

# MicroLab

## Operating Manual

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Micro Medical Ltd.,

PO Box 6,

Rochester,

Kent ME1 2AZ

ENGLAND

[www.micromedical.co.uk](http://www.micromedical.co.uk)

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## Introduction

The MicroLab is part of a new range of respiratory instrumentation with the most comprehensive range of features to be found in spirometers of their size and price.

The MicroLab is capable of performing spirometry, with or without tidal breathing before the forced manoeuvre and airways resistance measurements.

It is fully portable and can be operated directly from the mains power or from the integral rechargeable NiMH battery pack.

The MicroLab uses the Micro Medical Digital Volume Transducer, an extremely stable form of volume transducer, which measures expired air directly at B.T.P.S (Body Temperature and Pressure with Saturated water vapour) thus avoiding the inaccuracies of temperature corrections. This transducer is insensitive to the effects of condensation and temperature and avoids the need for individual calibration prior to performing a test.

The MicroLab has many advanced features including a high resolution graphic display giving real time respiratory traces, user customisation of instrument functions, predicted values, patient database, and the ability to carry out pre and post bronchodilator and post steroid testing.

The MicroLab may also be used with the MicroRint transducer to perform airways resistance measurements by the interrupter method.

The MicroLab can be used to make and record a minimum of 1000 complete respiratory tests, depending on type. The recorded tests can be uploaded to a computer or printed by direct connection to a printer.

To upload to a computer the unit is connected with the serial lead provided using SPIDA spirometry software. SPIDA is a fully Windows™ compatible spirometry system that can interface to the spirometer in either of two ways. Firstly, tests recorded with the spirometer can be uploaded to SPIDA and appended to the integral database, for subsequent storage and analysis. Secondly, live spirometry may be performed with the instrument connected to a computer running SPIDA. In this case MicroLab becomes a powerful respiratory laboratory tool with many display options including powerful reporting and database facilities.

Stored data may be printed to the integral thermal printer or to an external printer using the serial to parallel interface Cat. No. MLA350.

The manual is divided into two sections. The first section deals with the customisation of the instrument functions and the second with the operation. It is highly recommended that the MicroLab be configured prior to use, as many of the MicroLab's functions can be customised by the user to suit their own requirements. The defaults set by the user are stored permanently in the spirometer and will remain unchanged until customisation is repeated.

Thereafter, the user may refer to the second section only.

## Package Contents

The MicroLab is packaged in a sturdy carrying case containing this manual and the following items (Fig.1):

1. MicroLab microcomputer unit with graphic display
2. Micro Medical Digital Volume Transducer
3. Transducer housing.
4. AC Adapter (Cat. No. PSU7800)

Together with mains supply lead and disposable cardboard mouthpieces. (SPIDA 5 software is available separately)

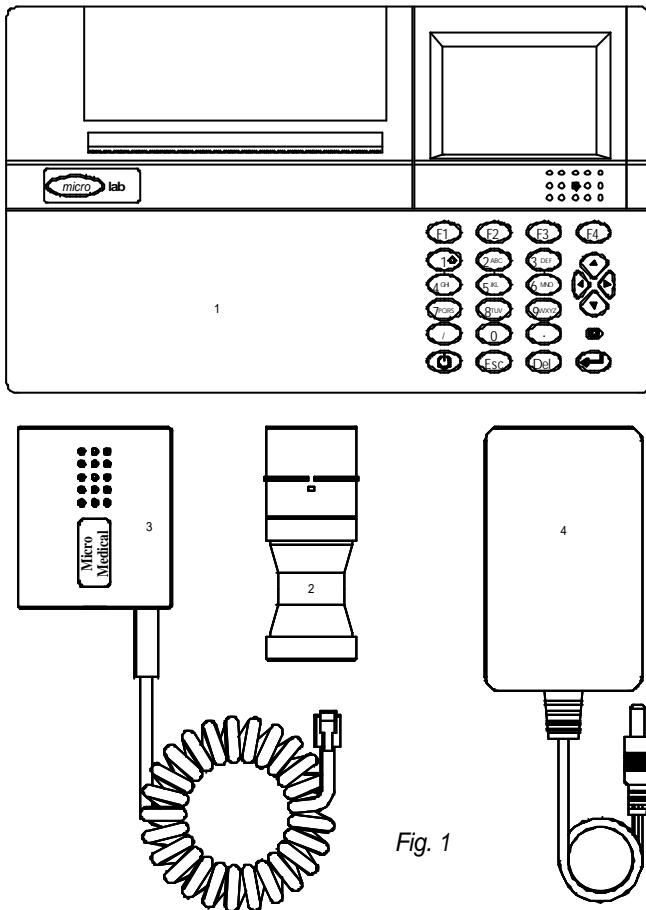
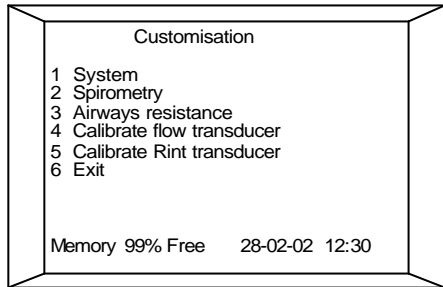


Fig. 1

# Section 1 - User Customisation

To customise the MicroLab hold down the enter key, turn the unit on, and then release the enter key after the display goes blank.

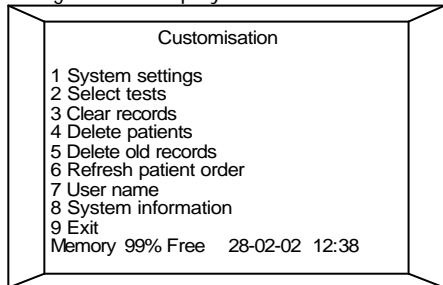
The following screen will then be displayed:



## Customisation option 1: System

When this option is selected the following will be displayed:

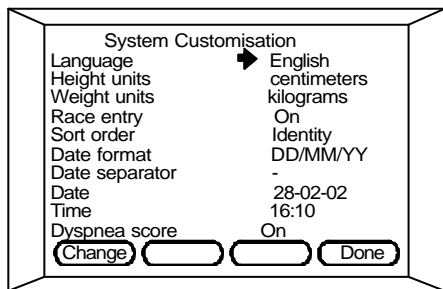
From this menu system settings such as date format and language may be changed, the required tests may be selected, records may be cleared from memory, and a user name may be entered.



## System Customisation option 1: System settings

When the system settings option is selected the following will be displayed:

The current settings are shown on the right hand side with an arrow pointing to the active entry. The active entry may be changed by pressing F1, in the case of multiple selections, or by using the delete and numeral keys, in the case of date and time entry. The arrow may be moved by using the up and down cursor keys.



**Language** – A choice of up to seven languages will be available depending upon national preferences.

**Height units** - The patient's height may be entered in centimetres or inches.

**Weight units** - The patient's weight may be entered in kilograms or pounds.

**Race entry** - The racial origin and correction factor, entered with the patient details, may be disabled using this option.

**Sort order** - When selecting a patient from the database the list may be displayed in order of first name, last name or patient identity number.

**Date format** - The date format may be selected as DD/MM/YY, MM/DD/YY, or YY/MM/DD.

**Date separator** - The date separator may be selected as - . or /  
Using these options, dates may be represented as 13-08-01, 13.08.01 or 13/08/01.

**Date** - The current date may be entered when this setting is active. If correction is required, first use the delete key to remove the previous setting and then type the correct date using the numeral keys.

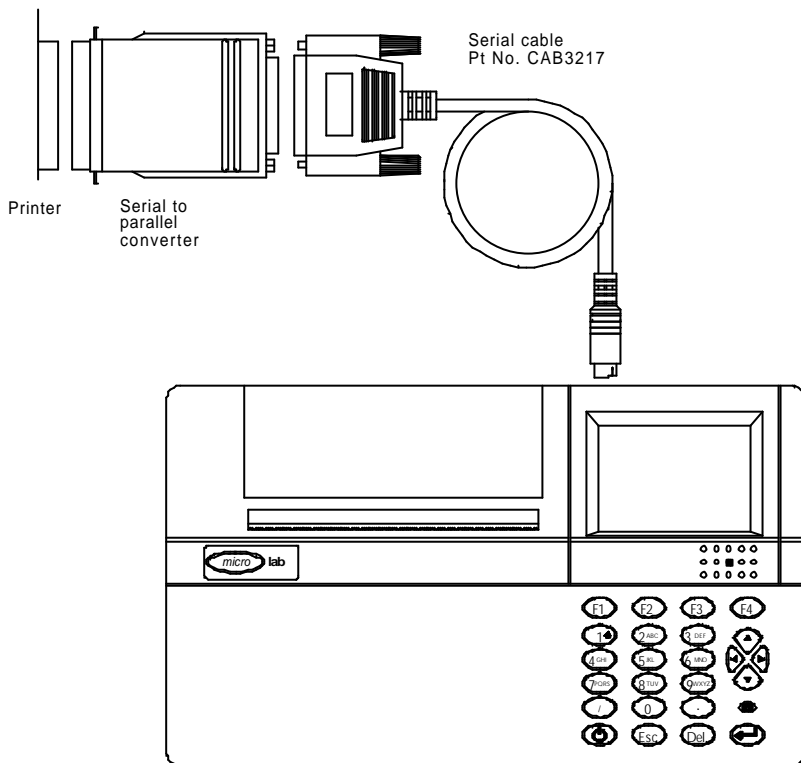
**Time** - The current time is displayed and may be corrected as follows. First use the delete key to remove the previous setting and then type the correct time using the numeral keys. The main rechargeable battery powers the internal clock. In normal use this battery is continuously monitored and the unit will display a warning and turn off automatically before the battery becomes completely discharged. If, however, the unit is left unused for several weeks the internal battery may become completely discharged and the clock will need adjusting once the battery is recharged.

**Dyspnea score** – A dyspnea score, entered with the patient details, may be disabled using this option.

**Printer** - The option to use either the integral thermal printer or external Canon or Hewlett Packard printers.

**Sound** - Select either : Off, High, Medium or Low pitch

Please note. If using an external printer, connect the MicroLab to the printer whilst both are switched off. The MicroLab must be connected to the specified printer with a serial to parallel converter Cat No. MLA 350. With both units switched off connect the round Mini-Din plug on the serial cable to the socket in the left hand side of the MicroLab. Connect the 25 way D connector to the serial to parallel converter and plug the converter into the printer Centronics type socket.



It is recommended that whilst printing the batteries are on charge with the unit connected to the mains adapter as more power is required to drive the serial to parallel converter.

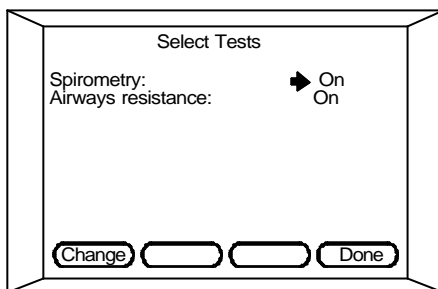
NOTE: Keep the printer out of reach of the patient when connected to MicroLab.

## System Customisation option 2: Select tests

When this option is selected the following will be displayed:

The MicroLab is capable of performing two types of respiratory function test.

It is recommended that only the required tests be activated to reduce the selections required during operation.



The spirometry test may be performed with a single forced expiration and inspiration or with tidal breathing prior to the forced manoeuvre.

Please note that the airways resistance test may only be performed using a MicroRint transducer.

Use the up and down cursor keys to move the arrow to the required test and then use F1 to turn the test on or off.

## System Customisation option 3: Clear records

This option is used to remove all patient records from memory. A warning will be displayed when selected to avoid the possibility of accidental erasure.

An individual patient's records may be deleted when a patient is selected during normal operation – see **Operation**, page 25

## System Customisation option 4: Delete patients

This option will delete all patients from the database who have no test results stored.

## System Customisation option 5: Delete old records.

This option will delete all old records. The period, from 3 to 36 months, for which records must be kept is specified when this option is used.

## System Customisation option 6: Refresh patient order

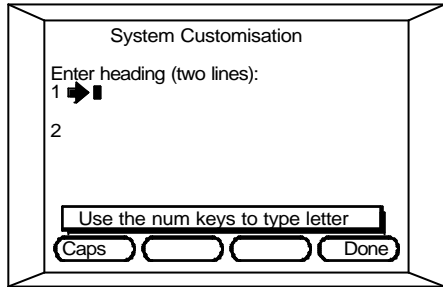
In some circumstances the order of the patients in the database may become disarrayed. This will be evident when the patients are listed in incorrect order when selecting a patient from the database, listed by name.

Using this option will correct the patients' name order.

### System Customisation option 7: User name

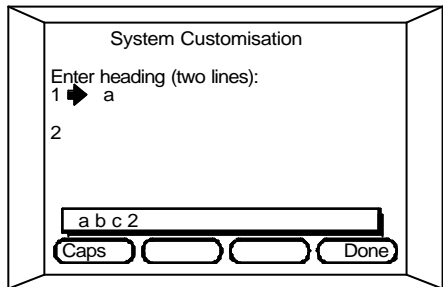
A two-line hospital or surgery name may be entered and will appear on the heading of the printed report. The lines may be up to 30 characters long each. When this option is selected the following will be displayed:

Type the required name using the keypad. The numerals 2 to 9 are ascribed letters of the alphabet in groups.



For example, 2 is ascribed the letters a, b, c, 2 and when pressed the following will be displayed:

Pressing 2 again will change the letter to the next one on the list at the bottom of the screen. Use the F1 key to change from lower to upper case. To type the next letter simply press the key with the required letter and the cursor will automatically move one place to the right.



If the next letter is on the same key then wait for two seconds and the cursor will move to the right automatically. If a mistake is made then use the delete key to go back. To insert a space in the text use the right arrow key.

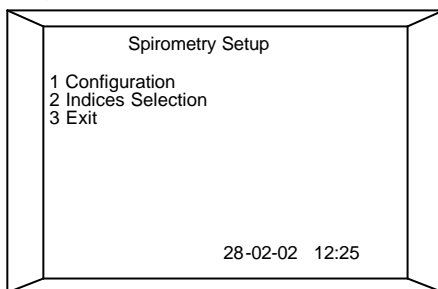
Continue until the required name is complete and then press enter. The second line may now be entered in the same way. Use the numeral keys together with the delete key to correct any mistakes and press F4 when complete. The display will then return to the system customisation menu.

**System Customisation option 8: System information** – issue status shown on either the display or as a print option.

## **Customisation option 2: Spirometry**

When this option is selected the following will be displayed:

From this menu the spirometry settings such as peak flow units and display default may be changed, and the required indices to be displayed and printed may be selected.

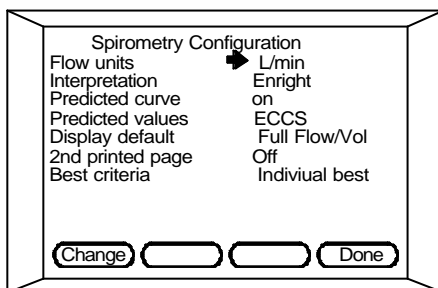


## **Spirometry customisation option 1: Configuration**

When this option is selected the following will be displayed:

The current settings are shown on the right hand side with an arrow pointing to the active entry. Pressing F1 will change the active entry.

The arrow may be moved by using the up and down cursor keys.



**Flow Units** - This option is used to change the displayed units of peak expiratory flow from litres per minute (L/min) to litres per second (L/sec).

**Interpretation** The interpretation displayed at the end of a spirometry test may be set to Enright<sup>2</sup>, BTS<sup>3</sup>, NICE<sup>6</sup> or 'none'.

**Predicted curve** - The dashed predicted curve and dotted baseline curve (displayed when performing a post-bronchodilator test) may be configured to appear as default using this option. However, regardless of default setting, they may be turned on and off during a spirometry test by using the up and down arrow keys.

**Predicted values** - Up to five sets of predicted values will be available depending upon national preferences.

Note: If Roca (Spanish) predicted values are selected, then a weight entry will appear, and must be entered, on the patient details screen.

**Display default** - During a spirometry test the display can be set to show the full flow/volume curve (Full Flow/vol), the expiratory part of the flow/volume curve (flow/vol), the volume/time (Vol/time) graphs, or the child incentive as the default. In either case the display can be changed after a spirometry manoeuvre has been performed by using the left and right arrow keys.

**2nd printed page** - There are four settings for this option which control the content of a full report:

Off - a single page report showing all the results together with the Flow/volume and Volume/time curves will be produced.

Flow/vol - a two page report will be produced with the second page giving a large Flow/volume loop exceeding ATS recommendations.

Vol/time - a two page report with a large Volume/time curve exceeding ATS recommendations.

Both - a two page report giving both Flow/volume and Volume/time curves to ATS recommendations.

**Best test criterion** - The criterion for the automatic selection of the best manoeuvre from a series of spirometry tests may be selected. The options are maximum FEV<sub>1</sub>, FVC, PEF, sum of FEV<sub>1</sub> and FVC best individual indices.

The selected criterion is used to automatically select the best blow when saving, printing or reporting on a series of manoeuvres.

If 'individual best' is selected then the greatest individual indices from a series of manoeuvres are selected except the indices derived from the flow/volume loop. These indices (MEF<sub>75</sub>, MEF<sub>50</sub> and MEF<sub>25</sub>) are measured from the composite flow/volume curve by the method described by ERS – Standardized Lung Function Testing<sup>5</sup>. The composite curve will then also be used for the printed report.

Note: when composite flow/volume curve is used only the expiratory part of the forced manoeuvre is stored and any tidal breathing pattern performed prior to the forced manoeuvre will be lost.

The chosen criterion is also used to select for display the best baseline result when a post-bronchodilator manoeuvre is performed.

## Spirometry customisation option 2: Indices selection

The spirometry indices reported and available for printout upon completion of a test may be customised using this option:

All indices, apart from FEV1, FVC and PEF, which are always displayed and printed, may be turned on or off. Up to 15

indices, from a total of 36, may be enabled at one time and will appear on the report screen upon completion of a spirometry test and on the printout. All the indices are stored irrespective of those selected and can be retrieved by changing the selection except for dyspnea score, which will only be stored if the patient's dyspnea score is stored with the patient's details.

Use the up and down arrow keys to select the required indices and press F1 to toggle on or off. An index will not turn on if 15 have already been selected.

Use F3 and F4 to page through the selection screens. Press F2 when all the selections have been completed.

Indices selection (Max 15)

VC	<input type="checkbox"/>	FEV1/FVC	<input checked="" type="checkbox"/>
FEV.75	<input checked="" type="checkbox"/>	FEV3/VC	<input checked="" type="checkbox"/>
FEV1	<input checked="" type="checkbox"/>	FEV3/FVC	<input checked="" type="checkbox"/>
FEV3	<input checked="" type="checkbox"/>	FEV.75/FEV6	<input checked="" type="checkbox"/>
FEV6	<input checked="" type="checkbox"/>	FEV1/FEV6	<input checked="" type="checkbox"/>
FVC	<input checked="" type="checkbox"/>	MEF25	<input checked="" type="checkbox"/>
PEF	<input checked="" type="checkbox"/>	MEF50	<input checked="" type="checkbox"/>
FEV.75/VC	<input checked="" type="checkbox"/>	MEF75	<input checked="" type="checkbox"/>
FEV.75/FVC	<input checked="" type="checkbox"/>	MMEF	<input checked="" type="checkbox"/>
FEV1/VC	<input checked="" type="checkbox"/>	FEF50/VC	<input checked="" type="checkbox"/>

Change Done PgDn

### **Customisation option 3: Airways resistance**

When this option is selected the following will be displayed:

Use the up and down arrow keys to select the required option and use the delete and numeral keys to enter the trigger flow and F1 to change the other options.

Press F4 when all the selections have been completed to save your selections and return to the customisation menu.

Airways Resistance Customisation	
Set trigger flow	0.00
Trigger method	Random
Operating mode	Continuous
Number of tests	10
Printout	With graphs
Display default	Flow/time
Predicted value	Lombardi

Change   Done

**Set Trigger Flow** - This option allows the default value of flow at which the occlusion occurs to be set. When selected the following will be displayed:

Any value between 0.1 l/s and 1.99 l/s can be entered. If a high value is chosen then it is possible that the unit will never occlude during a test, as the subject may never reach the set flow rate.

If a very low value is set then inconsistent values of Rint may be obtained, as the signal may be lost in physiological noise.

If zero is entered then the unit will trigger on the peak of the flow curve. The instrument will always occlude using this setting and the signal will be above any noise.

The trigger level can also be adjusted from the airways resistance main menu prior to performing a test.

**Trigger method** - This option sets the default for the trigger method, random or user.

If random is selected then occlusion of the patients tidal breathing will occur automatically in a random pattern until the required number of tests have been performed.

If user is selected then no occlusions will occur until the user initiates a test with a key press.

**Operating mode** - The airways resistance test may be operated in discrete or continuous mode.

With discrete mode each occlusions has the associated pressure and flow waveforms displayed immediately after the occlusion. The user may then choose to accept or reject the measurement before proceeding. In continuous mode the flow and pressure waveforms may be reviewed upon completion of the test and spurious results deleted.

**Number of tests** The airways resistance measurement is taken as the median of the results obtained from a number of occlusions up to a maximum of 15. The maximum number of occlusions per test may be set using this option.

**Printout** - The printed report will contain summary results of all the occlusions occurring during a test. This may be accompanied by the flow/time and pressure /time curves if required.

**Display default** - During a test the display can be set to show the full flow/volume curve (Flow / vol) or the flow/time graph (Flow / time). In either case the display can be changed after during a test by using the left and right arrow keys.

**Predicted value** – Lombardi, Eiser or Merkus predicted values may be selected.

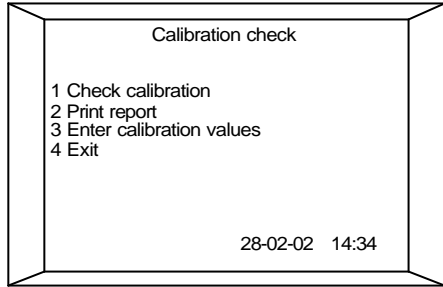
### Customisation option 4: Calibrate flow transducer

The MicroLab is calibrated to read volumes in litres at body temperature, barometric pressure saturated with water vapour (BTPS).

The calibration should remain stable indefinitely, unless the transducer is physically damaged, and the unit should not require re-calibration.

However, as a check on the correct functioning of the unit we do recommend that the calibration be checked periodically.

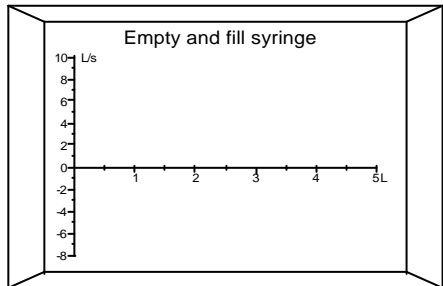
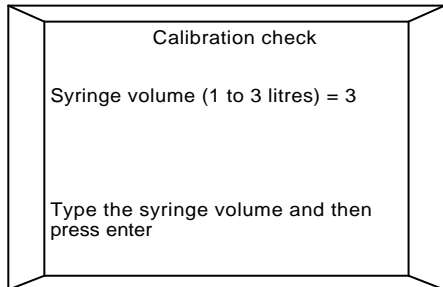
When this option is selected the following options will be displayed:



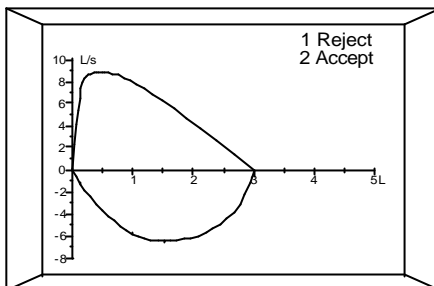
**Check calibration** – press 1 to check the calibration and the following will be displayed:

To check the calibration of the MicroLab a large syringe should preferably be used with a 30mm outlet. A 3 Litre Syringe is available from Micro Medical as Cat. No. SMI2125.

The MicroLab transducer should be connected to this syringe with the minimum of adapters. Type in the syringe volume and then press enter and the display will change to:

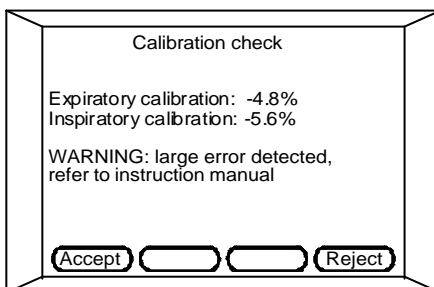


With the syringe connected press a key and empty the syringe evenly, without pausing, and avoid banging the syringe against the end stop. Once emptied, immediately reverse the procedure and fill the syringe to obtain both expiratory and inspiratory calibrations.



If the syringe was not emptied smoothly and without banging against the end stop, press 1 to reject the calibration and repeat the procedure. When a satisfactory manoeuvre has been performed press 2 to accept.

Upon completion, the inspiratory and expiratory calibration errors will be displayed. If the calibration error is greater than 3%, in either direction, then the following warning will be displayed:



If the calibration error was negative, check the syringe for leaks and the flow transducer for free rotation of the vane. If a fault is found then press F4 to reject the calibration.

Once the calibration check has been successfully completed press F1 and the new calibration values will be stored.

**Print report** – Press enter to start printing or ESC to cancel. A calibration report giving details of the last calibration check will be produced.

**Calibration values** - This option is only used when a replacement flow transducer is supplied by Micro Medical with ATS calibration factors.

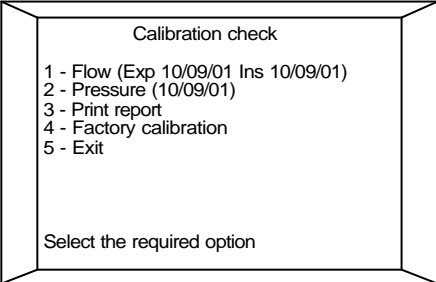
### Customisation option 5: Calibrate Rint transducer

The Rint value is calculated from the measurements of flow, prior to occlusion, and the pressure during occlusion. Both flow and pressure can be independently calibrated.

Flow is measured using the pressure differential across a stainless steel resistive element. A high fidelity, high frequency, pressure transducer is used with a long-term drift of +/- 0.5% per annum. It is only necessary, therefore, to perform the pressure calibration yearly. Micro Medical can supply a pressure calibration kit (Cat No. CAL6000).

The stability of the flow calibration depends on the pressure transducer and on the characteristics of the resistive element. These characteristics will remain stable for at least 50 tests as long as no physical damage has occurred and that the disposable filter is always used.

When calibration is selected the following options will be displayed together with the dates of the last calibrations:



Calibration check

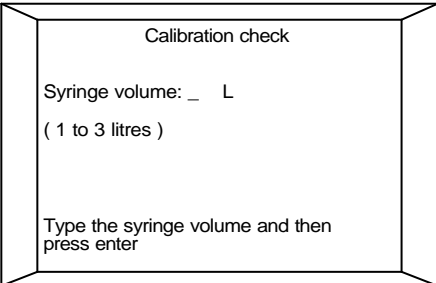
- 1 - Flow (Exp 10/09/01 Ins 10/09/01)
- 2 - Pressure (10/09/01)
- 3 - Print report
- 4 - Factory calibration
- 5 - Exit

Select the required option

### Option 1 - Calibrate flow

When this option is selected the display will show:

Type the syringe volume and then press enter.



Calibration check

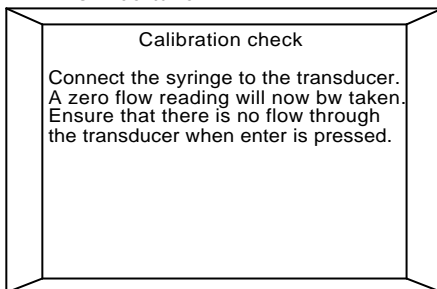
Syringe volume: \_ L

( 1 to 3 litres )

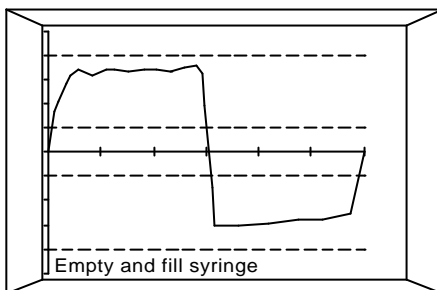
Type the syringe volume and then press enter

A zero flow reading of the transducer will now be taken:

Connect the syringe to the Rint transducer, using the respiratory filter, and withdraw the syringe handle fully. Ensure that there is no flow through the transducer, when enter is pressed.

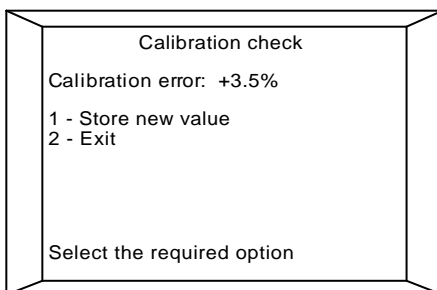


The display will then show a graph of the flow generated when the syringe is emptied: Try to keep the flow within the dotted lines. Once emptied, immediately reverse the procedure and fill the syringe to obtain both expiratory and inspiratory calibrations.



If the calibration drift is greater than 3%, in either direction, then the option to store the new value will appear:

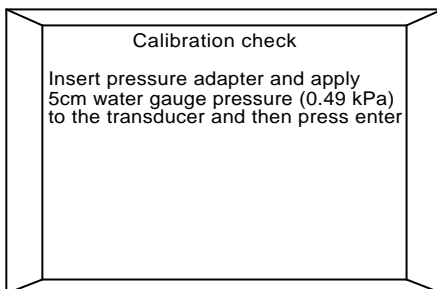
If the syringe is emptied too quickly then an error message indicating that the flow was too high is displayed and the procedure should be repeated with a lower flow.



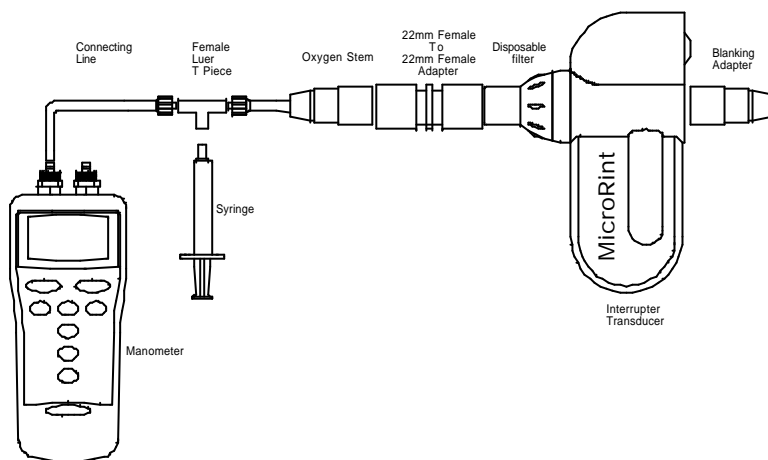
## Option 2 - Calibrate pressure

Pressure may be calibrated using the pressure calibration kit, CAL6000.

When selected, instructions for the auto-zero procedure are displayed followed by:

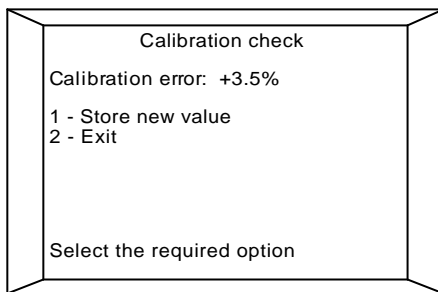


Connect the free end of the tubing to the electronic manometer and connect a syringe to the T piece as shown below:



Carefully close the syringe until 5cm of water gauge pressure is obtained, and remains stable, and then press enter.

If the calibration error is greater than 3% then the option to store the new value will appear:



### **Option 3 – Print report**

Press enter to start printing or ESC to cancel. A calibration report giving details of the last calibration check will be produced.

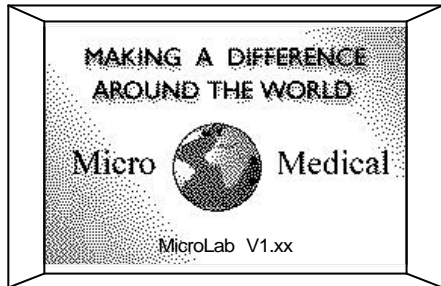
### **Option 4 – Factory calibration**

This option is only used when a replacement Rint transducer is supplied by Micro Medical with factory calibration flow and pressure values.

## Section 2 - Operation

Connect the transducer to the MicroLab unit using the socket located at the rear of the instrument and turn on.

An introductory screen giving the software version will be displayed momentarily:



### Main Menu

#### Overview

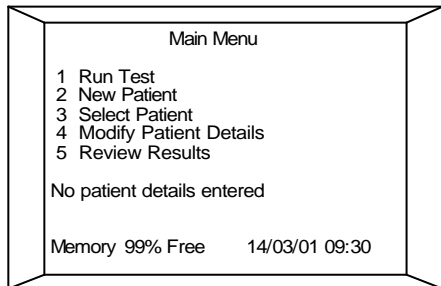
The main menu will appear:

From this menu the details of a new patient may be entered into the MicroLab database or an existing entry may be retrieved or modified.

A stored test may be retrieved in order to review or delete.

A retrieved test may have a post bronchodilator or post steroid test appended to the baseline test.

A test may be performed with no patient selected. In this case only the patient's age, height and sex need be entered if predicted values are required.



**Note:** The current date and time and the amount of memory available are displayed at the bottom of the display. If the date or time is incorrect, they may be altered. If the free memory is below 5% then more memory may be made available by deleting stored records. If a permanent record is required the stored results may be uploaded to a PC running SPIDA 5 software, see **PC connection using SPIDA 5**, page 49.

### Option 1 – Run test.

When this option is selected the test selection screen will be displayed:

The patient details will appear only if they have been entered or retrieved from the patient database using options 2 or 3.

Please note that if only one test has been enabled then this screen will be skipped - see **System Customisation**, page 6.

Select test

- 1 Spirometry
- 2 Airways resistance
- 3 Exit

Christopher Lawson  
12345ABCDE Male 186cm 85Kg  
BMI 254 Factor 100(Caucasian)  
Dyspnea score 5  
28-02-02 12:34

A test may be performed with or without a patient selected. If no patient has been selected then the following screen will appear when Run Test is selected:

These details must be entered to obtain predicted values. If predicted values are not required, press delete or F4 to continue.

Quick patient information

Sex → Male  
Age  
Height (cm)  
Factor

Change Done Done

### Option 2 – New Patient

Select this option to enter a patient's details not previously stored in the MicroLab.

Type the patient's identity, up to 15 characters, using the keypad – see **system customisation**, page 10.

When the identity has been entered press enter and the cursor will move down to the first name.

This is followed by the patient's second name, sex, date of birth, height, weight racial origin, correction factor and dyspnea score. The first and second name may be up to 12 characters long and must be abbreviated if longer names are required.

New patient

Identity →  
First name  
Last Name  
Sex  
Date of birth  
Height (cm)  
Weight (kg)  
Origin

Use the numeral keys to type letter

Caps Done Done

A dyspnea score of 1 to 5 should be entered, however, if the dyspnea score is not required then leave blank. When entering these details the keys will be numeric only.

Please note that in order to store the patient's test results the first and last names may be omitted, but all other data fields must be completed. The patient's name may be picked up from the SPIDA database if the results are uploaded at any time or added to the MicroLab database subsequently. In order for predicted values to be calculated and displayed the patient's age, height and sex must be entered.

**Note : For spirometry tests** - the age range is from 7 to 110 years, height from 110cm to 250cm depending upon the version.

The patient's weight must be entered if Roca predicted values are used or to obtain the body mass index, BMI. The dyspnea score is only entered if required – see **spirometry customisation**, page 11. **For Rint tests** – Lombardi values – the age range is 3 to 6 years, height from 94 to 130cm. Merkus values – No age required, height from 90 to 125cm.

The 'origin' entry will allow the patients ethnic origin to be selected from a list and printed on the test report; it is not used to adjust the patient's predicted values.

The 'factor' entry is an ethnic correction factor that reduces the adult predicted values of volumetric measurements.

The MicroLab may also be configured to disable the race entry and correction factor entries. - see **spirometry customisation**, page 7.

Press Esc to cancel this option and return to the previous screen or F4 to save the details into the patient database.

### Option 3 – Select Patient

To select a patient from the MicroLab's database chose this option and the display will show a list of patient ID and names:

The patients will be displayed in order of their ID, first name, or last names depending upon the

sort order selected with the system configuration settings. The current patient selection is highlighted. The sort order is displayed on the top line.

Select patient (Sort: Identity)

113345	Philip Chowienczy
23H67	David Cocks
7FF33	Richard Haynes
77789H4	Glen Hillsley
8765432	John Jones
ABCDE	Christopher Lawso
JNNB	Daniel Quirke
JOP1234	Martin Marsh
L54H67	John Giles
X56777	Samuel Harper

Re-Sort Search PgUp PgDn

If long ID's and names are used then text on the right hand side of the display may be truncated. By pressing F1 the data will be re-sorted and the truncated text will become visible as the order is changed.

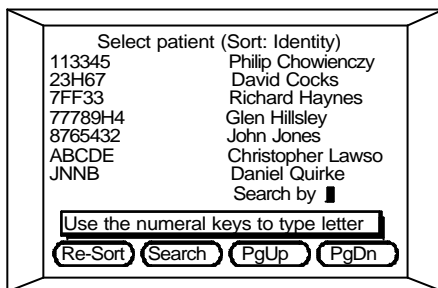
Use the up and down arrow keys in order to scroll through the list.

If the required patient does not appear on the screen then use F4, PgDn, to quickly page down to the required screen and then use the arrow keys to highlight.

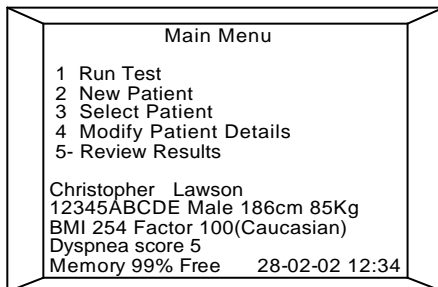
Use F1 to re-order the list by patient name or ID as required.

To search the database for a patient press F2 and the following will be displayed:

Typing the first letters of the required name or patient identity will search the list. After each letter is typed the display will shift to the nearest match.



Press enter when the required patient has been highlighted and the main menu will be displayed with the full patient details:

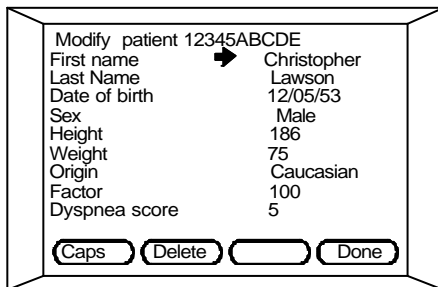


**Note:** Check that the patient's height, weight and dyspnea score are correct, as these may have changed since the data was last entered. If incorrect use option 4 to modify before proceeding.

### Option 4 - Modify Patient Details

To adjust any of the patient's details select this option and the current patient details will be displayed:

If no patient has been selected then the patient selection screen



will be displayed first.

To adjust the data use the up and down arrow keys to highlight the required field and type the correction. Please note that the patient ID cannot be altered.

To delete a patient from the database, press F2. A warning will be displayed to the effect that all stored results associated with the patient would also be deleted.

To accept the data and return to the main menu press F4.

Press Esc to cancel this option and return to the previous screen.

### Option 5 – Review Results.

Once a patient has been selected any of their stored test results may be retrieved. The tests will be displayed in chronological order:

Use the up and down arrow keys in order to scroll through the list.

If the required test does not appear on the screen then use F4, PgDn, to quickly page down to

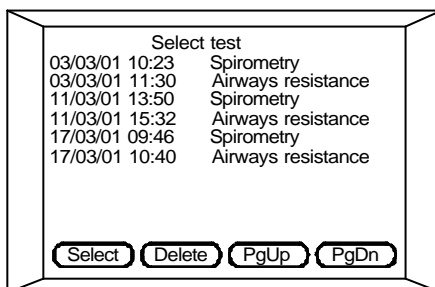
the required screen and then use the arrow keys to highlight.

The selected test may then be reviewed or deleted.

Once reviewed the display will show the report menu for the type of test performed. From this menu it is possible to perform post medication tests, view or print the results, see relevant section for details.

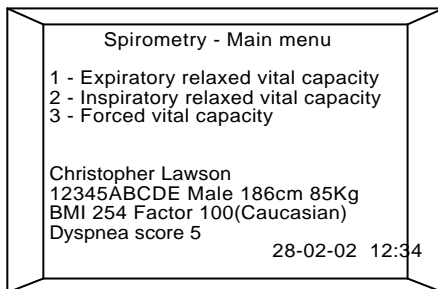
To delete a test press F2. A warning will be displayed to avoid the possibility of accidental erasure.

Press Esc to cancel this option and return to the previous screen.



## Spirometry overview

In the interests of clarity the following instructions assume that all configurable options and tests are enabled with the printed loops set to 'Both', display default set to full flow/volume and that the units for height and PEF are set to cm and L/sec respectively. See **user customisation**, page 11, for a detailed description of all available options.

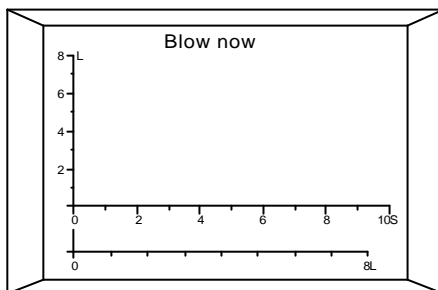


## Relaxed inspiratory/expiratory vital capacity

**Option 1 and 2** These options allow a relaxed vital capacity measurement to be made, prior to performing a forced vital capacity manoeuvre, if required.

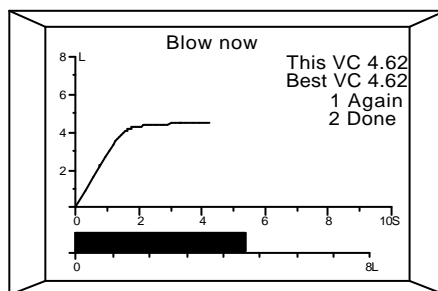
Insert the disposable (or clean reusable) mouthpiece into the transducer holder.

Instruct the patient to breathe in until their lungs are completely full, seal their lips around the mouthpiece, and blow out at a comfortable rate until they cannot push out any more air. When the patient has sealed their lips around the mouthpiece and is ready to blow, press a key to initiate the test.



The use of a nose-clip is advised. A solid moving bar on a volume axis is displayed together with a volume time curve as the patient breathes through the transducer: The Relaxed Vital Capacity of this blow and the 'best' blow for the current patient is displayed.

A line will appear on the volume



axis to mark the best VC value obtained.

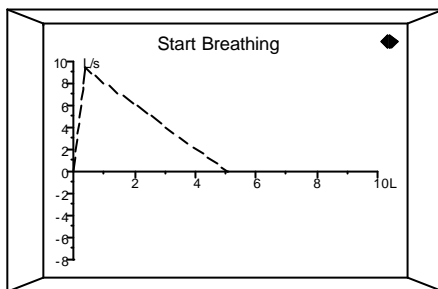
The test may be repeated as many times as is necessary to achieve an acceptable result.

To repeat the test press '1'.

To complete the VC test press '2' and the best result will be stored. The FVC test will start automatically.

## Forced vital capacity

**Option 3** -The forced vital capacity test is selected either as option 3 from the spirometry main menu, or after completion of a Relaxed VC test. If the forced vital capacity test is not required after a VC test then press Esc and the report screen will be displayed with the added option to perform a baseline FVC manoeuvre – see **report menu**, page 31.



The spirometry screen is displayed showing the predicted Flow/Volume curve as a dashed line. The predicted curve will only be displayed if the patient details have been entered.

The arrows in the top right hand corner of the screen indicate that the left and right cursor keys are active. In this case they are used to change the display between the full or expiratory only flow/volume loop, the full or expiratory only volume/time curve, or the child incentive display.

A spirometry test may be performed with or without tidal breathing through the transducer.

## Method 1 – No tidal breathing

Instruct the patient to breathe in until their lungs are completely full, seal their lips around the mouthpiece and blow out as hard and as fast as possible until they cannot push any more air out and then breathe in fully immediately after the expiratory manoeuvre, thus completing the Flow Volume loop.

The Flow/Volume loop is displayed as the patient performs the manoeuvre. At the end of the test values for FEV<sub>1</sub>, FVC and PEF are displayed, together with the Flow/Volume loop, and a manoeuvre quality check to allow a decision to be made to accept or reject this blow:

There are four quality checks performed on each spirometry manoeuvre to determine its acceptability.

If the patient performs an

acceptable manoeuvre 'Good blow' is displayed at the top of the screen.

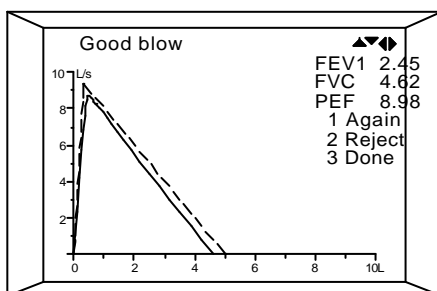
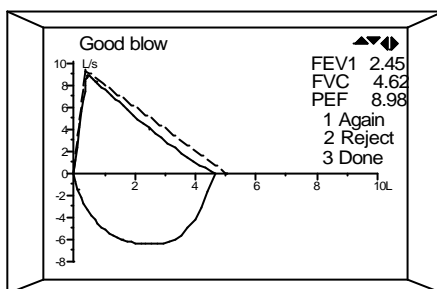
If the back extrapolated volume (BEV) was greater than 150ml then 'Slow start' will appear. This indicates that the patient did not blast out the air quickly and evenly during the forced expiration.

If the time to peak flow (PEFT) was greater than 120msec then 'poor effort' will appear indicating a sluggish effort during the forced expiration.

If the forced expiratory time (FET) was less than 6 seconds and the change in exhaled volume during the last half second was more than 100mL 'Abrupt end' will appear. The patient stopped exhaling prematurely.

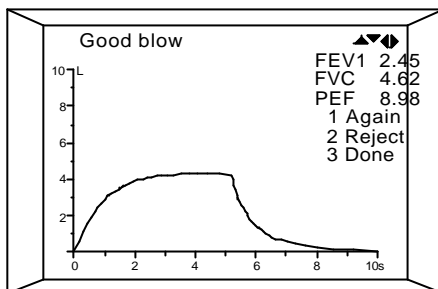
If the expiratory flow exhibited a secondary peak then 'Cough detected' will be displayed.

At this point using the up and down cursor keys will toggle the predicted curve on and off. Use the left and right arrow keys to toggle between the full flow/volume loop, expiratory flow/volume curve, and the volume/time curve.



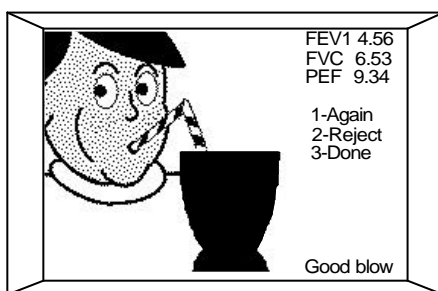
The child incentive 'milk shake kid' is only available during the spirometry manoeuvre.

Pressing delete will toggle the text on and off in order to allow a clear view of the curves, if obscured by the text. The axes for all of the curves are automatically scaled for a maximum volume between 1 and 2 litres above the predicted FVC.



The flow axes are scaled for a maximum flow between 2 and 4 litres/second above the predicted PEF. If the patient details have not been entered then the scaling is set to 8 litres and 15 litres/second.

If the child incentive is selected the glass will appear half full initially and will rise and fall as the child exhales and inhales respectively. To overflow the glass with bubbles, or drink the glass empty, the child must exhale or inhale greater than their previous largest breath.



Repeat the test as described above. The previous FVC loop will remain on the screen. The variation between the current test and the best test is displayed (Var). The measurement used to calculate this variation (FEV<sub>1</sub>, FVC, PEF, or FEV<sub>1</sub>+FVC) will depend upon the best test criterion selected with the spirometry customisation. If best individual indices have been selected then the variation will be calculated on FEV<sub>1</sub>+FVC.

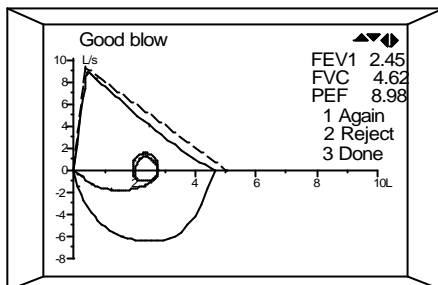
The total number of tests stored is nine (the 3 best baseline, post 1 and post 2 tests) from any number of attempts.

Pressing '2' will reject clearly poor or inconsistent efforts.

When satisfied with the blows, press '3'.

## Method 2 – With tidal breathing

Instruct the patient to seal their lips around the mouthpiece and breath quietly for at least three tidal breaths, but not more than 15 before attempting the forced manoeuvre. The patient should then breath in to TLC and then blow out as hard and as fast as possible until they cannot push



any more air out and then breathe in fully, immediately after the expiratory manoeuvre, thus completing the flow/volume loop.

The display will show the tidal breathing manoeuvre as well as the forced expiration and inspiration:

When the tidal breathing method is used the full flow/volume loop display is recommended to display the full tidal loop:

## Report menu

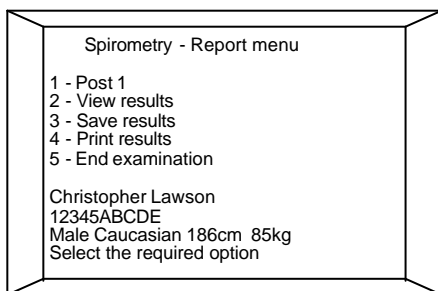
Now that the baseline spirometry test is complete a number of options become available and can be selected from the report menu: A post bronchodilator, Post 1, may be performed if required.

Alternatively the baseline results may be saved, using option 3, and recalled later to append a post bronchodilator or post steroid test.

The full results may be displayed using option 2 or the results printed using option 4.

When all required actions have been taken then use option 5 to end the examination.

The current patient's name and ID are also displayed.



### Option 1 - Post medication test

To begin a Post Bronchodilator or steroid test on the current patient, press 1.

The Forced Vital Capacity screen is displayed with the 'best' baseline loop or composite loop displayed as a dotted line:

The criterion for the 'best' can be defined by the operator - see

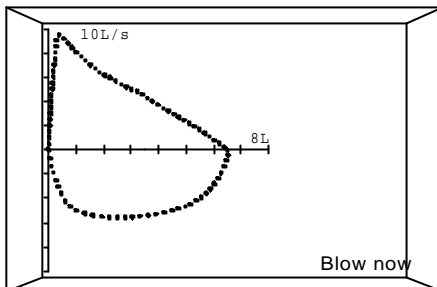
**spirometry customisation**, page 12.

The predicted curve can be toggled on and off by using the up and down arrow keys. Using the left and right arrow keys will toggle between the full flow/volume loop, expiratory flow/volume curve and volume/time curves.

Complete the tests as described above for the Forced Vital Capacity test.

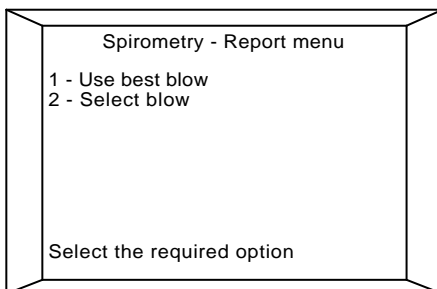
When a valid series of post bronchodilator tests is complete, press 3 (Done).

The Report Menu screen is then re-displayed. As the Post 1 test is then complete the first option is replaced with 'Post 2'.

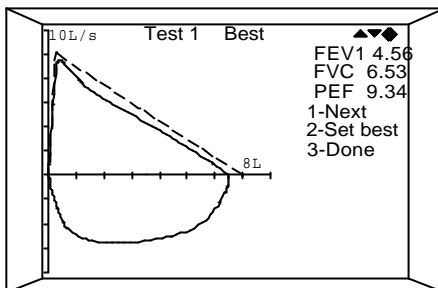


### Option 2 – View results

Use this option to display the results of the current patient. Firstly, however, a choice is offered to use the 'best' blow for the report or to manually select the 'best' blow.



If manual selection is chosen a summary of the manoeuvres is displayed showing the blow number, FEV<sub>1</sub>, PEF, and FVC for the baseline test: The 'best' selection is marked but can simply be changed by pressing 1 to move to the required test and then using option 2, set best.



After baseline selection the Post 1 blows are offered for selection (if applicable).

If the best test criterion was set to best individual results then the choice to select the best blow will not be offered.

Once the selection is complete the report appears giving the results for up to 15 spirometry indices:

The baseline, post 1 and post 2 results are given together with the percentage change and the percentage of predicted.

	FEV1	FVC	FEV1 /FVC	PEF
Base	4.56	6.88	88	9.86
%Pred	89	91	99	95
Post 1	4.66	6.99	87	10.18
%Pred	89	91	99	95
%Chg	+10	+10	+10	+10
Post2	4.66	6.99	87	10.18
%Pred	89	91	99	95
%Chg	+10	+10	+10	+10

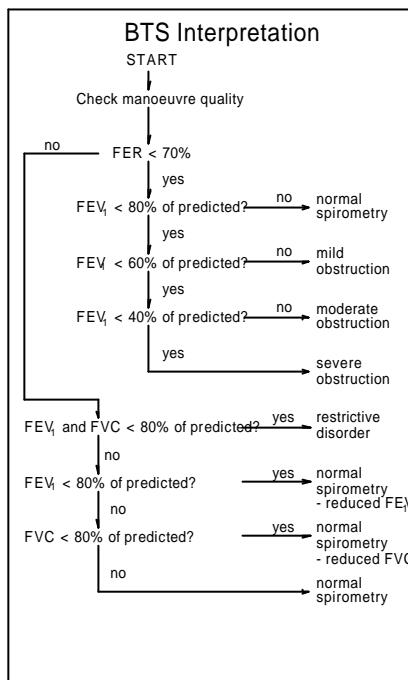
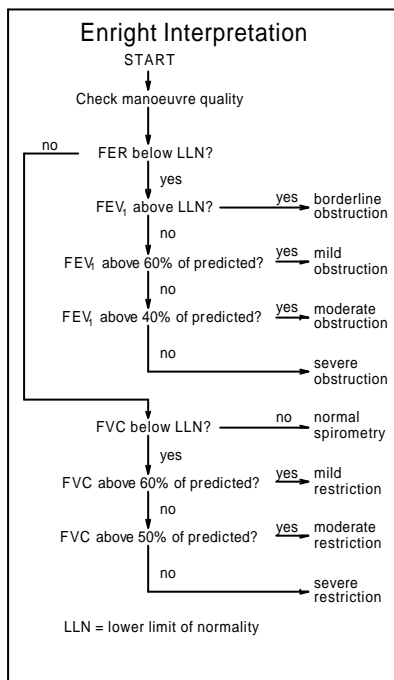
Print    Exit    PgUp    PgDn

Use function keys F3 and F4 to scroll through the results for up to a further 10 indices.

The results screens are followed by a report of 'Lung Age<sup>1</sup>' and an interpretation of the spirometry results according to the algorithm published by Enright<sup>2</sup> or the ECCS<sup>4</sup>.

The Enright and BTS algorithms relate airways' obstruction and restriction to the forced expiratory ratio, FER and the percent predicted of FEV<sub>1</sub> and FVC.

The Enright and BTS algorithms are given below:



The next screen shows the expiratory flow/volume loop with the predicted, baseline and post-bronchodilator curves shown as dashed, dotted, and solid lines respectively.

This screen is followed by the same information displayed as expiratory flow/volume and volume/time curves.

### Option 3 – Save Result

This option can be used to save the results for future processing by uploading to a computer, printing, or appending a post-bronchodilator test to a saved baseline result. The MicroLab saves the selected baseline and

any post steroid and post bronchodilator tests together with the respective flow/volume loops and volume /time curves.

### Option 4 – Print Result

See system customisation page 8 for external printing. To print the current patient's data select this option and the following printout will be obtained:

MicroLab Spiro VX.XX

Christopher Lawson I.D: 123DPY55

Sex: Male Age 41

Factor:100 (Caucasian)

Height: 160cm Weight: 96kg

BMI: 37.5

	FEV1	FVC	PEF	Var	Quality	Time: Date
Base	1.53	3.68	230	-3%	Good Blow	15:20 03/07/02
Base	1.68	3.79	245	0%	Good Blow	15:25 03/07/02
Base	1.53	3.69	238	-1%	Good Blow	15:32 03/07/02
Post 1	1.72	3.84	230	-3%	Good Blow	15:48 03/07/02
Post 1	1.79	3.86	230	-2%	Good Blow	15:51 03/07/02
Post 1	1.81	3.88	230	0%	Good Blow	15:55 03/07/02
Post 2	1.77	3.79	230	0%	Good Blow	12:04 14/08/02
Post 2	1.75	3.75	230	-1%	Good Blow	12:10 14/08/02
Post 2	1.76	3.68	230	-2%	Good Blow	12:20 14/08/02

Variation is based on FEV1

Best Spirometry Result Base = 3 Post = 4

:--- Normal---

	Base	%Pred	PostBD	%Pred	%Chg	Min	Pred	Max	
VC	4.00								L
FEV1	3.62	78	3.66	79	+1	3.79	4.63	5.47	L
FVC	3.82	68	3.76	67	-1	4.63	5.63	6.63	L
PEF	520	84	585	95	+12	496	616	735	L/M
FEV1%	95	117	97	120	+2	69	81	93	%
F50	4.78	83	4.80	83	0	3.58	5.75	7.92	L/S
F25	2.53	94	2.43	90	-3	1.42	2.70	3.98	L/S
MEF	4.22	86	4.26	87	0	3.21	4.92	6.63	L/S
I50	7.86		8.69		+10				L/S
R50	61		55		-9				%
PIF	8.30		9.18		+10				L/S
MVV	136		137		+1				L
FET	3.61		3.40		-6				S

Lung Age = 59 years

Interpretation: Mild Restriction

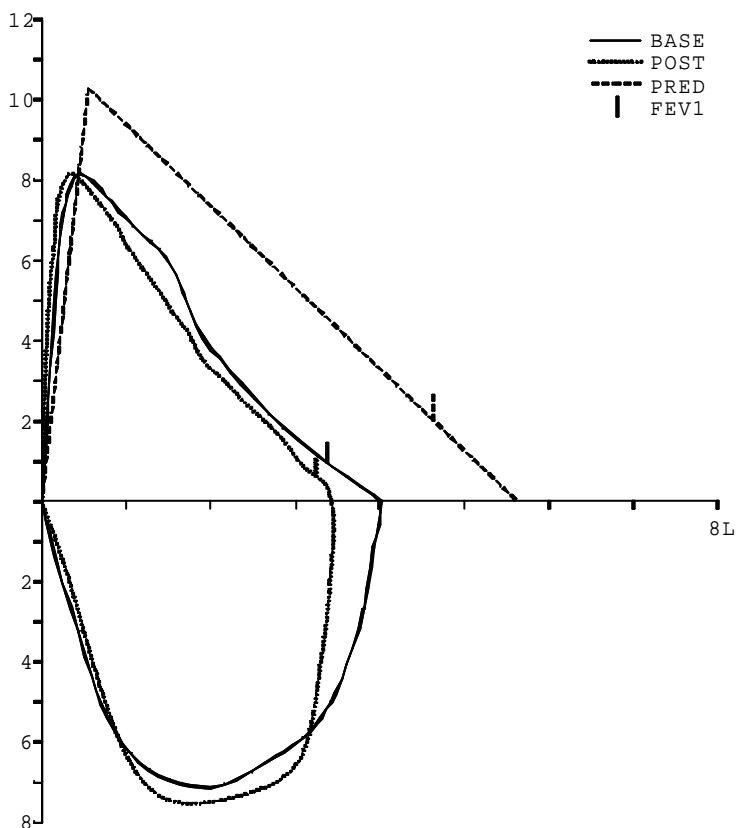
The first part of the report gives the patient name, ID, and physical details. This is followed by the baseline, post 1 and post 2 results (FEV<sub>1</sub>, FVC, and PEF) for all the recorded manoeuvres performed by the patient. The percentage variation (VAR) of each test from the best test given together with the date, time and quality check.

The best results are then printed in full with up to 12 other measurements from the manoeuvre. The percentage of predicted value, percentage post 1 change and the normal range is also given.

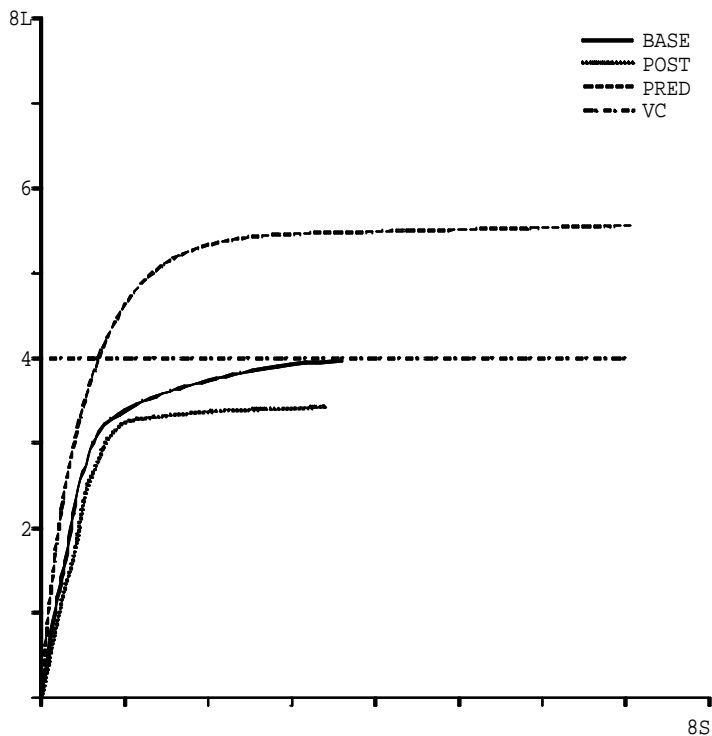
If a post 2 test was performed then the baseline results are repeated together with the post 2 results.

The results are followed by the Flow/Volume and Volume/Time curves:

Flow/Volume



Flow/Volume



Normal Values: ECCS (adult)  
Zapletal, Solymar, Cogswell (child)

Results at BTPS

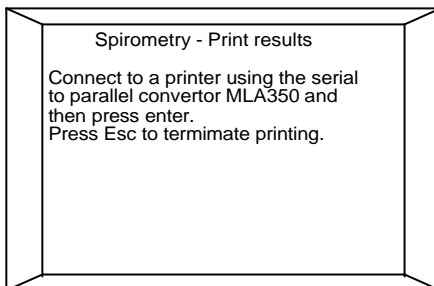
Technician: \_\_\_\_\_

Physician: \_\_\_\_\_

The predicted, baseline, and post 1 and post 2 curves are shown where applicable.

Note: The unit may be configured to print only the Flow/Volume loop or the Volume /Time curve or neither and the printout will be reduced accordingly.

The results may also be printed to an external printer – see system customisation page 8. In this case the following screen will be displayed:



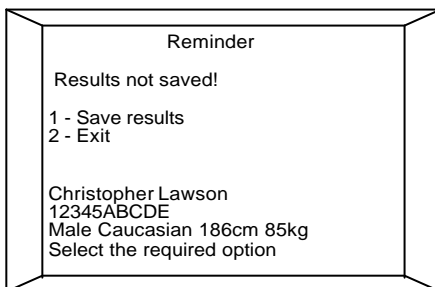
### Option 5 - End Examination

Selecting this option will delete test results of the current patient if they are not already saved.

In this case the following warning will be displayed:

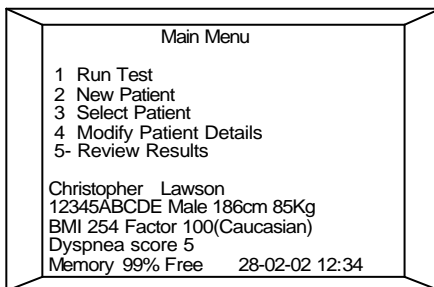
To save the results press 1.

Press 2 to end the examination and discard the current patient's results.



The main menu is again displayed:

From this menu it is possible to test a new patient as previously described or run a different test on the same patient.



## Airways resistance - overview

**Note: to make this measurement a MicroRint transducer, Cat No.MRT6000, is required.**

Airways resistance is measured by the interrupter method (Rint), first described by Von Neergaard and Wirz in 1927.

The method requires minimal subject co-operation and can be carried out during spontaneous breathing. It is therefore useful for measuring airway calibre in very young children and those unable to co-operate with conventional lung testing. It also provides a measurement of resistance that is easier, quicker, and more economic than any other method.

The basis of the measurement is that during transient interruption of airflow (100ms), alveolar pressure will equilibrate rapidly with pressure at the mouth. The alveolar pressure can therefore be derived from the measurement of mouth pressure immediately post-occlusion.

If the flow is measured immediately prior to occlusion then the ratio of flow to pressure gives the airway resistance.

Flow is measured with a pneumotachometer consisting of a stainless steel resistive element and a high frequency, high fidelity, solid-state pressure transducer. A second pressure transducer measures the mouth pressure post-occlusion.

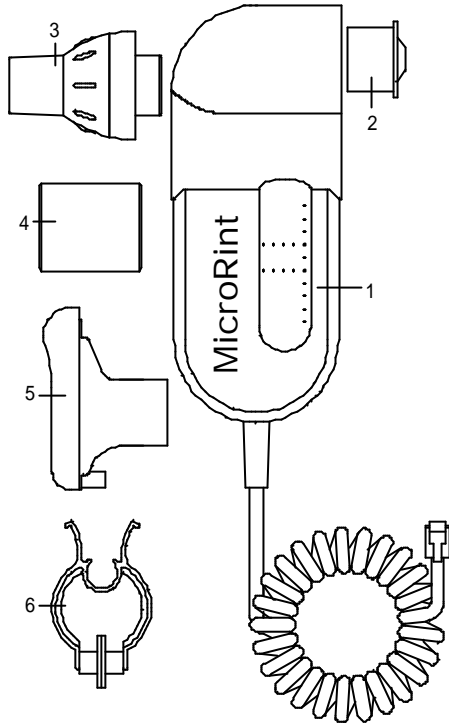
Occlusion occurs several times during a test, and the current and median value of Rint is calculated and displayed.

The Rint test has many advanced features including a graphic display giving both real time tidal breathing flow and the interrupted pressure curve, user customisation of instrument functions, and predicted values.

## Rint transducer

The Rint transducer is packaged in a sturdy carrying case containing the following items:

1. Micro Medical interrupter transducer.
2. 2 off caps.
3. Disposable filters.
4. Mouthpiece adapter.
5. Facemask.
6. Noseclip.



The Rint transducer is fully discharged when shipped from the factory and must be charged by connecting to the MicroLab supplied by the mains using the AC adapter. The MicroRint transducer will require 14 hours to become fully charged.

Connect the transducer to the MicroRint unit using the socket located at the rear of the instrument.

The disposable filter is connected between the facemask, or mouthpiece adapter, and the transducer as shown below:

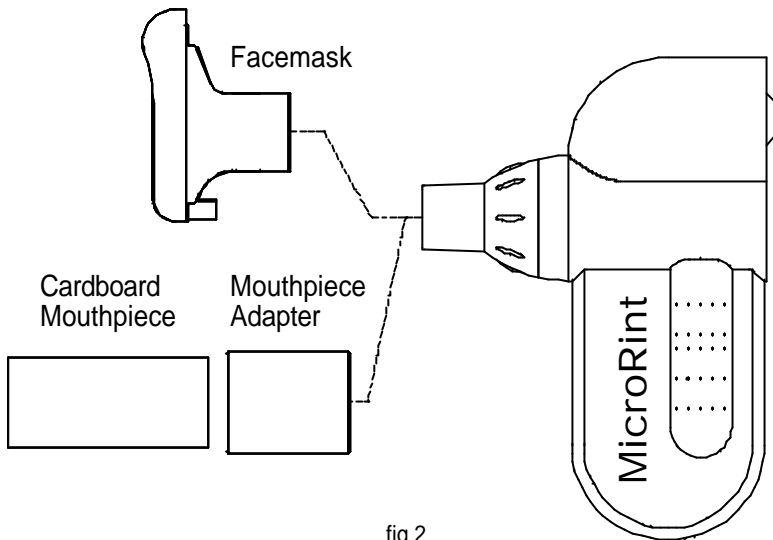


fig 2

The filter provides protection against bacterial and viral cross infection between subjects. It also protects the resistive element inside the transducer from contamination. A new filter must be used for each patient tested.

The MicroRint will measure the total airway resistance of the subject including any added resistance between the subject and the transducer. The small resistance of the Micro Medical breathing filter is automatically subtracted from the measurement. Use only the filter type supplied by Micro Medical as other types, with different values of resistance, will give erroneous results. The filter will gradually absorb moisture from the breath causing its resistance to rise. This rise will be negligible if used for one subject only, but will give significant errors if re-used on another subject.

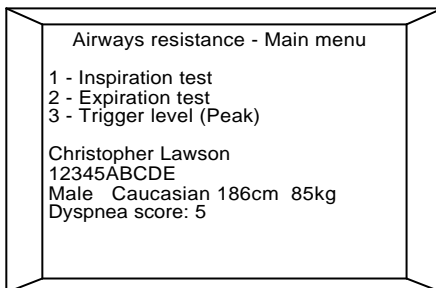
Ensure that the side stream cap is firmly in place blanking off the upper 22mm port. This port is only used when the transducer is used for measurement of airways flow limitation with negative expiratory pressure applied and must be sealed when performing an airways resistance test.

Before performing an airways resistance test enter a new patient's details to the MicroLab database or retrieve an existing patient – see **patient selection**, page 24.

Select run test from the patient selection screen and then airways resistance from the test selection screen and the following will be displayed:

From the menu an airways resistance test may be initiated on inspiration or expiration.

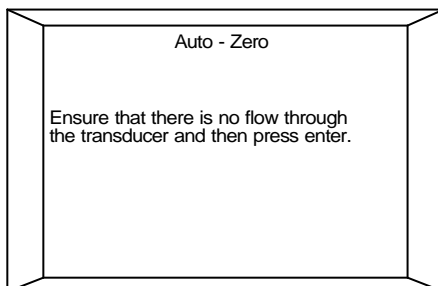
The flow at which the occlusion occurs can also be set.



### Option 1 - Inspiration test.

Select option 1 and the display will show:

Place the red 22mm end cap over the free end of the filter holder and then press enter. The instrument will now establish a zero calibration for the flow and pressure sensors.

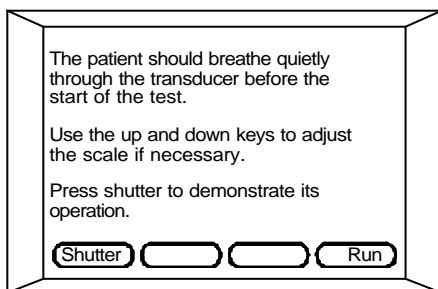


The display will then show:

For adult subjects the use of a disposable cardboard mouthpiece is recommended. The mouthpiece and adapter are assembled as shown on page 41. The subject should be instructed to wear the nose clip provided, seal their lips firmly around the mouthpiece, and

to lay the tongue on the floor of the mouth so that no obstruction can occur to the airflow.

The cheeks should be supported with one hand, to reduce the effect of the mouth compliance, and the transducer held with the other. The subject should then breathe as normally as possible with no panting or forced expiration. For children, a facemask may be used instead of the



mouthpiece and adapter. The facemask must be held firmly to the face to ensure that there are no leaks.

When the subject is breathing normally through the transducer the shutter may be operated by pressing F1 on the keypad in order to accustom the subject to the shutter action.

No measurements are taken during the shutter demonstration. Excessive use of this function will cause the batteries to discharge prematurely and therefore a maximum of 5 operations is recommended.

Once the subject is accustomed to the shutter action press F4 and the following screen is displayed:

The tidal flow is displayed with a maximum flow of 2 L/s. For clarity, the sensitivity of the display should now be increased, using the up and down keys, until the tidal flow occupies more than half of the vertical axis.

The scaling of the graph has no effect on the measurement taken.

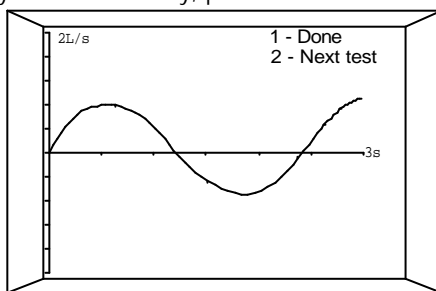
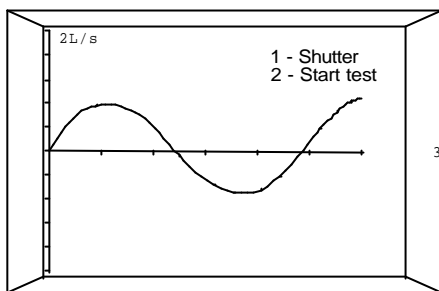
When the patient is breathing quietly and consistently, press 2 to start the test:

The point at which an occlusion occurs may be set to a fixed flow or to the peak of inspiration.

If the random trigger method has been chosen when customising the airways resistance measurement then occlusions will

occur automatically every few breaths until the specified number has been reached and option 2 will not be shown – **see airways resistance customisation**, page 14.

This will occur in a random pattern to avoid the anticipation of an occlusion by the subject.



When an occlusion takes place the Rint value obtained will be displayed on the bottom of the display and the 100ms interruption of the flow will be visible:

The median value from all the tests completed is also displayed.

If the instrument has been customised for discrete operation the flow profile and the pressure at interruption will be displayed after each occlusion:

Press F1 or F2 to either accept or reject the test and continue with the examination.

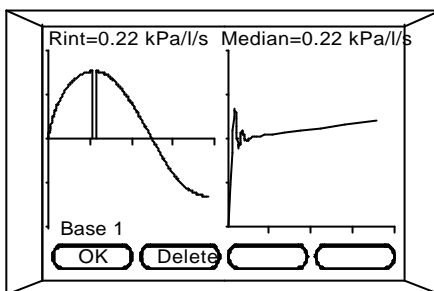
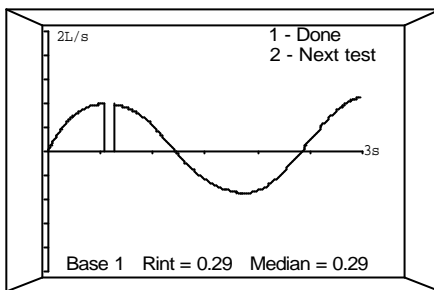
When the airways are occluded on the peak of the tidal flow the slope of the pressure curve, after the initial step and transient oscillation, is close to zero.

It is therefore possible to check the quality of the test automatically and the instrument will reject any tests with a large slope on the pressure curve, indicating a cough or irregular breathing pattern.

If the trigger level is set at a constant flow rate then this test is disabled, as much greater slopes will occur.

The MicroRint will continue until the pre-set number of acceptable tests have occurred or if the test is terminated by pressing 1 (Done). The test should be terminated if the subject becomes distressed and starts to pant or breathe erratically.

Upon completion of the test the Report menu is displayed.



## Option 2 - Expiration test.

The procedure for the expiration test is identical to that for the inspiration test.

### Option 3 – Trigger level (Peak)

The default flow trigger level is set by the Airways Resistance customisation, see page 14, and is shown in brackets. However, this may be changed before a test is started by using this option.

Any value between 0.1 l/s and 1.99 l/s can be entered. If a high value is chosen then it is possible that the unit will never occlude during a test, as the subject may never reach the set flow rate.

If a very low value is set then inconsistent values of Rint may be obtained, as the signal may be lost in physiological noise.

If zero is entered then the unit will trigger on the peak of the flow curve. The instrument will always occlude using this setting and the signal will be above any noise.

Note that the use of this option to change the trigger flow rate will not alter the default setting.

### Report menu

When the baseline airways resistance measurement is complete a number of options become available and can be selected from the report menu:

A post bronchodilator or post steroid test may be performed if required.

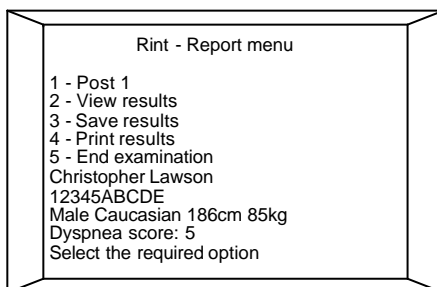
Alternatively the baseline results may be saved, using option 3, and recalled later to append a post bronchodilator or post steroid test.

The full results may be displayed using option 2 or the results printed using option 4.

When all required actions have been taken then use option 5 to end the examination.

The current patient's name and ID are also displayed.

The results reported will then be the median of all the acceptable tests.



### Option 1 - Post Bronchodilator/Steroid Test

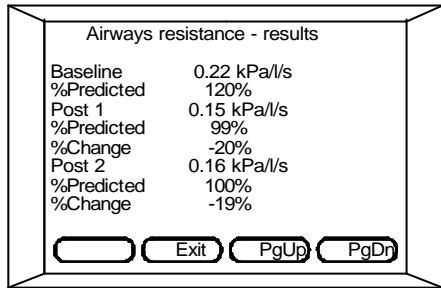
To begin a Post Bronchodilator or steroid test on the current patient, press 1 and repeat the test procedure as for the baseline test.

When the post 1 test is complete press 1 (Done) and the Report Menu screen will be re-displayed. As the Post 1 test is complete the first option changes to Post 2.

### Option 2 – Display results

Use this option to display the results of the current patient:

The baseline, and post bronchodilator/steroid results are given together with the post bronchodilator/steroid percentage change and the percentage of predicted.



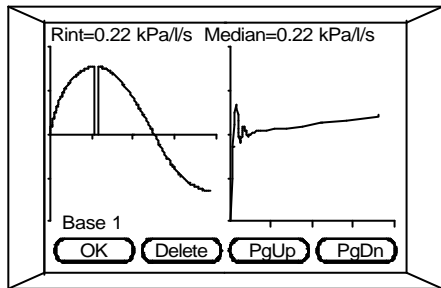
Use function keys F3 and F4 to scroll through the results. The next screens show the flow/time curve together with the pressure curve, at interruption, for each of the tests:

The Rint measurement for this test and the median Rint are given.

Any of the tests, which show

artefacts in the pressure or flow curves, may be rejected by using F2 and will be permanently deleted and the median value may change.

When the review is complete press F1 to return to the Report Menu.



### Option 3 - Save

This option can be used to save the results for future processing by uploading to a computer, printing, or appending a post-bronchodilator test to a saved baseline result. The MicroLab saves the baseline results and any post bronchodilator and post steroid tests performed.

## Option 4 - Print

To print the current patient's data select this option and the following printout will be obtained:

MicroLab Spiro VX.XX

Christopher Lawson      I.D: 123DPY55  
Sex: Male    Age 41  
Factor:100 (Caucasian)  
Height: 160cm    Weight: 96kg  
BMI: 37.5

Baseline	Date 04/07/02	Time 09:41
Post 1	Date 04/07/02	Time 09:54
Post 2	Date 26/08/02	Time 10:13

	--Baseline--		----Post1----		----Post2----	
Test	Resistance	Flow	Resistance	Flow	Resistance	Flow
	kPa/l/s	l/s	kPa/l/s	l/s	kPa/l/s	l/s
1	0.26	0.65	0.22	0.62	0.19	0.66
2	0.27	0.66	0.21	0.60	0.18	0.68
3	0.26	0.56	0.22	0.59	0.17	0.67
4	0.26	0.65	0.22	0.62	0.19	0.66
5	0.27	0.66	0.21	0.60	0.18	0.68
6	0.26	0.56	0.22	0.59	0.17	0.67
7	0.26	0.65	0.22	0.62	0.19	0.66
8	0.27	0.66	0.21	0.60	0.18	0.68
9	0.26	0.56	0.22	0.59	0.17	0.67

Median baseline	0.26kPa/l/s
Predicted	0.22kPa/l/s
Median post 1	0.22kPa/l/s
Percent predicted	100%
Percent change	-2%
Median post 2	0.18kPa/l/s
Percent predicted	91%
Percent change	-3%

Notes:

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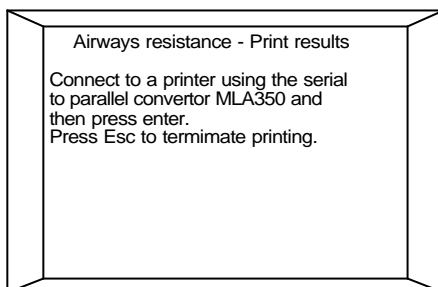
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This is followed by the flow/time curves and the pressure/time curves at the time of occlusion.

Note: The unit may be configured to print only the results or the results with the curves – see airways resistance customisation, page 14.

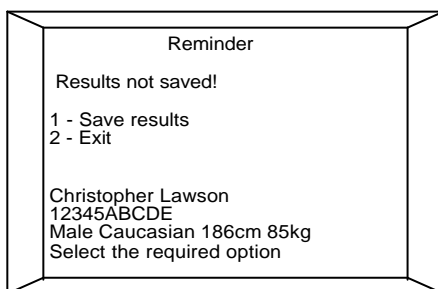
The results may also be printed to an external printer – see system customisation page 8. In this case the following screen will be displayed:



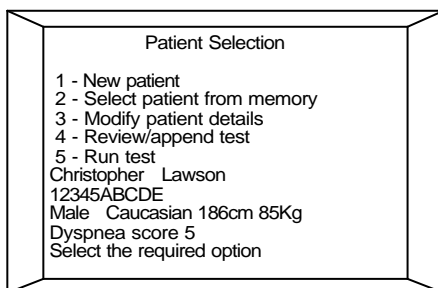
### Option 5 - End Examination

Selecting this option will delete test results of the current patient if they are not already saved.

In this case a warning will be displayed and the option not to continue will be offered.



The main menu is again displayed: From this menu it is possible to test a new patient as previously described or run a different test on the same patient.



## PC connection using SPIDA 5

SPIDA is an easy to use PC based windows application that interfaces to the MicroLab via a serial port. It incorporates a database into which patient details can be entered and downloaded to the MicroLab or test results may be uploaded from the MicroLab.

Using SPIDA and the MicroLab, live blows can be performed with the PC directly controlling the operation of the MicroLab.

The results and graphs produced are displayed directly on the PC screen.

The spirometer is connected from the serial port on the PC, to the port on the side of the instrument using the serial cable provided.

Connect the MicroLab to the P.C. whilst the MicroLab is turned off.

Note: the MicroLab should only be connected to a computer that is manufactured in accordance with EN60950 1992/1993 – ‘Safety of Information Technology Equipment including Electrical Business Equipment’.

Keep the PC out of reach of the patient when connected to the MicroLab.

It is recommended that whilst the unit is connected to a computer the batteries are on charge with the unit connected to the mains adapter as more power is required to drive the serial interface.

## Charging Procedure

The MicroLab is fully discharged when shipped from the factory and must therefore be used with the AC adapter until the internal rechargeable batteries can be fully charged.

The Charging light on the keypad will be illuminated while the batteries are being charged.

The batteries will take about 16 hours to become fully charged, however the instrument may be used continuously with the mains adapter connected.

The Rint transducer has its own internal battery pack that must be charged before use. These batteries charged at the same time as the MicroLab batteries as long as the two are connected.

**Note:** Use only the AC adapter supplied. Use of any other type may cause permanent damage to the MicroLab and cause a fire or electrical hazard.

## **Battery Management**

The microcomputer circuitry is supplied by a 7.2 volt, 1000mA-hour, rechargeable nickel metal hydride battery pack.

The voltage of the battery pack is monitored continuously and low battery warning symbol is displayed with alarm when the battery starts to become discharged:

This warning may occur at any time except when measurements are being taken. When this warning occurs, plug in the mains adapter and continue using the instrument.

If the main's adapter is not plugged in, then the battery will continue to discharge until a voltage is reached which could impair the integrity of the microprocessor.

At this point the unit will turn itself off.

The MicroLab also has an auto turn-off battery saving function whereby the unit will turn itself off if no keys are pressed for about 10 minutes. This function is only active with the main menu displayed and is intended to save power in the event of the unit being turned on accidentally.

The Rint transducer is supplied by a 6 volt, 50mA-hour, rechargeable nickel cadmium battery pack.

## **Looking after your MicroLab Spirometer**

Please observe the following precautions:

- ?? Avoid exposing the MicroLab to direct sunlight during use.
- ?? Avoid operating the spirometer in dusty conditions or near to heating appliances or radiators.
- ?? Do not keep the spirometer in a damp place or expose it to extremes of temperature.
- ?? Do not direct the transducer holder towards a strong light source whilst operating the spirometer.
- ?? Check the AC charger for compatibility with local power rating.

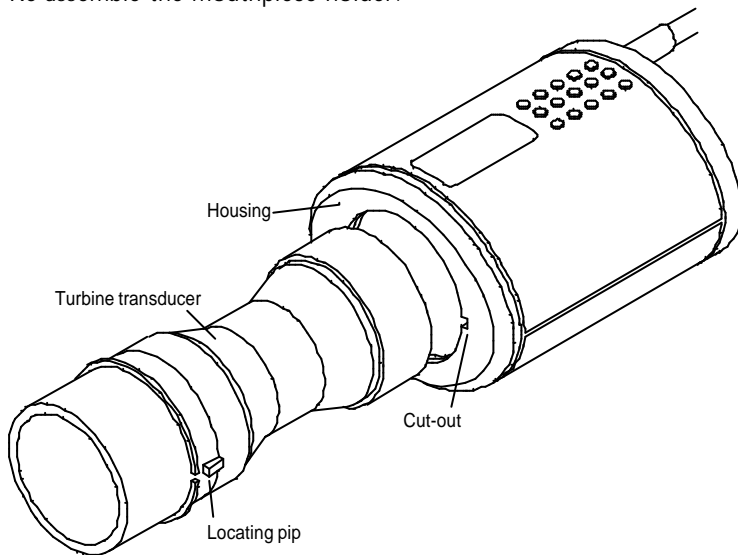
## Cleaning the Transducer

The transducer requires no routine maintenance or servicing. However, if you wish to sterilise or clean the transducer it may be removed by means of the following procedure:

- 1 Rotating the turbine transducer anti-clockwise until the locating pip lines up with the small rectangular cut-out in the housing as shown below.
- 2 Gently pull the transducer away from the housing.
- 3 The transducer may now be immersed in warm soapy water for routine cleaning or immersed in cold sterilising solutions e.g. Perasafe for a maximum of 10 minutes (Alcohol and chloride solutions should be avoided). After cleaning/sterilising, the transducer should be rinsed briefly in distilled water and dried.

Perasafe is available from Micro Medical in convenient 81g containers, Cat No. SSC5000.

- 4 Re-assemble the mouthpiece holder.



## Servicing

A full service manual including circuit diagrams and parts list is available upon request.

## Symbols



Type B device



In accordance with  
Directive 93/42/EEC

0120

## Environment

This instrument complies with directive EN60601-1-2 electromagnetic compatibility but can be affected by cellular phones and by electromagnetic interference exceeding levels specified in EN 50082-1:1992

## Electrical classification

Class I equipment.

## Consumables / Supporting Products

<b>Cat. No.</b>	<b>Description</b>
PSA1600	Thermal Printer Paper (pack of 5 rolls)
PSA1900	Archive Printer Paper ~ 25 Year Anti-Fade (pack of 5 rolls)
PSA1000	Adult Disposable Mouthpieces (500 per box)
SST1000	One-way Safety Mouthpieces (500 per box)
PSA1200	Paediatric Disposable Mouthpieces (250 per box)
PSA1100	Paediatric Adaptor
SPF6050	SpiroSafe Pulmonary Filters (50 per box)
SPF6250	SpiroSafe Pulmonary Filters (10 filter casings and 250 replacement pads)
SSC5000	PeraSafe Sterilising Powder 81g (to make up 5 litres of solution)
VOL2104	Nose Clips (pack of 5)
BAT0300	Alkaline PP3 Battery
SMI2125	3 Litre Calibration Syringe
SD5000	Spida Software
FIL6050	Rint Filters (50 per box)
FIL6250	Rint Filters (250 per box)
AFM1153	Face Mask

## Training

Micro Medical run spirometry training courses throughout the UK, sessions include:

- \* Anatomy and Physiology of Respiratory System
- \* Lung Volume Terminology
- \* Objectives of Spirometry
- \* Setting up the test & performing a good manoeuvre
- \* Errors of technique
- \* Interpretation of results
- \* Using Spirometry as an aid to diagnosing airways disease
- \* Choosing a Spirometer
- \* Case Studies

To place an order for consumables / supporting products, for details of training course dates and locations, or for general enquiries please contact Micro Medical on:

Tel: ++44 (0)1634 893500

Fax: ++44 (0)1634 893600

Email: [sales@micromedical.co.uk](mailto:sales@micromedical.co.uk)

[product.support@micromedical.co.uk](mailto:product.support@micromedical.co.uk)

Website: [www.micromedical.co.uk](http://www.micromedical.co.uk)

Or contact your local Micro Medical dealer.

## Specification of the MicroLab

### General

- Storage :** 1000 tests including Flow/Volume loops and Volume/Time curves.
- Printer Output:** All IBM Proprinter compatible Canon bubble jet printers e.g. BJC250, BJC4400, BJC80 and BJC50.  
All PLC3 compatible Hewlett Packard printers e.g. Deskjet 420, 695, 340, 880C and 895Cxi.
- Display:** Graphic LCD 240x160 pixels.
- Power supply:** Input 100 to 240V, 50 to 60Hz.  
Output 9V 1.12A (Class 1)
- Battery Pack:** Rechargeable NiMH 7.2V 1000mA-hours.
- Dimensions:** 134x274x51.5 mm. Transducer 50x60x90mm.
- Weight:** 829g, 2.75kg with carry case and accessories.
- Operating Temperature:** 0 to +40<sup>o</sup> C
- Operating Humidity:** 30% to 90% RH
- Storage Temperature:** -20 to + 70<sup>o</sup> C
- Storage Humidity:** 10% to 90% RH

## Spirometry

### Measurements:

A maximum of 15 indices may be selected from the following

- Relaxed Expiratory Vital Capacity (VC)
- Forced Expired Volume in 0.75 seconds (FEV.75)
- Forced Expired Volume in 1 second (FEV1)
- Forced Expired Volume in 3 second (FEV3)
- Forced Expired Volume in 6 seconds (FEV6)
- Forced Vital Capacity (FVC)
- Peak Expiratory Flow Rate (PEF)
- FEV<sub>0.75</sub> as a percentage of VC (FEV.75/VC)
- FEV<sub>0.75</sub> as a percentage of FVC (FEV.75/FVC)
- FEV<sub>1</sub> as a percentage of VC (FEV1/VC)
- FEV<sub>1</sub> as a percentage of FVC (FEV1/FVC)
- FEV<sub>3</sub> as a percentage of VC (FEV3/VC)
- FEV<sub>3</sub> as a percentage of FVC (FEV3/FVC)
- FEV<sub>0.75</sub> as a percentage of FEV6 (FEV.75/FEV6)
- FEV1 as a percentage of FEV6 (FEV1/FEV6)
- Maximum Expired Flow at 75% of FVC remaining (MEF75)
- Maximum Expired Flow at 50% of FVC remaining (MEF50)
- Maximum Expired Flow at 25% of FVC remaining (MEF25)
- Mean Mid-Expiratory Flow Rate (MMEF)
- Forced expiratory flow at 50% of volume as a percentage of VC (FEF50/VC)
- Forced expiratory flow at 50% of volume as a percentage of FVC (FEF50/FVC)
- Maximal voluntary ventilation indicated (MVV<sub>(ind)</sub>)
- Forced inspired volume in 1 second (FIV1)
- Forced inspiratory Vital Capacity (FIVC)
- Peak Inspiratory Flow Rate (PIF)
- FIV<sub>1</sub> as a percentage of FIVC (FIV1/FIVC)
- Forced inspiratory flow at 25% of inhaled volume (FIF25)
- Forced inspiratory flow at 50% of inhaled volume (FIF50)
- Forced inspiratory flow at 75% of inhaled volume (FIF75)
- Forced expiratory flow at 50% of volume as a percentage of FIF50 (FEF50/FIF50)

The time taken between 25% and 75% of the forced expired volume (MET2575)

Forced Expiratory Time (FET)

Tidal Volume (TV)

Expiratory reserve volume (ERV)

Inspiratory reserve volume (IRV)

Inspiratory capacity (IC)

- Tests per subject:** VC-unlimited (best reported)  
FVC-unlimited (best 3 from baseline, post 1 and post 2 tests)
- Predicted Values:** Various – depends upon national preference
- Transducer:** Micro Medical Bi-Directional Digital Volume.
- Resolution:** 10ml volume 0.03l/s flow
- Accuracy:** +/-3%. To ATS recommendations – Standardisation of spirometry 1994 update for flows and volumes.

### Airways Resistance

- Predicted Values:** Percent predicted and normal range reported.
- Transducer type:** Flow - Pneumotachometer  
Pressure - Piezo resistive
- Accuracy:** +/- 3% for flow and volume.
- Resolution:** 0.01 l/s
- Flow range:** 0 to 2 l/s
- Transducer battery:** Rechargeable NiCad 6V 50mA hours
- Transducer dimensions:** 160x65x40mm.
- Shipping Weight:** 2.75Kg including accessories

### References

- 1 Spirometric 'Lung Age' estimation for motivating smoking cessation.  
James F Morris, MD and William Temple  
Preventative Medicine 14 655-662 (1995)
- 2 Enright
- 3 BTS Guidelines for the management of Chronic Obstructive Pulmonary Disease (The COPD Guidelines Group of the Standards of Care Committee of the BTS)

Thorax 1997;53 (Suppl 5):S4-6

- 4 ECCS – European Community for Coal and Steel – Standardisation of Lung Function tests
- 5 ERS – Standardized Lung Function Testing
- 6 Chronic Obstructive Pulmonary Disease – Management of chronic obstructive pulmonary disease in adults in primary and secondary care