DMT
DANISH MYO TECHNOLOGY

DUAL WIRE MYOGRAPH SYSTEM

MODEL 410A

User Manual

Version 3.5

DUAL WIRE MYOGRAPH SYSTEM
MODEL 410A

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 Dual Wire Myograph System – Model 410A

Document Number: 410A – UG3.3A

CONTENTS

INTRODUCTION

Until the mid-1970s most of the details about the mechanical, morphological and pharmacological properties of vascular smooth muscle was obtained 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, and the vessel segment had to be directly manipulated with the dissecting equipment causing inevitable mechanical trauma. Investigations of smaller vessels were therefore limited to *in vivo* perfusion experiments and histological examinations.

In 1976, Professors Mulvany and 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 twofold: both ends of each mounting wire were secured under tension without any direct manipulation of the vessel segment. Segments of small vessels could now be atraumatically 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 programme for the existing myograph systems as well as a development programme 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 new electronic systems. In addition, new systems were introduced, like the Automatic Dual Myograph 510A, the Dual Myograph 410A, the Multi Myograph 620M 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 number one goal is to develop and manufacture first class research equipment within the fields of physiology and pharmacology.

SAFETY

The Dual 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: nor for the prevention, diagnosis, curing, treatment, or alleviation of disease, injury, or handicap.

- 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 apparatus 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.
- This apparatus must be grounded.
- Use a three-wire grounding-type cord similar to the one supplied with the product.
- Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two flat blades, one being wider than the other. A grounding type plug has two blades and a third (round) grounding pin. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
- 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	UL817 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.

Protect the power 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.

EMC / EMI

This equipment has been tested and found to comply 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.

APPROVALS

Complies with the EMC standards:	
EMC 89/336/EEC:	EN 61326-2-6:2005
	EN 61000-3-2.
Certified with the safety standards:	
Directive 2006/95/EC:	EN 61010-1:2001
	EN 61010-1/Corr.1:2003
	EN 61010-1/Corr.1:2003
	EN 61010-2-101:2003

CERTIFICATE OF CONFORMITY

DMT A/S, Skejbyparken 152, 8200 Aarhus N., Denmark,
hereby declares its responsibility that the following product:

Dual Wire Myograph System - Model 410A

is covered by this certificate and marked with CE-label conforms with the following standards:

EN 61010-1:2001 EN61010-1/Corr.1:2003 EN 61010-1/Corr.1:2003	Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements.
EN 61010-2-101:2003	Safety requirements for electrical equipment for measurement, control and laboratory use - Part 2-101: Particular requirements for in vitro diagnostic (IVD) medical equipment.
EN 61326-2-6:2005	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 2-6: Particular requirements - In vitro diagnostic (IVD) medical equipment.
	With reference to regulations in the following directives: 2006/95/EC, 89/336/EEC

ABOUT THIS MANUAL

This manual contains a complete list of procedures describing how to install, maintain and using the Dual Wire Myograph System – model 410A.

Chapter 1 provides an overview of the construction and basic features of the Myo-Interface and the Dual Wire Myograph Unit.

Chapter 2 describes step-by-step how to set-up a complete 410A Wire Myograph System including accessories.

Chapter 3 is a complete manual to the Myo-Interface. The chapter describes in detail the construction of the menu system and how to use all the features of the Dual Wire Myograph System.

Chapter 4 contains procedures describing general as well as daily maintenance of the myograph unit; e.g. adjustment of supports, weight calibration of the force transducer and cleaning instructions.

Appendices contain additional information about fuse replacement and system specifications.

UNPACKING THE MYOGRAPH SYSTEM

Please take a few minutes to carefully inspect your new Wire Myograph System for damage, which may have occurred during handling and shipping. If you suspect any kind of damage, please contact DMT immediately and the matter will be pursued quickly as possible. If the packing material appears damaged, please retain it until a possible claim has been settled.

We recommend that you store the packing material for any possible future transport of the Wire Myograph System. In case of transport and the original packing material is unavailable, please contact DMT Sales Department for advice and packing instructions.

After unpacking your new Wire Myograph System, please use the following list to check that the system is complete:

1. **Myo-Interface unit:**
   - Myograph connection cable with a temperature probe
   - Power cord (The shape of the AC plug varies by country; be sure that the plug has the right shape for your location)

2. **Dual wire myograph unit:**
   - Calibration kit (including bridge, balance and 2 g weight)
   - Chamber cover
   - Chamber separator

3. **Accessories:**
   - 1 roll of 40 µm stainless steel wire
   - 1 tube of high vacuum grease
   - 1 tube of grease for linear slides
   - 4 spare screws for mounting of jaws
   - 2 Allen keys
   - 1 small screwdriver

4. **Manuals**
   - 1 CD with user manuals for Wire Myograph Systems
   - 1 CD with the manual “Procedures for investigation of small vessels using small vessel myograph”, by Professor M. J. Mulvany, Department of Pharmacology, Aarhus University, Denmark and the video “Dissection and mounting of small vessels in wire myographs”

CHAPTER 1 - SYSTEM OVERVIEW

1.1 Myo-Interface front panel

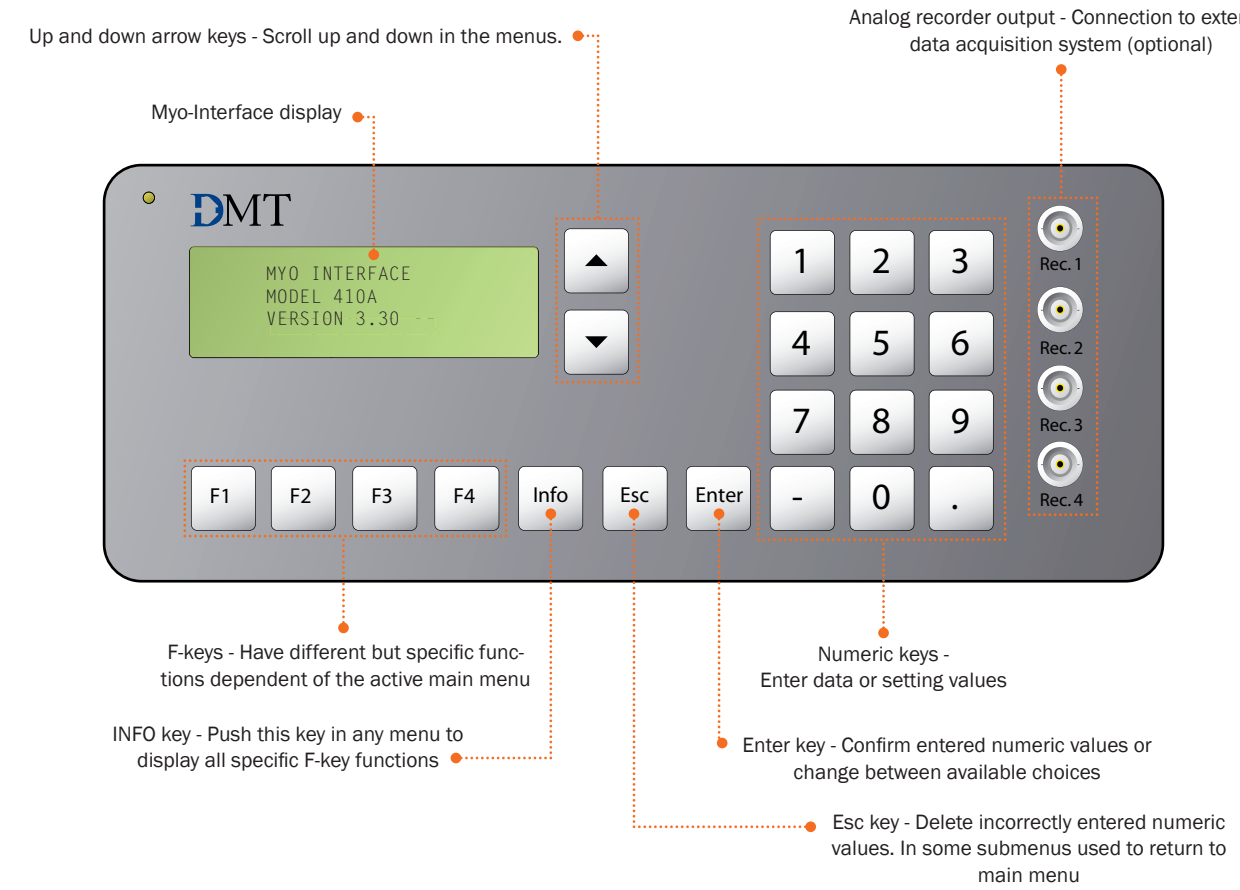


Figure 1.1 *Myo-Interface front panel*

1.2 Myo-Interface rear panel

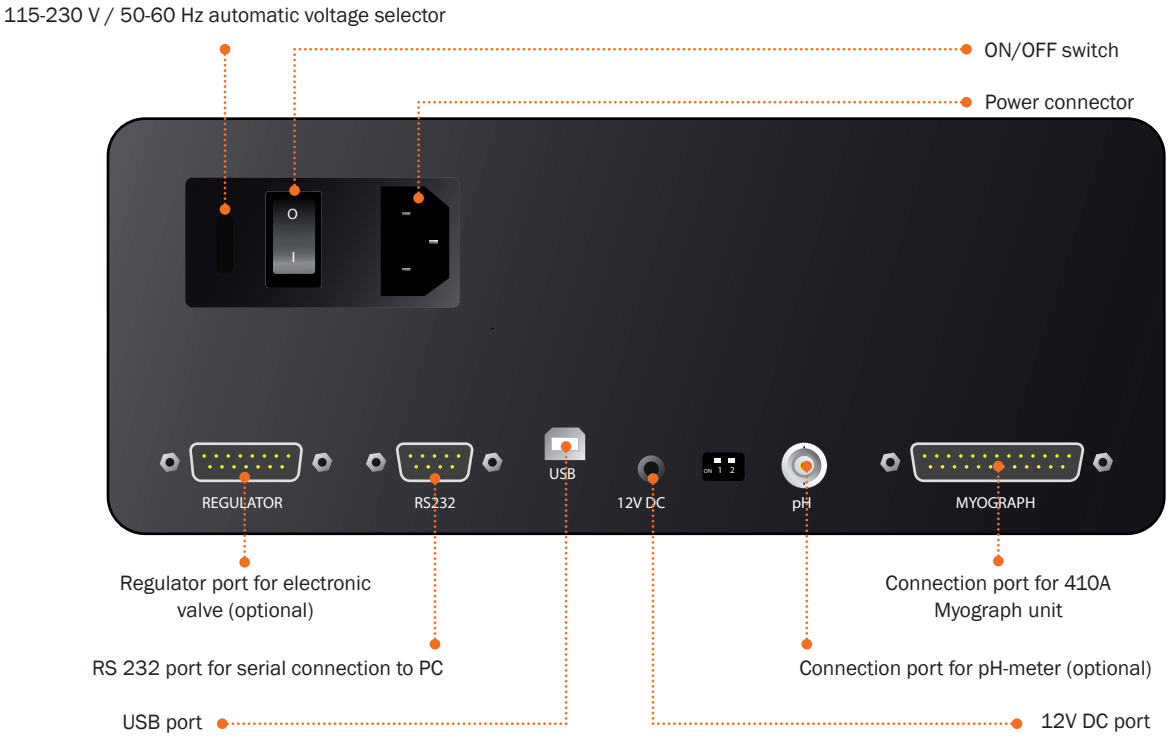
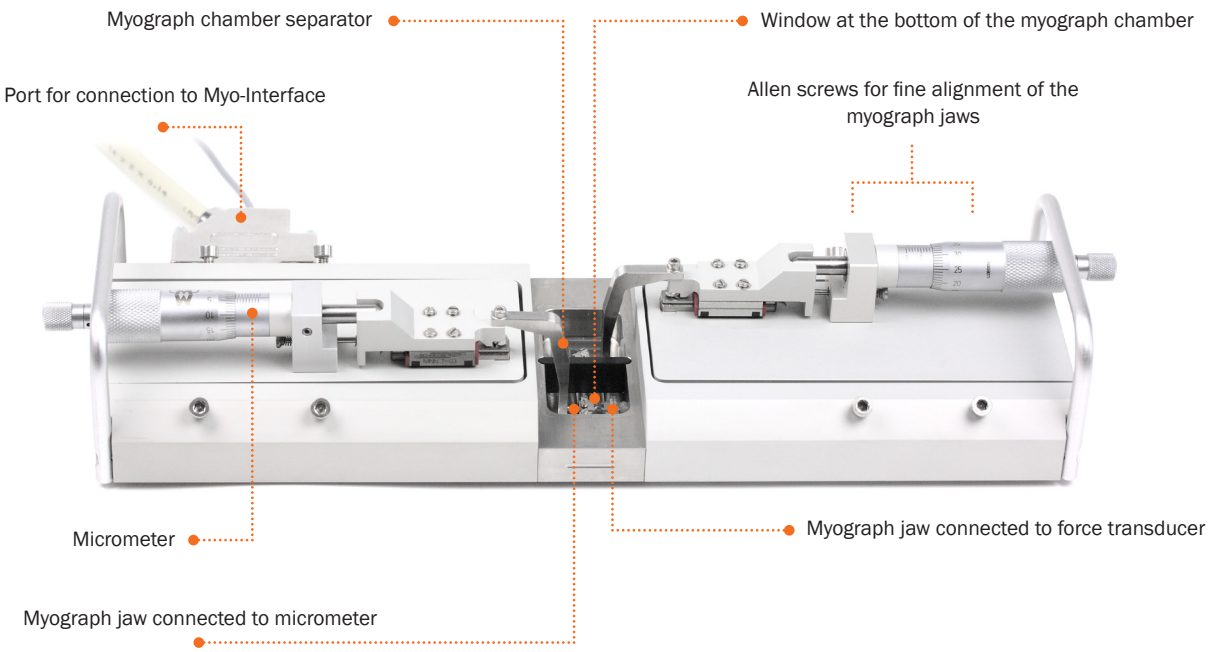
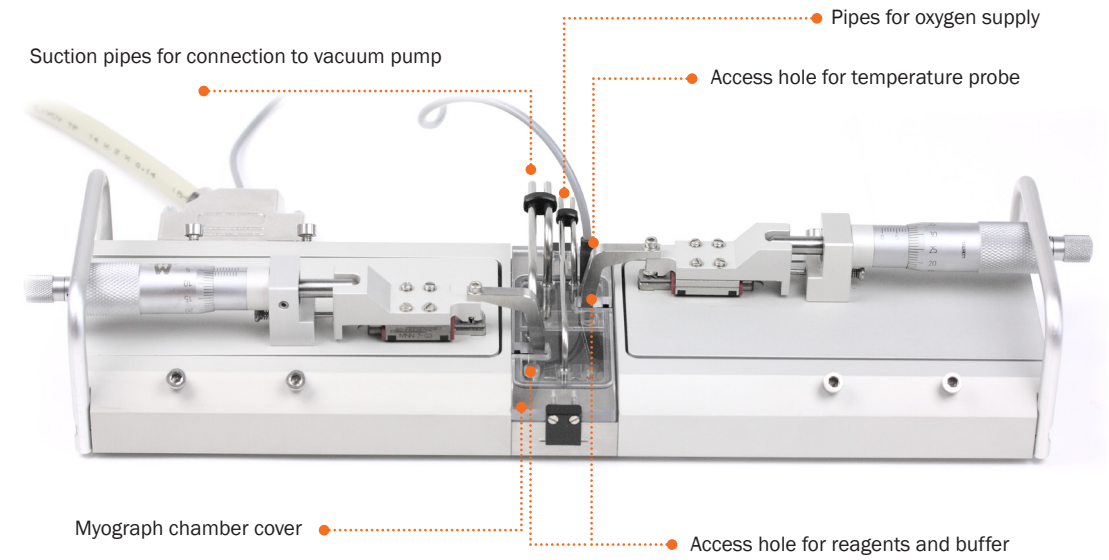


Figure 1.2 *Myo-Interface rear panel*

1.3 Dual Wire Myograph Unit



1.4 Dual wire myograph unit with chamber cover



CHAPTER 2 - SETTING-UP

2.1 The complete myograph 410A system

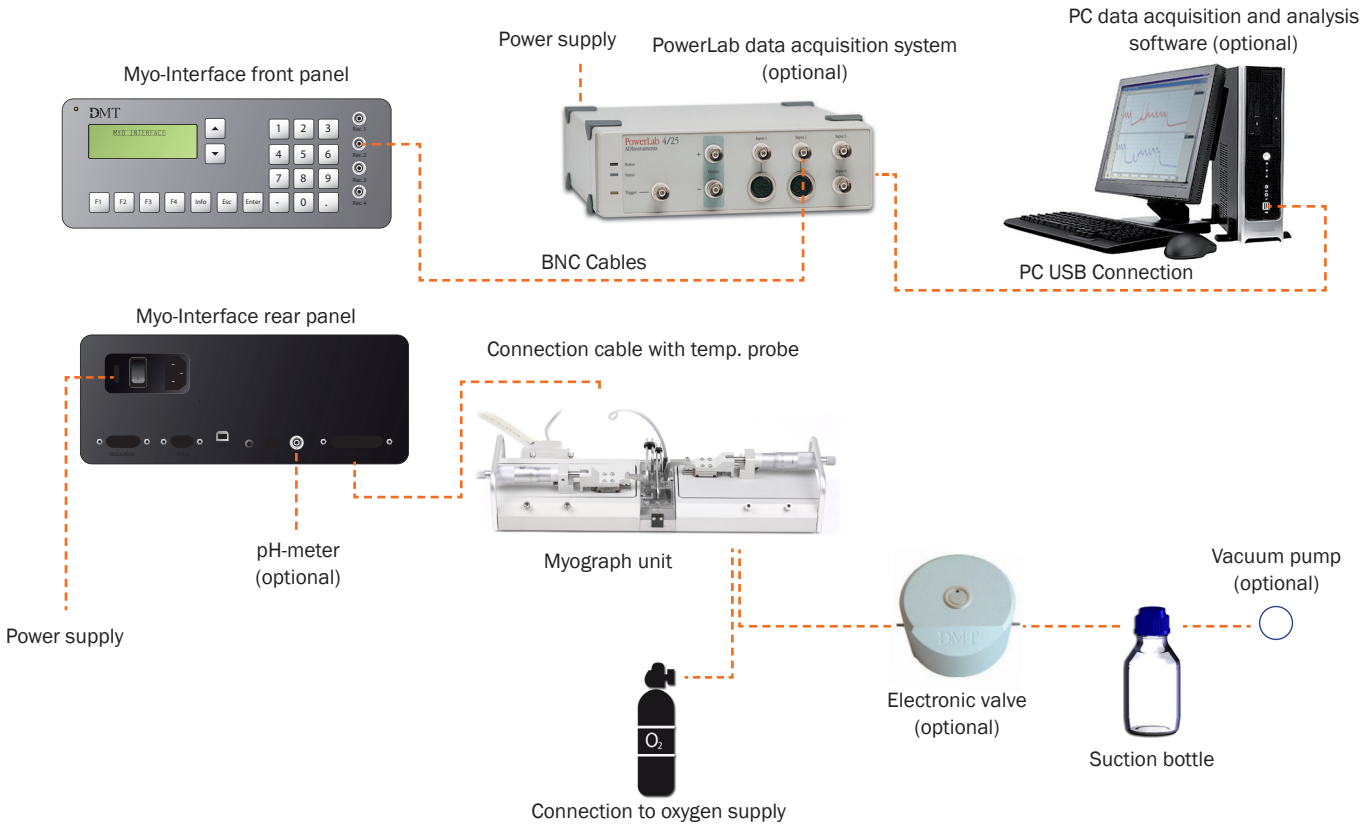


Figure 2.1 *The complete Dual Wire Myograph System - model 410A*

2.2 Setting up step-by-step

The chapter contains a complete step-by-step description of how to set up a complete Myograph 410A System as illustrated in figure 2.1 above.

1. **Myograph unit – Myo-Interface connection:**
   Connect the myograph 410A unit to the Myo-Interface using the grey 25-pin connection cable. The end of the cable with the temperature probe is used with the myograph unit.

2. **Myo-Interface – PC connection:**
   Data acquisition is possible either by connecting the Myo-Interface directly to a PC or through a PowerLab data acquisition and analysis system (optional).

   I. **Direct PC Connection:**
   Connect the Myo-Interface to one of the COM-ports on the PC using the serial cable delivered with the Dual Wire Myograph 410A System.

   II. **PowerLab (optional):**
   Connect the Myo-Interface to the PowerLab unit using BNC cables. Connect Rec 1 on the Myo-Interface to Input 1 on the PowerLab. Rec 2 to Input 2, and so forth.
   Connect the PowerLab unit to one of the USB-ports on the PC using the USB cable delivered with the PowerLab system.

3. **Oxygen supply**
   Connect the “small” pipes on the myograph chamber cover to an adjustable oxygen supply using small rubber tubes (internal diameter 1.5 mm).

4. **Suction connection**

   Connect the “large” pipes on the myograph chamber cover to a vacuum pump via a suction bottle and the vacuum valve as illustrated in figure 2.1 on previous page. The internal diameter of rubber tubes for connection to the pipes on the chamber cover is 2 mm. An electronic vacuum valve is optional.

5. **pH-electrode (optional)**

   Connect the pH electrode to the pH port on the backside of the Myo-Interface and install the software flash update, as provided with the electrode. Perform a pH calibration as described in ”Chapter 3 - The Myo-Interface” on page 15.

2.3 The force transducer calibration

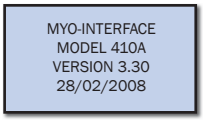
Prior to the shipment the 410A myograph system has gone through two days of continuous testing including a final force transducer calibration. However in order to ensure that the myograph is working at highest performance, DMT recommends that a new force transducer calibration is performed before starting to use the myograph system. The calibration is performed through the Calibration menu using the calibration bridge, balance and appropriate weight according to gain setting. As default the system is set with a range of ±200 mN and the calibration example is performed using a 2 g weight.

The weight calibration procedure is described in detail in “4.2 Force transducer calibration” on page 20

CHAPTER 3 - THE MYO-INTERFACE

3.1 Turning on the Myo-Interface

When the 410A Myo-Interface is switched on, the display shows that the system is starting up and initializing, after which the start-up message depicted to the right is shown.



The display automatically shows the Main menu after several seconds. Otherwise, press F1 to proceed to the Main menu.
When the start-up message is active, the ▲ and ▼ keys can be used to adjust the display contrast setting.

3.2 Menus and submenus

General navigation

The following controls are used to display the various menus, choose varying menu options and change values :

F1	Change to the next menu
F2 – F4	Have varying functions depending on the current active menu
Info	Push this key in any menu to display all specific associated F-key functions
Numeric keys	Enter data or setting values
Enter	Confirm entered numeric values or change between available choices
Esc	Delete incorrectly entered numeric values in some submenus used to return to main menu
▲ – ▼	Scroll up and down through the display, as only four lines are capable of being displayed at a time. Being in the top line of a submenu, use ▲ to change to the previous main menu.

The active line in the menu is indicated by a “>” symbol.

Main menu

The Main menu displays the current values from the force transducer, the actual temperature probe reading and heating setting (in °C), the heating status as well as the pH probe reading (optional).

Temperature
To change the temperature setting, move the Set. Temp line to the top of the display (the > symbol is displayed in that line). Use the numeric keys to enter a new temperature setting and press Enter to confirm.

Heating
To turn on the myograph heating move the Heat is line to the top of the display and use the Enter key to switch between on and off. Press the Info key and the display shows the F-key options associated with the Main menu. Choose one of the F-keys to proceed with the following options or press Info again to return to the Main menu:

F1	Change to the next main menu (Recorder).
F2	Opens the Valve Activation submenu. An optional electronic vacuum valve is available for the system, which can be activated here.
F3	Opens the Zero Force submenu (press F1 to zero the force or F4 to cancel)
F4	Displays a condensed Main menu. Press F4 to toggle between the condensed and the normal view.

3.3 Menu overview

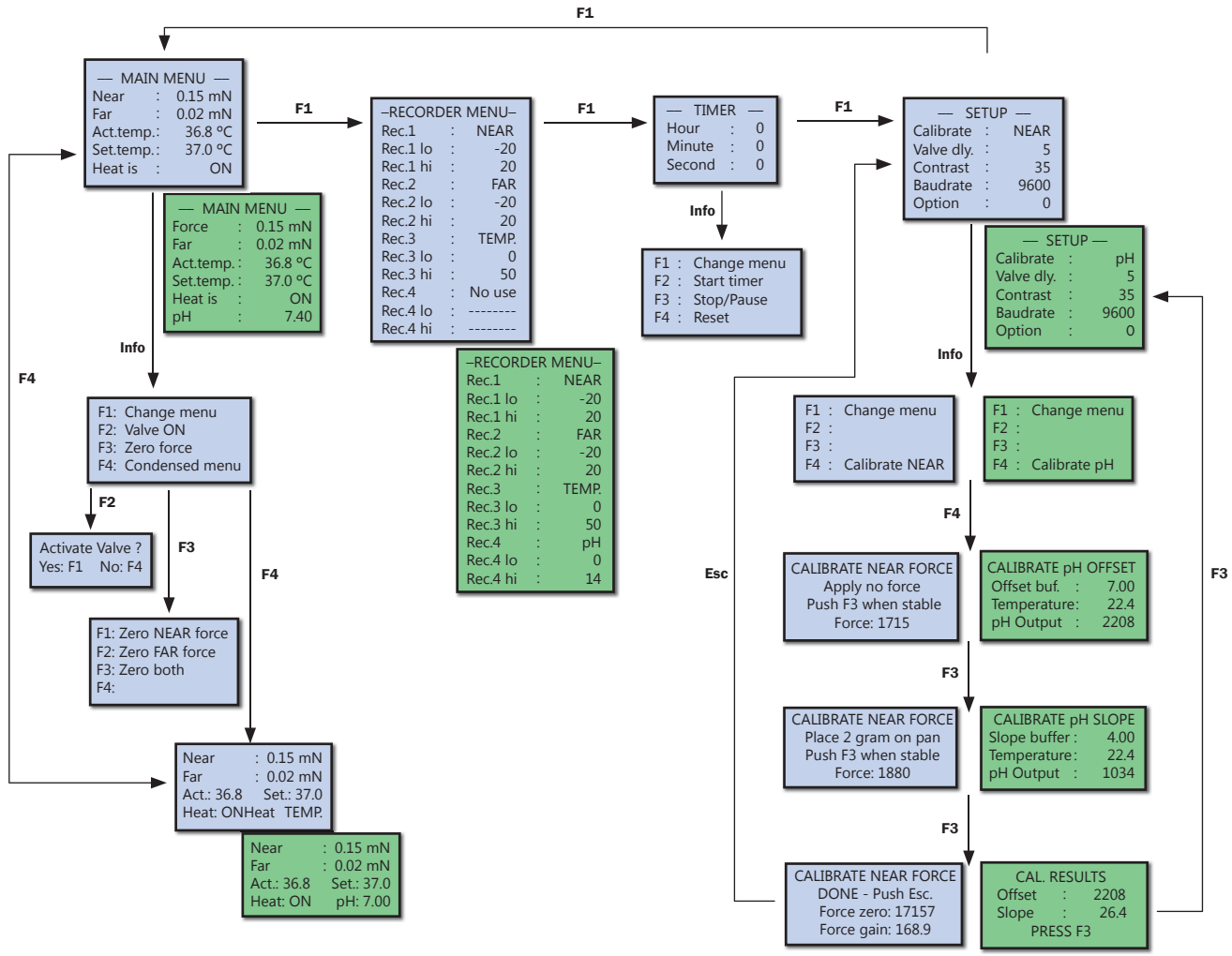


Figure 3.1 *Menu overview: the green panels indicate the menu appearance/options when the optional pH-meter is installed.*

Recorder menu

The 410A Myo-Interface has four analog output ports on the front panel for connection to a data acquisition system. These default settings for these output ports are:

Rec. 1 Myograph force (FORCE) output
Rec. 2 Temperature (TEMP.) output
Rec. 3 pH reading output (if, installed)
Rec. 4 No output

The output order can be programmed to whatever order you desire. Make the recorder line of interest active (uppermost in display) and use the Enter key to toggle between the available signals.
The full-scale output from the Myo-Interface is one volt. In the Recorder menu it is possible to change the associated values for each analog output that correspond to 0 V (lo) and 1 V (hi).

Timer menu

The Timer menu makes it possible for the Myo-Interface to act as a timer after a predefined countdown. To set the countdown time, move the line to be programmed (hour, minute or second) to the top of the display. Use the numeric keys to enter the time value and press Enter to confirm.

To control the timer function, press the Info key and the display shows the F-key options for the Timer menu. Choose one of the F-keys to proceed with the following options or press Info again to return to the Main menu:

F1 Proceed to the Setup menu.
F2 Start the countdown (the time values are entered in the Timer menu).
F3 Stop or pause the countdown.
F4 Reset the entered time values or to turn off the alarm.

Setup menu

Calibrate Displays the signal to be calibrated (either force or pH).
Valve dly The time in seconds that the electronic valve (optional to the system) remains open when activated.
Contrast The actual contrast setting in the display.
Baudrate Data transmission rate from the Myo-Interface to a PC via the RS-232.
Option The option line allows access to submenus using specific access codes.

Use the numeric keys to change the valve delay or display contrast settings and press Enter to confirm.
Press the Info key and the display shows the F-key options available for the Setup menu. Press Info again to return to the Setup menu or one of the F-keys to proceed with one of these options.

F1 Press F1 to proceed to the Main menu.
F4 Calibrate Force (or pH)

Having chosen in the Setup menu which signal to calibrate, press F4 to initiate the calibration process. Press Esc to return to the Setup menu if you do not wish to calibrate.

Force calibration

This procedure is described in detail in “4.2 Force transducer calibration” on page 20.

pH calibration (optional)

Having chosen to calibrate the pH settings, press F4 to initiate the calibration. In the Calibrate pH Offset display, the first line shows the value of the offset buffer (first buffer solution), which is always 7.00. The second line shows the temperature of the buffer solution. The temperature is an important parameter in the calibration formula and is obtained automatically by placing the myograph temperature probe in the buffer solution. The third line shows the output from the pH probe as raw data from the A-D converter.

Place the pH-meter electrode and temperature probe in the offset buffer solution and turn on stirring. When the relative pH output in the bottom line is stable, press F3 to proceed.
The first line now displays the value of the slope buffer (second buffer solution), which is always 4.00. Place the pH and temperature probes in the slope buffer solution and turn on stirring. When the relative pH output in the bottom line is stable, press F3 to proceed.
The pH calibration is now finished. The parameters are stored in the internal memory of the Myo-Interface. Press F3 to return to the Setup menu.

CHAPTER 4 - THE DUAL WIRE MYOGRAPH UNIT

This chapter contains a complete explanation of how to adjust, calibrate and maintain the 410A myograph unit to ensure the equipment performs to the highest standard.

4.1 Adjustment of supports

A successful mounting of any kind of tubular tissue segment in the wire myograph is to a high extent dependent on perfectly matching supports. The supports are matched prior to the shipment but daily use of the myograph system and greasing of the transducer pinhole will over time create a need for an adjustment of the supports.

Adjustment of the supports is performed using the following step-by-step procedure. Please note that the amount of force on the screws should be very little to avoid breaking the threads. The procedure is illustrated in figure 4.1 below.

1. Carefully loosen screw (D_1) on the top of the support connected to the force transducer. Align the horizontal support and carefully tighten the screw again.

2. Loosen screw (D_2) on the top of the support connected to the linear slide. Align the horizontal support matching the force transducer connected support as carefully as possible and gently tighten the screw again.

3. Loosen screw (C) on the linear slide to roughly match the linear slide support to the force transducer support in the horizontal plane as illustrated in figure 4.1 below. Tighten the screw before proceeding with step 4).

4. The plate (B), on which the linear slide is mounted is balanced on top of a small stainless steel ball making it possible to finely adjust the linear slide support in all vertical and horizontal planes using the four Allen screws (A). Use the four Allen screws to make the final horizontal (figure 4.1 below) and vertical (figure 4.2 on next page) adjustments to match the linear slide support to the force transducer support. The correct matching of the supports is illustrated in figure 4.3 on next page.

IMPORTANT:

BE CAREFUL NOT ONLY TO CONTINUOUSLY TIGHTEN THE ALLEN SCREWS WHEN DOING THE FINAL ADJUSTMENTS. ALWAYS REMEMBER TO LOOSEN THE ALLEN SCREW PLACED DIAGONAL TO THE ALLEN SCREW BEING TIGHTENED OR ELSE THERE IS A HIGH RISK OF DAMAGING THE MYOGRAPH FRAME.

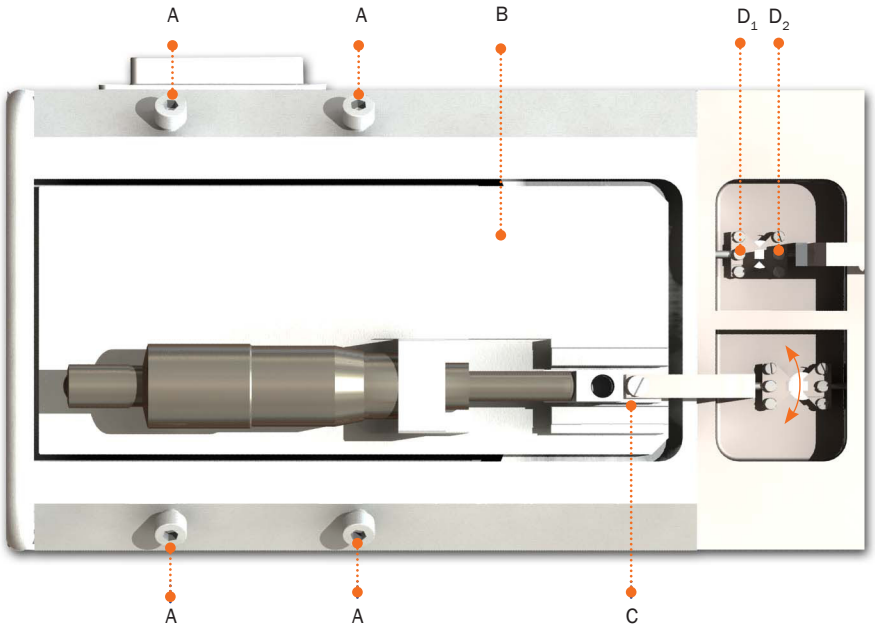


Figure 4.1 *Myograph unit - screws for adjusting supports*

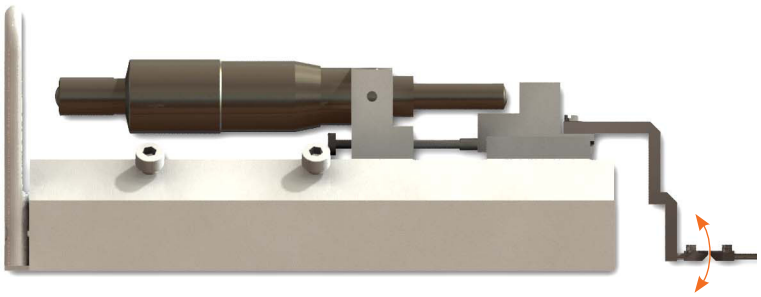


Figure 4.2 *Myograph unit displaying vertical adjustment*

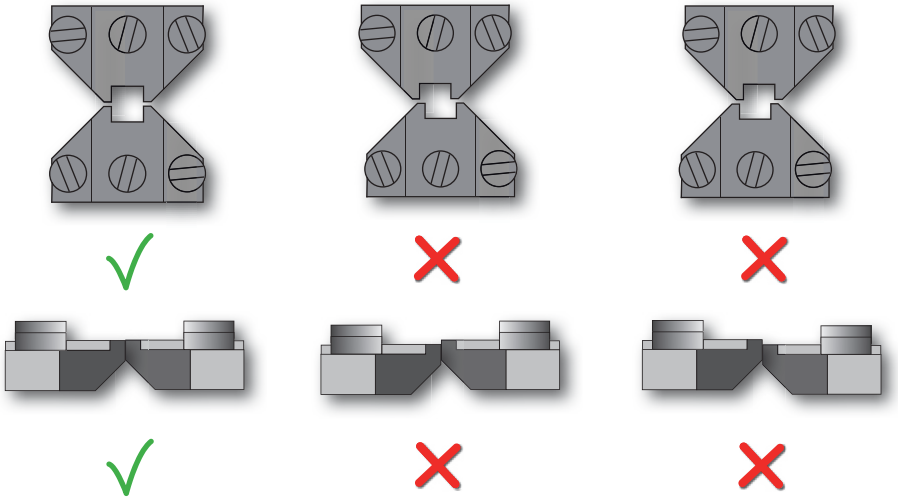


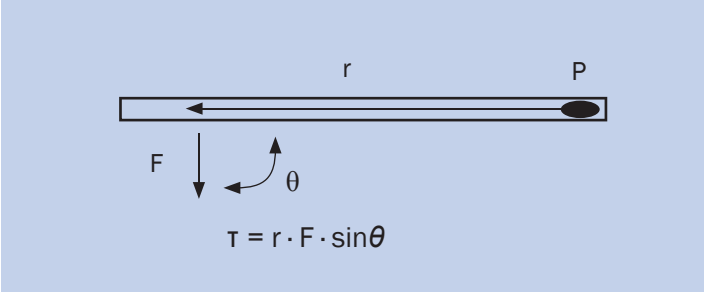
Figure 4.3 *Illustration of correctly aligned supports for small vessels (left) and incorrectly aligned supports (middle and right)*

4.2 Force transducer calibration

As a part of the general maintenance of the myograph, DMT recommends that the myograph is weight calibrated at least once every month. DMT also recommends that the myograph is weight calibrated every time the system has been moved or has not been used for a long period of time.

4.2.1 Principles of weight calibration

Weight calibrating the force transducer is based on simple physics: the net torque acting on a balance when applying a certain amount of weight. The magnitude of the torque τ about a point of rotation P is defined by:



where r is the distance from the point of rotation to the point on the object where the force F is acting with the angle of θ. Applying the physics to the weight calibration setup is illustrated in figure 4.4 below.

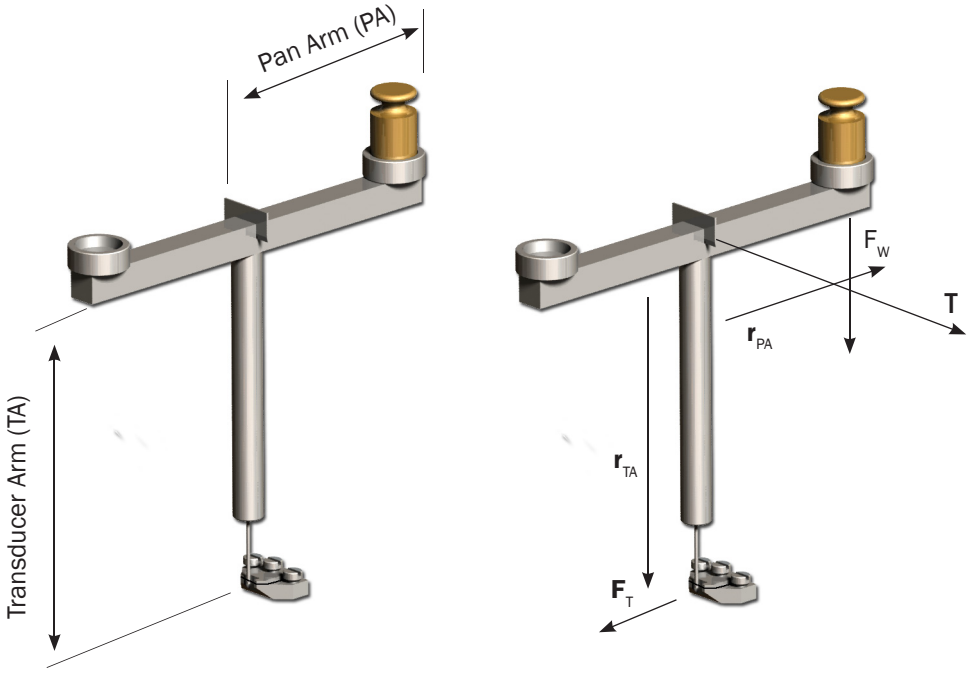


Figure 4.4 *Theoretical principle of the weight calibration*

Applying the weight on the pan arm creates a net torque acting at the “center of gravity” resulting in a force FT acting on the force transducer. The following two equations describe the forces working in the weight calibration system:

1. $\tau = r_{PA} \cdot F_W \cdot \sin\theta_1 = r_{PA} \cdot (m_{weigt} \cdot g) \cdot \sin\theta_1$
2. $\tau = r_{TA} \cdot F_T \cdot \sin\theta_2$

where r_{PA} is the length of the “pan arm”. F_W is the force acting on the “pan arm” when applying the weight. F_W is equal acceleration of gravity times the mass of the weight. r_{TA} is the length of the “transducer arm” and F_T is the force acting on the force transducer.

The net torque acting at “center of gravity” is constant for the weight calibration setup, which makes equation 1 and 2 equal, making it possible to calculate the force acting on the force transducer:

$$r_{TA} \cdot F_T \cdot \sin\theta_2 = r_{PA} \cdot (m_{weigt} \cdot g) \cdot \sin\theta_1$$

$$F_T = \frac{r_{PA} \cdot (m_{weigt} \cdot g) \cdot \sin\theta_1}{r_{TA} \cdot \sin\theta_2}$$

As the length of the “pan arm” is 2 cm, the length of the “transducer arm” is 4 cm, the weight is 2 g, both angles are 90^0 and the acceleration of gravity is 9.81 ms^{-2}, the force acting on the force transducer is:

$$F_T = \frac{2\ cm \cdot (2\ gram \cdot 9.81\ ms^{-2}) \cdot \sin 90}{4\ cm \cdot \sin 90}$$

$$F_T = 9.81\ gram \cdot m \cdot s^{-2}$$

As 1 N is equal 1 $kg \cdot m \cdot s^{-2}$, F_W is equal to:

$$F_T = 9.81\ mN$$

4.2.2 Weight calibration procedure

This section contains a complete step-by-step description of how to weight calibrate the force transducers.

1. Fill the myograph chamber with double distilled water and move the jaws apart. Mount a 40 µm stainless steel wire on the jaw connected to the force transducers.

2. Place the calibration bridge, balance and weight on the myograph unit, so that the calibration kit is warmed up together with the myograph unit. Turn on the heating in the Main menu on the Myo-Interface.

3. After approximately 20-30 minutes the whole system will have reached the target temperature (normally 37^0 C). Place the warmed calibration bridge and balance on the myograph unit as illustrated in figure 4.5 on next page.

4. Make sure that the tip of the transducer arm on the balance is placed in the gap between the wire and the jaw as illustrated in figure 4.6 on next page. Carefully move the calibration bridge until the tip of the transducer arm is placed freely in the gap, which means it does not touch either the wire or the jaw.

   NOTE: THE WEIGHT SHOULD NOT BE PLACED ON THE BALANCE YET.

5. Go to the Setup menu on the Myo-Interface and choose to calibrate the myograph force (see “Figure 3.1 Menu overview” on page 16). Press F4 to start calibration

6. Make sure that absolutely no force is applied on the force transducer by checking that the tip of the “transducer arm” is not touching either the wire or jaw. Also check that the relative force reading in the display is stable. Press F3 to proceed with calibrating.

7. Carefully place the 2 g weight on the pan as illustrated in figure 4.6 on next page. The force applied on the force transducer should mimic the stretch created by the contraction of a mounted ring preparation. Wait until the relative force reading is stable. Press F3 to finish the calibration.

8. Press Esc to return to the Setup menu and then press F1 to show the Main menu. The force reading on the Myo-Interface should now be very close to 9.81 mN. If the force reading is different from 9.81 mN then try to calibrate the fore transducer once again starting with step 3.

9. After calibrating the myograph, carefully remove weight, balance and calibration bridge. The myograph system is now ready for use.

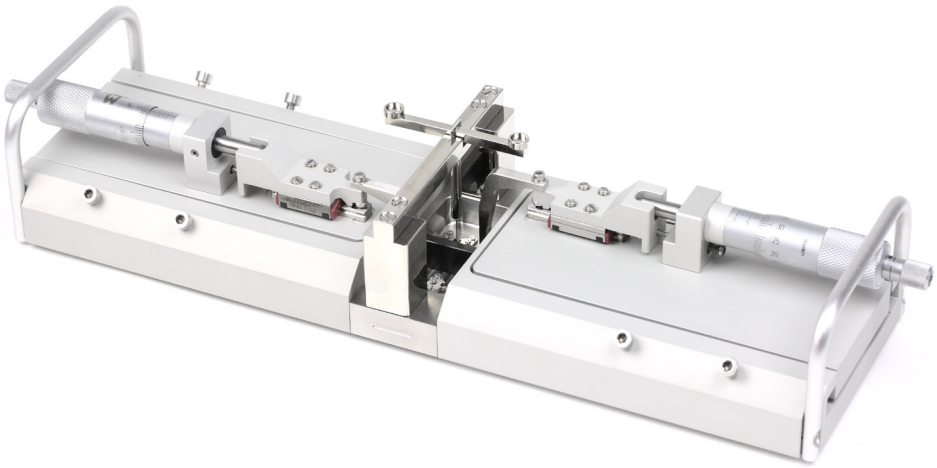


Figure 4.5 *Weight calibration setup*

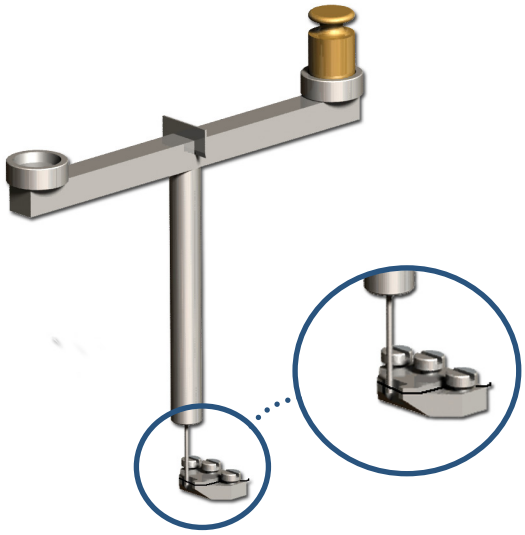


Figure 4.6 *Illustration of how to fit the balance between the wire and the gap in the support*

4.3 Checking or replacing force transducer

The myograph force transducer is a strain gauge connected in a Wheatstone bridge. The force transducers are placed in separate compartment. The separate compartment provide some mechanical protection for the force transducer but the transducers are still very vulnerable to applied forces exceeding 1 newton (100 g) or fluid running into the transducer compartment due to insufficient greasing of the transducer pinhole.

This section describes how easy it is to check the force transducer and how to replace it if necessary.

4.3.1 Simple transducer check

If the force reading on the Myo-Interface appears unstable then first check that the Myo-Interface and the Myograph Unit are properly connected through the 25-pin grey cable.
If the force reading still appears unstable then perform a new weight calibration of the force transducer as described earlier in this Chapter.

During the weight calibration monitor the relative force reading values in the calibration menu on the Myo-Interface:

- If the value is 0 or above 6500 the force transducer is broken and needs to be changed.
- If the reading is between 1–499 or 3001–6250 then contact DMT for further instructions.

If the message “OFF” is displayed in either of the force reading lines in the Main Menu on the Myo-Interface then the force transducer is broken and needs to be replaced.
In case of any other problems related to the force transducer, please contact DMT for further instruction and advice.

4.3.2 Force transducer replacement

In case that the force transducer is broken and needs to be changed, please follow this step-by-step replacement procedure carefully:

1. Disconnect the Myograph Unit from the Myo-Interface (grey cable).

2. Carefully remove the support connected to the transducer pin by loosening the screw on top of the support as illustrated in “Figure 4.1 Myograph unit - screws for adjusting supports” (D) on page 18.

3. Turn the myograph unit up side down and remove the bottom plate by loosening the four screws (A) as illustrated in figure 4.7 below.

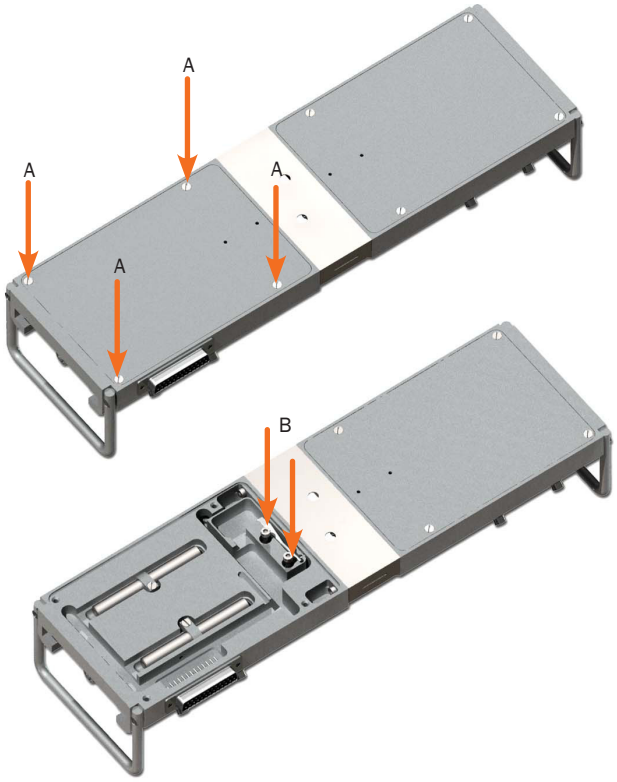


Figure 4.7 *Illustration of how to replace the force transducer*

IMPORTANT:
NOTICE HOW THE PLUG IS CONNECTED TO THE FORCE TRANSDUCER SO NO MISTAKE IS MADE WHEN CONNECTING THE PLUG TO THE NEW FORCE TRANSDUCER.

4. Carefully disconnect the plug on the force transducer.

5. Loosen and remove the two Allen screws (B) and washers as illustrated in figure 4.5 on previous page and carefully remove the old transducer.

6. Remove any remaining grease from the transducer pin left inside of the transducer compartment of the myograph unit. Clean the hole leading from the transducer compartment to the myograph chamber.

7. Gently place the new force transducer into position. Place the Allen screws and washers in their positions ready to be tightened.

8. Before tightening the Allen screws be sure that the transducer pin is placed directly in the center of the “chamber pinhole” when viewing from the side of the myograph chamber.

9. Tighten the two Allen screws and replace the bottom plate. Tighten the four screws on the bottom plate.

10. Place some high vacuum grease around the transducer pin in the myograph chamber. Make sure that the hole is completely sealed so absolutely no buffer solution is able to enter the transducer compartment, which will damage the force transducer.

11. Mount the support on the transducer pin and adjust the supports as described earlier in this chapter.

IMPORTANT:
BEFORE MAKING ANY EXPERIMENT ON THE MYOGRAPH, REMEMBER TO PERFORM A NEW WEIGHT CALIBRATION AS DESCRIBED IN THIS CHAPTER.

4.4 Myograph maintenance

The Dual Wire Myograph System Model 410A is a very delicate and sophisticated piece of research equipment, DMT recommend that the following sections are read carefully and that the instructions are followed at all times.

4.4.1 Myograph chamber pipes

To prevent the pipes from being blocked by buffer salt deposits after an experiment, remove the chamber cover from the myograph and turn on the vacuum pump and vacuum valve for about 10 seconds. Wait to turn off the oxygen supply until turning off the vacuum pump. Wipe off any buffer remaining on the outside of the pipes using a piece of paper.

4.4.2 Force transducer

The force transducer is the most delicate and fragile component of the myograph system. Therefore careful handling is necessary.

One of the jaws in each myograph is connected to the transducer pin. The transducer pin enters the myograph chamber through a pinhole in the chamber wall located below the surface level of the buffer as illustrated in figure 4.8 below. To prevent the buffer from running into the transducer house the hole is filled with high vacuum grease.

As a part of daily maintenance it is very important to inspect the greasing of the transducer hole before starting any experiment. Insufficient greasing causes damage and malfunction of the force transducer.

IMPORTANT:

- **DMT RECOMMENDS USE OF THE HIGH VACUUM GREASE ONCE A WEEK TO SEAL UP THE TRANSDUCER HOLE BY FREQUENTLY USE.**
- **DMT TAKES NO RESPONSIBILITIES FOR THE USE OF ANY OTHER KINDS OF HIGH VACUUM GREASE THAN THE ONE TO BE PURCHASED FROM DMT.**
- **DMT TAKES NO RESPONSIBILITIES FOR ANY KIND OF DAMAGE APPLIED TO THE FORCE TRANSDUCER.**

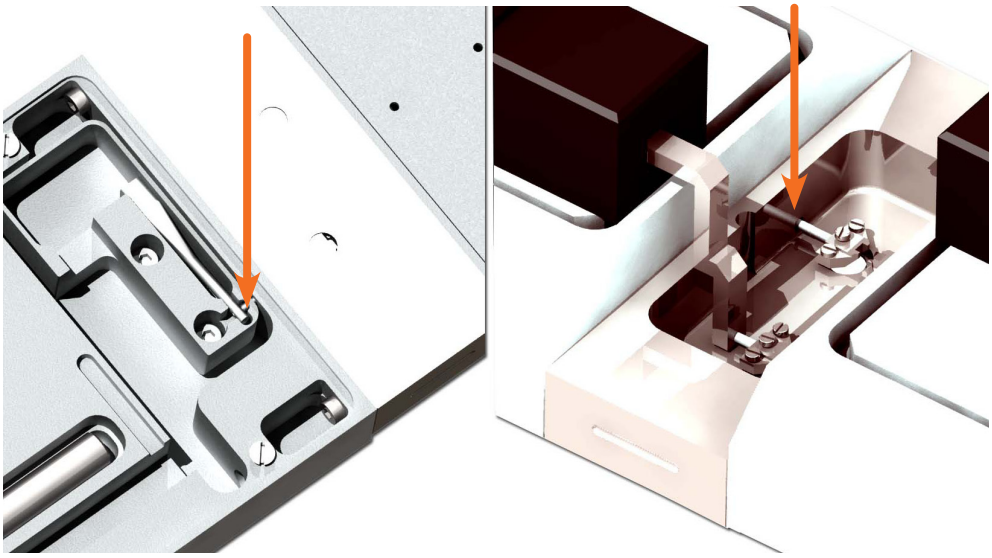


Figure 4.8 *Transducer pin hole to be sealed up with high vacuum grease*

4.4.3 Linear slides

Check the linear slides (under the black covers) for grease at least once a week. In case of insufficient lubrication (the micrometer will not move as effortlessly as it should) grease the slides with the original enclosed grease for linear slides at the points marked by the arrows in figure 4.9 on next page.

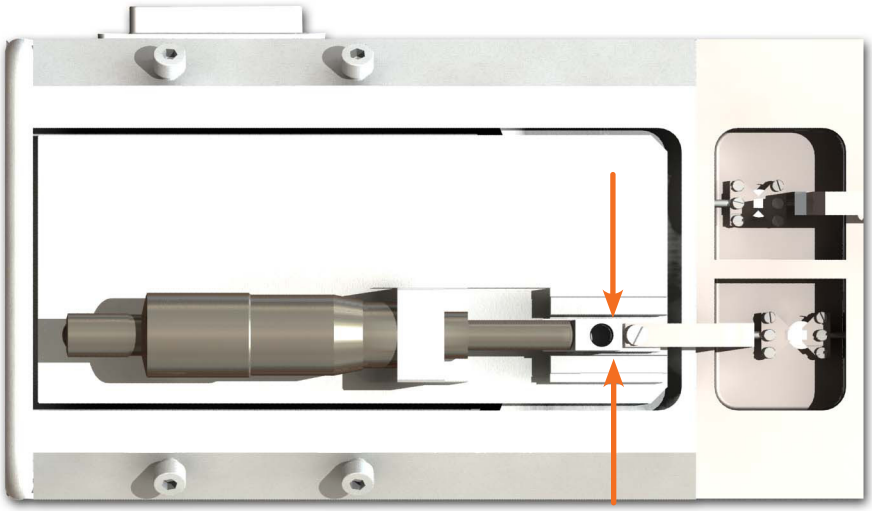


Figure 4.9 *Greasing points on the linear slides.*

4.4.4 Myograph cleaning

DMT strongly recommends that the myograph chamber and surroundings should be cleaned after each experiment.

After a normal experiment use the following procedure to clean the myograph chamber and supports:

1. Fill the myograph chamber to the edge with an 8% acetic acid solution and allow it to work for a few minutes to dissolve calcium deposits and other salt build-up. Use a swab stick to mechanically clean all chamber surfaces.
2. Remove the acetic acid and wash the myograph chamber and supports several times with double distilled water.
3. If any kind of hydrophobic reagent have been used, which might be difficult to remove using step 1) and 2) then try incubating the chamber and supports with 96% ethanol or a weak detergent solution.
4. To remove more resistant or toxic chemicals incubate the myograph chamber and supports with 1M HCl for up to 1 hour. In exceptional cases incubate the chamber and supports with an up to 3M HNO_3 solution for about 15 minutes.
5. Wash the myograph chamber and supports several times with double distilled water.

IMPORTANT NOTES:

- **BE VERY CAREFUL USING STEP 3) AND 4) REPEATEDLY TIMES AS STRONG REAGENTS MAY CAUSE EXTREME DAMAGE TO THE MYOGRAPH UNIT.**
- **AFTER CLEANING, ALWAYS CHECK THAT THE GREASING AROUND THE TRANSDUCER PIN IS SUFFICIENT TO KEEP THE BUFFER SOLUTION AWAY FROM THE TRANSDUCER COMPARTMENT.**

In cases of red or brown discolorations appearing on the chamber sides or on the supports, the following cleaning procedure will work in most cases:

1. Incubate the myograph chamber and supports for 30 minutes with 20 µl of a 2 mM T-1210 Tetrakis- (2-pyridylmethyl)-ethylenediamine solution dissolved in double distilled water.
2. Use a swab-stick to mechanically clean all the affected surfaces during the last 15 minutes of the incubation period.
3. Wash the myograph chamber and supports several times with double distilled water.
4. Incubate the myograph chamber with 96% ethanol for 10 minutes while continuing the mechanical cleaning with a swab-stick.
5. 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 10 minutes and continue the mechanical cleaning with a swab-stick.

APPENDIX 1 - FUSE REPLACEMENT

The main fuse of the myograph system is placed inside the power inlet on the Myo-Interface. If the fuse blows it is easily changed using the following procedure.

When a fuse blows and needs to be changed, it is imperative that the replacement fuse is equal to the one blown.

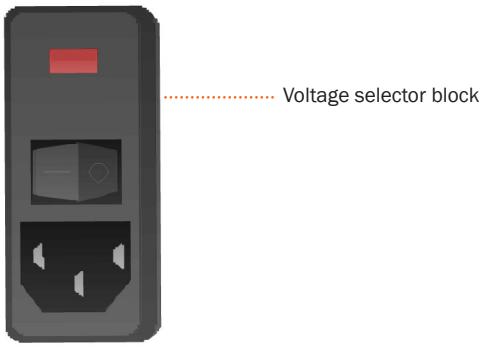
The 410A system uses: T1.6A / 250 V, 6.3 x 32 mm

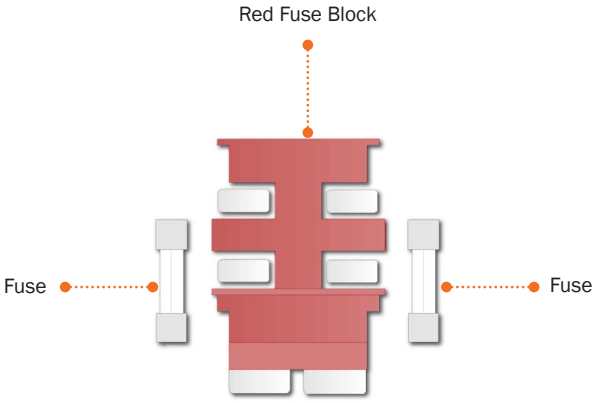
DMT recommends that both fuses in the fuse block are changed at the same time, as it can be difficult to determine which fuse is blown.

To replace the fuses:

1. Use a small screwdriver to open the voltage selector block.
2. Remove the red fuse block.
3. Remove the existing fuses.
4. Insert the new fuses.
5. Replace the fuse block back into the voltage selector block

NOTE: ENSURE THAT THE CORRECT VOLTAGE FOR YOUR COUNTRY IS DISPLAYED.





APPENDIX 2 - SYSTEM SPECIFICATIONS

Technical specifications

Tissue/Vessel size:	>60 µm
Chamber:	Dual, independent or dependent
Chamber material:	Acid-resistant stainless steel
Chamber volume:	Max. 10 ml
Chamber suction:	No
Chamber cover:	With connection for suction and gassing
Chamber gassing:	Yes
Force range:	-100 to +200 mN
Force resolution:	0.1 mN
Micropositioners:	Manually operated precision micrometer
Weight calibration:	Manual
Heating:	Built into chamber, independent of superfusion
Temp. range:	Ambient temp. - 50°C
Temp. resolution:	0.1°C
Temp. probe:	External
Output reading:	Force (mN)
Analogue output:	Up to four outputs, 1.0 V full scale for all acquired signals, user defined
Serial output:	Serial interface - RS232/RS485
Voltage:	100 to 240 VAC (auto) 50/60 Hz via external power supply
Ambient temp.:	15-30°C

Optional accessories

Enable pH-meter on the interface

- range:	pH 0 - 14
- temp. correction:	0 - 50°C

Electronic valve:	100 to 240 VAC (auto) 50/60 Hz via external power supply

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DMT A/S
Skejby Science Center
Skejbyparken 152
DK-8200 Aarhus N
Denmark

Tel.: +45 87 41 11 00
Fax: +45 87 41 11 01

www.dmt.dk
sales@dmt.dk
support@dmt.dk

DMT-Asia Ltd.
Rm 2402B, Great Eagle Centre
23 Harbour Road
Wanchai, Hong Kong S.A.R.
P.R. China

Tel.: +852 6621 8337
Fax: +852 3020 7554

www.dmt-asia.com
sales@dmt-asia.com
support@dmt-asia.com

DMT-Asia (China office)
Rm 28C, No. 8 Dong Fang Road
Lu Jia Zui Financial District
Shanghai 200120
P.R. China

Tel.: +86 (0) 21 5425 1330
Fax: +86 (0) 21 5877 0063

www.dmt-asia.com
sales@dmt-asia.com
support@dmt-asia.com

DMT-USA, Inc.
201 East Liberty Street
Suite 6
Ann Arbor, MI 48104
USA

Tel.: +1 770 612 8014
Fax: +1 678 302 7013

www.dmt-usa.com
sales@dmt-usa.com
support@dmt-usa.com

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