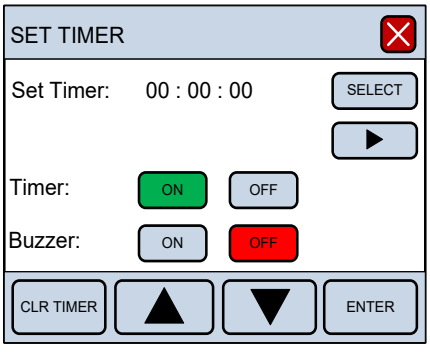
3.6 TIMER AND BUZZER MENU

The timer and buzzer are controlled from this menu.



Use SELECT to program the timer. The timer can be programmed in intervals from 0 to 23:59:59 (Hours: minutes: seconds). When Set Timer is selected press the UP and DOWN arrows to program the timer. The hours are programmed first, and then use the RIGHT arrow to get to the minutes and then the seconds.

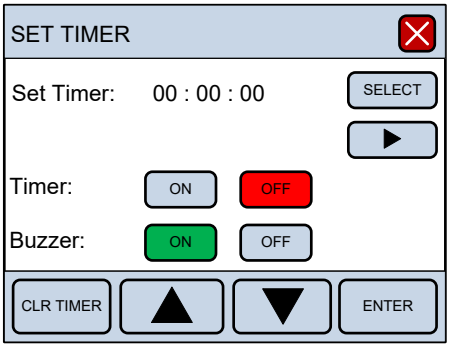
Pressing ENTER will save the programmed time.



To start the timer, press the Timer ON and it will turn green. When the timer reaches zero it automatically switches to OFF. If the buzzer is set ON it will make a tone when the timer reaches zero

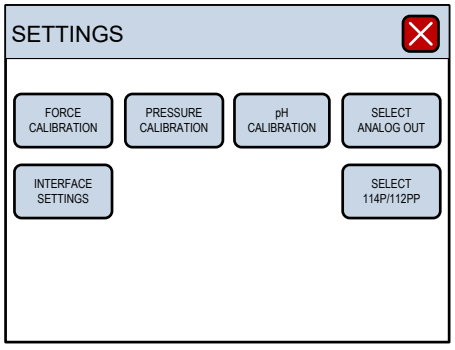
To activate the buzzer, press ON and it will turn green. In Main Menu the bell icon also turns green.

ON



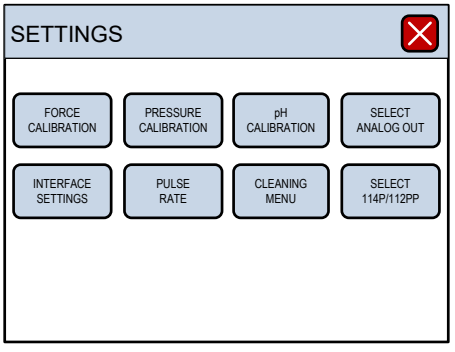
3.7 SETTING MENU

The Settings Menu for the 114P system contains several sub-menus. These sub- menus include:



- Force Calibration
- Pressure Calibration
- pH Calibration (optional)
- Select Analog Output
- Interface Settings
- Select 114P/112PP

The Settings Menu for the 112PP system contains several sub-menus. These sub-menus include:



- Force Calibration
- Pressure Calibration
- pH Calibration (optional)
- Select Analog Output
- Interface Settings
- Pulse Rate
- Cleaning Menu
- Select 114P/112PP

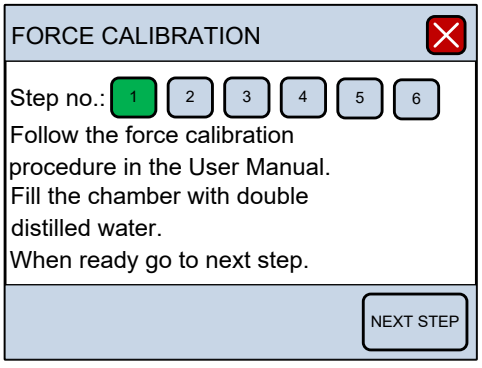
3.7.1 FORCE CALIBRATION MENU

Prior to shipping, the Pressure Myograph System has gone through two days of continuous testing, including final force calibrations. However, DMT recommends that new force calibrations are performed before starting to use the Pressure Myograph System for the first time. The calibration procedure needs to be performed to calibrate the system. Before starting the force calibration, the following is performed. Please see figure 3.1 and 3.2 for Pressure Myograph – 114P or Pulsatile Pressure Myograph - 112PP, respectively.

Enter Force Calibration Menu by pressing Settings in the Main Menu and then press Force Calibration Menu to begin the transducer calibration. The display will show the force calibration procedure. The calibration procedure is listed in 6 individual steps and needs to be performed one at a time to calibrate the system.

Step 1 - Involves setting up the chamber for calibration. Fill the chamber with double-distilled water to a normal level and move the glass cannulas apart.

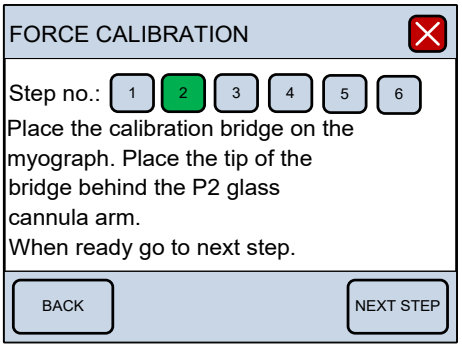
Press NEXT STEP.



Step 2 - Involves setting up the Calibration Kit for the actual force calibration.

Place the calibration bridge and T-balance on the Pressure Myograph allowing it to be pre heated. Make sure that the tip of the T-balance pin is placed behind the glass cannula fixation plate as illustrated in figure 3.1 and 3.2 for Pressure Myograph - 114P or Pulsatile Pressure Myograph – 112PP, respectively. Carefully move the calibration bridge until the tip of the T-balance pin is placed freely and properly in place.

Press NEXT STEP.



IMPORTANT:
MAKE SURE NO FORCE IS APPLIED TO THE TRANSDUCER.

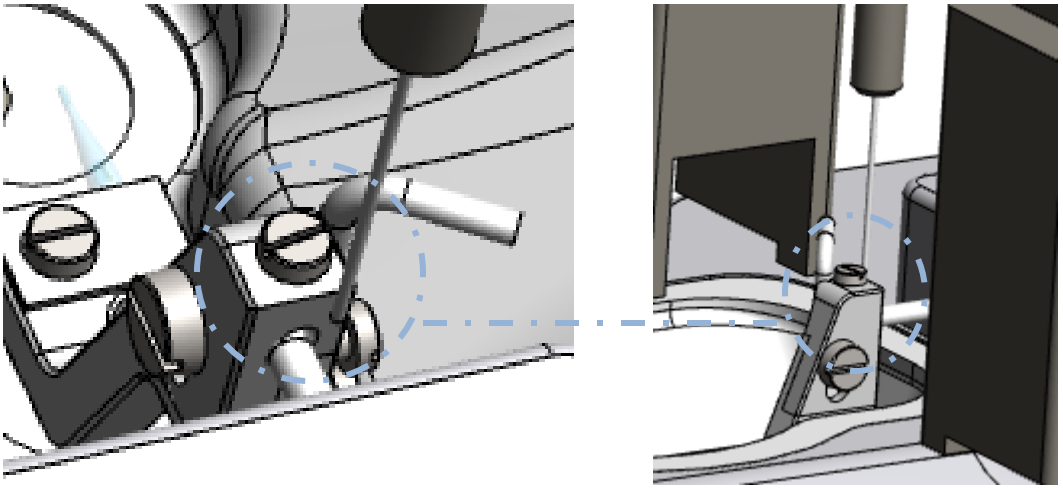
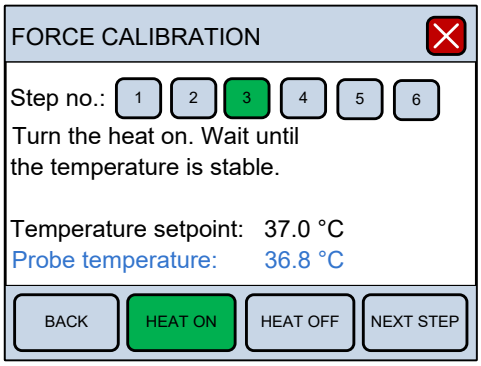


Figure 3.1 Illustration of how to fit the T-balance just behind the P2 glass canulla arm, as close as possible without touching.

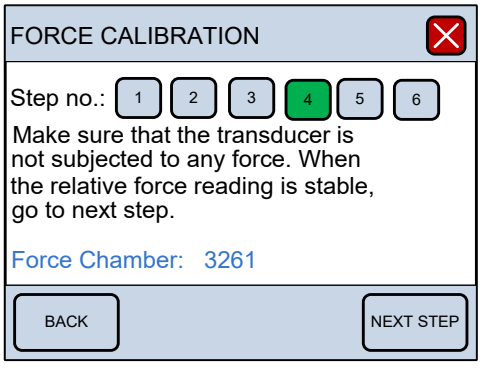
Step 3 - This step initiates the heating process for the chamber. In order for the calibration to be accurate, the transducer must be heated to the same temperature as used in your experiments. This allows for heat-induced expansion of the electronic parts in the transducer. Otherwise, inaccurate readings and transducer drift may occur. To start heating, press HEAT ON.



Place the temperature probe into the chamber for the first calibration to monitor when the chamber has reached the target temperature. After approximately 20- 30 minutes, the whole system will have reached the target temperature (normally 37° C).

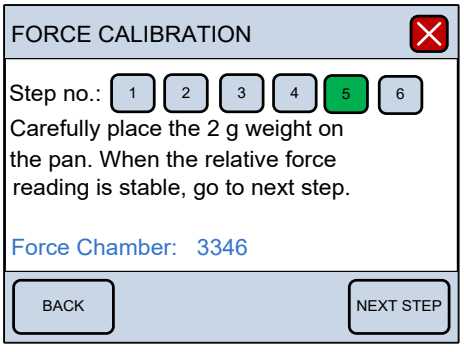
Press NEXT STEP when the chamber is heated and have reached the target temperature.

Step 4 - This is the first step in the actual force calibration process. A four- digit number will be displayed in blue at the bottom of the screen. If nothing has been disturbed during the heating process, the zero / 0 gram calibration should be stable. After 30 to 45 seconds, the four-digit number will not fluctuate. If the four-digit number is not stable, please wait.



Press NEXT STEP

Step 5 - At this step, carefully place the 2 gram weight in the pan closest to the transducer (over the transducer) to simulate the stretch created by the contraction of a mounted vessel preparation (figure 3.2).
Remember, a 2 gram weight in a 90° vector is divided, and the transducer will only detect 1 gram or 9.81 mN of force. The weight placement should cause a positive increase in the four-digit number. Wait at least 30 to 45 seconds for the applied force to stabilize. Press NEXT STEP



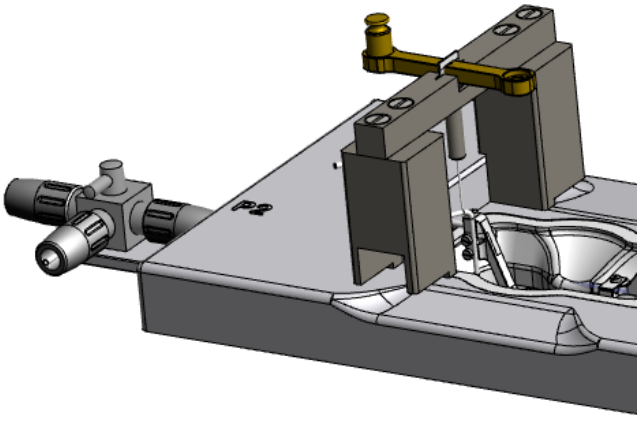
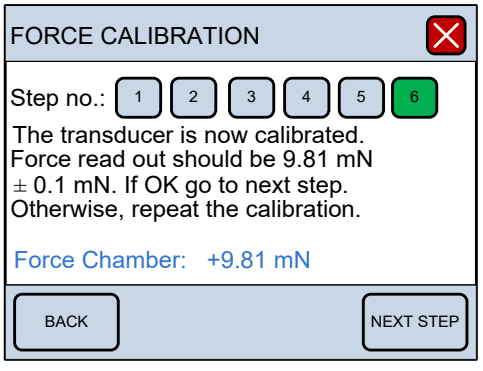


Figure 3.2 Place the 2 gram weight in the pan closest to the transducer (over the transducer) to simulate the stretch created by a mounted vessel preparation.

Step 6 - This step verifies that the calibration was performed correctly. The Force Chamber reading should be 9.81 ± 0.1 mN. If the Force Chamber reading is off by more than 0.1 mN then remove the weight, press BACK to return to step 4, and repeat the calibration process.



Press NEXT STEP if the Force Chamber reading is satisfactory.

After calibrating the force transducer, carefully remove weight, T-balance and calibration bridge. The Pressure Myograph System is now ready for longitudinal force measurements.

3.7.2 PRESSURE CALIBRATION MENU

3.7.2.1 Set-up the pressure calibration procedure

Press Settings in the Main Menu and then press Pressure Calibration. The set-up to perform the pressure transducer calibration procedure is illustrated in figure 3.3 Carefully follow the procedure described below to calibrate the Pressure Myograph System. The calibration procedure is listed in 5 individual steps and needs to be performed one at a time to calibrate the system.

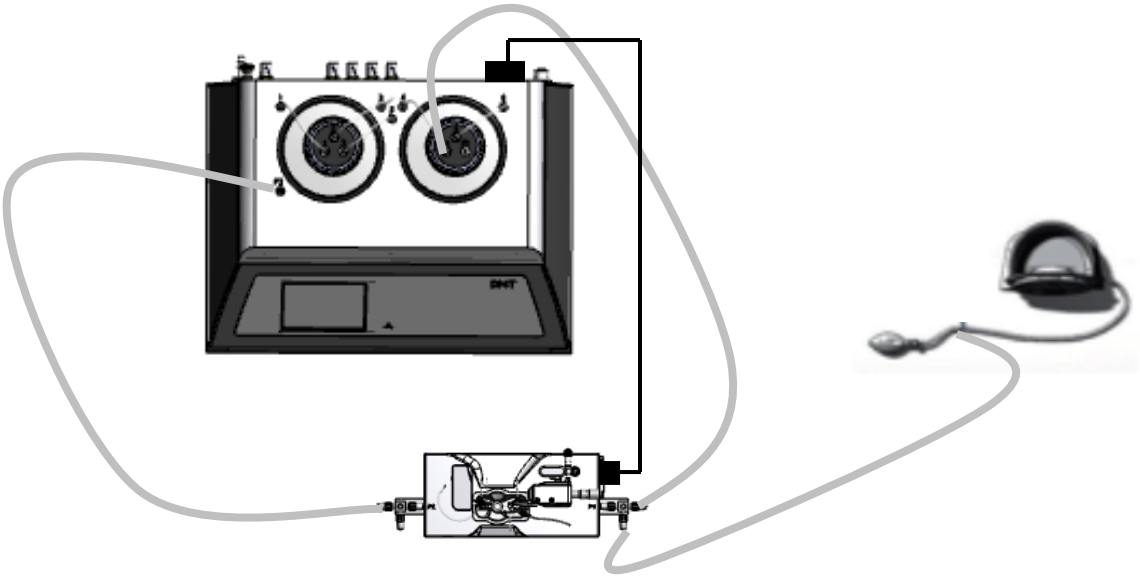


Figure 3.3 Illustration of proper set up for pressure calibration.

PRESSURE CALIBRATION PROCEDURE FOR PRESSURE MYOGRAPH 114P

1. Connect the Pressure Interface with the Pressure Myograph chamber.
2. Connect the Big Ben Pressure Manometer to the 3-way valve at P1 on the Pressure Myograph as illustrated in figure 3.3.
3. Inside the Pressure Myograph chamber, on the right hand side, is a small stainless steel pipe, which is connected to the right glass cannula via a small silicone tube “B”, see figure 3.4. Carefully disconnect the silicone tube from the stainless steel pipe.
4. Carefully disconnect the silicone tube “A” between the “outlet connecting pipe” and the “outlet pressure transducer connecting pipe”, see figure3.4.
5. Mount the enclosed calibration shunt (resistance tube) to the outlet connecting pipe “A” and the stainless steel pipe “B” as illustrated in figure 3.5.

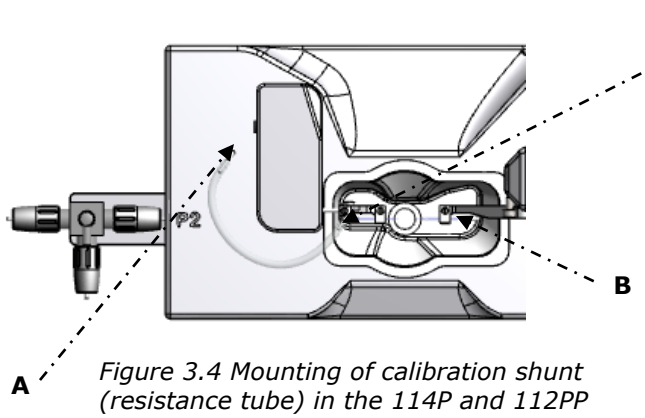


Figure 3.4 Mounting of calibration shunt (resistance tube) in the 114P and 112PP chamber

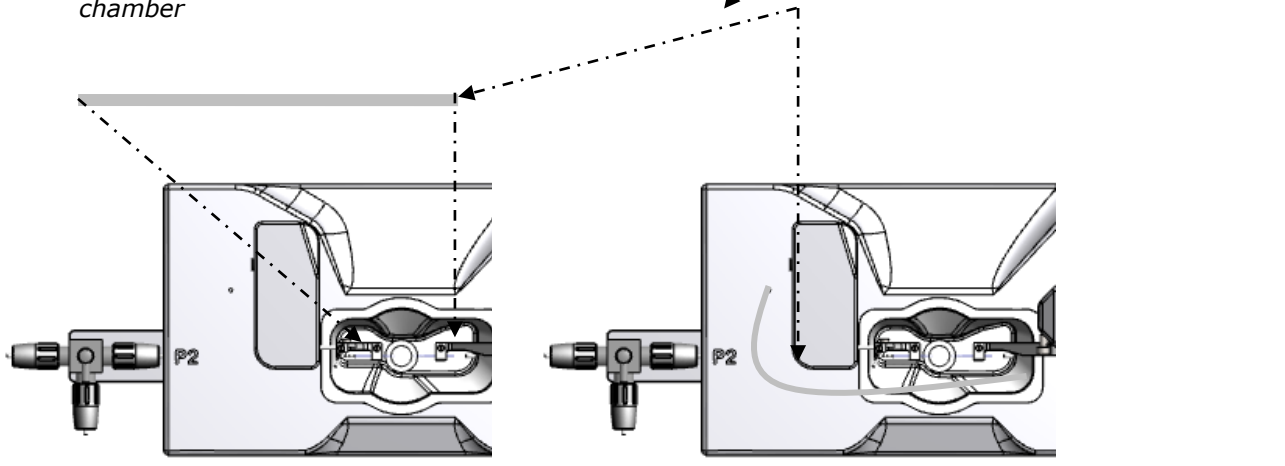


Figure 3.5 Mounting of calibration shunt (resistance tube) in the 114P and 112PP chamber

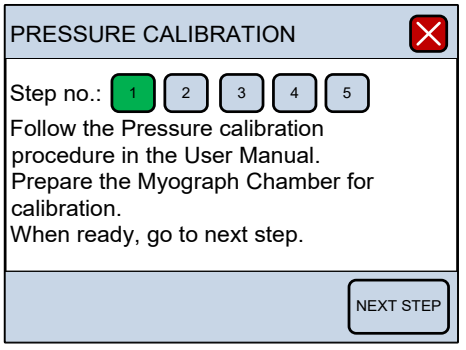
6. Close the P1 3-way valve towards the P1 bottle on the Pressure Interface, see figure 3.6normal inlet way, see figure 3.6. The inlet to P1 now comes from the pressure manometer and the Pressure Myograph system is now ready for a calibration procedure.

Figure 3.6 Three-way valve flow setting at P1

3.7.2.2 Set-up the pressure calibration on the Pressure Interface for the 114P System

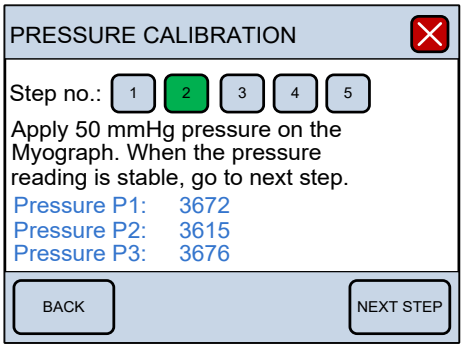
Press Settings in the Main Menu and then press Pressure Calibration. Carefully follow the procedure described below to calibrate the Pressure Myograph System. The calibration procedure is listed in 5 individual steps and needs to be performed one at a time to calibrate the system.

Step 1 - Press NEXT STEP when the system is ready.



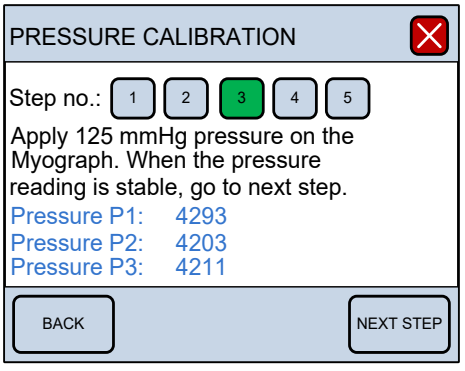
Step 2 - Apply a pressure of 50mmHg on the Pressure Myograph using the Big Ben Pressure Manometer. When the 3 blue lines of relative values stabilize, go to NEXT STEP.

The relative values should be between 3300 to 3900



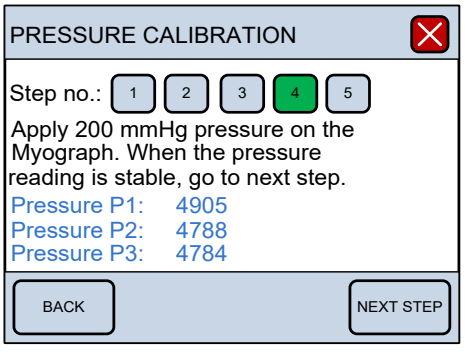
Step 3 - Apply a pressure of 125mmHg to the Pressure Myograph using the Big Ben Pressure Manometer. When the 3 blue lines of relative values stabilize, go to NEXT STEP.

The relative values should be between 3900 to 4500.



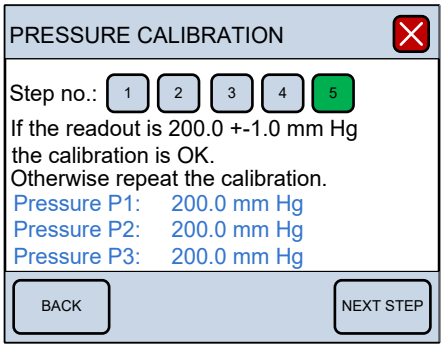
Step 4 - Apply a pressure of 200mmHg to the Pressure Myograph using the Big Ben Pressure Manometer. When the 3 blue lines of relative values stabilize, go to NEXT STEP.

The relative values should be between 4600 to 5200.



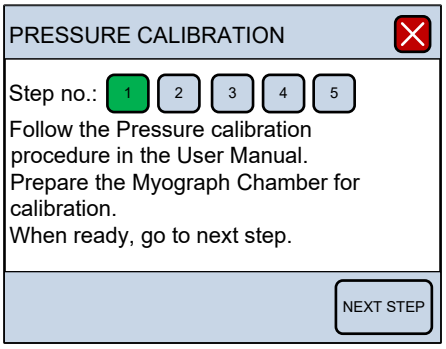
Step 5 - The calibration is now finished. The readings in the three bottom lines are the actual pressure on all three pressure sensors. The values must be 200.0 +/-1.0mmHg.

Carefully remove the calibration shunt tube and reconnect the tubing to the glass cannulas.



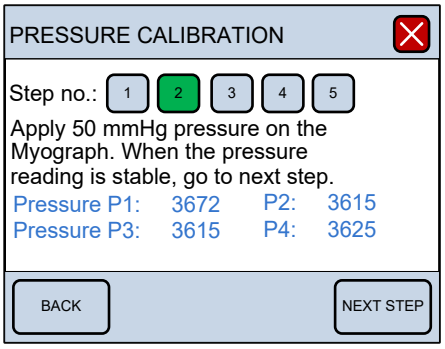
3.7.2.3 Set-up the pressure calibration on the Pressure Interface for the 112PP System

Step 1 - Press NEXT STEP when the system is ready.



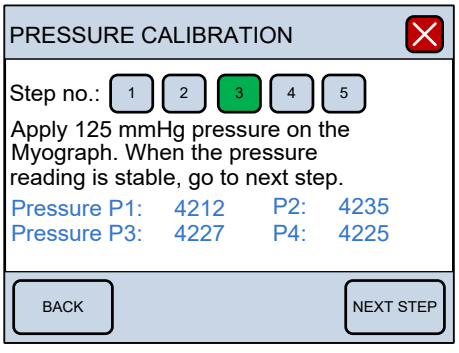
Step 2 - Apply a pressure of 50mmHg on the Pressure Myograph using the Big Ben Pressure Manometer. When the 4 blue lines of relative values stabilize, go to NEXT STEP.

The relative values should be between 3300 to 3900.



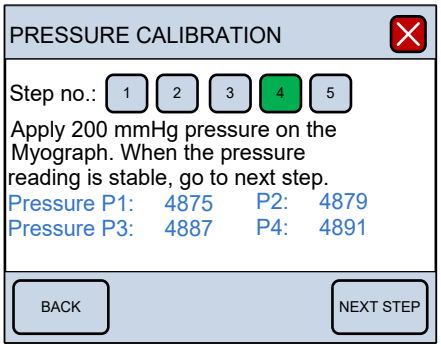
Step 3 - Apply a pressure of 125mmHg to the Pressure Myograph using the Big Ben Pressure Manometer. When the 4 blue lines of relative values stabilize, go to NEXT STEP.

The relative values should be between 3900 to 4500.

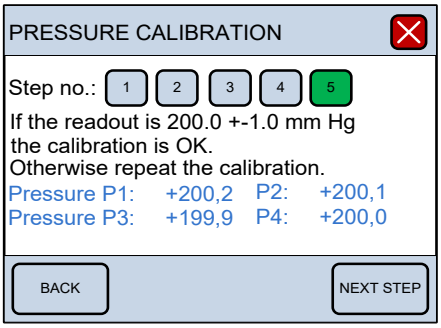


Step 4 - Apply a pressure of 200mmHg to the Pressure Myograph using the Big Ben Pressure Manometer. When the 4 blue lines of relative values stabilize, go to NEXT STEP.

The relative values should be between 4600 to 5200.



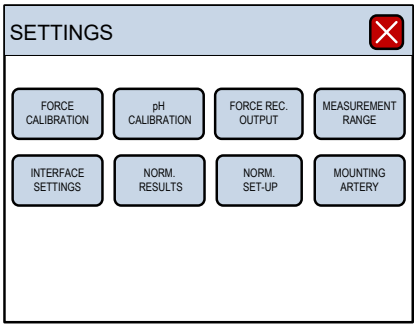
Step 5 - The calibration is now finished. The readings in the four bottom lines are the actual pressure on all four pressure transducers. The values must be 200.0 +/-1.0mmHg.



Carefully remove the calibration shunt tube and reconnect the tubing to the glass cannulas.

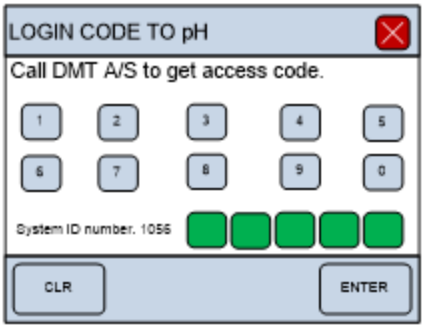
3.7.3 PH CALIBRATION PROCEDURE (OPTIONAL)

The pH Module menu in the 114P/112PP is only visible for users that have bought a pH electrode and pH module at DMT.



By ordering the pH sensor from DMT the pH sensor is delivered with the unlocking code and a quick guide how to do it. Entering the code will the pH Calibration menu visible and usable.

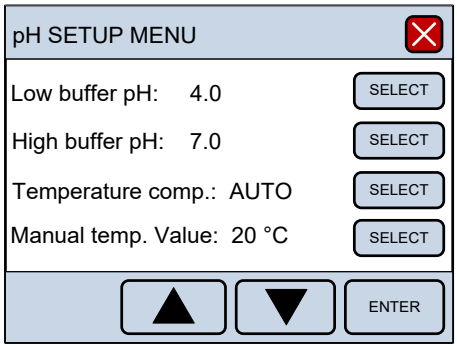
The 114P/112PP system has a build-in pH meter and a pH-meter electrode plug-in port marked PH on the back side of the 114P/112PP interface.



The pH electrode can be ordered at DMT by contacting your sales representative or emailing sales@dmt.dk.
The pH calibration procedure is listed in 4 individual steps and needs to be performed one at a time.

NOTE: BEFORE THE PH CALIBRATION IS PERFORMED BE SURE TO SELECT THE WAY THE PH ELECTRODE IS TO BE USED. SEE THE SUB-MENU UNDER PH SET-UP UNDER INTERFACE SETTINGS

Before the pH calibration is performed be sure to select the way the pH electrode is to be used. See the sub-menu pH Set-up under Interface Settings (3.6.5.2 pH Set-up Menu).

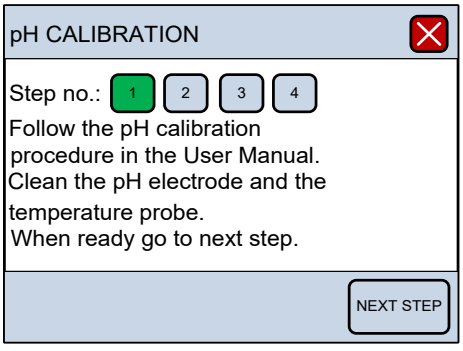


The temperature is an important parameter in the calibration formula and is obtained automatically if AUTO is selected in Temperature compensation function.

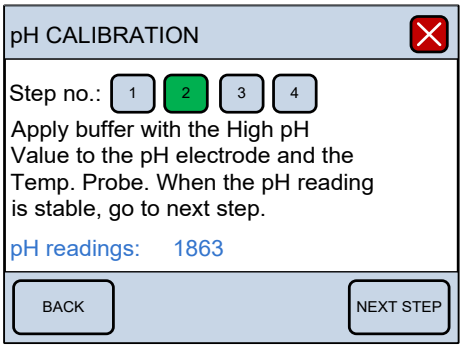
If Manual is selected, the manual temperature is used in the pH calibration formula, and the temperature probe is de-activated.
In the Manual mode, the temperature of the calibration buffers is measured with a thermometer and entered manually in the Manual Temp. value line.

The pH calibration procedure is listed in 4 individual steps and needs to be performed one at a time.

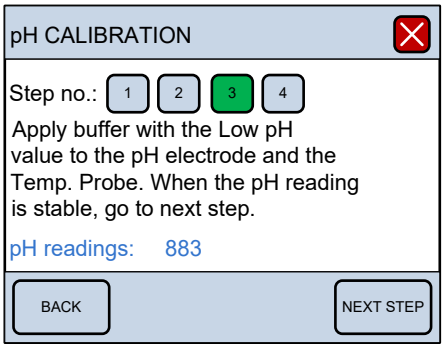
Step 1 - Step 1 involves cleaning the pH electrode and the temperature probe with double distilled water. When ready Press NEXT STEP.



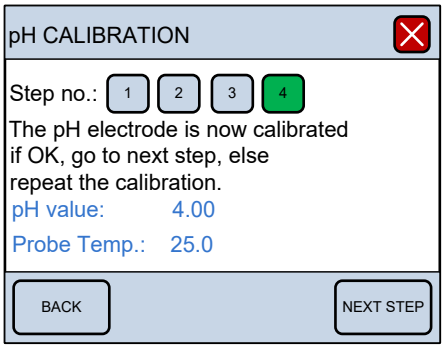
Step 2 - Place the pH electrode and temperature probe in the high buffer solution (here pH 7) and turn on stirring of the high buffer solution. When the relative pH output in the blue line is stable, go to NEXT STEP.



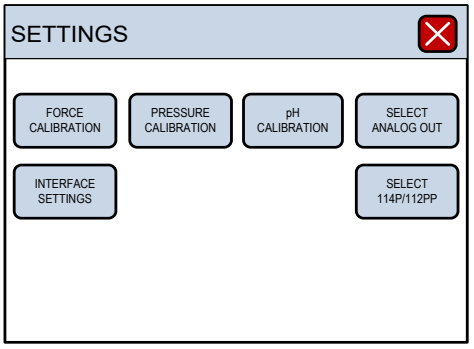
Step 3 - Place the pH electrode and temperature probe in the low buffer solution (here pH 4) and turn on stirring of the low buffer solution. When the relative pH output in the blue line is stable, go to NEXT STEP.



Step 4 - The calibration is now finished. The values in the two bottom lines are the actual pH and temperature reading.

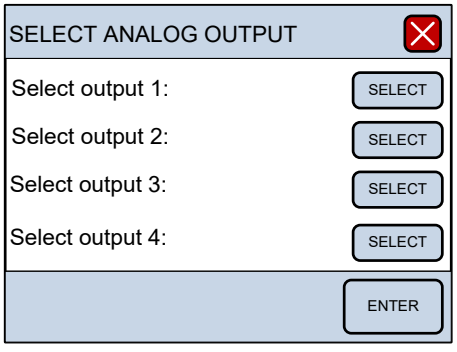


3.7.4 SELECT ANALOG OUTPUT (OPTIONAL)



The Analog Output Menu determines which data is sent to the BNC analog outputs (REC 1, REC 2 REC 3, REC 4) at the back of the Pressure Interface, four in total. Each output is individually programmable. Any changes made to the analog output will only affect the data collected by the external data acquisition system. Therefore, it is important to check the data acquisition setup when a change is made. The analog output works in range of -2,5V to +2,5V.

Use SELECT to select the channel number to be changed. Then press ENTER to go to the output set-up.



Use SELECT to select the line to be changed. Use Up and DOWN arrows or DEFAULT to change/select a new set-up.

The following parameter in the Pressure Interface can be selected as output on the analog channel for 114P:

Force, probe temperature, chamber temperature, pH1, pressure regulation ON/OFF, Flow ON/OFF, (Optional: Digital output 1, Digital output 2, Digital input 1, Digital input 2), Pressure P1, Pressure P2.

and for 112PP:

Force, probe temperature, chamber temperature, pH1, pressure regulation ON/OFF, Flow ON/OFF, (Optional: Digital output 1, Digital output 2, Digital input 1), Pressure P1, Pressure P2, P4.

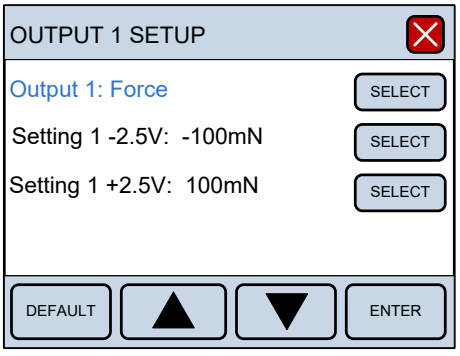
NOTE: REMEMBER TO PRESS THE ENTER KEY TO SAVE THE LINE CHANGES TO MEMORY.

When the parameter is selected press ENTER to save the value.

Example:

The output range is -2,5V to +2,5V. The user can select the parameter value that gives -2,5V and the value that gives +2,5V. In this example -100mN is -2,5V and +100mN is +2,5V.

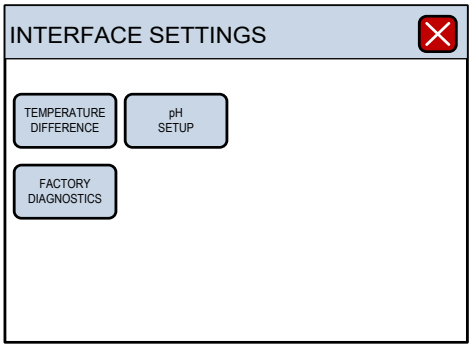
Selecting asymmetrical values is also valid. They can be -2,5V = 0mN and +2,5V = 100mN.



3.7.5. INTERFACE SETTINGS

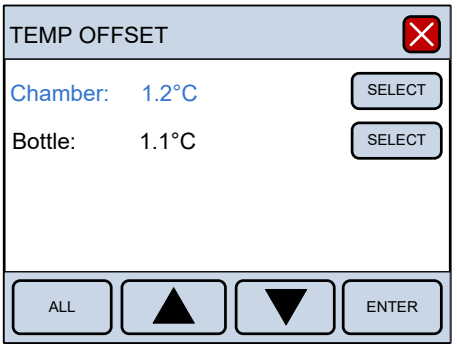
The Interface Settings sub-menu in Settings has an additional three sub-menus which include:

- Temperature Difference
- pH Set-up
- Factory Diagnostics



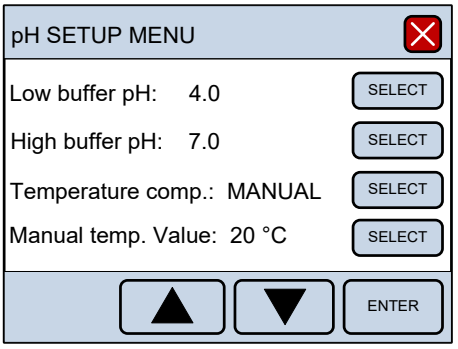
3.7.5.1 Temperature Difference (offset)

The temperature difference function allows the user to fine-tune the temperature setpoint of the system. Although the temperature setpoint for the system can be set in the Heat Menu, the actual temperature for the system may not heat to the exact setpoint. This function allows the user to adjust the temperature of the chamber and bottle individually, so the exact temperatures can be reached. This is referred to as a temperature offset (“TEMP OFFSET” on chamber). Pressing SELECT or ALL have the same function in this menu as previously described. Pressing ENTER will save the values for future experiments.



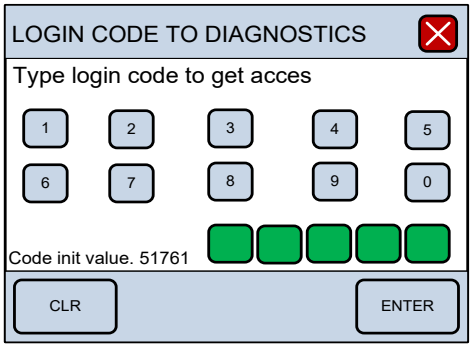
3.7.5.2 pH Set-up Menu

The temperature is an important parameter in the calibration formula and is obtained automatically if AUTO is selected in the temperature compensation, as shown below. If MANUAL is chosen, the manual temperature is used in the pH calibration formula, and the temperature probe is deactivated. In the MANUAL mode, the temperature of the calibration buffers is measured with a thermometer and entered manually in the Manual temp. Value line



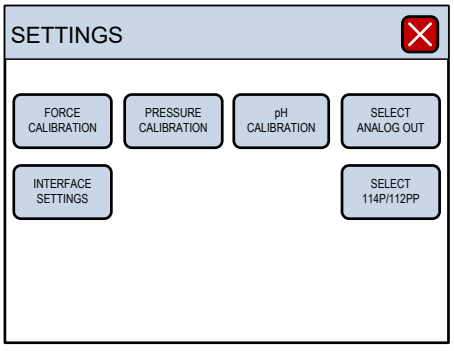
3.7.5.3 Factory Diagnostics

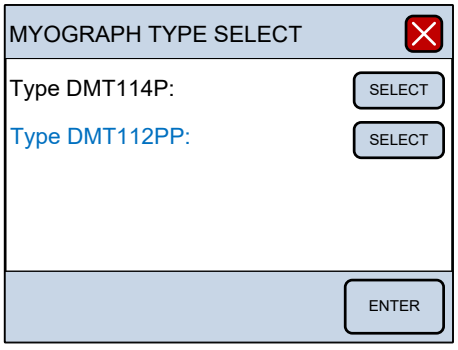
Entering Factory Diagnostics will display the Login code to diagnostics window. This window is for trained technicians and is used for diagnostics and troubleshooting purposes. The general user will not have access to this window. However, entering the proper five-digit login code, will give the trained technician access to diagnostics panels that will provide information during a malfunction, or mechanisms to change other settings controlled by the on-board computer.

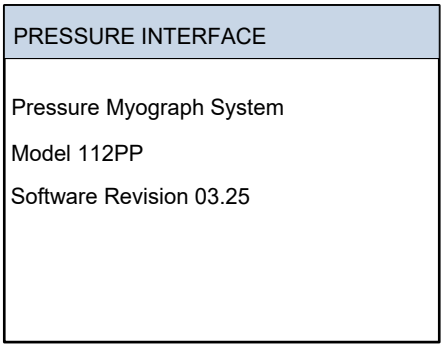


3.7.6. SELECT 114P/112PP

The Select 114P/112PP Menu is only for users that have an 114P and a Pulsatile Pressure 112PP chamber. Using this menu, the user can change the 114P Pressure Interface to an 112PP Pulsatile Pressure interface or vice versa.

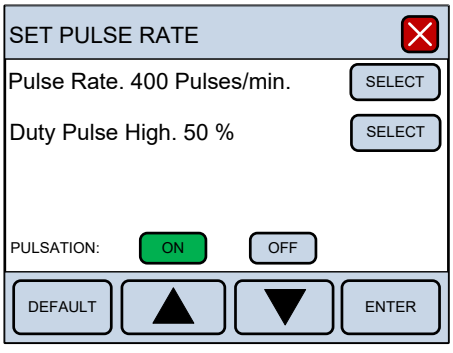






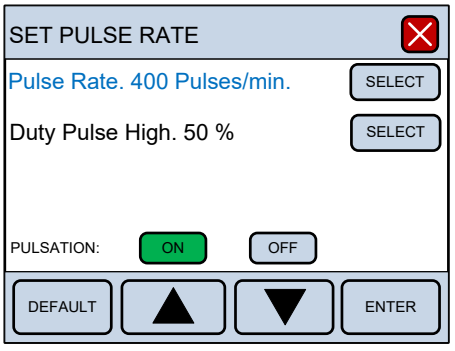
3.7.7. PULSE RATE (ONLY FOR PULSATILE 112PPSYSTEM)

The Select Pulse Rate Menu is only for users that have the Pulsatile Pressure 112PP chamber/system. In the Pulse Rate menu, the number of pulses per minute can be set between 50 and 600 Pulses per minute. By selecting 400 Pulse/min, the Pressure Interface will pulse between the P1 and P2 pressure 400 times a minute.



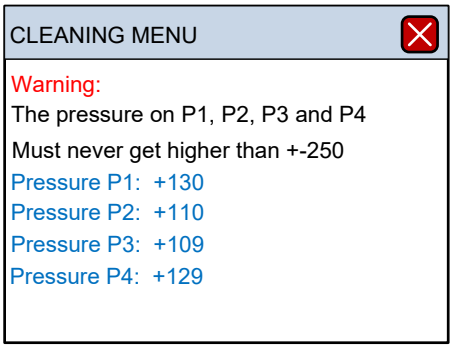
The Duty Pulse High is the percentage of the time the Pressure should be at the P1 pressure. With a setting of e.g. 30%, the Pressure Interface will be at the P1 pressure 30% of the given time and 70% of the time at the P2 pressure. Changing the Duty Pulse High value will change the pulsing profile if wanted.
PULSATION: Pulsation is turned ON or OFF

All the above settings can be controlled in the MyoVIEW 4.0 software.

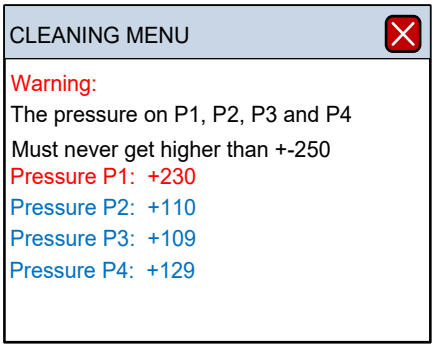


3.7.8. CLEANING MENU (ONLY PULSATILE 112PP)

The Cleaning Menu is mandatory to use when the system is filled/purged with running buffer or cleaned. In the Cleaning Menu the user is able to monitor all four pressure transducers live in the 112PP Pulsatile Pressure System. This is very useful to make sure that manual excessive pressure is not applied to the system at any time. Applied pressure above 250mmHg will break the Pressure Transducers on the 112PP system. Furthermore, the valve switching between P1 and P2 pressure will be active making the cleaning of the system is possible.



When the Pressure exceed 200mmHg the number will, turn red to indicate that the pressure applied manually is close to the maximum pressure the system can handle without breaking the pressure transducers.



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