

# Falling Number 1000

## Service Manual



**Perten**  
INSTRUMENTS  
a PerkinElmer company

©2016 Perten Instruments AB

**Perten Instruments AB**

PO Box 9006  
SE-126 09 Hägersten  
SWEDEN

Tel +46 8 505 80 900  
Fax +46 8 505 80 990

Email [info@percen.com](mailto:info@percen.com)  
Web [www.perten.com](http://www.perten.com)

Falling Number is a registered trade mark of Perten  
Instruments AB

This service manual describes the Falling Number 1000  
(FN 1000) instrument manufactured by Perten  
Instruments AB.

This service manual remains the property of Perten  
Instruments and is issued on condition that it is not  
copied, reprinted or disclosed either fully or in part to a  
third party without prior written consent of Perten  
Instruments.

Recommendations and suggestions regarding the  
product and its use that are offered by Perten  
Instruments in our information material, or information  
provided by any employee, broker, or distributor of  
Perten Instruments, are a guide in the use of this  
product and are not a guarantee of its performance  
since Perten Instruments has no control over its use.

In no event shall Perten Instruments or its affiliates be  
liable for indirect, incidental, or consequential damages  
of any nature including, but not limited to, loss of profits,  
revenue, production, or use, business interruption, in  
the use or performance of any Perten Instruments  
product.

Perten Instruments or its affiliates' total aggregate  
liability for damages of any nature, regardless of form of  
action, shall in no event exceed the amount paid by you  
to Perten Instruments, or its affiliates for the product  
upon which liability is based.

# Contents

<b>PART 1—GETTING STARTED</b>	<b>1</b>
<b>1.1 Safety instructions</b>	<b>2</b>
1.1.1 Symbols	3
1.1.2 Electrostatic discharge	3
<b>1.2 Introduction</b>	<b>4</b>
1.2.1 Recommended tools	4
1.2.2 Spare parts	4
1.2.3 Operation	4
1.2.4 Block diagram	5
<b>1.3 Installation</b>	<b>6</b>
1.3.1 Cooling water supply	8
1.3.2 Switching on the FN 1000	9
<b>1.4 Instrument settings</b>	<b>10</b>
1.4.1 Logging in as an administrator	10
1.4.2 Operating setup	11
1.4.3 Local settings	12
1.4.4 Altitude correction	13
<b>PART 2—SOFTWARE &amp; SERVICE FUNCTIONS</b>	<b>15</b>
<b>2.1 Service functions</b>	<b>16</b>
<b>2.2 The Diagnostics window</b>	<b>18</b>
<b>2.3 Test mode</b>	<b>20</b>
<b>2.4 Calibration procedures</b>	<b>21</b>
2.4.1 Temperature calibration	21
2.4.2 Calibrating the touchscreen	23
2.4.3 Air pressure sensor	24
2.4.4 Stirring motor calibration	25
<b>2.5 Software updates</b>	<b>26</b>
2.5.1 Updating the firmware and UI software	26
2.5.2 Updating the language or file transfer files	27
<b>2.6 Editing the serial number</b>	<b>28</b>
<b>PART 3—REPLACEMENTS &amp; ADJUSTMENTS</b>	<b>29</b>
<b>3.1 Casing</b>	<b>30</b>
3.1.1 Front casing	30
3.1.2 Rear casing	31
3.1.3 Feet	31
3.1.4 Visor	32
<b>3.2 Control board</b>	<b>33</b>
3.2.1 Testing the control board	33
3.2.2 Replacing the control board	35
3.2.3 PicoCOM board	36

3.2.4 Backup battery	36
<b>3.3 Electrical systems</b>	<b>37</b>
3.3.1 Touchscreen	37
3.3.2 Connector board	37
3.3.3 Top sensor board	38
3.3.4 Position sensors	38
3.3.5 Power supply	39
3.3.6 Fuses	39
3.3.7 Mains inlet	40
3.3.8 Changing the operating voltage	40
<b>3.4 Cooling lid</b>	<b>41</b>
3.4.1 Checking operation of the cooling lid	41
3.4.2 Guide plate for cooling lid	42
<b>3.5 Water bath</b>	<b>43</b>
3.5.1 Water bath guide plate	43
3.5.2 Access the base of the water bath	44
3.5.3 Heating elements	45
3.5.4 Temperature sensor	47
3.5.5 Water level sensor	48
3.5.6 Float adjustment	49
<b>3.6 Stirrer arm system</b>	<b>50</b>
3.6.1 Checking operation of the stirrer arm system	51
3.6.2 Stirrer motor	51
3.6.3 Stirrer rail and guide wheels	52
3.6.4 Stirrer motor TDC flag	52
<b>3.7 Claw system</b>	<b>53</b>
3.7.1 Claw stop position	54
3.7.2 Claw motor	54
3.7.3 Stirrer arm board	55
3.7.4 Claw spring	55
<b>3.8 Start arm system</b>	<b>56</b>
3.8.1 Start arm operation	57
3.8.2 Start arm sensor	58
3.8.3 Start arm vertical position adjustment	58
3.8.4 Start arm horizontal position adjustment	60
3.8.5 Start arm motor	61
3.8.6 Replacing the start arm	62
<b>3.9 Pump system</b>	<b>63</b>
3.9.1 Checking operation of the pump system	63
3.9.2 Peristaltic pump	63
3.9.3 Tubing	64

<b>PART 4—TROUBLESHOOTING</b>	<b>65</b>
4.1    Introduction	66
4.2    Functionality check	67
4.3    Error messages	68
4.4    Troubleshooting guide	71
<b>PART 5—ADDITIONAL INFORMATION</b>	<b>73</b>
5.1    Reference test	74
5.2    Obtaining accurate test results	75
5.3    Technical specifications	76
5.4    Contact information	77



# Part 1—Getting started

## 1.1 Safety instructions



ALL SERVICE WORK ON THE FN 1000 SHOULD BE CARRIED OUT BY A SUITABLY QUALIFIED AND AUTHORIZED PERSON.



ALWAYS DISCONNECT THE INSTRUMENT FROM THE MAINS POWER SUPPLY BEFORE MAKING ANY ADJUSTMENTS.



HIGH VOLTAGES ARE PRESENT INSIDE THE INSTRUMENT. TAKE GREAT CARE WHEN CONNECTING THE INSTRUMENT TO THE MAINS POWER SUPPLY TO CHECK OPERATION, PARTICULARLY WHEN THE INSTRUMENT HAS BEEN PARTIALLY DISASSEMBLED.



CHECK THAT DETAILS ON THE POWER MODULE OF THE FN 1000 AND WATER BATH LABEL AGREE WITH THE MAINS VOLTAGE BEFORE CONNECTING TO THE MAINS POWER SUPPLY.



ALL WIRING AND GROUNDING TO THE INSTRUMENT MUST CONFORM TO LOCAL REGULATIONS. THE POWER CABLE MUST BE CONNECTED TO A MAINS POWER OUTLET WITH A PROTECTIVE EARTH CONTACT.



ALWAYS DISCONNECT THE INSTRUMENT FROM THE MAINS POWER SUPPLY BEFORE CONNECTING OR DISCONNECTING THE WATER BATH AND/OR COOLING LID. WATER FROM THE WATER BATH OR COOLING LID MAY PRESENT AN ELECTRICAL HAZARD.



KEEP ALL BODY PARTS, HAIR, CLOTHING AND PERSONAL EFFECTS CLEAR OF THE INSTRUMENT DURING OPERATION, ESPECIALLY WHEN THE REAR CASING AND/OR VISOR HAVE BEEN REMOVED.



STIRRING STARTS FIVE SECONDS AFTER LOWERING THE VISOR. TO AVOID INJURY, KEEP CLEAR OF THE INSTRUMENT AFTER LOWERING THE VISOR OR ACTIVATING THE VISOR SENSOR.



THE VISCOMETER TUBES ARE GLASS AND MAY BREAK. ALWAYS INSPECT EACH VISCOMETER TUBE BEFORE USE TO ENSURE IT IS FREE FROM DEFECTS. NEVER USE DAMAGED TUBES. WHEN CLEANING WITH THE SPOLETT TUBE CLEANER, ALWAYS USE THE SPOLETT PROTECTION COVER.



THE WATER BATH AND COOLING LID BECOME HOT DURING OPERATION. DO NOT TOUCH THE WATER BATH OR COOLING LID SURFACES DURING OPERATION. IF THE WATER BATH OR COOLING LID NEED TO BE REMOVED, EMPTIED, CLEANED OR OTHERWISE ADJUSTED, OR IF THE PLASTIC TUBING FOR THE COOLING WATER NEEDS TO BE REPLACED OR OTHERWISE ADJUSTED, ENSURE THE WATER BATH AND COOLING LID ARE AT ROOM TEMPERATURE.



PERTEN INSTRUMENTS CANNOT ACCEPT RESPONSIBILITY FOR ANY ACCIDENTS THAT MAY OCCUR DURING APPARATUS REPAIR OR ADJUSTMENT. IF IN DOUBT, CONTACT PERTEN INSTRUMENTS.



### 1.1.1 Symbols

	Off (power) switch position
	On (power) switch position
	alternating current

caution—refer to this manual

caution—hot surface

caution—risk of electric shock

### 1.1.2 Electrostatic discharge



Electrostatic discharge (ESD) can cause unseen damage to electronic components during manufacture or repair of electronic assemblies and equipment.

To prevent ESD, all service work on an FN 1000 should be conducted in an Electrostatic Protective Area (EPA). An EPA is an area in which static electricity is kept below levels that could cause damage to electronic components handled within the area. Any surfaces on which ESD sensitive items are placed must be connected to the EPA ground and have a point-to-point resistance of between 100 kΩ and 100 MΩ.

## 1.2 Introduction

This service manual covers the Falling Number 1000 (FN 1000) instrument, manufactured by Perten Instruments.

### 1.2.1 Recommended tools

To service a Falling Number instrument, you may require the following tools (not supplied by Perten Instruments):

- a calibrated immersion thermometer with a resolution of at least 0.1°C
- a 13 mm guide wheel adjustment key
- spanner set (16 mm, 10 mm)
- Torx screwdrivers (T6, T8, T10, T15, T20 and T30)
- USB keyboard
- Touchscreen stylus
- a USB drive for transferring files to the FN 1000.

Nearly all screws on the FN 1000 use a Torx (hexolobular) head as defined by ISO 10664. These are referred to throughout this manual by the size of their required driver using the following abbreviations:

T6 = M2.5

T8 = M3

T10 = M4

T15 = M5

T20 = M6

T30 = M10.

### 1.2.2 Spare parts

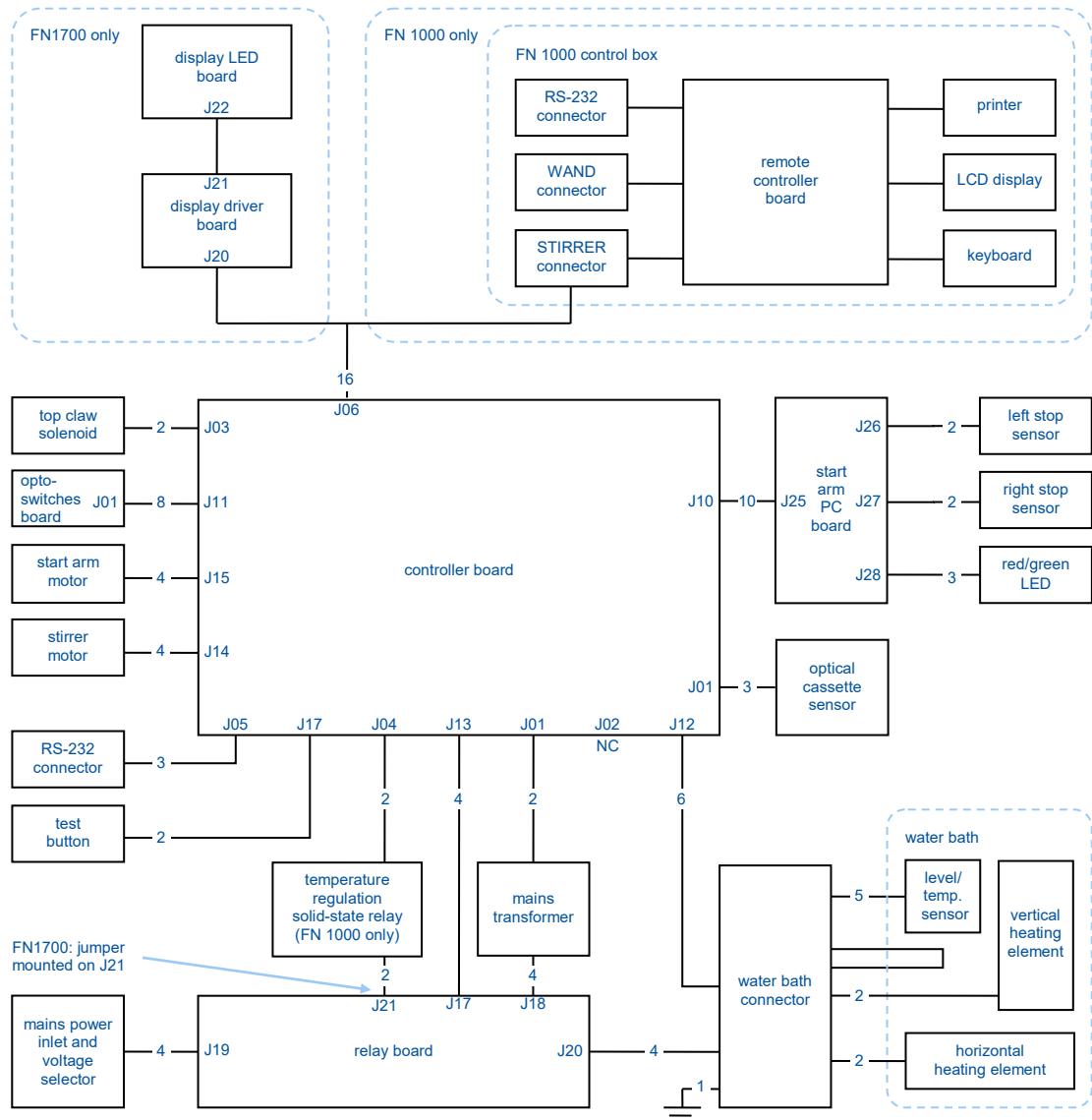
Perten Instruments publishes a *Spare Parts Price List* annually. Please refer to this price list for part numbers and prices. Parts can also be visually identified from the Perten Instruments web shop at [percen.com/webshop](http://percen.com/webshop).

### 1.2.3 Operation

For details on the operation of the FN 1000, please refer to the operation manual for the instrument.

## 1.2.4 Block diagram

[update]



## 1.3 Installation

Installation procedures are provided in the FN 1000 operator manual. The following section includes these procedures plus additional quality control steps not available to the typical user, to ensure a trouble-free installation.



### WARNINGS



**ALWAYS DISCONNECT THE INSTRUMENT FROM THE MAINS POWER SUPPLY BEFORE CONNECTING OR DISCONNECTING THE WATER BATH AND/OR COOLING LID.**



**ENSURE THE OUTLET TUBE IS PROPERLY FITTED INTO THE REFILL WATER BOTTLE. EXCESS WATER PUMPED INTO THE BOTTLE FROM THE WATER BATH MAY ATTAIN TEMPERATURES UP TO 100°C.**



**COOLING WATER MUST FLOW WHENEVER THE FN 1000 IS SWITCHED ON.**



### To install the FN 1000

- 1 Unpack the instrument and check all items against the packing list provided.
- 2 Remove the rear casing (see 3.1.2, page 31). Check all cables are fitted correctly and the earth loom is firmly attached to the rear casing.
- 3 Check that the mains voltage matches the voltage on the rear label of the FN 1000 (shown).
- 4 Check there are fuses in the two rear fuse holders, as shown (see 3.3.6, page 39), and these fuses match the fuse rating label.
- 5 Ensure the fuse rating label is properly fitted.<sup>1</sup>
- 6 Check that the Luer connectors on the tubes to the peristaltic pump are properly fastened at both ends with cable ties (see 3.10, page 63).
- 7 Install the rear casing (see 3.1.2, page 31).
- 8 Position the instrument on a sturdy, level surface.
- 9 Raise the visor and remove the cooling lid.
- 10 Connect the cooling water supply (see 1.3.1, page 8).



- 11 Fill the water bath with distilled water, or water of equivalent purity, to approximately 4 cm (1.5 inch) below the top of the water bath (about 2.9 L) and install the water bath and cooling lid.
- 12 Ensure that the refill water tubing is properly fitted between the cooling lid via the frame connection to the pump on the back of the instrument.
- 13 Fill the refill water bottle with distilled water, or water of equivalent purity, to approximately 75% of its volume (about 0.7 L).
- 14 Connect the supply tube to the left connection on the pump and connect the metal filter to the other end of the supply tube, as shown.
- 15 Insert the tube and filter into the refill water bottle, as shown, and screw the lid onto the bottle. Ensure the water refill bottle is properly sealed to prevent escape of hot water.
- 16 Switch on the FN 1000 (see 1.3.2, page 9).



### Notes

- 1 The blue tape used during manufacture has a tendency to pull the fuse rating label off the instrument.

### 1.3.1 Cooling water supply

For safe and correct operation, the FN 1000 requires a supply of cooling water whenever it is switched on. The cooling water can be supplied by a cold water tap or recirculation cooler. The required flow rate is at least 400 mL per minute.



#### To connect the cooling water supply

- 1 Remove the cooling lid.<sup>1</sup>
- 2 Cut the plastic tubing supplied (PN 30718) into two lengths. Securely connect one end of a tube to a nozzle on the underside of the cooling lid using one of the hose clamps provided, as shown. Repeat for the second tube and nozzle.
- 3 Feed the tubes through the cutouts provided in the cooling lid.
- 4 Connect one of the tubes to the cooling water supply the other to a suitable drainage point.
- 5 Installed the included flow indicator in the inlet tubing so it is visible to the operator, as shown.
- 6 Turn on the water supply and check that it flows at a rate of at least 400 mL per minute.



#### WARNINGS



**ALWAYS DISCONNECT THE INSTRUMENT FROM THE MAINS POWER SUPPLY BEFORE CONNECTING OR DISCONNECTING THE WATER BATH AND/OR COOLING LID.**



**ENSURE THE OUTLET TUBE IS PROPERLY FITTED INTO THE REFILL WATER BOTTLE. EXCESS WATER PUMPED INTO THE BOTTLE FROM THE WATER BATH MAY ATTAIN TEMPERATURES UP TO 100°C.**



**COOLING WATER MUST FLOW WHENEVER THE FN 1000 IS SWITCHED ON.**



#### Notes

- 1 The water bath and cooling lid are individually adjusted for each FN 1000 instrument. Do not remove the water bath or cooling lid from one instrument and install it on another instrument. Doing so may affect test results.

### 1.3.2 Switching on the FN 1000

#### ► To switch on the FN 1000 for the first time

- 1 Verify that the mains voltage matches the voltage on the rear label of the FN 1000 (shown) before connecting the FN 1000 to the mains power supply.
- 2 Press the on/off button on the rear panel to switch on the FN 1000.
- 3 Login as an administrator (see 1.4.1, page 10) and edit the operating setup (see 1.4.2, page 11) and local settings (see 1.4.3, page 11).
- 4 Pull down the plastic visor.<sup>1</sup> Both water bath elements will switch on automatically and heat the water until the water is boiling (about 20 minutes).
- 5 If required, conduct a functionality check (see 4.1, page 67).



#### Notes

- 1 If the plastic visor is not closed when you switch on the FN 1000, the instrument will show the message **Please close visor**. The heating elements will not switch on until the visor is closed. Close the visor before continuing.

## 1.4 Instrument settings

### 1.4.1 Logging in as an administrator

To change the instrument settings of an FN 1000, you must be logged in as an administrator.



#### To login as an administrator

- 1 From the main window, tap **Menu > General Settings > Login**.
- 2 The **Access Right** will be set to **Default**, which prevents any changes to the settings. Tap **Default**.
- 3 Enter the administrator password **142857**,<sup>1</sup> as shown, and tap **Enter**.
- 4 Tap **Home** to return to the main window.



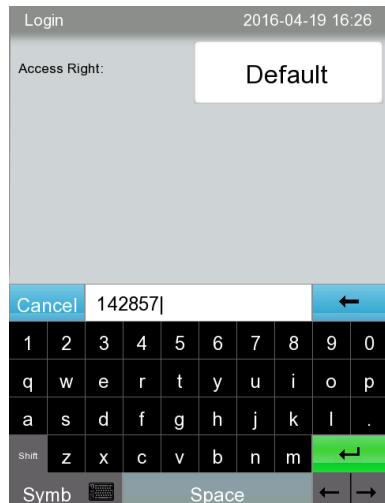
#### To logout as an administrator

- 1 From the main window, tap **Menu > General Settings > Login**.
- 2 The **Access Right** will be set to **Admin**. Tap **Admin**.
- 3 Tap **Enter**. The **Access Right** will be set to **Default**.
- 4 Tap **Home** to return to the main window.



#### Notes

- 1 You can also login as **Perten** using the password **199258**. This gives you the same permission as an administrator, while also allowing you to access the Service Functions window (see 2.1, page 16).

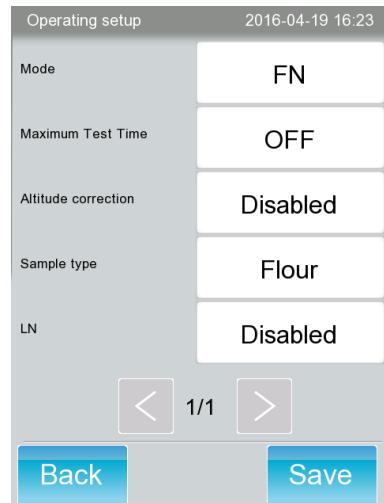


## 1.4.2 Operating setup

To change how the FN 1000 operates, you need to access the **Operating setup** window.

### ► To change the operating setup

- 1 Switch on the instrument and login as an administrator (see 1.4.1, above).
- 2 Tap **Menu > Operating setup** to open the **Operating setup** window.
- 3 Edit the settings as required.
- 4 When you have finished, tap **Save**.
- 5 Tap **Back** to return to the main window.



The following settings are available in the **Operating setup** window:

- **Mode**—Set to **FN** for normal mode or **Fungal FN** for fungal FN mode.
- **Maximum Test Time**—If required, you can set the maximum length of a test in seconds. The value must be at least 100. Set to OFF to disable. If altitude correction is used, the maximum test time applies only to the uncorrected time. For example, if the maximum test time is set to 280 seconds and altitude correction is set to 1500 meters, the maximum corrected Falling Number value is 220 for meal and 239 for flour.
- **Altitude correction**—Set to **Enabled** or **Disabled**. FN values are affected by boiling temperatures, which are a function of atmospheric pressure. Elevated locations may give FN values that are different from those determined at sea level, so some correction may be required. No corrections are applied for altitudes below 610 meters (meal) or 760 meters (flour).
- **Sample type**—Select **Flour** or **Meal**, depending on the type of samples being tested. This affects the formula used for altitude correction.
- **LN**—Set to **Enabled** or **Disabled** to show or hide the LN on screen.

### 1.4.3 Local settings

Before using the FN 1000 for the first time, you should set the time, altitude and other settings in the **Local Settings** window.



#### To access the Local Settings window

- 1 Switch on the FN 1000 and login as an administrator (see 1.4.1, above).
- 2 Tap **Menu > General settings > Local settings**.
- 3 Edit the date, time and altitude as required. Use the **« « » »** buttons to navigate between the three pages of settings.
- 4 Set the volume level to **5**.<sup>1</sup>
- 5 When you have finished, tap **Save**.
- 6 Tap **Back** to return to the main window.

The following settings are available in the **Local settings** window:

- **Date format**—yyyy-mm-dd or mm/dd/yyyy
- **Date**—used to set the correct date
- **Time format**—am/pm or 24 Hours
- **Time**—used to set the correct time
- **Volume**—used to set the speaker volume (**0–5**)
- **Lab altitude**—used to set the instrument altitude in meters or feet (see 1.4.4, page 13).
- **Printout name**—used to add up to 20 characters of information to printouts
- **Ref. Moisture(%)**—**14** or **15**
- **Temp unit**—**C** (celcius) or **F** (fahrenheit)
- **Altitude in**—**Meter** or **Feet**
- **Language**—used to toggle between the available languages
- **Share folder**—**Enabled** (for external communication services) or **Disabled**.



#### Notes

The recommended speaker volume is level **5**. A lower level can be set if required.

Local Settings		2016-04-19 16:24
Date Format	yyyy-mm-dd	
Date	2016-04-19	
Time Format	24 Hours	
Time	16	24
Volume	3	
<span style="border: 1px solid #ccc; padding: 2px;">«</span> <span style="border: 1px solid #ccc; padding: 2px;">&lt;</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">1/3</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">&gt;</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">»</span>		
<span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">Back</span>	<span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">Save</span>	

Local Settings		2016-04-19 16:25
Lab altitude	50	
Printout name	Perten Instruments AB	
Ref. moisture (%)	14	
Temp Unit	C	
Altitude in	Meter	
<span style="border: 1px solid #ccc; padding: 2px;">«</span> <span style="border: 1px solid #ccc; padding: 2px;">&lt;</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">2/3</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">&gt;</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">»</span>		
<span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">Back</span>	<span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">Save</span>	

Local Settings		2016-04-19 16:25
Language	English	
Share folder	Enabled	
<span style="border: 1px solid #ccc; padding: 2px;">«</span> <span style="border: 1px solid #ccc; padding: 2px;">&lt;</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">3/3</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">&gt;</span> <span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">»</span>		
<span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">Back</span>	<span style="border: 1px solid #0070C0; background-color: #0070C0; color: white; padding: 2px;">Save</span>	

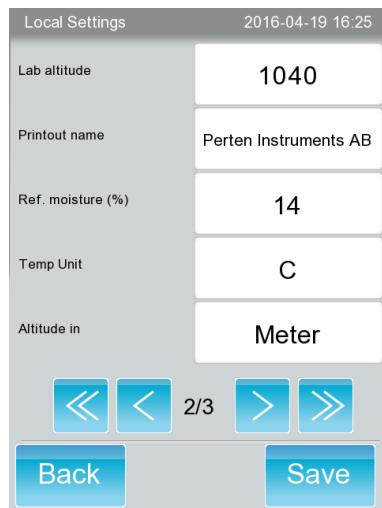
#### 1.4.4 Altitude correction

If the altitude of the location where the FN 1000 is being installed exceeds 2000 feet (610 meters), you should enable altitude correction.



##### To enable altitude correction

- 1 Switch on the FN 1000 and login as an administrator (see 1.4.1, above).
- 2 Tap **Menu > Operating setup**.
- 3 Tap the **Altitude correction** field and set it to **Enabled**.
- 4 Tap **Save** to return to the main menu.
- 5 Tap **General settings > Local settings**.
- 6 Tap **>** to access the settings page **2/3**.
- 7 Tap the **Lab altitude** field and enter the local altitude in meters or feet.
- 8 If required, tap the **Altitude in** field and select the altitude units as **Meter** or **Feet**.
- 9 Tap **Save** to return to the main menu.





## Part 2—Software & service functions

## 2.1 Service functions

The FN 1000 has a number of built in service functions for testing, adjusting and calibrating the instrument.

These can be accessed via the **Service Functions** window.



### To access the Service Functions window

- 1 Switch on the FN 1000.
- 2 Tap **Menu** and select **General settings > Login** to access the login window.
- 3 Tap **Default** and enter the access code **199258**. The access right will now change to **Perten**.
- 4 Tap **Exit** (not **Back**). The user interface (**UI**) will close, to be replaced by the Service Functions window.



### To return to the FN 1000 UI

- 1 Return to the main Service Functions window and tap **Back to UI**.<sup>1</sup> The Service Functions window will close, to be replaced by the UI.

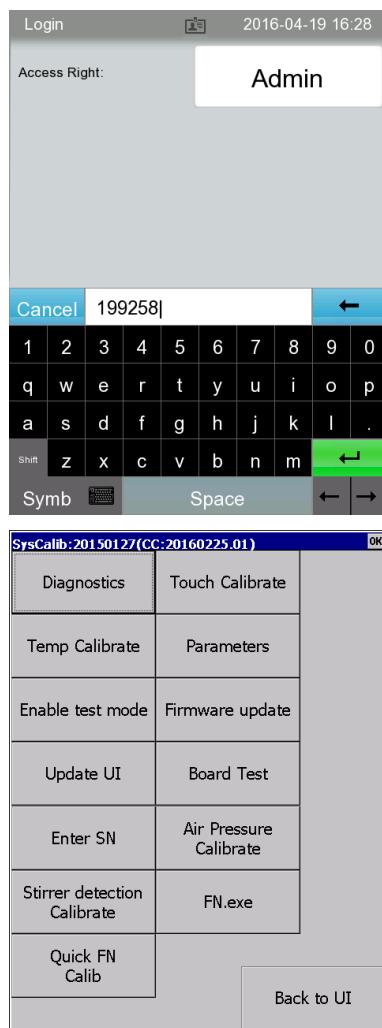


### Notes

- 1 If you have saved the settings required, you can also return to the UI by switching off the FN 1000 and switching it on again.

The following functions are available under the Service Functions window.

- **Diagnostics**—for accessing the Diagnostics window (see 2.2, page 18).
- **Touch Calibrate**—for calibrating the touchscreen (see 2.4, page 21).
- **Temp Calibrate**—for calibrating the temperature sensor (see 2.4.1, page 21).
- **Parameters**—for viewing and editing various instrument parameters (see [include further details?]).
- **Enable/Disable test mode**—for enabling and disabling test mode (see 2.3, page 20).
- **Firmware update**—for updating the instrument firmware (see 2.5.1, page 26).



- **Update UI**—for updating the user interface software of the FN 1000 (see 2.5, page 26).
- **Board Test**—for testing the control board (see 3.2, page 33).
- **Enter SN**—for viewing and editing the instrument serial number (see 2.6, page 28).
- **Air Pressure Calibrate**—air pressure calibration is not required. This function may be updated in future.
- **Stirrer detection Calibrate**—for calibrating the stirrer detection sensor (see 3.8.2, page 58).
- **FN.exe**—[Details? Doesn't seem to do anything.] (see [?]).
- **Quick FN Calib**—[give details?].

## 2.2 The Diagnostics window

The **Diagnostics** window displays information about the state of the FN 1000 and allows you to control individual instrument systems such as the motors and heating elements. This window is useful for checking the operation of the instrument and troubleshooting problems.

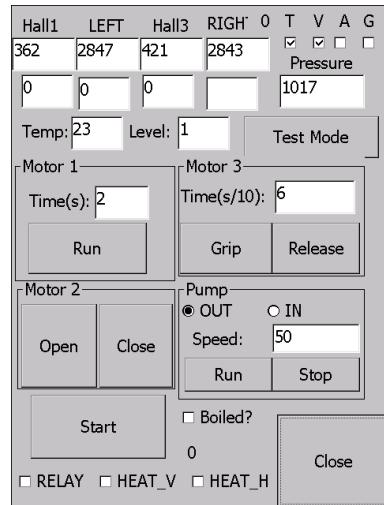


### To access the diagnostics window

- 1 Access the Service Functions window (see 2.1, page 16).
- 2 Tap **Diagnostics**.
- 3 When you have finished, tap **Close** to return to the Service Functions window.

The Diagnostics window includes the following settings and controls:

- **Hall1** and **Hall3**—The raw values from the two Hall effect sensors on the control board, used to detect the forward and back positions of the start arm (see 3.8.1, page 57).
- **LEFT** and **RIGHT**—The raw values from the two Hall effect sensors in the start arm sensor, used to detect the presence and position of the stirrers (see 3.8.1, page 57).
- **T**—Checked when the stirrer motor TDC sensor on the top sensor board is triggered by the **stirring motor** being in the top dead center (TDC) position (see 3.6.4, page 52).
- **V**—Checked when the **visor** sensor on the top sensor board is triggered by the flag attached to one of the visor arms when the visor is in the down position.
- **A**—Checked when the start arm sensor is triggered by the **start arm** being in the forward (closed) position.
- **G**—Checked when the sensor on stirrer arm board detects that the **claws** are in the grip position (see 3.7.1, page 54).
- **Pressure**—The atmospheric pressure (in hPa), measured by the pressure sensor.
- **Temp**—The calibrated value (in °C) measured by the temperature sensor (see 3.5.4, page 47).



- **Level**—The water level (1, 2, 3 or 4) measured by the level sensor in the water bath (see 3.5.5, page 48).
- **Test Mode**—Test mode is **[\*]**. To enter test mode, tap **Test Mode**. See
- **Motor 1**—To run the **stirring motor** for a set time, enter the time in seconds and tap **Run**.
- **Motor 2**—To move the start arm to its forward position (using the **start arm motor**), tap **Close**. To move the start arm to its back position, tap **Open**.
- **Motor 3**—To operate the **claw motor**, tap **Grip** or **Release**.
- **Pump**—To operate the pump, select whether you want to pump water out of (**OUT**) or into (**IN**) the water bath, enter a **Speed** in **[units]** and tap **Run**. Tap **Stop** to stop the pump.
- **Start**—Tap to **[\*]**
- **Boiled?**—**[\*]**
- **RELAY**—Check or clear to close or open (respectively) the relay to the heating elements. The relay must be closed for the heating elements to operate.
- **HEAT\_V** and **HEAT\_H**—Check to switch on the vertical and/or horizontal heating elements, respectively (the RELAY box must also be checked). Clear to switch off one or both heating elements.

## 2.3 Test mode

[Description of test mode]

► **To access test mode from Service Functions window**

- 1 Access the Service Functions window (see 2.1, page 16).
- 2 Tap **Enable test mode**.

► **To access test mode from Diagnostics window**

- 1 Access the Diagnostics window (see 2.2, page 18).
- 2 Tap **Test Mode**.

SysCalib:20150127(CC:20160225.01)		OK
Diagnostics	Touch Calibrate	
Temp Calibrate	Parameters	
Enable test mode	Firmware update	
Update UI	Board Test	
Enter SN	Air Pressure Calibrate	
Stirrer detection Calibrate	FN.exe	
Quick FN Calib		Back to UI

## 2.4 Calibration procedures

### 2.4.1 Temperature calibration

The FN 1000 measures water temperature using a semiconductor sensor located in the base of the water bath (see 3.5.4, page 47).

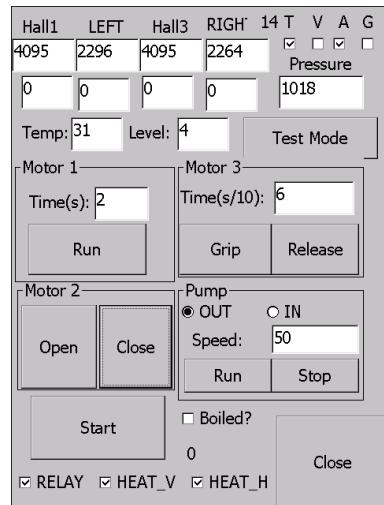
To measure temperatures accurately, the temperature sensor must be calibrated using an externally calibrated thermometer with an accuracy of better than 0.1°C. The calibration procedure involves measuring the temperature at two points, then calculating a slope and offset to convert the raw output of the sensor into temperature measurements.

To maintain accurate temperature measurements, the temperature sensor should be periodically checked and recalibrated. The sensor must also be recalibrated whenever it or the control board is replaced.



#### To check the calibration of the temperature sensor

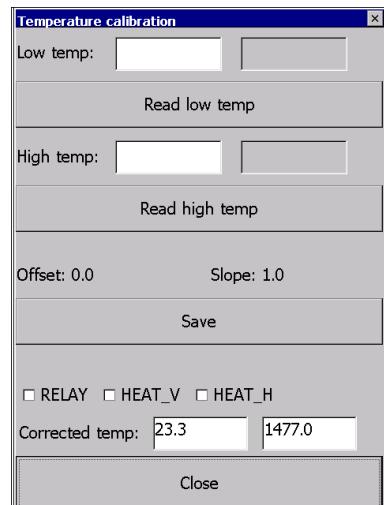
- 1 Switch off the FN 1000 and disconnect it from the mains power supply.
- 2 Remove the water bath and fill it with water at room temperature. Install the bath and cooling lid. Ensure the water bath and cooling lid are properly fitted and the cooling water supply is switched on.
- 3 Switch on the FN 1000.
- 4 Access the Diagnostics window (2.2, page 18).
- 5 Insert a calibrated immersion thermometer through one of the flaps in the cooling lid until it is approximately 7 cm from the surface of the water in the bath.
- 6 Allow 2 minutes for the temperature reading to settle, then measure the temperature.
- 7 Check the temperature measured by the thermometer and that measured by the FN 1000 agree to within ±0.1°C.
- 8 Check the **RELAY**, **HEAT\_V** and **HEAT\_H** boxes, as shown, to switch on the heating elements.
- 9 Allow 15 minutes for the water in the bath to boil. As the water heats up, check that the temperatures measured by the thermometer and those measured by the FN 1000 agree to within ±0.1°C.





## To calibrate the temperature sensor

- 1 Switch off the FN 1000 and disconnect it from the mains power supply.
- 2 Remove the water bath and fill it with water at room temperature. Install the bath and cooling lid. Ensure the water bath and cooling lid are properly fitted and the cooling water supply is switched on.
- 3 Switch on the FN 1000.
- 4 Access the **Service Functions** window (2.1, page 16).
- 5 Tap **Temp Calibrate** to open the **Temperature calibration** window (shown).
- 6 Insert the thermometer through one of the flaps in the cooling lid until it is approximately 7 cm from the surface of the water in the bath.
- 7 Allow 2 minutes for the temperature reading to settle, then measure the temperature to a precision of 0.1°C or better.
- 8 Enter the measured temperature value in the **Low Temp** field in the temperature calibration window.
- 9 Ensure the uncalibrated value shown in the bottom right field of the temperature calibration window is stable and click **Read low temp**.
- 10 Check the **RELAY**, **HEAT\_V** and **HEAT\_H** boxes to switch on the heating elements. Allow 15 minutes for the water in the bath to boil.
- 11 Uncheck the **HEAT\_V** box to switch off the vertical heater and allow the water to boil for about 5 minutes.
- 12 Again insert the thermometer through one of the flaps in the cooling lid until it is approximately 7 cm from the surface of the water in the bath.
- 13 Allow 2 minutes for the temperature reading to settle, then measure the temperature to a precision of 0.1°C or better.<sup>1</sup>
- 14 Enter the measured temperature value in the **High Temp** field in the temperature calibration window.
- 15 Ensure the uncalibrated value shown in the bottom right field of the temperature calibration window is stable and click **Read high temp**.
- 16 Click **Save**. The temperature sensor will be recalibrated using the newly calculated slope and offset.



- 17 Uncheck the **RELAY** and **HEAT\_H** boxes to switch off the heating elements.
- 18 Check the calibration of the temperature sensor using the above procedure.



### Notes

- 1 Measure the actual boiling point temperature. Do not assume it is 100°C, as the boiling point of water can vary with air pressure and water purity.
- 2 [Are there any potential problems running calibration procedure if existing calibration constants are far from their correct values?]

## 2.4.2 Calibrating the touchscreen



### To calibrate the touchscreen

- 1 Access the **Service Functions window** (2.1, page 16).
- 2 Tap **Touch Calibrate** and follow the on-screen instructions using a stylus.<sup>1</sup>



### Notes

- 1 To ensure the accuracy of the touchscreen calibration, always use a stylus instead of a finger.

fully press and briefly hold stylus on the center of the target.  
Repeat as the target moves around the screen.  
Press the Esc key to cancel.



### 2.4.3 Air pressure sensor

The FN 1000 includes an air pressure sensor. This sensor does not require calibration, but can be checked against the known air pressure.



#### To check operation of the air pressure sensor

- 1 Access the Diagnostics window (see 2.2, page 18).
- 2 Note the displayed air pressure. Typical sea level values are 995–1025 hPa.
- 3 Compare the measured value to a local reading and ensure they agree to within ±10 hPa [check].

Hall1	LEFT	Hall3	RIGH	0	T	V	A	G
362	2847	421	2843		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0	0	0			Pressure			
					1017			
Temp: 23 Level: 1				Test Mode				
Motor 1		Motor 3						
Time(s): 2		Time(s/10): 6						
Run		Grip						
Motor 2		Pump						
Open	Close	<input checked="" type="radio"/> OUT	<input type="radio"/> IN					
Start		Speed: 50						
Run		Stop						
Boiled?		0						
<input type="checkbox"/> RELAY		<input type="checkbox"/> HEAT_V		<input type="checkbox"/> HEAT_H		Close		

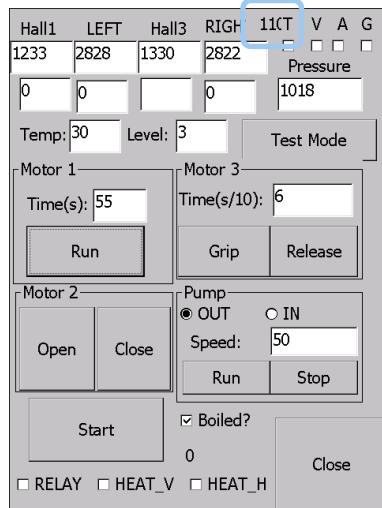
## 2.4.4 Stirring motor calibration

Speed calibration of the stirring motor is required only for the first 50 FN 1000 instruments, which have serial numbers beginning with 150. All other FN 1000 instruments do not require calibration of the stirring motor.



### To calibrate the stirring motor

- 1 Insert a cassette with stirrers and tubes in the water bath
- 2 Access the Diagnostics window (see 2.2, page 18).
- 3 Tap **Test Mode**.
- 4 In the **Motor 1** field, enter a time of **55** seconds and tap **Run**.
- 5 Allow the stirring motor to run for 55 seconds. During this time, the number of cycles will be shown at the top of the window (shown).
- 6 When the motor stops, note the number of cycles shown at the top of the screen. The target value is 110.
- 7 If the displayed value is not 110, close the Diagnostics window and tap **Parameters**.
- 8 Increase or decrease parameter **15** proportionally. For example, if the number of cycles shown is 109, increase parameter 15 to 404 (=  $400 \times 110 / 109$ ). A change in parameter 15 of about 4 units corresponds to one cycle of the stirring motor.
- 9 Tap **Save** and wait a few seconds for the window to close.
- 10 Return to step 2 and repeat the procedure until a cycle value of 110 is achieved.
- 11 Tap **Run** at least two more times (three in total) to ensure the results are consistent.



## 2.5 Software updates

The FN 1000 uses a Windows CE 6.0 platform. Two main pieces of software run on this platform—a hardware controller (the firmware), and a custom user interface (**UI**) program for operating the FN 1000.

Perten Instruments sometimes releases new versions of these programs to add new features, improve performance and/or fix bugs. You should always install the latest versions on an FN 1000.

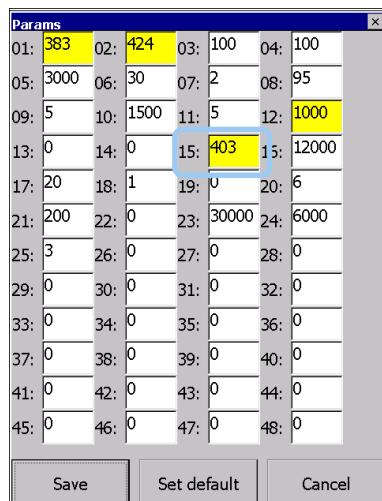
### ► To check the FN 1000 software versions

- 1 Turn on the FN 1000.
- 2 Tap **Menu > System info**.
- 3 Check the fields labelled **UI Software Version** and **Controller Software Vers.**
- 4 Tap **Home** to return to the main menu.

### 2.5.1 Updating the firmware and UI software

#### ► To update the FN 1000 firmware and UI software

- 1 Obtain the latest FN 1000 software from the Perten Supportweb ([perthen.com/supportweb](http://perthen.com/supportweb)). The software file should have a name of the form **FN\_yyyymmdd.zip**.
- 2 Extract the zip file. This will create a folder named **FN** containing the new software.
- 3 Copy the FN folder and its contents to the root of a USB drive.
- 4 Access the Service Functions window (see 2.1, page 16).
- 5 Tap **Parameters** and note the value of parameter **15**. Tap **Cancel** to return to the setup window.
- 6 Tap **Update UI**.
- 7 When the display has returned to the analysis screen, switch off the power to the FN 1000 and switch it on again.
- 8 When the instrument has restarted, again access the Service Functions window.
- 9 Tap **Firmware update**.
- 10 When requested by the FN 1000, again restart the instrument.



- 11 When the instrument has restarted, again access the Service Functions window.
- 12 Tap **Parameters**.
- 13 Change parameter 15 to the value noted at step 5 above and the following parameters to the values shown:  
P17: 20  
P18: 1  
P19: 0  
P21: 200.
- 14 Tap **Save** to return to the Service Functions window.
- 15 Tap **Back to UI** to run the UI software.
- 16 Check the FN 1000 software versions using the above procedure.
- 17 Check the **Language version**. If it is blank, update the language file manually (see 2.5.2, below).
- 18 Tap **Home** to return to the main window. The instrument is now ready for operation.

## 2.5.2 Updating the language or file transfer files

If, after an instrument restart, the **Language version** field in the System info window is blank, as shown, then you may need to update the language file and/or file transfer software manually.

### ► To update the language or file transfer software manually

- 1 Obtain the latest language file (**Langauge.xx**) or file transfer software file (**FileTransfer.exe**) from the Perten Supportweb ([perten.com/supportweb](http://perten.com/supportweb)).
- 2 On a USB drive, create the folder **Perten\Import** and copy the file to the folder and insert the USB drive into one of the USB ports on the FN 1000.
- 3 Login as an administrator (see 1.4.1, page 10) and tap **General settings > Maintenance > Import/export**.
- 4 Tap **Import**.
- 5 After a short time, the FN 1000 will display the message **{xx} files updated**. Switch off the instrument and restart it to activate the new files.

System info	2015-07-17 4:45 PM
Instrument manufacturer	Perten Instruments AB
Serial Number	1505471
UI Software Version	UI 20150717.01
Controller Software Version	20150717.01
Language version	
<	1/2 >
Back	Home

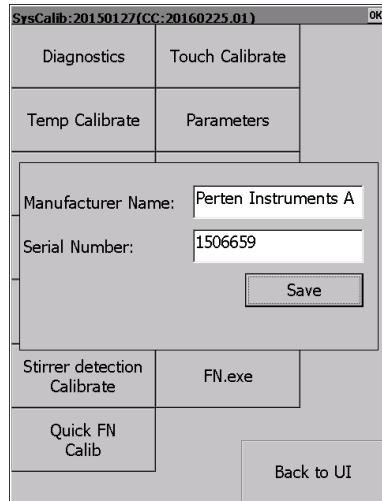
## 2.6 Editing the serial number

You can use the Service Functions window to edit the instrument serial number.



### To edit the serial number

- 1 Access the Service Functions window (see 2.1, page 16).
- 2 Tap **Enter SN**.
- 3 Edit the serial number as required.
- 4 Tap **Save**.



## Part 3—Replacements & adjustments

## 3.1 Casing

### 3.1.1 Front casing

The front casing of the FN 1000 can be easily removed by the user to facilitate filling the water bath.



#### **WARNING**



**ALWAYS DISCONNECT THE INSTRUMENT FROM THE MAINS POWER SUPPLY BEFORE CONNECTING OR DISCONNECTING THE WATER BATH AND/OR COOLING LID.**



#### **To remove the front casing and water bath**

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the cooling lid.
- 3 Hold the front casing firmly on either side, as shown, and pull it towards you.
- 4 Hold the water bath firmly on either side, as shown, and pull it towards you.



#### **To replace the front casing and water bath**

- 1 Slide the water bath gently away from you along the steel rail until it clicks into place.
- 2 Hold the front casing firmly on either side and slide it away from you into place.
- 3 Replace the cooling lid.

### 3.1.2 Rear casing



#### WARNING

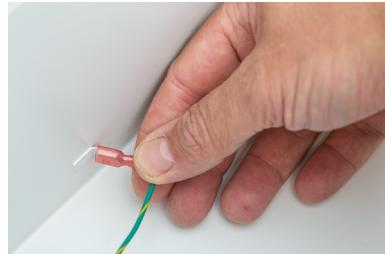


**ALWAYS DISCONNECT THE INSTRUMENT FROM THE MAINS POWER SUPPLY BEFORE REMOVING THE REAR CASING.**



#### To remove the rear casing

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Disconnect the cooling tube, as shown.
- 3 Remove the eight T20 screws from the rear casing—three on either side and two at the bottom rear of the casing.
- 4 Pull the rear casing away from the chassis until the casing tabs are released from the front chassis and lift off the casing, as shown.
- 5 Disconnect the grounding cable between the main body and the rear casing, as shown, before removing the casing entirely.



### 3.1.3 Feet

The plastic feet (PN 30617)



#### To replace a plastic foot

1

PN 30617

### 3.1.4 Visor

The transparent plastic visor (PN 30340) provides a shield to prevent injury during operation of the FN 1000. The visor can be raised and lowered by the user.



#### WARNING

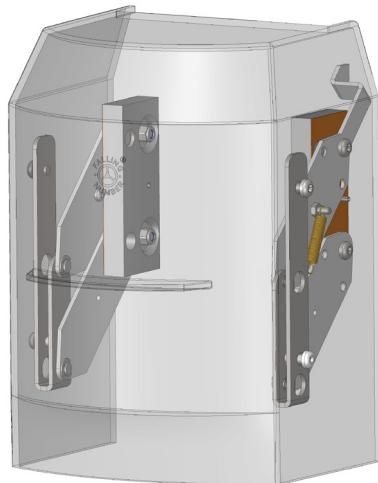


**THE VISOR PROVIDES PROTECTION AGAINST INJURY WHEN THE FN 1000 IS OPERATING. IF YOU MUST REMOVE THE VISOR, TAKE GREAT CARE TO KEEP CLEAR OF THE INSTRUMENT WHEN IT IS OPERATING.**



#### To remove the visor

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30).
- 3 Undo the four T20 Torx screws that secure the visor to the visor arms, as shown, taking care not to lose the two springs and rubber stoppers connected to the bottom two screws.
- 4 Carefully remove the visor, taking care not to scratch the sides of it on the metal visor arms.



#### To install the visor

- 1 Position the visor, taking care not to scratch the sides of it on the metal visor arms.
- 2 Fully insert the upper two (short) T20 Torx screws through the visor and into the visor arms.
- 3 Partially insert the bottom two (long) T20 Torx screws. Leave a gap of 2–3 mm between the end of each screw and the visor arm.
- 4 Using a pair of needle-nose pliers, loop one end of each spring (PN 30369) over each of the long screws, as shown, and pull the other ends of the springs over the studs on the visor arms.
- 5 Insert the rubber stoppers between the ends of the long screws and the visor arms and tighten the screws to clamp the stoppers in place.



## 3.2 Control board

The control board is the main board for the FN 1000. It includes a computer-on-module (COM, see 3.2.3, below), a miniSD card on which the instrument software is stored, a lithium backup battery, and connections to the:

- touchscreen (3.3.1, page 37)
- connector board (3.3.2, page 37)
- power supply (3.3.5, page 39)
- water bath (3.5, page 43)
- top sensor board (3.3.3, page 38)
- start arm motor (3.8.5, page 61)
- start arm sensor (3.8.2, page 58), and
- pump (3.10, page 63).



See also the block diagram in Section 1.2.4, page 5.

### 3.2.1 Testing the control board

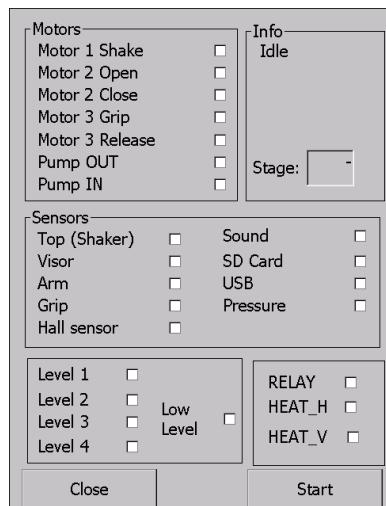
The service functions include a utility for testing the control board. This can be useful for troubleshooting problems and identifying whether a problem lies on the control board or with an instrument subsystem.

[Further details of Board Test functions].



#### To access the Board Test window

- 1 Access the Service Functions window (see 2.1, page 16).
- 2 Tap **Board Test** to open the Board Test window.
- 3 Check the box(es) corresponding to the function(s) you wish to test on the board. [Further details. Explain how this works].
- 4 Tap **Start**.
- 5 When you have finished, tap **Close** to close the Board Test window and return to the Service Functions window.





## Notes

The Board Test window includes the following functions:

Label	Function
Motor 1 Shake	
Motor 2 Open	
Motor 2 Close	
Motor 3 Grip	
Motor 3 Release	
Pump OUT	
Pump IN	
Top (Shaker)	
Visor	
Arm	
Grip	
Hall sensor	
Sound	
SD Card	
USB	
Pressure	
Level 1–4	
Low level	
RELAY	
HEAT_H	
HEAT_V	

### 3.2.2 Replacing the control board

#### ► To replace the control board

- 1 Access the Service Functions window (see 2.1, page 16).
- 2 Tap **Parameters** and note the value of parameters **01, 02, 12 and 15 [check]**.
- 3 Switch off the instrument and disconnect it from the mains power supply.
- 4 Remove the rear casing (see 3.1.2, page 31).
- 5 Disconnect all the ribbon cables and other connectors from the old control board.
- 6 Remove the miniSD card from the old control board.
- 7 Remove the PicoCOM board (see 3.2.3, below) [check—is PicoCOM board included with control board spare?].
- 8 Remove the four M3 (5.5 mm) locking nuts securing the control board to the chassis and remove the old control board.
- 9 Insert the miniSD card into the new control board.
- 10 Install the PicoCOM board on the new control board (see 3.2.3, below).
- 11 Position the new control board and secure it to the chassis using the four locking nuts.
- 12 Connect the ribbon cables and other connectors to the new control board.
- 13 Switch on the instrument and access the Service Functions window (see 2.1, page 16).
- 14 Tap **Parameters** and enter the values of parameters **01, 02, 12 and 15 [check]** noted at step 2 above.
- 15 Run a full functionality check (see 4.1, page 67).

Params							
01:	383	02:	424	03:	100	04:	100
05:	3000	06:	30	07:	2	08:	95
09:	5	10:	1500	11:	5	12:	1000
13:	0	14:	0	15:	403	16:	12000
17:	20	18:	1	19:	0	20:	6
21:	200	22:	0	23:	30000	24:	6000
25:	3	26:	0	27:	0	28:	0
29:	0	30:	0	31:	0	32:	0
33:	0	34:	0	35:	0	36:	0
37:	0	38:	0	39:	0	40:	0
41:	0	42:	0	43:	0	44:	0
45:	0	46:	0	47:	0	48:	0
<b>Save</b>				<b>Set default</b>		<b>Cancel</b>	

### 3.2.3 PicoCOM board

The PicoCOM board (PN 31047) is a computer-on-module (COM) mounted to the control board.



#### To replace the PicoCOM board

- 1 Access the Service Functions window (see 2.1, page 16).
- 2 Tap **Parameters** and note the value of parameters **01, 02, 12 and 15 [check]**.
- 3 Switch off the instrument and disconnect it from the mains power supply.
- 4 Remove the rear casing (see 3.1.2, page 31).
- 5 Remove the four T8 Torx screws that secure the PicoCOM board to the control board and remove the old PicoCOM board.
- 6 Position the new PicoCOM board and secure it to the control board.
- 7 Switch on the instrument and access the Service Functions window (see 2.1, page 16).
- 8 Tap **Parameters** and enter the values of parameters **01, 02, 12 and 15 [check]** noted at step 2 above.
- 9 Run a full functionality check (see 4.1, page 67).



### 3.2.4 Backup battery

The control board includes a 3 V lithium backup battery (type CR2032). The expected life of the battery is 5 years [check].

If the backup battery is replaced, you will need to set the date and time in the system BIOS [Check. Details on how to do this?].

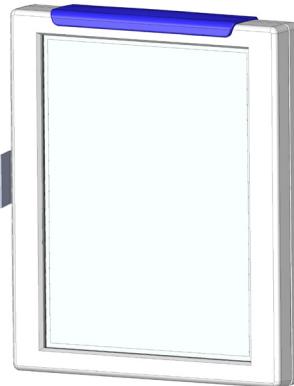


## 3.3 Electrical systems

### 3.3.1 Touchscreen

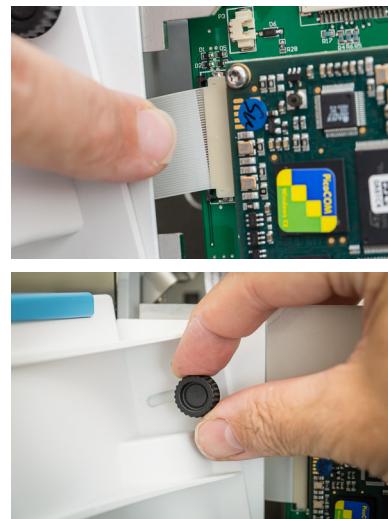
The touchscreen (PN 29468) is the main interface between the user and the FN 1000. It is used to control and setup the FN 1000, to show the status of the instrument, and to view test results.

You should calibrate the touchscreen following replacement or a prolonged period of operation (see 2.4, page 21).



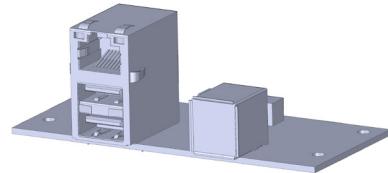
#### To replace the touchscreen

- 1 Switch off the FN 1000 and remove the rear casing (see 3.1.2, page 31).
- 2 Disconnect the ribbon cable that connects the touchscreen to the COM board, as shown.
- 3 Loosen the two thumb screws securing the touchscreen to the chassis, as shown.
- 4 Carefully remove the touchscreen and bracket.
- 5 Install the new touchscreen by reversing the above procedure.
- 6 Calibrate the new touchscreen (see 2.4, page 21).



### 3.3.2 Connector board

The connector board includes four USB ports and a LAN port. It is connected to the main board via a ribbon cable.



#### To replace the connector board

- 1 Switch off the instrument and remove the rear casing (see 3.1.2, page 31).
- 2 Disconnect the ribbon cable from the connector board.
- 3 Remove the four M8 screws securing the connector board to the chassis and remove the connector board.
- 4 Position the new connector board and secure it to the chassis using the screws.
- 5 Connect the ribbon cable to the new connector board.

### 3.3.3 Top sensor board

The top sensor board (PN 30217) holds the sensors for the visor and stirrer arm TDC flag. [+ shake detection?]

#### ► To replace the top sensor board

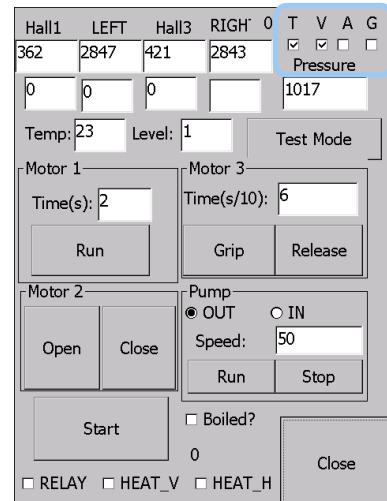
- 1 Switch off the FN 1000 and remove the rear casing (see 3.1.2, page 31).
- 2 Disconnect the two ribbon cables from the top sensor board.
- 3 Remove the two T10 screws securing the top sensor board to the chassis and remove the old sensor board.
- 4 Position the new sensor board and secure it to the chassis using the two T10 screws.
- 5 Connect the two ribbon cables to the sensor board.

### 3.3.4 Position sensors

The FN 1000 includes four position sensors, one for each of the stirrer arm (T), visor (V), start arm (A), and claws (G). Checkboxes for these sensors are shown in the top right corner of the **Diagnostics** window.

#### ► To check operation of the position sensors

- 1 Switch off the FN 1000 and rotate the stirrer motor arm into the top position.
- 2 Switch on the instrument and access the Diagnostics window (see 2.2, page 18).
- 3 Ensure the **T** box is checked when the sensor flag is in the TDC position. Rotate the motor by hand so the sensor flag is not in the TDC position and ensure the **T** box is unchecked.
- 4 Lower the visor and ensure the **V** box is checked. Raise the visor and ensure the **V** box is unchecked.
- 5 In the **Motor 2** section, tap **Close** and ensure the **A** box is checked. Tap **Open** and ensure the **A** box is unchecked.
- 6 In the **Motor 3** section, tap **Grip** and ensure the **G** box is checked. Tap **Release** and ensure the **G** box is unchecked.

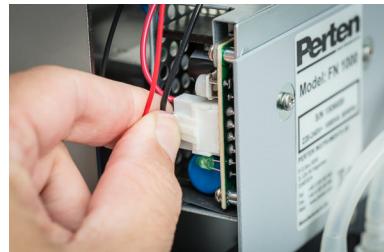


### 3.3.5 Power supply

The FN 1000 power supply (PN 29922) converts the mains input power to 24 V<sub>dc</sub> power, which is supplied to the main board.

#### ► To replace the power supply

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the rear casing (see 3.1.2, page 31).
- 3 Disconnect the two cables from the old power supply.
- 4 Remove the two T10 Torx screws securing the power supply to the chassis and remove the old power supply.
- 5 Position the new power supply and secure it to the chassis using the two T10 Torx screws.
- 6 Connect the two cables to the new power supply.



### 3.3.6 Fuses

The FN 1000 uses two fuses, which can be located on the rear of the instrument near the mains power inlet.

If your mains supply is 230V~ use a fuse marked T6.3AH 250 V. The fuse part number is 30949. Insert the new fuse (fuses) in the fuse holder(s) and fit them in the instrument.

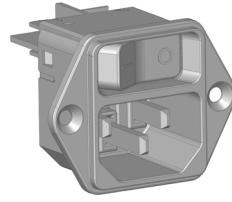
#### ► To replace a fuse

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the rear casing (see 3.1.2, page 31).
- 3 Using a small flat-tip screwdriver, turn the fuse holder counter-clockwise and remove the holder, as shown.
- 4 Remove the old fuse from the holder and replace it with the new one.
- 5 Insert the fuse holder and turn it clockwise.



### 3.3.7 Mains inlet

The mains inlet (PN 30321) provides both a socket for connecting the mains power cable to the FN 1000 and the main switch for turning the instrument on and off.



#### ► To replace the mains inlet

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the rear casing (see 3.1.2, page 31).
- 3 Disconnect the three internal leads to the mains inlet.
- 4 Remove the two T10 Torx screws securing the mains inlet to the chassis and remove the old inlet.
- 5 Position the new mains inlet and secure it to the chassis.
- 6 Connect the three internal leads to the inlet.

### 3.3.8 Changing the operating voltage

The FN 1000 can be configured to operate at either 100–120 or 220–240 V<sub>ac</sub>. No changes are required when switching between 50 and 60 Hz.

#### ► To change the operating voltage

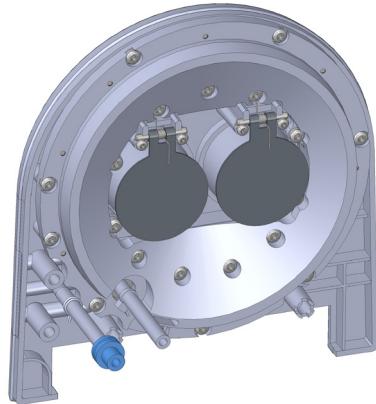
- 1 Exchange both heating elements (see 3.5.3, page 45). Alternatively, replace the entire water bath (see 3.5, page 43).
- 2 Remove the fuse holder and replace the two fuses (see 3.3.6, page 39).
- 3 Change the voltages marked on the instrument label (shown).
- 4 Change the fuse label (shown).



## 3.4 Cooling lid

The cooling lid (PN 30327) sits atop the water bath. It has several functions, including:

- providing a lid to the water bath to prevent the user from injury through accidental contact with boiling water in the bath
- cooling and condensing steam and water vapor rising from the water bath, returning it to the bath to minimize water loss and preventing the visor from fogging up
- providing inlet and outlet tubes to the water bath to allow water to be circulated between the water bath and external reservoir, thereby maintaining the level in the water bath.



For effective operation, the cooling lid requires a constant supply of cooling water, either from a reticulated water supply or a recirculation cooler (see 1.3.1, page 8).



### WARNING



**THE COOLING LID AND WATER BATH BECOME HOT DURING OPERATION. DO NOT TOUCH THE COOLING LID OR WATER BATH DURING OPERATION. IF THE COOLING LID NEEDS TO BE REMOVED, CLEANED OR OTHERWISE ADJUSTED, ENSURE THE COOLING LID AND WATER BATH ARE AT ROOM TEMPERATURE.**

### 3.4.1 Checking operation of the cooling lid



#### To inspect and check operation of the cooling lid

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 When the cooling lid has sufficiently cooled, remove it and inspect it for faults.
- 3 Check that the steam flaps (shown) operate unhindered and are correctly aligned when closed.
- 4 Check the tubing to the cooling lid is in good condition and does not leak.
- 5 Fit the cooling lid. Check that it sits firmly on the water bath without any noticeable gap. If required, adjust the position of the guide plate (see 3.4.2, page 42).



- 6 Start the FN 1000 and ensure the lid cooling system operates effectively.
- 7 Select the standard test mode (see [\[\\*\]](#))
- 8 Lower the visor and allow the instrument to warm up until boiling for at least 5 minutes.
- 9 Check the lid and ensure there is no escaping water vapor.
- 10 Check there is no condensation on the visor.

### 3.4.2 Guide plate for cooling lid

The cooling lid is held in position by the guide plate on the chassis of the FN 1000. The guide plate should be positioned so that the cooling lid sits snugly on the water bath. Adjustment of the guide plate is rarely required and should only be carried out when absolutely necessary.



#### To adjust the position of the guide plate

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30).
- 3 Loosen the two T10 Torx screws that secure the guide plate to the chassis, as shown [\[replace photo\]](#).
- 4 Position the guide plate and tighten the two screws.
- 5 Fit the cooling lid and check the position of the guide plate. Repeat the above steps as required.
- 6 Securing the screws with Loctite 222 [\[check\]](#).



## 3.5 Water bath

The water bath can hold several liters of water for heating the sample during a test. It includes:

- two heating elements (3.5.3, page 45)
- a temperature sensor (3.5.4, page 47), and
- a water level sensor (3.5.5, page 48).

The entire water bath can be ordered as a replacement:

Description	Part no.
Water bath for FN 1000 230 V complete	30066
Water bath for FN 1000 115 V complete	30618



### WARNING

**THE WATER BATH BECOMES HOT DURING OPERATION. DO NOT TOUCH THE WATER BATH SURFACES DURING OPERATION. IF THE WATER BATH NEEDS TO BE REMOVED, EMPTIED, CLEANED OR OTHERWISE ADJUSTED, ENSURE THE WATER BATH IS AT ROOM TEMPERATURE.**



### 3.5.1 Water bath guide plate

The water bath should be horizontally positioned so that the electrical plug on the water bath is securely connected to the socket on the main instrument body whenever the bath has been clicked into place. If the water bath does not easily click into place or the plug and socket do not mate securely, you may need to adjust the position of the water bath guide plate.



#### To check the position of the water bath guide plate

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30).
- 3 Slowly slide the water bath into place, as shown, and stop as soon as you hear a click.
- 4 Check the gap between the electrical plug and socket. The gap should not exceed 2 mm [check]. If it does, or if you are unable to easily click the water bath into place, adjust the position of the guide plate using the following procedure.





### To adjust the position of the water bath guide plate

- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30).
- 3 Tip the instrument onto its side and locate the three positioning bolts for the water bath guide plate, as shown.
- 4 Using a spanner, loosen the three M4 (7 mm) nuts securing the positioning bolts and adjust the position of the guide plate.
- 5 Lightly tighten the nuts and tip the instrument back onto its base.
- 6 Check the position of the guide plate using the above procedure. Repeat the above steps as required.
- 7 When the guide plate is in the correct position, tip the instrument back onto its side and fully tighten the nuts to secure the guide plate. Secure using Loctite 222 [check].



### 3.5.2 Access the base of the water bath

To replace or adjust the heating elements, temperature sensor or water level sensor, you will need to access the base of the water bath.



### To access the base of the water bath

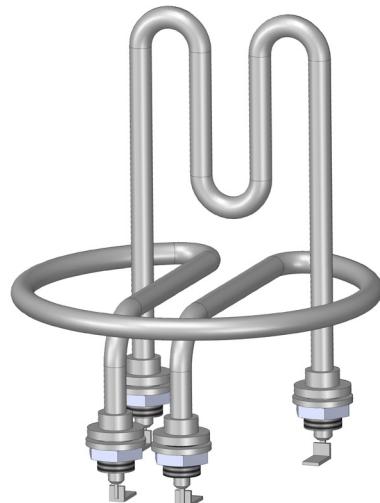
- 1 Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30) and turn the water bath over.
- 3 Remove the T25 Torx screw, as shown, and remove the base plate from the water bath.
- 4 When you have finished, replace the base plate and secure it to the water bath using the T25 Torx screw.



### 3.5.3 Heating elements

The water bath contains two heating elements—a horizontal heating element and a vertical heating element. These are available as a set complete with nuts and fiber washers for both 100–120 and 220–240 V<sub>ac</sub> units.

Description	Voltage	Part number
Heating element set	220–240 V <sub>ac</sub>	10.06.40
Heating element set	100–120 V <sub>ac</sub>	10.06.90



#### To check the operation of the heating elements

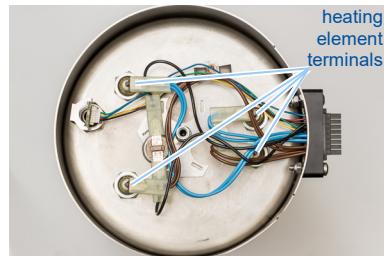
- 1 Switch off the FN 1000 and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30).
- 3 Fill the water bath with water at room temperature and install the bath. Leave the cooling lid off.
- 4 Raise the visor and leave it raised.
- 5 Switch on the instrument and access the Diagnostics window (see 2.2, page 18).
- 6 Uncheck the **RELAY**, **HEAT\_V** and **HEAT\_H** boxes.
- 7 Check the **RELAY** box, as shown, and listen for an audible click of the relay.
- 8 Check the **HEAT\_V** box and note turbulence around the vertical heater element. Uncheck the **HEAT\_V** box.
- 9 Check the **HEAT\_H** box and note turbulence around the vertical heater element. Uncheck the **HEAT\_H** box.
- 10 Replace the cooling lid.

Hall1	LEFT	Hall3	RIGH	14 T	V	A	G
4095	2296	4095	2264	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
0	0	0	0	Pressure 1018			
Temp: 31 Level: 4				Test Mode			
Motor 1		Motor 3					
Time(s): 2		Time(s/10): 6					
Run		Grip Release					
Motor 2		Pump					
Open	Close	<input checked="" type="radio"/> OUT	<input type="radio"/> IN				
Start		Speed: 50					
Run Stop		<input type="checkbox"/> Boiled?					
0		Close					
<input checked="" type="checkbox"/> RELAY <input type="checkbox"/> HEAT_V <input type="checkbox"/> HEAT_H							



## To replace the heating elements

- 1 Access the base of the water bath (see 3.5.2, page 44).
- 2 Disconnect the blade connectors from the four heating element terminals.
- 3 Unbolt the old heating elements and remove them from the water bath.
- 4 Mount the new horizontal heating element with a fiber washer on the inside of the water bath at each terminal.<sup>1</sup> Ensure the element is centered and parallel with the bottom of the water bath.<sup>2</sup> Be careful not to twist the element tube or damage the connectors by over-tightening the nuts.
- 5 Mount the new vertical heating element with a fiber washer on the inside of the water bath at each terminal. Again be careful not to twist the element tube or over-tighten the nuts.
- 6 Reconnect the blade connectors to the four heating element terminals.
- 7 Replace the base plate, install the water bath and test the heating elements using the above procedure.



### Notes

- 1 Always mount the horizontal element first.
- 2 Incorrect positioning of the horizontal element may affect the test results.

### 3.5.4 Temperature sensor

The water temperature sensor (PN 00000) is a semiconductor device attached to the base of the water bath and used to measure the water temperature.



#### To replace the temperature sensor

- 1 Access the base of the water bath (see 3.5.2, page 44).
- 2 Disconnect the two spade connectors to the temperature sensor, as shown.
- 3 Remove the 8×20 mm standoff, 8 mm nut and flat washer from the center of the water bath base, as shown. Note the orientation of the standoff.
- 4 Remove the sensor from the water bath, as shown.
- 5 Apply a small amount of Dow Corning 340 heat sink compound to the new sensor.
- 6 Position the new sensor on the base of the water bath.
- 7 Secure the sensor to the base with the flat washer, M5 (8 mm) nut and M5 × 20 mm standoff. Ensure the standoff is reinstalled in the correct orientation.
- 8 Connect the two spade connectors to the new sensor.
- 9 Reinstall the base plate on the water bath and reinstall the water bath.
- 10 Recalibrate the temperature sensor (see 3.5.4, page 47).



### 3.5.5 Water level sensor

The water level sensor (PN 30500) is used by the FN 1000 to measure the level of water in the water bath. It comprises a stainless steel tube containing a PCB with numerous reed switches and a float containing a magnet.

The PCB component of the water level sensor (PN 30530) can be replaced without removing the entire water level sensor.



#### To replace the water level sensor PCB

- 1 Access the base of the water bath (see 3.5.2, page 44).
- 2 Disconnect the cable from the water level sensor, as shown.
- 3 Pull back the spring clip from the PCB, as shown.
- 4 Pull the old PCB up out of the tube, as shown.
- 5 Gently insert the new PCB into the tube.
- 6 Position the spring clip to hold the PCB firmly in place.
- 7 Connect the cable to the water level sensor.
- 8 Reassemble the instrument. Check the operation of the water level sensor and adjust the float as required (see 3.5.6, page 49).

#### To replace the entire water level sensor

- 1 Access the base of the water bath (see 3.5.2, page 44).
- 2 Disconnect the cable from the water level sensor.
- 3 Undo the M10 (17 mm) nut securing the water level sensor to the water bath.
- 4 Remove the old water level sensor.
- 5 Fit a fiber washer (PN 000000) onto the water level sensor and insert it into the hole in the water bath.
- 6 Replace the M10 nut securing the sensor to the water bath.
- 7 Connect the cable to the water level sensor.
- 8 Reassemble the instrument. Check the operation of the water level sensor and adjust the float as required (see 3.5.6, page 49).



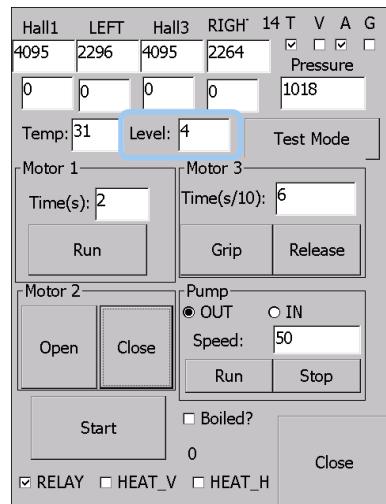
### 3.5.6 Float adjustment

The float wraps around the water level sensor. It includes a small magnet, the position of which can be sensed by reed switches on the water level sensor.



#### To check operation of the float

- 1 Ensure the FN 1000 is NOT in test mode (see 2.3, page 20). Switch off the instrument and disconnect it from the mains power supply.
- 2 Remove the front casing and water bath (see 3.1.1, page 30).
- 3 Fill the water bath with water at room temperature and install the bath and cooling lid.
- 4 Raise the visor and leave it raised.
- 5 Switch on the instrument and access the Diagnostics window (see 2.2, page 18).
- 6 Note the displayed water level. It should read **4**.
- 7 Check the **RELAY** box and uncheck the **HEAT\_V** and **HEAT\_H** boxes.
- 8 Slowly push the float in the water bath downwards. As you do so, check that the displayed water level decreases from **4** to **1**. Near the bottom of the float's travel, you should hear an audible click, indicating that the heating element relay has opened.
- 9 The lower end of the float's travel is marked by a pair of circlips (shown). Check that the float touches these circlips 1–2 mm below the level where the audible click is heard.



#### To adjust the float level

- 1 If required, push the lower pair of circlips up the shaft of the water level sensor until they are no more than 1 cm below the top of the vertical heating element.
- 2 Slowly push the float and circlips downwards until you hear an audible click, indicating that the heating element relay has opened.
- 3 Push the float and circlips a further 1–2 mm below the level where the audible click is heard.
- 4 Check operation of the float using the above procedure.

## 3.6 Stirrer arm system

The stirrer arm system grips the stirrers and moves them up and down to mix the sample during a test. The stirrers are then released in their top position and the time required for them to reach their bottom position is recorded as the falling number test result.

The stirrer arm system includes:

- a stirrer motor (see 3.6.2, page 51), which drives the stirrer rail and arm
- a vertical stirrer rail (see 3.6.3, page 52), which is held in position by four guide wheels
- a crank arm and connecting rod between the stirrer rail and stirrer motor
- a claw system (see 3.7, page 53), which is used to grip and release the stirrers, and
- the stirrer arm itself, which is a horizontal beam connecting the stirrer rail and claw system.



The top sensor board (see 3.3.3, page 38) is used to detect the top position of the stirrer arm.



### WARNINGS



**KEEP ALL BODY PARTS, HAIR, CLOTHING AND PERSONAL EFFECTS CLEAR OF THE INSTRUMENT DURING OPERATION, ESPECIALLY WHEN THE REAR CASING AND/OR VISOR HAVE BEEN REMOVED.**

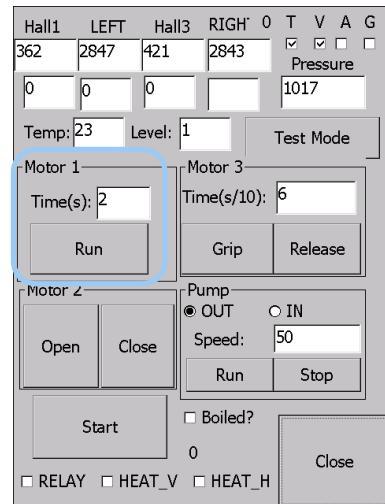


**STIRRING STARTS FIVE SECONDS AFTER LOWERING THE VISOR. TO AVOID INJURY, KEEP CLEAR OF THE INSTRUMENT AFTER LOWERING THE VISOR OR ACTIVATING THE VISOR SENSOR.**

### 3.6.1 Checking operation of the stirrer arm system

#### ► To check the operation of the stirrer arm system

- 1 Switch off the FN 1000 and remove the rear casing (see 3.1.2, page 31).
- 2 Switch on the FN 1000 and access the Diagnostic window (see 2.2, page 18).
- 3 In the **Motor 1** field, set the time to **2** seconds and tap **Run**. Ensure the system runs smoothly and the motor does not skip any steps or make excessive noise.<sup>1</sup>
- 4 With the visor up, place a weight of about 2 kg (e.g. the GM calibration weight) on top of the PCB box on the stirrer arm.
- 5 Set the time to **10** seconds and tap **Run**. Ensure the system runs smoothly and the motor does not skip any steps.



#### Notes

- 1 It is possible for the crank arm to hit a fully retracted start arm support rod. Move the start arm forward in this case.

### 3.6.2 Stirrer motor

The stirrer motor (PN 30076) is the stepper motor that drives the stirrer arm. It is the largest of the three motors in the FN 1000.

#### ► To replace the stirrer motor

- 1 Switch off the instrument and remove the rear casing (see 3.1.2, page 31).
- 2 Disconnect the stirrer motor from the control board.
- 3 Loosen the T30 grub screw securing the crank shaft to the stirrer motor shaft.
- 4 Remove the four T20 screws securing the stirrer motor to the chassis and remove the old stirrer motor.
- 5 Position the new stirrer motor and install it by reversing the above procedure.

### 3.6.3 Stirrer rail and guide wheels

The two guide wheel holders on the right side of the instrument (as viewed from the front) are eccentric, allowing adjustment of the play between the stirrer rail and the four guide wheels.

#### ► To adjust the guide wheel holders

- 1 Switch off the FN 1000 and remove the rear casing (see 3.1.2, page 31).
- 2 Slightly loosen the two M4 (7 mm) nuts for the two adjustable guide wheel holders (shown).
- 3 Turn the holders until the play between the wheel and the rail is eliminated, no more.
- 4 Tighten the nuts.
- 5 Move the stirrer rail up and down to check that the adjustment is correct.

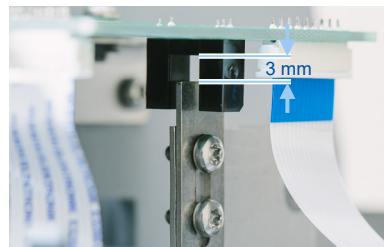


### 3.6.4 Stirrer motor TDC flag

At the top of the stirrer arm system is a flag used to sense when the stirrer arm and motor are in their top dead center (TDC) position.

#### ► To check the position of the stirrer motor TDC flag

- 1 Switch off the FN 1000 and remove the rear casing (3.1.2, page 31).
- 2 Rotate the stirrer motor to the TDC position.
- 3 Check that the flag is aligned with the upper optical sensor. The distance between the tip of the flag and the sensor base should be 3 mm, as shown, so that the tip of the flag is half way into the sensor.



#### ► To adjust the position of the stirrer motor TDC flag

- 1 Loosen the two screws securing the TDC flag to the stirrer arm.
- 2 Adjust the position of the TDC flag and tighten the screws.
- 3 Check the position of the TDC flag using the above procedure and repeat the above steps as required.
- 4 Secure the screws on the TDC flag with Loctite 222 [check].

## 3.7 Claw system

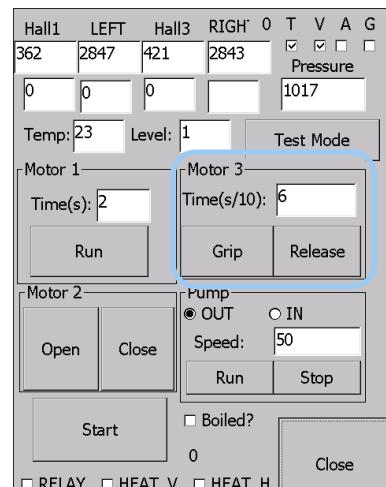
The claw system sits at the end of the stirrer arm and is used to grip the cassette and stirrers. The claw system includes:

- the claws
- the claw motor, which moves the claws from their forward (grip) position to their back (release) position (see 3.7.2, page 54)
- the stirrer arm board (see 3.7.3, page 55), and
- a spring (see 3.7.4, page 55), for returning the claws to their forward (grip) position.



### To check the operation of the claw system

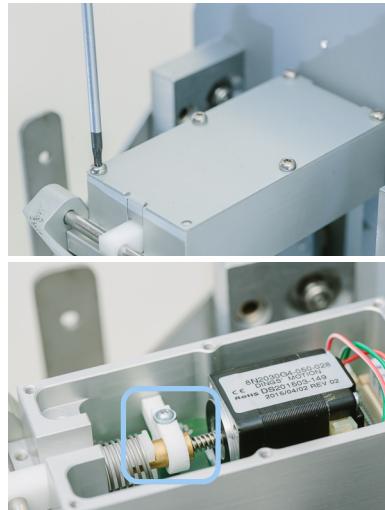
- 1 Lift the visor (see 3.1.3, page 32).
- 2 Switch on the FN 1000 and access the Diagnostics window (see 2.2, page 18).
- 3 In the **Motor 3** panel, set the **Time** parameter to 6.
- 4 Tap **Grip**. The claw motor should move the claws forward into their vertical grip position.
- 5 Tap **Release**. The claw motor should retract the claws into their release position.
- 6 With the claws in their release position, check if it is possible to push the claws any further back, as shown.
- 7 If the grip or stop position of the claw motor is incorrect or the claw motor skips steps during operation, adjust the claw stop position using the following procedure.



### 3.7.1 Claw stop position

► **To adjust the claw stop position**

- 1 Switch off the FN 1000 and remove the visor (see 3.1.3, page 32).
- 2 Remove the six T8 Torx screws from the top of the claw motor PCB enclosure, as shown.
- 3 Loosen the T6 Torx screw on the motor shaft (shown) and adjust the position of the magnet.
- 4 Tighten the screw and check the operation of the claw motor using the above procedure. Repeat as required.
- 5 When you have finished, secure the screw on the claw motor shaft using Loctite 222.
- 6 Replace the PCB cover and replace the visor.



### 3.7.2 Claw motor

The claw motor (PN 31510) moves the claws from their forward (grip) position to their back (release) position.

► **To replace the claw motor**

- 1 Switch off the FN 1000 and remove the visor (see 3.1.3, page 32).
- 2 Remove the six T8 Torx screws from the top of the stirrer arm enclosure, as shown.
- 3 Remove the four T8 Torx screws securing the claw motor frame to the stirrer arm.
- 4 Remove the claw motor and frame.
- 5 Position the new claw motor and install by reversing the above procedure.
- 6 Adjust the claw stop position (see 3.7.1, above).

### 3.7.3 Stirrer arm board

The stirrer arm board (PN 30218) is located inside the box on the stirrer arm, underneath the claw motor (shown). It provides an interface between the control board and claw motor.



#### To replace the stirrer arm board

- 1 Remove the claw motor (see 3.7.2, above).
- 2 Remove the T8 Torx screw securing the stirrer arm board to the stirrer arm and remove the old board.
- 3 Position and install the new stirrer arm board.
- 4 Reinstall the claw motor.
- 5 Adjust the claw stop position (see 3.7.1, above).

### 3.7.4 Claw spring

The claw spring (PN 30800) returns the claws to their forward (grip) position when the claw motor retracts from the release position.



#### To replace the claw spring

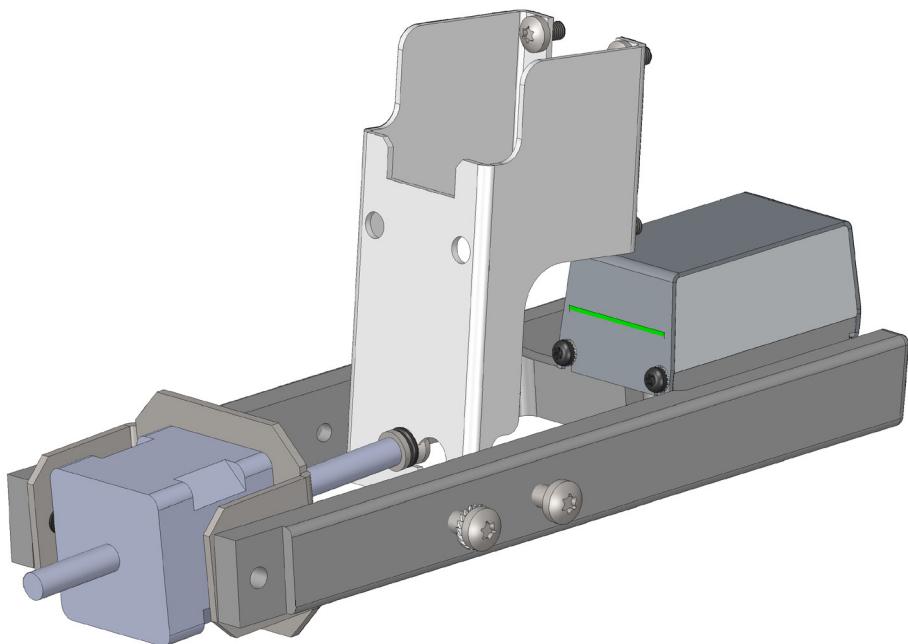
- 1 Remove the claw motor (see 3.7.2, above).
- 2 Remove the old claw spring and replace it with the new spring.
- 3 Reinstall the claw motor.
- 4 Adjust the claw stop position (see 3.7.1, above).



## 3.8 Start arm system

The start arm system includes:

- the start arm itself (see 3.9, page 62), which is connected to the chassis by two struts
- a start arm motor (see 3.8.5, page 61) for controlling back and forth movement
- a start arm sensor (3.8.2, page 58) for detecting the cassette and stirrers<sup>1</sup>, and
- a red/green indication LED.



### WARNINGS



**KEEP ALL BODY PARTS, HAIR, CLOTHING AND PERSONAL EFFECTS CLEAR OF THE INSTRUMENT DURING OPERATION, ESPECIALLY WHEN THE REAR CASING AND/OR VISOR HAVE BEEN REMOVED.**



**STIRRING STARTS FIVE SECONDS AFTER LOWERING THE VISOR. TO AVOID INJURY, KEEP CLEAR OF THE INSTRUMENT AFTER LOWERING THE VISOR OR ACTIVATING THE VISOR SENSOR.**



### Notes

- 1 The start arm sensor detects both when the cassette is present at the beginning of a test and when the stirrers have reached the stop position at the end of a test.

### 3.8.1 Start arm operation

The start arm should move smoothly between its forward and back positions, without hindrance.

The position of the start arm is determined by two hall effect sensors located on the control board (see 3.2, page 33), which align with two magnets attached to the rear of the start arm via a small bracket.



#### To check operation of the start arm

- 1 Access the Diagnostics window (see 2.2, page 18).
- 2 If required, remove the cassette and stirrers from the water bath.
- 3 In the Motor 2 field, tap **Close** to move the start arm to the forward (closed) position and then **Open** to move it to the back (open) position.
- 4 Check that the motor runs smoothly and stops in the correct position<sup>1</sup>, and that the start arm moves freely and in the middle of the two rectangular hold in the fascia.
- 5 Check that the LED on the start arm is green, as shown, and the displayed **Hall1** and **Hall3** values are less than 1500, as shown.
- 6 Insert the cassette and stirrers. Check that the LED on the start arm is red, as shown.
- 7 In the Motor 2 field, tap **Close**.
- 8 Check that the motor runs smoothly and stops in the correct position<sup>2</sup>, and that the start arm moves freely and in the middle of the two rectangular hold in the fascia.
- 9 Check that the displayed **Hall1** and **Hall3** values are greater than 3000, as shown.
- 10 If there is a problem with the start arm position, adjust the vertical (see 3.8.3, page 58) or horizontal (see 3.8.4, page 60) position of the start arm.



#### Notes

- 1 When in the open position, the start arm should be well clear of the stirrer heads and [better define position?].
- 2 When in the closed position, the start arm should fully enclose the stirrer heads and stop approximately 1 mm before the start arm rods hit the rear of the fascia.



Hall1	LEFT	Hall3	RIGH'	14 T	V	A	G
1171	2829	1200	2826	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0	0	0	0	1018			Pressure



Hall1	LEFT	Hall3	RIGH'	14 T	V	A	G
4095	2296	4095	2264	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
0	0	0	0	1018			Pressure

### 3.8.2 Start arm sensor

The start arm sensor (PN 30219) is located in a small black box on the end of the start arm. It is used to detect the presence of the cassette, automatically starting the test cycle when a cassette with one or both stirrers is placed in the water bath. It is also used to detect when the stirrers are in their stop position to signal the end of a test.



#### To replace the start arm sensor board

- 1 Pull out the start arm to the forward position.
- 2 Remove the two M3 (5.5 mm) screws on the back of the box containing the start arm sensor and remove the box cover, as shown [replace photos].
- 3 Disconnect the LED from the sensor board.
- 4 **Disconnect other cables?**
- 5 Remove the four screws securing the PC board and remove the old board.
- 6 Position the new board and install it by reversing the above procedure.



### 3.8.3 Start arm vertical position adjustment

The start arm needs to be vertically positioned to ensure detection of the stirrers and cassette.



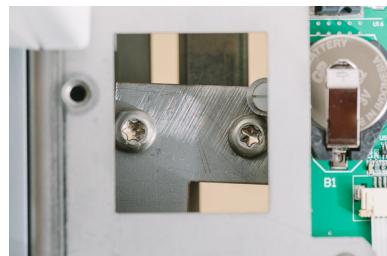
#### To check the start arm vertical position

- 1 Switch off the FN 1000.
- 2 Install the water bath and cooling lid.
- 3 Insert a cassette loaded with tubes and stirrers.
- 4 Pull the start arm all the way forward.
- 5 Check that there is approximately 1 mm vertical clearance [check] between the stirrer collar and start arm. If not, adjust the start arm position using the following procedure.



### To adjust the start arm vertical position

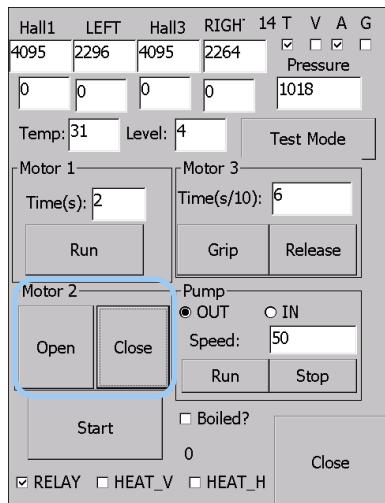
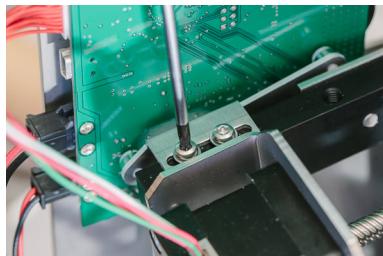
- 1 Switch off the FN 1000.
- 2 Install the water bath and cooling lid.
- 3 Insert a cassette loaded with tubes and stirrers.
- 4 Loosen the four T15 screws securing the start arm to the start arm struts (shown).
- 5 Pull the start arm all the way forward and push it downwards onto the cassette, as shown.
- 6 While holding the start arm in place, tighten the four screws.
- 7 Check the start arm position using the above procedure.
- 8 Secure the four screws on the start arm with Loctite 222 [check].



### 3.8.4 Start arm horizontal position adjustment

► To adjust the horizontal position of the start arm

- 1 Switch off the FN 1000.
- 2 Install the water bath and cooling lid.
- 3 Insert a cassette loaded with tubes and stirrers.
- 4 Loosen the two T8 screws securing the magnet bracket to the rear of the start arm, as shown.
- 5 Switch on the instrument and access the Diagnostic window (see 2.2, page 18).
- 6 In the **Motor 2** field, tap **Close** to move the start arm to the forward (closed) position.
- 7 If the motor skips steps, slide the bracket to align the Hall effect sensor on the control board with the magnet so that the motor stops. Ensure that the front position is approximately 1 mm behind the full mechanical stop, defined by the start arm rods hitting the rear of the fascia.
- 8 Click **Open** to move the start arm to the back (open) position.
- 9 If the motor skips steps, slide the bracket to align the second Hall effect sensor on the control board with the magnet so that the motor stops.
- 10 Repeat steps 6–9 until the open and closed positions are correctly sensed and the motor operates without skipping steps. Check that the start arm holds the cassette and stirrers in place somewhat firmly when in the closed position.
- 11 Tighten the two T8 screws to secure the magnet bracket to the start arm and secure with Loctite 222 [check].



### 3.8.5 Start arm motor

The start arm uses a stepper motor (PN 30077) for its back and forth movement.

To check the operation of the start arm motor, use the procedure for checking operation of the start arm (see 3.8.2, page 58).



#### To replace the start arm motor

- 1 Remove the rear casing (see 3.1.2, page 31).
- 2 Disconnect the start arm motor from the control board.
- 3 Remove the two M6 (10 mm) nuts on the rear end of the start arm, as shown.
- 4 Using a hex key, remove the two blind screws on the rear end of the start arm, as shown.
- 5 Slide the shaft of the start arm motor out of the keyhole in the motor yoke and remove the start arm motor and bracket.
- 6 Undo the four T8 screws securing the old start arm motor to the motor bracket and separate the motor and bracket.
- 7 Install the new motor by reversing the above procedure.
- 8 Check the operation of the start arm (see 3.8.2, page 58).



### 3.8.6 Replacing the start arm



#### To replace the start arm

- 1 Switch off the FN 1000 and remove the front casing and water bath (see 3.1.1, page 30).
- 2 Remove the rear casing (see 3.1.2, page 31).
- 3 Remove the start arm motor and bracket (see 3.8.5, above).
- 4 Remove the start arm sensor (see 3.8.2, page 58).
- 5 Remove the magnet bracket (see 3.8.4, page 60).
- 6 Remove the four T15 screws securing the start arm to the start arm struts, as shown.
- 7 Disconnect the start arm cable[s?] from the control board.
- 8 Remove the start arm by pulling it forwards.
- 9 Position the new start arm and insert the four T15 screws without tightening them.
- 10 Connect the start arm cable[s?] to the control board.
- 11 Reinstall the magnet bracket (see 3.8.4, page 60).
- 12 Reinstall the start arm sensor (see 3.8.2, page 58).
- 13 Reinstall the start arm motor and bracket (see 3.8.5, above).<sup>1,2</sup>
- 14 Adjust the start arm vertical position (see 3.8.3, page 58) and tighten the four T15 screws.
- 15 Adjust the start arm horizontal position (see 3.8.4, page 60).

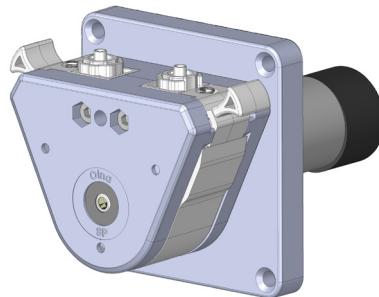


#### Notes

- 1 When mounting the motor, the key end of the screws holding the motor should be aligned with the outer surface of the locking nuts for the screws.
- 2 The stopper screws need to act as an axle for the motor. If these are screwed in too far, the arms will become splayed and may jam in the slots on the front panel when the arm moves forward.

## 3.9 Pump system

The pump system includes the peristaltic pump and its associated tubing. The pump system is used to circulate water between the water bath and the water bath refill bottle, via the cooling lid.



### 3.9.1 Checking operation of the pump system

#### ► To check operation of the pump system

- 1 Check the tubing to the pump. Ensure the tubes are not cracked and they are firmly connected at either end by cable ties.
- 2 Access the Diagnostics window (2.2, page 18).
- 3 In the **Pump** field, select **OUT** and set the pump speed to **50**.
- 4 Ensure the water bath is full and tap **Run**. Check that water is pumped from the water bath to the external reservoir with no leaks.
- 5 In the **Pump** field, select **IN** and tap **Run**. Check that water is pumped from the external reservoir to the water bath with no leaks. The system will pump water into the bath faster than it will pump it out.

### 3.9.2 Peristaltic pump

#### ► To replace the pump (PN 30544)

- 1 Switch off the instrument and remove the rear casing (see 3.1.2, page 31).
- 2 Disconnect the pump from the control board.
- 3 Twist and disconnect the two tubes to the pump, as shown.
- 4 Remove the four T20 screws securing the pump to the chassis, as shown.
- 5 Carefully remove the old pump, as shown.
- 6 Position the new pump and secure it to the chassis using the four T20 screws.
- 7 Connect the tubes to the new pump.
- 8 Connect the new pump to the control board.
- 9 Check the operation of the pump system (see 3.10.1, above).



### **3.9.3 Tubing**

The pump system includes five lengths of tubing and their associated connectors (PN 31508). These lengths of tubing connect the following components:

- 1 Water reservoir filter ⇔ Pump
- 2 Pump ⇔ Connector on chassis
- 3 Connector on chassis ⇔ Free connector
- 4 Free connector ⇔ Cooling lid
- 5 Cooling lid ⇔ Free (inside water reservoir).

After replacing any tubing, check the operation of the pump system using the above procedure.

## Part 4—Troubleshooting

## 4.1 Introduction

Please use the following guide to help diagnose and remedy any problems with an FN 1000. If you encounter a problem not covered in this guide, please contact Perten Instruments so we can add it to future versions of this service manual. If you encounter a problem that you cannot fix, please contact Perten Instruments for assistance.

## 4.2 Functionality check

A functionality check can be used to confirm correct operation of most major systems in an FN 1000 instrument. You should carry out a functionality check at the end of each major service.



### To conduct a functionality check

- 1 Check the operation of all the position sensors (see 3.3.4, page 38).
- 2 Check the calibration of the temperature sensor (see 2.4.1, page 21).
- 3 Check the operation of the relay and heating elements (see 3.5.3, page 45).
- 4 Check the operation of the water level sensor (see 3.5.6, page 49).
- 5 Check the operation of the stirrer arm system (see 3.6.1, page 51).
- 6 Check the operation of the claw motor (see 3.7.1, page 54).
- 7 Check the operation of the start arm (see 3.8.1, page 57) and start arm sensor (see 3.8.2, page 58).
- 8 Conduct a reference test (see 5.1, page 74).

## 4.3 Error messages

The following error messages may be displayed by an FN 1000. These error messages may indicate a problem with either the instrument or its operation.

Error message	Possible cause	Remedy
Visor not closed within 4 seconds	<ul style="list-style-type: none"> <li>• Visor not lowered within four seconds.</li> <li>• Start arm sensor triggered by external magnetic field.</li> <li>• Start arm sensor is too sensitive.</li> <li>• Faulty visor sensor.</li> </ul>	<ul style="list-style-type: none"> <li>• Instruct user to lower visor as soon as the sample is loaded.</li> <li>• Remove external source of magnetic field.</li> <li>• Access the Diagnostic window (2.2, page 18) and test the start arm sensor. Replace if required (3.8.2, page 58).</li> <li>• Access the Diagnostic window (2.2, page 18) and test the visor sensor. Replace the top sensor board if required (3.3.3, page 38).</li> </ul>
Please close visor	<ul style="list-style-type: none"> <li>• The visor is in the up position.</li> <li>• Faulty visor sensor.</li> </ul>	<ul style="list-style-type: none"> <li>• Pull down the visor, wait for a short while and then pull it up again.</li> <li>• Access the Diagnostic window (2.2, page 18) and test the visor sensor. Replace the top sensor board if required (3.3.3, page 38).</li> </ul>
Low level alarm	<ul style="list-style-type: none"> <li>• Low water level.</li> <li>• Tubing blocked.</li> <li>• Faulty pump.</li> <li>• Faulty water level sensor.</li> <li>• Faulty connection between water bath and main unit.</li> <li>• Water bath guide plate requires adjustment.</li> <li>• Faulty control board.</li> </ul>	<ul style="list-style-type: none"> <li>• Fill the water bath and refill water bottle. Switch off instrument and switch it on again.</li> <li>• Check the tubing for blockages. Test the pump system (3.9, page 63).</li> <li>• Test the pump system (3.9, page 63). If required, replace the pump (3.9.2, page 63).</li> <li>• Check and, if required, replace the water level sensor or sensor board (3.5.5, page 48).</li> <li>• Check connection between water bath and main unit.</li> <li>• Adjust position of water bath guide plate (3.5.1, page 43).</li> <li>• Test and, if required, replace the control board (3.2, page 33).</li> </ul>
Wait, bath cold	<ul style="list-style-type: none"> <li>• Water bath not at operating temperature.</li> </ul>	<ul style="list-style-type: none"> <li>• Wait for water bath to attain correct temperature.</li> </ul>
Wait, high temp	<ul style="list-style-type: none"> <li>• Water bath is cooling.</li> <li>• Incorrect temperature calibration.</li> <li>• Faulty temperature sensor.</li> <li>• Faulty control board.</li> </ul>	<ul style="list-style-type: none"> <li>• Wait for water bath to attain correct temperature.</li> <li>• Check the temperature calibration. Recalibrate if required (2.4.1, page 21).</li> <li>• Check and, if required, replace the water level sensor or sensor board (3.5.5, page 48).</li> <li>• Test and, if required, replace the control board (3.2, page 33).</li> </ul>

Error message	Possible cause	Remedy
Water bath not in place	<ul style="list-style-type: none"> <li>• Water bath not installed.</li> <li>• Faulty connection between water bath and main body.</li> <li>• Water bath guide plate requires adjustment.</li> <li>• Faulty control board.</li> </ul>	<ul style="list-style-type: none"> <li>• Install water bath.</li> <li>• Check connection between water bath and main body.</li> <li>• Adjust position of water bath guide plate (3.5.1, page 43).</li> <li>• Test and, if required, replace the control board (3.2, page 33).</li> </ul>
Wait, stabilizing	<ul style="list-style-type: none"> <li>• Normal operation. Temperature is within 5°C of set temperature.</li> </ul>	<ul style="list-style-type: none"> <li>• Wait for the 300 second countdown to complete.</li> </ul>
Sample moisture out of range	<ul style="list-style-type: none"> <li>• The entered moisture level is too high or low for moisture correction.</li> </ul>	<ul style="list-style-type: none"> <li>• Enter a different moisture level.</li> </ul>
Required FN is not within the range	<ul style="list-style-type: none"> <li>• Associated with calculation of blends (MIX) and malt addition.</li> </ul>	<ul style="list-style-type: none"> <li>• Change test settings or test different samples.</li> </ul>
Minimum possible FN value is 62	<ul style="list-style-type: none"> <li>• Associated with calculation of blends (MIX) and malt addition with moisture correction.</li> </ul>	<ul style="list-style-type: none"> <li>• Change test settings or test different samples.</li> </ul>
Difference between FN values should be greater than 2	<ul style="list-style-type: none"> <li>• Associated with calculation of mix proportions or malt addition.</li> </ul>	<ul style="list-style-type: none"> <li>• Change test settings or test different samples.</li> </ul>
Measurement has been interrupted	<ul style="list-style-type: none"> <li>• Visor opened during analysis.</li> <li>• Faulty visor sensor.</li> </ul>	<ul style="list-style-type: none"> <li>• Close visor and wait until the claws have reach the top position and the start arm is in the back position. Open the visor and remove cassette and sample tubes. Restart test procedure.</li> <li>• Access the Diagnostic window (2.2, page 18) and test the visor sensor. Replace the top sensor board if required (3.3.3, page 38).</li> </ul>
Measurement stopped	<ul style="list-style-type: none"> <li>• STOP tapped on display while running an analysis.</li> </ul>	<ul style="list-style-type: none"> <li>• Open visor and remove cassette and sample tubes. Restart test procedure.</li> </ul>
Pump error	<ul style="list-style-type: none"> <li>• Water refill bottle too low.</li> <li>• Tubing blocked.</li> <li>• Faulty pump.</li> <li>• Faulty control board.</li> </ul>	<ul style="list-style-type: none"> <li>• Refill the water refill bottle.</li> <li>• Check the tubing for blockages. Test the pump system (3.9, page 63).</li> <li>• Test the pump system and replace if required (3.9, page 63).</li> <li>• Test the control board and replace if required (3.2, page 33).</li> </ul>
Low level alarm	<ul style="list-style-type: none"> <li>• Low level in water bath.</li> <li>• Tubing blocked.</li> <li>• Faulty pump.</li> <li>• Faulty control board.</li> </ul>	<ul style="list-style-type: none"> <li>• Switch off instrument, fill water bath and water refill bottle, and restart.</li> <li>• Check the tubing for blockages. Test the pump system (3.9, page 63).</li> <li>• Test the pump system and replace if required (3.9, page 63).</li> <li>• Test the control board and replace if required (3.2, page 33).</li> </ul>

Error message	Possible cause	Remedy
Altitude correction should be activated	<ul style="list-style-type: none"><li>Instrument installed at elevated altitude.</li><li>Faulty pressure sensor on control board.</li></ul>	<ul style="list-style-type: none"><li>Enable altitude correction (1.4.4, page 13).</li><li>Replace control board (3.2.2, page 35).</li></ul>
Please remove cassette	<ul style="list-style-type: none"><li>Start arm obstructed.</li><li>Fault in start arm system.</li></ul>	<ul style="list-style-type: none"><li>Remove obstruction. To reset the start arm, lift visor, push start arm back, remove cassette and close visor.</li><li>Check start arm system (3.8.1, page 57).</li></ul>

## 4.4 Troubleshooting guide

Symptom	Possible cause	Remedy
Stirrers not released	<ul style="list-style-type: none"><li>• Incorrect claw stop position.</li></ul>	<ul style="list-style-type: none"><li>• Check and adjust claw stop position (3.7.1, page 54).</li></ul>
[others?]	<ul style="list-style-type: none"><li>• [?]</li><li>• [?]</li><li>• [?]</li></ul>	<ul style="list-style-type: none"><li>• [?]</li><li>• [?]</li><li>• [?]</li></ul>



## Part 5—Additional information

## 5.1 Reference test

A reference test is a useful method for confirming that an FN 1000 instrument is generating accurate and repeatable results.



### To conduct a reference test

- 1 Prepare two samples using a current batch of Perten FN Reference Flour, one for each side of the FN 1000.<sup>1</sup>
- 2 Test the samples using the FN 1000.
- 3 Repeat the above steps twice to generate three sets of results in total.
- 4 Confirm that all results fall within the range of specified values for the reference flour.



### Notes

- 1 Follow ICC method 107/1 or AACCI method 56.81.03. See the FN 1000 Operator Manual for details.

## 5.2 Obtaining accurate test results

Problems in obtaining accurate and repeatable Falling Number results are often caused by problems with the test methodology rather than by any problem with the instrument.

To obtain accurate and repeatable test result, the following points should be observed.

Sample particle size	If testing flour, ensure that a representative sample is taken. Use a sample divider. If testing grain, grind at least 300 g and ensure that the laboratory mill used produces a sample with a correct particle size distribution. Suitable mills include the Perten Instruments LM 3100 and LM 120 laboratory mills. ICC 107/1 describes the correct particle size distribution to use for Falling Number analysis.
Sample weight	Check that the balance used for weighing samples is accurate and calibrated using known standard weights.
Moisture correction	When preparing a sample, correct for moisture content (see the FN 1000 Operator Manual for details). This ensures that the relative proportions of starch and water in each test sample are consistent. ICC 107/1 requires correction to a 14% moisture basis. AACC methodology uses either a weight adjustment or a recalculation to a fixed (14%) moisture content. Check that comparisons are being made using the same moisture correction methods.
Water volume	The volume of water in each sample should be $25.0 \pm 0.2$ mL. Check that the pipette used is accurate by weighing the volume of water. The weight of 25.0 mL of water is 24.96 g at 20°C or 24.93 g at 24°C.
Water quality	Use distilled water or water of equivalent purity. The pH of the water will affect the measurement. If water quality is suspect, compare by using water from other sources. (Pharmacies often supply distilled water, which could be used for comparison.)
Dispenser water temperature	The temperature of the dispensed water should be $22 \pm 2^\circ\text{C}$ . Large variations in water temperature can adversely affect accuracy. The viscometer tubes should not be hot (e.g. after being dried in an oven) as this will affect results.
Water bath	When installing the water bath, ensure it is pressed firmly towards the tower until it clicks into place.

## 5.3 Technical specifications

### Physical specifications

Dimensions	515 mm (H) × 290 mm (W) × 390 mm (D)
Net weight	19 kg

### Operating environment

Environment	Indoor use only
Ambient temperature*	5–40°C
Relative humidity	<80% (up to 31°C) <70% (34°C) <60% (37°C) <50% (40°C).

### Power

Power requirements	115 or 230 V <sub>ac</sub> , 50/60 Hz, 1050 VA (refer to nameplate)
Fuses	115 V <sub>ac</sub> : T6.3AH 250V (×2) 230 V <sub>ac</sub> : T10AH 250V (×2)

### Acoustic noise

Acoustic noise emission	<70 dB(A) (operator position, normal operation)
-------------------------	---

### Interfaces, data and connectivity

User interface	5.7" color touchscreen
Results presentation	Large digits on screen, print-out (optional)
Internal data storage	4 GB miniSD card
Communication	4 × USB 1 × LAN (10/100) WiFi, RS-232 and others available using USB adapters

## 5.4 Contact information

Perten Instruments has representatives in most regions of the world to provide you with local support. Support information is also available from our web site.

**Perten Instrument AB**

PO Box 9006  
SE-126 09 Hägersten  
SWEDEN

Tel +46 8 505 80 900  
Fax +46 8 505 80 990

E-mail [info@perten.com](mailto:info@perten.com)  
Web [www.perten.com](http://www.perten.com)