DMT
DANISH MYO TECHNOLOGY

TISSUE PULLER

MODEL 560TP

User Manual

Version 1.0

TISSUE PULLER
MODEL 560TP

TRADEMARKS

Danish Myo Technology A/S 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

Tissue Puller - 560TP

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SAFETY

560TP 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.
- Only use secure industry standard connectors and tubing for pressure connections. Faults, defects and mistakes due to wrong connections void warranty. We are not liable for errors and mistakes due to inappropriate pressure connection.
- Do not install near any heat sources such as radiators, heat registers, stoves, or any other apparatus that produces heat.
- Only use attachments and accessories specified by the manufacturer.
- Unplug this apparatus during lightning storms or when unused for long periods of time.

The 560TP is delivered with an external 100-240V AC to 24V DC ADAPTER. Protect the power ADAPTER and cord from being walked on or pinched. Particularly at power plugs and at 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, including: the power-supply cord or plug being damaged, liquid spilling onto or objects falling into the apparatus, exposure to rain or moisture, abnormal operation, or the unit being dropped.

UNPACKING THE TISSUE PULLER SYSTEM

Take a few minutes to carefully inspect your new Tissue Puller System - 560TP 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 as soon 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 future transport of the 560TP 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 560TP System, please use the following list to check that the system is complete:

- 1 Tissue Puller - 560TP System unit (electromechanical)
- 1 USB cable
- 1 power cord* (24V Powerconverter)
- 1 box with mounting hook or other customer defined mounting supports
- 1 calibration weight 5g weight
- 1 Allen key
- 1 CD with MyoPULL Software (Windows 7)
- 1 CD with user manual

** The shape of the AC plug varies by country; be sure that the plug fits the outlets for your location.*

CHAPTER 1 - SYSTEM OVERVIEW

1.1 Tissue Puller - 560TP front and rear panel

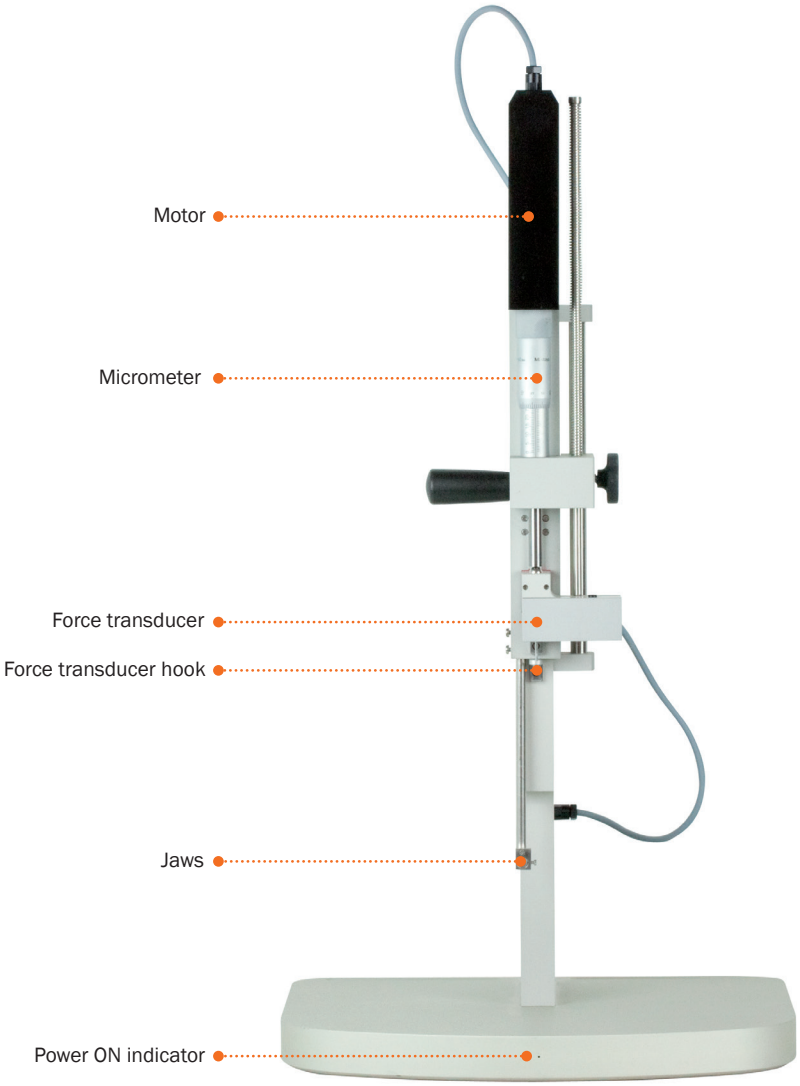

Figure 1.1 *Tissue Puller - 560TP front panel*

Figure 1.2 *Tissue Puller - 560TP back rear panel*

CHAPTER 2 - SETTING UP

2.1 The complete Tissue Puller System - 560TP

Figure 2.1 *Set-up for the Tissue Puller with MyoPULL Data Acquisition Software*

2.2 Setting up step-by-step

To set up the 560TP System as illustrated in figure 2.1 above:

1. Connect the 560TP to the PC with the supplied USB cable.
2. Follow the supplied Quick Installation Guide for MyoPULL.
3. Connect the supplied 24V power converter to the 560TP.
4. Turn on the power to the 560TP. See figure 1.2
5. Start the MyoPULL software on the PC.

The following MyoPULL screen should now be visible on the screen:

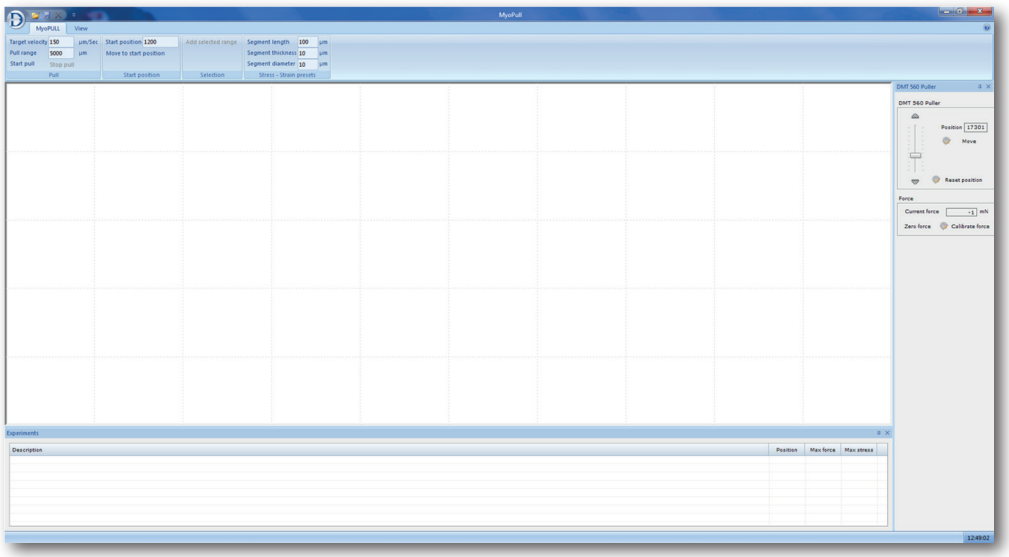

Figure 2.2 *MyoPULL Software*

2.3 Configuration and calibration of the 560TP System

On the right hand side of the MyoPULL window the 560TP Puller controller window is shown.

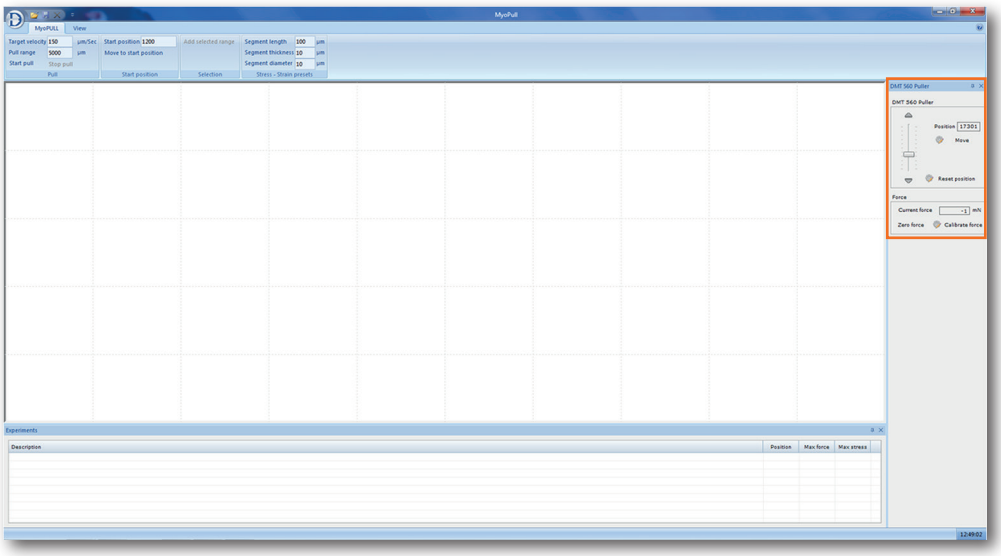

Figure 2.3 *MyoPULL Software - Puller controller at the far right*

The 560TP Puller controller window has the following functions:

- **Position** - This is used to enter the position the micrometer positioner should move to when clicking the 'Move' button. Enter the position in micrometers and hit the 'Enter' key on the key board.
- **Move** - Activating this function will cause the micrometer positioner to move to the position set in the 'Position' field.
- **Reset Position** - Used to synchronize the 560TP micrometer positoner and the MyoPULL program. **IMPORTANT – ALWAYS SYNCHRONIZE MICRO POSITIONER AND MyoPULL BEFORE STARTING AN EXPERIMENT.**
- **Arrow up and down** - Manually move the micrometer positioner up or down by clicking the Arrow Up or Arrow Down button, respectively.
- **Current Force** - This box will always show the current force of the force transducer.
- **Zero** - To zero the force transducer press this button.
- **Calibrate Force** - To weight calibrate the force transducer on the 560TP (see chapter 2.3.2 - Weight Calibration of Force transducer.

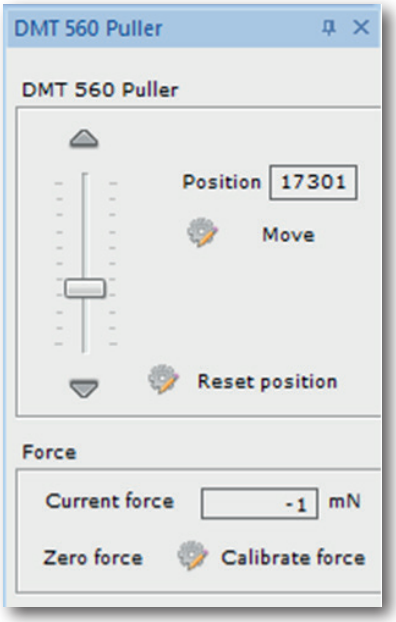

Figure 2.4 *Puller Controller close-up*

2.3.1 Configuration of the 560TP

The 560TP will not remember the position of the micrometer after the MyoPULL software has been closed and the 560TP has been turned off. Therefore it is vital to synchronize the 560TP and the MyoPULL program by clicking the Reset Position button on the far right in the MyoPULL window. A box will appear on the screen and here the actual position of the micrometer should be entered, see figure 2.5 below (see Appendix 1 - Reading a millimetre micrometer). Carefully read the position of the micrometer on the 560TP and enter the value in the 'Reset Position' box and hit enter. The actual position of the micrometer is now entered in the MyoPULL program and it will store this position until the MyoPULL software is closed or the power of the 560TP is turned off.

NOTE: RESETTING OF MICROMETER POSITION IS VERY IMPORTANT BEFORE STARTING AN EXPERIMENT.

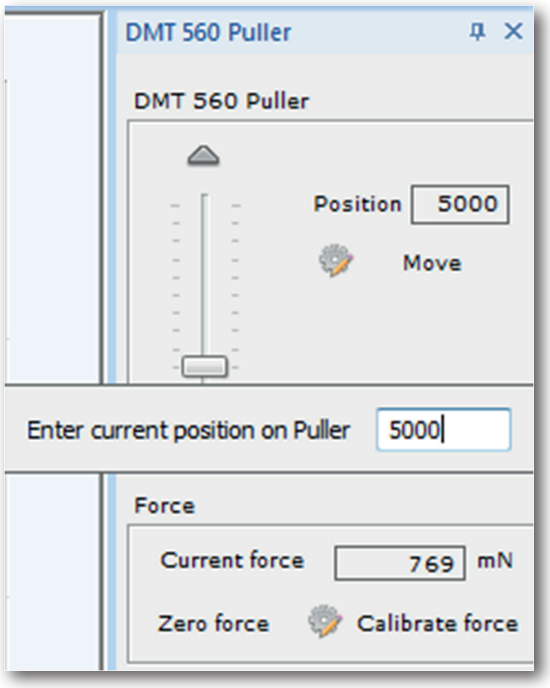

Figure 2.5 *'Current position' box*

2.3.2 Weight Calibration of Force transducer

Before the 560TP is packed and shipped it has gone through two days of continuous testing, including a final force transducer calibration. However, DMT recommends that a force transducer calibration is performed before using the 560TP System for the first time. The force transducer calibration is described in the following section.

Force Transducer Calibration:

1. Click on the 'Calibrate Force' button on the right hand side of the MyoPULL software window (see figure 2.5 above).
2. Read the calibrate information on the screen carefully. Please note that even very small vibrations or slight instability of mounting supports will affect the calibration.
3. Zero the force by clicking the Zero Force button (se figure 2.6 on next page). The force transducer is now zeroed.
4. Press 'Next'

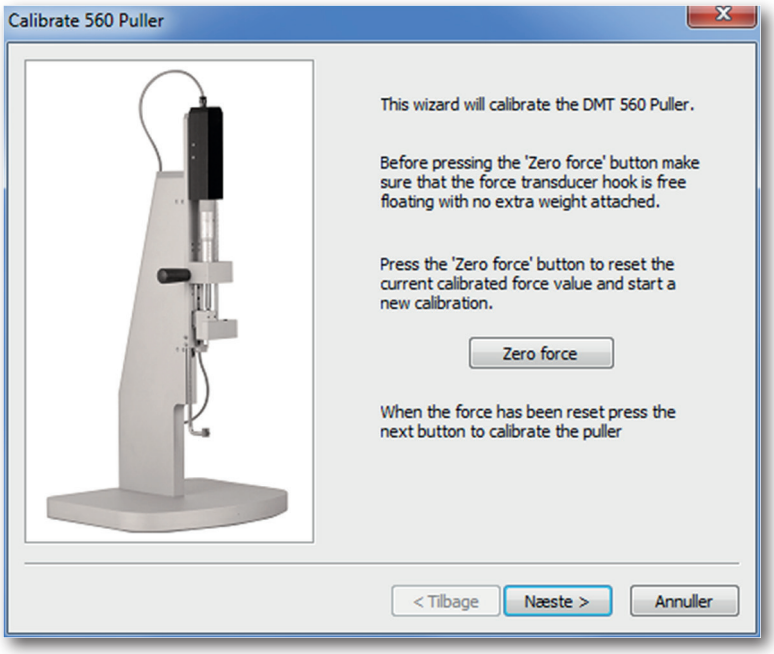

Figure 2.6 *'Zero Force' button and 'Next' button*

5. Read the new Calibrate Menu Box carefully.
6. Carefully place the supplied 5g weight or another precise weight on the mounting device attached to the force transducer.
7. Wait until the weight on the force transducer mounting support is no longer moving. This is very Important. Please note that even very small vibrations or slight instability of mounting supports will affect the calibration.
8. Enter the corresponding force (see figure 2.7 below) in mN of the weight placed on the force transducer. 1 gram equals 9,81mN and therefore a 5g weight is 5x 9,81mN = 49,05mN
9. Press the Set Force button and the 560TP force transducer has now been weight calibrated.
10. To complete and store the weight calibration press 'Finish'.

The 560TP System is now ready for an experiment.

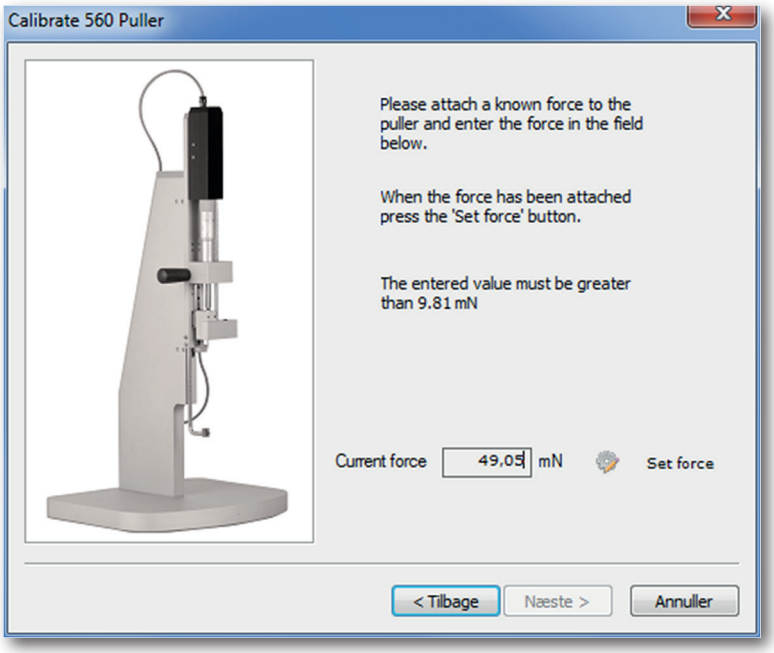

Figure 2.7 *'Set force' button*

CHAPTER 3 - THE MYOPULL MENUS

The 560TP is operated via the MyoPULL software. The function of the software is to record force/displacement curves of tensile strength tests with a force between 0 – 3000 mN over a displacement distance of 0 – 50000 µm, with speeds of 1 – 150 µm/sec.

In the MyoPULL program there are two main menus: the **MyoPULL menu** and the **View menu**.

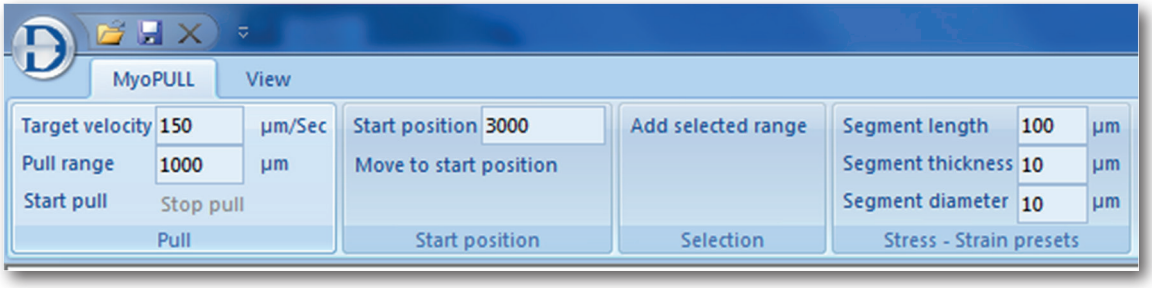

Figure 3.1 *MyoPULL menu*

3.1 MyoPULL Menu

In the MyoPULL menu there are four sub-menus, the **Pull**, **Start Position**, **Selection** and **Stress - Strain Preset** menu.

Pull sub-menu:

- **Target Velocity** - setting of the velocity of the motor in µm/second
- **Pull Range** - Setting of the distance the motor will pull from the given start point.
- **Start Pull and Stop Pull** - Clicking these buttons will either start the motor or stop it

Start Position sub menu:

- **Start Position** - Enter the start position of the motor in µm.
- **Move to Start Position** - Activating this button will move the micrometer to the position entered in the Start Position.

Selection sub menu:

- **Add Selected Range** - Select a part of the curve of interest by dragging the mouse across the curve. The maximum force, stress and distance of the selected part of a Pull-curve is transferred to the Experiments window by clicking the Add Selected Range button. The selected part will be shown on the screen. To return to the original Pull experiment simply double-click on the appropriate Pull in the Experiments list.

Strain - Stress presets: MyoPULL needs information on the mounted segment length, thickness and diameter to be able to calculate and draw a Stress - Strain Graph

- **Segments Length** – Enter the length of the mounted segment in µm
- **Segment Thickness** – Enter the thickness of the mounted segment in µm
- **Segment Diameter** – Enter the diameter of the mounted segment in µm

3.2 View Menu

In the View menu there are two sub-menus: the **View** and **Graph Type** sub-menu.

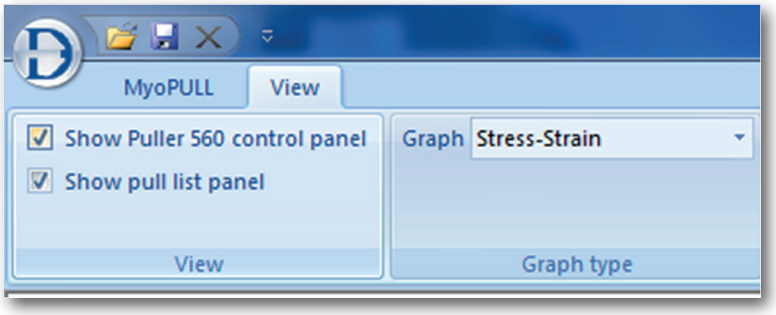

Figure 3.2 *View menu*

View sub-menu:

- **Show Puller 560 Control Panel** - Show or hide 560TP control panel.
- **Show Experiment List Panel** - Show or hide the Experiment List containing all the experiments performed.

Graph Type sub-menu:

- **Selection of the Graph Type** - MyoPULL can display the experiment as Displacement-Force Graphs or Strain - Stress Graphs. In Displacement-Force Graphs the x-axis is shown in µm and the Y-axis in mN. In the Strain - Stress Graphs the X-axis is Strain and the Y-axis is Stress (mN/mm2).

3.3 Experimental setup

The 560TP is a system specifically designed to perform tensile strength tests.

1. Mount the sample you wish to test tensile strength for between the motor (via the force transducer) and the jaw.
2. Enter the µm the tissue is to be stretched in **Pull Range**.
3. Enter the velocity (0-150µm/sec) the motor is to use during the stretch in **Target Velocity**.
4. If you want to repeat a stretch enter the micro-positioner position in the **Start Position box** and press Enter.
5. If you want to display the experiment as a **Stress - Strain Graph** enter the values for segments length, segment thickness and segment diameter, all in µm.
6. Select how the experiment should be displayed; either as a **Force-Displacement Graph** or a **Stress - Strain Graph**.
7. To start the Pull experiment press **Start Pull.** The force that the sample is exposed to and the motor's present position is plotted by the MyoPULL software, thereby creating a **Force-Displacement Curve** as seen in figure 3.3 on next page or as a **Stress - Strain Curve** as shown in figure 3.4 on next page.
8. After a completed Pull experiment MyoPULL automatically transfers the maximum force or stress value to the Experiment List where the **Micrometer Position**, **Max Force** and **Max Stress** will be recorded.

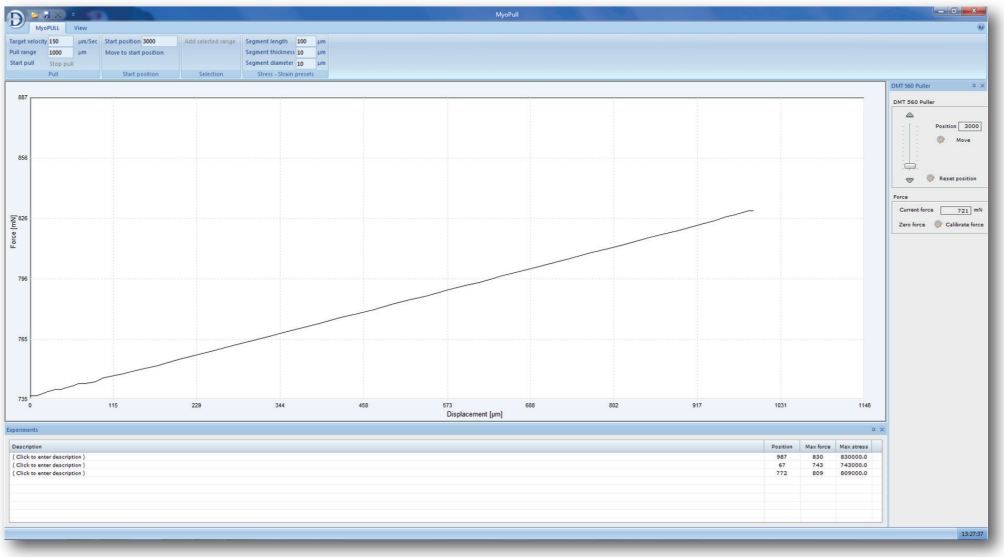

Figure 3.3 *Example of a Tensile Strength Test Curve.*
The force (mN)readings are shown on the Y-axis and the displacement in µm is shown on the X-axis

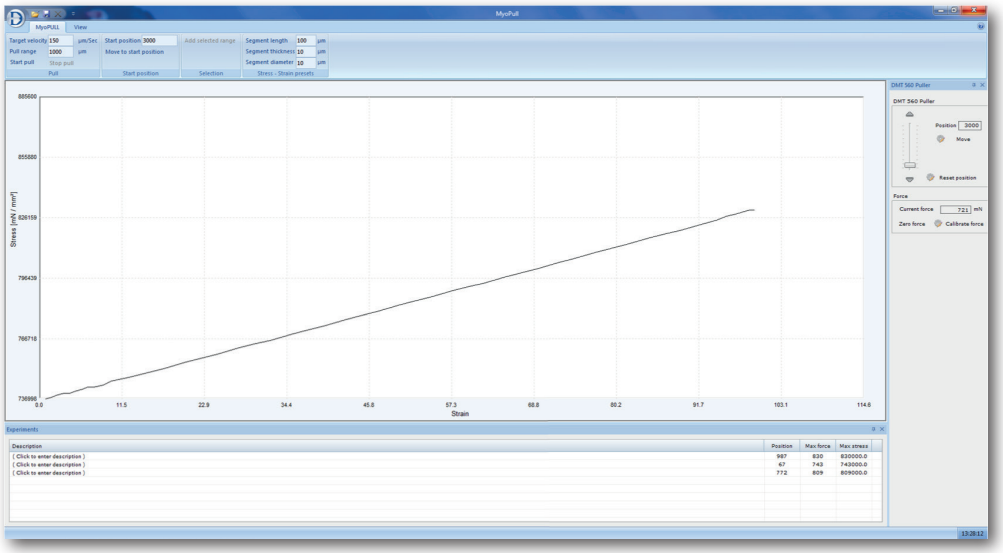

Figure 3.4 *Example of a Stress - Strain Test Curve.*
The stress (YY) readings are shown on the Y-axis and the strain in mN/mm2 is shown on the X-axis.

CHAPTER 4 - TRANSDUCER CHECKING AND MAINTENANCE

4.1 Checking the force transducer

The 560TP force transducer is a strain gauge connected to a Wheatstone bridge. The force transducer is housed in a separate, protective compartment (see figure 4.1 below). While the protective cover offers some mechanical protection for the force transducers, it is still very vulnerable to applied forces exceeding 1 Newton (100 grams) or fluid running into the transducer compartment due to inadequate greasing of the transducer pinhole (see chapter 4.3 Maintenance). If the force readings in MyoPULL appear unstable or noisy, then perform a new calibration of the force transducer as described in chapter 2.3.2 - Weight Calibration of force transducer. During the calibration monitor the relative force reading values in the FORCE CALIBRATION sub-menu in the MyoPULL Software. 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 replaced.
- If the value is less than 2000 or greater than 4500, the force transducer is broken and needs to be replaced.

In addition, if the force reading 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.

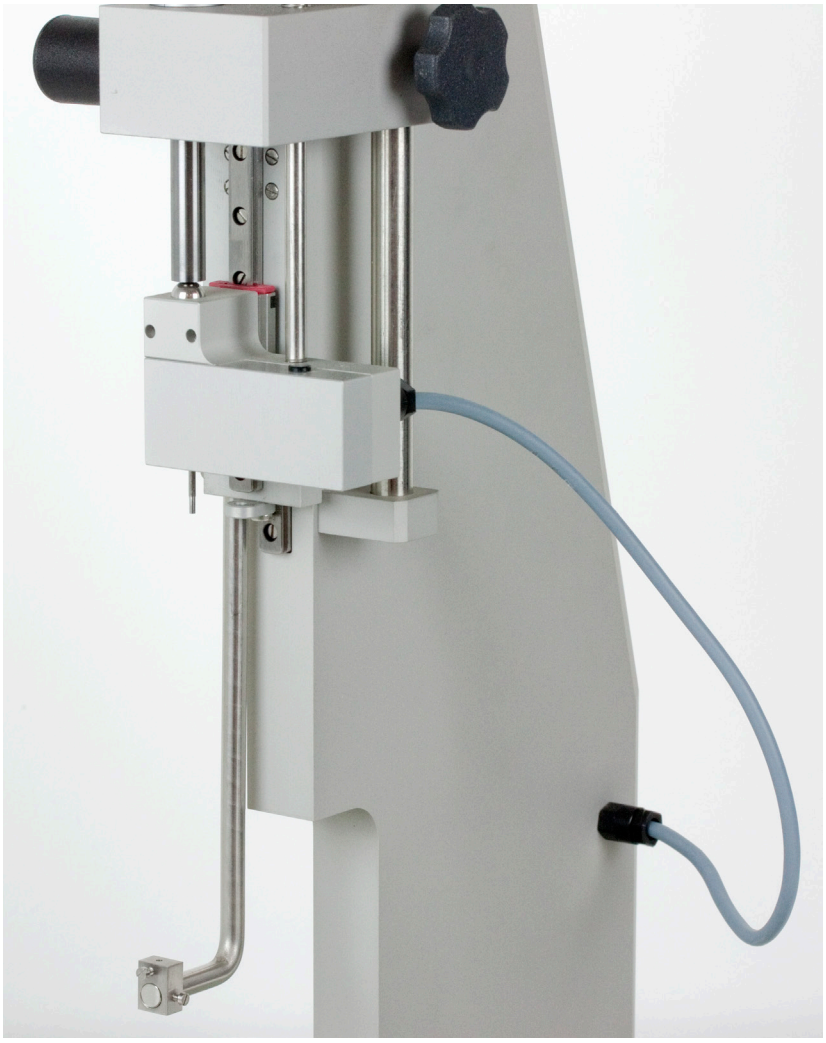

Figure 4.1 *Illustration of the transducer compartment*

4.2 Force Transducer Replacement

If the force transducer breaks and needs to be replaced the 560TP need to be shipped back to DMT for replacement. The shipping address is:

Danish Myo Technology A/S
Skejby Science Center
Skejbyparken 152
DK-8200 Aarhus N.
Denmark

Tel: +45 8741 1100

Please contact your Sales Representative and request a Return to Manufacturer Authorisation (RMA) Number to attach to your shipping documentation.

4.3 Maintenance

The 560TP is a very delicate and sophisticated piece of research equipment. DMT recommends that the following sections are read carefully and that the instructions are followed at all times.

Force transducer: The force transducer is the most delicate and fragile component of the 560TP. Extreme care must be used when handling or touching the force transducer. As part of daily maintenance, inspect the grease around the transducer pin extending from the transducer compartment pinhole before starting any experiment. Insufficient grease in this area will allow buffer and water to enter the transducer compartment and cause irreparable damage to the force transducer.

IMPORTANT NOTES:

- **DMT RECOMMENDS THAT THE HIGH VACUUM GREASE SEALING THE TRANSDUCER PINHOLE IS CHECKED AND REPLACED AT LEAST ONCE A WEEK, ESPECIALLY IF THE MYOGRAPH IS USED FREQUENTLY**
- **DMT TAKES NO RESPONSIBILITY FOR THE USE OF ANY OTHER KIND OF GREASE OTHER THAN THE GREASE SUPPLIED BY DMT FOR THIS PURPOSE**
- **DMT TAKES NO RESPONSIBILITY FOR ANY KIND OF DAMAGE CAUSED BY MISHANDLING OF THE FORCE TRANSDUCERS**

APPENDIX 1 - READING A MILLIMETRE MICROMETER

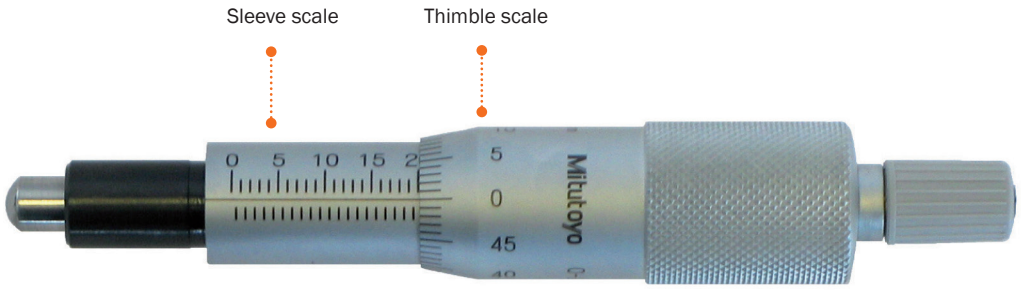

Figure A1.1 *Overview of the micrometer parts (actual reading 20000 µm = 20 mm)*

Sleeve scale

The micrometer sleeve scale has a total length of 25 mm divided into fifty equal parts. Each part of division above the horizontal line represents 1 mm where each fifth line is marked by a longer line and a number, which designates the length in mm. Each part of division below the horizontal line is placed between each 1 mm mark (scale above the horizontal line) and represents 0.5 mm.

Thimble scale

The thimble is divided into fifty equal parts, and one complete rotation of the thimble is indicated by the smallest division on the sleeve, which equals 0.5 mm. Each divi¬son on the thimble scale is 10 µm. If the thimble scale falls between two lines, then a number between 0 and 10 µm must be approximated.

Example 1

1. Note that the thimble has stopped at a point beyond “10” on the sleeve indicating 10000 µm (10 mm).
2. Note that there is no mark completely visible between the 10 mm mark and the thimble.
3. Read the value on the thimble corresponding to the intersection with the horizontal line on the sleeve.

A. Reading on sleeve:	10000 µm
B. No additional mark visible:	0 µm
C. Thimble reading:	380 µm
Total reading:	**10380 µm**

Figure A1.2 *Example 1: reading = 10380 µm*

Example 2

1. Note that the thimble has stopped at a point beyond “16” on the sleeve indicating 16000 µm (16 mm).
2. Note that this time a mark is visible between the 16 mm mark and the thimble indication 500 µm.
3. Read the value on the thimble corresponding to the intersection with the horizontal line on the sleeve.

A. Reading on sleeve:	16000 µm
B. One additional mark visible:	500 µm
C. Thimble reading:	280 µm
Total reading:	**16780 µm**

Figure A1.3 *Example 2: reading = 16780 µm*

APPENDIX 2 - SYSTEM SPECIFICATIONS

Technical specifications

Vessel size/tissue length:	>500 µm – 20 mm
Force range:	0 – 2N (0 – 2000 mN or ~ 204 g)
Tare range:	0 – 1N (0 – 1000 mN or ~ 104 g)
Force resolution:	1 mN (~ 0.1 g)
Displacement range:	0 – 50 mm (5 cm or 50,000 µm)
Displacement resolution:	1 µm
Max displacement speed:	150 µm/second (~9 mm/minute)
Weight calibration:	Semi-automatic (via software)
Data communication:	USB (2.0)
Voltage:	100 to 240 VAC (auto) 50/60 Hz via external power supply
Data Acquisition software:	MyoPULL software - Requirements: Windows 7 (32- and 64-bit)

Optional accessories

Mounting supports:	Different mounting support available

APPENDIX 3 - EC DECLARATION OF CONFORMITY

Danish Myo Technology A/S
Certify and declare that the following apparatus:

Tissue Puller 560TP
Restrictive use: Only for laboratory use.

Manufactured by:
Danish Myo Technology A/S
Skejbyparken 152
8200 Aarhus N.
Denmark

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

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

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

NOTES

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Goethe-Universität • Jagiellonian University • James Cook University • Johann-Wolfgang-Goethe-Universität • Johns Hopkins University • Juntendo University • Justus-Liebig-Universität Giessen • Kaohsiung Medical University • Karolinska Institute • KAS Glostrup • Katholieke Universiteit Leuven • King's College London • King's College London GKT School of Medicine • KK Women's and Children's Hospital • Klinikum Der Universität Zu Köln • København Universitet • Korea University • Laboratorios Almirall (Barcelona) • Linköping University • Liverpool University • Loma Linda University • Loyola University At Chicago • Ludwig Maximilians University • Lund Universitet • Lundbeck Pharmaceuticals • Luther College • M.V.Lomonosov Moscow State University • Manchester Royal Infirmary • Manchester University • Manitoba Institute of Child Health • Marquette University • Martin-Luther Universität Halle-Wittenberg • Massachusetts General Hospital • Max-Delbrück-Centrum • Mayo Clinic • McMaster University • MDC Berlin • Medical College of Georgia • Medical College of Wisconsin • Medical University of South Carolina • Memorial University Of Newfoundland • Michigan State University • Mogiglass Artigos Para Laboratorio LTDA • Monash University • Mount Sinai School of Medicine • Nanyang Technological University • Nat. 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