USER MANUAL, VOL.2.1

AUTOMATED MULTI MYOGRAPH SYSTEM - 630MA

TRADEMARKS

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New information may be supplied separately.

This documentation is provided with the DMT Automated Multi Wire Myograph System – Model 630MA

Every attempt is made to ensure accurate information, misprints, construction- and specification changes, can occur.
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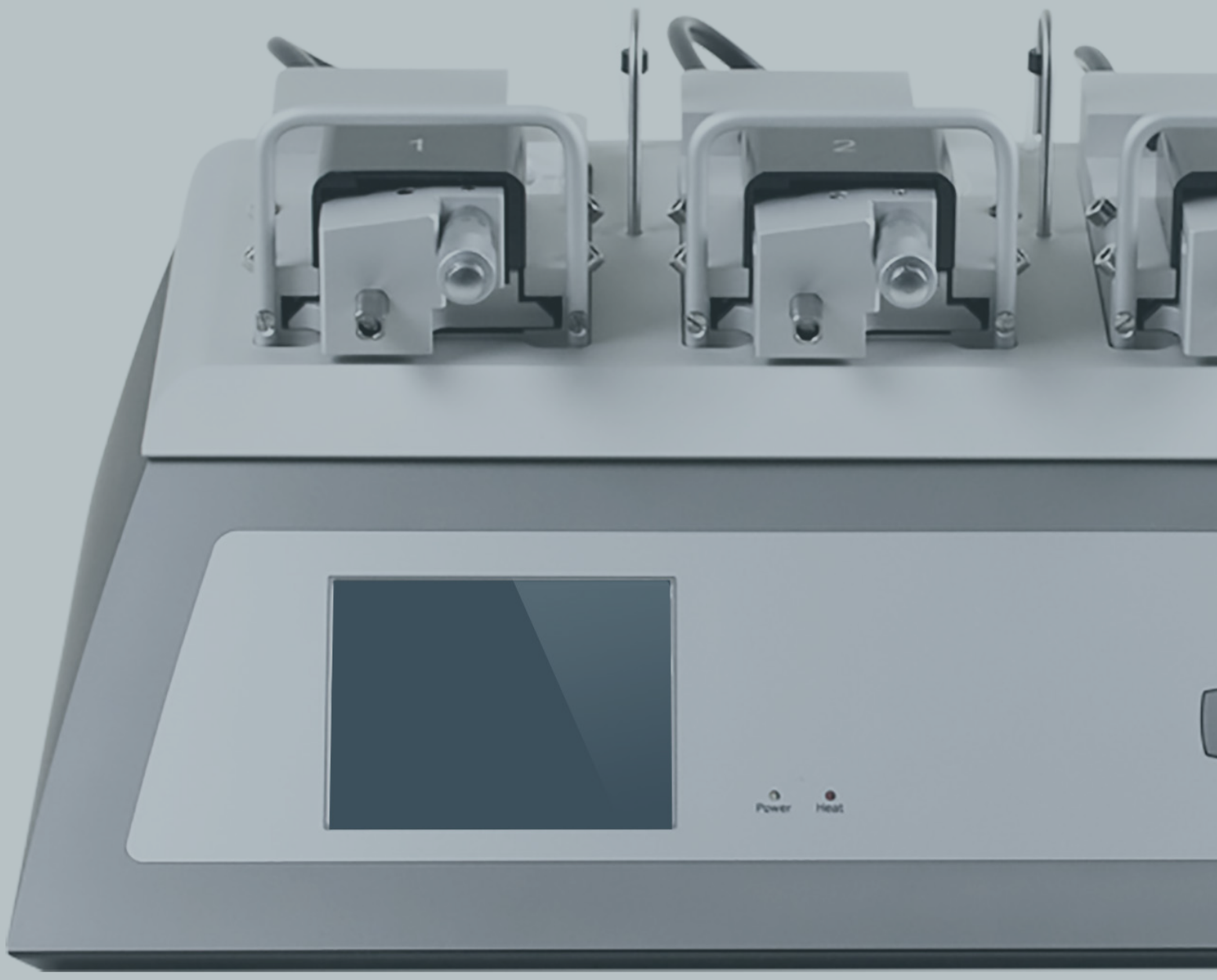

1
2
Power
Heat

CONTENTS

INTRODUCTION

Until the mid-1970s most of the information about the mechanical, morphological and pharmacological properties of vascular smooth muscle were only obtainable from studies on relatively large vessels. At that time rat-tail arteries were the smallest vessels to be investigated in detail due to limitations in the available in vitro techniques. For example, studies measuring the contraction force were routinely performed with only one of the mounting wires secured. Furthermore, relatively large wires (100-200 µm) were used, which precluded the use of small vessels. In addition, the vessel segment had to be directly manipulated with dissecting instruments, causing mechanical trauma. Investigations of smaller vessels, therefore, were limited to in vivo perfusion experiments and histological examination.

In 1976 Professor M. J. Mulvany and Professor W. Halpern described, for the first time, a new technique that made it possible to investigate highly isometric responses from vessels with internal diameters as small as 100 µm. The mounting procedure was refined in 2 ways: 1) both ends of each mounting wire were secured under tension without any direct manipulation of the vessel, and 2) segments of small vessels could not be automatically mounted as ring preparations in a myograph for recording of highly isometric force measurements.

During the late 1970s, some improvements were made to the myograph, and in 1981, a new dual myograph that allowed simultaneous testing of two vessels was introduced. In parallel, the technique became widely acknowledged, resulting in a growing interest in the myograph systems. In 1986, the growing demand resulted in the foundation of the private company, J. P. Trading, with the purpose of making the myograph systems commercially available worldwide. At the same time, J. P. Trading initiated a comprehensive improvement program for the existing myograph systems as well as a development program of new myograph systems in close co-operation with Professor M. J. Mulvany and The University of Aarhus.

During the late 1980s and through the 1990s, several improvements were applied to the myograph systems, such as a new mechanical design, a more robust transducer, and a new electronic system. New systems also were introduced, such as the automatic dual myograph 510A, the multi myograph 610M and the confocal myograph 120CW. In 2000, J. P. Trading changed its company structure and became known as DMT - Danish Myo Technology A/S.
Today, DMT is one of the world's leading designers and manufacturers of wire myographs, pressure myographs, culture myographs and organ/tissue baths. Driven by our global customer base, our singular goal is to develop and manufacture first-class research equipment within the fields of physiology and pharmacology.

SAFETY

The 630MA Automated Multi Wire 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, or for the prevention, diagnosis, curing,treat ment, or alleviation of disease, injury, or handicap.

Protect the power cord from being walked on or pinched, particularly at power outlets 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.

⚠ CAUTION:

- **Do not open the unit; the internal electronics pose a risk of electric 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 not be placed on the apparatus.**
- **Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.**
- **Do not install near any heat sources such as radiators, heat registers, stoves, or other equipment or devices that produce heat.**
- **Only use attachments and accessories specified by the manufacturer.**
- **Unplug this apparatus during lightning storms or when unused for long periods of time.**
- **Be advised that different operating voltages require the use of different types of line cord and attachment plugs. Check the voltage in your area and use the correct type. See the table below:**

Voltage	Line plug according to standard
110 - 125 V	UL81 and CSA C22.2 No. 42
220 - 230 V	CEE 7 page VII, SR section 107-2-D1/IEC 83, page C4
240 V	BS 1363 of 1984. Specification for 13A fused plugs and switched and unswitched socket outlets.

EMC/EMI

This equipment has been tested and complies with the limits for a Class B Digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in residential installations. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception (which can be determined by monitoring the interference while turning the equipment off and on), the user is encouraged to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different to that which the receiver is connected to.
- Consult the dealer or an experienced radio/TV technician for help.

EC DECLARATION OF CONFORMITY

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

Automated Multi Wire Myograph System - Model 630MA
Restrictive use: Only for laboratory use.

Manufactured by:
DMT A/S
Skejbyparken 152
8200 Aarhus N.
Denmark

Conforms with the essential requirements of the EMC Directive 2014/30/EU.
Based on the following specifications applied by:

EN 61326-1:2013
EN 61326-2-6:2013

And with the LVD Directive 2014/35/EU.
Based on the following specifications applied by:
EN 61010-1:2010
EN 61010-2-010:2014
EN 61010-2-030:2010

RoHS2 Directive 2011/65/EU.
Based on the following specifications applied by:
EN 50581:2012

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

CHAPTER 1 - SYSTEM OVERVIEW

1.1 INTERFACE FRONT PANEL

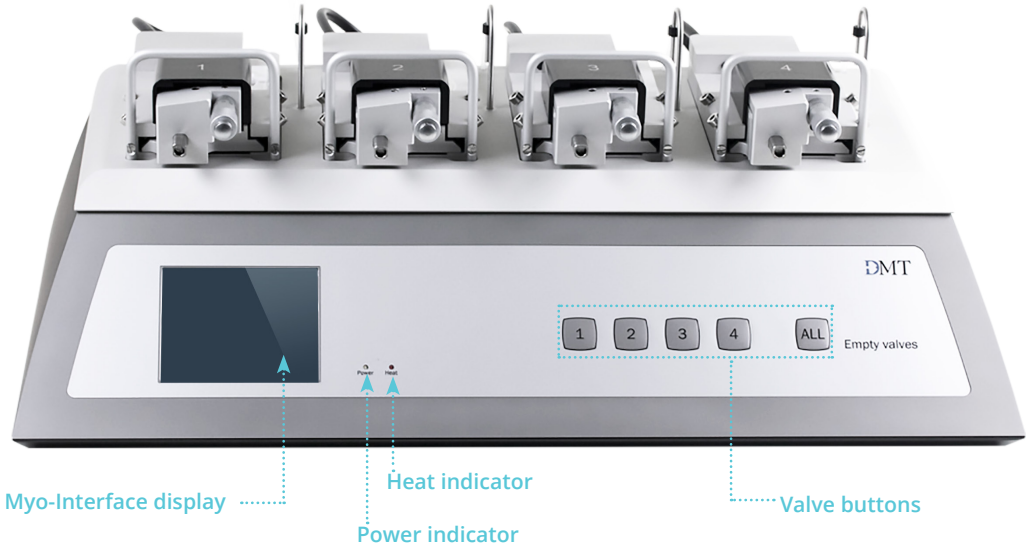


Figure 1.1 Interface Front Panel

1.2 INTERFACE REAR PANEL

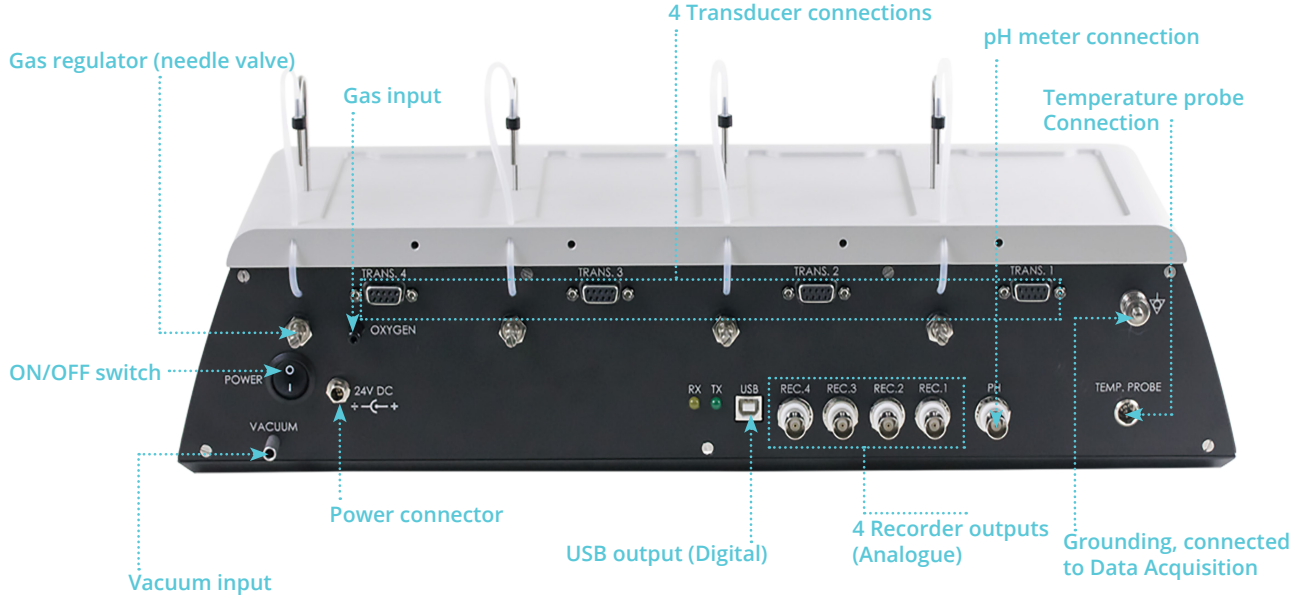


Figure 1.2 Interface Rear Panel

1.3 MULTI WIRE MYOGRAPH UNIT

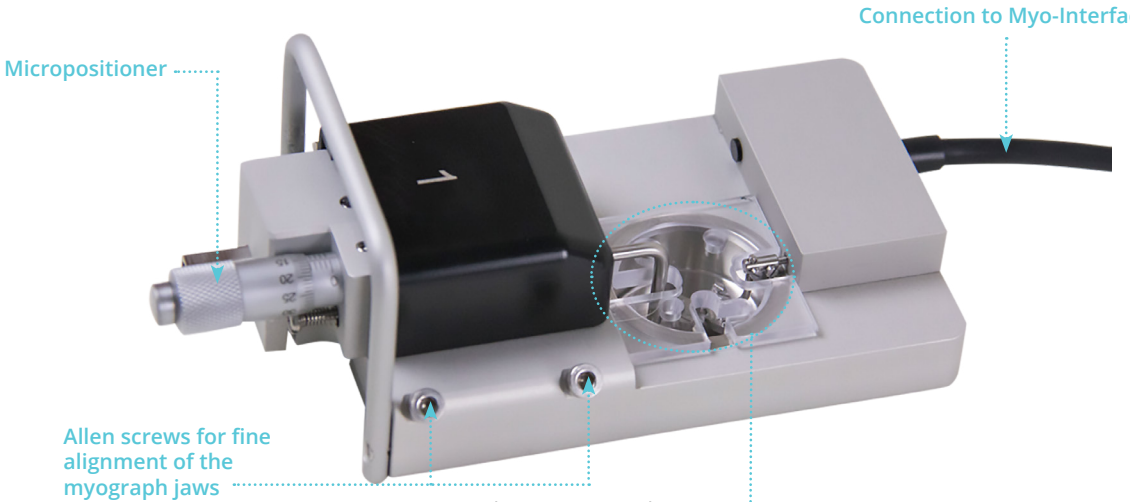


Figure 1.3 Multi Wire Myograph Unit

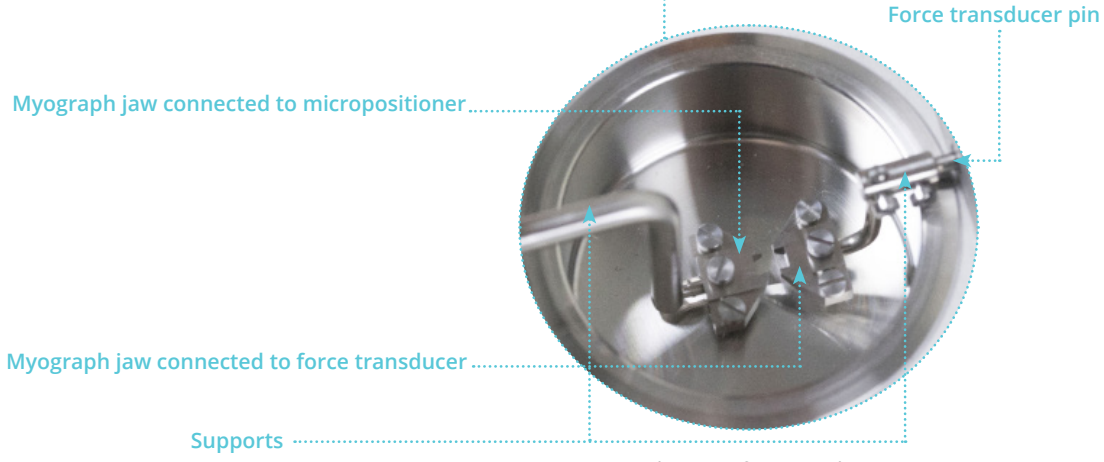


Figure 1.4 Close up of myograph jaws

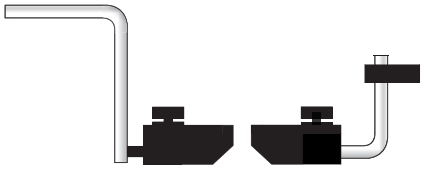


Figure 1.5 Mounting jaws for small vessels - Side View

Figure 1.6 Mounting pins for larger vessels - Top View

CHAPTER 2 - SETTING UP

2.1 THE COMPLETE MYOGRAPH 630MA SYSTEM

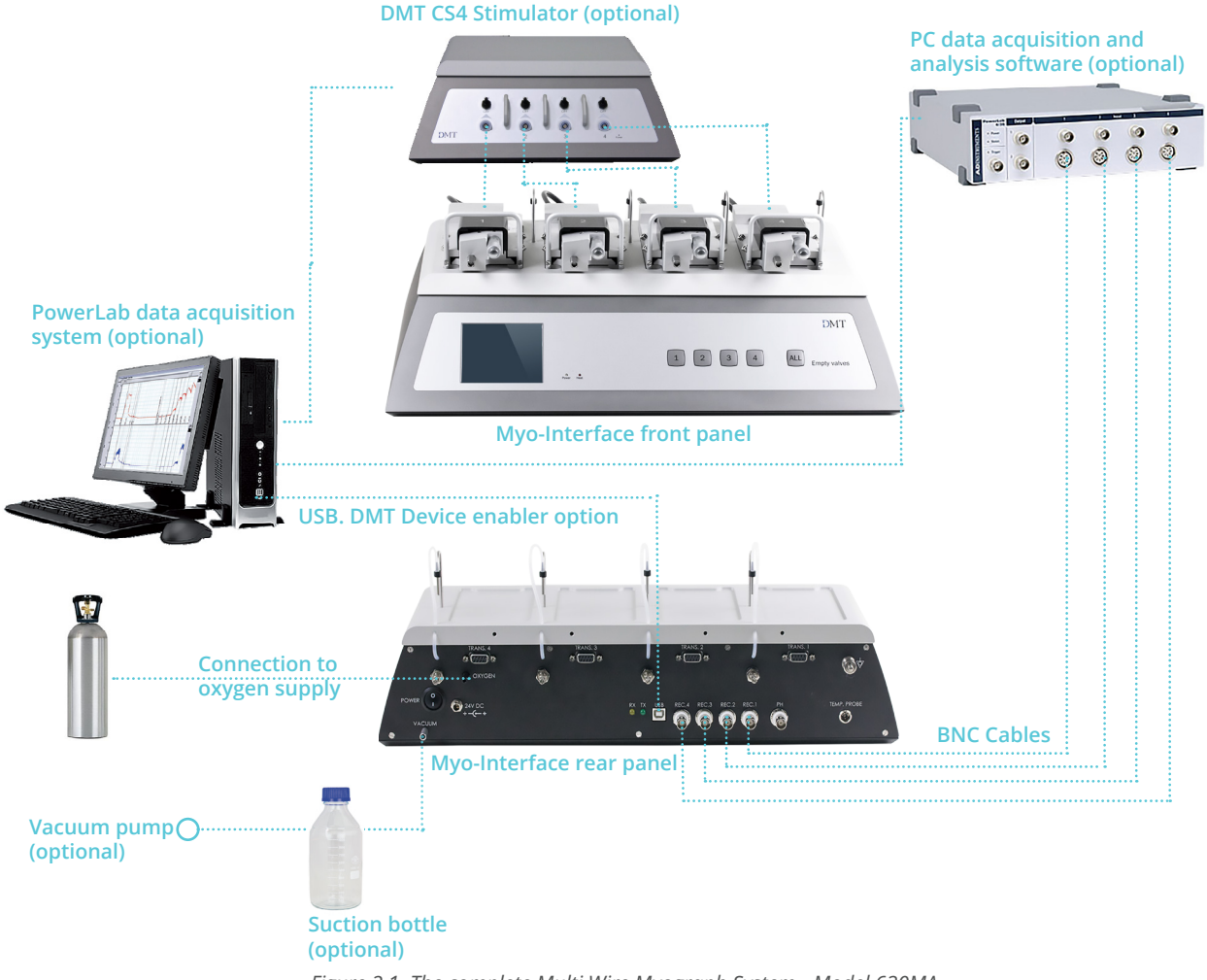


Figure 2.1 The complete Multi Wire Myograph System - Model 630MA

2.2 SETTING UP STEP-BY-STEP

This chapter contains a complete step-by-step description of how to set up a complete myograph 630MA system as illustrated in Figure 2.1.

1. **Interface – PC Connection:** Data acquisition is possible either by connecting the 630MA Interface directly to a PC with Labchart Pro and the DMT Device enabler installed or through the BNC connectors and BNC cables from the 630M interface e.g. to the Powerlab box and the Powerlab box is then connected using a USB cable to the computer with Labchart installed.(optional).
   I. **Direct PC Connection:** Connect the 630MA Interface using the applied USB cable directly to the PC with Labchart Pro (version 8 or newer) and DMT device enabler installed.
   II. **PowerLab (Optional):**Connect the 630MA Interface to the PowerLab unit using BNC cables. Connect Rec 1 on the Interface to Input 1on the Power Lab, Rec 2 to Input 2 etc. Connect the PowerLab unit to one of the USB-ports on the PC using the USB cable delivered with the PowerLab system. Connect the Powerlab box using the USB cable to the computer with Labchart installed.
2. **Oxygen Supply:** Connect the gas supply (95% 02, 5% CO2 or 21% 02, 5% CO2, balance N2) with tubing running from the gas supply to the gas inlet on the back of the Interface. Oxygen is supplied to the chambers by tubing attached to the stainless steel vacuum pipe. The oxygen and vacuum tubing need to be inserted into the chamber in order to aerate the heated buffer. Needle valves on the back of the interface can be adjusted to regulate the amount of bubbling that occurs. Turning the regulator clockwise increases the bubbling while turning it counter-clockwise decreases the bubbling. Each regulator has a lock device attached that can be used when the desired bubbling is achieved. See Figure 2.2 on next page.
3. **Vacuum Connection:** The system has a built-in manifold with separate valves that allows each chamber to be drained individually. After connect ing the vacuum source at the back of the Interface, the vacuum pipes need to be inserted into the chambers in order for this feature to work properly. The pipes are inserted into the chamber by gently pulling up on the curved part of the pipe, turning it 90° counter-clockwise and gently lowering it into the chamber. A chamber can then be emptied by pressing the corresponding numbered button. Pressing the “all” button will empty all the chambers at the same time, see Figure 2.2.

NOTE: The needle valves need to be greased (using the grease for the linear slides – the brown grease) and turned at regular intervals to prevent them from sticking or permanently freezing.

NOTE: When draining the chambers using the automatic vacuum function, press the appropriate button for an additional 3-5 seconds after the initial emptying. This will help drain residual buffer and solutions retained in the tubing and valves.

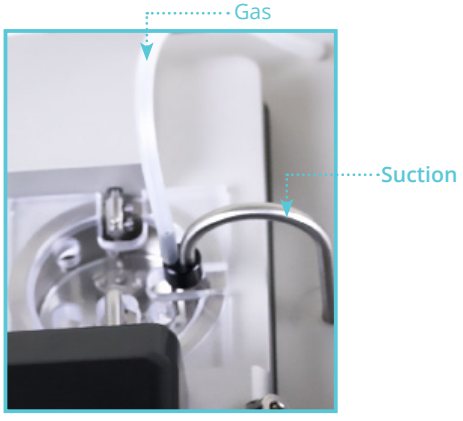


Figure 2.2 Suction connection

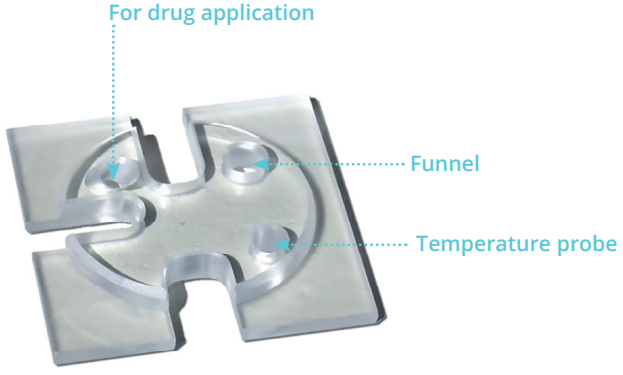


Figure 2.3 Chamber cover

4. **Chamber Covers**: The chamber covers will help maintain the temperature and other buffer conditions (gas tension, pH) fairly constant. Holes in the chamber covers serve different purposes, and they are illustrated in Figure 2.3 above. The slots allow the covers to be placed over the chamber around the support arms and gas/vacuum tubes.

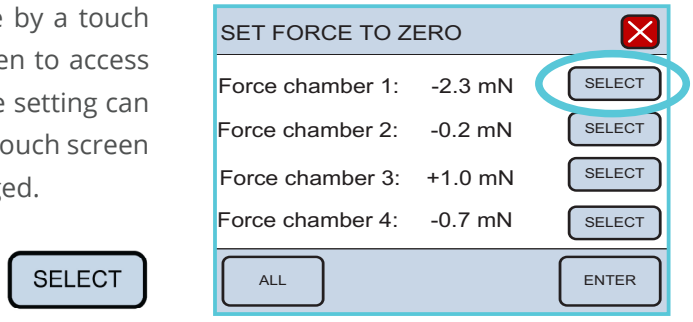
2.3 THE FIRST FORCE TRANSDUCER CALIBRATION

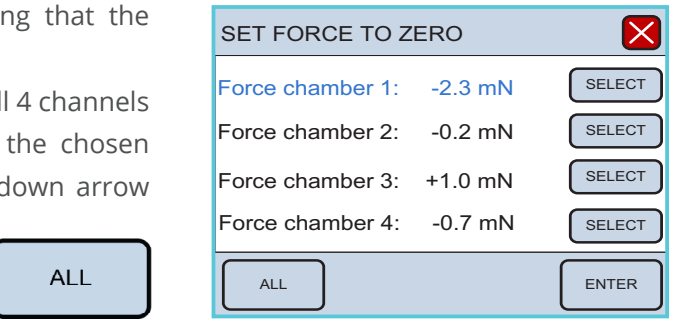
Prior to the shipment of the Automated Multi Wire Myograph 630MA System, has gone through two days of continuous testing, including a final force transducer calibration. However, DMT recommends that a new force transducer calibration is performed before using the myograph system for the first time. The force transducer calibration procedure is described in detail in the FORCE CALIBRATION sub-menu under SETTINGS, as explained in Chapter 3.

CHAPTER 3 - THE INTERFACE MENUS

Chapter 3 is a complete manual for the 630MA Interface. The chapter contains a detailed description of how to navigate the touch-screen menus and how to use the special features of the 630MA myograph.

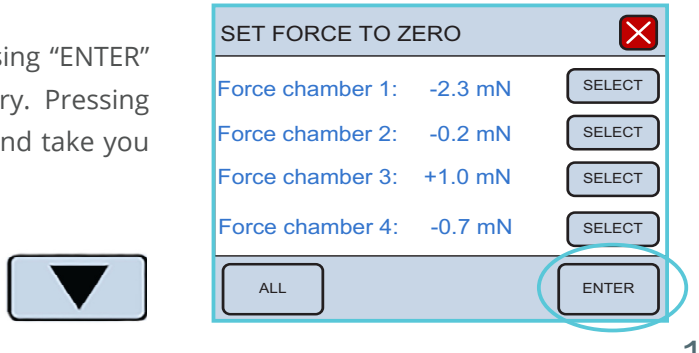
Menus on the 630MA interface are all accessible by a touch screen. To access a menu, simply touch the screen to access a menu. When a setting needs to be changed, the setting can be changed by pressing the "SELECT" icon on the touch screen corresponding to the desired channel to be changed.





The line to be modified will turn blue, indicating that the interface is waiting for input.
When "ALL" is chosen, all lines corresponding to all 4 channels will turn blue. Changing the numeric value for the chosen parameter can be done by touching the up or down arrow keys.

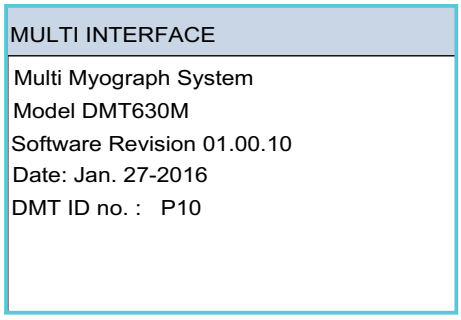
Once the desired setting has been chosen, pressing "ENTER" will lock the selection and be stored in memory. Pressing the white "X" in the red box will exit that menu and take you automatically to the Actual Force Display.



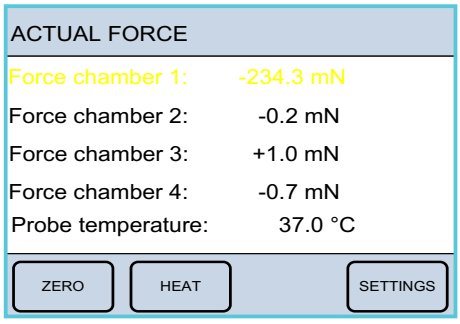
Power-Up Screen:

After turning on the Interface, an "Introduction" screen appears. The system is auto-calibrating the A/D converters while this screen is displayed.

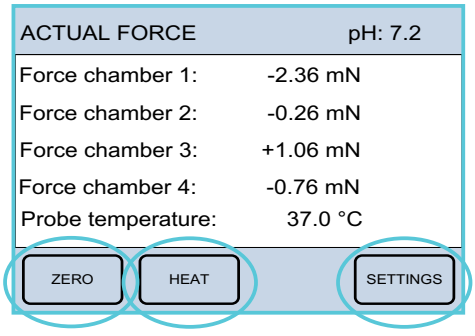
The 630MA Introduction screen is seen here.



and the 820MS introduction screen is seen here.

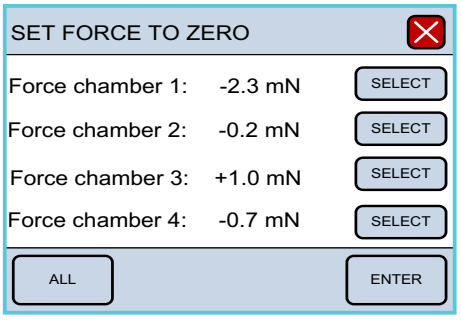


Three menus are accessible from the default "Actual Force" screen. These menus are: Zero, Heat, and Settings.



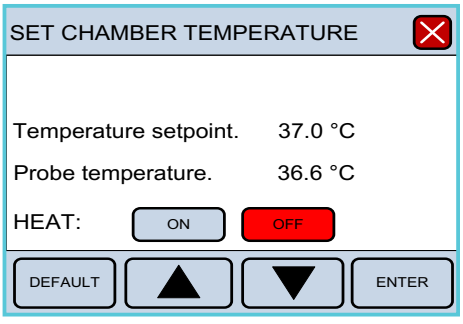
Zero Menu:

This menu is used to zero the output of the transducers. When using a data acquisition program like LabChart by ADInstruments®, using this feature will reset the baseline of the chart traces without affecting the calibrations or physically changing any pre-load tensions placed on the mounted vessels. The channels can be changed individually by pressing "SELECT" or all at once by pressing "ALL"". Pressing "ENTER" will execute the zero function and return the user to the ACTUAL FORCE display.



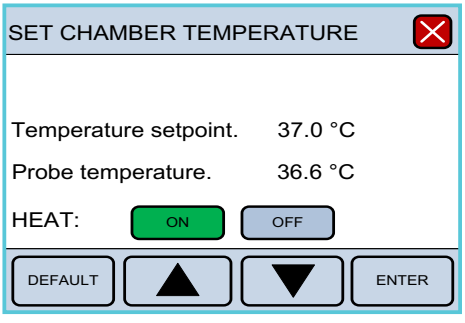
Heat Menu:

The heating unit and temperature are controlled from this menu. To turn the heat on or change the preset temperature for the system, access the temperature control menu. Pressing the "HEAT" key will enter the menu and allow the user to change the default system temperature, as well as turn the heat on or off. Pressing "DEFAULT" will automatically reset the temperature set-point to 37°C. Manually change the temperature by pressing the up or down arrows.



To turn the heat on, touch "ON" and the "ON" icon will turn green, indicating the heat has been turned on. The system will heat to the designated temperature set-point.

Pressing the white "X" in the red box will send the user back to the "ACTUAL FORCE" display.

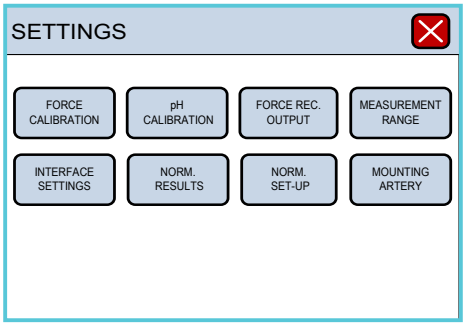


Settings Menu:

The "Settings Menu" contains several sub-menus that can be accessed to change functional aspects of the interface.

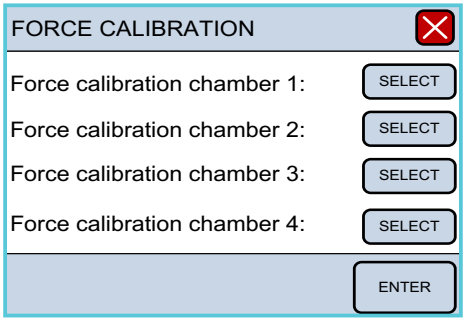
These sub-menus include:

1. **Force Calibration**
2. **pH Calibration**
3. **Force Rec. Output**
4. **Measurement Range**
5. **Interface Settings**
6. **Norm. Results**
7. **Norm. Set-up**
8. **Mounting Artery**



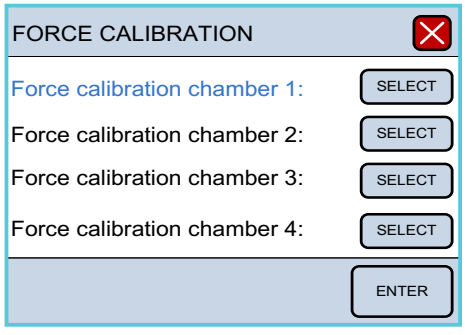
1. Force Calibration:

Entering the FORCE CALIBRATION sub-menu begins the transducer calibration procedure. Begin the calibration procedure by pressing "FORCE CALIBRATION" to enter the sub-menu. The sub-menu will list all 4 chambers for calibration.



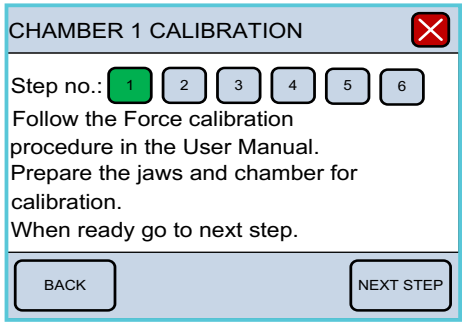
To begin the calibration, press "SELECT" for the chamber which calibration will be performed on. The text for the chamber to be calibrated will turn blue. Pressing "ENTER" will enter the 6-step procedure for calibrating the force transducer on the desired chamber.

The calibration procedure is listed in 6 individual steps and needs to be performed for each channel or transducer when calibrating the system.

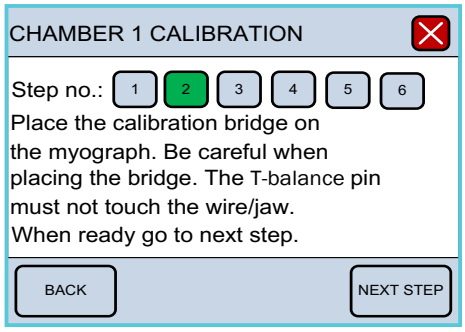


NOTE: Everytime a force calibration is performed the measurement range is set to default 200 mn. set measurement range after the force calibration.

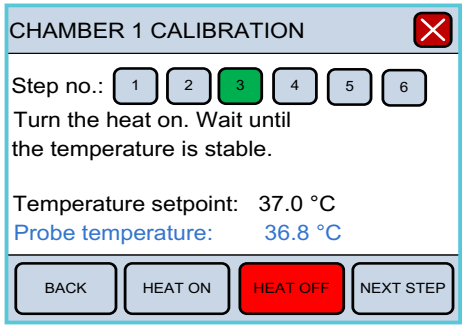
Step 1 involves setting up the chamber for calibration. Make sure the chamber contains the pins or jaws, depending on the type of vessel being studied. If jaws are being used for smaller vessels, a wire needs to be strung on the transducer-side jaw for the calibration. Fill the chamber with double-distilled water for the volume to be used experimentally. Press “NEXT STEP”.



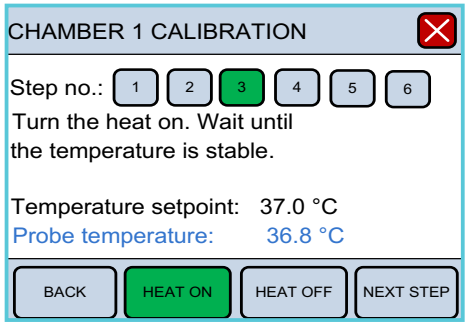
Step 2 involves setting up the calibration kit appropriately for the actual weight calibration. Verify that the transducer arm pin does not touch the mounting wire on the jaw or the mounting pin for larger vessels, as instructed. The pin should be as close as possible to the mounting wire or mounting pin without touching in order to get the most accurate calibration. Press “NEXT STEP” when the calibration kit has been properly placed.



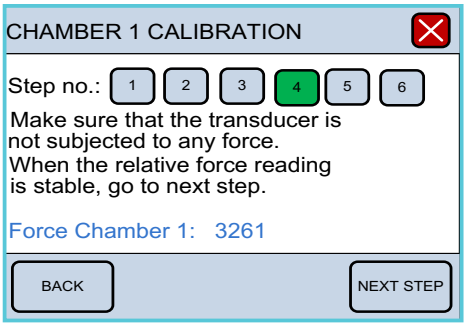
Step 3 initiates the heating process for the chambers. In order for the calibration to be accurate, the transducers must be heated to the experimental temperature to be used to accommodate heat-induced expansion of the electronic parts in the transducer. Otherwise, inaccurate readings and transducer drift may occur, introducing large errors into the experiment.
To start heating, press “HEAT ON”.



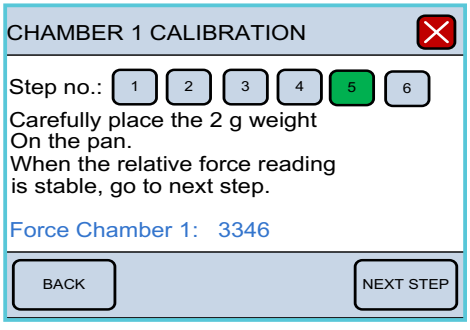
Covering the chambers with the chamber covers will expedite the chamber heating. Place the temperature probe into the chamber for the first calibration to monitor when the chamber has reached the target temperature. Heating will take about 20 to 30 minutes for the chambers and transducers to come to 37°C with the chamber covers in place. Once the chamber(s) are heated and have reached the target temperature, press “NEXT STEP”.



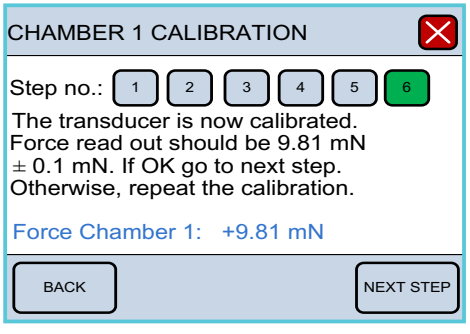
Step 4 is the first step in the actual weight calibration process. A 4-digit number will be displayed in blue at the bottom of the screen. If nothing has been perturbed during the heating process, the zero, 0 gram, or 0.00 mN calibration should be stable as indicated by the 4-digit number. By waiting 30sec at this point before pressing "NEXT STEP" will make the calibration more consistent. After the 30sec and when the 4-digit number is stable and not fluctuating press "NEXT STEP".



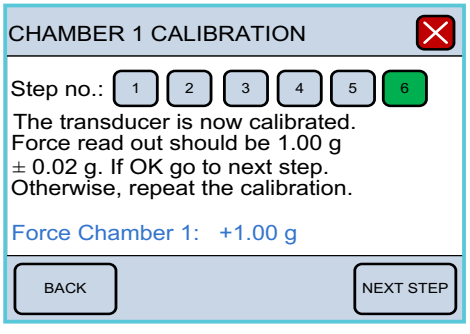
Step 5 is the 2 gram weight calibration. At this step, place the 2 gram weight in the pan closest to the transducer so as to simulate a vessel pulling on the jaw or pin attached to the transducer. Remember, a 2 gram weight in a 90° vector is cut in half, and the transducer will only detect 1gram or 9.81 mN of force. The weight placement should cause a positive increase in the 4-digit number. Wait at least 30 to 40 seconds for the applied force to stabilize before pressing "NEXT STEP". Once the 4-digit number has stabilized, press "NEXT STEP".



Step 6 is to verify that the calibration was performed correctly. The "Force Chamber 1" reading should be 9.81± 0.1mN. If the "Force Chamber 1" reading is off by more than 0.1mN, then remove the weight, press "BACK" to return to Step 4, and repeat the calibration process. If the "Force Chamber 1" reading is satisfactory, then press "NEXT STEP". Calibrate the other chambers in the same manner.



If gram is selected as the force read-out then the Step 6 will be as shown here. The "Force Chamber 1" reading should be 1.00± 0.01g. If the "Force Chamber 1" reading is off by more than 0.02g, then remove the weight, press "BACK" to return to Step 4, and repeat the calibration process. If the "Force Chamber 1" reading is satisfactory, then press "NEXT STEP". Calibrate the other chambers in the same manner.



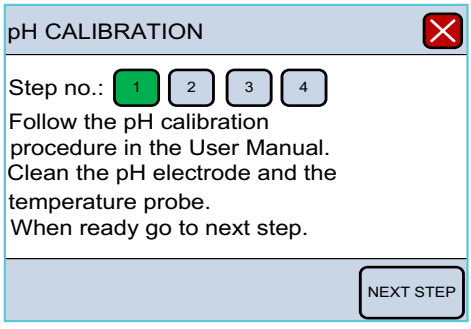
2. pH Calibration Menu (Optional):

The 630MA system has a build-in pH meter and a pH-meter electrode plug-in port marked PH on the back side of the 630MA interface. The pH electrode can be ordered at DMT by contacting your sales representative or emailing sales@dmt.dk.

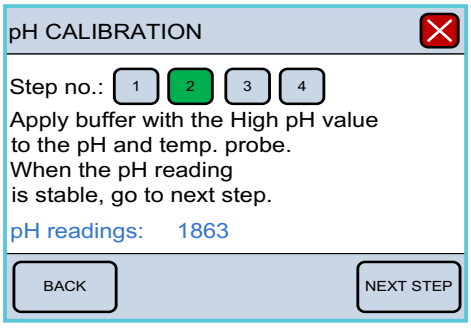
Before the pH calibration is performed be sure to select the way the pH electrode is to be used. See the sub-menu pH Set-up under Interface Settings (See section 3.5.111).

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

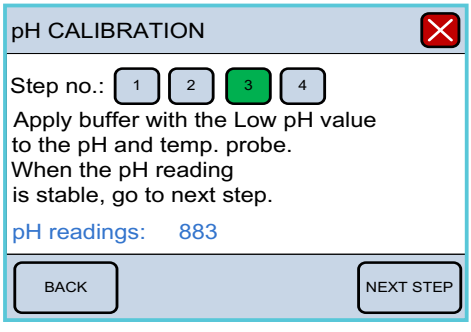
Step 1 - Step 1 involves cleaning the pH electrode and the temperature probe with double distilled water. When ready Press NEXT STEP.



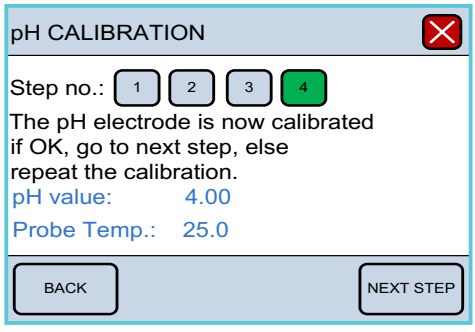
Step 2 - Place the pH electrode and temperature probe in the high buffer solution (here pH 7) and turn on stirring of the high buffer solution. When the relative pH output in the blue line is stable, go to NEXT STEP.



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.

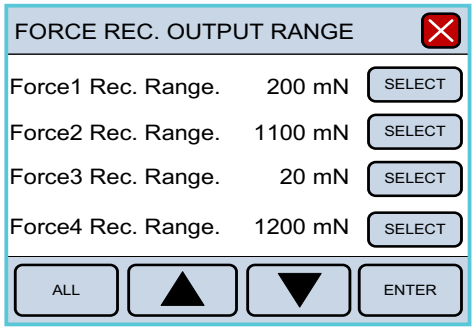


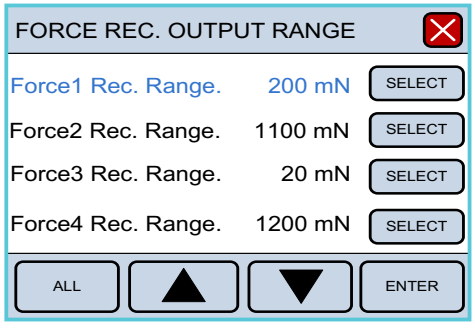
Step 4 - The calibration is now finished. The values in the two bottom lines are the actual pH and temperature reading



3. Force Rec. out:

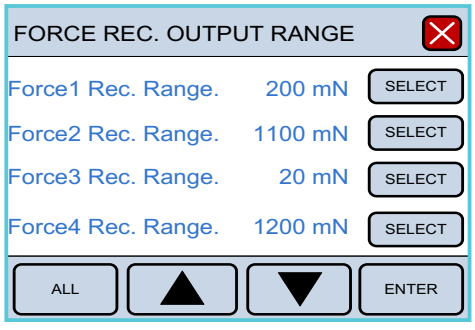
The FORCE RECORDING OUTPUT, or FORCE REC. OUT, sub-menu determines the upper limit for force sent from the BNC analogue output connectors to the Powerlab or similar data acquisition system. The factory default setting for FORCE REC. OUT is 20 mN, meaning that if the force of the mounted vessel exceeds 20 mN, the force recorded in the data acquisition software will not record more than 20 mN and will appear as a flat-line trace at 20 mN, even though the force readings on the interface may exceed 20 mN. Therefore, change the FORCE REC. OUT settings to an appropriate setting so as to capture any maximal response from the mounted tissue of interest. This value should not exceed the settings for the transducer range, which is defined by the sub-menu, MEASUREMENT RANGE and is explained in the next section. As can be seen on the below screen figure the Force Rec Output can be set to different values on different chambers.





The "SELECT" for a single chamber is used if different values is needed for the four chambers and changed by pressing the Up and Down arrow keys and stores in the interface setting by pressing ENTER.

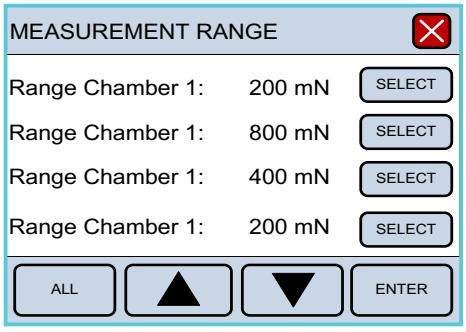
The "ALL:' functions are used to change all four chambers Force Rec Output values at the same time. Pressing "ENTER" will store the numbers in memory for future experiments.



NOTE: For users using the analog BNC outputs of the 630MA interface for data acquisition on a Powerlab or similar system: Anytime the Force Rec Output is changed, a new 2-point calibration must be performed in e.g. Labchart to enter the new voltage values into the data acquisition system being used. For DMT Device Enabler users (without the Powerlab box): Labchart must be restarted before the new settings are transferred to Labchart.

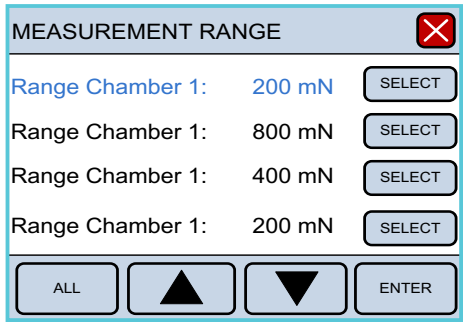
4. Measurement Range:

The MEASUREMENT RANGE sub-menu in SETIINGS determines the maximum force capacity of the transducer.



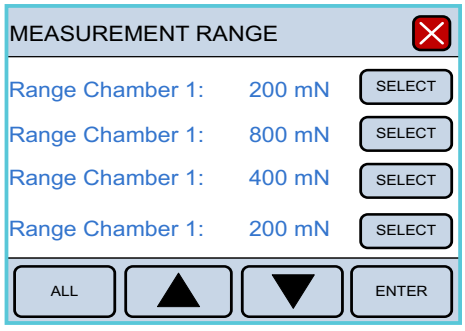
The factory setting is 200 mN, but the transducer capacity can be changed to 400 mN, 800 mN or a maximum of 1600 mN of force detection, depending on the contractility capacity of the mounted tissue used. As can be seen on the screen image the Measurement Range setting can be set to different values on the four chambers. If the Measurement Range is changed to e.g. 400mN then the Force Rec Out Put also has to be changed to 400mN. After this change users of the analogue signal from the BNC connectors must go into the data acquisition software and set 0V equals 0mN and 2.5V equals 400mN. For DMT Device Enabler users the only thing to do is to restart Labchart then the new settings are transferred to Labchart.

The "SELECT" for a single chamber is used if different values are needed for the four chambers and changed by pressing the Up and Down arrow keys and stores in the interface setting by pressing ENTER.



NOTE: For DMT Device Enabler users Labchart has to be restarted after changing the Measurement Range values otherwise the old setting will persist in Labchart and the force readings will NOT be correct.

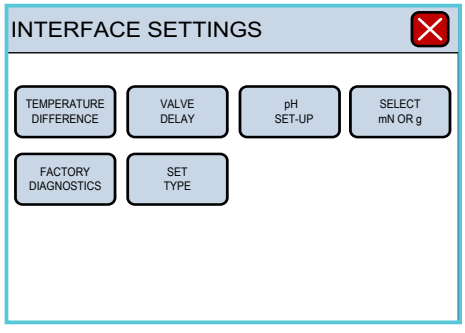
The "ALL:' functions are used to change all four chambers Force Rec Output values at the same time. Pressing "ENTER" will store the values in memory for future experiments.



5. Interface settings:

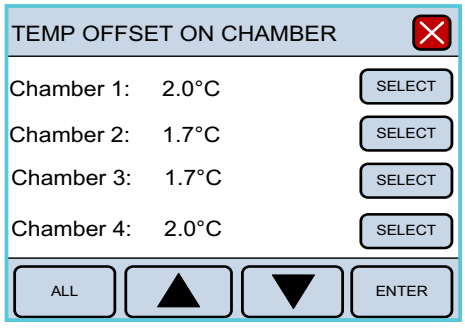
The INTERFACE SETTINGS sub-menu in SETTINGS has an additional six submenus. The six additional sub-menus are:

I. **Temperature difference**
II. **Valve delay**
III. **pH set-up**
IV. **Select mN or g**
V. **Factory diagnostics**
VI. **Myograph type**



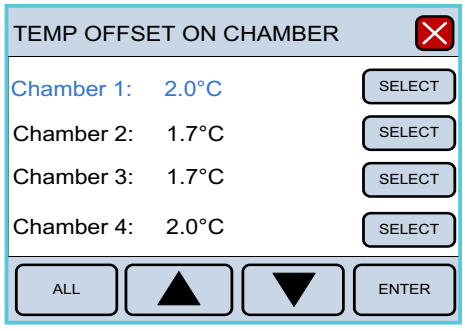
I. TEMPERATURE DIFFERENCE:

The TEMPERATURE DIFFERENCE function allows the user to fine tune the temperature set point of the system. Although the temperature set point for the system can be set in the HEAT MENU, the actual temperature for the system may not heat to the exact defined set point. Therefore, the user can adjust the temperature of each chamber individually to fine-tune the temperature setting so that EXACT temperatures

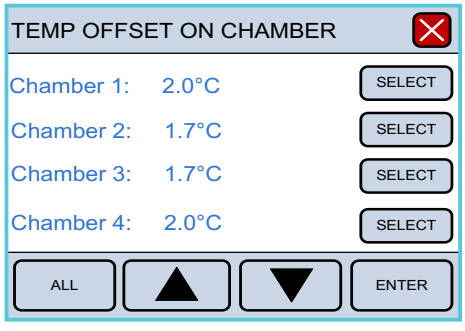


can be achieved for any particular chamber. This is referred to as a temperature offset (TEMP OFFSET ON CHAMBER). Use the thermometer connected to the backside of the 630MA interface to check the actual temperature of the buffer in the chamber and use that information to adjust the offset temperatures.
An example: If a temperature of 35°C is measured in chamber 1 with the temperature probe and the temperature where set to 37°C, the actual temperature is 2.0°C to low. The temperature offset on chamber 1 should then be increased with 2.0 degrees.

The “SELECT”



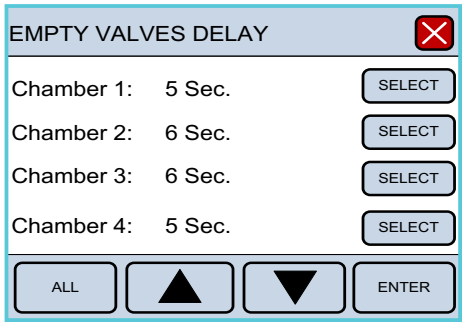
and “ALL” functions are the same in this menu as previously described menu’s.



Pressing “ENTER” will store the numbers in memory for future experiments.

II. VALVE DELAY

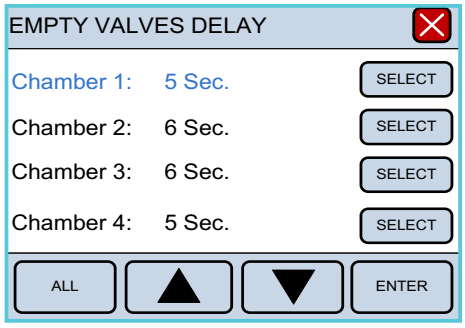
Pressing “VALVE DELAY” in the INTERFACE SETTINGS sub menu will allow the user to modify the time duration that the vacuum valves stay open for washes. Factory default is set at 1second, but 1second is usually not enough time to completely empty a chamber with even as small a volume of 5 ml.



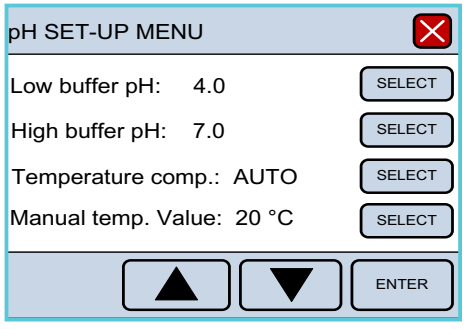
Pressing “ALL” will cause all the lines to turn blue, meaning all chambers can be modified at the same time. Again, the up and down arrow keys can be used to modify the length of time the vacuum valves stay open.

Pressing “SELECT” next to any given channel will cause the line selected to turn blue. The up and down arrow keys can then be used to modify the length of time the vacuum valves stay open after the valves have been activated with the push buttons on the front panel of the interface.

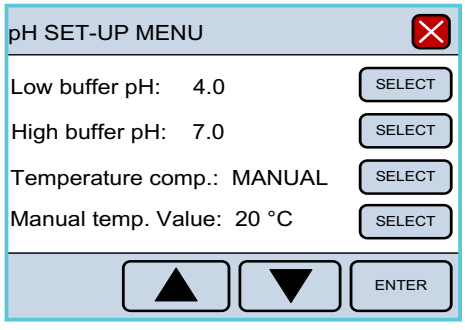
Pressing “ENTER” after modifying the value(s) for valve delay will lock in the number(s) and be retained in memory every time the system is turned on.



III. pH SET-UP MENU:
The temperature is an important parameter in the pH calibration formula and is obtained automatically if AUTO is selected in Temperature compensation function.



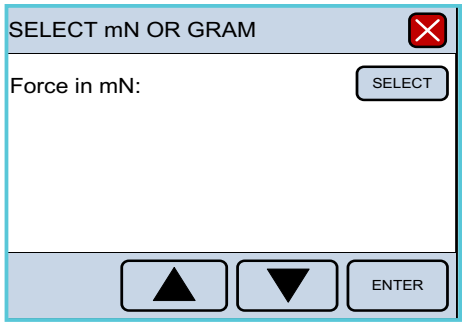
If Manual is selected, the manual temperature is used in the pH calibration formula, and the temperature probe is de-activated. In the Manual mode, the temperature of the calibration buffers is measured with a thermometer and entered manually in the Manual Temp. value line.



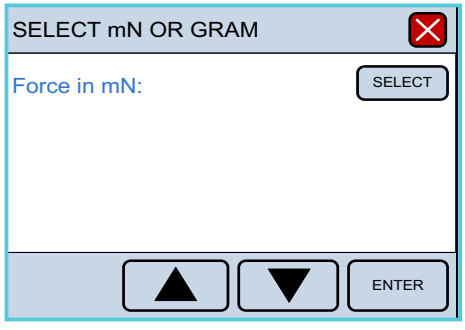
IV. SELECT mN OR g:

The contraction force can be shown in gram or in mN on the touch screen and for Labchart Pro and DMT device enabler users the selected force unit will be shown automatically in Labchart as well. Users of Powerlab and the analog signal from the BNC connectors still have to make the unit conversion in the appropriate data acquisition system to get the force in either gram or mN.

To change the Force units press SELECT.

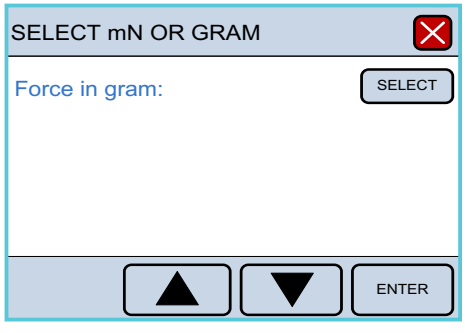


The 'Force in mN' will turn blue.



Press the arrow key to change the force unit between mN and gram.

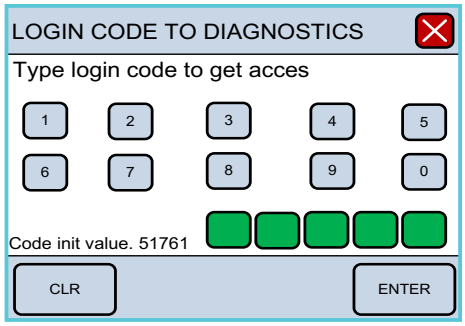
When the wanted force unit is shown press ENTER to select this force unit. The color of the text will turn black when it is saved in the system.



NOTE: For DMT device enabler users (no Powerlab) it is very important to restart Labchart Pro after changing the force units otherwise the force units will NOT be transferred to Labchart.

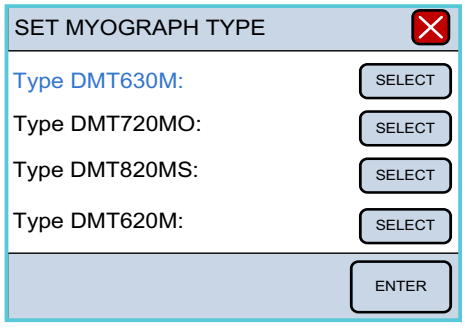
V. FACTORY DIAGNOSTICS:

Entering FACTORY DIAGNOSTICS will display the LOGIN CODE TO DIAGNOSTICS window. This window is for trained technicians and used for diagnostics and troubleshooting purposes. The general user will not have access to this window. Entering the proper 5-digit pin number, however, will allow 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.



VI. MYOGRAPH TYPE:

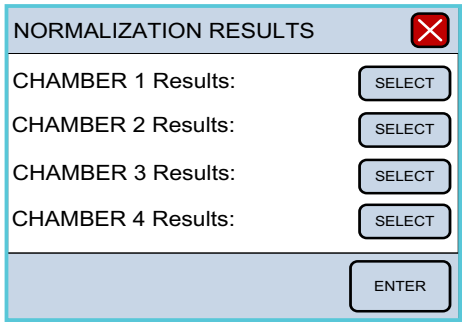
The interface of the 630MA system is identical to the interfaces of the DMT 620M Muti Myograph, 720MO Organ Bath and 820MS Muscle Strip Myograph system. The difference between these three systems is the chambers. This make it possible to combine the four different type of chambers on this Interface. There are small differences in the menu's of these four systems and to shift between these different menu's the user can load these into the interface using the Myograph Type menu.



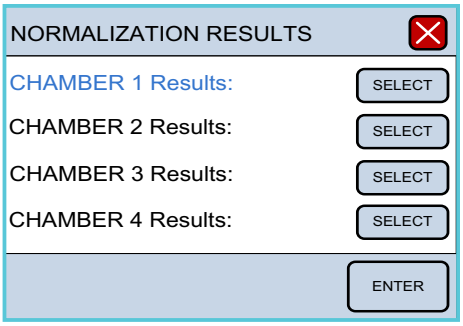
In this menu the active myograph menu is marked by bold letters. To change to one of the other systems press SELECT and the text line will turn blue and then press ENTER. The text line will not be in bold letters indication that this systems menu structure is selected. Turn off the power of the system and turn it ON again. Now the system will load the menu's of the select myograph system into the interface and is now ready for use. It is important to make a new weight calibration and make sure that the Measurement Range is correct. If the device enabler is not used the then also check the Force Rec Output values.

6. Normalization Results:

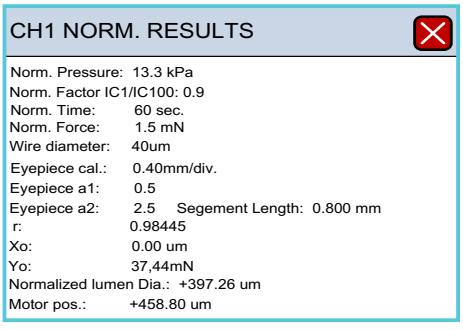
The Normalization Result menu contains a list with all the values entered and calculated during the automated Normalization Procedure for each chamber.



To see the result of e.g. Chamber 1 press SELECT and the line CHAMBER 1 Results will turn blue.



Then press ENTER to get the result list as shown.

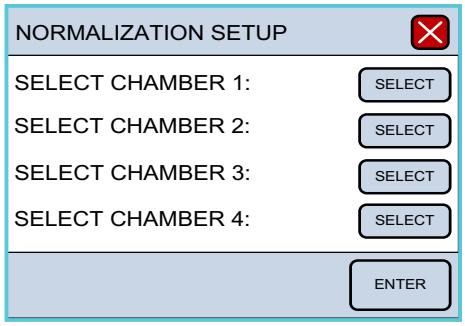


Description of the parameters listed on the NORM RESULTS menu

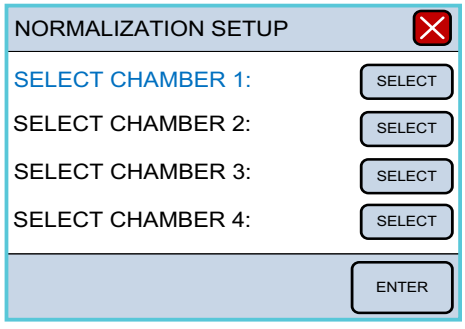
- Norm. Pressure: Target transmural pressure, usually 13.3kPa (100 mmHg)
- Norm Factor IC1/IC100: IC100 is the internal circumference corresponding to a certain target transmural pressure, typically 13.3 kPa (100 mmHg). IC1 is the normalized internal circumference calculated from IC100 by multiplying it with a Norm Factor
- Norm. time: Time setting in seconds, defining the duration of each step in the automatic normalization
- Norm. Force: The stretch performed for each step in mN
- Wire Diameter: The diameter of the wires used for mounting in µm
- Eyepiece cal: in mm/eyepiece divisions
- Eyepiece a1: Microscope eyepiece reading from the near end of the mounted segment
- Eyepiece a2: Microscope eyepiece reading from the far end of the mounted segment
- r: Regression coefficient for fit of (Xi, Yi) to an exponential curve
- Y0: The force in mN before start of the Normalization procedure
- X0: The micropositioner value at the start of the Normalization procedure
- Normalized lumen Dia: The diameter of the artery after the Normalization procedure
- Motor position: The position of the Motor after the Normalization procedure

7. Norm. Set-up:

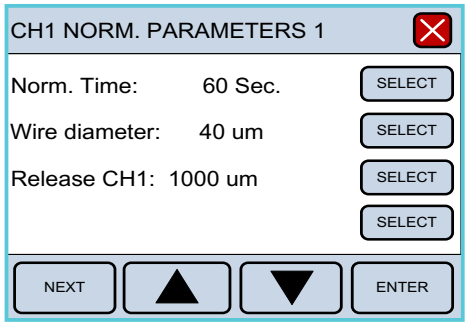
In the Normalization Setup menu the values used for the automated normalization procedure has to be entered. It is very important that the values are entered correctly otherwise the Automated normalization procedure will not be correct and affect your results. In worst case the mounted artery could be severely damaged.



In the M.J.Mulvany manual "Procedures for investigations of small vessel using small vessel Wire Myograph" there is a description on how the normalization is done, and also a description of the parameters used. Before the automatic normalizations are started, the normalization parameters must be set.



To enter the Normalization parameters of the different chambers go into the Normalization Setup menu and select the appropriate channel and press ENTER.



Norm. Time:

The Time setting in seconds that defines the duration of each step in the automatic normalization. It is the time between the first passive stretch and the next passive stretch of the artery in the normalization process. Default is set to 60sec. To change the Norm. Time press SELECT and use the arrow keys to change the values. The Norm. Time has to be long enough for the artery to reach at a Force plateau after each passive stretch.

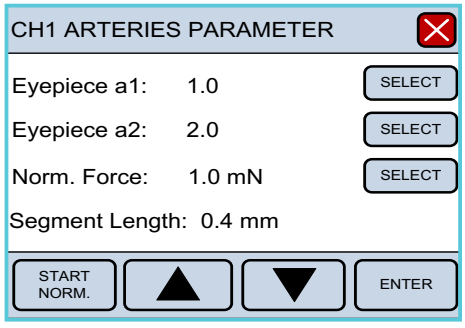
Wire diameter:

The diameter of the wire/pin in µm used to mount the tissue. To change the Wire diameter press SELECT and use the arrow keys to change the values

Release CH1 (chamber 1):

The predefined distance in µm that the jaws will move apart, when RELEASE is pressed in the Mounting Artery menu. The motor run until the distance between the jaws is equal to the release value. To change the Release distance press SELECT and use the arrow keys to change the values.

Press next to enter the last Normalization Setup parameters needed for doing the automated normalization of the mounted tissue.



WARNING: If the Release value is too high and you press the RELEASE button in the Mounting Artery menu when an artery is mounted there is a high risk that the artery will be severe damaged.

Norm. Pressure:

The target transmural pressure; usually 13.3 kPa (100 mmHg). The Normalization Pressure is the normal mean pressure in kPa of the artery mounted in the chamber. The normal mean blood pressure of a rat mesenteric artery is 100mmHg which is equal to 13.3kPa. If your artery of interest is higher or lower, then change the Norm Pressure accordingly be pressing SELECT and use the arrow keys to change the kPa values to the appropriate value.

Norm. Factor

IC100 is the internal circumference corresponding to a certain target transmural pressure, typically 13.3 kPa (100 mmHg). IC1 is the normalized internal circumference calculated from IC100 by multiplying it with a Norm Factor which is usually 0.9 for rat mesenteric arteries and 1.1 for mouse mesenteric arteries. Read carefully the DMT Normalization Guide to find the Norm Factor for your type of vessel.

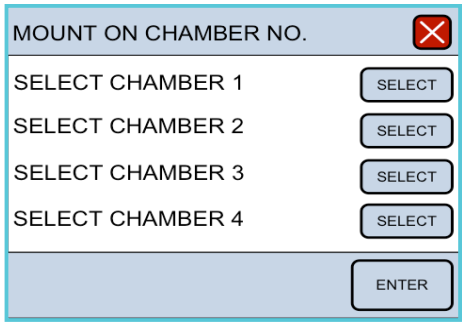
Eyepiece cal:

The distance in (mm) between two lines on the eyepiece of your dissection microscope. To find that value place an Object micrometer ruler (can be ordered from DMT) under your dissection microscope and see the distance in millimeter between two divisions of the eye-piece ruler. In the above example there is 0.4mm between two lines. Having eyepiece cal. Factor then the length of the mounted artery can be measured by using the eyepiece ruler and the eye piece values has to be entered in the MOUNTING ARTERY submenu (Section 3.8).

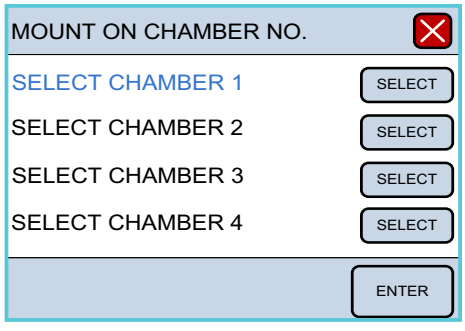
NOTE: It is very important to find the optimal Norm factor for your type artery and species. The DMT Normalization Guide has a detailed description of how to find the optimal Norm Factor for your type of vessel.

8. MOUNTING ARTERY:

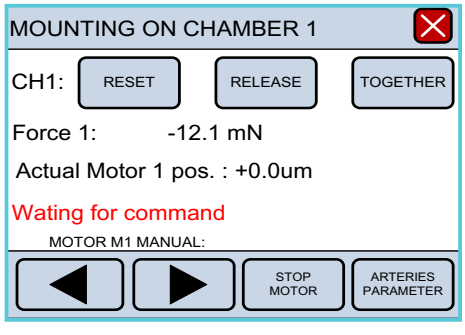
This menu is used for mounting the artery/tissue and performing the automated normalization.



First select the Chamber to mount and press ENTER.



The MOUNTING ON CHAMBER 1 menu.



WARNING: DO NOT USE THE "RELEASE" FUNCTION WHEN THE TISSUE IS MOUNTED.

RESET makes the jaws move together. When the jaws/wire/Pins touch each other the motor stops and the Actual Motor pos. is set to 0.00µm. It is important to reset the motor position after the tissue IS mounted and BEFORE starting the automated normalization.

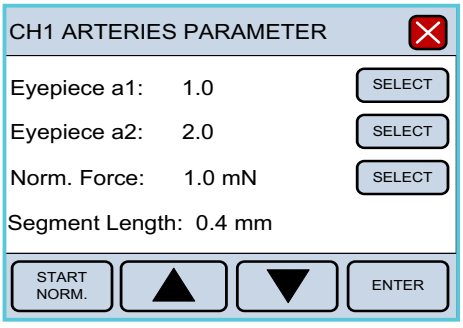
RELEASE makes the jaws move apart the distance set in the “Release Set Value” (see 3.7).
TOGETHER makes the jaws move together until they touch each other. When the jaws touch the motor stops.

LEFT and RIGHT arrows move the jaws/pins in the given direction using the build-in motor.

STOP MOTOR stops the motor immediately when pressed.

ARTERIES PARAMETERS

After the vessel is mounted go to Arteries Parameter to put in the length of the vessel.



Eyepiece a1:

Microscope eyepiece reading from the far end of the mounted segment.

Eyepiece a2:

Microscope eyepiece reading from the near end of the mounted segment.

Segment Length:

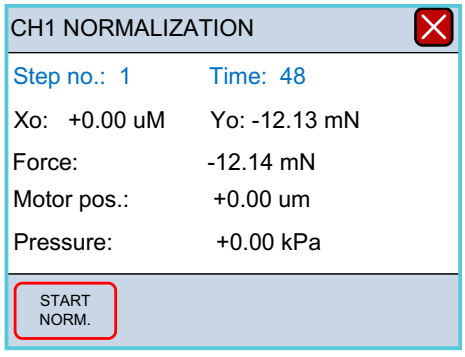
When the a1 and a2 values has been entered the calculated segment length Is calculated based on the a1 and a2 values and the Eyepiece Calibration Factor in the NORMALIZATION PARAMETER 2 menu. Make sure that the artery segment length is correct.

IMPORTANT: MAKE SURE THE EYEPIECE CALIBRATION FACTOR HAS BEEN ENTERED IN THE NORMALIZATION PARAMETER 2 MENU.

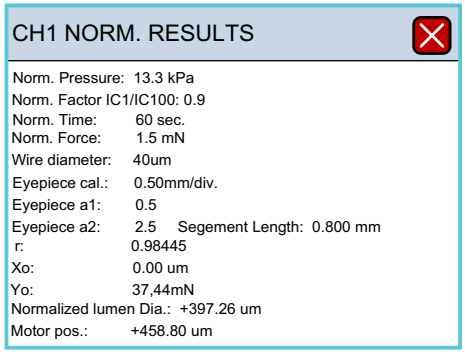
Norm. Force:
This is the force that the vessel is stretched successively at the stretch steps 1, 2, 3... The smaller the artery (diameter) the smaller the Norm. Force should be.

When all parameters are programmed, start the automatic normalization.

PAUSE NORM.

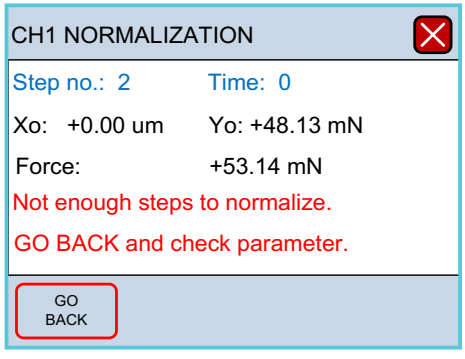


If the normalization is successful a parameter screen is shown and the mounted artery is ready for use with the optimal pre-load tension.

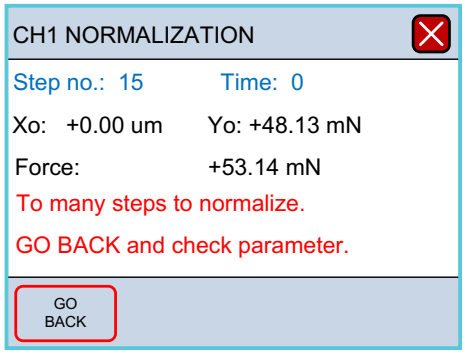


If the normalization is NOT successful an error message is shown here.

If the message **"Not enough steps to normalize"** appears then go into the Norm. Force parameter in the Ch1 ARTERY PARAMETER menu and lower the Norm Force value. Also check if the right segment length has been entered.



If the message **"Too many steps to normalize"** appears then go into the Norm. Force parameter in the Ch1 ARTERY PARAMETER menu and Raise the Norm Force value. Also check if the right segment length has been entered.

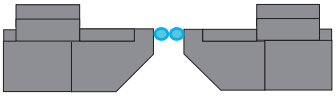


Mounting artery segment on mounting Jaws

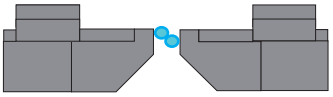
Mounting of artery segments on mounting Jaws is described in details in the 630MA User Guide.

After the artery has been mounted is it very important that the following is checked and performed before going into this MOUNTING ARTERY Menu:

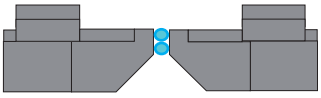
I. The jaws are not touching but very close to each other and positioned in a way that the two wires will 'bump' into each other and not will go beneath or on top of each other as shown below.



Correct position of the two wires (Blue color) on the Jaws. This is a side view of the two wires on the two jaws.



In-correct position of the two wires (Blue color). Here one wire is lower positioned than the other. Correct the wires before continuing. This is a side view of the two wires on the two jaws.



In-correct position of the two wires (Blue color). Here one wire is completely above the other wire. Correct the wires as shown in first example before continuing. This is a side view of the two wires on the two jaws.

II. Buffer is in the chamber
III. The heat is turned ON and is stable at the setting temperature
IV. Enter the appropriate values in the NORMALIZATION SET-UP menu

1. Make sure that the wires are as close as possible without touching each other using the micrometer positioner. Zero the force by pressing ZERO in the Main Menu.
2. Go into the MOUNTING ARTERY Menu and the appropriate chamber and press RESET to zero the position of the motor positioner. Make sure that the display shows zero force and Actual Motor pos. shows 0.0µm
3. Go into the ARTERY PARAMETER menu and enter the correct Eyepiece a1 and a2 values. The calculated artery segment length is shown.
4. Enter the Norm Force value. The smaller the mounted artery is the smaller the Norm Force value has to be to get enough steps in the automated normalization.
5. To start the Automated normalization Press START Norm. Make sure that you have started the data acquisition to collect the data from the automated normalization.
6. While Chamber 1 is performing the normalization start mounting of the nest artery segment on chamber 2.

NOTE: It is ONLY possible to perform the automated normalization on one chamber at a time.

7. Therefore, the working process should be;

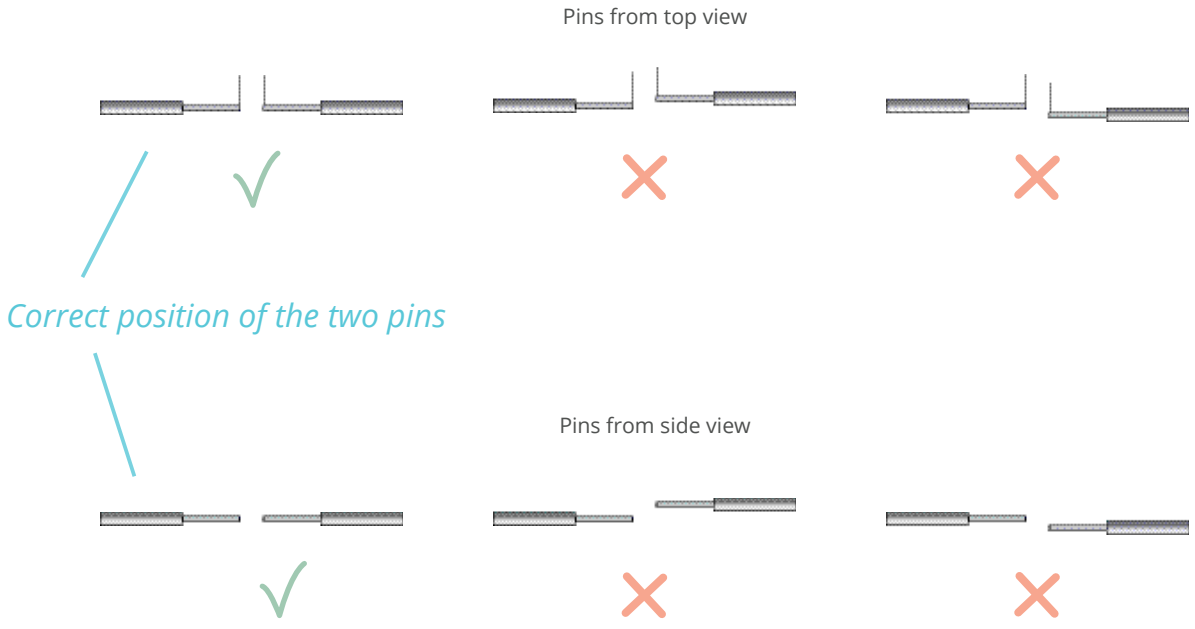
- Mount chamber 1 and start the automated normalization
- Mount chamber 2 and start the automated normalization when chamber 1 has finished
- Mount chamber 3 and start the automated normalization when chamber 2 has finished
- Mount chamber 4 and start the automated normalization when chamber 3 has finished

Mounting artery segment on mounting Pins

Mounting of artery segments on mounting Pins is described in details in the 630MA User Guide.

After the artery has been mounted is it very important that the following is checked and performed before going into this MOUNTING ARTERY Menu:

I. The pins are not touching but very close to each other and positioned in a way that the two pins will 'bump' into each other and not will go beneath or on top of each other as shown here (see Chapter 4 how to align the pins).



1. Make sure that the pins are as close as possible without touching each other using the micrometer positioner. Zero the force by pressing ZERO in the Main Menu.
2. Go into the MOUNTING ARTERY Menu and the appropriate chamber and press RESET to zero the position of the motor positioner. Make sure that the display shows zero force and Actual Motor pos. shows 0.0µm
3. Go into the ARTERY PARAMETER menu and enter the correct Eyepiece a1 and a2 values. The calculated artery segment length is shown.
4. Enter the Norm Force value. The smaller the mounted artery is the smaller the Norm Force value has to be to get enough steps in the automated normalization.
5. To start the Automated normalization Press START Norm. Make sure that you have started the data acquisition to collect the data from the automated normalization.
6. While Chamber 1 is performing the normalization start mounting of the nest artery segment on chamber 2.

NOTE: It is ONLY possible to perform the automated normalization on one chamber at a time.

7. Therefore, the working process should be;

- Mount chamber 1 and start the automated normalization
- Mount chamber 2 and start the automated normalization when chamber 1 has finished
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- Mount chamber 4 and start the automated normalization when chamber 3 has finished

CHAPTER 4 - THE MULTI WIRE MYOGRAPH UNIT

This chapter contains a complete explanation of how to adjust, calibrate and maintain the myograph 620M system so that the myograph is always performing at peak performance.

4.1 CHANGING AND ADJUSTING THE MOUNTING SUPPORTS

Each chamber can accommodate mounting supports for either small vessels (>30µm) or larger segments (>500µm). Because the mounting supports can be changed easily, experiments can be performed with different vessels of varying internal diameter. Continuous use and repeated greasing of the transducer arm holes will cause some misalignment of the mounting supports. The mounting supports, therefore, whether they are the jaws for wires or the pins, will need occasional adjustments.

Changing and adjustment of the supports is performed using the following step-by-step procedure.

WARNING: THE TRANSDUCERS ARE FRAGILE AND SENSITIVE TO MECHANICAL STRAIN. BE VERY CAREFUL WHEN CHANGING OR ADJUSTING THE MOUNTING SUPPORTS!

4.1.1 CHANGING THE SUPPORTS (FIGURE 4.1):

1. Use the micrometer to separate the supports as far apart as possible.
2. Use the small screwdriver provided to gently loosen screw D on the support attached on the transducer side using the small screwdriver. Screw D is the screw on the transducer-side support closest to the transducer.
3. Gently pull the support away from the transducer pin.
4. Loosen screw B on the micrometer side with the appropriate fitting allen key.
5. Pull the support away. Note: Number the supports with the chamber number they were removed from using some kind of permanent marker. Store the supports in the provided plastic case. Numbering the supports will save time when the sup ports are changed again, limiting the amount of adjustments needed after each change.

4.1.2 COURSE-ADJUSTING THE JAWS FOR SMALL VESSELS (FIGURE 4.1):

1. Loosen screw A to move the micrometer-side jaw toward or away from the micrometer.
2. Loosen screw B to move transducer-side jaw toward or away from the transducer.
3. Loosen screw C to vertically alight the transducer-side jaw. Screw C is the screw on the transducer-side support that is furthest away from the transducer.

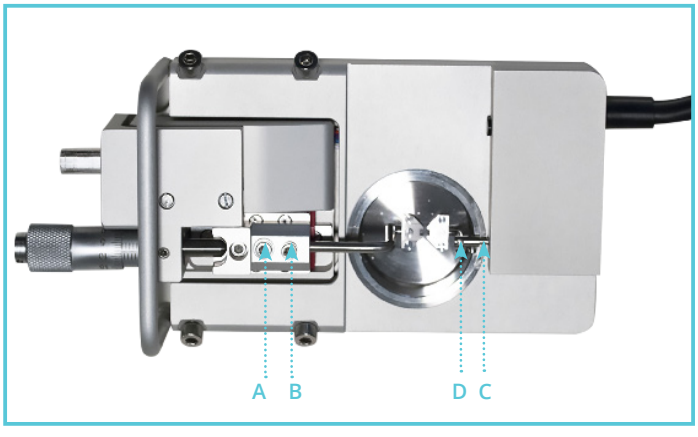

Figure 4.1 Myograph unit - screws for changing supports and coarse adjustment of the jaws

4.1.3 FINE-ADJUSTING THE JAWS FOR SMALL VESSELS (FIGURE 4.2 AND FIGURE 4.3):

1. Tightening Screw “D” will move the micrometer side jaw downward and to the left.
2. Tightening both screws “D” and “B” will move the micrometer side jaw straight down
3. Tightening both screws “C” and “A” will move the micrometer side jaw straight up..

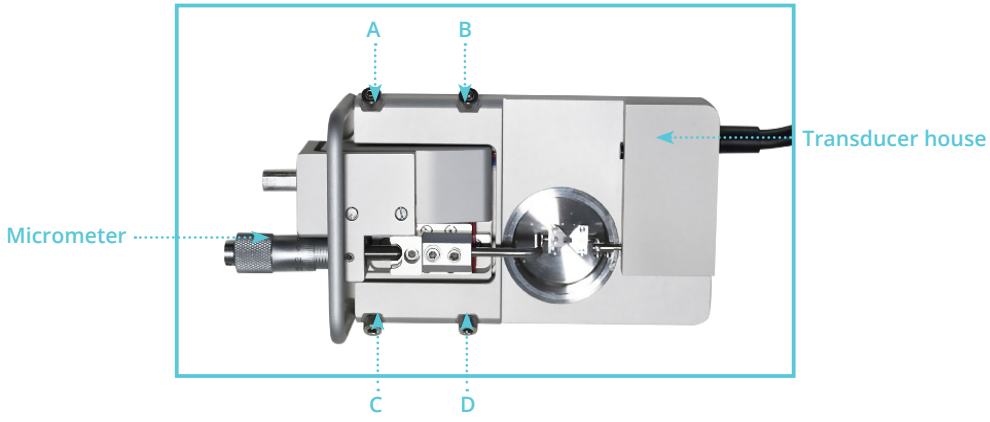

Figure 4.2 Fine adjustments of the jaws in the myograph chamber

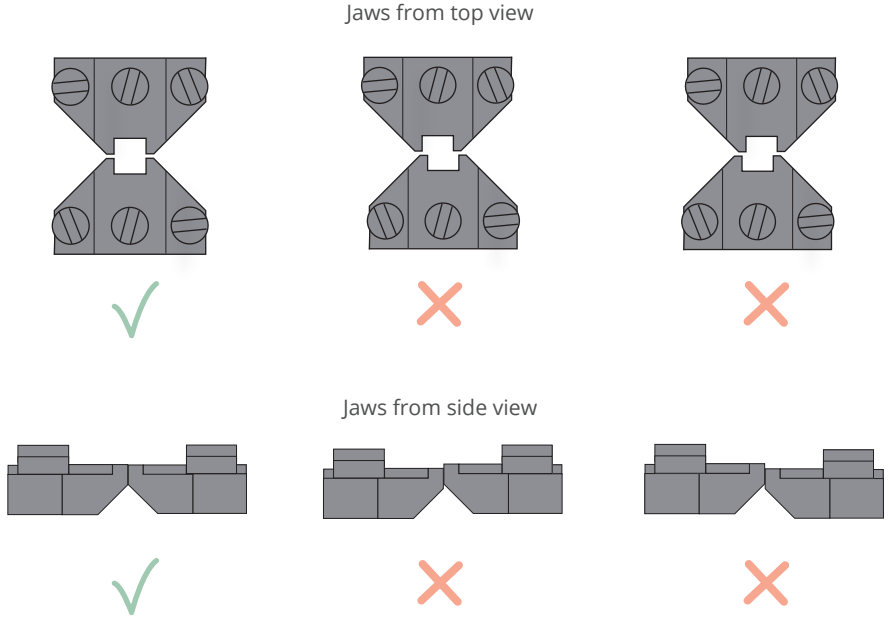

Figure 4.3 - Illustrations of properly aligned jaws (depicted on the far left) and incorrectly aligned jaws (depicted in the middle and far right).

4.1.4 FINE-ADJUSTING THE PINS FOR LARGER VESSELS (FIGURE 4.4 AND FIGURE 4.5):

1. Loosen screw A to move the micrometer-side arm holder sideways.
2. Loosen screw B to move the micrometer-side pin toward or away from the transducer
3. Loosen screw C to align the transducer-side pin horizontally.
4. Loosen screws D and E to align the heights of the pins vertically.

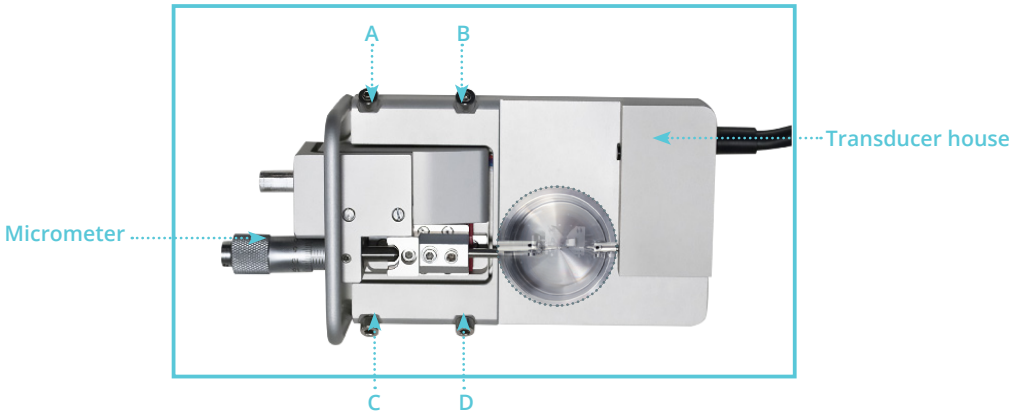

Figure 4.4 - Fine adjustments of the pins in the myograph chamber

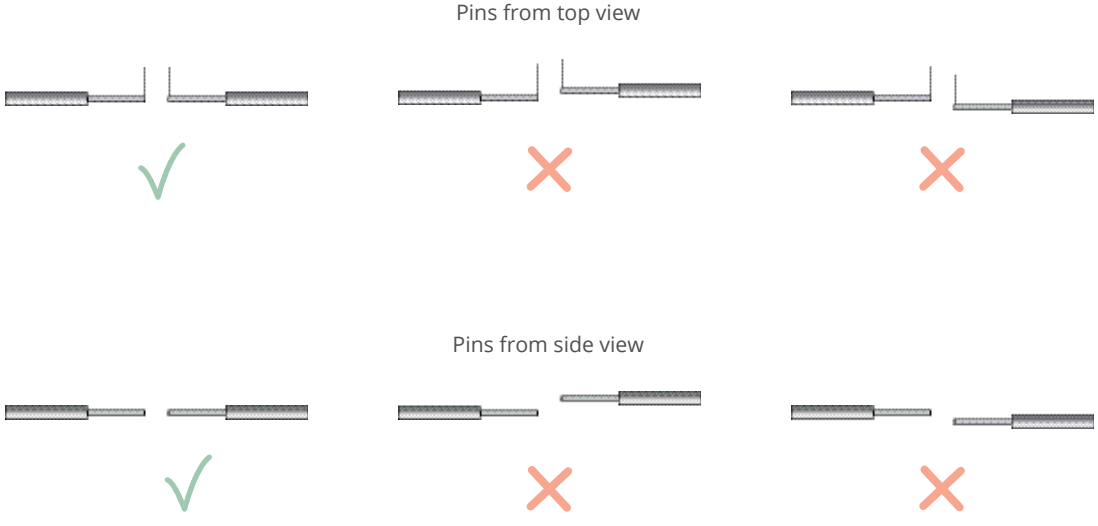

Figure 4.5 - Illustrations of properly aligned pins (depicted on the far left) and incorrectly aligned pins (depicted in the middle and far right).

4.2 CALIBRATION OF THE FORCE TRANSDUCER

As a part of the general maintenance of the myograph, DMT recommends that the myograph is weight-calibrated at least once a month. The myograph should also be weight-calibrated every time the interface has been moved. Although lab benches are all supposedly perfectly horizontal, small differences in lab bench pitch can affect the calibration of the system. The myograph also should be calibrated if the system has been idle for longer than a month. A step-by-step procedure is included in the FORCE CALIBRATION sub-menu under SETTINGS, as explained in Chapter 3.

FORCE TRANSDUCER CALIBRATION PROCEDURE

This section contains step-by-step instructions to calibrate the force transducer and should be used in conjunction with the steps described in Chapter 3.1 (FORCE CALIBRATION sub-menu under SETTINGS).

1. Move the jaws/pins apart. If calibrating the transducer with the jaws in place, make sure a wire is mounted on the transducer-side jaw. Fill the chamber with distilled water or buffer. Use the same volume that will be used during the experiments.
2. Set up the calibration kit (bridge and balance) on one of the myograph chambers as illustrated in Figure 4.6. Also place the weight on one of the chambers. Turn the heat on as discussed in Chapter 3. The system takes about 20 to 30 minutes to reach 37 °C. Make sure ad equate time is allowed so that calibration can be performed at the temperature at which the experiments will be performed. Placing the calibration kit and weight on the chamber allows them to warm up to the experimental target temperature. No need to bubble the chambers while waiting for the system to heat up.

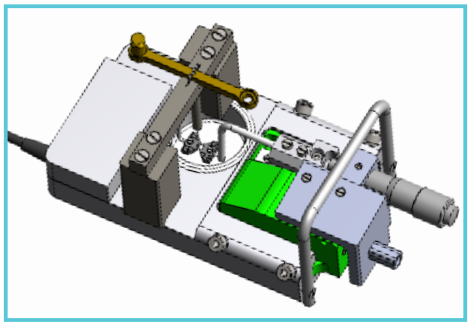

Figure 4.6 - Weight calibration kit shown in place on a single myograph chamber

3. When the system reaches target temperature, adjust the calibration kit so that the tip of the transducer arm is as close to the wire (if jaws are being used) or pin on the transducer side as possible without touching, as illustrated in Figure 4.7. One way to do this is to use the following technique. Start with the calibration kit in place so that the transducer arm of the bridge with the pans is not touching any part of the jaw or wire (if the jaws are being used) or not touching any part of the pins. Go to the main menu displaying the forces, and zero the channel being calibrated so the force reads zero. Slowly and gently slide the calibration kit forward toward the micrometer so that the transducer arm rests on the wire or pin, creating a force reading on that channel. Carefully slide the calibration kit back toward the transducer slowly until the force reads zero or very close to zero. At this point, as soon as the force reads zero, the transducer arm will be properly placed for weight calibration.

4. Go to the FORCE CALIBRATION sub-menu of the SETIINGS menu on the Interface to begin the actual transducer calibration. The process that is described above is reiterated in 6 steps once the FORCE CALIBRATION sub-menu is initiated, which is described in detail in Chapter 3.1.

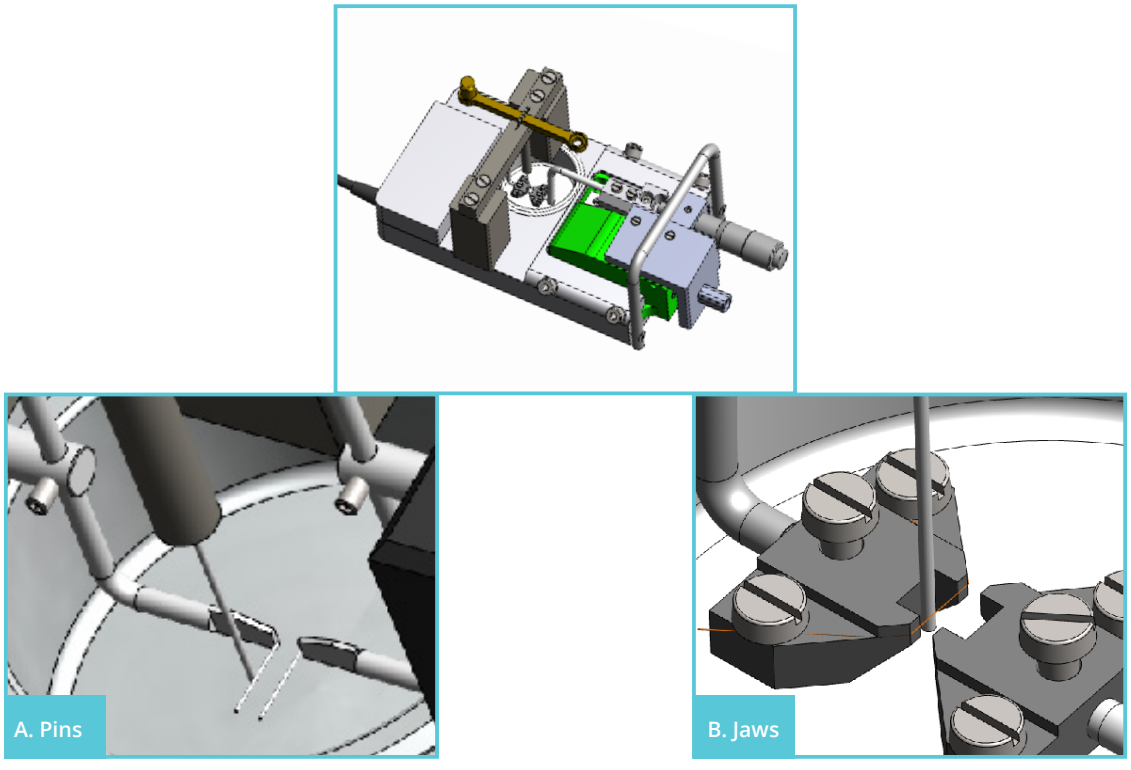

Figure 4.7 - Illustration of the proper placement for the balance transducer arm for calibration

4.3 CHECKING THE FORCE TRANSDUCER

The myograph force transducer is a strain gauge connected to a Wheatstone bridge. The force transducers for each chamber are housed in a separate, protective compartment (See Figure 4.8 below). While the protective cover offers some mechanical protection for the force transducers, they are still very vulnerable to applied forces exceeding 1600 mN (160 grams) or fluid running into the transducer compartment due to insufficient greasing of the transducer pinhole.

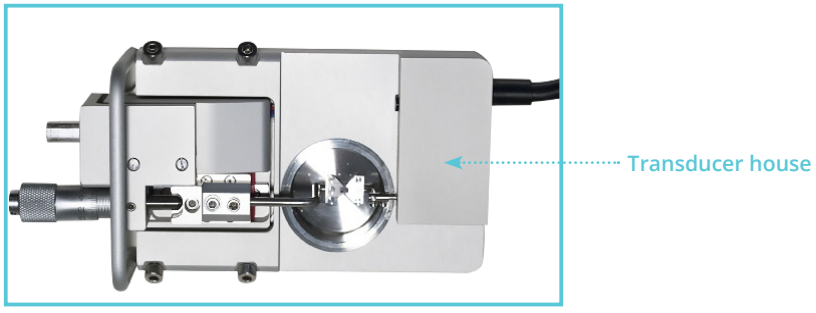

Figure 4.8 - Illustration of the proper transducer house

If the force readings on the Interface appear unstable or noisy, then first check that the chambers are connected properly to the 630MA Interface and that the chambers are plugged all the way into the interface. If the force reading(s) are still unstable or noisy, then perform a new calibration of the force transducer as described in Chapter 3.1 and Chapter 4.2.

During the new calibration, monitor the relative force reading values in the FORCE CALIBRATION sub-menu on the Interface (Steps 4 and 5 of the calibration procedure). The normal operating values for the force transducer during calibration should be between 3000 and 3500.

- If the value is 0, a single digit, or a three-digit number, the force transducer is broken and needs to be either recomprensated or replaced.
- If the value is less than 2000 or greater than 4500, the force transducer is broken and needs to be replaced.
- If the message “OFF” is displayed on the main page of the Interface, even though the chamber is plugged in at the rear of the interface, the force transducer is broken and needs to be replaced. In addition, if the force reading(s) appear yellow in color, cannot be reset to zero, AND the transducer cannot be recalibrated, the force transducer is broken and needs to be replaced.

If any other problems related to the force transducer are encountered, please contact DMT for advice or further instructions.

4.4 FORCE TRANSDUCER REPLACEMENT

If the force transducer breaks and needs to be replaced, follow this step-by-step replacement procedure carefully:

1. Remove the pin or jaw from the transducer pin coming out of the transducer house.
2. Disconnect the Myograph Chamber from the 630MA Interface.
3. Turn the Myograph Chamber upside down and remove the transducer housing by loosening the two screws (A+B) as illus trated in Figure 4.9 below. Lift off the transducer housing and detach the small connector between the transducers and the chamber.

Figure 4.9 - The 2 screws that secure the transducer house to the chamber

4. The replacement transducer will be shipped with the new transducer inside a new transducer house.
5. Place a small amount of vacuum grease (clear or whitish grease) around the bottom of the transducer housing to seal the transducer housing when put back in place.
6. Carefully realign the transducer housing with the new transducer on the Myograph Chamber and reinsert the allen screws through the bottom of the Myograph Chamber.
7. Tighten the screws and place some vacuum grease around the transducer pin that protrudes from the transducer housing. Make sure that the hole is completely sealed to prevent buffer solution or water from entering the transducer housing and damaging the new force transducer.

IMPORTANT: CALIBRATE THE NEW FORCE TRANSDUCER BEFORE PERFORMING A NEW EXPERIMENT, AS DESCRIBED IN CHAPTER 3.1 AND 4.2.

4.5 MYOGRAPH MAINTENANCE

The Multi Wire Myograph System Model 630MA is a very delicate and sophisticated piece of research equipment. DMT recom mends that the following sections are read carefully and that the instructions are followed at all times.

Myograph chamber tubing

To prevent the tubing from becoming blocked with buffer salt deposits after an experiment, remove the chamber cover from the Myograph Chamber and turn on the vacuum and press the vacuum valve for about 10 seconds by holding down the valve button(s) down. Turn off the vacuum and gas supply. Remove any water or buffer remaining in the chamber or on the tubing using absorbent paper.

Force transducer

The force transducer is the most delicate and fragile component of the myograph system. Extreme care must be used when handling or touching the force transducers.

As a part of daily maintenance, inspect the grease around the transducer pin extending from the transducer housing pinhole before starting any experiment. Insufficient grease in this area will allow buffer and water to enter the transducer housing and cause damage to the force transducer.

IMPORTANT:

- **DMT recommends that the high vacuum grease sealing the transducer pinhole is checked and sealed at least once a week, especially if the myograph is used frequently.**
- **DMT takes no responsibilities for the use of any other kinds of high vacuum grease other than the one available from DMT.**
- **DMT takes no responsibilities for any kind of damage applied to the force transducer.**

Linear slides

Check the linear slides (under the black covers) for grease at least once a week. In case of insufficient lubrication, grease the slides with the “Grease for Linear Slides” included with your system.

Cleaning the myograph

DMT strongly recommends that the myograph chambers and surrounding areas are cleaned after each experiment.

At the end of each experiment, use the following procedure to clean the myograph chambers and supports:

1. Fill the 630MA myograph chamber close to the edge with an 8% acetic acid solution and allow it to work for one minutes to dissolve calcium deposits and other salt build-up. Use a cotton-tipped applicator to mechanically clean all chamber surfaces with distilled water.
2. Remove the acetic acid and wash the myograph chamber and supports several times with double distilled water.
3. If any kind of hydrophobic reagents have been used which might be difficult to remove using steps 1) and 2), then try incubating the chamber and supports with 96% ethanol or a weak detergent solution (i.e. 0.1% triton-100).
4. To remove more resistant or toxic chemicals, incubate the myograph chamber and supports with 1M HCl for 1 minute. In exceptional cases, incubate the chamber and supports with no stronger than a 3M HN03 solution for about 1 minute.
5. Wash the myograph chamber and supports several times with double distilled water.
6. If acids such as 1M HCl and 3M HN03 are used to clean the chambers, make sure ALL surfaces are thoroughly dried after copious washes with double distilled water. Any residual acid will cause corrosion of the stainless steel jaws and pins.

IMPORTANT:

- **Be very careful using HCl or HNO3 because these acids may cause extreme damage to the stainless steel chambers and supports. DO NOT USE bleach to clean the chambers. Repeated use of chlorinated solutions such as bleach and HCl will cause damage to the stainless steel parts of your myograph system. Avoid using them if at all possible.**
- **After cleaning, ALWAYS check that the grease around the transducer pin is sufficient to keep the buffer and water from entering the transducer housing.**
- **Any acids spilled outside the high grade steel chamber onto the myograph has to be removed immediately.**

If red or brown discolorations appear on the chamber sides or on the supports, the following cleaning procedure will work in most cases:

7. Incubate the myograph chamber and supports for 30 minutes with 2mM T-1210 Tetrakis-(2-pyridylmethyl) -ethylenediamine solution dissolved in double distilled water.
8. Use a cotton-tip applicator to mechanically clean all the affected surfaces during the last 15 minutes of the incubation period.
9. Wash the myograph chamber and supports several times with double distilled water.
10. Incubate the myograph chamber with 96% ethanol for 10 minutes while continuing the mechanical cleaning with a cotton tip applicator.
11. Remove the ethanol solution and wash a few times with double distilled water. Incubate the myograph chamber and supports with an 8% acetic acid solution for 1 minute and continue the mechanical cleaning with a swab-stick.
12. Wash the myograph chamber and supports several times with double distilled water.
13. Dry the surfaces using absorbent paper (i.e. Kim-Wipes) or cotton-tip applicators.

IMPORTANT: In exceptional cases, the supports (jaws or pins) may need to be removed from the myograph chamber and cleaned individually to assure proper cleaning of all support surfaces. NEVER SOAK THE SUPPORTS IN ANYTHING STRONGER THAN 8% ACETIC ACID FOR EXTENDED PERIODS OF TIME (i.e. several hours or overnight)!

APPENDIX 1 - SPEC SHEET

CHAMBER:	
Chamber volume (min - Jaw mount)	4 ml
Chamber volume (min - pin mount)	2.2 ml
Chamber(s)	4
Chamber material	Acid resistant stainless steel
Vessel size - jaw mount	>30 µm
Vessel size - pin mount	>450 µm
Vessel normalization	Automatically
Micrometer resolution	0.01 mm
Mounting type	Jaws and pins
TEMPERATURE:	
Range	15.0 to 50.0 °C
Resolution	0.1 °C
Stability	±0.2 °C
Heating	Yes
TRANSDUCER:	
Output reading	mN or g
Range	±200/±400/±800/±1600 mN
Resolution	0.01 mN
Force calibration	Yes
OUTPUT:	
Data communication	USB 2.0
Analogue output channels	4
Analogue output range	±2.5 V

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