Manual of spirometer PC-Spiro

Contents

Introduction

The use of personal computers for capturing and storing medical signals such as spirometer recordings has enormous advantages:

- Inexpensive and very precise.
- Ease of use.
- Electricity feeding by USB cable. No need for batteries.
- Better cooperation from the patient, who can follow his examination on the computer screen.
- High quality print-outs on A4 paper.
- Recordings saved in database which can be consulted any time.
- Possibility to send recordings in protected PDF format by email.
- Possibility to compare several recordings on the computer screen.
- Heavy duty, no mechanical parts inside.

I Installation

1.1 Hardware

In our delivery you find:
- Spirometer PC-Spiro. Measures are 12 * 6 * 4 cm.
- Disposable mouth-pieces.
- Installation Guide
- Installation CD
- Nose grip

The connection to your personal computer takes place by USB. After the software installation, you can connect / disconnect the device to/from your computer at any time except during recording.

Side view
For cleaning purposes, the outlet of the spirometer can easily be removed.
Lay the apparatus on a flat surface, press in the direction of the big arrow and pull the side pin in the direction of the small arrows.

1.3 Technical data

Power consumption 40 mA by USB cable. No batteries inside.
Maximum distance to computer: 3.8 meters
Resolution : 15 ml / second
16 bits A/D conversion.
Flow Capacity: 15 liters / second
Sampling rate :600 / second
Recording time: up to 4 minutes, pause is possible.

1.2 Software

Install the software before the connection of the spirometer.
The software is delivered on CD-ROM. Allow 'Install.exe' to execute.

Select installation directory **C:\PC-Spiro**.
When the installation is finished you will find in this directory:
   Spiro.exe : the program
   *.spi : Spirometer records
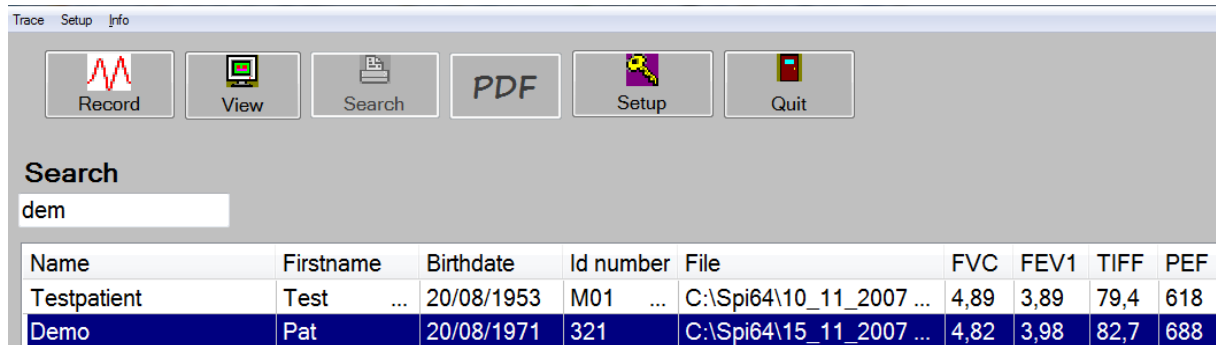   *.PDF: Manual
   Calfile.bin. File with calibration data.
   SpiRef.xml File with values for the regression formulas.
   SpiConfig.xml contains setup data, user name etc.

Select C:\PC-Spiro\Spiro.exe to start the program. You can also start the program by
Windows menu Start- Programs – Spiro.exe

1.4 Main menu

Header menu
There are 6 speed buttons for frequently used options:

1. Record
2. View
3. Print
4. PDF
5. Setup
6. Quit

You can search by name (A), first name (B), birth date (C)
or number (D).
Use arrows to go to the selected record. Type Enter to view.

Delete a record:
Select it then press the 'Delete' key

Sorting
Click on 'Name' 'First name, Birth date, FVC .. to sort ascending or descending.
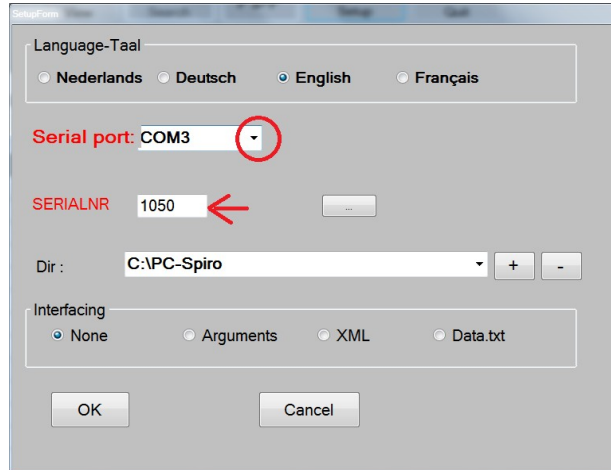
Shortcut menu:
Clicking on the right mouse button, shows a shortcut menu, to the most important options.

It is mandatory to start **by the Setup** in order to configure properly
the hard- and software.

1.5 Setup

Select Setup – Configuration to view the setup settings.

Language: Choose English

COMPORT:
Connect the spirometer. Wait a while. Windows will show you the number of the comport
that your spirometer received. If not, then click on the little arrow at right from 'serial port';
between the red circle A list will appear and indicate the existing comport numbers.
Select the highest number with OK message. Most often, but not always, the highest number
is the correct choice. It is very important to select the right number, if not the spirometer
won't work.
*If you don't know the number, do the test with the little arrow twice: once with the spirometer
connected to the PC and once without. Quit and launch the software between the two trials.
The extra number with the spirometer connected, is the good choice.*

DIR
Work directory. This directory may differ from the installation directory.
At right a drop down-arrow and two buttons are visible.
With the '+'   button the user can add up to 12 directories to a list.
With the **'-'**   button the user can delete a directory from the list. The directory itself
is not removed from the hard disk.
With the drop down-arrow switching between the different directories of the list is easy.
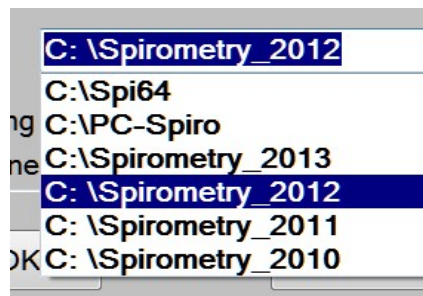
It is possible to put a shared network directory here if required (example: //Servername/Aud2013)
Different users connected by a network can store and retrieve all their recordings on the same server.

SerialNr

On each spirometer you find a yellow label with a 4 number code (fore example 1234). →
Enter this number here ! ←

Interfacing

Provides a means for starting our software from other software, without the need to reenter the patient data. See the appendix. Leave **'None'** selected when the program is launched on its own.
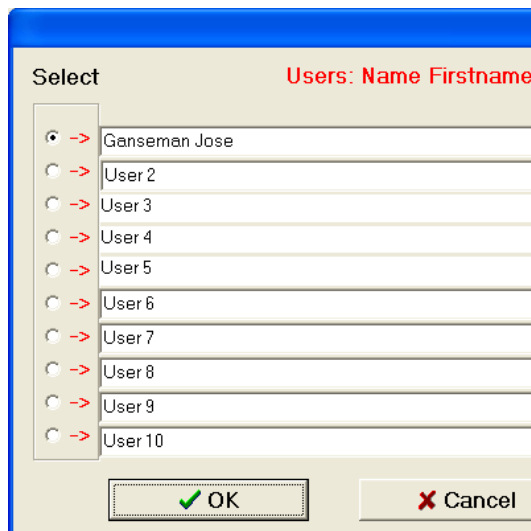
OK
Save setup parameters (in the file \SpiConfig.xml)

With **Setup - Users** you can enter up to 10 different users.

If there is only one user, leave the settings User2 etc.. in place.
If there is more than one user, you have to select user name on start of program.
Afterwards, you can always see who leaded the recording.

Users

II Working with Spiro.exe

2.1 Record

Information

Make sure patient can see the computer screen. Click on Record.
Enter sex, age and size (cm). This is important for the calculation of the patient's target values.
Birth year (4 digits) is also necessary. At right from birth date it's possible to select dateformat dd/mm/yyyy or mm/dd/yyyy

Maybe place a clamp on the patient's nose.
Click on 'Ok' to go to next screen.

If the patient has never performed a spirometry, it's better to show it once.

Afterwards it's possible to delete the first curve, your own curve.

TEST	FVC	FEV1	DIF	RES
1	4,98	3,05		
2	5,28	4,04		
3	5,12	4,27	,17	OK
4				

A record in action

Click on **Start**. Inspire and expire as hard, deep and long as possible. When expiration is completely finished, inspire as deep as possible. Wait a couple of seconds, to recover and repeat this at least 3 times.
It is particular important to expire long enough, at least 3 seconds and
4 or 5 is even better.
Spirometry demands a good cooperation of the patient.
If the results are not ok, start again. No paper has been wasted.
The recording time is up to 4 minutes. It is recommended that the patient produces 3 curves with similar FVC's and FEV1's.

The software will indicate OK next to the values of FVC and FEV1 if their difference to a previous curve is below 200 ml.

Recording may be stopped in the following cases:

- The patient has produced 3 nearly equal spirometry complexes. The message OK is then twice displayed on the right.

- When after 8 tries, the patient has not yet produced 3 similar complexes.

2.2 View
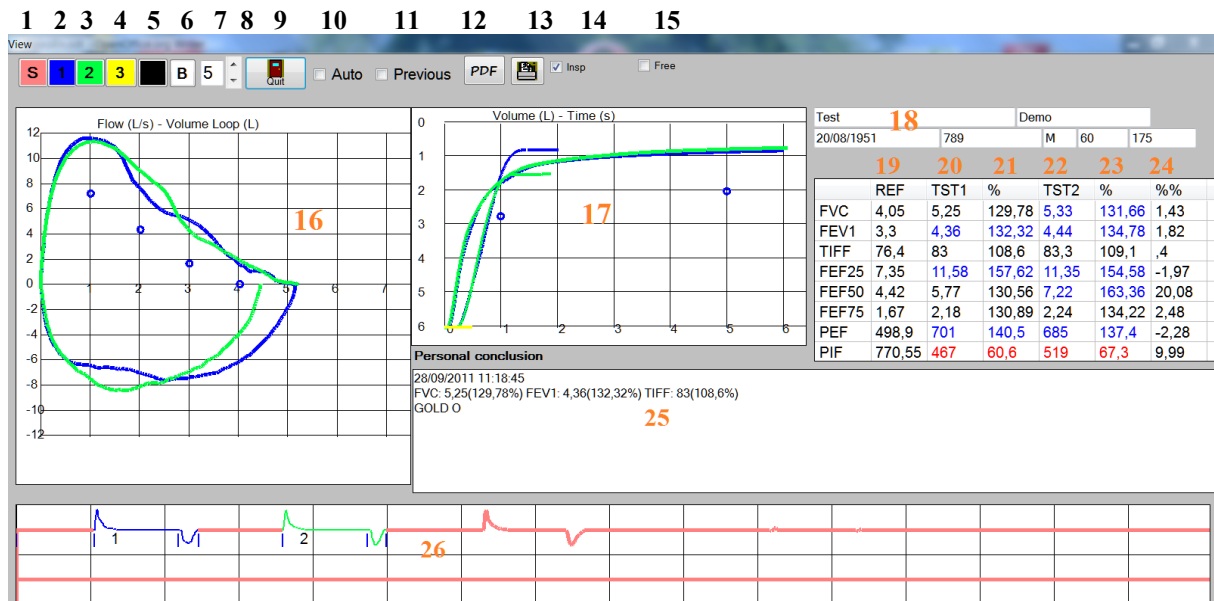
1. The color of the signal.
2. The color of the first curve.
3. The color of the second curve.
4. The color of the third curve.
5. The color of the grid.
6. Background color.
7 en 8. Signal thickness.
9. Quit
10. **Auto**. When selected, the 3 best curves are selected automatically. TST1 is the curve with the highest sum of FVC and PEF, followed by TST2 and TST3. When Auto is not selected you can select manually 1 or 2 curves by clicking on the inspiration of a curve below on the screen. Note that a curve needs to end by an inspiration in order for this to work properly. The expiration time must not exceed 12 seconds.

11 **Compare with a previous record**. Columns 20 and 21 stay fixed.
12 **PDF.**
13. **Print on A4**. If necessary, it is possible to modify the data secondary.
14. When **INSP** is not selected, the inspiration curve is not shown on the Volume-Time graph.
   15. **Free:**
Some patients are not capable of inspiring immediately after having expired. In such cases, the software cannot delimit and calculate the curves.
Proceed then as follows:
Click on Free. Enter a value which corresponds to the duration of the expiration (300 = 1 second).Then click on the curve on the exact place that corresponds to the start of the expiration.
Free gives also the possibility to measure the data of a calibration syringe !

16.   Flow-volume loop
17.   Volume-Time
18.   Personal data of the patient.
        If you made an error on entering them, you can correct it here.
19. The **reference results** in function of sex, age, size of the patient.
20 The results of **TEST 1** The values of the results of TEST 1. The values from which the standard deviation is 2 times higher or lower than the reference value are drawn in blue or red.
21. **Percent**. The values of the results of TEST 2 divided by the reference results*100. The values from witch the standard deviation is 2 times higher or lower than the reference value are marked with blue or red.
22. The results of **TEST 2**.
23. **Percent**. The values of the results of TEST 2. The values from witch the standard deviation is 2 times higher or lower than the reference value are marked with blue or red.

24. Percent percent. The **difference in percent** between the last 2 curves selected. The percent of difference is important for measuring the reversibility of airway obstruction after inhalation of salbutamol.

25. Your **personal conclusion**. Double click on 'FVC' to add FVC, FEV1, PEF and TIFF to your conclusion.

26. The user can **click on an inspiration, a downwards going part of the curve,** below the screen (red arrows) to select a curve or use 'Free'. It' possible to delete a curve by clicking below of the screen with the right mouse button on it. This might be useful if you have given a demonstration to your patient and you want to delete your own curve.

2.3 Flow Volume Loop

On the vertical axis you have Flow in liter / second.
On the horizontal axis Volume in liter. You can see on this graph
FVC Forced Vital Capacity. On horizontal axis you see forced expiratory volume in liter. The reference value is indicated by a small blue circle on the horizontal axis. You will find the formula used to calculate reference value at the end of this installation guide.
FEF25 Forced Expiratory Flow (liter/s) when 25 percent of the volume has been expired. The reference value is indicated by a small blue circle.
FEF50 Forced Expiratory Flow (liter/s) when 50 percent of the volume has been expired. The reference value is indicated by a small blue circle.
FEF75 Forced Expiratory Flow (liter/s) when 75 percent of the volume has been expired. The reference value is indicated by a small blue circle.
PEF Peak Expiratory Flow. Maximum flow during expiration in liter / minute) This is what you can measure with an ordinary Peak Flow meter.
PIF Peak Inspiratory flow. Maximum flow during inspiration in liter / minute.
Remarks: PEF and PIF are expressed in liter / minute, the other values in liter / second. FEF25 multiplied with 60 gives a value close to the PEF for most patients.

2.4   Volume Time

On the vertical axis you have Volume in liter. On the horizontal axis Time in seconds.
On this graph it is easy to read the **FEV1** (One Second Value).
TIFF (Tiffenau) is the proportion between FEV1 and FVC. Normally TIFF is above 72
percent. A lower TIFF in combination with a normal FVC indicates an obstructive syndrome
(e.g. asthma).
Lower values of all metrics indicate a restrictive syndrome (e.g. Spondylitis ankylosans).
Note that TIFF will be too high if a patient's expiration time is not sufficiently long.
COLD patients can expire for more than 6 seconds. In this case, the horizontal axis adapts
automatically.
The inspiration curve is also shown. Even though no standard formulas exist to evaluate this
curve, it can be important in certain cases (e.g. swimmers).
You can record for up to 4 minutes. To select a curve in the record, click below on it. You can
select and compare up to 3 curves simultaneously.

2.5 Relation between the 3 curves

Interpretation of Flow-Volume curve is not always easy. The relation between the 3 curves is
indicated in the figure below. The blue horizontal lines have the same duration. You
understand that the Flow-Volume curve is almost fully determined during the first second.
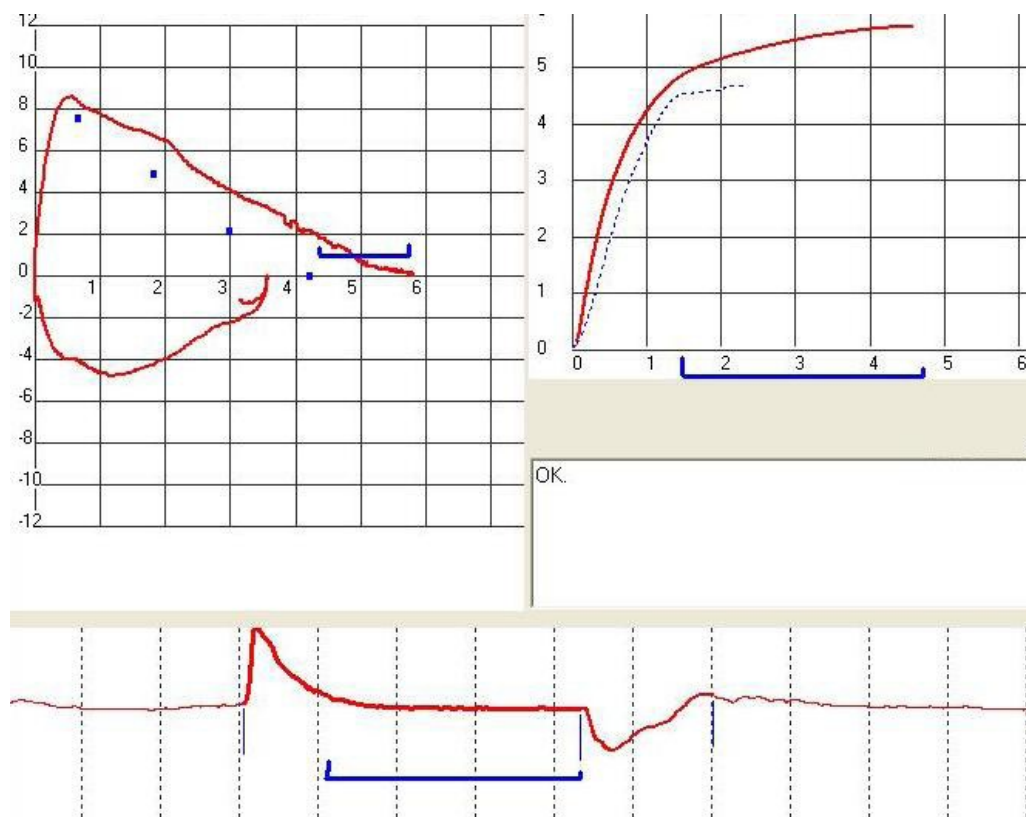
Relation between 3 curves

2.6 Compare two recordings

It is possible to compare the values of two recordings on screen.
The recordings may be of the same or of a different patient.
Load first the previous recording. Select Auto for showing the best curve.
Click below on the best curve to make I that '1' appears next to it.
Click then on the save button on top of the screen.

Load now the last recording. Click on Previous.
The values of the previous curve are displayed below TST1 and %.
Click below of the screen on the curve that you want to compare.
The values of it are displayed below TST2 and % .
%% shows the difference of the values between the two curves.

As long as 'Previous' is on, the values below TST1 - % stay fixed.

	REF	TST1	%	TST2	%	%%
FVC	4,05	5,25	129,78	5,43	134,15	1,85
FEV1	3,3	4,36	132,32	4,43	134,46	-,24
TIFF	76,4	83	108,6	81,6	106,8	-2,13
FEF25	7,35	11,58	157,62	11,22	152,7	-1,23
FEF50	4,42	5,77	130,56	5,39	121,99	-33,92
FEF75	1,67	2,18	130,89	2,19	131,2	-2,3
PEF	498,9	701	140,5	683	136,8	-,43
PIF	770,55	467	60,6	505	65,6	-2,58

2.7 PDF

Select a record, then click on the main menu - PDF the following screen pops up.
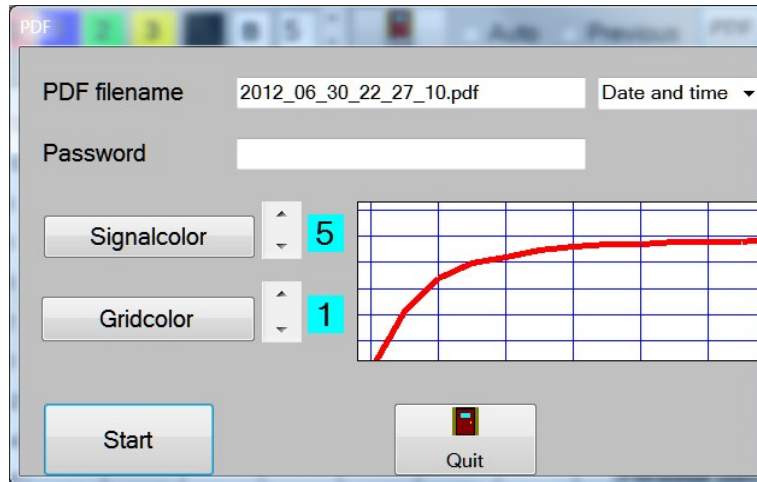
PDF Print

You can create a PDF file from your record. PDF files can be read by Acrobat Reader, which can be downloaded for free at www.adobe.com.

You can protect your PDF file by a **password** and send it as attachment with an email. If you leave this box empty, the file will not be protected with a password.

Filename : you can modify the name of your PDF file, so you are able to easy find it. Even the path name of another dir is possible.

Click **'Start'** to open the PDF file in Acrobat Reader.

Examination

SMITH JOHN   10/10/955   M123

| Age | 52 | Length | 175 | Weight | 72 | Sexe | M |

	REF	TST1	%	TST2	%	%%
FVC	4.40	5.42	123.0	5.17	117.3	-4.87
FEV1	3.53	4.06	115.1	3.91	110.7	-3.97
TIFF	77.85	74.95	96.3	75.60	97.1	0.86
FEF25	7.58	9.09	120.0	8.32	109.9	-9.17
FEF50	4.67	4.53	97.1	4.23	90.5	-7.26
FEF75	1.88	1.35	72.0	1.35	72.0	0.00
PEF	520	643	124	637	123	-0.96
PIF		424		412		-3.08

Flow (L/s) - Volume Loop (L)
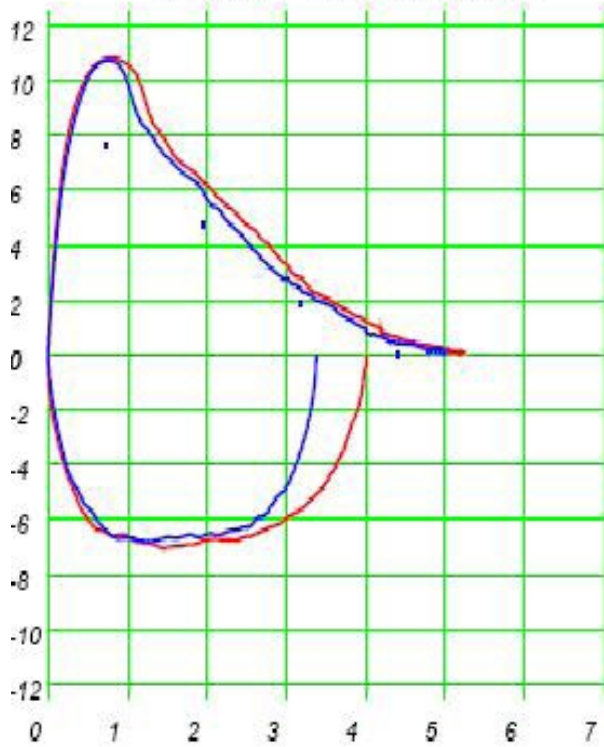
Volume (L) - Time (s)
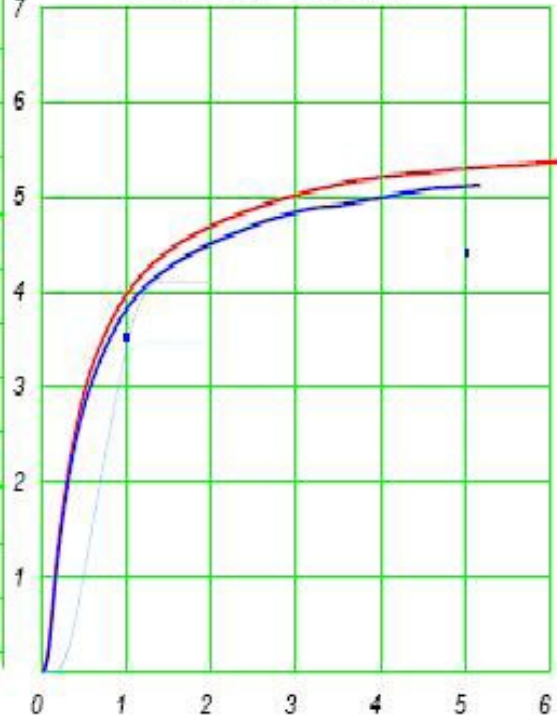
PDF printout.

III Addenda

3.1 Integration

Starting from a patient program it is easy to start the software directly.
The advantage is that it is not necessary for the user to retype the name, first name, birth date and ID of the patient
We give support to tree different mechanisms.

A/ Start our software with arguments.

Ask your software developer to write in its code one single line like this:
Process.Start('C:\PC-Spiro\Spiro.exe "SMITH" "JOHANNAH" 20/08/1952 456 F 55 160 82')
Spiro.exe executes and places itself on the patient SMITH JOHANNAH if she is present. If the patient is not yet available, click immediately on the leftmost icon to start a new recording of him.
The other software has to launch our program with the following arguments:
- name between " "` (can have more then one part)
- first name between " "`
- birth date.
- ID number.
- M (male) of F (female)
- age in years.
- length in cm
- weight in kg
You can test this link in Windows with Start - Execute or from the dosprompt :
C:\PC-Spiro\Spiro.exe "SMITH" "JOHN" 20/08/1951 123 M 56 176 74
enter and click on the leftmost icon.

B/ XML
Some software has the possibility to make an XML file ident.xml in the
working directory.

C/ Textfile

The patient data are obtained from a file 'Data.txt' with the following content

name
first name
birth date.
ID number.
M (male) of F (female)
age in years.
length in cm
weight in kg

Launch then Spiro.exe with a shortcut.

3.2 Reference Values - Regression formulas

Man:

FVC Height* 5.77-Age*0.025-4.34
FEV1 Height * 4.30-Age *0.029+1
TIFF -0.18*Age+87.2
FEF25 Height*5.46-Age *0.029-0.47
FEF50 Height*3.79-Age*0.031-0.25
FEF75 Height*2.61-Age*0.026-1.34
PEF (Height*6.14-Age*0.043+0.16) * 60

Women:

FVC Height*4.44-Age*0.026-2.89
FEV1 Height*3.95-Age *0.025-2.60
TIFF -0.18*Age+87.2
FEF25 Height*3.22-Age *0.025+1.61
FEF50 Height*2.45-Age*0.025+1.15
FEF75 Height*2.61-Age*0.024+1.11
PEF (Height*5.51-Age*0.030-1.10) * 60
You can modify constants in these formulas by Menu - Setup - Formulas.

3.3 FAQ

Recording seems not possible or software doesn't work :

. COMPORT: wrong choice. In the setup, click on the down arrow at right from 'serial port'.
In general, the highest number marked with OK will be the good one.
A wrong choice will not harm your PC but recording is not possible .
If not ok, click twice on the down arrow, once with the spirometer connected and once
without the spirometer connected to the PC.

Software has been installed in another **directory** than C:\PC-Spiro
With Setup - Dir you have to select the correct directory.
Verify that the file Calfile.bin is in the installation directory.

After installation of **other new software** spirometry recording seems not possible. The new
software occupies your serial port even when the software is not in use. Examples are Palm
communication or Pocket PC's, PDA's. Change the Hot sync or Active Sync so that is only
active when you use the software. Mark in its setup that it is not necessary to use the serial
port.

**Why is it not necessary to indicate the air pressure, room temperature
 and body temperature ?**
The absolute air pressure is not important because the apparatus works with the difference of
two pressures.

The room temperature is also not important because the airflow is not much cooled before it is measured. (to 34 degree Celsius). Also the apparatus uses temperature stabilized pressure sensors.
The body temperature of humans is also constant.
There is one important exception: when the user uses a calibration syringe. The air in that syringe has the ambient temperature.(or a little bit more dependent on the degree of compression) The volume has to be adjusted with degrees Kelvin of the air in the syringe divided by the degrees of the normal expired air. An example for an ambient temperature of 22 degree Celsius and a calibration syringe of 3 liters :
$3 * (273 + 22) / (273 + 34) = 120$ ml less are to be measured.

How to make a backup or move to another PC?

Backup is possible to every other location: CD-R ou RW, USB stick, other PC, etc. Use Windows Explorer to copy many Spirometer files (.spi) at once from
C:\PC-Spiro to your other location. To work with the files on another support, change the working directory of Spiro.exe in the setup.
Important: Files on a CD-ROM have the Readonly attribute. When they are transported again to the hard disk then Readonly must be inactivated.
With the Windows Explorer select them and press the right mouse button.
Deselect the read only attribute. On a CD-RW this is not necessary.

New PC – How can I move my *.spi files to a new PC?

Three possibilities:

A/ Install the program again from CD-ROM and copy the old *.spi files to the
 installation directory on the new PC.

B/ Download the newest version on our site www.ganseman.com   Unzip and execute Setup.exe. Copy the old *.spi files to the installation directory on the new PC.

C/ Copy the directories C:\PC-Spiro and content to the new PC.

Option B/ and C/ demands **sometimes** installation of the driver for the USB-serial converter.
The driver is located on the CD in the file CDMUSB.exe and on our website in CDMUSB.zip.   Download, unzip. Execute 'CDMUSB.exe' once.
This seems to do nothing. Afterwards plug the converter in the pc and wait a few moments.

Before recording, go to the setup and make the
correct **comport choice**: see previous page and Setup page.
And **SerialNr !**