USER GUIDE
19-461’02 REV D

RFM300-T Series Refractometer

Bellingham + Stanley
a xylem brand

RFM300-T User Guide (EN)

Code	19-461
Issue	02
Revision	D
Date	September 2017

Bellingham + Stanley, a Xylem brand, has been manufacturing high quality optical instruments in the UK for over 100 years and is a leading manufacturer of refractometers and polarimeters.

Our current range of products includes optical and digital hand refractometers as well as a full range of laboratory refractometers and polarimeters available through a network of trained distributors throughout the world. Process refractometers are also available through specialist outlets.

Visit our website, www.bellinghamandstanley.com, for full details of Bellingham + Stanley, our products and foreign language brochures.

Contact our Sales team to discuss a particular application or to receive details of your local distributor.

Every effort has been made to ensure the accuracy of the contents of the manual. However, Bellingham + Stanley Ltd. and Xylem Inc. can assume no responsibility for errors contained in the manual or their consequences.

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Declaration of conformity

According to ISO/IEC 17050-1 & 2: 2004

Manufacturer's Name	Bellingham + Stanley
Manufacturer's Address	Longfield Road, Tunbridge Wells, Kent TN2 3EY United Kingdom

declares that the product

Product Name	RFM300-T Series Refractometer
Model Number	All

Is designed to conform to the following Product Specifications:

Safety:
BS EN 60950-1:2002

Applied and met EMC test standards:
Emissions
EN 61326-1:2013

- Radiated emissions — CISPR 11:2009 inc. A1:2010, Class A
- Conducted emissions, ac port — CISPR 11:2009 inc. A1:2010, Class A
- Conducted emissions, ethernet port — CISPR 11:2009 inc. A1:2010, Class A

EN 61000-3-2:2014

- Mains harmonics — Class A

EN 61000-3-3:2013

- Mains voltage flicker (dmax=4%)

Immunity:
EN 61326-1:2013 - Basic immunity requirement (Table 1)

- Electrostatic discharge — EN 61000-4-2:2009
- Radiated RF interference — EN 61000-4-3:2006 inc. A1:2008 & A2:2010
- Fast transient bursts — EN 61000-4-4:2012
- Surge — EN 61000-4-5:2014
- Conducted immunity — EN 61000-4-6:2014
- Voltage dips and interruptions — EN 61000-4-11:2004

Supplementary:
The product herewith is designed to comply with the requirements of the EMC Directive 2014/30/EU and the Low Voltage Directive 2014/35/EU.

CE RoHS Compliant

This symbol is an internationally agreed indicator that the product bearing it should not be disposed of as general waste or garbage which might end up in landfill sites, but should instead be sent for special processing and/or recycling in those countries where appropriate legislation and facilities are in place.

The symbols below are used throughout this user guide.

Caution or warning.

Electrical hazard.

Hint or tip.

Conformity

Section 1: Installation

Section 1

Instrument overview

The RFM300-T Series Refractometer is a self-contained easy to use instrument suitable for measuring the refractive index of samples in demanding factory environments as well as for use as a primary quality control tool.

The instrument is housed in a case which is light in weight whilst being extremely rugged. The ergonomic design ensures spills are dealt with by the sloping of the case and the PEEK spill barrier and stainless steel prism dish gasket ensure high resistance to chemical attack from the majority of commonly used samples. The large sampling area on the prism surface allows measurements of not only homogenous fluids like juices, sodas and edible oils but also difficult to read samples like fruit pulps and industrial resins.

Sample temperature is controlled by the Peltier Temperature control system and intelligent temperature management which enables rapid stabilisation and little noise. The low profile sample dish and non-contact presser makes sample application and cleaning easy.

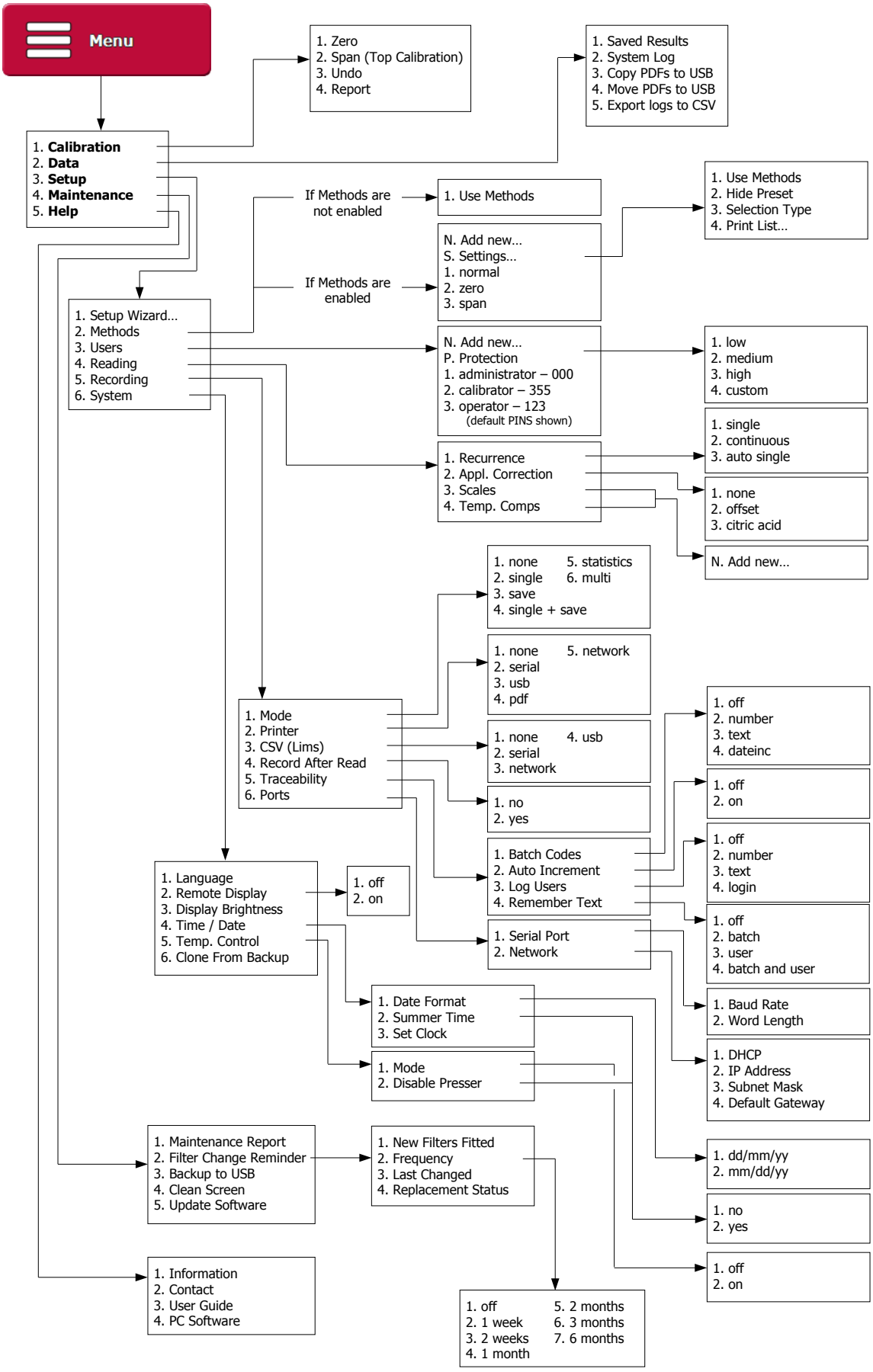
A high definition, capacitive touchscreen display facilitates operation in factory environments, even when operated whilst wearing gloves, and the GUI helps the operator quickly manoeuvre through the user and configuration menus. On-screen graphical prompts support simple operation such as method loading, calibration and routine maintenance.

The instruments conform to a number of industry measurement standards and offer operational features that allow use in an environment controlled by FDA regulation 21 CFR Part 11. Built in RFID technology helps provide clearance and a log of operator and configuration functions.

Readings can be printed via USB, serial or network ports. Alternatively they can be stored in a database or as secure PDFs to later download via either a USB removable storage device or across a local area network.

A wide range of accessories including printers, barcode readers and USB keyboards is available.

Menu flow chart



Unpacking

Carefully remove all of the packing material. It is recommended that the box and other packing materials are retained so that, should the need arise, the refractometer can be safely returned to the supplier for service. Check that all parts listed below are present and that no transit damage has occurred. If any are damaged or missing, contact the supplier immediately.

Contents list

Quantity	Item	Code
1	RFM300-T Series Refractometer	See below
1	Mains lead	See below
1	Power supply	55-105
1	Quick Start Guides	19-406
2	Card type ID tag	37-530
2	Spare air vent filter	22-482
2	Touchscreen stylus	19-203
1	Touchscreen protector	19-204

RFM300-T refractometer code numbers:

Model	Complete refractometer	Refractometer module only
RFM330-T	19-30	19-330
	19-31	19-331
RFM340-T	19-40	19-340
	19-41	19-341

Mains lead code numbers:

Moulded plug type for	Code
Switzerland	61-181
Denmark	61-182
India / South Africa	61-188
Australia	61-189
UK 13 Amp square pin to BS1363/A	61-191
United States (3 pin)	61-192
Europe (Schuko)	61-193

Positioning the system

Place the instrument on a flat and stable bench that is:

- Dry and indoors.
- Capable of holding the instrument's weight.
- Away from draughty or hot equipment like fans or heaters.
- Out of direct sunlight or strong ambient light.
- Away from potential sources of interference, such as RFI generating equipment.
- Within reach of a power point.
- Not using a power circuit that also has large motors or noise generating equipment connected to it.

Do not block the air vents.

Mains connection

The power supply adapter is supplied with a moulded mains cord and plug to suit one of several socket types. For UK leads, replace the fuse only with the type indicated on the plug.

Power requirements

Voltage	110 to 230 V ~ ±10%
Frequency	50 to 60 Hz
Maximum current	2 A

Warning

RISK OF ELECTRIC SHOCK:

- For indoor use only.
- Must be kept dry.
- Disconnect the equipment from the mains supply before unplugging the mains lead from the instrument.

WARNING:

- Do not cover, designed to operate with free air convection.
- No cleaning required

A waterproof power supply adaptor, code no. 55-250, which can be used in damp environments, is available as an optional extra.

Section 2: Instrument operation

Section 2

Section 2

Basic operation

Switching on and off

Plug in the power supply and switch on the mains supply, after startup the instrument will show a loading screen indicating the software version. Once loaded, the instrument will be in standby mode. To switch on, swipe a finger or stylus across the display. After a few moments the instrument will show the Measurement Display (or the Setup Wizard if switching on for the first time). An Auto Zero will be requested once the instrument temperature has stabilised, see Page 27.

To switch to standby mode press and hold the Menu Button for several seconds and select Yes on the confirmation screen. It is then safe to turn off the mains supply and disconnect the power lead.

Manoeuvring through menus

The RFM300-T Series Refractometer features a capacitive, high-resolution touchscreen display. On-screen buttons can be easily used by simply touching the display. A compatible stylus can also be used, as supplied with the instrument.

Use the supplied stylus and screen protector to keep the touchscreen clean and avoid damage from improper use. The touchscreen should only be used with a finger or stylus designed for use with a capacitive touchscreen.

Alternatively, a USB keyboard, available from Bellingham + Stanley, can be used to select items and navigate menus. The USB keyboard can perform the following actions from the Measurement Display.

USB keyboard key	Function
F1 / Space	Start a reading
F2 / Enter	Print / Save the current reading
F3 / z	Zero
F4 / m	Open Mode / Methods
F5 / Esc	Open Main Menu
F6 / d	Data
Left / Right	Logout

Whilst in a Menu, options that are currently unavailable will appear faded.

Many buttons feature a quick select option, indicated by the two arrows on the right of the button. Simply touch either arrow to cycle through the possible settings.

When in a menu, the Quit and Home buttons become available.

Press the Quit Button to return to the previous menu. Any changes made will be saved. The Home Button will exit to the Measurement Display, again any changes made will be saved.

The USB keyboard can be used for Menu navigation.

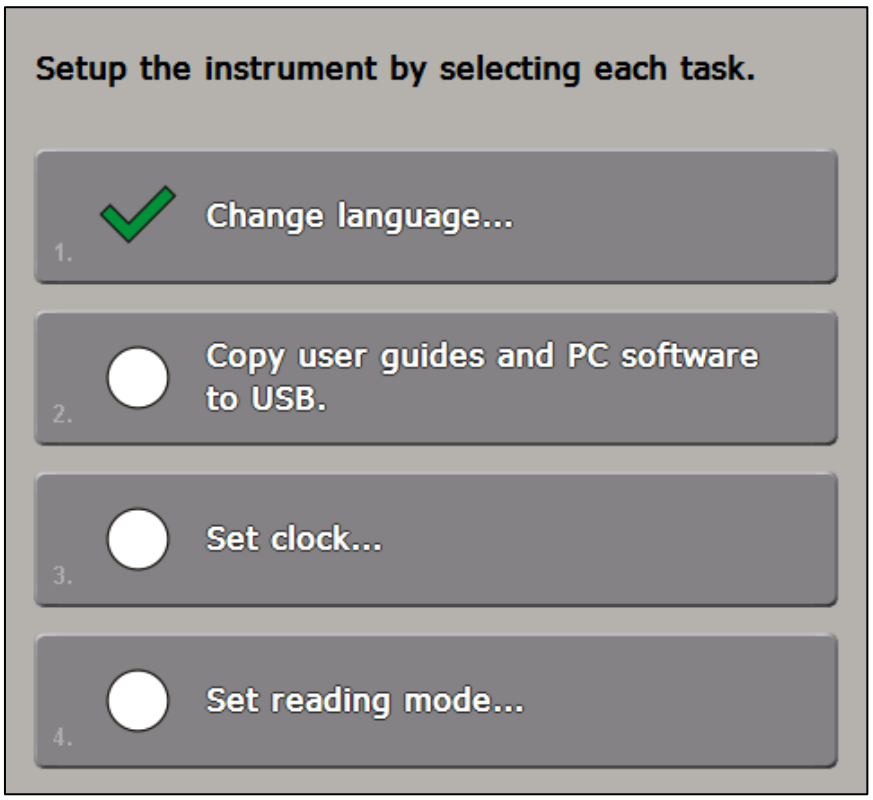
USB keyboard key	Function
Up / Down	Change highlighted button
Enter	Push highlighted button
Left / Right	Cycle quick select options
Esc	Quit
Shift + Esc	Home

The USB keyboard also allows menu items to be selected by pressing the related number or letter shown on the left of the on-screen buttons.

Text or number entry boxes can be completed with either the on-screen keypads or a USB keyboard.

Setup Wizard

When switching on for the first time, after the instrument has completed its startup procedures, the Setup Wizard will appear. First select the desired language. A list of different options will then appear.



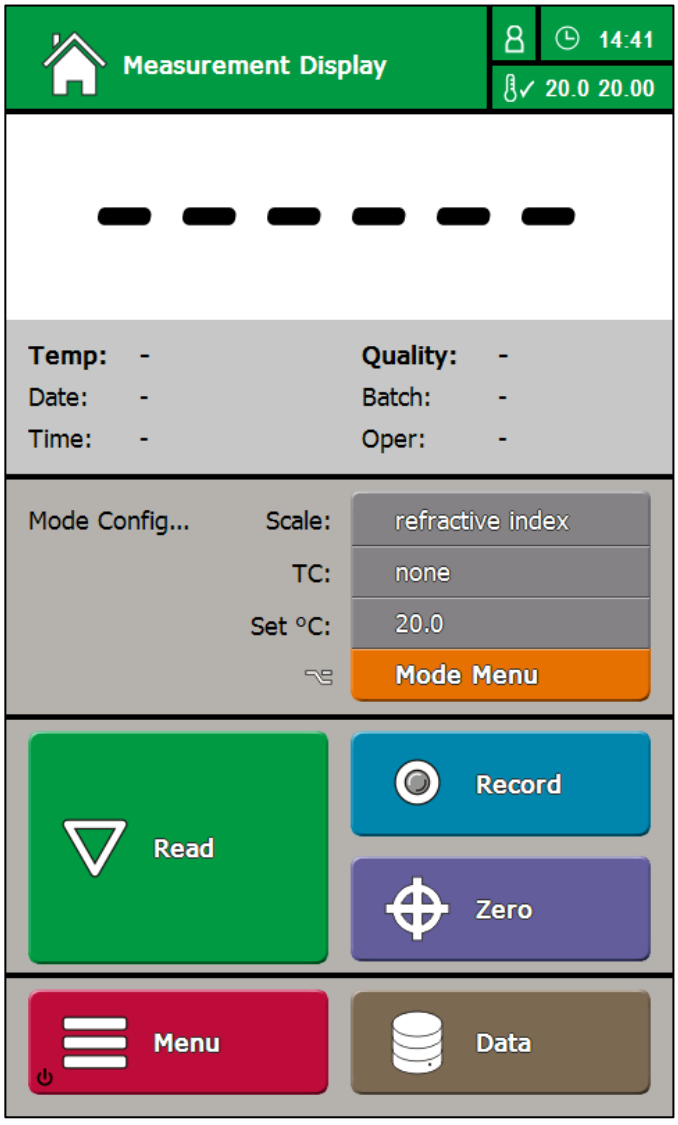
- **Copy user guides and PC software to USB:** Makes copies of all user guides and PC software compatible with the instrument to a removable USB storage device.
- **Set clock:** Set the instrument to local time and set the date format, see Page 60.
- **Set reading mode:** Make changes to the measurement settings, see Page 20.
- **Set record settings:** Specify how reading results will be printed or saved, see Page 30.
- **Set user settings:** Alter the security settings to a level suitable for the area of operation, see Page 42.

Select each in turn and alter the settings as desired, then press Quit to return to the Setup Wizard Menu. Each menu will be marked by a tick after the settings are altered.

Once all required settings are changed press Quit on the Setup Wizard Menu to show the Measurement Display.

Measurement Display

From the Measurement Display readings can be taken, viewed and saved. Quick access to all the frequently used features of the instrument is also available.



Title bar

Reading display and data

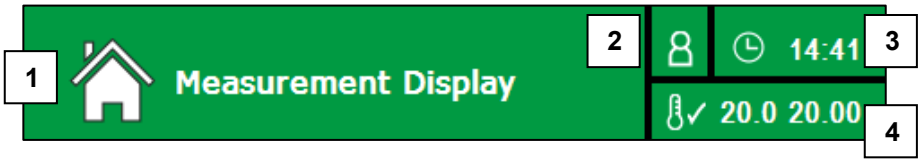
Reading configuration

Action buttons

Menu buttons

Title Bar

The title bar contains several elements that will be displayed on every screen.



1. Title: Current location within the instrument's menu structure.

The colour of the title bar will change depending on the current operation.

Red: In the Main Menu structure. This indicates that changes will be made to the instrument's settings.

Orange: In Modes/Methods. Changes made will affect the measurement settings.

Green: Associated with taking and initiating readings.

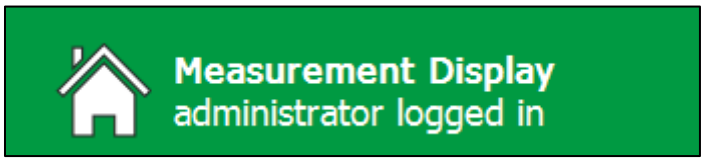
Blue: Within a process that affects how the current reading will be printed or saved.

Purple: For calibration requests.

Brown: Whilst exporting or viewing saved readings, logs or PDFs.

These colours are replicated on the associated Action and Menu buttons.

If security settings are in use, the username of a logged-in user will also appear here whilst in the Measurement Display and in the Main Menu.



Pressing the title bar will also log out the current user. User accessibility is discussed in detail from Page 42.

2. Security status: A further indicator for whether a User is logged in, displayed in all menus within the instrument.


Users logged out, symbol orange


User logged in, symbol green

3. System clock: Shows the current system time in a 24 hour format. To alter the time, see Page 60.

4. Temperature control status: Displays the stability status, prism set temperature and current prism temperature. The colour and status symbol will change depending on the set-point temperature and the measured temperature.

- Temperature stable

The tick indicates that the measured prism temperature (second value) is stable to within ±0.05°C of the set-point temperature (first value).

- Temperature stabilising

This will often occur when applying a fresh sample which has a significantly different temperature to the prism.

The stability symbol oscillates to show that the prism temperature is not yet stable.

- Temperature changing

This will occur when the temperature set-point is changed or after the instrument is switched on.

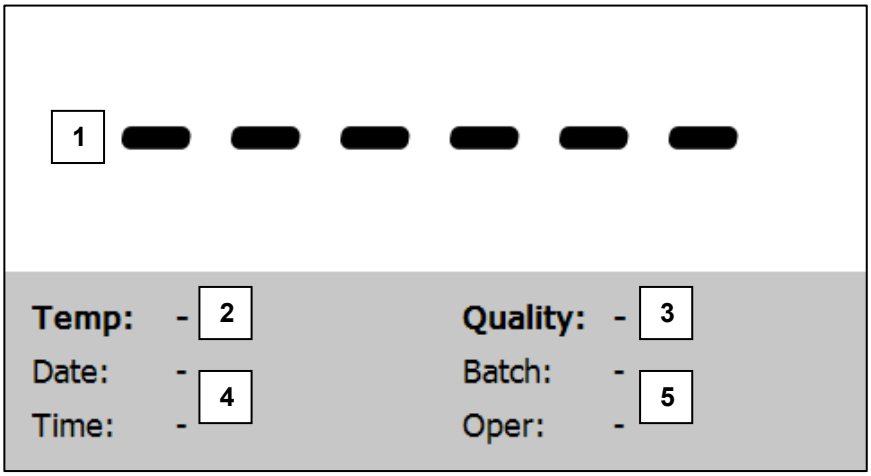
The stability symbol becomes a cross and there can be a significant difference between the measured temperature and the set-point temperature.

An Auto Zero will be required after changing the temperature set-point, see Page 28.

- Temperature control off

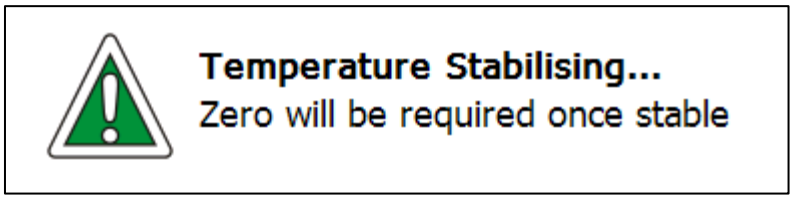
If the instrument temperature control is turned off (see Page 61) the control status will turn red.

Reading display and data



1. Reading result: After taking a reading, the final result will be displayed here. The result will be displayed in the units set in the Mode/Method, shown in the reading configuration section of the Measurement Display.

Warning and alert messages will also appear here. For example, after the temperature set-point is changed, a Zero calibration will be requested.



2. Temperature: The temperature that the prism was at when the reading was recorded will be displayed here.

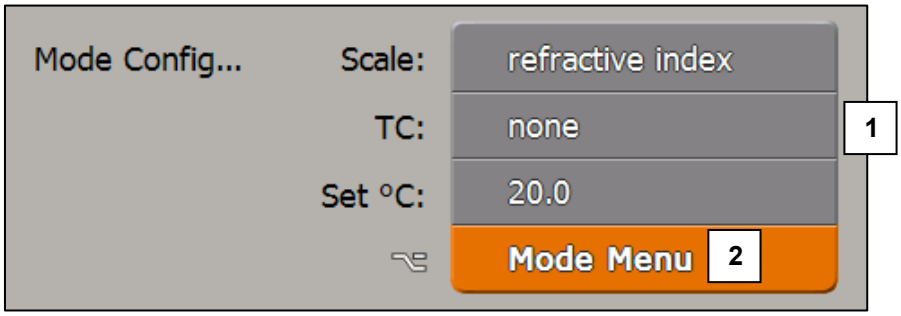
3. Quality: The Quality figure is derived from the optical pattern that falls upon the instrument detection system. A high Quality value indicates that the optical pattern is well-defined, making the reading signal easy to resolve. A low Quality value, caused for instance by an opaque sample or poor sample application, means a less well defined optical pattern so the reading will be less reliable.

The Quality value for the sample used to set Zero is automatically set to 100, which can then be used as a reference with which to compare other measured samples.

4. Date/Time: When the displayed result was obtained.

5. Traceability data: Displays batch and operator codes associated with each reading. See Page 31 for details on traceability settings.

Reading configuration

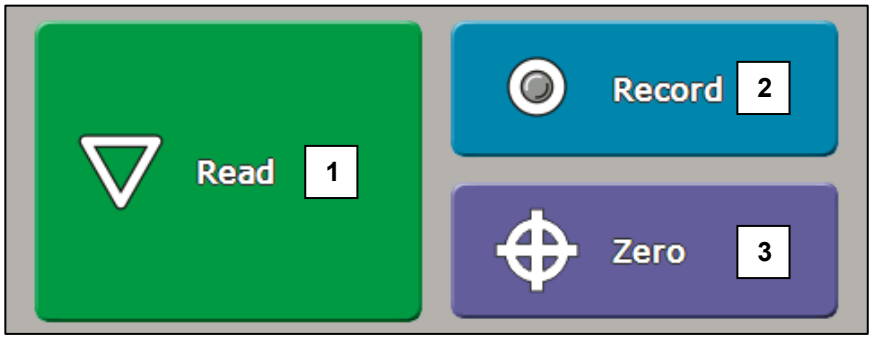


1. Reading Configuration Panel: Displays the measurement settings for the currently displayed reading or, if a result is not currently displayed, the settings to be used for the next reading. It also allows for quick changes to the Basic reading settings, see Using the Reading Configuration Panel, Page 21.

2. Mode button: Gives access to edit all Basic and Advanced reading settings (Page 20).

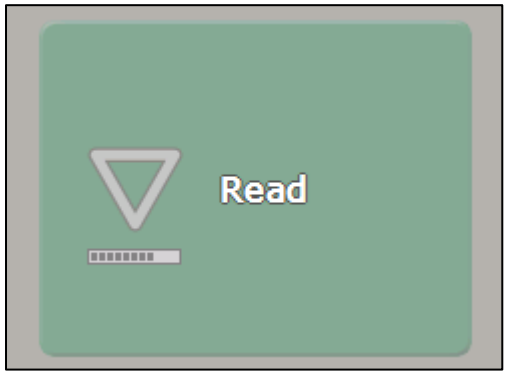
When working with Methods the Reading Configuration Panel is disabled, see Page 39.

Action Buttons



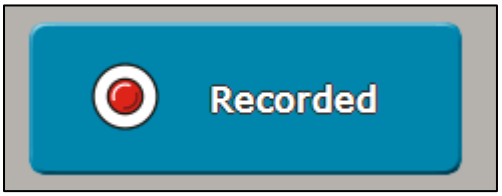
1. Read button: Initiates a reading. Readings will be taken in the manner described in Mode or the current Method, the Basic settings can be seen in the Reading Configuration screen section.

If using continuous read mode (Page 51) a progress bar will appear on the Read button.

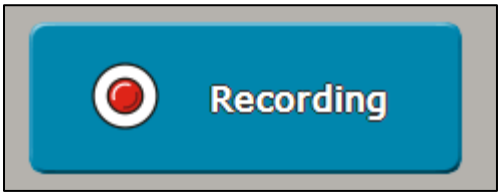


Holding down the Read button for several seconds will display the Reading setup menu.

2. Record button: If a result has yet to be printed or saved and a printer is set, the record icon will appear grey. Pushing the button will record the result to the Reading Log (Page 35) or printer depending on the print settings, see Page 30. The record icon will then turn red.



If the print mode is set to record after read (Page 30) the record icon will be red permanently.

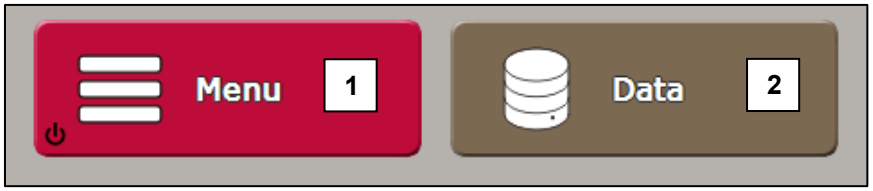


Holding down the Record button for several seconds will display the Recording Menu for quick change of printer settings.

3. Zero button: Initiates a Zero calibration routine. A Zero can be performed with any sample but distilled water is typically used. See Page 27 for Zero calibration procedure and recommendations.

Holding down the Zero button for several seconds will open the Calibration Menu.

Menu Buttons



1. Menu button: Opens the instrument's Main Menu from where all instrument settings can be changed. Hold for several seconds to switch the instrument to standby.

2. Data button: Opens the Data Menu, this includes viewers for saved results and the System Log (see Page 35) as well as the ability to download the results and any saved PDFs.

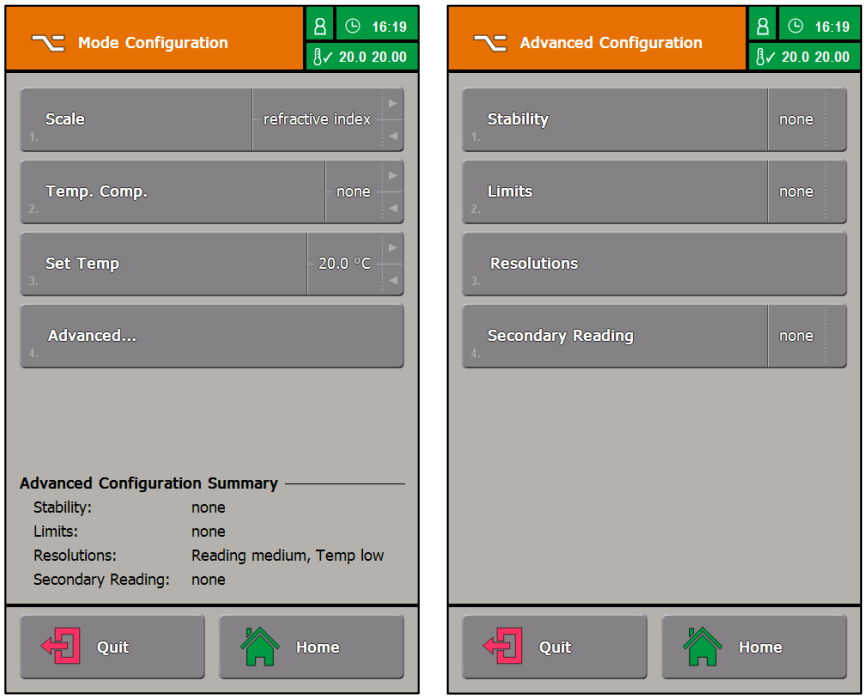
Holding down the Data button for several seconds will open the Saved Results viewer.

Measurement settings

The measurement settings affect how a reading is collected and presented. If different sets of measurement settings are required then Methods can be enabled. For simplicity, the instrument is supplied in Mode operation.

Changing settings

To change measurement settings press the orange Mode button. The Mode Configuration is divided into two screens with Basic and Advanced settings.



The Basic settings change the way a result is calculated, for example the scale units and temperature compensation applied, and also allows changes to temperature. The Basic settings are:

- Scale, Page 21
- Temp. Comp., Page 21
- Set Temp, Page 22

The Advanced settings allow the use of additional criteria to affect how a measurement is taken and displayed. The Advanced settings are:

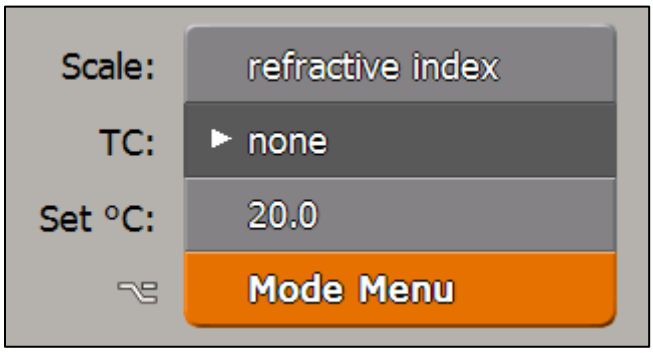
- Stability, Page 22
- Limits, Page 22
- Resolutions, Page 25
- Secondary Reading, Page 25

Once set, press the Quit button or Home button to return to the Measurement Display. Changes to the Basic settings will be displayed on the Reading Configuration section of the screen, ready for the next reading.

Using the Reading Configuration Panel

Basic settings can be changed with the Reading Configuration Panel.

To change a setting, touch and hold the panel and an arrow will appear next to the selected item. If the wrong item is selected, the user can slide their finger up or down until the required item is highlighted.



When the arrow is next to the desired item, release the screen. The options for the selected item will then be displayed.

Changing settings in this manner overwrites the settings in the Mode Menu, a login may therefore be required if PINs are active.

Basic settings

The following settings can be changed in the Mode Menu, in each Method or with the Reading Configuration Panel.

Scale

By default the available scales are:

Scale name	Scale ID
Refractive Index	ri
Brix	bx

Many other pre-installed scales, as well as custom scales, can be added, see Page 53.

Temp. Comp. (temperature compensation)

By default the available temperature compensation modes are:

TC name	TC ID
none	no
sugar	su
ag fluid	ag

Sugar compensation operates in accordance to ICUMSA in the range 10 to 40°C and has been extended to cover the range 5 to 70°C.

Ag fluid compensation can be used with Bellingham + Stanley's range of AG Fluid calibration materials, see the Accessories section.

Additional temperature compensations can be added, see Page 56.

Set Temp (temperature control set-point)

The temperature control system in the instrument can be set over a wide range of temperatures. In many situations, it is likely that all samples will be measured at the same temperature, e.g. 20°C for a bottling plant or 70°C for a preserves factory.

Some manufacturers, who produce a range of different products for different markets at one facility, may need to measure samples at more than one temperature. However, temperature changes must be used with care. Due to the time required for stabilisation it is not practical to continually adjust the temperature set-point for every sample.

After changing the Set Temp, the instrument will inhibit measurement until the system has stabilised and a Zero calibration has been carried out (see Page 28 for information on Auto Zero). Changing the set-point will be more practical if, say, all samples to be measured at 20°C were carried out in a morning session and then those at 70°C in the afternoon.

⚠ **The temperature of the stainless steel prism plate will be similar to the temperature control set-point and so could become extremely hot. Direct contact with skin should be avoided when applying sample or cleaning the prism plate at temperatures above 50°C.**

Advanced settings

Advanced settings can be changed in the Mode Menu or in the individual Methods. They cannot be changed via the Reading Configuration Panel.

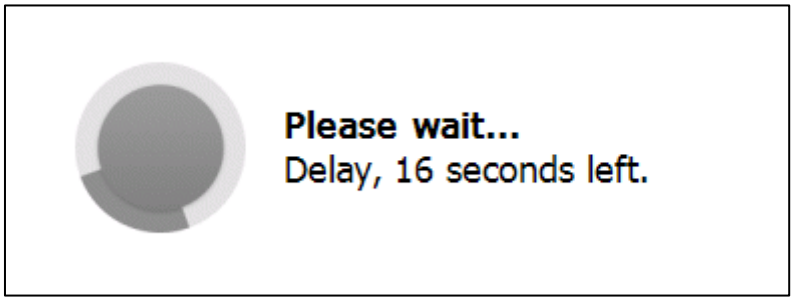
Stability

Stability sets conditions that must be met before a reading will be taken.

Stability can be set to:

- none
- delay
- repeatability
- SMART

Delay causes a wait period before measurements are initiated after pressing the Read button. This delay provides a fixed time for the sample to stabilise on the prism and to achieve thermal equilibrium throughout the sample mass.



Repeatability will take readings continuously until a number of readings are below a specified range. The range can be set on the reading value, temperature or Quality.

Example: A set of consecutive readings is shown below. The displayed result will vary depending on the set repeatability condition.

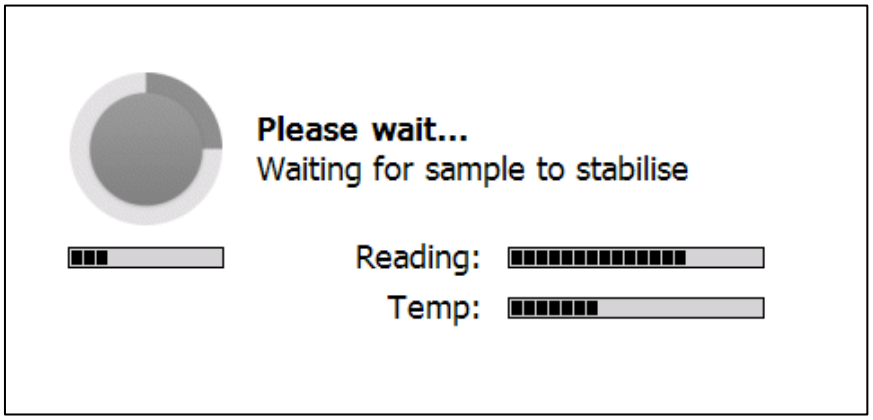
Reading no.	Reading	Temp.	Quality
1	14.66	24.84	96
2	14.72	24.94	99
3	14.81	24.98	99
4	14.83	25.02	99
5	14.82	25.00	98
6	14.83	24.99	99

- A stability setting of 3 reading values within 0.1 will display reading number 5.
- A stability setting of 4 temperature values with 0.05 will display reading number 6.
- A stability setting of 2 Quality values within 2 will display reading number 3.

The tolerance value entered must be in the units of the selected scale e.g. if the scale is Brix then the tolerance could be, say, 0.1 or if the scale is refractive index then the tolerance could be 0.00015.

The number of readings value cannot be greater than 10.

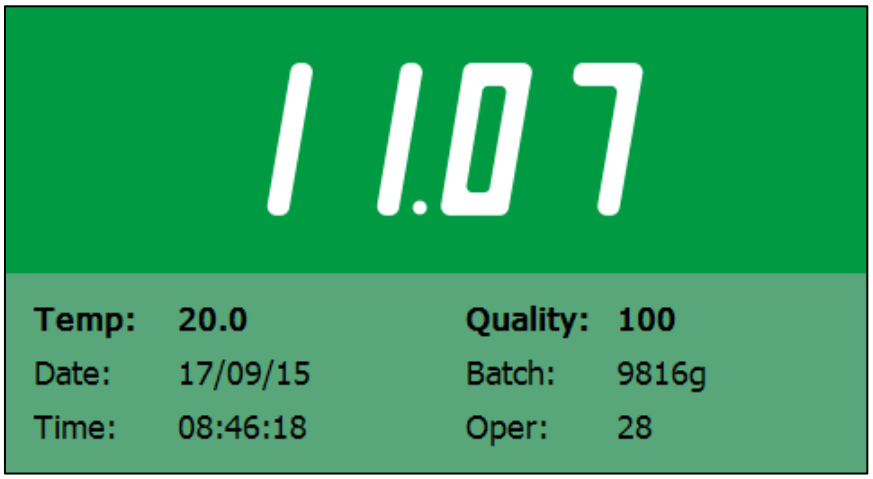
SMART stability takes the repeatability feature described above one stage further by testing both the reading and the temperature of the sample. The combination of both stable reading and temperature will give a good indication that the sample has stabilised. Measurements are required to be within ±0.05 °C of the aim control temperature.



Limits

Limits notify users if readings have fallen outside set criteria. If the measured values fall outside the set Limit the Reading Display will turn red and a line will be drawn through the result.

If the measured values are within the set Limits the Reading Display will turn green.



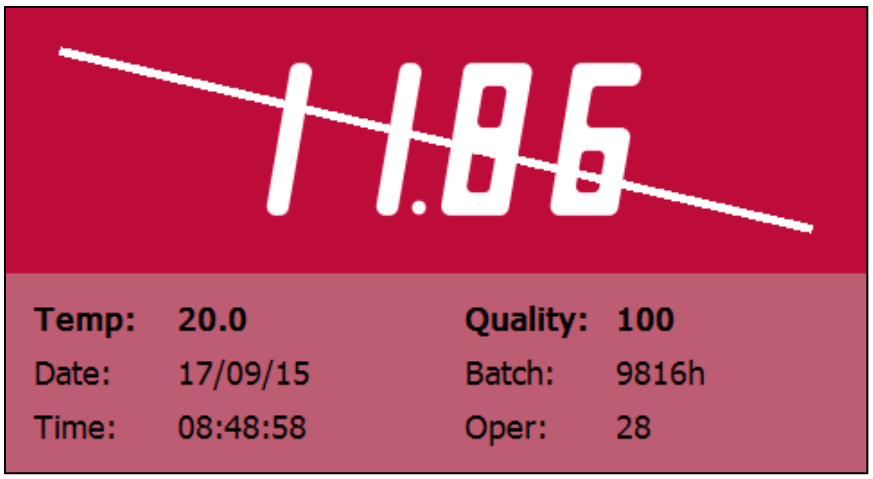
Limit acceptance will also appear on printed results.

The Limits can be set to check the reading value, temperature, Quality or all three.

Example: Limits have been set with the scale set to °Brix, with checks on both reading and temperature:

Reading value:	lower limit = 10.5	upper limit = 11.5
Temperature:	lower limit = 19.5	upper limit = 20.5

If the Reading value is lower than 10.5 or higher than 11.5 or the temperature is less than 19.5 or higher than 20.5, then the reading will be recorded as “fail” and displayed with a line through it on a red background.



Resolution

The instrument has settings for both temperature and reading resolution.

The temperature can be shown to 1 (low) or 2 (high) decimal places.

Each measurement scale has a number of decimal places assigned to it that is appropriate for that scale. Changing the resolution adjusts the scale's assigned decimal places, i.e. low resolution reduces a scale by 1 decimal place.

Resolution setting	Change to the Scale's assigned d.p.	Resolution examples	
		Refractive Index	Brix
low	1 less decimal place	4 d.p. (0.0000)	1 d.p. (0.0)
medium	No change	5 d.p. (0.00000)	2 d.p. (0.00)
high	1 more decimal place	6 d.p. (0.000000)	3 d.p. (0.000)

This can be set to be appropriate to the required accuracy for the sample under test or scale type.

Note that the reading time is increased slightly at high resolution to improve stability of measurement.

Secondary reading

The instrument has the optional facility to display the current measurement in a different scale, temperature compensation and resolution. This can be of use if a result is required in two different scales. Having both scales displayed removes any need to swap between configurations.

Secondary mode:

Equal mode:

Both results will also be shown on PDF printouts.

Limit checks will be performed on the primary scale. The secondary reading is unaffected by any Application Correction (see Page 52) applied to the primary measurement.

Using Methods

A Method is a named set of measurement settings. They include all the settings necessary for the instrument to take and check a particular sample.

If the complete range of product types that is to be measured with the refractometer requires the same measurement settings then using the Mode Menu is most suitable.

However, if a number of products with different reading requirements are to be read then a Method can be added for each of them. For example, a range of different soft drinks could be regularly measured and the display can show whether each product is within its set tolerance. Alternatively, Methods may be created to fulfil different Pharmacopoeia requirements or Monographs.

An additional benefit of Methods is that, whilst Mode/Method access user right (Page 46) will allow users to change measurement settings when operating with the Mode Menu, Methods access only allows for change of Method. Only users with the higher Setup security rights are able to change the measurement settings of a Method. This will ensure an analysis is performed the same way every time.

To enable the use of Methods see Page 39.

The “normal” Method will use the same settings as those specified in Mode.

Calibration and Reading

Allow the instrument to stabilise for at least 30 minutes after switching on before taking accurate readings.

Zeroing the instrument

The instrument should be Zeroed regularly to ensure accurate readings. Any sample can be used to set Zero but typically distilled water is used.

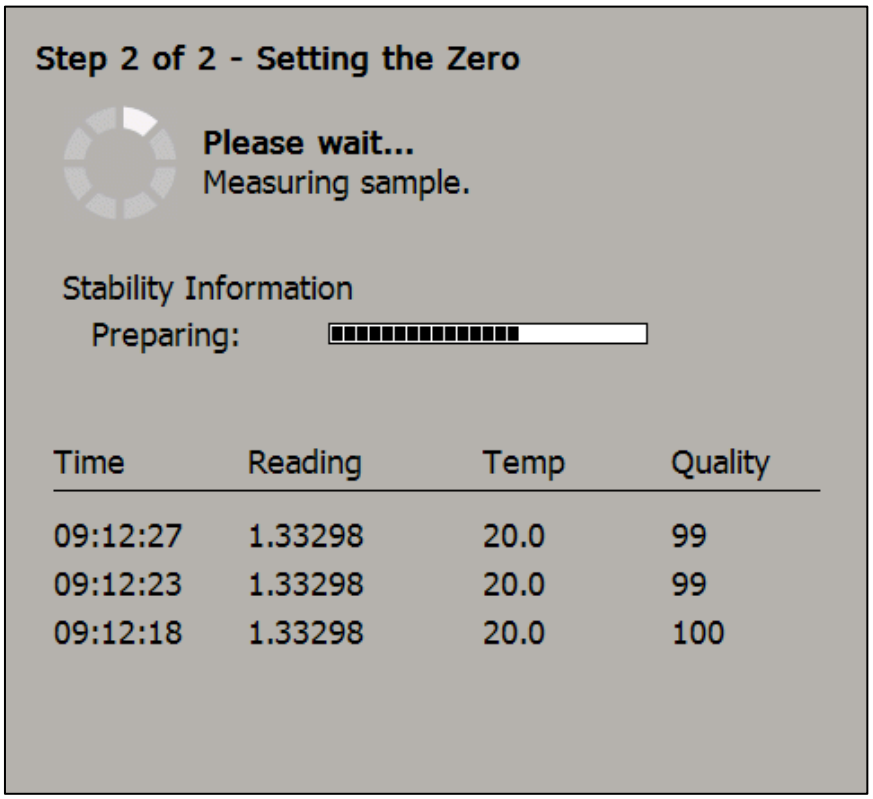
To Zero the instrument press the Zero button on the Measurement Display or access Zero via the Calibration Menu in the Main Menu.

Follow the onscreen instructions – ensure that the prism is thoroughly clean and that the presser is then lowered. If a Zero has been carried out within the last 30 minutes the option to skip this part of the calibration is given (this allows another Zero to be carried out without removing the sample).

The instrument stores the details of the last sample used for Zero calibration. If a different sample is to be used press the Change Sample button and enter the data as requested, the sample value must be entered in the scale used for calibration.

Once the sample details are correct apply the Zero sample to the instrument prism. The complete prism surface must be covered, 1ml is generally sufficient to achieve this. Lower the presser and press ok.

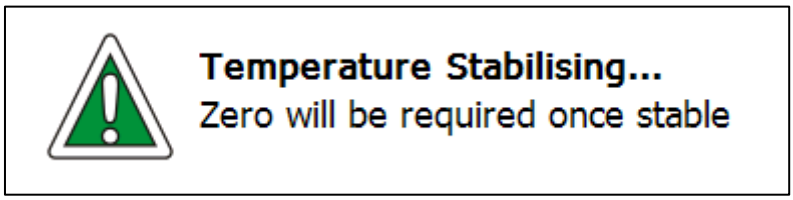
If traceability options are active (see Page 31) the instrument will request the required details. Continuous readings will then be taken until the sample stabilises.



The Zero point will then be set.

Auto Zero

When the instrument is turned on or the set-point temperature is changed a Zero calibration will be requested by the instrument. This is to ensure that readings are as accurate as possible. Whilst the temperature stabilises the Reading Result section of the screen will display a warning message.



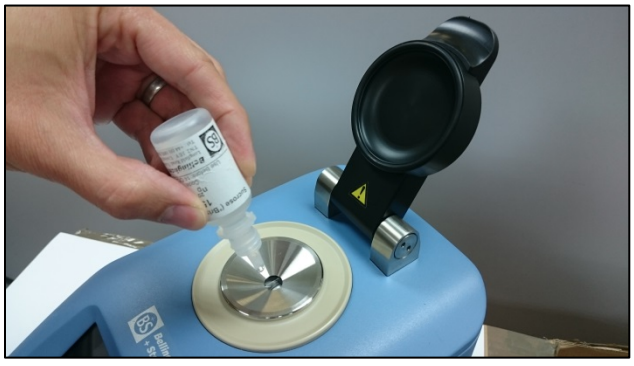
Once the temperature has stabilised the user can then perform the Zero calibration.

To skip the Zero calibration simply push the Read button. This is not advised as the accuracy of subsequent readings could be diminished.

Taking a reading

Raise the presser and thoroughly clean the prism surface. Whilst the presser is raised a message to lower it will be displayed. With the presser raised the temperature control performance is reduced, therefore it is beneficial to limit the time the presser is up.

Place a small amount of the sample to be measured on the prism. The complete prism surface must be covered, 1ml is generally sufficient to achieve this.



Lower the presser, if auto-single or continuous reading recurrence (see Page 51) are active readings will be initiated, otherwise press the Read button.

The instrument will display a progress bar dependant on the stability criteria set (see Page 22) whilst the required measurements are taken.

The reading will then be displayed using the scales and temperature compensations specified in the Mode Menu or current Method as shown on the Reading Configuration Panel.

Span calibration

Regular calibration is required to maintain instrument accuracy.

Span calibration sets the high end of the measurement range, performed using a selection of calibration samples available from Bellingham + Stanley.

To perform a Span press Menu, then select:

- 1. Calibration
- 2. Span (Top Calibration)

Holding down the Zero button on the Measurement Display for several seconds will also open the Calibration Menu.

Ensure that the correct calibration sample details are entered and apply the sample to the prism. The complete prism surface must be covered, 1ml is generally sufficient to achieve this. Lower the presser and press ok.

Continuous readings will then be taken until the result is stable. The Span calibration will then be set.

Undo calibration

If a calibration was performed in error or, for example, the wrong calibration sample was measured by mistake the last performed calibration can be undone with this option.

Calibration report

The calibration report shows the details of the last Zero and the last Span. This includes the date, time and measured value.

If traceability options are active then batch and operator details can be stored.

The calibration report can also be printed.

Saving results

To access the Recording Menu to set up printing and saving, press Menu then select:

- 3. Setup
- 5. Recording

Alternatively hold down the Record button on the Measurement Display for several seconds.

Set the print mode

The print mode (option 1) has several different settings:

Mode	Function
none	The Record button will be disabled preventing results from being printed or saved.
single	Print the last displayed reading to the selected printer.
save	Save the last displayed reading to the Reading Log (see Page 35).
single + save	Print the last displayed reading to the selected printer and save it to the Reading Log.
statistics	Allows a group of up to 10 measurements to be recorded and printed with a statistical analysis of the data (see Page 33 for a description of the process)
multi	Allows a group of up to 10 consecutive measurements to be recorded with a statistical analysis. Stability settings (Page 22) are only applied to the first measurement. Press the Record button then specify the number of readings to initiate. The average result will be displayed.

If Record After Read, option 4 in the Recording Menu, is set to yes then after each reading the instrument will automatically print or save the result using the mode chosen above. This helps prevent data from being accidentally lost.

Print formats

There are a number of different print formats. Several different printer types are available from Bellingham + Stanley, see the Accessories section. The print format is set in option 2 of the Recording Menu.

Printer	Description
none	Result will not be sent to a printer, this format can be used if only CSV results are required. Results will also be stored in the Reading Log if the print mode is set to single + save.
serial	Readings can be sent to a terminal program or serial printer.
usb	For printing to a PCL compatible printer connected via a USB port.
pdf	The instrument will save a PDF of results to memory which can be later downloaded via FTP or removable USB storage device, see Page 36. PDFs are secure to prevent any alteration.
network	Result can be sent to a printer connected to a local area network. To configure the use of a network printer see Page 58.

Results can also be printed in CSV form, see Page 58.

For GLP the use of serial dot matrix printers is recommended.

Traceability

All printed and saved readings are recorded together with the measurement settings selected and the time and date of the measurement. In addition, an optional product batch code and a user code can be entered. Traceability is also used on Zero and Span calibrations and will be displayed on printed reports.

To setup traceability, press Menu then select:

- 3. Setup
- 5. Recording
- 5. Traceability

If either batch or user codes are enabled the instrument will request them at the start of a reading.

Batch codes

The instrument can request batch codes in the following formats:

Setting	Description
off	The instrument will not request a batch code.
number	Number from 0 to 32000.
text	14 character alpha-numeric string.
dateinc	The date followed by an auto increasing number from 0 to 9999, in the format of: yymmddnnnn **Example:** 1603117235 (11th March 2016, number 7235)

If number is selected, an Auto Increment option is available which will then offer a batch code which is one greater than the previously used batch code when a reading is requested.

If text is selected, a barcode scanner can be used to input values. When the batch code is requested simply scan the barcode.

Compatible barcode scanners are available from Bellingham + Stanley, see the Accessories section.

User codes

The instrument can request user codes in the following formats:

Setting	Description
off	The instrument will not request a user code.
number	Number from 0 to 99.
text	24 character alpha-numeric string.
login	Requires the user to login, see Page 42 for User Accessibility. The Actual Name set in the user's profile will then be used as the user code.

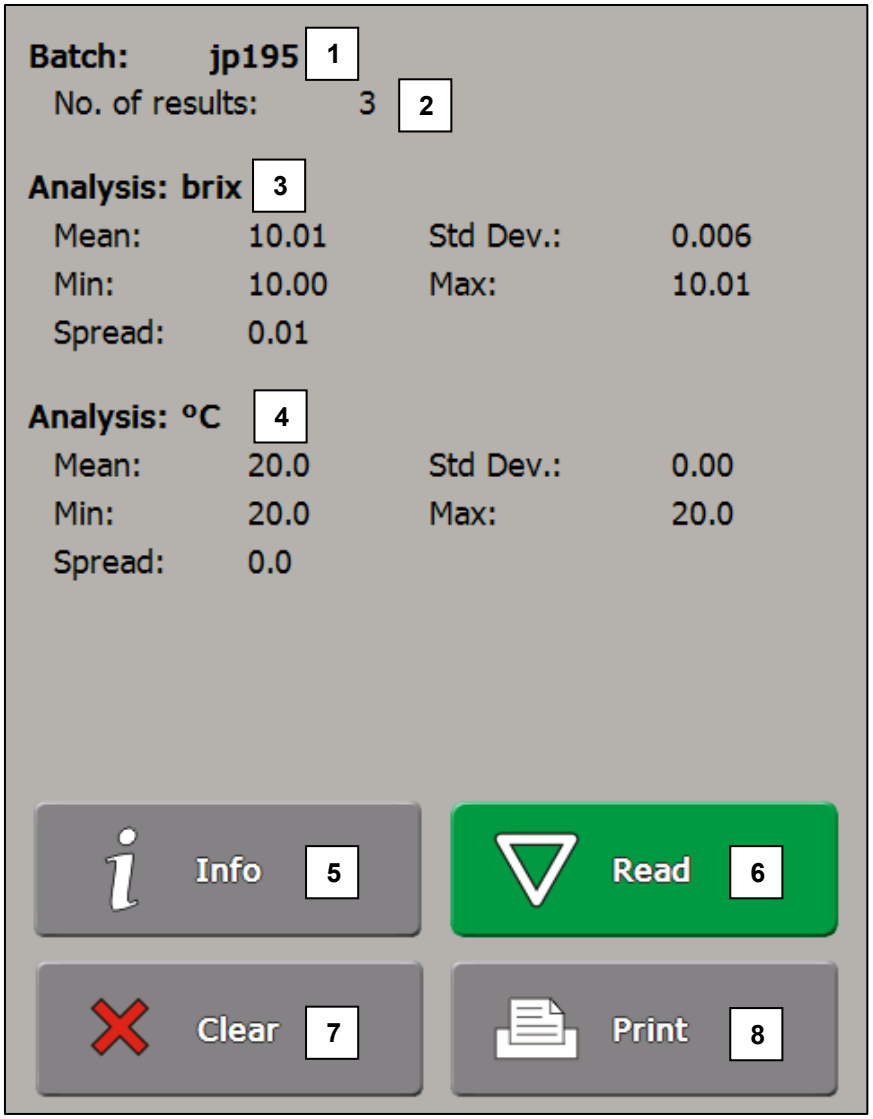
Remember text

If this option is set, the instrument will display the last entered batch or user code in the input box when text Traceability is required.

Statistics print mode

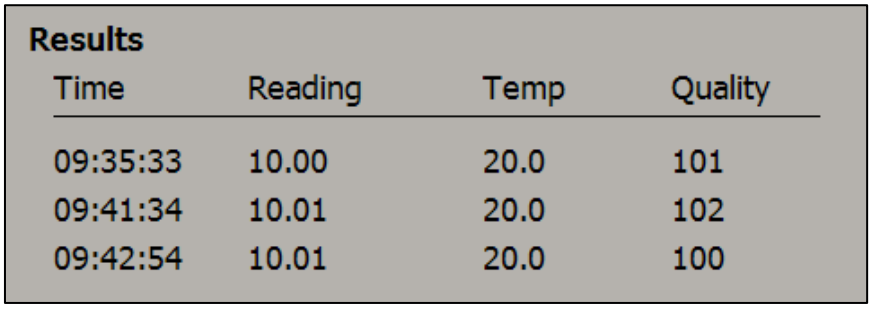
If the print mode (see Page 30) is set to statistics, a group of up to 10 readings can be temporarily logged together and a statistical analysis carried out upon the results.

To perform a statistical reading set, prepare and read a sample as normal. After the reading is complete press the Record button and enter traceability data as required. The statistics screen will then be displayed.



- **1.** Traceability details.
- **2.** Result counter – up to 10 readings can be used in each set of statistics.
- **3.** Statistical analysis of readings.
- **4.** Statistical analysis of temperature.

- **5. Info button:** Displays a list of the individual readings



- **6. Read button:** Stores the current statistics in memory and initiates the next reading. After more readings are taken any that are recorded will be included in the statistical analysis.
- **7. Clear button:** Clears the currently stored statistics.
- **8. Print button:** Prints the statistics and individual readings to the set printer. The statistics are also cleared.

Saving results

Data Menu

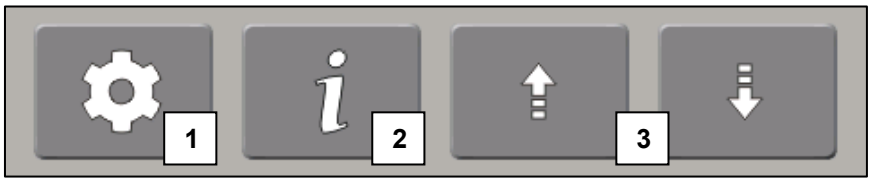
The instrument has two separate logs for storing data. This data will be held in the instrument whether the power is on or off and can be downloaded to a computer using the PC Data Acquisition Program, downloadable from the instrument or available for free at the Bellingham + Stanley website, or using a USB removable storage device.

The logs can be accessed by pressing the Data button on the Measurement Display or via the Main Menu.

The Reading Log

If the print mode is set to “save” or “single + save” then pressing the Record button will save the last displayed reading to the Reading Log. Over 4000 readings can be stored in the log.

On selecting Saved Results in the Data Menu the viewer will be displayed, along with several action buttons.



- **1. Saved Results Options:**

  Filter By Date will show only results taken on a selected day in the results viewer, it will also limit exported readings to those from the selected date.

  Export to USB will transfer a CSV file of filtered results to a USB removable storage device. Ensure only one USB removable storage device is present in the instrument. Do not remove the storage device during transfer as data can be lost.

  Clear Results will delete all saved results from instrument memory. Ensure required results are downloaded before clearing.

- **2. Result Information:** Displays more detailed information about a reading, for instance calibration details at the time, reading configuration and secondary reading results.

  The result can be reprinted by pressing the Print button. The printer type used can be different to the one set in the main Recording Menu. To change the printer used simply hold the Print button down for several seconds and a printer select screen will appear.

- **3. Arrow buttons:** Used to change the selected result.

If user codes are set to login (see Page 32) results from an individual user can be displayed and then exported by scanning that user’s RFID tag. Scan again to remove filter.

Press Space or Enter on a connected USB keyboard to use the Options and Information buttons respectively.

The System Log

The System Log maintains a record of all changes and adjustments made to the instrument by its users. This will include each Zero and Span calibration, changes to the setup, configuration and Methods.

The System Log functions in the same way as the Reading Log however instead of filtering by date the filter is based on the event type.

Downloading Logs

- Export CSV to USB

In the Options Menus of both Logs is the ability to export the Logs to CSV files with whatever filter may be set.

Option 5, Export logs to USB, in the Data Menu will download both logs in full to a USB removable storage device.

- PC Data Acquisition Program

The PC Data Acquisition Program enables all the data from both of the above logs to be transferred to a PC.

This will clear the logs in the instrument.

The data can then be sorted, easily viewed and also saved in csv format files, which can then be opened in a spreadsheet. This program can be downloaded for free from the Bellingham + Stanley website.

Downloading PDFs

If the print format is set to PDF (see Page 31), every time a reading result is recorded or if a calibration report or Method list, for example, is printed, a PDF is created and stored within the instrument's memory. In order to access the PDFs, they can be downloaded either via a removable USB storage device or via FTP if a network is available.

PDFs are encrypted to prevent any alteration and are ideal for transferring and storing data securely.

Downloading PDFs to a USB removable storage device can be done in the Data Menu. Copy PDFs (option 3) will make a copy of the PDFs currently stored in the instrument but also leave copies in the instrument.

Move PDFs (option 4) will download any PDFs in memory to the USB removable storage device and remove them from internal instrument memory.

If more than one USB removable storage device is detected the transfer will not be performed.

If a large number of PDFs are copied or moved this process can take several minutes, do not remove the USB removable storage device during file transfer as this can lead to loss of data.

PDF and FTP

If a large number of PDFs have built up in the instrument, transfer via USB could take several minutes. In this case it may be preferable to transfer PDFs from the instrument via FTP.

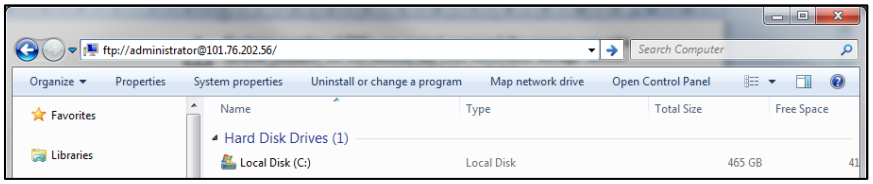
Additionally, the PDFs can be viewed whilst still in the instrument using FTP.

To view the instrument's current IP address, press Menu then select:

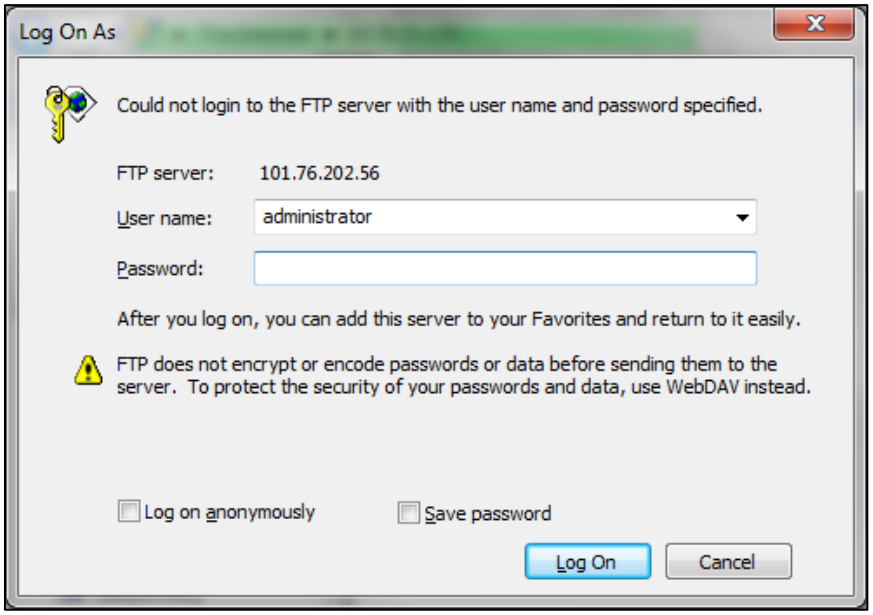
- 5. Help
- 1. Information

The current IP address can then be seen under the Network heading. The network configuration for the instrument can be changed, see Page 59.

To view the PDFs from a Windows computer open Windows Explorer, then in the address bar type "ftp://administrator@XXX.XXX.XXX.XXX/" (without quotes), where the Xs represent the numbers in the instrument's IP address.



A log on will be required using the details of the administrator user, even if the administrator PIN is set to 000 in the instrument.



With access to the instrument's FTP server, images can be assigned to users and to individual Methods for ease of identification. PDF headers can also be changed. Contact Bellingham + Stanley for details.

Section 3: Instrument Setup

Section 3

Methods

A Method is a defined set of measurement settings. This allows for measurement settings to be quickly changed between frequently used configurations or for reading different products with specific test requirements. For example, if a range of different soft drinks is regularly measured a Method could be created for each with the display set to show whether each product is within its set tolerance using the limits system. Alternatively, Methods may be created to fulfil different Pharmacopoeia requirements or Monographs.

Initially there are three Methods set in the instrument:

- normal — for measuring samples
- zero — scale and temperature compensation used for the Zero calibration
- span — scale and temperature compensation used for the Span calibration

The “normal” method settings will match those configured in the Mode Menu. Only the scale and temperature compensation can be set in the “zero” and “span” methods, the temperature and resolution will be the same as the method used prior to the calibration, other advanced settings are preconfigured.

To activate Methods press Menu, then select:

- 3. Setup
- 2. Methods

Then set Use Methods to yes. This makes the Hide Preset, Selection Type and Print List buttons available.

Hide preset

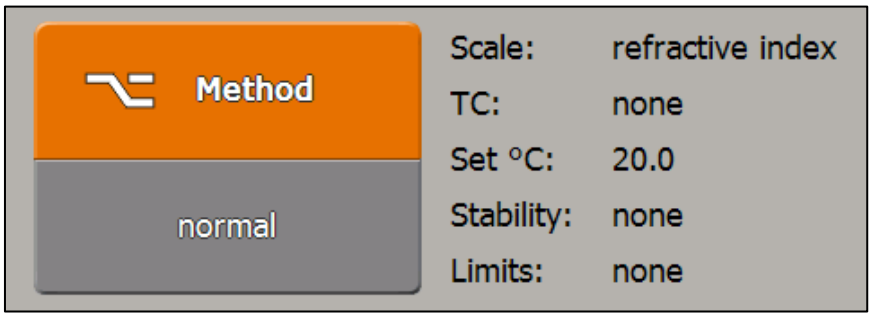
This will hide the three default Methods, “normal”, “zero” and “span”.

If no custom Methods are added then the Methods button will be disabled on the Measurement Display. The settings in the “normal” Method will always be used for readings, this will help to ensure the measurement settings are not changed.

Alternatively, if a number of Methods are created for a standard range of products, e.g. mint oil, lavender oil, orange oil, and the preset Methods will never be required, then it could be advantageous to hide the default Methods from the Methods list. This will make it easier to select the Method required.

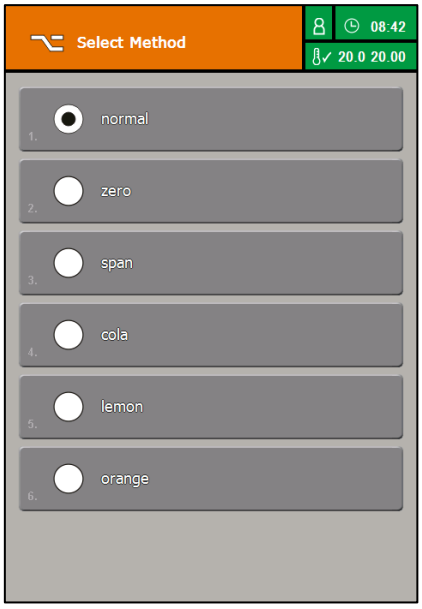
Selection type

Before reading a sample, the relevant Method should be selected by pressing the Method button on the Measurement Display.

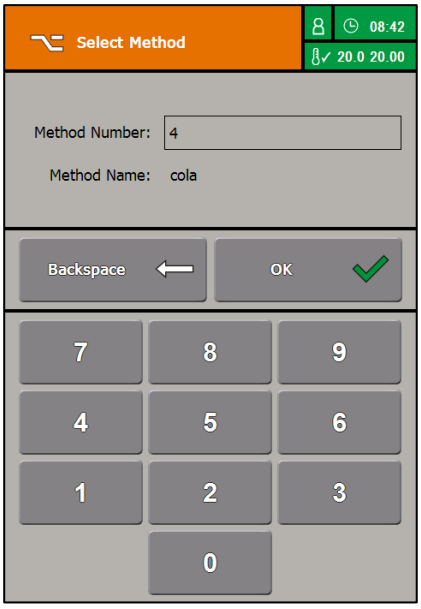


Holding down the Method button for several seconds will enable editing of the currently displayed Method, a login from a user with Setup rights will be required if PINs are active.

This will show a list of all available Methods and the appropriate one can be selected. However, if a large number of Methods have been created then it could be easier to select the required Method by its index number rather than scrolling through the list. The instrument therefore gives list and number selection type.



List selection type



Number selection type

Print List

This will print a list of all Methods to the set printer, providing a useful reference if a large number of Methods are in use.

Adding a new Method

With Methods switched on, pressing Quit from the Method Settings menu will show a list of current Methods. This list will be shown first when re-entering Methods at a later time.

To add a new Method, press the Add new... button.

Enter the Method name, this could be a common name, such as mint oil or orange oil, a trade name or a product reference code. Do not use a batch code. Method names should identify a generic product type.

The Basic and Advanced measurement settings can then be configured as required for the product type the Method will be used for. See Page 21 for a description of each of the measurement setting options. The starting settings will be the same as those in the “normal” Method.

Once the Method settings are configured as required press Quit to return to the Method list, from where more Methods can be added, or Home to return to the Measurement Display.

Editing a Method

There are several ways to edit a Method’s configuration.

From the Method List in the Setup menu simply touch the name of the Method which requires editing and then change the settings as desired.

Accessing the Method this way is the only way for a Method to be deleted.

If the active Method needs to be edited simply hold down the Method button on the Measurement Display for several seconds.

Methods can also be edited from the Select Method screen, accessed by pressing the Method button on the Measurement Display. This is dependent on selection type.

With List selection type simply press and hold the button of the Method to be edited.

With number selection type, type the Method number then press and hold OK.

If PINs are active then a login by a user with Setup rights will be required before the Method configuration can be accessed.

User accessibility

RFID tags offer rapid user clearance, see Page 49.

Access to the instrument's functions and Menus can be restricted, with the sophistication of the protection set to match the operating environment.

There are a range of security features that can be activated to preset levels for convenience or customised to user preference.

It is recommended that the high level of preset protection settings is used if working in a FDA controlled environment (e.g. 21 CFR part 11).

To access the Users menu press Menu, then select:

- 3. Setup
- 3. Users

Security features

It is important to set the level of security required before adding users as some changes require the deletion of custom users to maintain a secure environment.

The level of security can be set from the Protection button at the top of the Users menu. There are four security levels, three with preset features - low, medium and high - and a fourth custom option so security can be set to any desired level.

The preset protection levels and the custom level use the following settings:

- User Selection (PIN only or user and PIN)

With "PIN only", when a login is required, the user will only have to type in a PIN. The length of the PIN can be set separately. This is used by the low preset level.

Several features will not work when User Selection is set to PIN only as they require two identifiers.

If using "user and PIN", the user will first have to type in a username and then a PIN. This is more secure than PIN only as two identifiers are needed. Medium and high security levels use this setting.

- PIN Length (3 to 8 digits)

The greater the number of digits, the lower the chance of a PIN being guessed. However, as the PIN length increases it will be harder to remember.

This should be set before adding custom users as they will be deleted if this setting is changed.

User accessibility

- Keep Logged In (0 (off) to 300 seconds)

This option specifies how long a user is kept logged in for whilst idle before automatically being logged out. If set to 0, a user will be logged out on returning to the Measurement Display.

Leaving the instrument logged in can lead to security issues as unauthorised use of the instrument could occur. Therefore ensure that the “Keep Logged In” feature is set appropriately for the instrument’s working environment.

- Max PIN Age (0 (off) to 366 days)

This specifies how often a PIN must be changed. If the PIN is not changed within this period the account PIN will be reset and a new PIN requested on next login attempt.

- Remember Last User (0 (off) to 720 mins)

This option specifies how long the instrument will remember the last user for.

If set, the instrument will display the last entered username in the input box when a login is required. If the same user is logging in they will not have to re-enter their username, only their PIN.

- Reset PIN Only (no / yes)

If selected, an administrator will only be able to reset a user’s PIN rather than changing it. When a PIN is reset the next time the user logs in they will be requested to set a new PIN.

If an administrator resets a user’s PIN the user should be present so that they can create a new PIN for their username immediately.

- Prohibit PIN Recycling (no / yes)

When active, the instrument will check when a new PIN is set that it has not been used within the last 10 changes. This stops a user from switching between frequently used PINs.

- User Lockout (no / yes)

If selected, the instrument will automatically lockout a user if they enter their PIN incorrectly more than 5 times.

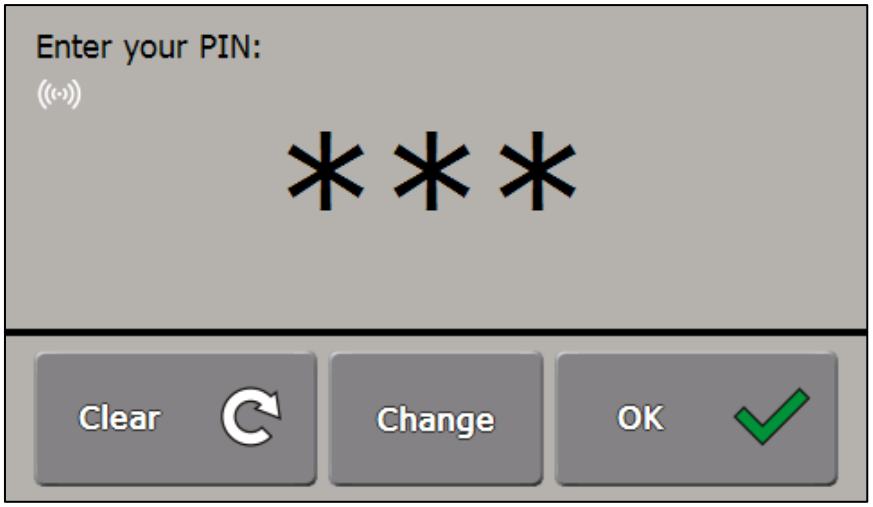
An administrator will then be required to reset or change that user’s PIN.

The default administrator profile (Page 46) cannot be locked out.

- Fast PIN Change (no / yes)

This will allow the user to change their PIN without having Setup rights. These are required to gain access to the Users menu where PINs are usually changed.

A fast PIN change can be performed from the login screen. Whilst logging in a user should enter their username (if required) then their PIN. With the PIN entered press the Change button.



If the user entered their login details correctly a new PIN will be requested. The new PIN must be input twice to ensure no errors are made.

After the PIN has changed, the instrument will continue to whatever was requested that required a login to access.

Preset protection levels

The preset protection levels use the following configurations of the above security features.

- Low

The instrument will request a PIN when entering the Menu or Mode/Methods.

Security feature	Setting
User Selection	PIN only
PIN length	3
Keep Logged In	30 secs
Maximum PIN Age	off
Remember Last User	no
Reset PIN Only	no
Prohibit PIN Recycling	no
User Lockout	no
Fast PIN Change	no

- Medium

This preset improves security by requiring the user to enter their username and then their PIN. This preset does not have features enabled that could increase administration overheads.

Security feature	Setting
User Selection	User and PIN
PIN length	4
Keep Logged In	30 secs
Maximum PIN Age	off
Remember Last User	10 mins
Reset PIN Only	no
Prohibit PIN Recycling	no
User Lockout	no
Fast PIN Change	no

- High

This preset features all the security options set to recommended levels required when using the instrument in a FDA controlled environment, see Page 50.

Security feature	Setting
User Selection	User and PIN
PIN length	4
Keep Logged In	off
Maximum PIN Age	120 days
Remember Last User	10 mins
Reset PIN Only	yes
Prohibit PIN Recycling	yes
User Lockout	yes
Fast PIN Change	yes

Users

After setting the security level as required users can then be added. The current users are shown in the Users menu.

There are three default users in the instrument. These users can only have their PINs changed or ID tags paired (see Page 49). Their set rights cannot be altered and have the following settings by default:

	Username	administrator	calibrator	operator
	Default PIN	000	355	123
Access Rights	Mode / Method	Yes	Yes	Yes
	Zero	Yes	Yes	Yes
	Span (Top Calibration)	Yes	Yes	No
	Data	Yes	No	No
	Setup	Yes	No	No
	Maintenance	Yes	No	No

The instrument comes with the protection level set to low, hence the 3 digit PIN numbers. If the level has been changed, the PINs will have the required number of leading zeroes, e.g.

PIN Length	PIN Code
3	355
4	0355
8	00000355

The administrator PIN is initially set to all zeroes (000). This disables all security features, giving all users unrestricted instrument access. The administrator PIN must be changed before security settings come into effect.

If the operator PIN is set to all zeroes (000), then there will be unrestricted access to the Mode/Methods selection, ideal for product familiarisation and training.

If the calibrator PIN is set to all zeroes (000), then there will be unrestricted access to the Calibration Menu.

WARNING! Access to all the functions is only possible for the administrator or a user with full rights after entering the correct PIN. DO NOT FORGET IT!

In the event of the administrator PIN being forgotten, contact Bellingham + Stanley or your supplier for assistance.

The different user rights give access to the following:

Right	User access
Mode / Method	If using the Mode Menu, users will be able to change the measurement settings. If Methods are active, users will be able to change Method but Method measurement settings cannot be changed. Method measurement setting changes requires Setup rights.
Zero	The user will be able to perform Zero calibrations.
Span (Top Calibration)	This will allow access to the Calibration menu. This should be restricted to users who are trusted to handle the expensive, traceable standards.
Data	Gives access to Data in the Main Menu or via the Data button from where logs can be reviewed and downloaded. PDF records can also be downloaded from here.
Setup	With access to the Setup Menu, all of the instrument's settings can be changed along with security settings. This should be restricted to the highest level users.
Maintenance	This should be granted to users responsible for the care of the instrument such as ensuring filters are regularly changed.

Adding a user

Press the Add new… button at the top of the Users Menu to add a new user. Up to 47 additional users can be added, giving a total of 50 users with the default profiles included.

First a username is requested. This is the name that will be used to login when User Selection is set to "user and PIN".

The user's Actual Name is then required, this will be used for Traceability purposes, for instance on calibration reports and when recording results with User codes set to login (see Page 32).

The user's PIN will then need to be set (entry is requested twice to avoid errors).

Finally, the user's access rights can be set.

From the User list, created user details can also be edited. Simply select the user for whom details need to be changed.

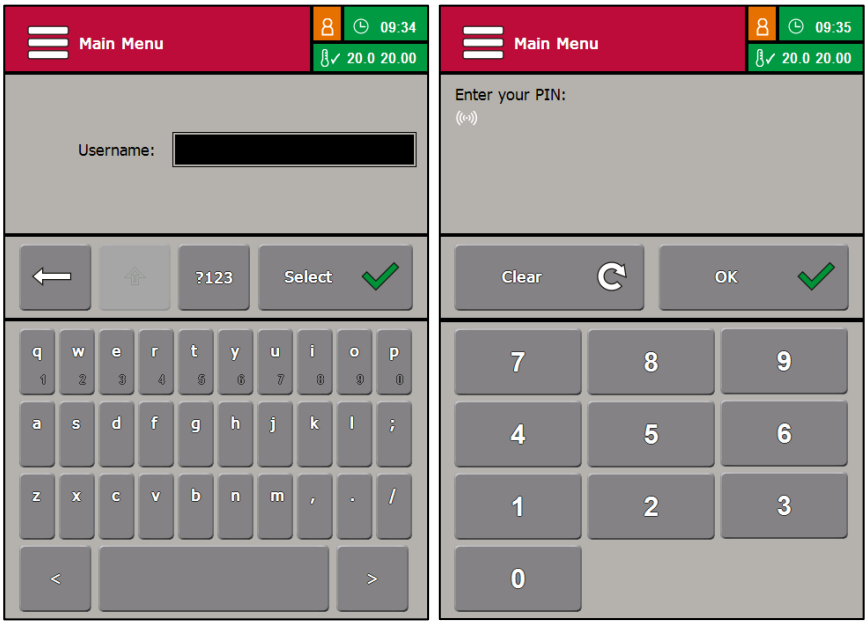
If protection level is set to high, users will not have the option to change PINs from the Manage Users menu, however the user can have their PIN reset. This will cause the instrument to request that the user change their PIN when they next attempt to login.

Logging in/out

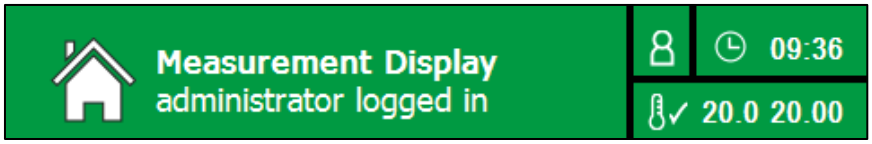
If “user and PIN” is active, when a user tries to access a Menu, for example, the instrument will first request their username.

If “remember last user” is active there may already be a username in the text box.

After confirming username entry or if user selection is set to “PIN only”, the PIN entry screen will appear.

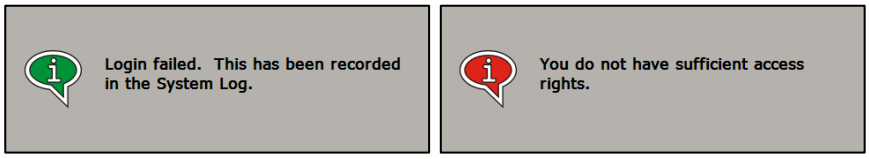


After typing in the PIN and pressing OK, if both the username and PIN were correct, the user will have access to the requested Menu (if they have sufficient rights) and the security icon will turn green. In the Main Menu the user’s username is also displayed.



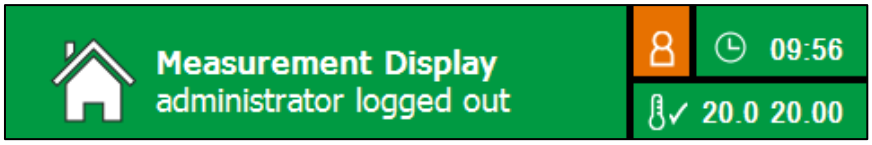
Instead of typing out the user’s details login can be performed simply by swiping an assigned RFID tag, see over page.

If the username or PIN was incorrect, or the user does not have sufficient rights for the current activity, a notification will be given.



If “keep logged in” is set to 0 (off) users will be automatically logged out when they return to the Measurement Display. However, if “keep logged in” has a value, when viewing the Measurement Display the currently logged in username will be shown in the title bar.

To log a user out simply touch anywhere on the title bar, the security icon will then turn orange and a logged out message will appear briefly.



Logging out can also be performed by swiping an RFID tag.

RFID Tags

RFID (radio frequency identification) tags are used to wirelessly identify a user. RFM300-T instruments are fitted with an RFID reader at the top of the body. Several RFID tags come with the instrument and additional tags can be obtained from Bellingham + Stanley, see the Accessories section.

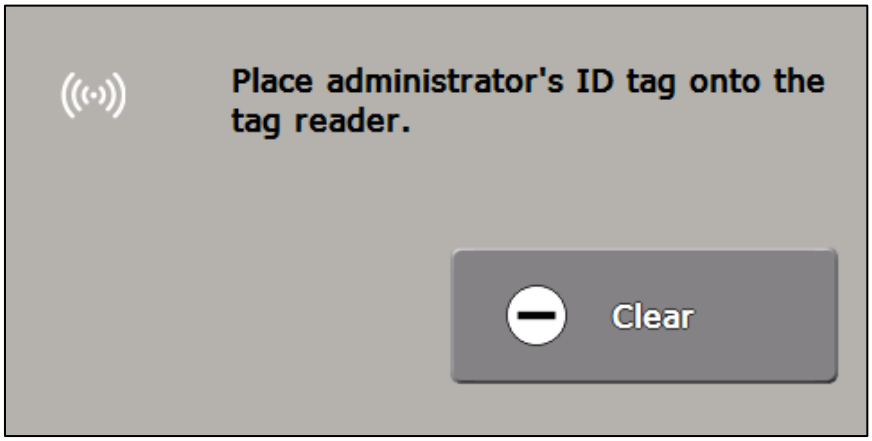
ID tags are read by placing the tag within 2cm of the reader:

RFID tags are paired to a user. This enables the user to be identified and logged in simply and quickly without the need for further authentication (PIN or username entry).

As RFID tags alone will authenticate a user, ensure that ID tags are protected from misuse.

To pair an ID tag with a user, first select the user from the Users Menu.

The Pair ID Tag value should be none. Select Pair ID Tag and the instrument will request that the relevant ID tag is placed onto the reader.



The Pair ID tag value will then change to “set”.

To unpair a tag from a particular user, push the Clear button on the Pair ID tag screen.

RFID tags can only be read when the instrument is showing the Measurement Display, when a PIN or username is requested, or when specifically prompted by the instrument. A flashing RFID icon will be shown on screen when tags can be scanned.

To log in, simply swipe the RFID tag over the reader when required.

To log out, read the user's RFID tag a second time. Logging out can only be performed on the Measurement Display.

FDA regulation 21 CFR Part 11

This instrument complies with the technical aspects of FDA regulation 21 CFR part 11. However the instrument capabilities are only a small part of compliance, standard operating procedures are required.

To setup the instrument to be used in a 21 CFR Part 11 environment the following steps are required.

- Set the Protection level to high.
- Set user Traceability to login (Page 31).
- Set the appropriate Print Mode (Page 30). PDFs are stored securely so that they cannot be altered once created. Saved results in instrument memory cannot be changed. However, once downloaded from the instrument appropriate measures must be taken to prevent tampering.
- Add all necessary users.
- Reset the administrator user PIN.
- Login as administrator and set a new PIN.

Reading setup

In addition to the measurement settings there are several other factors that can affect how readings are taken.

To access the Reading menu, press Menu, then select:

- 3. Setup
- 4. Reading

Or hold the Read button on the Measurement Display for several seconds.

Recurrence

Recurrence specifies the action that will initiate a reading.

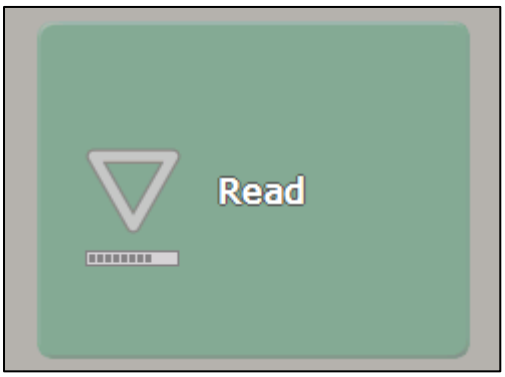
Recurrence can be set to:

- Auto-single
- Single
- Continuous

Auto-single will activate a reading whenever the presser is lowered, provided that there is sample on the prism. Additional readings can be taken by pressing the Read button.

Single recurrence will only take readings when the Read button is pressed.

Continuous will disable the Read button with readings repeatedly taken and updated on the display. A progress bar indicates when the next measurement will be displayed.



Stability settings (Page 22) will be disabled when recurrence is set to continuous.

Application correction

- Offset

The instrument has the ability to apply a simple offset and scaling factor to results from each individual Method. This can be used, for example, to adjust the refractometer to give values equivalent to a reading taken on a density meter.

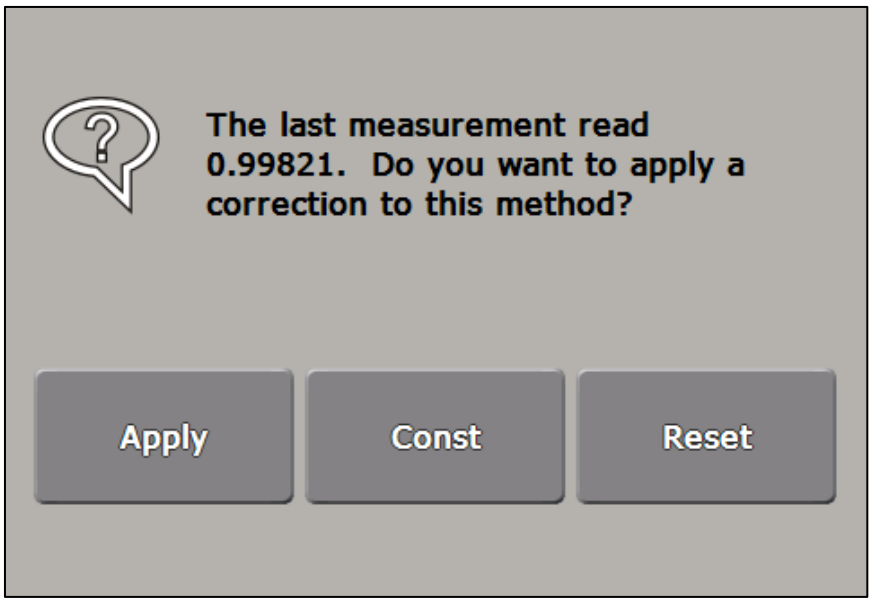
Offset correction requires the instrument to be operated with Methods active, each Method can have its own correction values.

Offset correction alters measurement results using the following formula:

$$y = (x + O) \times S$$

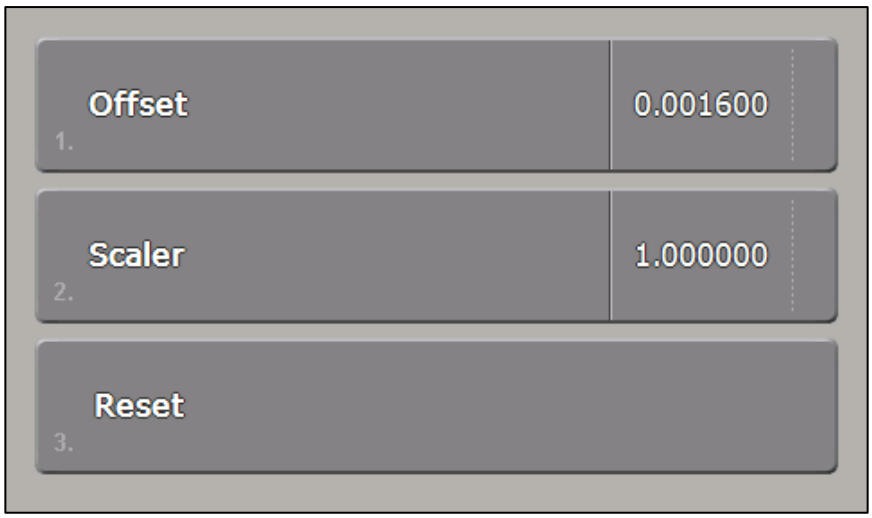
Where
y = corrected reading (in selected scale units)
x = uncorrected reading (in selected scale units)
O = offset value
S = scaler value

To apply an offset correction, first select the relevant method and take a reading of a sample with a known target value. Then open the measurement settings for that Method (either hold down the Method button or access the Method Menu via the Setup Menu). In the Advanced Configuration push the now available Offset button.



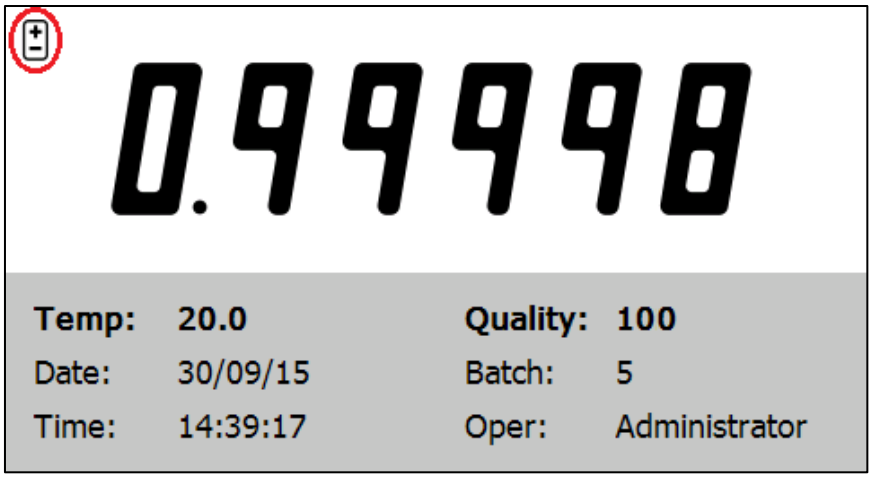
Press Apply and then input the value that is desired for the instrument to return when measuring the sample just read. The instrument will then calculate required offset and scaler values.

The Const button allows for manual entry of offset and scaler values or to view the currently applied values.



Reset will return the offset and scaler to the default values (0 and 1 respectively).

With an offset correction applied, all readings taken with that Method will be displayed with an identifier on the Measurement Display.



- Citric acid

Acid correction allows for automatic correction of the effects of citric acid on readings. The correction conforms to BS EN 12143:1996. Acid correction is only available when the Brix scale is in use.

If Methods are in use each Method can have its own default percent acid value (total acid expressed as anhydrous citric acid), set in the Advanced Configuration section of the Method.

When a measurement is recorded the user is given the opportunity to change the percent acid value.

Adding extra scales

By default, readings can be displayed in Refractive Index (RI) or Brix. Scales can be added to convert the readings to other standard units, such as Zeiss, or company specific units for a particular product.

To access the Scales menu, select option 2 (Scales) in the Reading Menu. This will present a list of current custom and installed library scales and the option to add new.

Adding a library scale

Press the Add new… button in the Scales List screen, then press From Library.

The following scales can then be installed.

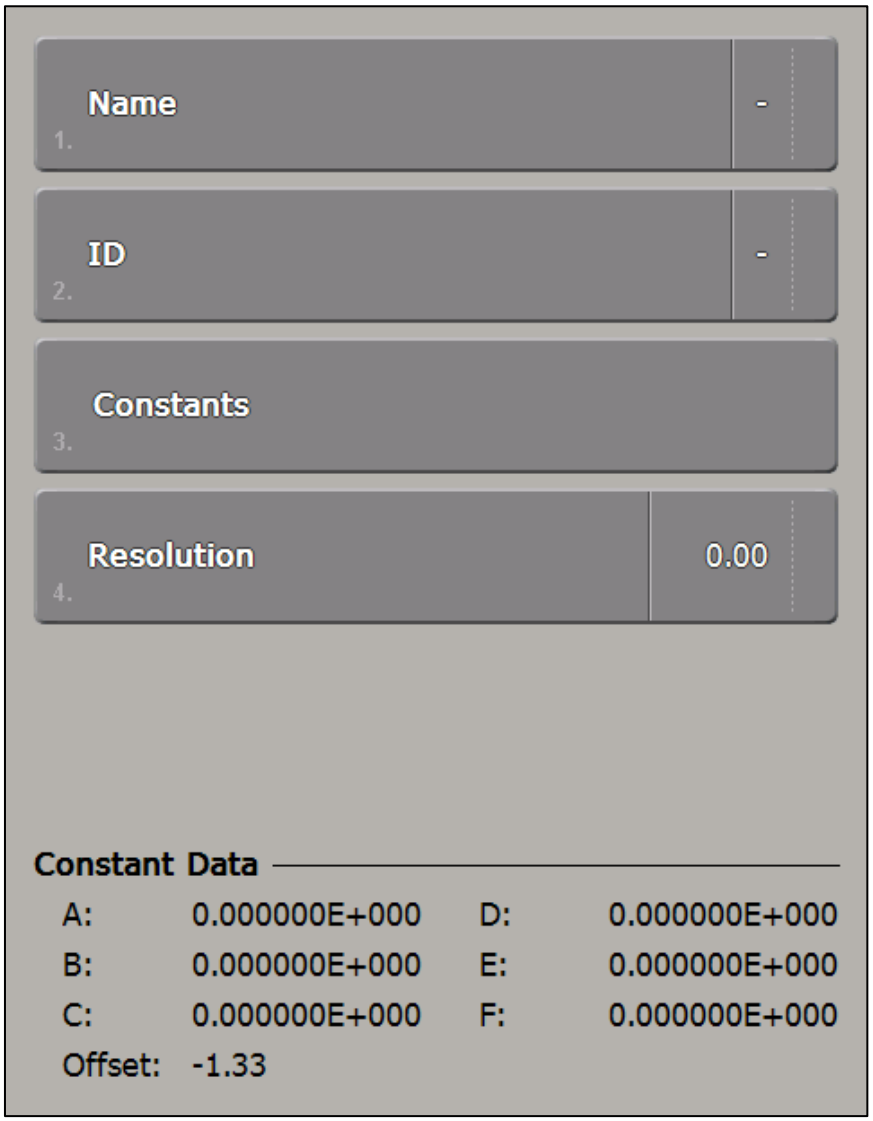
Library number	Title	Scale name	Scale ID
1	Zeiss	zeiss	ze
2	Oechsle (German)	oechsle (de)	o2
3	Butyro	butyro	bu
4	42% Fructose	42% fructose	f1
5	55% Fructose	55% fructose	f2
6	90% Fructose	90% fructose	f3
7	Baumé	baume	bm
8	Sodium Chloride	sodium chloride	sc
9	Oechsle (Swiss)	oechsle (ch)	o1
10	Glucose	glucose	gl
11	Fructose	fructose	fr
12	Invert Sugar	invert sugar	is
13	Probable Alcohol	probable alcohol	pa
14	Urine Solids, Cat (SG)	urine (cat)	uc
15	Urine Solids, Human (SG)	urine (human)	uh
16	Urine Solids, Bovine (SG)	urine (bovine)	ub
17	KMW (Babo)	kmw (babo)	km
18	Vol % Fuel System Icing Inhibitor	vol % fsii	ii
19	Aqueous Sucrose SG (d 20/20)	sg (d20/20)	d1
20	Aqueous Sucrose SG (d 20/4)	sg (d20/4)	d2
21	Aqueous Sucrose Density (g/cm3)	density (g/cm3)	d3

Once loaded, the scale will be available for use in Mode or Methods.

Please contact Bellingham + Stanley should additional information be required regarding the standard scales.

Adding a custom scale

As well as the library scales, readings can be converted to any custom units. To set up a custom scale, press Add new... on the Scales list then select From Data.



First, enter a unique name for the scale. Up to 16 characters can be used. A unique scale ID is also required. This is a two character code that will be used to identify the scale on printouts and saved results where space is limited.

Up to 6 scale constants can then be entered by pressing the Constants button. Scale units are calculated using the following polynomial equation:

$$\text{Reading} = A + Bx + Cx^2 + Dx^3 + Ex^4 + Fx^5$$

where: x = measured refractive index – Offset
A,B,C,D,E and F are polynomial constants

Input a value for each required constant by selecting them in turn, if a constant is not used leave it as zero.

An Offset value is available in the Constants screen, this can be set to 0 although greater accuracy can be achieved when calculating a polynomial for a range starting at water by using an Offset of –1.33.

Set the resolution to have the number of decimal places suitable for the accuracy required of the scale.

Once data entry is complete press Quit, the scale will then be added to the Scales List and can subsequently be Altered, Deleted or transferred to USB if a removable storage device is present by selecting it again. The scale will also be available in measurement settings.

Adding a custom temperature compensation

Temperature compensations can be entered in a similar manner to scales via the Temp. Comp. menu (option 4 in the Reading Menu). This will present a list of current custom temperature compensations and the option to add new. To set up a custom temperature compensation, press the Add new... button and enter data as discussed above. Offset and resolution are not required for temperature compensations.

Temperature compensations are calculated using the following polynomial equation:

Reading Correction = $A + Bt + Ct^2 + Dt^3 + Et^4 + Ft^5$

where: t = sample temperature (°C)
A,B,C,D,E and F are constants

The final result is given by:

Compensated reading = Uncorrected reading + Reading Correction

Temperature compensations can also be installed via USB or network transfer, see below.

USB and network scales

Custom scales and temperature compensations can also be transferred from and to the instrument using the USB or network ports. This is useful for reinstalling mistakenly altered scales or quickly transferring them between instruments.

- USB

Place a USB removable storage device into the instrument then access the Scales List or Temp. Comp. menu. Select the item that is required for export then Export to USB. After giving the file an appropriate name it will be saved to the USB device in a folder named either “Scales” or “TCs”.

The file can then be imported into another instrument or reloaded to the same instrument in case of accidental loss. With the USB device in the instrument press the Add New… button in either Scales List or Temp. Comps. The From USB option will then be available. Select it then choose the file to be imported.

The instrument checks the USB storage device for files in folders called “Scales” for compatible scale files (extension .usc) or “TCs” for temperature compensation files (extension .utc). By creating the required

folder and placing compatible files within, it is possible to import files saved or created by other means

- Network

It is possible to import scales and temperature compensations to the instrument via a network. Connect to the instrument via FTP (see Page 37), create a folder called “Scales” or “TCs” and place a compatible file (.usc or .utc respectively) inside. Press the Add New… button in either the Scales or Temp. Comp. Menu and then From Network. A list of compatible files in the folder will be displayed, simply select the one required for it to be installed. The file will be removed from the network folder once installed.

Communications

The instrument can save and print results in a number of different formats, see Page 30. Serial and USB printers available from Bellingham + Stanley will work on a plug and play basis, see the Accessories section at the rear of this User Guide. However, to print to a network printer its IP address will be required.

In addition to the basic printers, results can be obtained from the instrument in CSV form via the serial port or across a network.

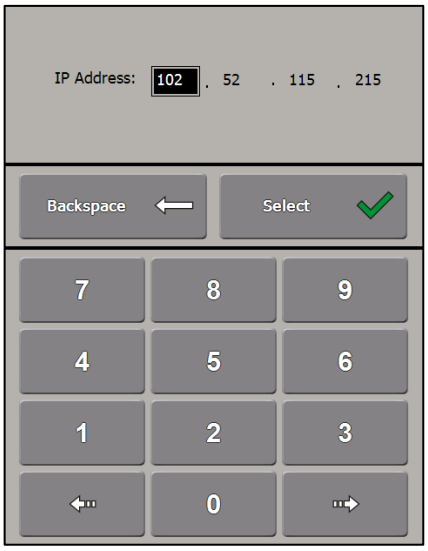
To access the Recording Menu to set up printing press Menu, then select:

- 3. Setup
- 5. Recording

Alternatively hold down the Record button on the Measurement Display for several seconds.

Network printer

To print results to a printer on a local area network via the Ethernet port, from the Recording Menu select Printer then option 5, network.



The option to enter the IP Address of the desired printer is then given.

The cursor will skip to the next number box once a valid three digit number is entered, or the arrow buttons can be used to advance.

Press Select at any time to confirm the IP address. The entry will also be accepted once all four numbers blocks are input.

CSV (Lims)

As well as the standard printer options, readings can also be printed as CSV (comma separated values) suitable for connection to a LIMS.

In serial mode, readings will be sent to the serial port and can be received by a proprietary terminal program or custom software.

With CSV (Lims) set to network, CSV readings can be sent via the Ethernet port to a program capable of receiving UDP (user datagram protocol) transmissions.

With USB, a file is created on a connected USB removable storage device.

When CSV (Lims) mode is active, a CSV result is sent every time the Record button is pressed on the Measurement Display. This allows a result to be recorded as a CSV and by any selected printer simultaneously.

Results in the Reading Log are also stored in CSV form and can be downloaded separately, see Page 36.

Port settings

The settings of both the serial and network ports can be altered from the Recording Menu using option 6, Ports.

- Serial Port

The baud rate and word length of the serial port can be alerted to suit the receiving device.

The default settings are:

Baud rate: 9600
Word length: 8 bit, no parity

These settings are those used by serial printers provided by Bellingham + Stanley, see the Accessories section.

- Network communications

By default, the instrument uses DHCP to obtain an IP address. IP address, Subnet Mask and Default Gateway can be changed as required by first disabling DHCP. The instrument must be powered down for changes to network settings to take effect.

To quickly view the current IP address of the instrument from the Main Menu select:

- 5. Help
- 1. Information

System settings

To make changes to the system settings press Menu, then select:

- 3. Setup
- 6. System

Language

There are several language options available in the instrument by default.

Select the required language and press Yes to confirm the change.

If the language you require is not available, contact Bellingham + Stanley and we will do our best to accommodate your needs.

Remote Display

By turning Remote Display on it will be possible to interact with the instrument using PC software available for download from the Bellingham + Stanley website.

The instrument and PC must be connected to a Local Area Network to use the remote display feature.

Display Brightness

If the display is difficult to read its brightness can be altered to be suitable for the operating environment.

Time/Date

- Date Format

The instrument can display the date in two formats, “dd/mm/yy” and “mm/dd/yy”. These formats will also be used on any printouts.

- Summer Time

This will adjust the instrument’s clock for daylight saving time (adding one hour to the clock).

Set it to yes to advance the clock one hour. Set summer time to no to revert to the system time

- Set Clock…

Enter the time and date in the format displayed on screen, as specified in Date format.

Use the arrow buttons to change the cursor position.

Press ok when the clock is set to the correct time and date.

Temperature control

Under certain conditions it may be useful to disable the prism temperature control or disable the presser.

If the presser is disabled the Auto-single reading setting will no longer function.

Disabling the presser is not recommended unless strictly necessary. Ambient light not shielded by the presser could cause measurement errors, and the presser insulates the prism and sample from ambient temperature.

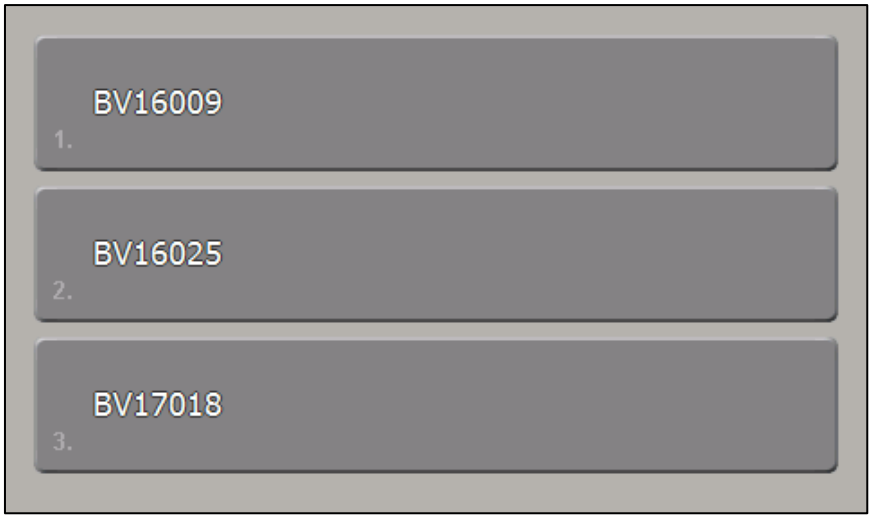
Clone settings

Clone is ideal for restoring parameters if a default has been performed.

The instrument settings can be backed up from the Maintenance Menu, see Page 66. With the USB removable storage device that contains a valid Clone file inserted into the instrument, enter the System Menu and the Clone option will be available.

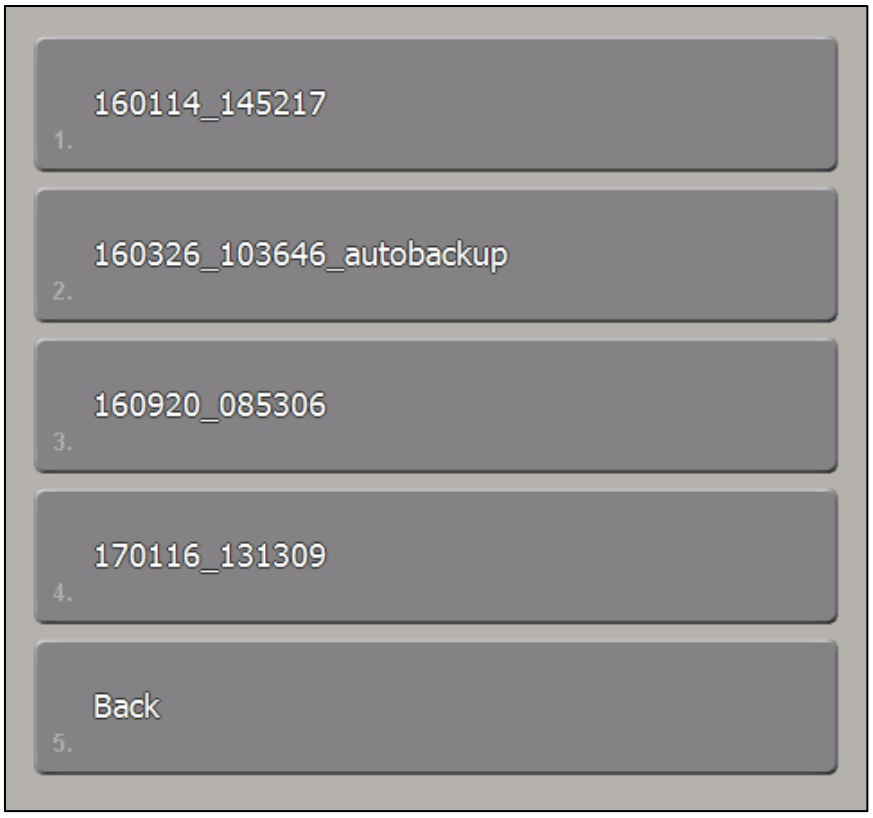
This will copy all settings from the Clone file to the current instrument, useful if settings are accidentally changed or lost, or if multiple instruments are in use only one needs to be setup then the settings copied via USB to all other instruments. This enables quick integration of new or hire instruments.

Once the Clone option is accessed and confirmation given a list of instruments from which backups are available will be displayed.



Select the instrument, by serial number, which has the settings required for the current instrument.

A list of date and time stamped backups will then appear. Select the backup with the required settings.



A backup of the current settings will be made in case the Clone needs to be undone, this will be labelled as an “autobackup”. The selected backup will then be installed.

⚠ **If more than one USB removable storage device is detected the Clone will not be performed.**

⚠ **Do not remove the USB removable storage device during a Backup or Clone as this can lead to loss of data.**

Section 4: System maintenance

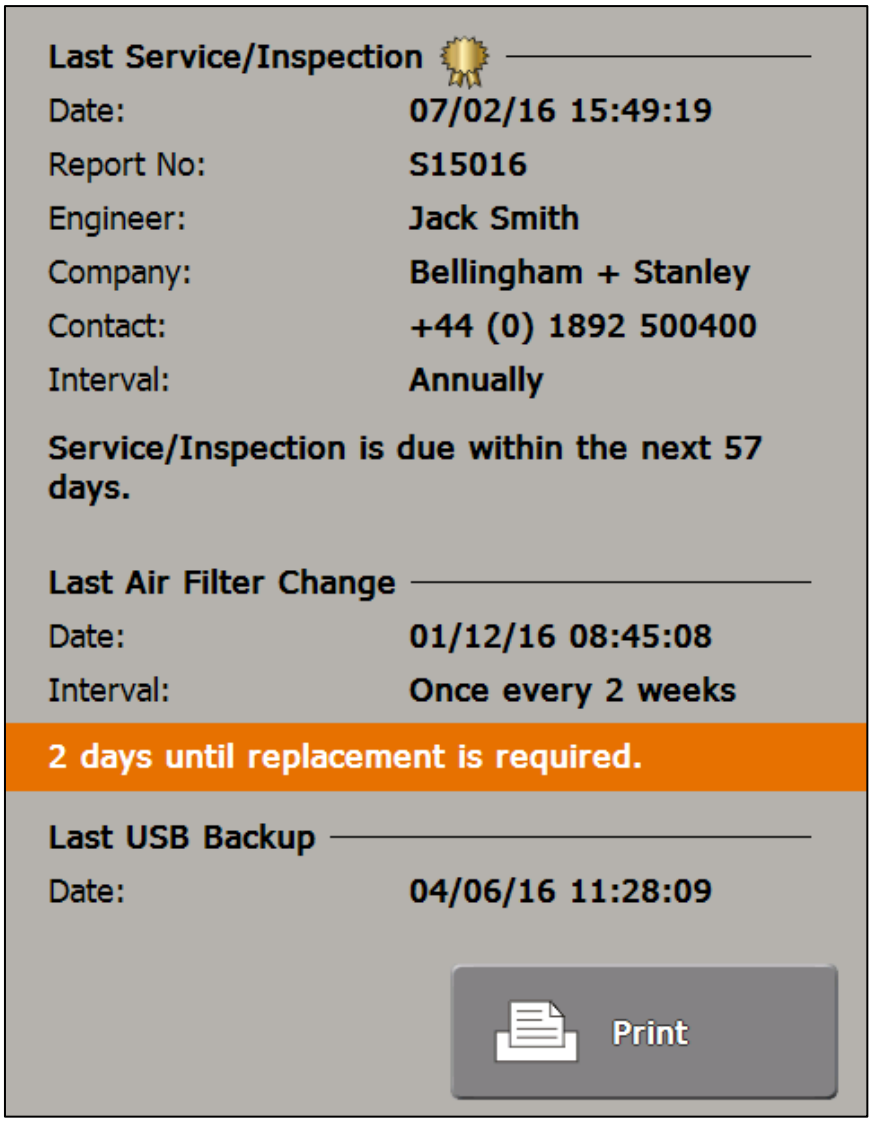
Section 4

Maintenance Menu

There are several options to help keep the instrument in good working order. To access the Maintenance Menu select option 4 in the Main Menu.

Maintenance Report

It is recommended that the instrument is regularly serviced by Bellingham + Stanley trained personnel. Contact Bellingham + Stanley or your local distributor to arrange a service visit.



The Maintenance Report provides a useful reminder of when servicing is required. The reminders also appear on the instrument's standby screen.

A coloured ribbon symbol indicates that the instrument was last serviced by Bellingham + Stanley personnel or an engineer who has received training from Bellingham + Stanley.

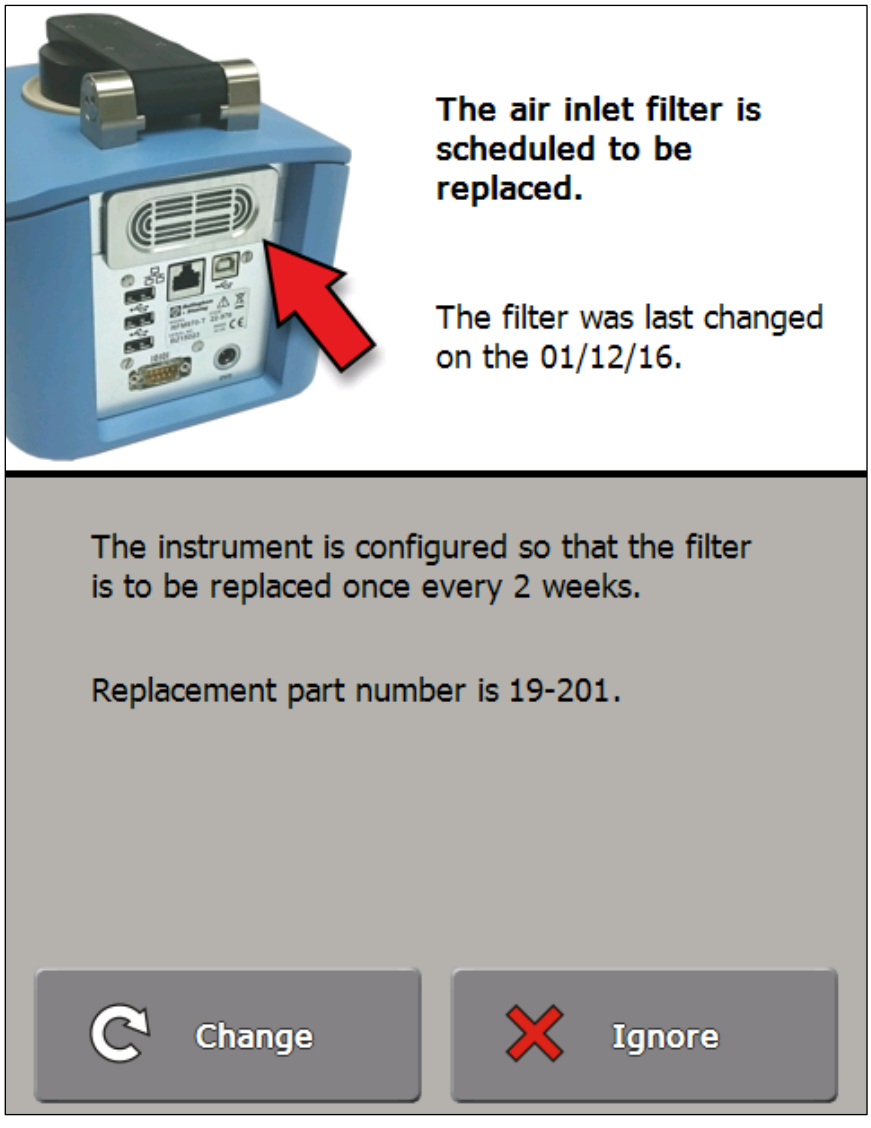
Filter change

The instrument is fitted with a replaceable filter on the cooling air inlet vent which will prevent airborne dust or grease entering the ducting and clogging the fans. Filters should be removed and replaced at regular intervals.

⚠ **The instrument must not be operated with blocked filters or without the filters in place. Doing so could damage the instrument and invalidate the instrument's warranty.**

The replacement interval could be weekly for environments with high levels of atmospheric contaminants or up to every six months for clean room applications. A reminder can be set in the Filter Change Reminder section of the Maintenance Menu.

When the warning period expires, on the next attempt to take a reading a reminder will appear on screen. To change the filter simply pull away the cover at the rear of the instrument, remove the filter, insert a new one and replace the cover. Press change then give confirmation that the filter has been swapped. Press ignore to delay the procedure for a brief period.



Spare filters, code number 19-201, are available from Bellingham + Stanley.

Backup

The Backup option creates a copy of all the settings changed in the instrument.

Using Clone (see Page 61) these changes can be reloaded at a later date to undo accidental changes or deletions.

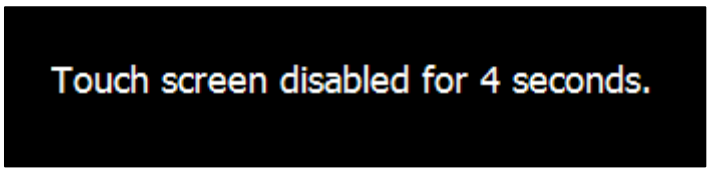
Alternatively, the settings can be Cloned to another instrument. This is useful if multiple RFM300-Ts are available for use. The required settings only need to be configured on one instrument then they can be easily Cloned to all the others. This will also enable quick integration of any new or hire instruments.

To create a backup insert a USB removable storage device before entering the Maintenance Menu. Select Backup to USB, option 3, and the instrument will create a backup file with a date and time stamp.

Backup & Clone is ideal for restoring parameters if a default has been performed. Make backup part of your SOP.

Clean screen

With frequent use the touchscreen can become dirty. To enable the screen to be cleaned without switching off the instrument press Clean Screen. The touchscreen will be temporarily disabled for 10 seconds.



Always use appropriate solvents to clean the instrument's painted surface or the touchscreen, avoid using aggressive solvents or any abrasive cleansers. Contact Bellingham + Stanley for advice on chemical compatibility.

Software update

Bellingham + Stanley pursue a policy of continuous product development and improvement and as such, from time to time, new versions of software will become available. Contact Bellingham + Stanley to obtain new software.

When new software is received it can be installed using a USB removable storage device. Place the software update folder on the USB device, ensure no other USB removable storage devices are in the instrument, and then insert the device holding the update files. Access the Maintenance Menu and select option 5, Update Software.

Confirm the software installation and the instrument will then perform the update.

The instrument will restart after the update is complete.

Do not remove the USB removable storage device during the update process as this can lead to loss of data.

Information and Help

From the Main Menu the Help Menu can be accessed (option 5).

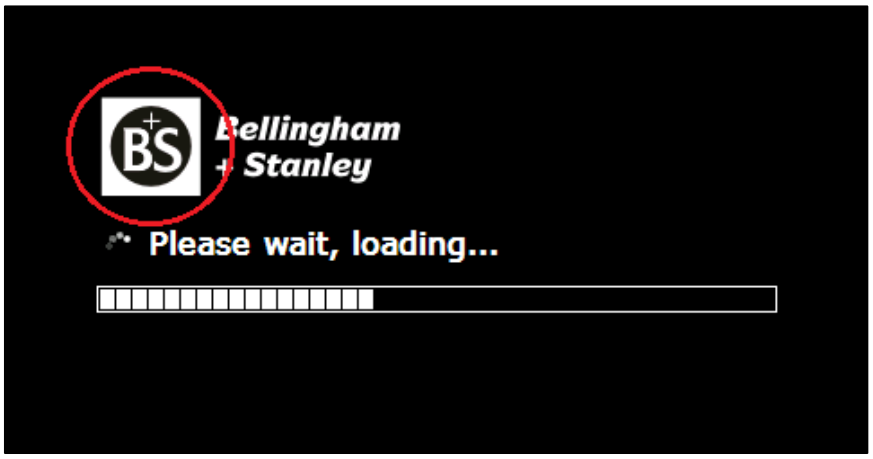
From here information regarding the instrument's software, hardware and network configuration can be seen and printed. This is useful to have available when contacting Bellingham + Stanley for assistance and can be printed to the selected printer. Contact details of Bellingham + Stanley are provided in the Help Menu.

Copies of this User Guide and compatible PC software can also be made to a USB removable storage device or viewed on the instrument display.

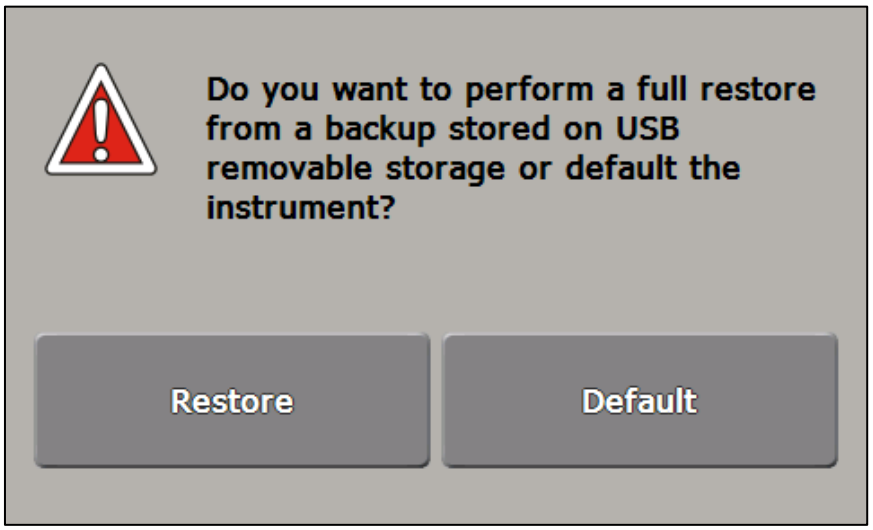
Setting default values

If the instrument fails to start up correctly after switching on, or it is functioning unexpectedly, it could be advisable to reset certain settings to the original factory set (or default) values.

Power the instrument off. Power up the instrument and wait for the loading screen to appear. Press and hold the B+S logo.



Do not release the logo until the restore / default message appears.

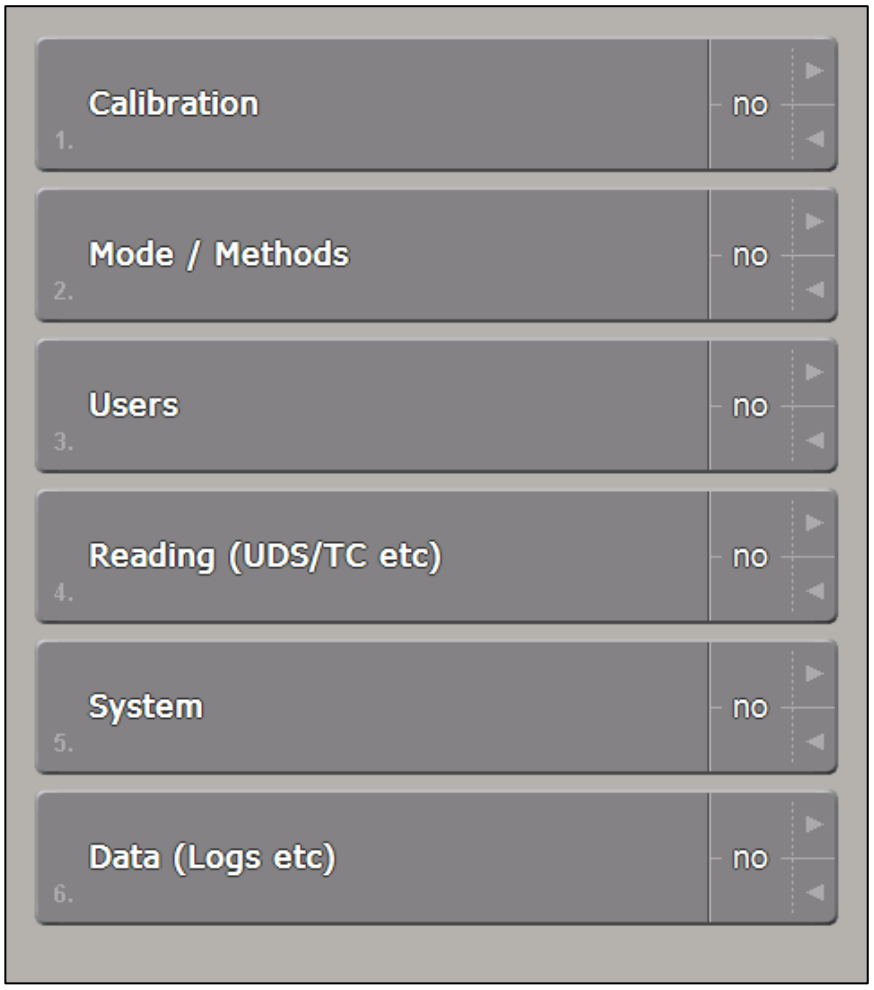


Press Restore to load a backup stored on a USB removable storage device. The instrument will request a USB device is inserted then the Clone procedure can be carried out (Page 61).

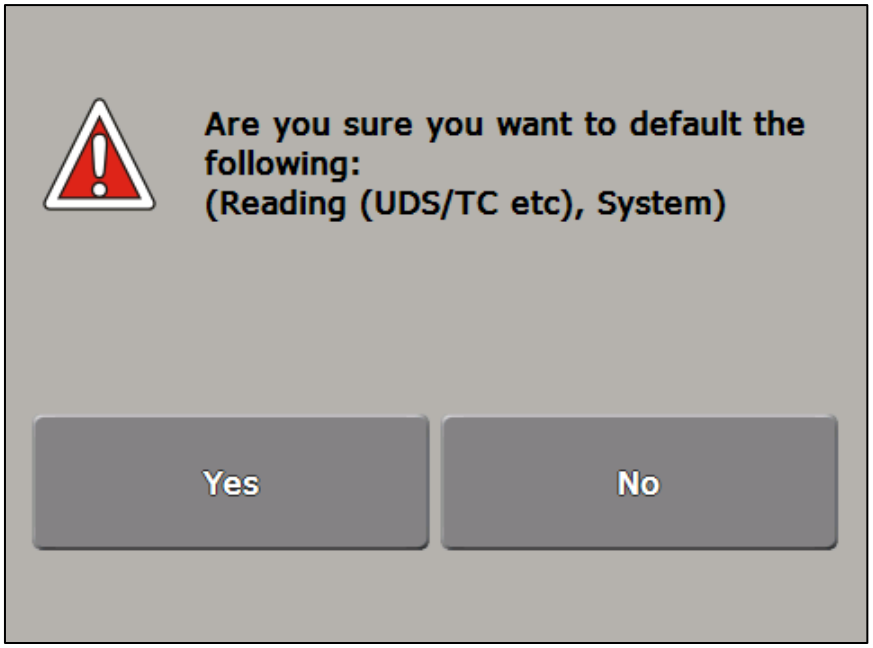
Press Default to return various settings to their factory configuration.

⚠ **Default should be performed as a last resort as all customisation can be lost. Contact Bellingham + Stanley for assistance.**

Initially the options will be set to “no”. Select the settings that you want to return to default values by setting them to show “yes”.



When set as desired press the Quit button.



The instrument will ask the user to confirm their choice. Pressing Yes will carry out the default.

Section 5: Specification

Section 5

Specification

Performance

Model	RFM330-T	RFM340-T	
Refractive index			
Measurement Range	1.32 to 1.58	1.32 to 1.38115	1.38115 to 1.58
Display resolution	0.0001	0.0001 / 0.00001 / 0.000001	
Accuracy (±)	0.0001	0.00002	0.00004
Precision (±)	0.00005	0.000005	
Brix			
Measurement Range	0 to 100	0 to 30	30 to 100
Display resolution	0.1	0.1 / 0.01 / 0.001	
Accuracy (±)	0.1	0.01	0.03
Precision (±)	0.05	0.005	

Temperature

Ambient operating range	0 to 40°C
Measuring low limit	0 to 10°C below ambient (whichever greater)
Measuring high limit	70°C
Stability	±0.05°C
Sensor accuracy	±0.03°C
Storage	-5 to 60°C

Temperature compensation

Sugar (ICUMSA)	10 to 40°C
Sugar (extended)	5 to 10 and 40 to 70°C
AG fluid	10 to 40°C

Prism

Material	Artificial sapphire
N_D	1.7681
Sample surface diameter	12 mm

Prism plate

Material	316 stainless steel
Dish diameter	59 mm
Prism seal	Silicone rubber and resin
Spill barrier material	PEEK

Specification

Communication ports

USB	Type A x3 Type B x1
Ethernet	10/100Mbps
RS232	Baud rate: 4800, 9600, 19200, 38400 Word Length: 7 bit even parity, 8 bit no parity

Default values underlined

Physical

Length (refractometer module only)	340 mm
Width (refractometer module only)	200 mm
Height (refractometer module only)	170 mm
Weight (refractometer module only)	3.0 kg

Power requirements

Voltage	110 to 230 V ~ ±10%
Frequency	50 to 60 Hz
Maximum current	2 A

Specification

Section 6: Accessories and Contact

Section 6

Accessories

Calibration fluids

Bellingham + Stanley, a UKAS accredited calibration laboratory number 0834, offer a number of different calibration materials for verifying and calibrating refractometers, traceable to NIST and ICUMSA. The standards are made to the highest quality and are supplied with certificates in either single or multi-pack formats. Values at temperatures other than 20°C are available in RI and °Brix from a table supplied with the fluid or via the Technical Centre at www.bellinghamandstanley.com.

AG Fluids

AG Fluids are an organic solution calibrated in °Brix and RI and have a long shelf life. They have no special storage or transit requirements and are therefore easy to ship and store.

AG Fluids are manufactured on a %weight/weight basis in a UKAS laboratory using only the highest quality chemicals and AnalaR® distilled water. Manufactured in large batches, the resultant samples are checked using a controlled refractometer that has been carefully calibrated with NIST and PTB primary standards, providing further traceability.

Type	Specification		Code		
	Refractive Index[1]	°Brix[2]	Single 5ml Bottle	Multi-pack of 5 x 5ml Bottle	Multi-pack of 20 x 5ml Bottles
AG2.5	1.33659	2.50	90-401	90-501	90-601
AG5	1.34026	5.00	90-402	90-502	90-602
AG7.5	1.34401	7.50	90-403	90-503	90-603
AG10	1.34782	10.00	90-404	90-504	90-604
AG11.2	1.34968	11.20	90-405	90-505	90-605
AG12	1.35093	12.00	90-406	90-506	90-606
AG12.5	1.35171	12.50	90-407	90-507	90-607
AG15	1.35568	15.00	90-408	90-508	90-608
AG40	1.39986	40.00	90-418	90-518	90-618

[1] Refractive index at 589.3nm and 20.0°C
[2] Equivalent °Brix value

Calibration Oils

Calibration Oils are organic compounds that cover the top end of the Brix scale and are one of the most commonly used materials for calibrating refractometers as they have good traceability, particularly to NIST.

Description	Specification		Code
	Refractive Index[1]	°Brix[2]	Multi-pack of 5 x 5ml Bottles
BSLP	1.46512	69.86	90-525
BSDC	1.51655	89.59	90-530
BSDD	1.55835	n/a	90-535

[1] Example Refractive Index at 589.3nm and 20.0°C
[2] Equivalent °Brix value at 589.3nm and 20.0°C.

Accessories

Printers

	Code
Dot matrix impact printer serial: Euro version 230V	55-14
Dot matrix impact printer serial: UK version 230V	55-15
Dot matrix impact printer serial: US version 110V	55-16
USB Printer – Thermal: 110-240V	55-18

Cables

	Code
Computer (9way D type)	54-07
LAN cable – 2m	54-075
USB cable A to B (male/male) – 2m	54-081
USB cable A to A (male/male) – 2m	54-082
RS232 to USB converter	55-85

Other accessories

	Code
Barcode scanner - USB version	55-82
USB keyboard	55-86
Sample contact presser	22-017
Validation documentation (IQOQPQ)	19-451

Spares

	Code
Paper for dot matrix impact printers (20)	55-91
Printer ribbon for dot matrix impact printers	55-93
Paper for USB thermal printer (20)	55-95
ID tag card (single)	37-530
ID tag key-fob pack (3)	22-071
ID tag key-fob pack (10)	22-072
Touchscreen stylus	19-203
Touchscreen protector	19-204
Air filter pack (12)	19-201

Power supplies

	Code
Power supply (unsealed) 110-230V	55-105
Mains lead for 55-105 with plug suitable for:	
Switzerland	61-181
Denmark	61-182
India / South Africa	61-188
Australia	61-189
UK 13 Amp square pin to BS1363/A	61-191
United States (3 pin)	61-192
Europe (Schuko)	61-193
Power supply (IP65) 110-230V	55-250

- Waterproof (IP65) Power Supply - Code 55-250

A Waterproof Power Supply can be used in place of the standard Bellingham + Stanley non-sealed unit if it is to be operated in a wet or humid environment.

Specification:

Ambient Temperature	5 to 40°C
Physical L x W x H	25 x 8 x 6 cm
Rating	IP 65
Voltage	100 – 240 V~ ±10%
Frequency	50 - 60 Hz

Sample contact presser insert

If the instrument is to be used with samples that are very viscous or solid the standard (non-contact) presser can be replaced with a sample contact presser insert (code 22-017). This insert causes a sample to be pressed against the prism when the presser is lowered.

Because the presser comes into contact with sample it must be thoroughly cleaned between applications to stop cross contamination of samples.

To fit, unscrew the four screws on the top of the presser arm. The presser insert and arm can then be separated.

Fit the new presser insert and replace the four screws to hold the insert in place.

Contact

For product support, please contact your local supplier or contact us via our regional offices below:

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About Xylem

Xylem |ˈzīləm|

1) The tissue in plants that brings water upward from the roots;
2) a leading global water technology company.

We're a global team unified in a common purpose: creating advanced technology solutions to the world's water challenges. Developing new technologies that will improve the way water is used, conserved, and re-used in the future is central to our work. Our products and services move, treat, analyze, monitor and return water to the environment, in public utility, industrial, residential and commercial building services, and agricultural settings. With its October 2016 acquisition of Sensus, Xylem added smart metering, network technologies and advanced data analytics for water, gas and electric utilities to its portfolio of solutions. In more than 150 countries, we have strong, long-standing relationships with customers who know us for our powerful combination of leading product brands and applications expertise with a strong focus on developing comprehensive, sustainable solutions.

To learn more about Xylem products and services, including other analytical devices, please visit our websites:

http://www.xylemanalytics.com

http://www.xyleminc.com

Contact