TSE
Technical & Scientific
Equipment GmbH

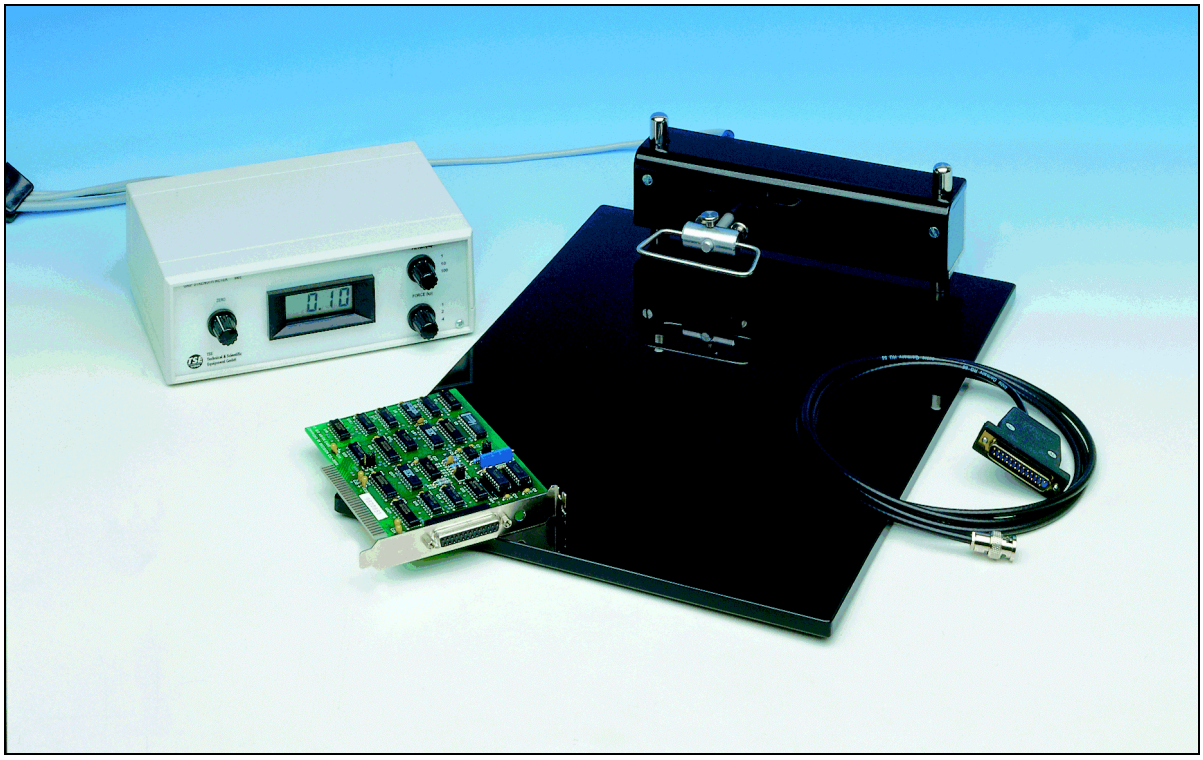
TSE Grip Strength Meter

for small laboratory animals

TSE Grip Strength Meter

1. General information

The TSE **Grip Strength Meter** system is a computer-supported measuring system for determining the **gripping strength** (holding strength) of a small laboratory animal (mouse or rat).



Within the context of neuromuscular investigations this test system can be used to quantify the effects of hormones, toxins, muscle relaxants as well as disease or the aging process on the muscular strength of the animal.

In the trial setup the animal pulls a special height-adjustable grip which is mounted on a high-precision force sensor. If the animal releases the grip then the **maximum force** exerted is determined and shown numerically and graphically; it can also be stored. The force units can be selected by the operator (pond, gram or newton).

3 different measuring ranges up to a maximum force of 4000 pond allows adaptation to the type of animal used. The system is supplied with a trapezoidal stainless steel grip 3.5mm diameter as standard; special grips are available on request.

The system includes

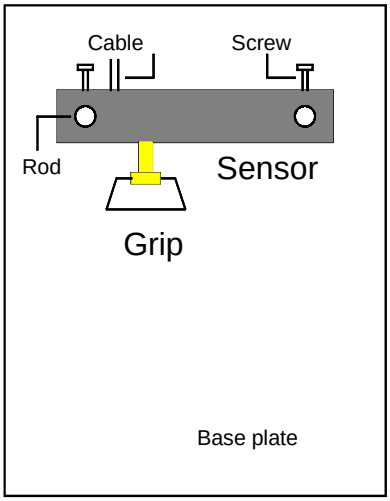
- a special **Grip Strength Meter Module**, which is mounted on a baseplate; its height can be adjusted. This module consists of the force sensor and the grip for the laboratory animal.
- a **measurement amplifier**
- an **interface** which is built into the PC
- the GSM **software for Windows**, which controls the trial and is used for recording and storing the measuring data (force).

GSM Module	
Baseplate	400mm deep x 300mm wide x 10mm high
Grip	3.5mm dia. (stainless steel)
Vertical height of grip above baseplate	
Minimum	17mm
Maximum	70mm
Force sensor	
Measuring range	up to 4 kp
Accuracy	0.03%
Max. overload	12 kp

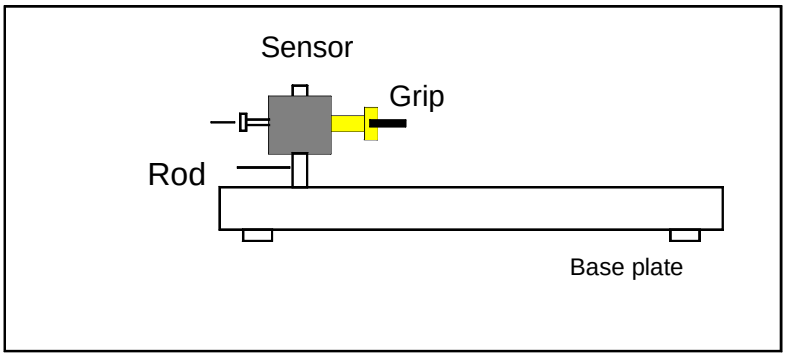
Custom configurations are available on request.

2. Installation of the sensor

- The **GSM sensor** is fixed to the holding rods mounted on the baseplate at the required height by tightening the two knurled screws. The grip faces the front; the connection cable is at the rear.
- The angle of inclination of the grip can be adjusted with the knurled screws of the grip if necessary.



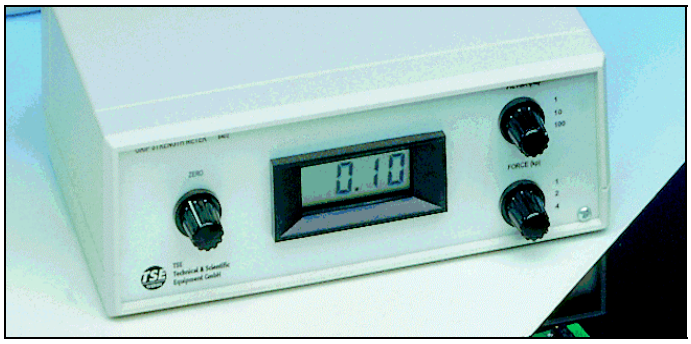
Plan view



Side view

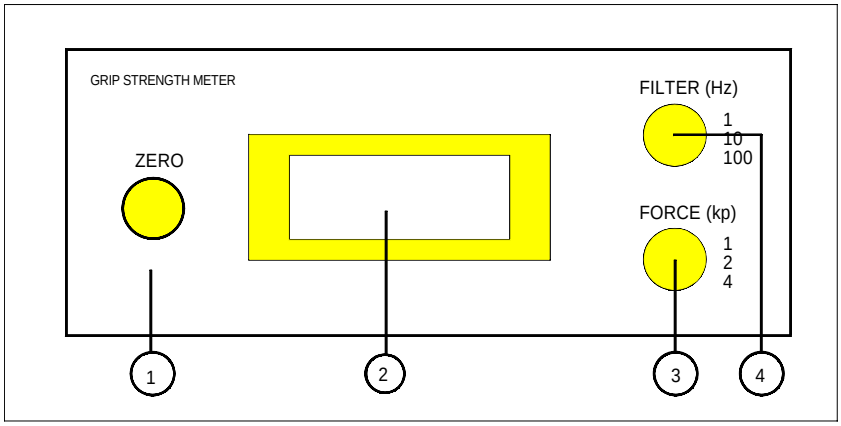
3. The measuring amplifier

The measuring amplifier provides the power supply for the GSM sensor via its built-in power unit and also carries out the amplification and filtering of the measuring signals as well as control of the PC.



The amplifier is calibrated in the factory. The measured force (kp) can be read off from the digital display (display range 0.01...4.00 kp).

In preliminary trials this display can be used to test the approximate force which the animal can exert without needing to start the software. This is important for the selection of the measuring range **(3)** and the subsequent calibration of the software. In order to obtain a correct display the zero point regulator ZERO **(1)** must be used to set the zero point of the display.



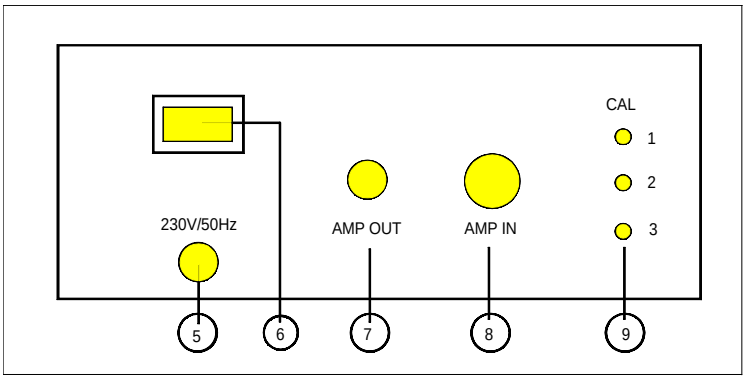
Front panel

Front panel control elements:

1 Zero point regulator ZERO
2 LCD Display (force)
3 Measuring range selection switch
1: 0....1 kp
2: 0....2 kp
4: 0....4 kp
4 Filter frequency selection switch
1 Hz, 10 Hz, 100 Hz

Rear panel control elements:

5 Mains cable (permanently attached)
6 Mains switch
7 Signal output to PC
8 GSM sensor input
9 Fine calibration *(only for service)*



Rear panel

There are 3 different **measuring ranges** available:

Range 1	**up to 1 kp**
Range 2	**up to 2 kp**
Range 3	**up to 4 kp**

The built-in **filter** is used to smooth the measuring signals. 3 settings (1 Hz, 10 Hz and 100 Hz) are available. The **100 Hz** setting is usually recommended for carrying out the measurements (weakest smoothing of the signals).

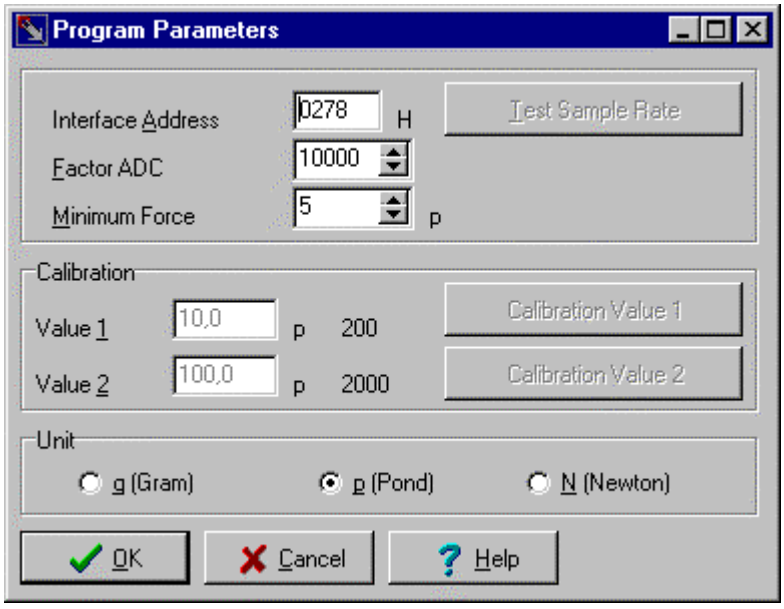
- The **measuring amplifier** is connected to the 25-pin SUB-D socket of the interface, which has been built into the PC. The connection is made to the **AMP OUT (7)** socket on the rear panel.
- The connection cable of the **GSM sensor** is connected to the **AMP IN (8)** socket of the measuring amplifier.

Technical data of measuring amplifier	
Output:	0 to +9 V direct current
Filter:	1 Hz, 10 Hz, 100 Hz
Display:	3-place LCD
Fuses:	2 fine fuses 50mA, slow-blow, in instrument

4. Software configuration and calibration

4.1. Setting the parameters

After installation of the software the existing hardware must be adapted. This is carried out in the menu item ***Parameters/Program parameters***.



1. The **address of the ADC interface** is preset; it should only be changed after consulting our service department.

2. The **ADC Factor** must be set by the operator; it depends on the PC which is used. This factor adapts the working speed of the ADC interface to the computer speed. The quicker the PC, the greater the value which should be selected. Very quick PCs require values of up to 100 000!

   The **sample rate test** switch is used to provide help. When the switch is depressed the scanning frequency achieved is tested and displayed (in Hz). This scanning frequency is inversely proportional to the selected factor. The factor should be set so that the scanning frequency lies between 200 and 1000Hz.

   A scanning frequency which is too low (<200Hz) results in inexact measurements (fewer measuring points per unit of time). A frequency which is too high (>1000Hz) can adversely affect the functioning of the A/D converter.

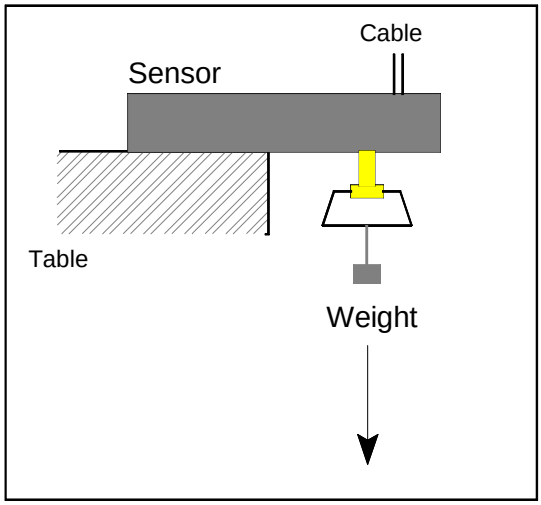
3. The **minimum force** influences the trial procedure. Measurements are only recorded (and the measuring curve only starts) when the animal has ***exceeded*** this value.

4.2. Calibration

The software must be **calibrated** before the measurement. This calibration always applies to *only one* measuring range of the amplifier!

If the measuring range is changed for the measurement then a new calibration must be carried out.

Calibration takes place via two measured values. The first value is usually the zero value (unloaded sensor). The second value is a value which is slightly above the expected maximum value during the trial (the maximum value of the measuring range can also be used!). This means that an appropriate **calibration weight** or a calibration spring is required for the calibration.



Calibration position of the sensor

The sensor must be in a specified **position** for the calibration.

Remove the sensor from the holding rods and rotate it through 90° so the grip is pointing downwards (in this position the connection cable is at the top). Place the sensor on a base so that the grip is hanging down freely (e.g. projecting over the edge of a bench). During the following calibration the sensor should be held at its other end.

1. Switch on the measuring amplifier.

In order to obtain an exact measurement there should be a **waiting period** of at least 5 minutes after it is switched on to allow the instrument to warm up!

2. Set measuring range **(3).** The smallest possible range for the expected grip strength should always be selected.
3. Set the display to 0.00 with the zero point regulator ZERO.
4. Set the filter to 100 Hz.
5. Move the sensor to the calibration position.
6. Initially the sensor is **not** loaded.
7. Operate the **Calibration Value 1** button. The zero value is measured and displayed as an internal numerical value (ADC-value).
8. Enter 0.0 in the "**Value 1**" input field.
9. Attach calibration weight to grip.
10. Operate the **Calibration Value 2** button. The force value is measured and displayed as an internal numerical value (ADC-value).
11. Enter the weight in the "**Value 2**" input field.
12. Select the unit used: pond (p), gram(g) or newton (N).
13. After the calibration the position of the grip on the holding rod should not be altered again.

Remarks: 1 pond corresponds to 9.807 x 10^{-3} newton

5. Carrying out an experiment

5.1. Preparation

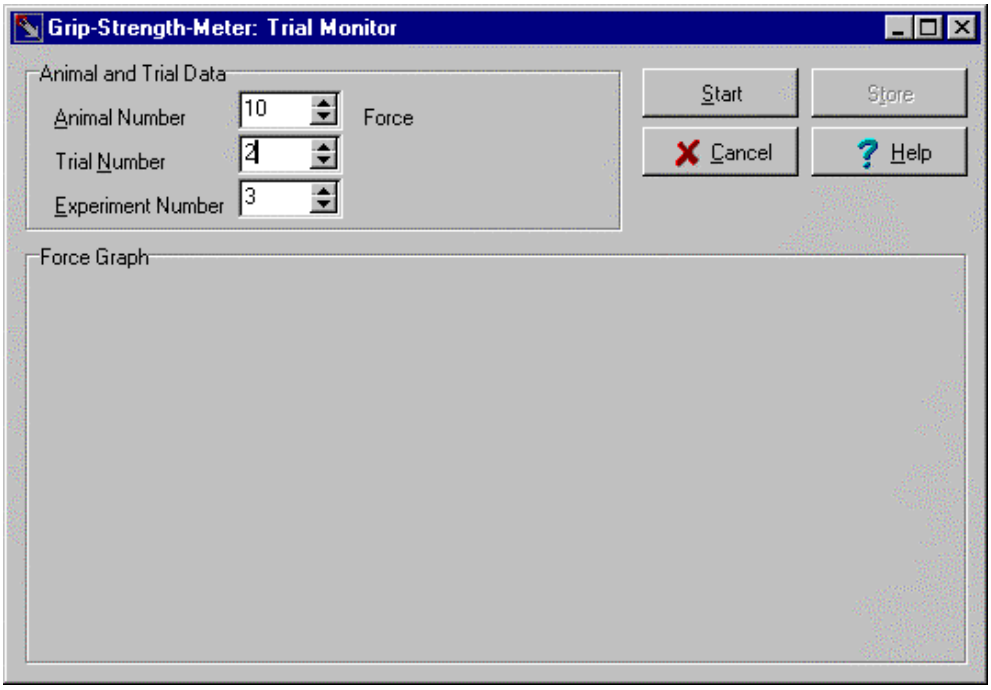
- Set the height and inclination of the grip.
- Switch on the measuring amplifier and wait for 5 minutes.

- Check measuring range **(3)**. If a different measuring range from that of the previous calibration is to be used then a **new calibration must** first be carried out.
- Set the zero point of the measuring amplifier to about 0.00 with the zero point regulator ZERO **(1)**.
- We recommend the **100Hz** setting for the filter frequency (i.e. weakest smoothing of the measuring curve).
- In the menu item ***Sensor test*** display the ADC value without any load on the sensor. The value should be larger than +10. If it is too low then turn the zero point regulator on the measuring amplifier up a little.
- Enter the required minimum force in the menu item ***Program parameters***.
- Check the set **Data archive** before the measurement and change it if necessary.

5.2. Trial monitor

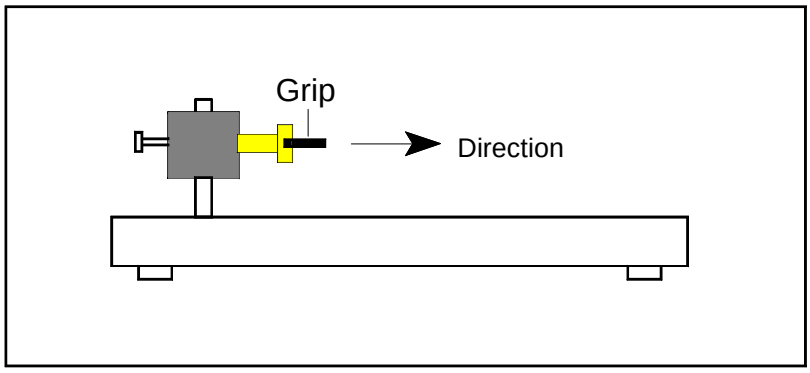
In order to measure the gripping force the trial monitor is opened in the ***Experiment/Trial*** menu. This trial monitor always shows the actual measurement status.

The data which characterize the animal and the trial must first be entered here (animal, trial and experiment numbers).

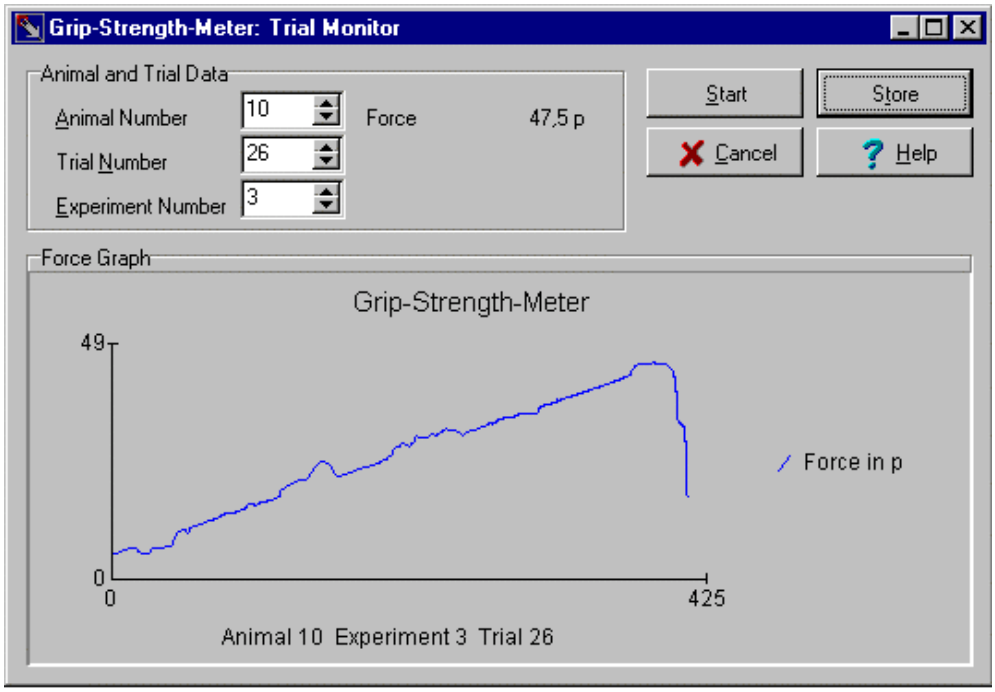


Before the start of the measurement

5.3. Starting and carrying out the trial



1. A trial is started via the **Start** button.
2. The gripping reflex of the animal is now triggered. If the animal holds on firmly to the grip then this is pulled backwards with a slow and continuous movement. The movement should be horizontal to the baseplate and in line with the attachment axis of the grip.
3. The actual measured value is now outputted continuously in an internal ADC-format (0...4095).
4. In **Phase 1** a check is first made as to whether the **minimum force** has been exceeded. This minimum force is set by the operator under ***Program parameters***. As long as the exerted force is less than this minimum value the ADC value appears in **black**.
5. When the minimum force is exceeded the real measurement starts (**Phase 2**). At the start of Phase 2 the color of the ADC value changes from black to **green**.
6. When the animal releases the grip the measured value returns to 0. The force therefore becomes less than the minimum force. The measurement is stopped.
7. The **maximum value** of the force is calculated and outputted as the "measured force".
8. The course of the measurement is shown in a coordinate system with the **force as the Y-axis** and time as the X-axis (relative value). The final value of the Y-axis corresponds to the calculated value of the run curve (rounded up to a whole number). The curve offset on the Y-axis corresponds to the selected minimum force.
9. The graph can be altered and printed out.



The measuring curve

5.4. Storing the measuring data

If the trial manager accepts the measured values then operating the **Save** button, which is available after the measurement has been concluded, stores the measurement. On storage the measured value is completed by adding the animal and trial data together with the date and time. The recorded data can then be viewed in tabular form.

6. Data analysis – the run table

The menu item ***Analysis/Table*** can be used to call up a table which lists all the trial data stored in the currently set data archive. The contents of the display window can be printed out with the **Print** button (the printer settings made under Windows apply).

```
Grip-Strength-Meter  Sanofi, Frankreich

    1     1     1  27.05.98  16:12:33  423,3 p
    1     1     1  27.05.98  16:13:05  809,9 p
    1     1     1  28.05.98  16:10:20  1,0 p
    1     1     1  28.05.98  16:13:00  244,6 p
    1     1     1  28.05.98  16:14:48  682,6 p
    1     1     1  28.05.98  16:16:08  82,4 p
    1     1     1  28.05.98  16:16:17  557,2 p
```

The following are outputted:

- Animal number
- Trial number
- Experiment number
- Date
- Start time
- **Maximum force in the selected units**

The table can be stored as a file via the **in File** button.

The table columns in the file are separated from each other by blank spaces. Numbers are formatted using a full stop as the decimal separator character.

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