

Addendum to WinTherm32 Software Manual for FOX 200LT

The WinTherm32 Software Manual is a general guide for use with all of LaserComp's FOX family of instruments. Please ignore sections that do not pertain to the FOX 200LT, such as discussion of water flow and water tubing. It should also be noted that the "Pre-Saved Calibration of the FOX Instrument" section shows calibration set points used in the standard instruments.

Please refer to the FOX200LT instrument manual for information regarding usage of liquid nitrogen, low temperature calibrations, and other information specific to running the FOX200LT.

When running tests use the NIST 1450b calibration found on your computer which covers the full temperature range of the instrument. This calibration was installed with the WinTherm software from the installation CD. A UserType calibration is also included which covers a much narrower temperature range. Do not use the calibrations saved on the instrument.

WinTherm32 Software Manual

TA Instruments-LaserComp, Inc., © 2002-2016
107 Audubon Rd. Suite 1-40, Wakefield, Massachusetts 01880 U.S.A.
Phone: (781) 233-1717; Fax: (781) 941-2484;
Website: www.lasercomp.com; E-mail: lasercomp@tainstruments.com

TABLE OF CONTENTS

1. INTRODUCTION	4
2. QUICK START OF TESTS	5
3. PRIMARY OPTIONS	10
3.1 Run type - Test or Calibration	10
3.2 Calibration type - 1450b (NIST) type or User type	10
3.3. Run mode - Manual (Instrument) Run Mode	
Auto (“WinTherm32” or Computer) Run Mode	11
3.4. Calculating Results - Instrument or Computer	11
4. “WINTHERM32” RUN (AUTO RUN)	12
4.1. Establishing Computer-Instrument Communication	13
4.2. “WinTherm32” Application and “FOX Instrument –COMport” Windows	15
4.3. “Test Setup” Window	
(“Setup – Parameters” menu command)	18
5. MENU COMMANDS	23
5.1. “File” commands	23
5.2. “View” commands	25
5.3. “Setup” commands	28
5.4. “Run” commands	33
5.5. “Preferences” Commands	36
5.6. “Aux” commands	38
5.7. “Help” commands	39
6. FOX INSTRUMENT RE-CALIBRATION USING “WINTHERM32”	40
6.1. Pre-Saved Calibrations of the FOX Instrument	40
6.2. Re-Calibration of the FOX Instrument	41

6.3. Step-by-step Procedure of Re-Calibration	41
6.4. How to Save Calibrations Permanently	48
6.5. Multi-Thickness Calibration	50
7. RE-STARTING THE “WINTHERM32”	52
7.1. Re-Starting Tests	52
7.2. Re-Starting Calibrations	54
8. INSTALLATION OF ADDITIONAL “WINTHERM32” COPIES TO CONTROL SEVERAL FOX INSTRUMENTS	57

1. INTRODUCTION

The “WinTherm32” software is applicable to all FOX family instruments, except FOX50 FOX600GHP and A100. These three instruments have their own special PC software. For your better understanding how the WinTherm32 software and FOX instruments work we urge you to peruse both this Manual and FOX Instrument Manual.

This Manual explains many of the components of the “WinTherm32” software. Full “Help” index in the software will answer any and all questions you may have. As always, you can call us or send your questions via e-mail or fax. Please also send us (as attachments) your test files (and your calibration, if it was used in the tests).

To start tests immediately skip ahead to Chapter 2, “Quick Start”. More detailed explanations of all steps and commands can be found in the rest of the Manual.

The “WinTherm32” software requires the following to operate: IBM compatible PC, Microsoft Windows (all versions are compatible), with one available RS-232 or USB port.

To load “WinTherm32” Software:

1. Start Microsoft Windows;
2. Insert the “WinTherm32” CD into the CD drive;
3. Press the “Start” button and choose “Run”;
4. Type “d:\WinTherm32v3\setup” and press “ENTER”.

“WinTherm32” software enables you to operate the FOX instrument from your IBM-compatible computer through a standard RS-232 or USB port. Using a series of windows all the test parameters and formats of output data can be set up and changed at any moment during the run. All selected data are automatically stored on a computer’s memory and can be saved in computer file. Once the test parameters have been set and the test started, the computer can be used to display any desired output data.

Up to 8 instruments (with additional RS-232 I/O cards or available USB ports) can be run simultaneously on one host computer using additional renamed copies of the “WinTherm32” software (see Chapter 8 to find how to install the additional copies).

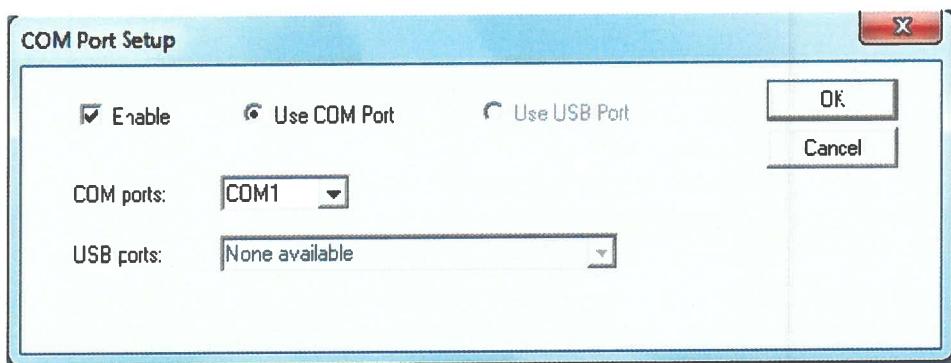
2. QUICK START OF TESTS

Important! Make sure that water flow is connected to the instrument. Neglecting this will cause shut down of the instrument and can cause serious damage of its heating/cooling system! Cold (upper) plate should be cooled first!

Use rigid or semi-rigid $\frac{1}{4}$ " (6.35 mm) OD plastic hose for small FOX Instruments (200 and 300s), and $\frac{3}{8}$ " (9.52 mm) OD for big FOX Instruments (600s and 800s). We don't recommend using a TYGON® hose - it is not rigid enough and does not seal the water properly.

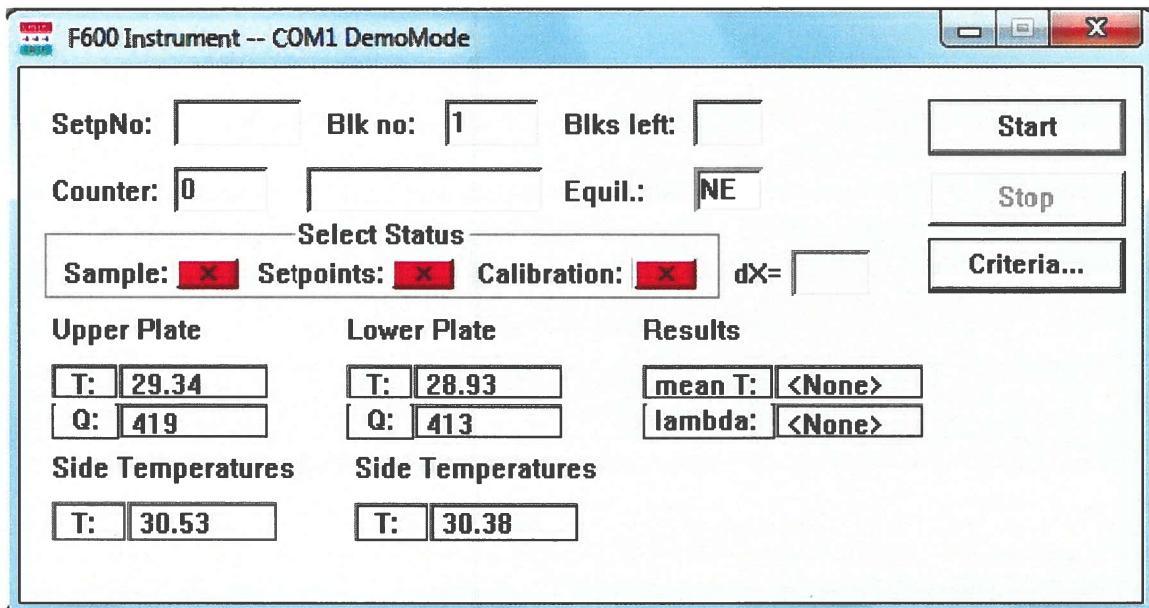
Typical water flow rate is about 57-75 liters (15-20 US gallons) per hour at $\sim 18^{\circ}\text{C}$ ($\sim 64^{\circ}\text{F}$) for FOX200 and FOX300s, and 75-95 liters (20-25 US gallons) per hour for FOX600 and FOX800. By observing the temperatures of the plates during a run you can determine whether the water flow rate is sufficient or not. Normally the temperatures of the plates are stable within $\pm 0.02^{\circ}\text{C}$ after the set point has been reached. If the temperature changes by more than a few hundredths of degree Centigrade or if the set point is not reached, the water flow rate most likely is not sufficient for the instrument.

1. Connect the FOX instrument to a computer using a RS-232 or USB cable and turn on the power to the instrument (check the water flow!)
2. Open the "WinTherm32" program on your PC. The first time, a "COM Port Setup" window should appear automatically. After subsequent tests, this window will not appear. If you'd like to re-open the window, select "Aux" on WinTherm's drop-down menu and select "Port".



To establish the PC-FOX communication, select "Use COM Port" and the correct COM port (if your instrument has a RS232 communication board installed), or "Use USB port" (if a USB communication board is installed). Check "Enable" and select "OK".

The "FOX Instrument – COM#" window should appear next:



3. To set a directory where the test results are to be saved, use the drop-down menu: select "Preferences", "File defaults", "Test Directory", and select the directory (using "Browse" button), then click "OK".

Important! To save all your current settings (including COM port number) – click "File" and "Exit" – it will close the "WinTherm32". Then open the program again (all the current settings will be saved only if "Auto Save on Exit" square is marked on "Test Setup" window – see Chapter 4.3).

A message "Calibrate Stack Screen is detected" appears if the FOX Instrument's LCD (Liquid Crystal Display) is on "Calibrate Delta X" screen:

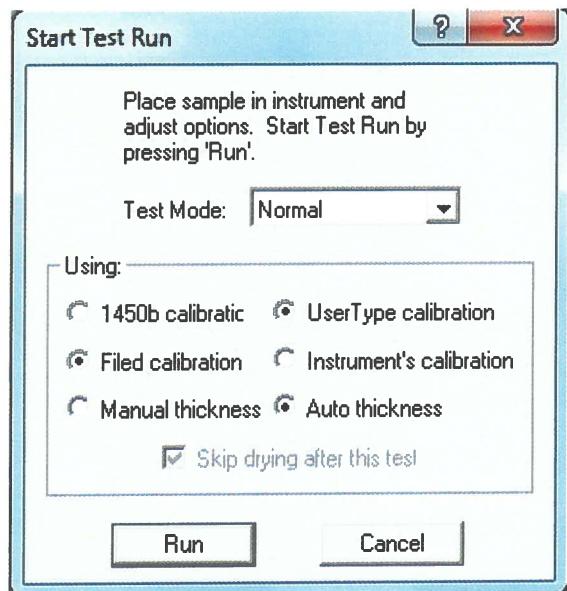


Remove the sample from the instrument's chamber (if present), and click "Calibrate" to set zero level on the thickness measurement system (make sure that the plates' surfaces are clean). Wait until the instrument's motors stop.

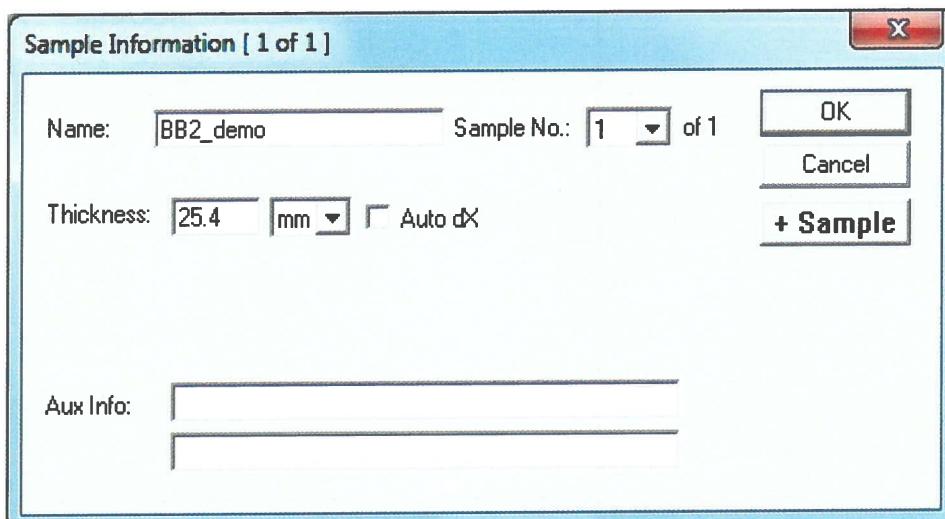
4. Insert your sample into the instrument's chamber. If size of your sample is smaller than size of the plates, place the sample on the center of the lower plate and use surrounding insulation to cover the rest of the plate. **The thickness of the surrounding insulation should be a little bit smaller than the thickness of the sample!**

5. Press "Start" button on the "FOX Instrument - COM" window.

6. "Start Test Run" window should appear. Leave "Test Mode" as "Normal". Select calibration type - either "1450b" or "User type" (usually both NIST-based reference materials' calibrations). Select either "Filed calibration" (from the instrument's CD or computer files – i.e. IRMM or Multi-Thickness calibration file - "User type" should be selected in this case) or instrument's calibration (see Chapter 6.1 "Pre-Saved Calibrations of the FOX Instrument"). Select either "Manual Thickness" (in case of soft sample) or "Auto Thickness" (in case of rigid sample). Click "Run".

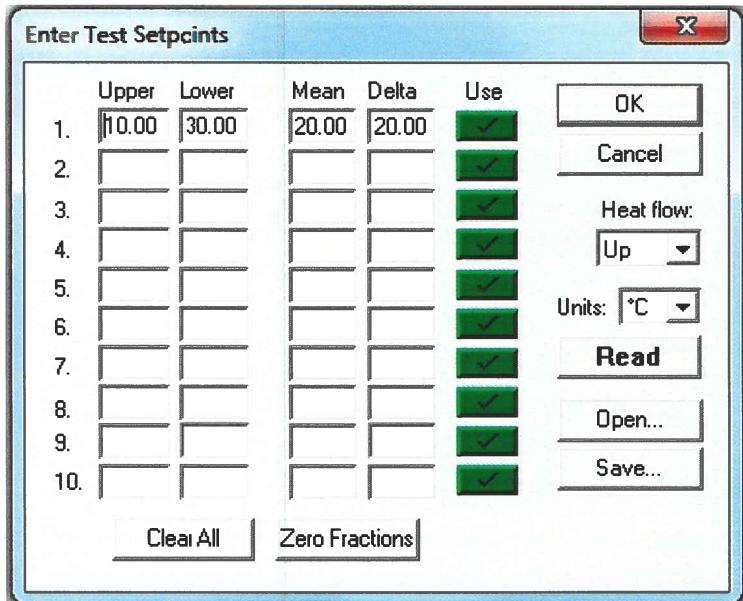


7. "Sample Information" window should appear. Enter the file's name. If "Manual Thickness" was selected, enter the thickness of the sample. Conversely, you can select "Auto Thickness" and the instrument will determine the thickness of the sample.



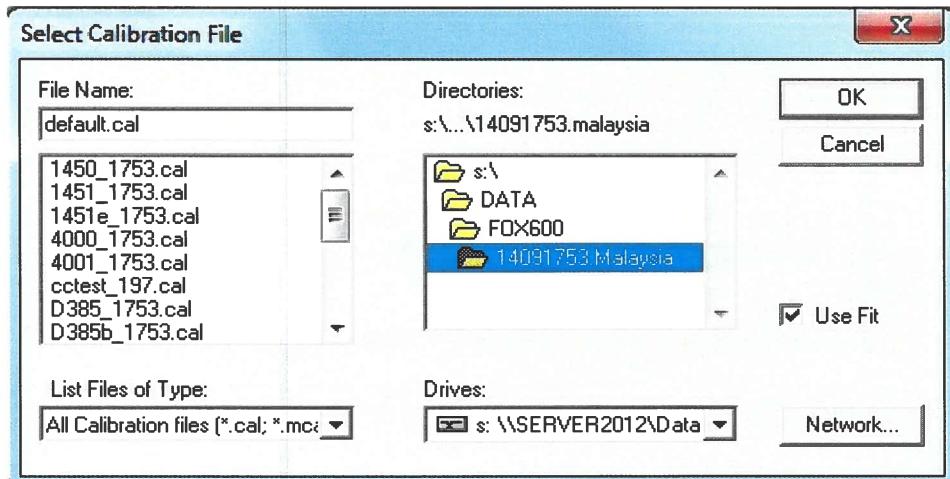
Enter any additional information about the sample or conditions of the run in "Aux Info" window. Click "OK".

8. Next the “Enter Test Setpoints” window should appear. Enter either the pairs of temperatures (set points) for upper and lower plates (no more than 9 pairs) or mean temperatures and delta T:



Instead of manual entry you can use pre-saved sets of set points (these files as saved as “.stp”) using the “Open” button. You can save the current set of the set points for future needs using the “Save” button. You can exclude any of the set points by clicking on green squares. Select “OK”. (Only for the low temperature FOX instruments: if both setpoints are higher than 35C then the liquid nitrogen valves will remain closed!).

9. If “Filed Calibration” was selected, the “Select Calibration File” window should appear. Select the calibration file to be used for calculations (e.g. IRMM_xxxx.cal). Calibration files have “.cal” extensions (tests files have “.tst” extensions). The selected calibration file will be used for thermal conductivity calculations during the current test. Click “OK” - test run now is started.



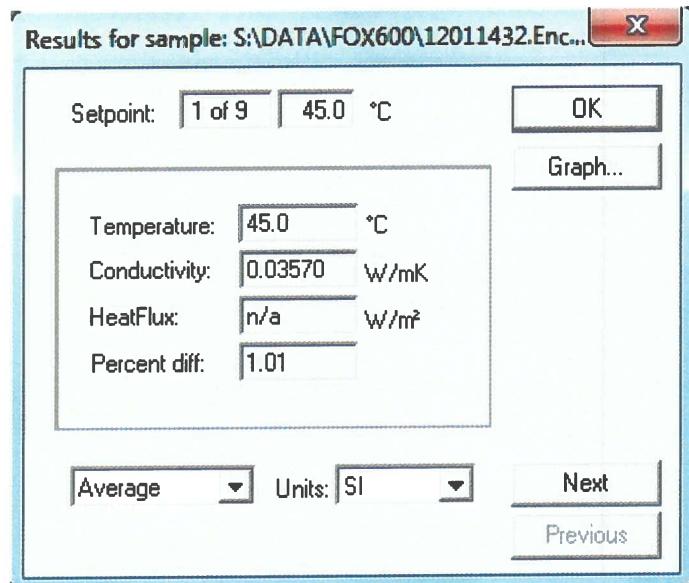
To use Multi-Thickness calibrations for thermal conductivity calculations with thick sample tests, simply choose the ".mcal" ("User type") calibration file (click "List Files of Type" on the left bottom corner). "WinTherm32" will automatically use the thickness of the tested thick sample and will choose the proper calibration factors for that thickness.

10. If necessary (in case of thick samples), select "Criteria" on the "FOX Instrument - COM" window and enter increased values of the thermal equilibrium criteria (see Chapter 9 "Equilibrium Criteria" of FOX Instrument Manual). Thicker samples need greater % of the HFM signals tolerance, and greater number of blocks (to guarantee full thermal equilibrium). Typically for the ~50 mm-thick insulation material samples we recommend to use 2% for the HFM Percent Change (i.e. tolerance), ~10 for Min. number of blocks, and 3 for Calculation blocks; for ~75 mm-thick sample use 2.5%, ~20 and 5 blocks; and for ~100 mm-thick samples – 3%, ~30 and 5 blocks. Click OK.

11. After completing a test (normally between 40 minutes to an hour per set point on a 1 inch thick material such as Expanded Polystyrene), WinTherm32 calculates values of thermal conductivity λ (in Watt m⁻¹ K⁻¹ or Btu in hr⁻¹ ft⁻² °F⁻¹). The calibration file selected by user at the beginning of the test run, and Equation3 from Instrument Manual are used:

$$\lambda_{test} = S_{cal}(T) Q \Delta x_{test} / \Delta T$$

where $S_{cal}(T)$ is calibration factor of the heat flow transducer, Q is signal of the transducer, Δx_{test} is thickness of the sample, and ΔT is temperature difference. Results shown on the PC screen will be saved in the file with ".tst" extension - click "OK".



Click "Next" to open results of the next set point. You can check either upper or lower plate results (click on drop-down arrow in lower left corner of the window), or change the units (click on drop-down arrow on the bottom of the window). "Heat Flux" is not shown on the window because it was not selected to be added to the result file using the "Preferences - Test Results" menu command. "Percent diff" shows difference between values calculated using upper and lower heat flow meters.

3. PRIMARY OPTIONS

3.1 Run type - Test or Calibration

A test is the measurements of thermal conductivity (or thermal resistance) of samples. The sample is placed between two metal plates maintained at constant temperatures and having constant (usually 25⁰C or 20⁰C) temperature differences. After reaching full thermal equilibrium, signals of the heat flux transducers become stable. The heat flux is proportional to the temperature difference and the sample's thermal conductivity is divided by its thickness. The heat flux transducers' signals (in microvolts) and the heat flux (in Watts per square meter) are related through transducer's calibration factor (see FOX Instrument Manual).

The heat flux transducers of both plates were calibrated at LaserComp using NIST-certified calibration standards at several various set points (pairs of temperatures). The heat flux transducers' microvolt readings were used to calculate the calibration factors (see Chapter 6.1 "Pre-Saved Calibrations of the FOX Instrument").

You may run a new calibration or recalibration using your own calibration standard to verify the original calibrations. As many filed calibrations as necessary may be stored on the computer's hard drive and can be used during tests. Calibration factors values of all the calibrations should be close to one other.

3.2 Calibration type - 1450b (NIST) type or User type

The calibration factors are saved on the Instrument's non-volatile memory - one set for the NIST 1450b (fiberglass) Standard Reference Material (SRM) and one set for so-called User type (Expanded Polystyrene - EPS) Standard. Both standards used for the calibrations were tested and certified in the National Institute of Standards and Technology (NIST). The calibration factors saved in the Instrument's memory enables you to run tests immediately (see Chapter 2 of this Manual and Instrument's Manual).

Starting the 1450b-type calibration you do not need to enter values of the standard's thermal conductivity because they are calculated by FOX Instrument.

Starting the "User type" calibration the reliable values of the standard's thermal conductivity (e.g. from the NIST or IRMM Certificates) should be entered either manually from Instrument's keypad or automatically from computer using "WinTherm32".

3.3. Run mode - Manual (Instrument) Run Mode or Auto (“WinTherm32” or Computer) Run Mode

Manual (or Instrument) Run Mode means that the test or calibration has been started on the FOX Instrument and all selections were chosen on the Instrument (i.e. the “WinTherm32” was initiated **later** than the run has been started). At this point the computer connected with the instrument is used for data storage and for viewing of real time data and results.

Auto (“WinTherm32” or Computer) Run Mode enables you to start tests and calibrations making all selections entirely on the computer once the instrument has been turned on, the thickness measurement system have been zeroed and the sample has been inserted.

Note: As noted in the Instrument Manual, the zeroing of the thickness measurement system should be done every time the FOX Instrument is turned on. The plate position control system has readouts of each of four corners of the moving plate. When the instrument is turned on, the plates come into full contact twice, so that the sophisticated digital thickness reading system is reset to zero to guarantee the stated accuracy of about +/-0.025mm (+/- 0.001"). We recommend the re-zeroing be done on a regular basis.

3.4. Calculating Results - Instrument or Computer

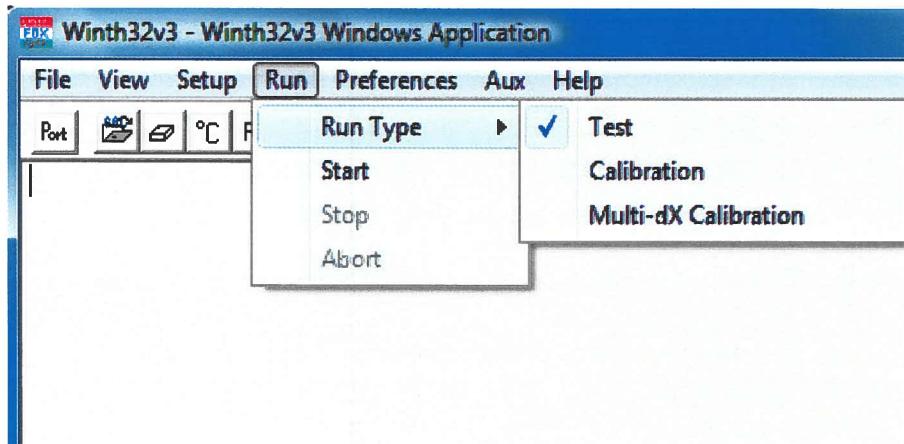
“WinTherm32” does its own calculations using more decimal places than FOX Instrument’s calculations. The “WinTherm32” will show results calculated by the FOX Instrument only:

- a) for already completed set points - i.e. when the “WinTherm32” was initiated later than test was started on the FOX Instrument;
- b) or for almost completed set points - when less than the Minimum Number of Blocks, selected in Equilibrium Criteria, were remaining before completing the set point (see Instrument Manual).

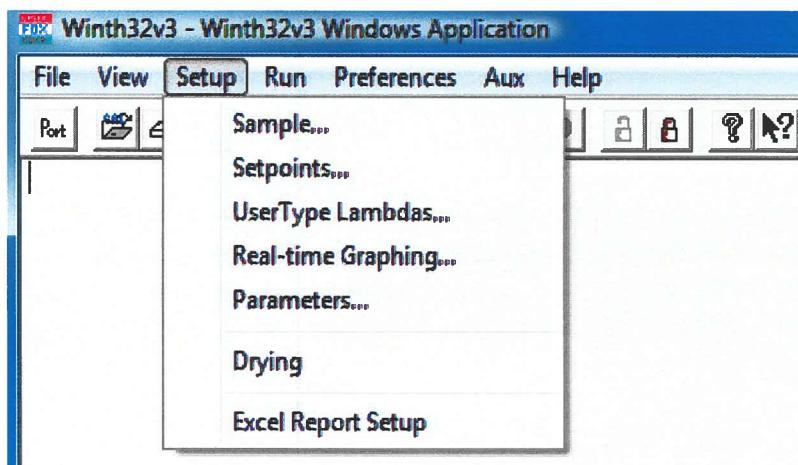
4. “WINTHERM32” RUN (AUTO RUN)

Before starting a test or calibration run for the first time use the following menu commands to check and/or correct the “WinTherm32”s to your specifications.

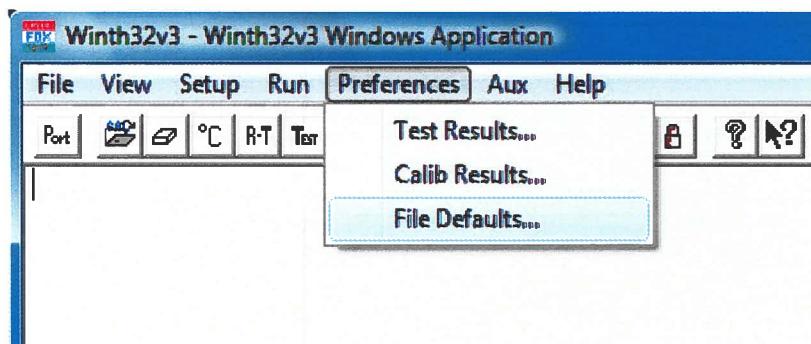
- a) “Run - Run Type – Test / Calibration / Multi-dX Calibration”:



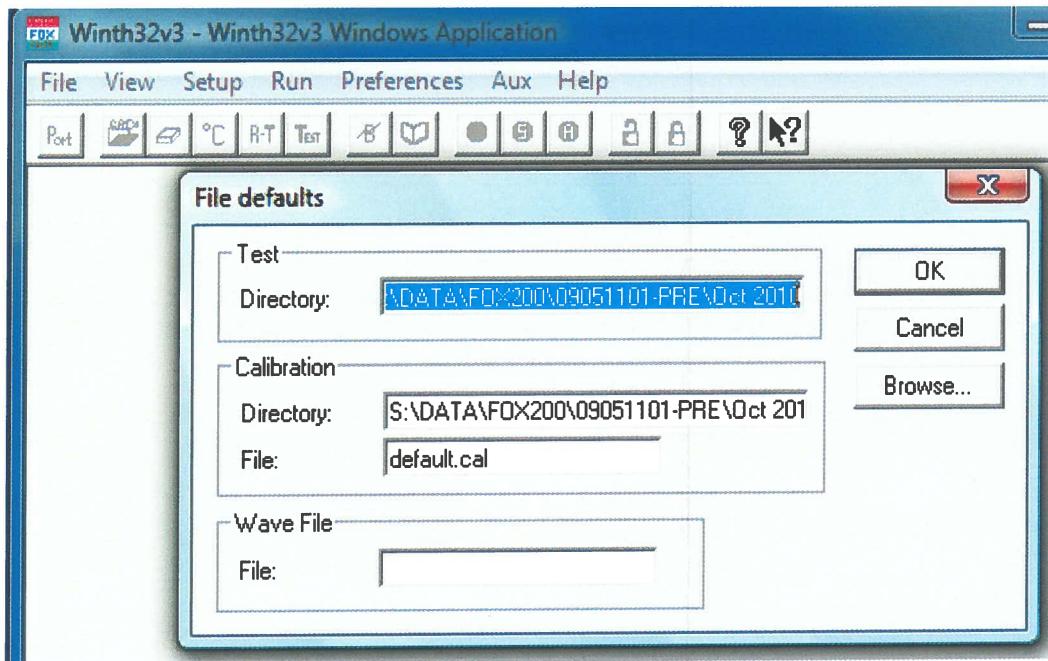
- b) “Setup - Parameters” (see Chapter 4.3):



- c) “Preferences - File Defaults”:



Set directories for test files ("Test - Directory") and for calibration files ("Calibration - Directory")

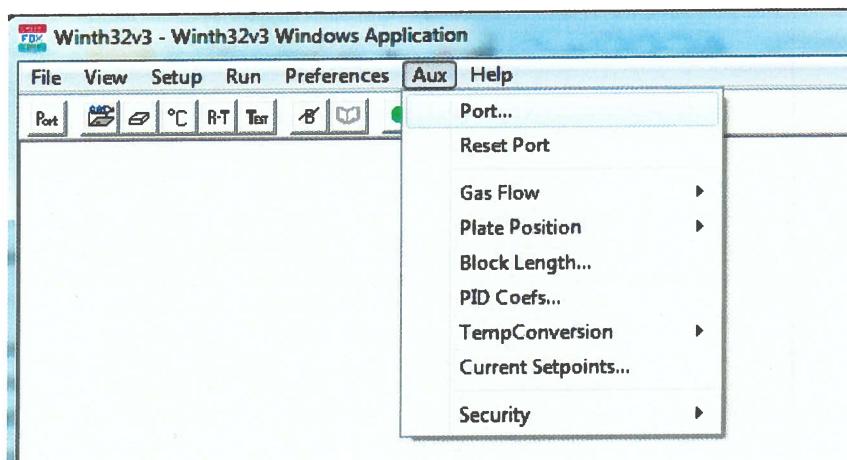


Set directories where the resulting ".tst" test files and the ".cal" calibration files will be saved, and where the wave file (for sound signal) will be taken from.

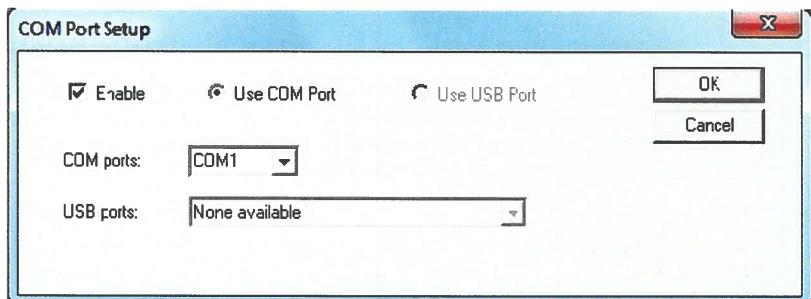
Important! To save all your current settings (including COM port number see next Subchapter 4.1) – click "File" and "Exit" – it will close the "WinTherm32". Then open the program again (all the current settings will be saved only if "Auto Save on Exit" square is marked on "Test Setup" window – see Chapter 4.3).

4.1. Establishing Computer-Instrument Communication

To establish communication between computer and FOX Instrument through a RS-232 interface cable the appropriate computer's COM-port should be activated. Click "Aux" and "Port":

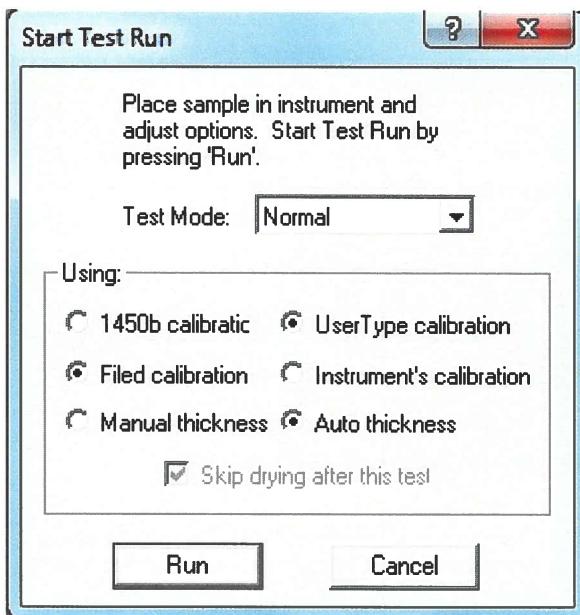


"COM port Setup" window should appear automatically at the "WinTherm32" start if no communication was previously set as default:



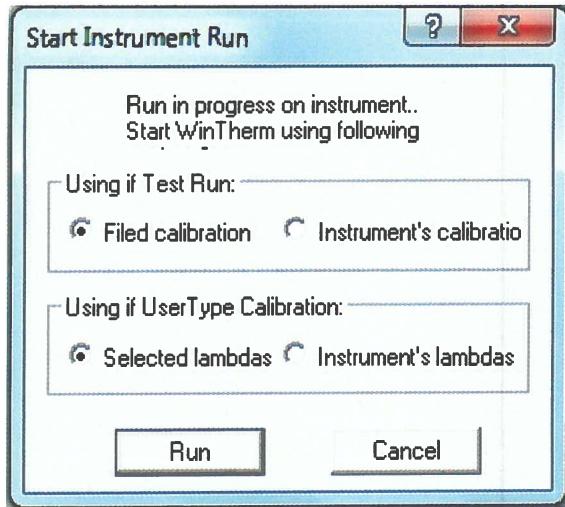
Select appropriate COM-port or USB port (if instrument came with a USB Communication board), select "Enabled" and select "OK. The computer reads the current state of the FOX Instrument.

One of the following windows should appear next:



"Start Test Run" window appears if Instrument is ready to start test run:

Select Test Mode – Normal, Multi-Thickness or Aging. Select the type of calibration to be used for calculations – either 1450b or User type, either Filed or Instrument's calibration, either Manual or Auto thickness. Click "Run".

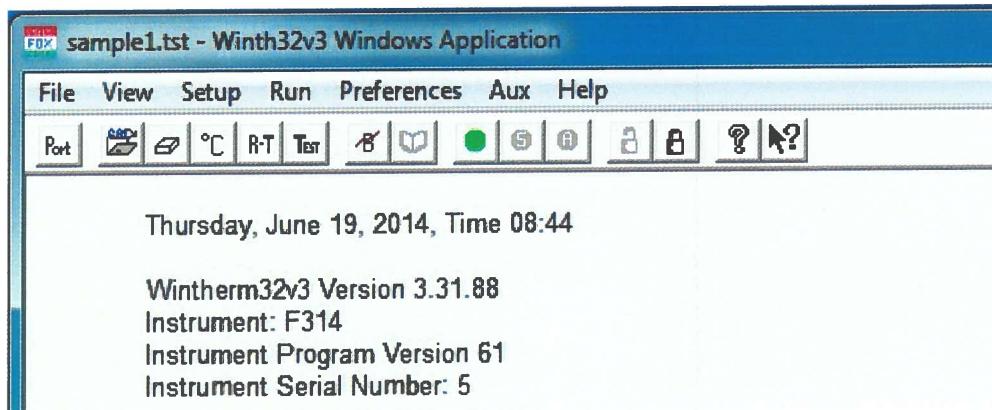


“Start Instrument Run” window appears if the Instrument is running – the current run was already started either from Instrument’s keypad or from computer using the “WinTherm32” which was then closed (or because of computer crash, etc.):

This window is used both for tests and for calibrations. Select either a saved file or the instrument’s calibration to be used for calculations if starting a test anew. Alternatively, selects saved values to be used for calculations if calibrating.

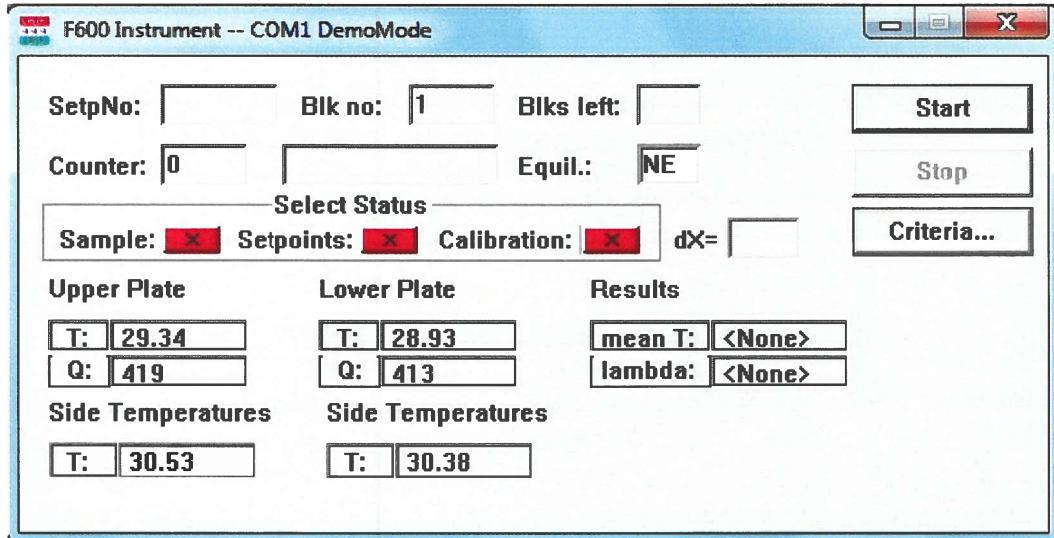
4.2. “WinTherm32” Application and “FOX Instrument –COMport” Windows

“WinTherm32” Application window has seven drop-down menus and a toolbar:



Detailed explanation of the seven groups of the menu commands is presented in Chapter 5, “Menu Commands”. Toolbar square buttons were created for most frequently used commands. Explanation of each button appears automatically after pointing it by mouse cursor.

When the COM-port (to which the FOX instrument is connected) is activated, the “FOX Instrument - COM port” window appears, showing the type of the FOX instrument and COM-port at the top of the window:



The following fields and values are displayed:

SetpNo: - current set point number and the total number of all defined set points.

Blk No: - current block number.

Blks left: - after the Percent Equilibrium (P.E.) criterion is met, this is the expected number of blocks left until the end of the current run. See Instrument Manual to know more about the Equilibrium Criteria.

Counter – ADC readings counter – 1...[block length = 512, or 256 or 128 or 64]. Block length is set by “Aux – Block Length” menu command.

Test Type – type of the current run, i.e. Test Run or Calibration Run.

Equil. – shows which one of the Thermal Equilibrium Criteria has been met. The possible Criteria are as follows:

- | | |
|-----------|--|
| NE | - No one Equilibrium Criterion met |
| TE | - Temperature Equilibrium ($^{\circ}\text{C}$ or $^{\circ}\text{F}$) |
| SE | - Semi Equilibrium (μV) |
| PE | - Percent Equilibrium (%) |
| FE | - Final Equilibrium - end of the run |

Select Status - three red (or green) check boxes visually show if sample information, set points and calibration information have been entered (green) or not entered (red).

You will be automatically prompted to enter it if any one of the three sets of information were not entered yet (red color of the check boxes) after pressing "Start" button. If, for example, you have already entered the set points, but you wish to re-enter them again on run start, just click on the "Setpoints" button. The buttons are disabled while a run is in progress.

Start -use this command to start entry of information necessary for run. You can use the menu "Run" "Start" command instead of this button.

Stop/Abort - use the "Stop" command to stop "Wintherm32" run. After pressing the "Stop" you can press the same button (now "Abort" command) to stop FOX Instrument run. You can use menu "Run" commands - "Stop" and "Abort" - instead of this button.

Criteria – use this button to read/change the Thermal Equilibrium Criteria, which are used by the FOX instrument to determine if the run has reached steady state or not.

After the "WinTherm32" established communication with a FOX instrument, computer reads the Instrument's type, and starts to display temperatures and heat flow transducers' signals of both plates:

- T:** Temperatures of upper and lower plates. In the case of multi-transducer Instruments, this is the individual temperatures of each transducer.
- Q:** Heat flow transducers readings (in microvolts) of upper and lower plates. In the case of multi-transducer Instruments, this is the individual readings of each heat flow transducer.

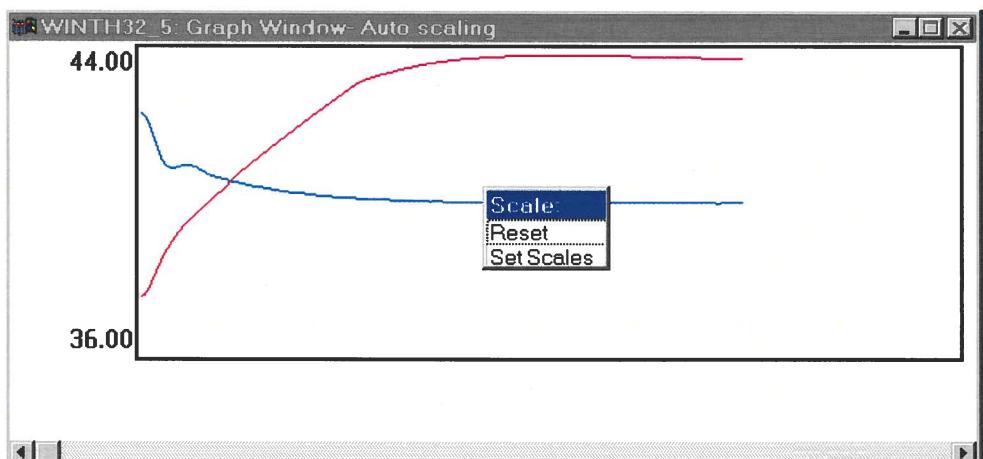
Results shown are run-type (test or calibration) dependent:

- mean T:** Shows the current mean (average) temperature of the plates (and of the sample). In case of multi-transducer Instruments – average temperature of all transducers of both plates.
- Lambda/
CalibConst** Current calculated value of either Thermal conductivity (in case of test run), or Calibration factor (in case of calibration run)

Any of the displayed transducer and thermocouple readings can be graphed in real time by clicking on its square (showing their values). This will pop-up a Color Selection box: Choose a color, and the real-time graph will be displayed in an existing or new graph window:



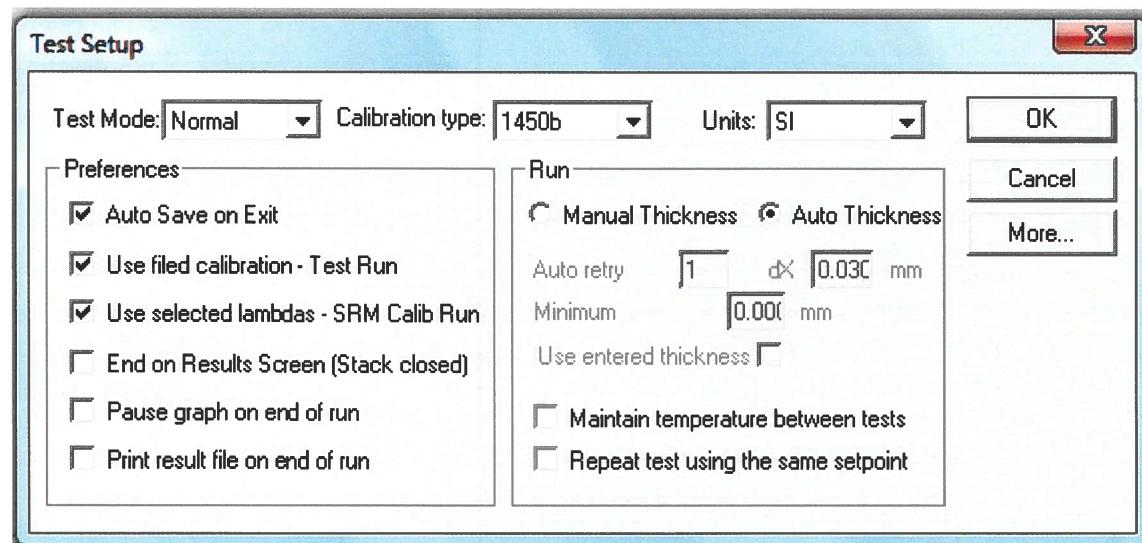
Click twice on the graph to change the limits of the "Y" scale. Click "Set Scales" and set the limits.



Scale numbers on "Y" axis correspond to the graphed signal marked by asterisk **. All other signals are shown in some arbitrary scale to fit the graph. You can move the asterisk to any of the graphed signals using right mouse button to make the scale related with that signal.

4.3. "Test Setup" Window ("Setup – Parameters" menu command)

This is an extremely important part of the Manual! This window's settings pre-determine test and calibration designations. Please review all these options carefully before starting a test or calibration.



Test Mode - select the desired Test Mode – Normal, Multi dX, or Aging. (this field has no effect when running a calibration):

- Normal** - normal one-sample or multi-sample test run;
- Multi dX** - multi-thickness test – test of soft compressible sample at several different thicknesses;
- Aging** - A repeating test that detects any changes of thermal conductivity of the sample with time (aging of the sample). This mode also is used in FOX Instruments having the sample auto-feeder system to test batches of similar samples. A time interval between tests can be entered.

Calibration type - this field sets type of calibration – either 1450b type or User type. In case of test run versus instrument's calibration, one of the two stored Instrument's calibrations (of selected type) will be used for the test results calculations.

Units – select either SI or British units. SI units – degrees Centigrade for temperature, and $\text{W m}^{-1} \text{K}^{-1}$ for thermal conductivity. British units – degrees Fahrenheit for temperature, and $(\text{BTU}/\text{hr})/\text{ft}^2/(\text{°F} / \text{inch})$ for thermal conductivity. The units are related as:

$$\begin{aligned} T(\text{°C}) &= [T(\text{°F}) - 32] \frac{5}{9}; \quad T(\text{°F}) = T(\text{°C}) \times 1.8 + 32 \\ 1 \text{ W m}^{-1} \text{ K}^{-1} &= 6.9348 (\text{BTU}/\text{hr})/\text{ft}^2/(\text{°F} / \text{inch}) \end{aligned}$$

Preferences (left square settings)

Auto Save on Exit – check this square if you would like all settings—preferences (directories), options, set points, sample and test information, and window positions—to be saved in the “WinTherm32” “.ini” file every time you exit the program using “File – Exit” menu command. Next time when the “WinTherm32” application will be started, all the saved information will be used as defaults.

Use filed calibration - Test Run – mark this square if you would like to use a filed calibration (not Instrument's one!) for calculations when running a test. If this square is not marked then the “WinTherm32” will read one of two sets of Instrument's calibration factors (either 1450b type or User type – selection is done above) on test start.

Use selected lambdas - SRM Calib. Run – check this square to use thermal conductivity data of the User type calibration standard (only for User type calibrations!). “Enter User type Lambdas” window will appear later where you will be prompted to enter the thermal conductivity data either manually or from a “.lmd” file. If this square is not marked the “WinTherm32” will read the User Type standard thermal conductivity data from the FOX Instrument when the calibration is started. Always make sure that the thermal conductivity data match the calibration standard used for calibration run! Otherwise the calculated calibration factors will be wrong!

End on Results Screen (Stack closed) - specifies if at the end of a test run the Fox Instrument is to be left on the screen showing the test results (the stack will remain closed). The Instrument default state is the "Repeat Using Same Temperature?" screen (with the stack opened).

Pause graph on end of run – mark this square to stop updating the graph when the run ends (the graph will be “frozen”).

Print result file at end of run - With this option selected the “WinTherm32” will automatically print the result file to the default printer once the run ends.

Run (right square settings)

Manual Thickness / Auto Thickness – select “Manual Thickness” if you know thickness of the sample (mandatory in the case of soft compressible samples). If you want the Instrument to determine the sample thickness - use “Auto Thickness” mode (only for rigid samples!).

Auto retries count - if “Manual Thickness” is selected then this number specifies the number of retries to re-adjust the plate’s position to reach the entered thickness of the sample. The number can range from 0 (no retries) to 10. The message “Abort- Retry- Ignore?” will appear in case the thickness is still out of range (thickness +/- dX – see below) after all the retries.

dX± ... cm - if “Manual Thickness” is selected, this value specifies the acceptable range of sample thickness error. If the stack closes at thickness out of the error range then a question message box appears with the following options: “Retry, Abort, or Ignore?”

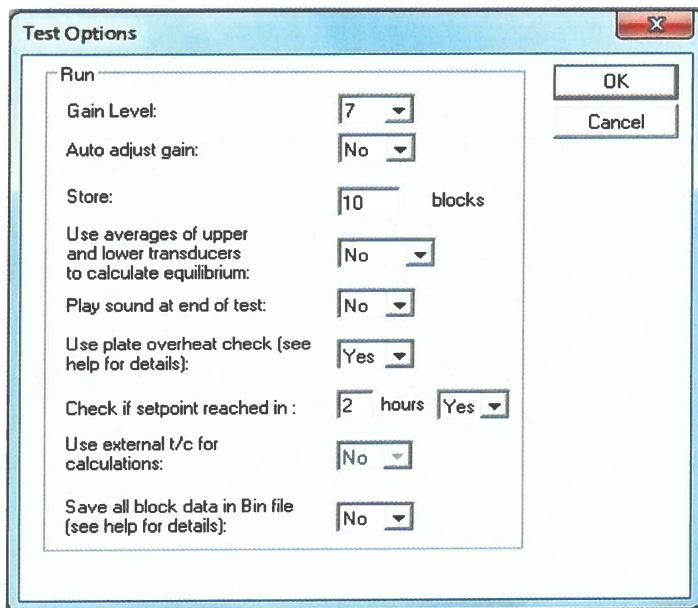
Minimum Thickness ... cm – set zero in case of rigid samples, and set minimum thickness value to prevent squashing of soft samples. “WinTherm32” will not allow you to enter thickness of sample smaller than entered “Minimum Thickness” value.

Use entered thickness – if this square is marked (it can be marked only if “Manual Thickness” is selected) then the “WinTherm32” will use the user entered thickness for calculations in case the thickness is not reached after the entered number of “Auto retries” (and “Ignore” button was clicked on).

Maintain temperature between test – mark this square if you want the Instrument to maintain the temperatures of the plates at the last set point after the test is over.

Repeat test using the same set points - select this option to use the same set of set points (from the previous test) for the next test run.

More... - after pressing this button “Test Options” window appears and some additional test options can be entered:



Gain Level - default gain level value 7 corresponds to +/-20,000 microvolts of heat flow meters signals upper limit. Gain level 6 corresponds to +/-40,000 microvolts, 5 corresponds to +/-80,000 microvolts, etc. Usually FOX Instruments are not overflowed at gain level 7, but in case of samples with small thermal resistance (high thermal conductivity and/or small thickness) signals of the heat flow meters may exceed 20,000 microvolts, so the gain level value should be diminished to avoid the overflowing.

Auto adjust gain – if yes is selected WinTherm will automatically adjust the gain level when the signal becomes saturated. The adjustment is performed at the end of a block once the plate temperatures are within the Temperature Equilibrium setting.

Store ... blocks - number of blocks to be kept in file and to be displayed using “View - Block Data” menu command. Also this value sets a maximum for number of blocks that can be used for calculations (see Chapter “Thermal Equilibrium Criteria” of the FOX Instrument Manual) and number of blocks saved in the file (see “Preferences – Test Results / Calibration Results” menu command).

Use averages of upper and lower transducers to calculate equilibrium – if “Yes” is selected then thermal Equilibrium Criteria will be applied to average values of the two plates’ signals, which reach the equilibrium earlier than their individual values.

Play sound at end - If “Yes” is selected and a sound card is installed in the computer system, a sound file will be played at the end of a run. Name of the sound file (wave file) should be specified in “Preferences – File Defaults...-Wave File” menu command.

Use plate overheat check - If "Yes" is selected, the program will monitor the plates temperatures to prevent accidental overheating e.g. due to cooling water flow problems or any other reasons ("Temperature runaway conditions" message will appear). If overheating is detected then the run will be aborted.

Check if set point reached in ... hours - If "Yes" is selected the "WinTherm32" will check <n> hours after the start of a run if plates temperatures have reached their set point values. If the plates' temperatures have not reached the set point values after <n> hours, then the set point will be skipped and an error message will appear.

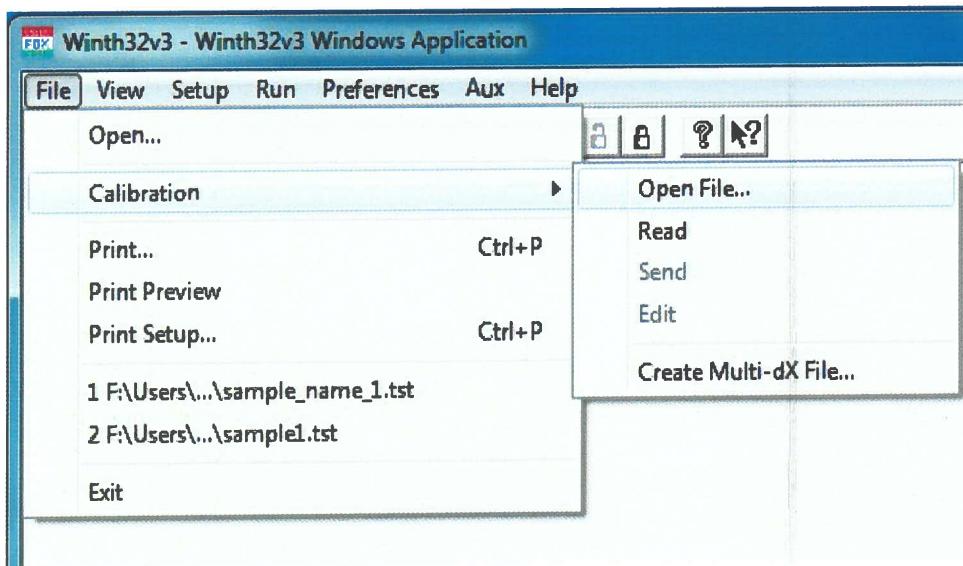
Use external t/c for calculations – If Yes is selected and the instrument has the external thermocouple option the thermocouples attached to the instrument's external port located on the front of the unit will be used for all calculations. The Instrument Display window will be redrawn and the thermocouple reading will be displayed labeled as Sample Temperatures.

Save all block data in Bin file - If Yes is selected at the end of the test all block data will be saved in a file with a *.bin extension. The name of the file will be the same as the test file name. To view the data use the View - Filed Block data menu command.

5. MENU COMMANDS

5.1. “File” commands

The menu “File” button offers the following commands:



Open - open one of the existing files (e.g. test file).

Calibration - calibration files commands:

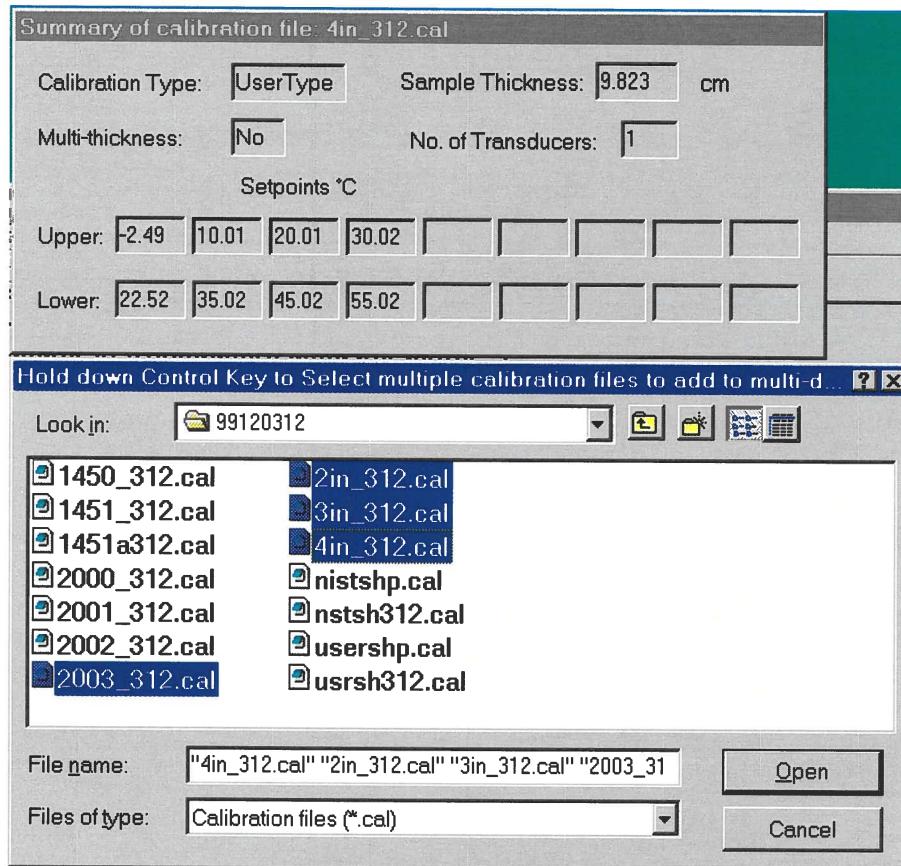
Open – to open one of the existing calibration files;

Read – to read calibration from FOX Instrument (type of the calibration - 1450b or User type - should be selected on the FOX Instrument’s keypad);

Send – to send (opened) calibration to FOX Instrument;

Edit calibration file;

Create Multi-dX File – to create multi-thickness calibration file using several various thickness calibration runs, e.g. 1", 2", 3", and 4" thickness standards (see Chapter 6.4). To create the Multi-thickness calibration file using several calibrations done using various thickness calibration standards you have to select the files using keyboard’s “Ctrl” key. Then enter name of the new file (it will have “.mcal” extension) and press “Enter”:



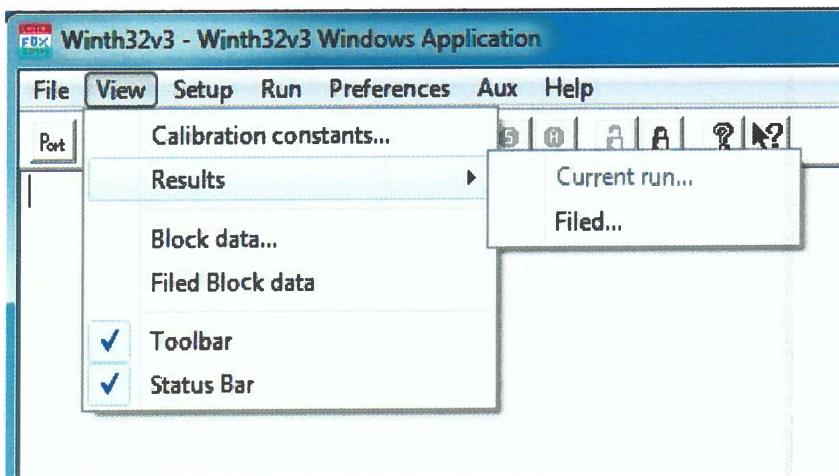
Print – to print the opened file.

Print Preview – to show the file to be printed on the computer monitor as it would appear printed.

Print Setup – to select printer and printer connection.

Exit – to exit “WinTherm32” (all settings will be saved if the “Auto Save on Exit” square is marked on the “Test Setup” window opened by “Setup-Parameters” menu command). To close the “WinTherm32” you can also click on “x” on the upper right corner or use the standard “Close” command on the Windows control menu on upper left corner (current settings will not be saved in this case!).

5.2. “View” commands



The menu “View” button offers the following commands:

Calibration constants - either to view the calibration factors from selected file or to read them from FOX instrument’s non-volatile memory.

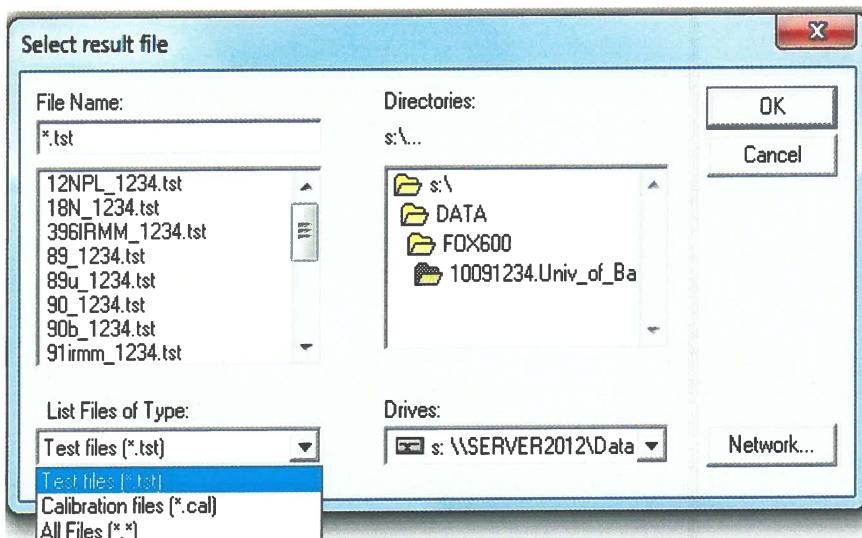
Results – to view either filed or current run results.

Block data – to view block average data and their graphs of the current run.

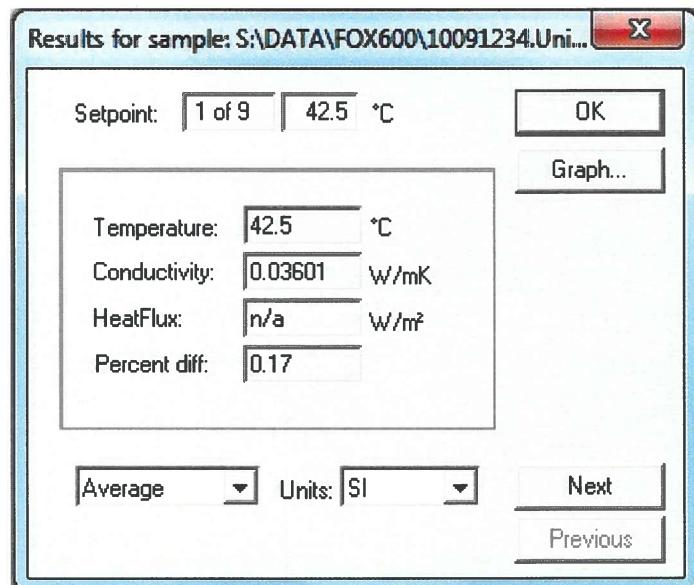
Toolbar - to show or not to show the “WinTherm32” toolbar.

Status bar - to show or not to show the “WinTherm32” status bar.

Using “View – Results” menu command you can view either filed results of previous runs or current run results. Select name of the file on the “Select Result File” “window and click “OK”.

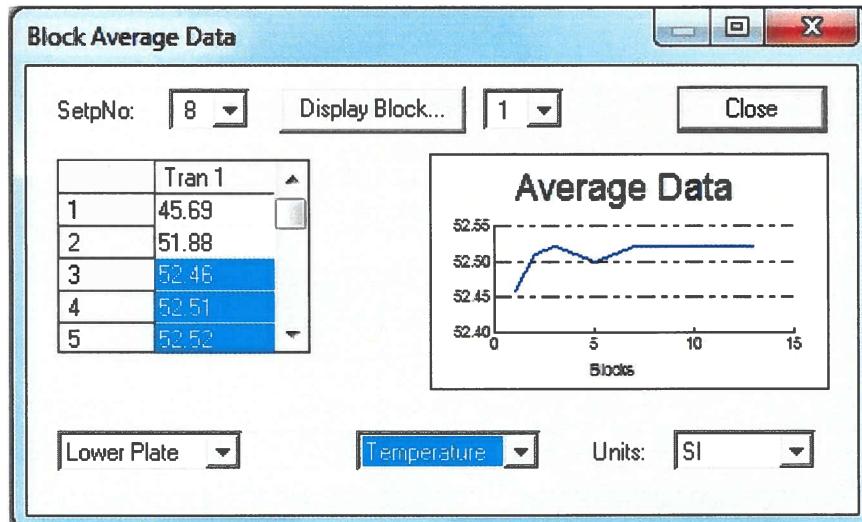


After selecting file you want to look at, the “Results for sample: ...” window appears:



To see next set point results click “Next”. You can get graph of the results versus temperature using “Graph” button.

Using “View - Block Data” menu command you can view and graph current run block data (during the run). The following options allow you to set what data are displayed and graphed:



SetpNo - select the set point for which you want to display block average data.

Upper/Lower Plate - select the plate for which you want to display block average data.

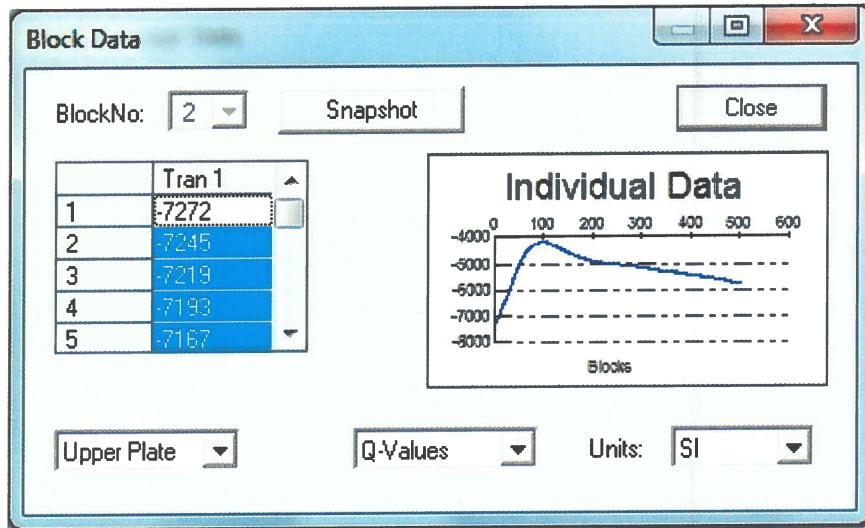
Data selection - select the type of data (run type dependent – test or calibration) which you want to display.

Units - select SI or British units you want the data to be displayed in.

Two large fields display the selected block data – numerical (left) and graphical (right):

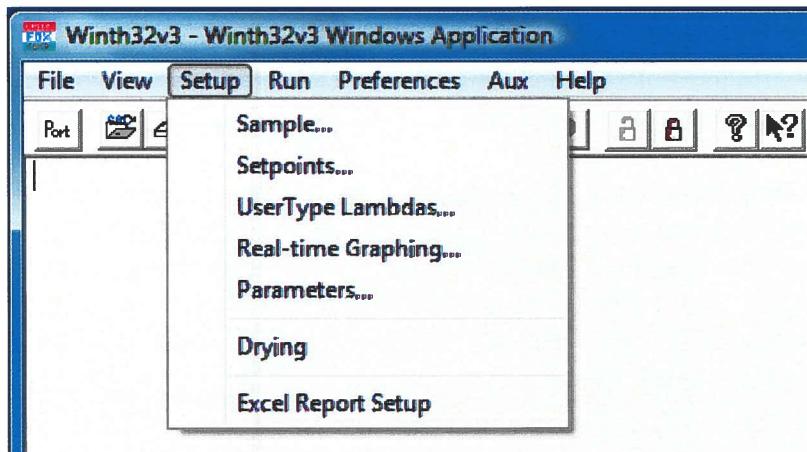
Left (numerical) field shows average block results. The maximum number of blocks displayed depends on the number of blocks to store specified in the “Test Options” window (“Setup-Parameters-More” menu commands). Use mouse (click and drag) to highlight the block data to be graphed. To graph all the column just click on the column header. The block data highlighted in the left field will be graphed on the right field. In case of multi transducer FOX Instrument the data for each transducer will be graphed in a different color.

Display Block ... - select number of block for which you want to display individual reading data and click on “Display Block” button. New window will appear showing the readings of the selected block:



Snapshot - this option allows you to save the data of selected block in a text file. Just select the number of block, and click on the “Snapshot” button. The name of the resulting file is “snap’S’_‘B’.txt”, where ‘S’ is the set point number, and ‘B’ is the block number. For example, the resulting file name for block 2 of the 3rd set point would be “snap3_2.txt”. Tabs separate all data elements in the file to make them suitable for use in spreadsheets (e.g. in Excel).

5.3. “Setup” commands

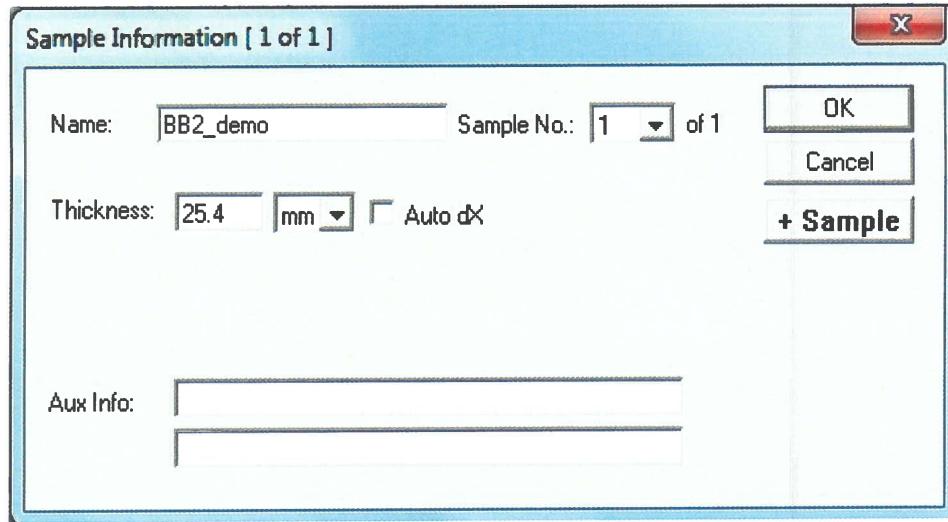


The menu “Setup” button offers the following commands:

- | | |
|---------------------------|---|
| Sample | Enter/check sample(s) information. |
| Setpoints | Enter/check/correct set points (temperatures of the plates). |
| User Type Lambdas | Enter/check/correct User type standard's temperature-thermal conductivity pair values to be used for calibration. |
| Real-time Graphing | Select the number of graph windows to use when plotting the real-time data shown in the “FOX Instrument - COM” Window.
Select automatic graph print options. |
| Parameters | Enter/check/correct all parameters of the run: Preferences (directories); Test Mode, Units, and more. |
| Drying | Select the drying option after finishing run, and its parameters – temperature and duration. <u>Recommended after every run at low temperatures.</u> |
| Excel Report Setup | Select (and set parameters) of the Excel report: Workbook location (directory), and possible entries to save. |

5.3.1. “Setup - Sample”

After clicking “Setup-Sample” the “**Sample Information**” window appears. You can use it to enter, check or correct information about your sample (or samples):



Name - enter file name to be used as the name of the run's result file.

Sample No.: – in case of multi-sample test (only on FOX instruments having samples Auto-feeder System) this number specifies the sample number for which information is being entered.

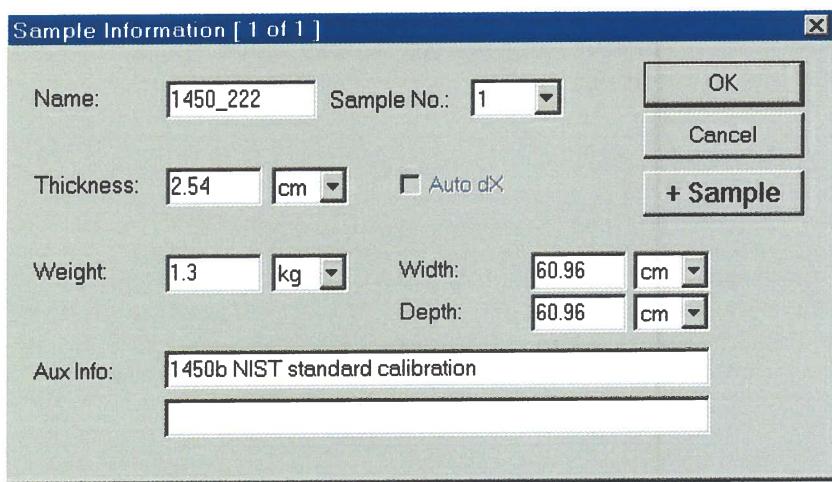
Thickness - enter sample's (or standard's) thickness if "Auto dX" is not selected (in case of soft sample). "Auto dX" is never used in calibrations to avoid standard's compression, so the standard's thickness should be entered.

Auto dX - if you select this option the sample thickness will be measured by the FOX instrument at the beginning of the run and will be read by computer (only for rigid samples!).

Aux Info – you may enter any additional text information to describe the sample or conditions of the run. This information will be saved in the result file.

Sample - this button is used in a multi sample test to enter information for other samples or to delete existing sample ID. To toggle between the samples names click the right mouse button.

"Sample Information" window for 1450b calibration is slightly different:



Weight, Width and Depth – should be entered in case of 1450b calibration to be used in calculation of the standard's density. The density is used for the standard's thermal conductivity calculations (using formula from the 1450b SRM NIST Certificate).

5.3.2. “Setup - Setpoints”

After clicking “Setup-Setpoints” the “Enter Test Setpoints” window appears:

	Upper	Lower	Mean	Delta	Use
1.	10.00	30.00	20.00	20.00	<input checked="" type="checkbox"/>
2.					<input type="checkbox"/>
3.					<input checked="" type="checkbox"/>
4.					<input checked="" type="checkbox"/>
5.					<input checked="" type="checkbox"/>
6.					<input checked="" type="checkbox"/>
7.					<input checked="" type="checkbox"/>
8.					<input checked="" type="checkbox"/>
9.					<input checked="" type="checkbox"/>
10.					<input checked="" type="checkbox"/>

The process of entering the set points is partially automated. For the first set point only two of the following four fields need to be entered. For all the following set points, assuming the same delta T, only one of the four fields - upper, lower or mean temperature - needs to be entered. (Only for the low temperature FOX instruments: if both setpoints are higher than 35C then the liquid nitrogen valves will remain closed!).

Upper -temperature of the upper plate;

Lower - temperature of the lower plate;

Mean - mean temperature of the two plates' temperatures;

Delta – difference between temperatures of upper and lower plates (if delta T is too small – less than, say, 15⁰C - measurement errors may be higher).

Use of the following fields simplifies the set points entry and their modification:

Heat Flow Up/Down - heat flow direction. “WinTherm32” will automatically re-calculate all entered temperatures if the direction of the heat flow is changed.

Units $^{\circ}\text{C}/^{\circ}\text{F}$ - the temperature units (scale) you would like to enter/display the temperatures.

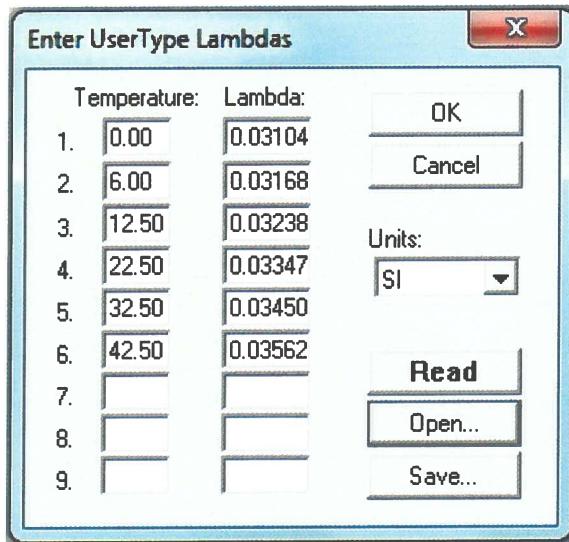
Read/Send - use this button either to read set points from a FOX Instrument, or to send the changed or corrected set points to the Instrument. To toggle between the “Read/Send” commands click the right mouse button. “Send” command is especially useful when adding, deleting or modifying the entered set points when the run is already started.

Open – you can use previously saved set point files (these files have “.stp” extension).

Save - you may save the current set points set as a file for future use (these files have “.stp” extension).

5.3.3. “Setup – User type Lambdas”

After clicking “Setup – User type Lambdas” the “Enter User Type Lambdas” window appears.

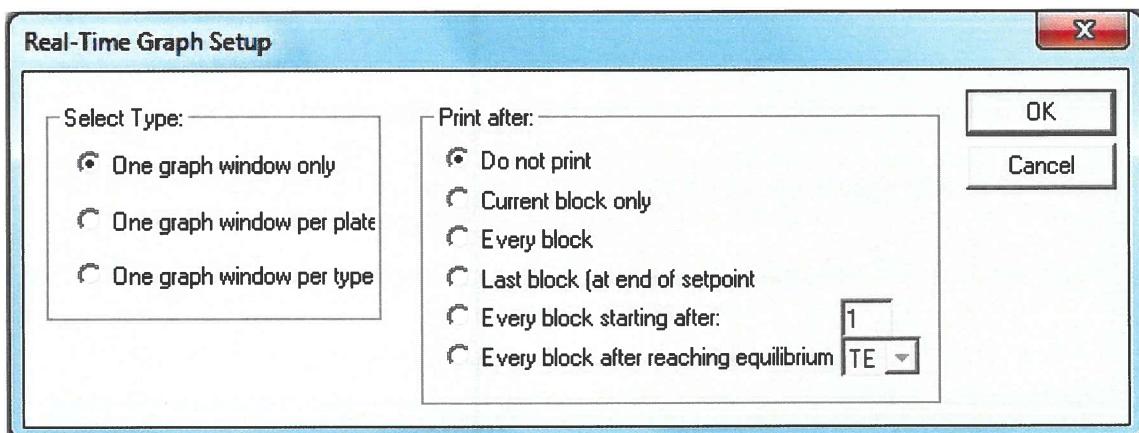


The temperature - thermal conductivity pair values will be used for calibration factors calculations during the user type calibration. The values can be entered either manually or using the “Open” button. To save current set of temperature – thermal conductivity pairs for future in special file use the “Save” button. This kind of files has “.lmd” extension.

Read/Send - use this button either to read Instrument’s current thermal conductivity values from a FOX Instrument, or to send the changed or corrected values to the Instrument. To toggle between the “Read/Send” commands click the right mouse button. “Send” command is especially useful when adding, deleting or modifying the entered thermal conductivity values when the run is already started. Click “OK.”

5.3.4. “Setup – Real-time Graphing”

After clicking “Setup – Real-time Graphing” (or after clicking on the “R-T” tool bar button) the “Real-Time Graph Setup” window appears:



Select Type: (left square)- select number of graph windows to use when plotting the real time data – one graph window only, one per plate, or one per type (temperature readings, or heat flow meters readings, or thermal conductivity calculated values).

Print after: (right square) - the selected graph window can be printed using one of the following selected options:

Do not print -nothing is printed.

Current block only - the Graph window will be printed at the end of the current block only.

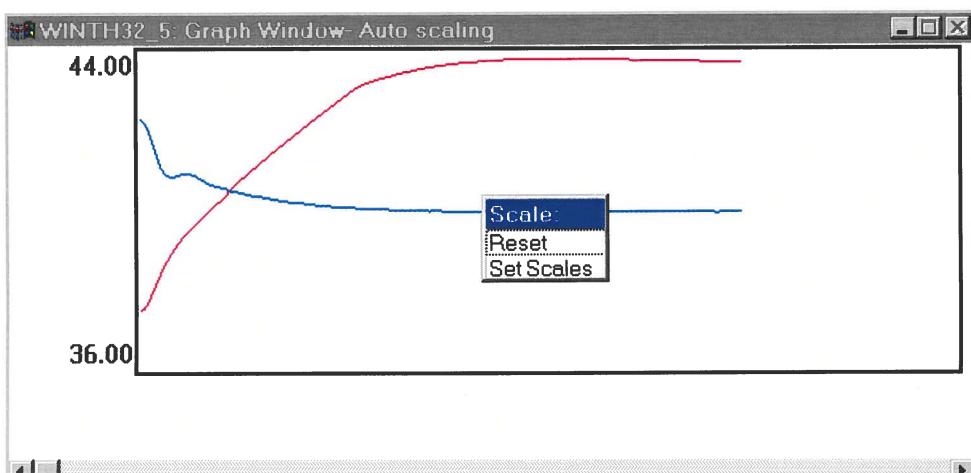
Every block - the Graph Window will be printed at the end of every block.

Last block (at end of set point) - the Graph Window will be printed at the end of every set point.

Every block starting with block number: ...” - the Graph Window will be printed at the end of every block starting with block number given.

Every block after reaching equilibrium: TE, SE, PE” - the Graph Window will be printed at the end of every block after specified equilibrium is reached.

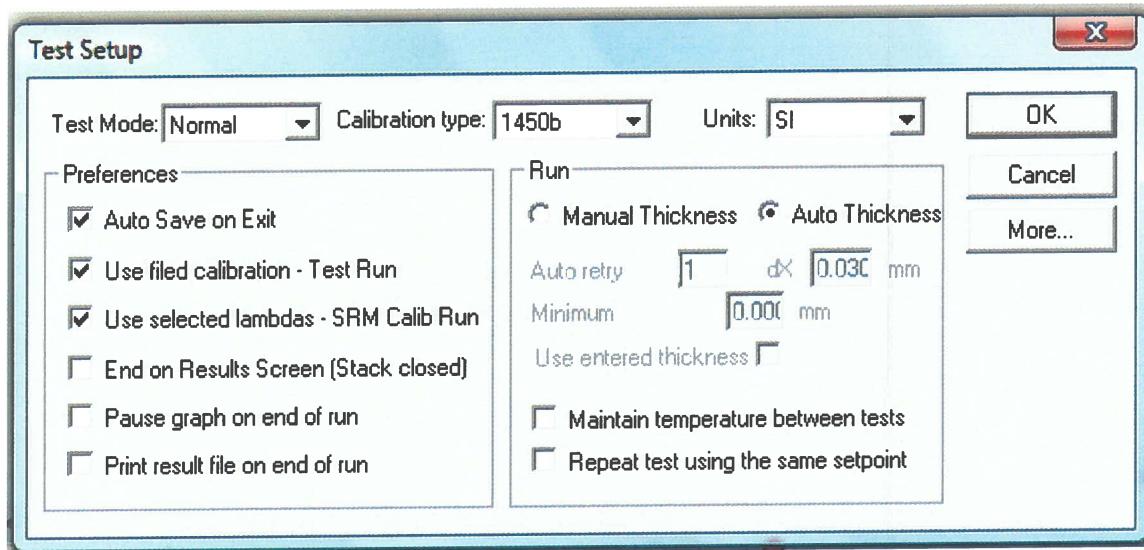
Note: Double clicking on the Graph window will let you change the scale of the graph:



Scale numbers on "Y" axis correspond to one of the graphed signals marked by asterisk **". All other signals are shown in some arbitrary scales to fit the graph. You can move the asterisk to any of the graphed signals using right mouse button to make the scale related with that signal.

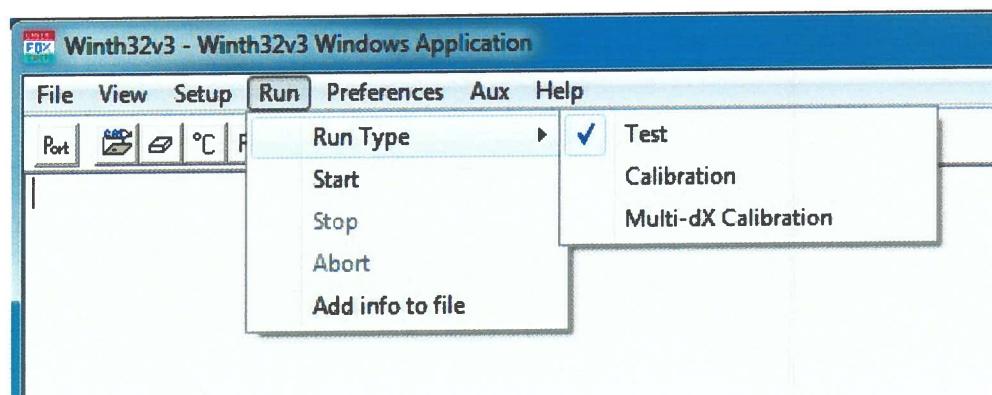
5.3.5. "Setup – Parameters"

After clicking "Setup – Parameters" the "Test Setup" window appears.



Detailed explanation of this extremely important window is presented in Chapter 4.3. "Test Setup" Window.

5.4. "Run" commands



The menu “Run” button offers the following commands:

Run Type	Select type of the run: Test, Calibration (see Chapters 6.2 and 6.3) or Multi-dX Calibration (see Chapter 6.4).
Start	Start information entry for the run.
Stop	Stop the “WinTherm32”.
Abort	Abort and stop the run on FOX Instrument.
Add info to file	Add information/notes to current test file

5.4.1. “Run – Run type”

Use this command to specify type of the current run – test, calibration or multi-thickness calibration. You have to select one of these three types. “Test” is default type. Detailed explanation of the calibration procedures is presented in Chapter 6 (both regular one-thickness type, and multi-thickness type).

5.4.2. “Run - Start”

Use this command to start information entry necessary for the run. Once the run is started the “Start” command is disabled and the “Stop” command is enabled. “Abort” command enables back the “Start” command.

“WinTherm32”’s action will depend on the current state of the FOX instrument. You will be prompted before any action is taken.

FOX Instrument state	WinTherm32’s action
“SRM Type Select” screen	Automatic run is initiated.
Run is in progress	Instrument run is started.
Results are displayed	The results are read from the instrument and displayed.
Undefined state	The instrument (if possible) should be returned to the “SRM select” screen (by pressing “ESC” or “ENT” keys) and then an automatic run can be initiated.

5.4.3 “Run – Stop”

Use this command to stop the “WinTherm32” run, i.e. to return “WinTherm32” to its idle state. The Instrument will continue run independently of “WinTherm32”. The “Stop” command is enabled once the run is started by the “Start” command. The execution of the “Stop” command enables the “Start” and “Abort” commands.

5.4.4. “Run – Abort”

Use this command to abort and to stop the current run on the FOX Instrument.

In case of test run the “Repeat Test at Same Temperatures?” screen will appear on the Instrument’s screen.

In case of calibration run the “Save new Calibration?” screen will appear on the Instrument’s screen.

Results can be reviewed by pressing Instrument’s “ESC” button. Also, the results should be saved in the file created by “WinThrem32”. Most probably the last set point result is not valid, because the last set point was prematurely stopped.

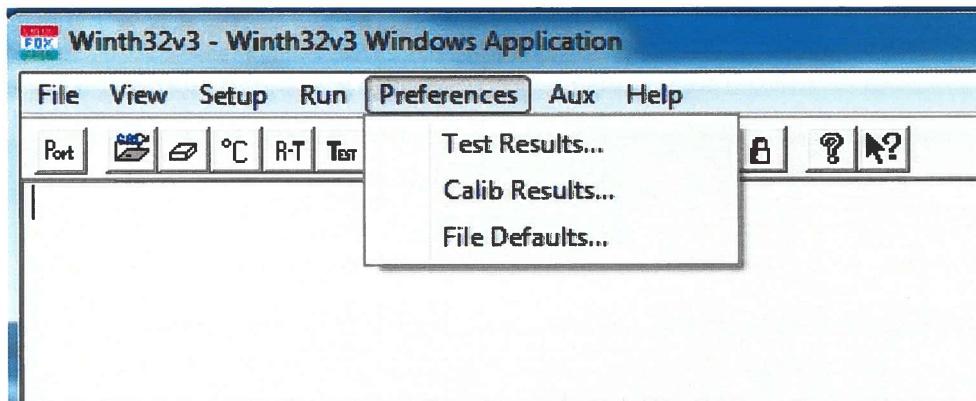
The “Abort” command is enabled during a run once the “Stop” command is executed.

Important Note: To get results in “WinTherm32” you must press FOX Instrument’s “ESC” button. Aborting a test from the computer will give only last block data and no results in “WinTherm32”!

5.4.5. “Run – Add info to file”

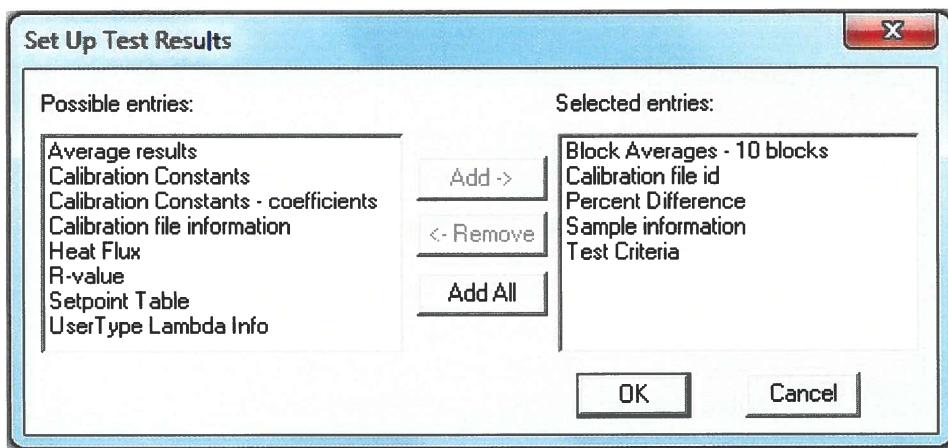
Use this command to add information/notes to current test file.

5.5. “Preferences” Commands



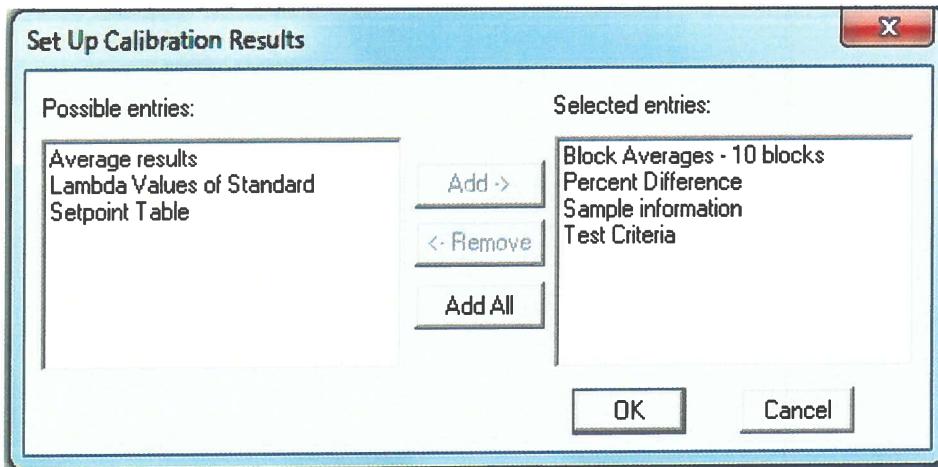
The menu “Preferences” button offers the following commands:

Test Results - specify information to be saved in “.tst” test result file by moving any of available types of the information from left window to the right one:



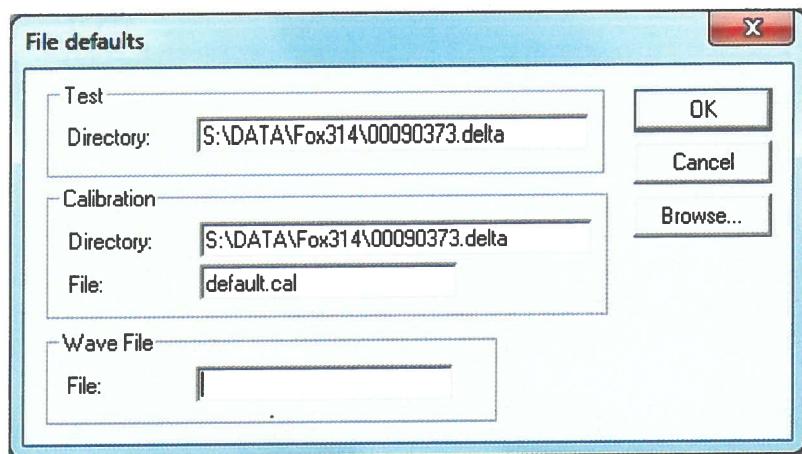
You can remove any unnecessary type of information from the test result file by moving it from the right window back to the left one.

Calibration Results - specify information to be saved in “.cal” calibration result file by moving any of available types of the information from left window to the right one:



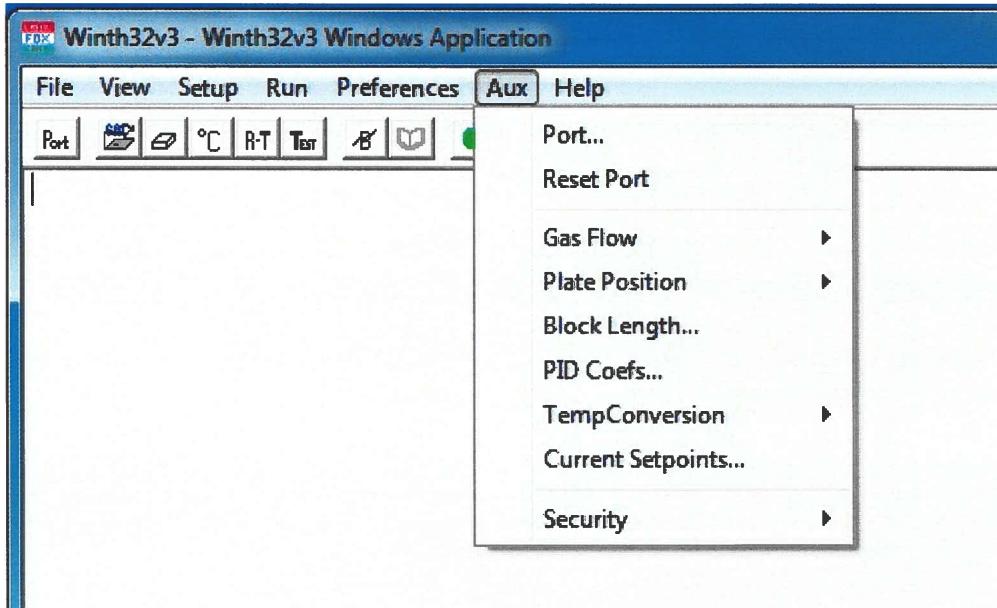
You can remove any unnecessary type of information from the calibration result file by moving it from the right window back to the left one.

File Defaults - set directories where the ".tst" test result file and the ".cal" calibration result file will be saved, and where the wave file (for sound signal) will be taken from (using "Browse" button") and click "OK":



Important! To save all your current settings (including COM port number - see Subchapter 4.1) – click “File” and “Exit” menu commands – it will close the “WinTherm32”. Then open the program again (all the current settings will be saved only if “Auto Save on Exit” square is marked on “Test Setup” window – see Subchapter 4.3).

5.6. “Aux” commands



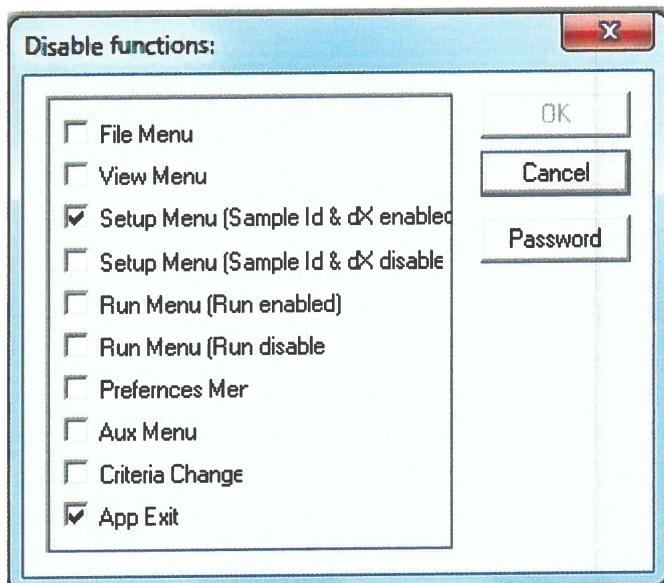
The menu “Aux” button offers the following commands:

- | | |
|-------------------------|--|
| Port | Select and activate RS-232 COM-port. |
| Reset Port | Reset selected RS-232 COM-port (to re-establish computer-Instrument communication). |
| Gas Flow | Select dry gas purge flow mode: On, Off, Auto (to control dry gas valve - see FOX Instrument's Manual). |
| Plate Position | Read plate's current position (all four corners). Set the plates' maximum opening. |
| Block Length | Read/Send FOX Instrument block length: 512, 256, 128, or 64 (number of readings in one block - see Instrument's Manual). |
| PID Coeffs | Read/Send FOX Instrument Main PID Coefficients and Equilibrium PID Coefficients for plates' temperature control (two separate sets for heating and for cooling). |
| TempConversion | Select “Thermocouple signal – Temperature” conversion mode: “Fit” - polynomial, or “Look up” – from table (more accurate). |
| Current Setpoint | Shows the FOX Instrument's current set point. |

Security

Lock/Unlock “WinTherm32”’s functions.

After clicking “Security-Lock” next window appears:



You can lock any of the listed groups of settings to prevent unauthorized changes.

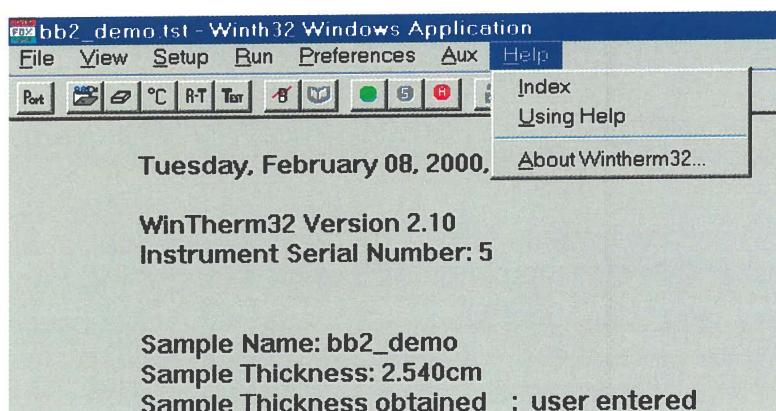
5.7. “Help” commands

The “Help” menu button offers the following commands:

Index Shows index of Help topics

Using Help Provides general instructions on using Help topics.

About Displays the “WinTherm32” version number and FOX Instrument’s serial number.



6. FOX INSTRUMENT RE-CALIBRATION USING “WINTHERM32”

WARNING! We strongly urge you not to save any new calibrations on FOX Instrument. To check your Instrument's calibration simply use a standard of accurately known thermal conductivity and run a test to check if the results are within the 0.5% reproducibility expected in our Instruments. Keep a running log over time of these results. Unless there is a significant discrepancy between the results and what is expected there is no need to save new calibrations on the Instrument.

As many additional calibrations as are desired can be performed on the Instrument and saved on the computer. Every new calibration performed by the computer will be automatically saved in a calibration file having “.cal” extension.

6.1. Pre-Saved Calibrations of the FOX Instrument

Two independent (but similar) calibrations (1450b type and User type – both NIST-traceable) were performed, and are saved on each Instrument shipped by LaserComp. IRMM calibration (with mean temperatures range from -10⁰C to +50⁰C and 20⁰C plates' temperature difference) is saved on the instrument's CD. The following pairs of plate temperatures usually are used for the calibrations saved on the instrument (in degrees Centigrade):

1450b type

T _{upper}	T _{lower}	T _{mean}
-20 ⁰ C	5 ⁰ C	-7.5 ⁰ C
-10 ⁰ C	15 ⁰ C	2.5 ⁰ C
0 ⁰ C	25 ⁰ C	12.5 ⁰ C
10 ⁰ C	35 ⁰ C	22.5 ⁰ C
20 ⁰ C	45 ⁰ C	32.5 ⁰ C
30 ⁰ C	55 ⁰ C	42.5 ⁰ C
40 ⁰ C	65 ⁰ C	52.5 ⁰ C
50 ⁰ C	75 ⁰ C	62.5 ⁰ C

(the lowest and the highest set points of the 1450b are not used in 600s/800s)

User type (25⁰C temperature difference)

T _{upper}	T _{lower}	T _{mean}
0 ⁰ C	25 ⁰ C	12.5 ⁰ C
10 ⁰ C	35 ⁰ C	22.5 ⁰ C
20 ⁰ C	45 ⁰ C	32.5 ⁰ C
30 ⁰ C	55 ⁰ C	42.5 ⁰ C
40 ⁰ C	65 ⁰ C	52.5 ⁰ C
50 ⁰ C	75 ⁰ C	62.5 ⁰ C
User type (20 ⁰ C temperature difference)		
0 ⁰ C	20 ⁰ C	10 ⁰ C
10 ⁰ C	30 ⁰ C	20 ⁰ C
20 ⁰ C	40 ⁰ C	30 ⁰ C
34 ⁰ C	54 ⁰ C	44 ⁰ C

where T_{upper} and T_{lower} are temperatures of the upper and the lower plate, and T_{mean} is the resulting mean temperature of the set point.

During the calibration run the calibration factors S_{calU} (T) (for upper plate) and S_{calL} (T) (for lower plate) were determined at different temperatures using the standards with well-known thermal conductivity λ_{cal} (T_{mean}) (see Instrument Manual). Values of the 1450b NIST standard's

thermal conductivity are calculated by FOX Instrument using entered values of mean temperature, size, and mass of the standard (size and mass are necessary for density calculations used in the NIST formula).

You can check the Instrument's calibrations using the WinTherm32's drop-down menu – first select on the Instrument's keypad which of the two calibrations (1450b NIST type or User type) you want to check, and then click "File", "Calibration", "Read".

6.2. Re-Calibration of the FOX Instrument

Users can re-calibrate the FOX Instrument using their own standard, provided that reliable values of its thermal conductivity are known. During the re-calibration new corrected values of calibration factor $S_{calU}(T)$ and $S_{calL}(T)$ at entered temperatures T_{upper} and T_{lower} are obtained (in general, they should be very similar to the LaserComp's calibration factor values). Values of signals from the heat flow meters Q_{hfmU} and Q_{hfmL} , temperature differences ΔT , standard's thermal conductivity $\lambda(T)$, and its thickness Δx are used. New values of the calibration factor are saved on the computer file and can be saved permanently in the Instrument's non-volatile memory.

If the re-calibration was performed at more than one temperature, then tests can be run at any temperatures of the plates between their lowest and highest calibration temperatures. If the re-calibration was performed only at one temperature, then the plate's test temperatures should be the same as during the calibration (in general, they can differ by not more than $+/-2^{\circ}\text{C}$ from the calibration temperatures).

6.3. Step-by-step Procedure of Re-Calibration

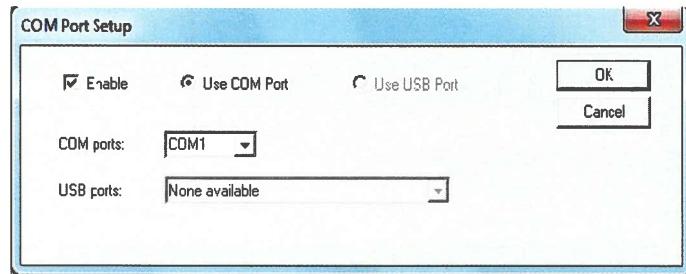
Important! Make sure that water flow is connected to the instrument. Neglecting will cause shut down of the Instrument and can cause serious damage of its heating/cooling system!

Use rigid or semi-rigid $1/4"$ OD plastic hose. We do not recommend using TYGON® hose. It is not rigid enough and is not able to seal the water flow properly.

Typical water flow rate is about 57-75 liters (15-20 US gallons) per hour for FOX200 and FOX300s Instruments, and 75-95 liters (20-25 US gallons) per hour for FOX600 and FOX800 Instruments at $\sim 18^{\circ}\text{C}$ ($\sim 64\text{F}$). Observing temperatures of the plates during a run you can determine whether the water flow rate is sufficient or not. Normally the temperatures of the plates are stable within $+/-0.02^{\circ}\text{C}$ after the set point has been reached. If the temperature changes by more than a few hundredths of degree Centigrade or if the set point even can't be reached, the water flow rate most likely is not sufficient.

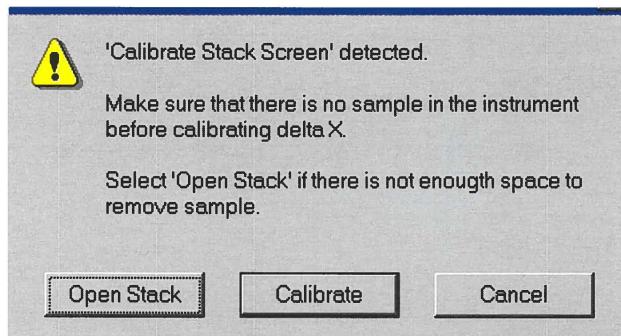
1. Hook up the FOX Instrument to personal computer running Microsoft Windows using RS-232 cable, turn on the power to the instrument (check the water flow!).

2. Open “WinTherm32” program on your PC. Next “COM Port Setup” window appears automatically if no COM port has been previously saved:



Establish the PC-FOX Instrument communication - click “Enabled”, select number of COM port or USB port, and click “OK”. You also can open the “COM Port Setup” window using “WinTherm32”s drop-down menu. Click “Aux”, and “Port”.

3. A message “Calibrate Stack Screen is detected” appears:

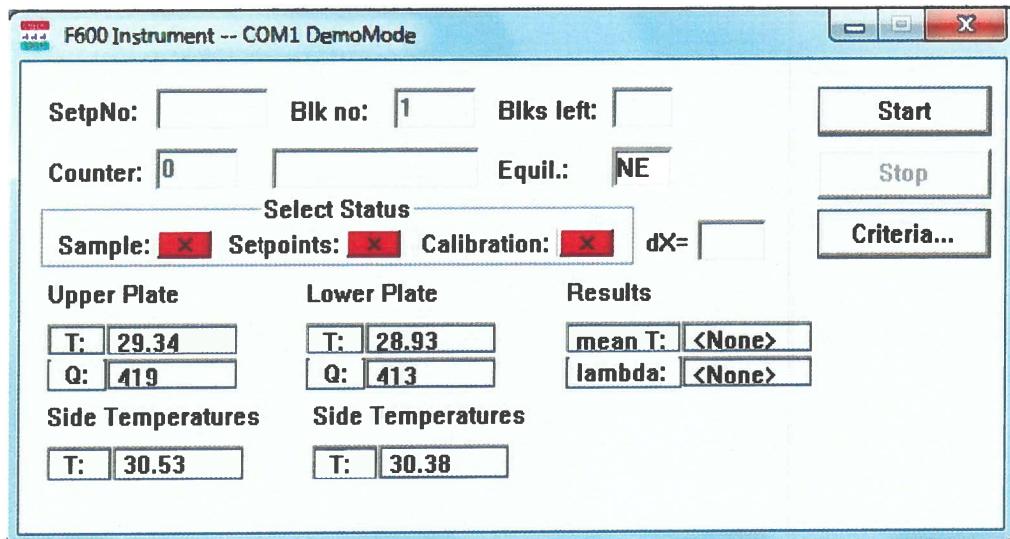


if the FOX Instrument’s liquid crystal display (LCD) is on “Calibrate Delta X” screen:



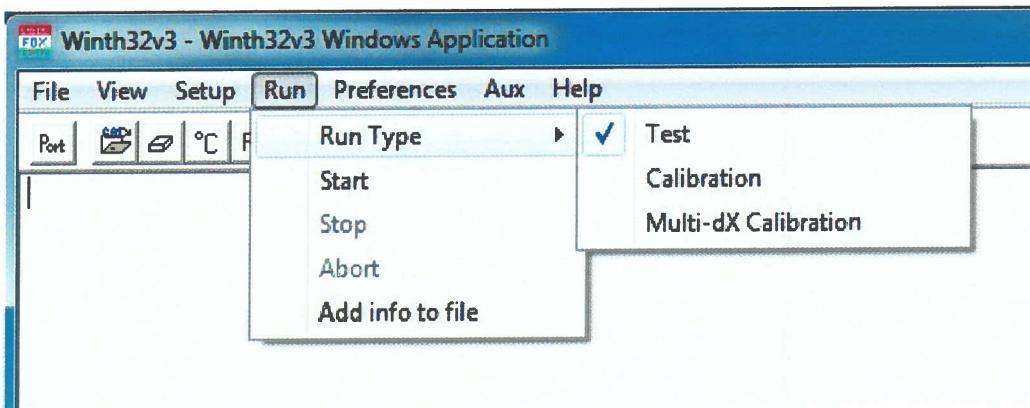
Remove sample from the instrument’s chamber (if present), and click “Calibrate” to set zero of the thickness measurement system (make sure that the plates’ surfaces are clean!). Wait until the instrument’s motors will stop.

4. Next a “FOX__ Instrument – COM_” window appears:



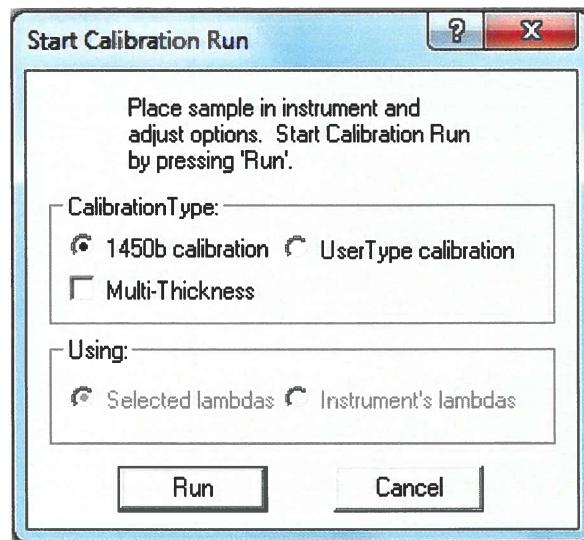
Insert your calibration standard into the Instrument's chamber. If size of your standard is smaller than size of the plates, place the sample on the center of the lower plate and use surrounding insulation. **Thickness of the insulation should be a little bit smaller than thickness of the standard!**

Using WinTherm32's drop-down menu click “Run”, “Run Type”, and select “Calibration”:



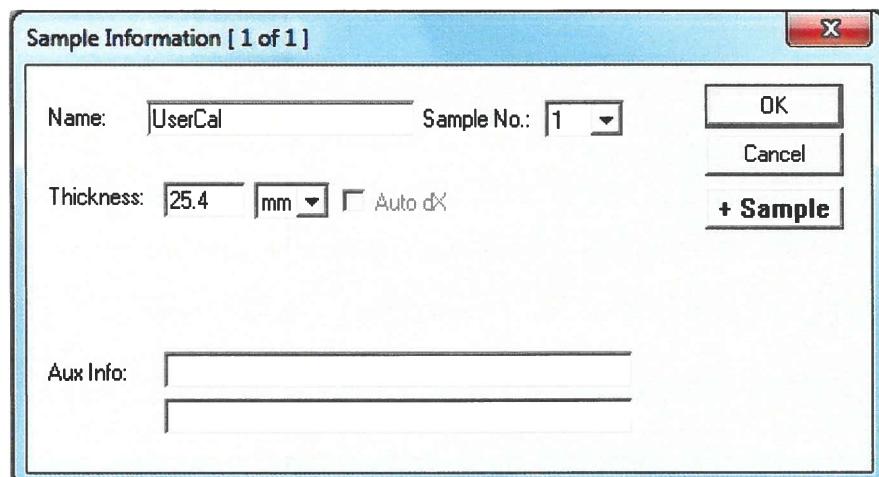
5. Next press “Start” button on the “FOX__ Instrument - COM_” window.

6. “Start Calibration Run” window appears. Select one of two calibration types – “1450b” or “User type” calibration. In case of multi-thickness calibration click on “Multi-Thickness” square (see next two subsections 6.4 and 6.5). If “1450b” calibration was selected, then FOX instrument will calculate thermal conductivity values itself (1450b standard's mass and size must be entered later). If “User type” calibration was selected, then next select either “Selected lambdas” or “Instrument's lambdas” - standard's thermal conductivity values to be used for calibration factors calculations. The “Selected lambdas” values must be entered later in Step 9. The “Instrument's lambdas” (two sets of standard samples' thermal conductivity and calibration factors values) are stored in Instrument's memory (you can read them using “File-Calibration-Read” menu command). Click “Run”.

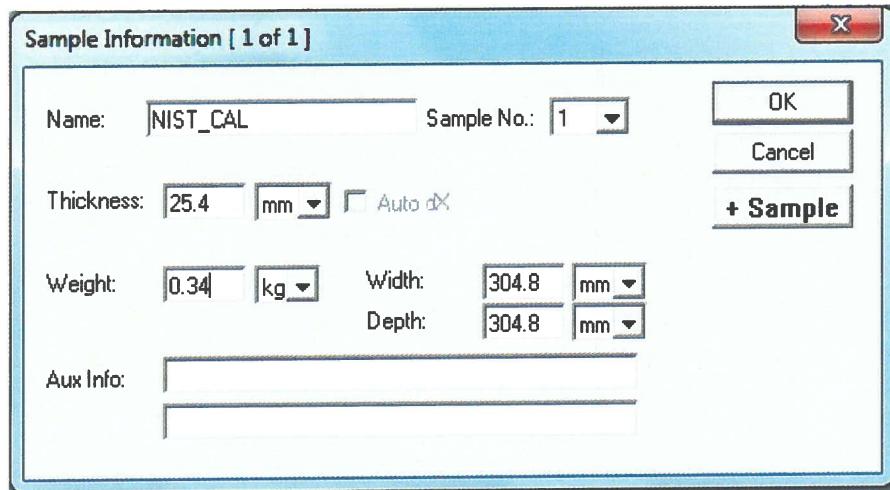


7. Next “Sample Information” window appears (one of two variants – either for “User type” or for “1450b” calibrations – see subsection 5.3.1). Enter file’s name. Enter thickness of the standard (in centimeters or inches) or click “Auto Thickness” (only for rigid standards!). In case of “1450b” type calibration enter “Weight” (in kilograms), “Width” and “Depth” of your 1450b fiberglass Standard. Always use “Manual Thickness” to avoid compressing the 1450b Standard, and enter the standard’s correct thickness - 2.54 cm. Any additional information about the standard or conditions of the run you can enter in “Aux Info:” window to save in result file. Click “OK”.

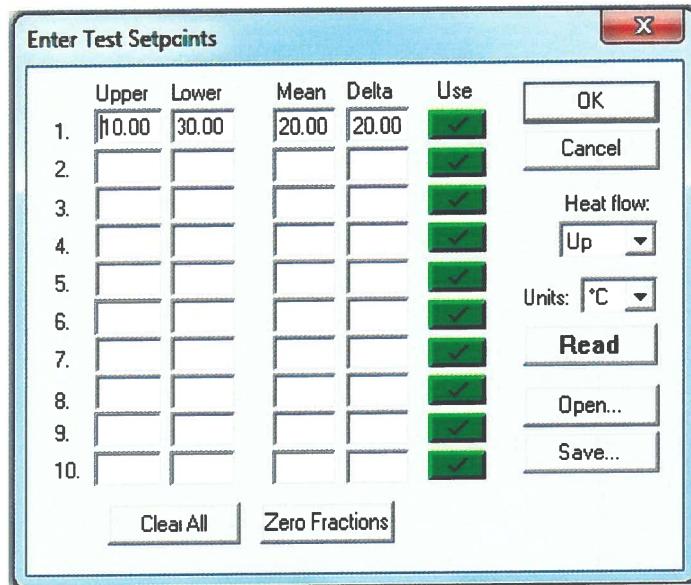
“Sample Information” window for “User type” calibration:



“Sample Information” window for “1450b” type calibration is slightly different:



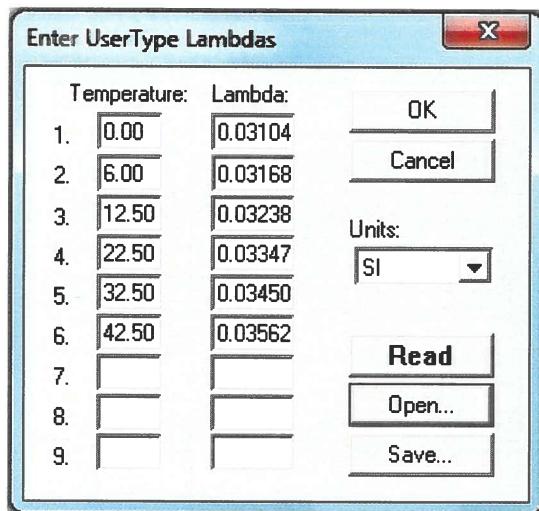
8. Next “Enter Setpoints” window should appear (see subsection 5.3.2). Enter either pairs of temperatures (set points) for upper and lower plates (not more than 9 pairs) or values of mean temperatures and delta T. The calibration set points have to be entered from the lowest to the highest temperature:



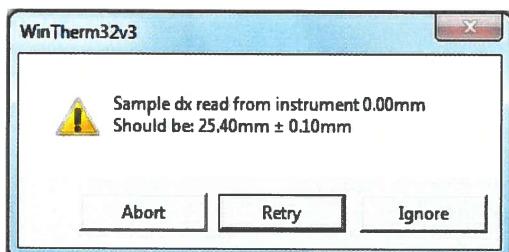
You can exclude any of the set points by clicking to green squares to make them red. Instead of the manual entry you can open and use filed sets of the set points (these files have “.stp” extension) using “Open” button. You can add or correct the set points and then save the current set for future needs using “Save” button. Click OK.

9. (Only for “User type” calibrations). If “Selected lambdas” (not “Instrument’s lambdas”) calibration standard values were selected on Step 6, then next “Enter User Type Lambdas” window appears. Either manually or using “Open” button you must enter temperature - thermal conductivity pair values for your standard to be used for calculations. These values will be used for calibration factor calculations during the current calibration. You can save this set of

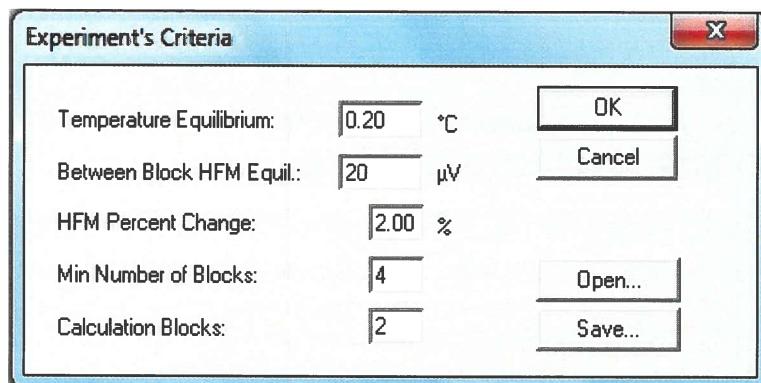
temperature – thermal conductivity pairs for future use in special file using “Save” button. These kinds of files have “.lmd” extension. Click “OK”.



If a difference between the entered thickness and the thickness measured by the Instrument is larger than the acceptable limit entered in the “dX” box on the “Test Setup” window, “Wintherm32” will show you the difference and will ask about next actions - “Abort, Retry or Ignore”. Select one of them:

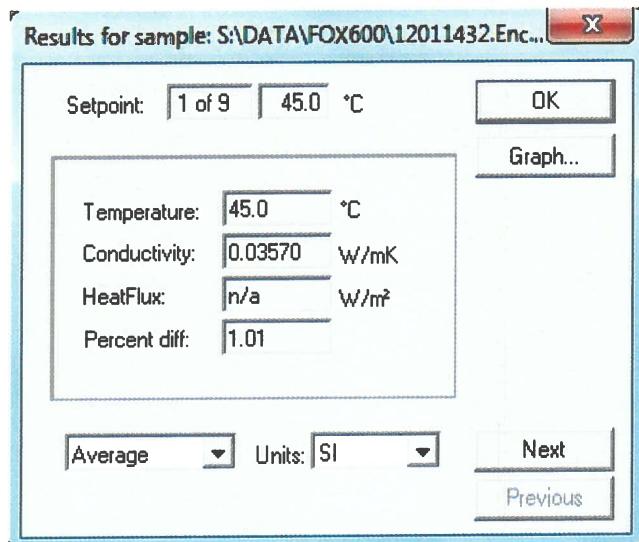


10. Now, after the run has been started, click “Criteria” to check and, if necessary, to enter corrected values of the thermal equilibrium criteria. Usually thicker standards need greater number of blocks to guarantee full thermal equilibrium (see Chapter “Thermal Equilibrium Criteria” in Instrument Manual).



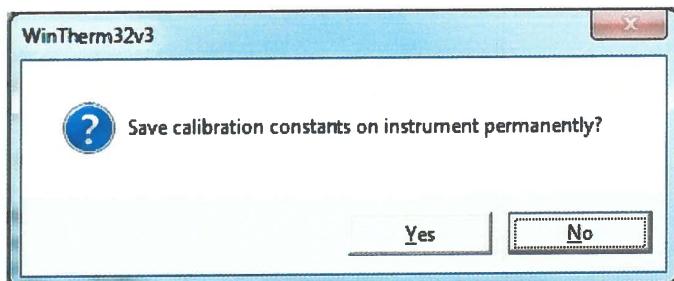
For calibrations we recommend increasing the default values of "Min. Number of Blocks" up to 12 blocks for FOX200 and FOX300s and up to 16 blocks for FOX600 and FOX800 (using 1"=2.54cm-thick and ~0.034 W/mK thermal conductivity standards) to assure a precise calibration. If the sample is thicker or thermal conductivity (actually, thermal diffusivity) is lower, the "Min. number of Blocks" should be increased even more (for 2"-thick standard – 25 blocks, for 4"-thick standard – 45 blocks). The longer the calibration run duration, the better.

11. After finishing the calibration (normally it takes about 1-2 hours for each set point for 1"=2.54cm-thick material like Expanded Polystyrene) the "WinTherm32" calculates values of calibration factor in $\text{W m}^{-2} \mu\text{V}^{-1}$. Entered thermal conductivity values of the standard, and formulas from "Theory of the Method" Chapter of Instrument Manual are used. Results are shown on the PC monitor and are saved in the created file.



Click "Next" to open result of next set point. You can check upper or lower plate results (click on drop-down arrow in lower left corner box of the window), or change units (click on drop-down arrow on the bottom of the window. "Percent diff" shows difference between values calculated using upper and lower heat flow meters.

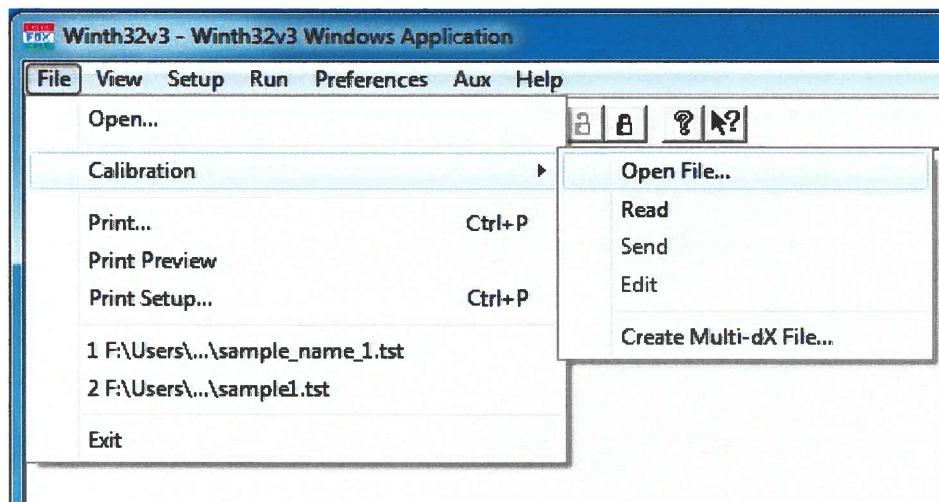
After completion of the calibration the "WinTherm32" proposes to save the calibration in Instrument's memory permanently:



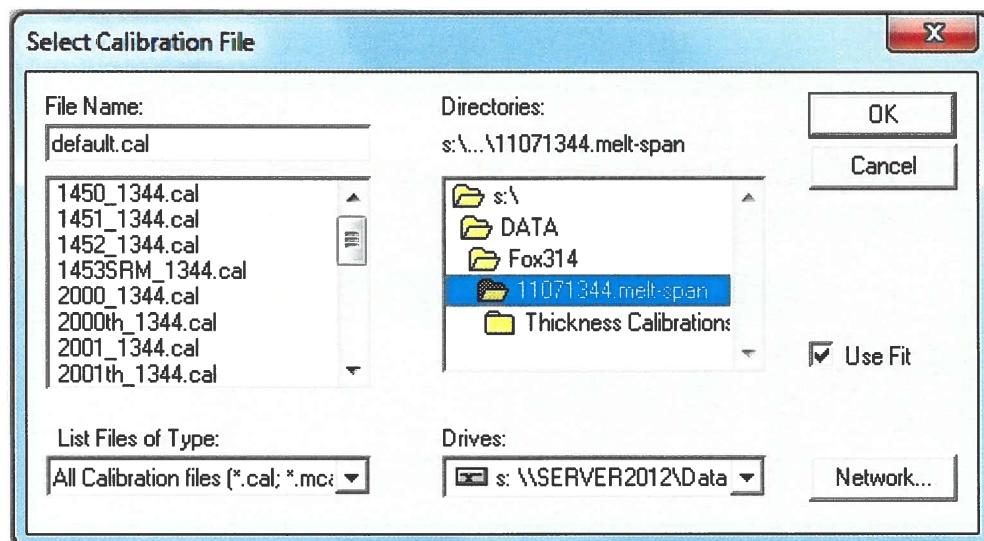
Even if you click “No” now, later you can send the filed calibration from computer to the Instrument and save it permanently in its memory. **Do not click “Yes” unless you have already copied the existing “1450b type” and “User type” calibrations from the Instrument onto the computer and the new calibration is going to be used more often than the original calibrations.** Copies of the original calibration files are stored in LaserComp’s archive, and can be sent to you by e-mail, if necessary.

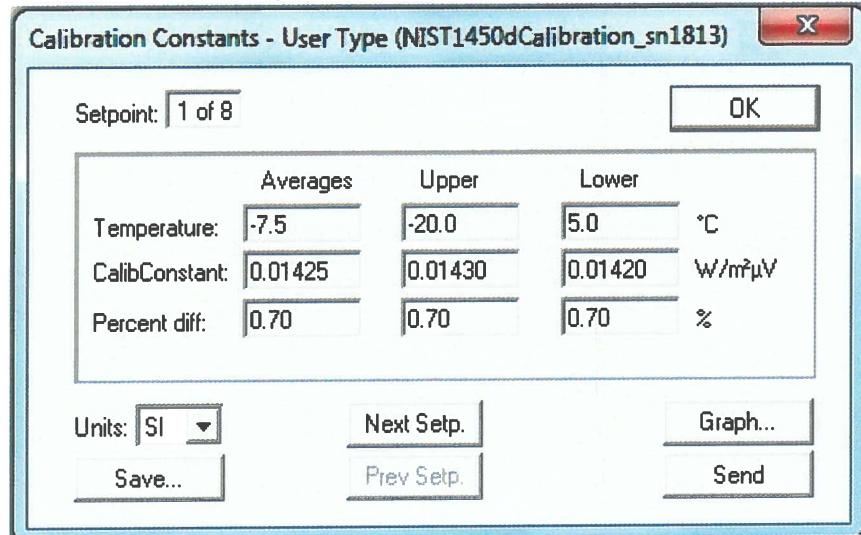
6.4. How to Save Calibrations Permanently

FOX Instrument is able to store only one “1450b type” and one “User type” calibration in its memory. Any filed calibration can be saved permanently in the Instrument’s non-volatile memory. Using drop-down menu click “File”, Calibration”, “Open file”:



Select one of the calibration files you want to save permanently, and click OK:





You can check all the set points results by clicking “Next Setp.” button, and to plot graph using “Graph” button.

On the FOX Instrument’s keypad go to “SRM type Select” screen - by pressing “ESC” button to go back, or by pressing “1” or “2” to go forward from the very first screens:

LASERCOMP FOX
SRM Type Select
1. NIST 1450b
2. User Type

Select which one of the two calibrations - “1450b type” (press “1”) or “User type” (press “2”) - you want to replace.

Click “Send” button on “Calibration Constants” window to send the calibration data to the FOX Instrument and click OK.

On the FOX Instrument’s keypad press “2” to select “Calibration”:

LASERCOMP FOX
Select Run Mode:
1. Test
2. Calibration

On the next screen press “1” – “Show Constants” - to check the calibration data sent to the Instrument:

Show Calibration or
Start a New One?
1. Show Constants
2. Start New

If “User type” calibration was selected on Screen 3 “NIST type or User type?” then next screen will show thermal conductivity versus temperature of the standard used in the “User type” calibration.

Cal. Standard Data	
T1=10.00C	$\lambda_1=32.11$
T2=22.50C	$\lambda_2=33.47$
T3=32.50C	$\lambda_3=34.50$

Press “ENT” to go to next same screen to view the standard’s thermal conductivity values for higher temperatures. Press “ENT” and the program will show the “Save Calibration?” screen. Press “1” - “Yes” to save these standard’s thermal conductivity values:

Save New Calibration Permanently?
1. Yes
2. No

Next the “Results” screens will show the calibration factors at different temperatures of the calibration data sent to the Instrument:

Cal. 1 of 4 Results:
$U=0.01C \quad L=25.01C$
$sU=30.23 \quad sL=30.27$
Press Enter

Press “ENT” to show all the set points calibration data and then have the “Save Calibration?” screen again. Press “1” to save the calibration data permanently in FOX Instrument’s non-volatile memory

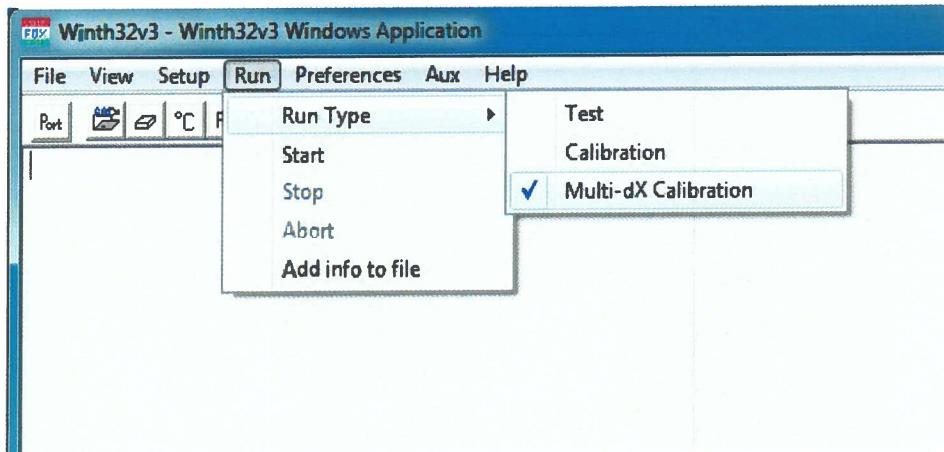
FOX Instrument does not show the thermal conductivity values $\lambda(T)$ calculated for NIST 1450b standard using formula (5) in Chapter “Pre-Saved Calibrations of the Instrument” of the FOX Instrument Manual.

6.5. Multi-Thickness Calibration

The Multi-Thickness Calibration mode was developed to take into account some slight variation of the calibration factors obtained using thick standards. It is therefore advisable to test thick samples using the multi-thickness calibration. Multi-thickness calibration file is created using four different thickness calibrations using four different thickness standards (1”, 2”, 3” and 4”-thick, or ~2.5, ~5, ~7.5 and ~10 cm). These four calibrations are combined in a single multi-thickness calibration file. The calibration factors from the multi-thickness calibration file based on the tested sample’s thickness and temperature then are used for the sample’s thermal conductivity calculations.

Notes: All of the multi-thickness calibration runs must be done at the same set of set points. Multi-thickness calibration is used only in FOX314 and FOX304 instruments.

The Multi-thickness calibration run can be selected (“Multi-dX Calibration”) using “Run – Run Type” menu command.



The first run of the Multi-Thickness calibration is the same as a normal calibration except that at the end of the run you will not be prompted to save the calibrations factors. The stack will open and you will be instructed to insert the next thickness calibration standard into the instrument. Before the next run is started you will be asked to enter the next standard's thermal conductivity data but you will not be prompted to enter the temperature set points.

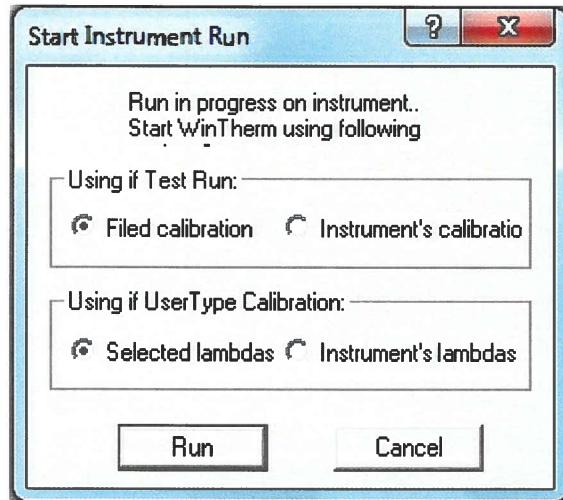
The multi-thickness calibration must consist of at least three separate calibration runs at different thicknesses. After the three runs you will be given an option to continue with more standards. The different thickness calibration standards can be used in any order.

After all the calibrations runs have been finished you will be prompted to enter the name of the Multi-thickness calibration file. The file has always “.mcal” extension to distinguish it from the regular “.cal” calibrations.

If the process of the multi-thickness calibrations is interrupted you still can create the multi-thickness calibration file. Just continue to run the calibrations using all the standards and then use the “File - Create Multi-dX File” menu command (see Subchapter 5.1).

7. RE-STARTING THE “WINTHERM32” (INSTRUMENT RUN)

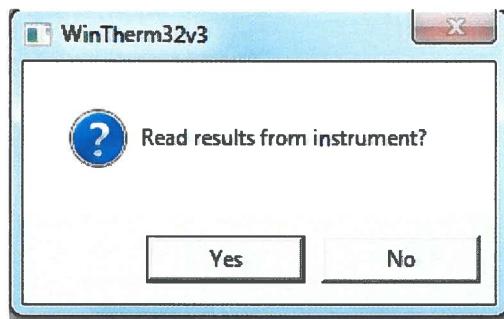
In the event of “WinTherm32” was closed during a run (accidentally, or because of computer crash, etc.), user can re-start the software without interrupting the run on the FOX Instrument. After the re-start the computer can read all the data from the Instrument and all data is recovered. Following “Start Instrument Run” window appears after re-starting “WinTherm32”:



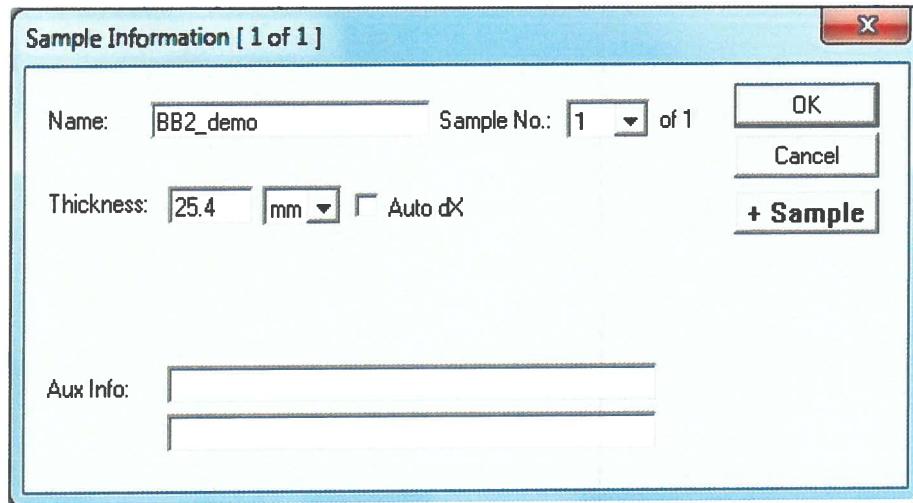
7.1. Re-Starting Tests

In upper of the two selections (“Using if Test Run”) shown on the window user has to select either “Filed calibration” or “Instrument’s calibration” to be used for calculations of the thermal conductivity values. If “Filed calibration” was selected then you will be prompted later to select the calibration file. Otherwise the calibration data will be read from the Instrument. Click “Run”. Second (lower) selection (“Using if User Type Calibration”) is meant only for calibration runs (see next subchapter).

If you re-started “WinTherm32” after a test had already finished then next question appears on screen:

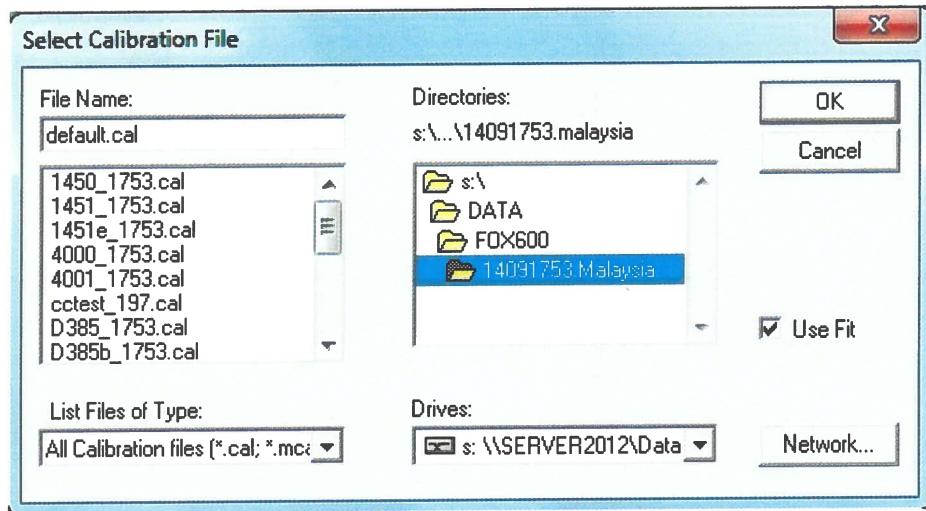


Click “Yes” and computer will read all information from the Instrument. Next “Sample Information” window appears:



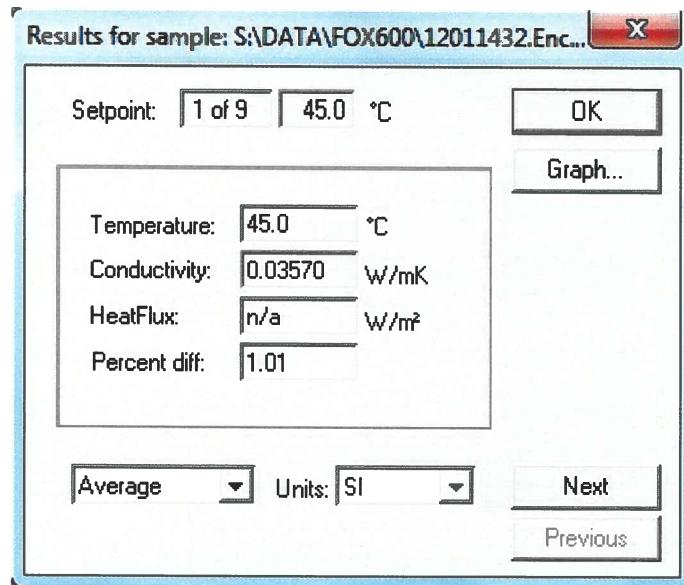
This window shows information read from the FOX Instrument. Check and correct, if necessary, name of the file and thickness of the sample (if the stack is opened, thickness may be wrong). Only digits (no letters) of the file name can be read from the instrument. Re-enter any additional information about the sample or conditions of the run in to "Aux Info:" window, and click "OK". Thermal equilibrium criteria values are also read from the Instrument.

Sequence of next windows is almost the same as during starting test runs. If "Filed calibration" (not "Read from Instrument") was selected then "Select a *calibration file" window appears:



Select a calibration file to be used for calculations. Calibration files have ".cal" extensions. The selected calibration file will be used for thermal conductivity calculations during the current test. Click "OK".

After finishing test the "WinTherm32" calculates the thermal conductivity (in $\text{W m}^{-1} \text{K}^{-1}$ or Btu in $\text{hr}^{-1} \text{ft}^{-2} ^{\circ}\text{F}^{-1}$) using selected calibration. Computer will show results on the PC's monitor and will save them in the created ".tst" file.

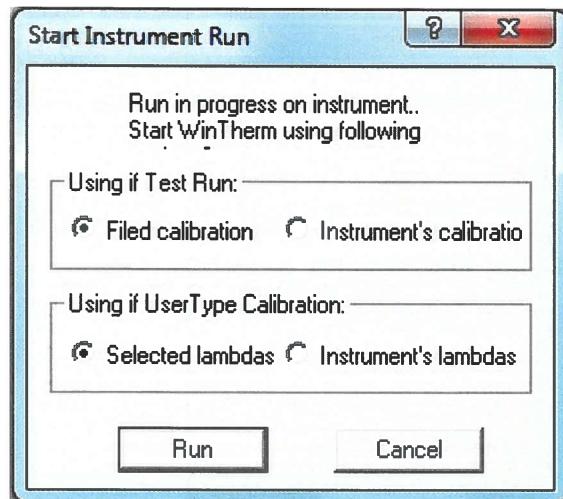


Select “Next” to open result of next set points. You can check upper or lower plate results (click on drop-down arrow in lower left corner of the window), or change units (click on drop-down arrow on the bottom of the window).

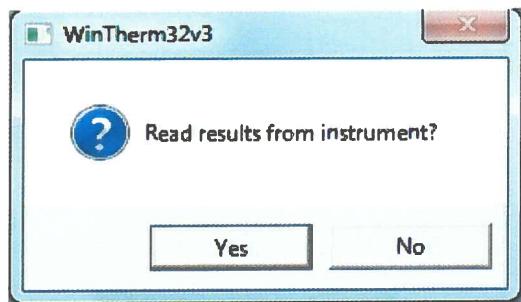
Click “Graph” to view graph of the test results. You can graph upper plate, lower plate, average values, or all of them versus mean temperature of the plates. “Heat Flux” shown on the window is zero because it was not selected to be added to the result file using the “Preferences” menu. “Percent diff” shows difference between values calculated using upper and lower plate heat flow meters.

7.2. Re-Starting Calibrations

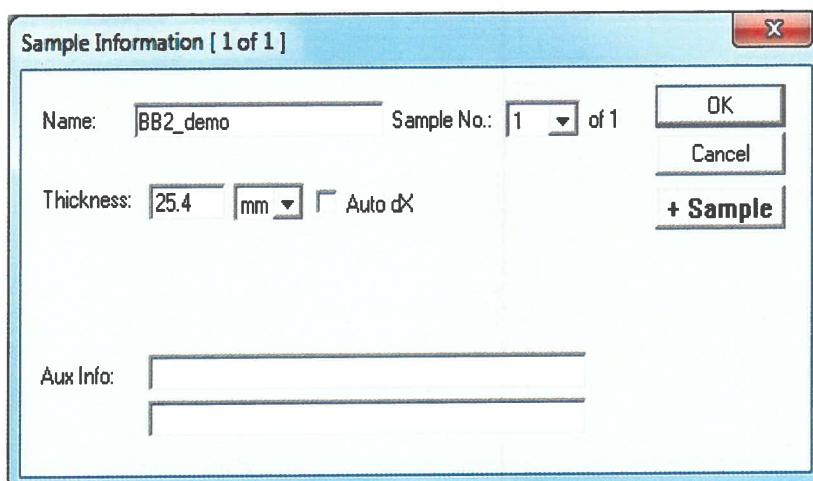
After re-starting “WinTherm32”, in case of “User type” calibration run, you have to select in the second (lower) of the two selections (“Using if User type Calibration”) what “lambdas” should be used for calculations during the current calibration run. Click “Run”.



If you re-started “WinTherm32” after the calibration run had finished then next question appears on screen:



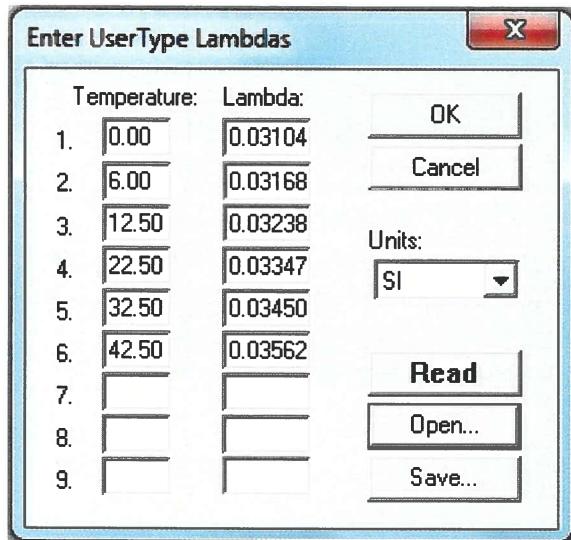
Click “Yes” and computer will read all information from the Instrument. Next the “Sample Information” windows appears:



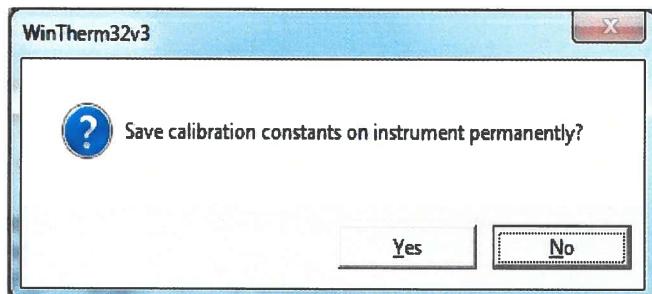
The window shows information read from the FOX Instrument. Check and correct, if necessary, name of the file and thickness of the sample (if the stack is opened, thickness may be wrong!). Only digits (no letters) of the file name can be read from the instrument. Re-enter any additional information about the calibration standard or conditions of the run. Click “OK”.

Sequence of next windows is almost the same as during starting calibration runs. Thermal equilibrium criteria values are read from the Instrument.

If “User entered” (not “Read from Instrument”) calibration standard values were selected then “Enter User Type Lambdas” window appears next. Either manually or using “Open” button you must enter pairs of temperature - thermal conductivity values for your standard to be used for calculations. You can save the set of temperature – thermal conductivity pairs for future use in special file using “Save” button. The file will have “.lmd” extension. Click “OK”.



After finishing calibration “WinTherm32” calculates the values of calibration factor ($\text{W m}^{-2} \mu\text{V}^1$). Entered thermal conductivity values are used. Computer shows results on screen, saves them in the created file, and proposes to save the calibration in Instrument’s memory permanently:



Even if you click “No”, you can still save the calibration on FOX Instrument permanently later using the created file (see subchapter 6.4 “How to Save Calibration Permanently”).

Note: FOX Instruments are able to store two calibrations in its memory – one NIST 1450b type and one User type calibration.

8. INSTALLATION OF ADDITIONAL “WINTHERM32” COPIES TO CONTROL SEVERAL FOX INSTRUMENTS

To run more than one FOX instrument simultaneously using single computer you can install additional copies of the “WinTherm32” software. The following procedures should be followed:

1. Install WinTherm32 from one of the CD's
2. Go to C:\Program Files\LaserComp\
3. Make a copy of the newly created WinTherm32v3 folder
4. Rename both:
 - WinTherm32v2 to WinTherm32v3_1
 - Copy of WinTherm32v2 to WinTherm32v3_2
5. Go to the WinTherm32v3_1 folder and rename the WinTherm32v3.exe and WinTherm32v3.chm to WinTherm32v3_1.exe and WinTherm32_1.chm;
6. Go to the WinTherm32v3_2 folder and rename the WinTherm32v3.exe and WinTherm32v3.chm to WinTherm32v3_2.exe and WinTherm32_2.chm;
7. Create Shortcuts for both executables
8. Go Documents\LaserComp folder
9. Rename the WinTherm32v3 folder (it contains the calibration files) to WinTherm32v3_1
10. Under Documents\LaserComp folder create a new folder called WinTherm32_3_2
11. From the 2nd WinTherm CD (not the one that was used for the initial installations), copy all calibrations files from the Calibration Files folder to the WinTherm32v3_2 folder.

