

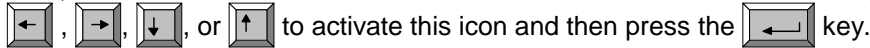
I 2 Operation

I 2.1 Starting the "ZLM Stat" program module

When the "Esox" management program is started, the "ZLM Stat" program module is not active yet. To start this program module,

1. activate the "ZLM" application window (as described in detail in Section "C 3 Starting measurement programs") and open it to regular or maximized size.

2. Now, either double-click the "ZLM Stat" icon with the mouse or use the keys



I 2.2 Elements of the "ZLM Stat" window

If you want to work with the "ZLM Stat" measurement program for a longer time, we recommend to maximize its window after having started it.

Within the window, several fields can be distinguished:

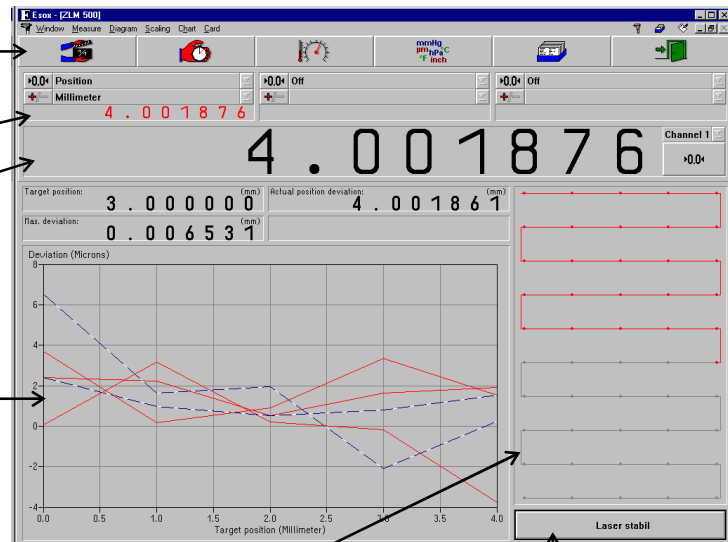
The top margin shows a row of buttons.

Below this there are display and setting fields showing the current readings of the various measuring channels. The reading of one channel can be shown enlarged.

The bottom left portion of the window is occupied by a large button showing a diagram generated from the measured data currently in the memory. This field is empty if no data are in the memory.

The field to the right of the diagram shows the number of readings currently in the memory and the positioning method by which the readings were obtained. With no data in the memory, this field is empty, too.

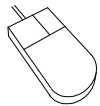
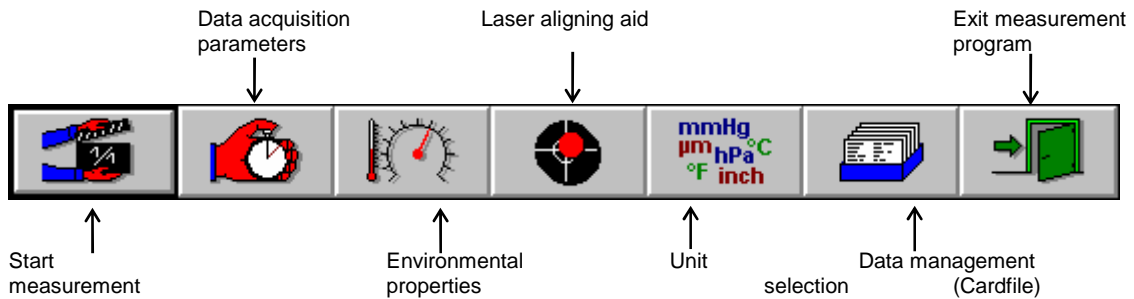
The field in the bottom right corner indicates if the laser operates stably and which light intensity hits the detector.



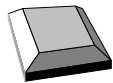
During the measurement and diagram analysis processes the appearance of the window changes, as described in detail in the following subsections.




I 2.2.1 Button field

With these buttons you can activate specific functions of the program, such as start of data recording, setting options for data recording, and data evaluation by diagrams. All these functions can also be started via menu commands. They are explained in detail in the following subsections.



Clicking a button with the mouse activates the function assigned to this button.



On program start, the first (left) button  is made active as is indicated by the thicker black frame around it. By pressing the  key you can make the next button active. The function assigned to the active button is released by pressing the  key.

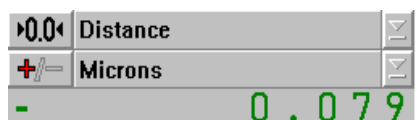
I 2.2.2 Display and setting boxes

Below the row of buttons, each measurement channel has a set of boxes for the most frequently used settings. At the far left you find the boxes for channel 1, with the boxes for the next channels following in succession from left to right. The number of channels is preconfigured to match the number of measuring axes. Further settings that can be made for the channels are described in section I 2.4.1 "Channel settings".



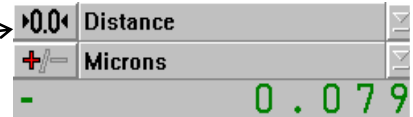
In the upper drop-down list box you can select the unit of measurement to be assigned to the channel.

List box option	Explanation
"Off"	No measured data are displayed for the respective channel. During the acquisition of data for permanent storage, this channel is ignored.
"Distance"	The n-th display from the left indicates the distance computed from the counter reading of the n-th measuring axis.
"Angle"	The n-th display from the left indicates the angle computed from the counter reading of the n-th measuring axis.
"Straightness"	Use this option if you want to measure a transverse displacement with an optical straightness measuring component at the n-th measuring axis, to be indicated in the n-th display box from the left.
"Displacement m-n"	The n-th display box from the left indicates the distance computed from the difference between the counter readings of the m-th and n-th measuring axes.
"Displacement m+n"	The n-th display box from the left indicates the distance computed from the sum of the counter readings of the m-th and n-th measuring axes.
"Angle m-n"	The n-th display box from the left indicates the angle computed from the difference of the counter readings of the m-th and n-th measuring axes via the arc tan function. You need to enter the required reflector spacing in the " Beam spacing " line of the "Configuration" dialog box for the n-th axis.



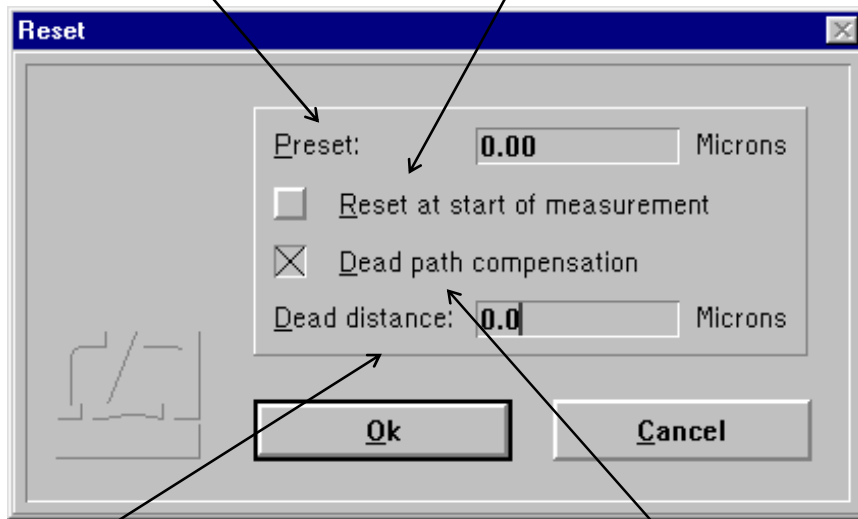
In the lower drop-down list box you can select the unit of measurement for the display. See section I 2.3 "Unit systems" for information on how to change from one system of units to another (metric or imperial measure; degrees/minutes/seconds/radians).

Use this button to open a dialog box "Reset", in which you can set the reference point and the dead distance.



In the "Preset" text box you can preset the distance or angle to be assigned to the present position.

If the button "Reset at start of measurement" is on , the preset value will be assigned to the instantaneous position at the time you start a measurement.

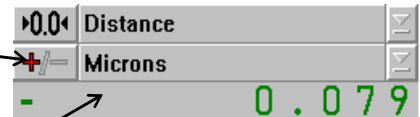


In the "Dead distance" box you can enter the distance between the reflectors. See Annex III for a detailed explanation of the term "dead distance".
The dead distance is of significance only in high-accuracy measurements with the environmental properties changing during the measurement. If you specify a dead distance, mind the correct sign. Specify the dead distance so that, after resetting, the sum of measurement readout and dead distance has always the same amount as the distance between the two reflectors.

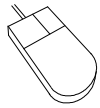
If it can be assumed that the environmental conditions will not change during a measurement, the "Dead distance compensation" button can be switched off ()


The reference point is only assigned when the button is activated. The actions and settings made in this dialog box only act on the respective measuring axis.

With this button you can change the sign.

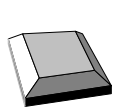










The bottom line indicates the current reading. It is updated 10 times a second, unless the computer is overloaded by other tasks.




To release a function with the  or  button, click on it.

To change the active option in a drop-down list box, click on the underlined arrow right of the list box. This opens the list box and allows you to click the desired option.



Press the  key until the wanted list box or button is marked and thus active. Active buttons ( or ) are displayed with a thicker black frame around the button. An active drop-down list box is marked by a highlighted (white on black ground) entry. To open the pull-down list and see the options available, press the key combination  + . By pressing the  or  keys you can choose the wanted option. To confirm your choice, press the  key.

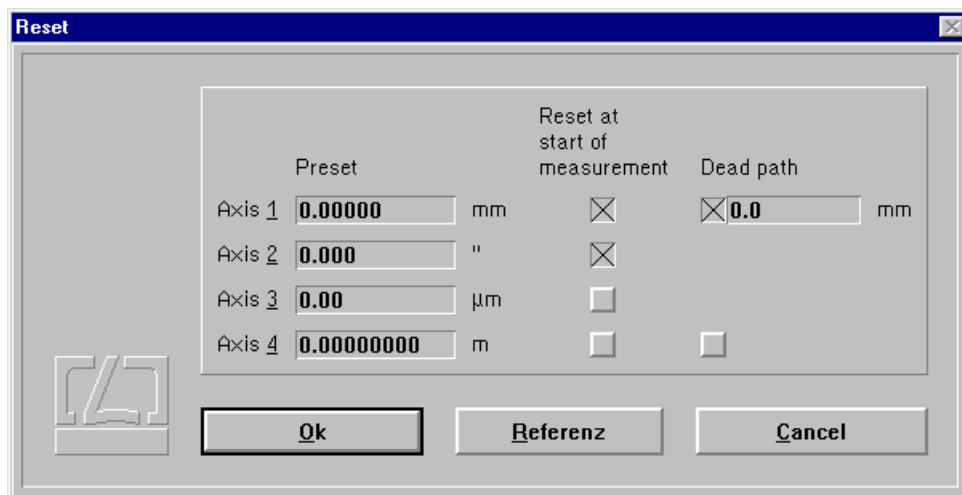
To release a button function, press the  key.

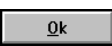
I 2.2.3 Large numerical display

This display box indicates the instantaneous reading of a channel with large digits. Use the drop-down list box on the right of the display to select the channel.



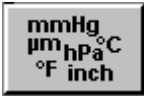
Use the button below the list box to set the reference point simultaneously for all measuring axes. Clicking this button opens the "Reset" dialog box. In this box you can make the same settings as in the Reset boxes of the individual channels, but here they act on all measuring axis simultaneously.



Upon actuating the  button, assignment of the reference points is made simultaneously for all measurement axes.

I 2.3 Unit systems

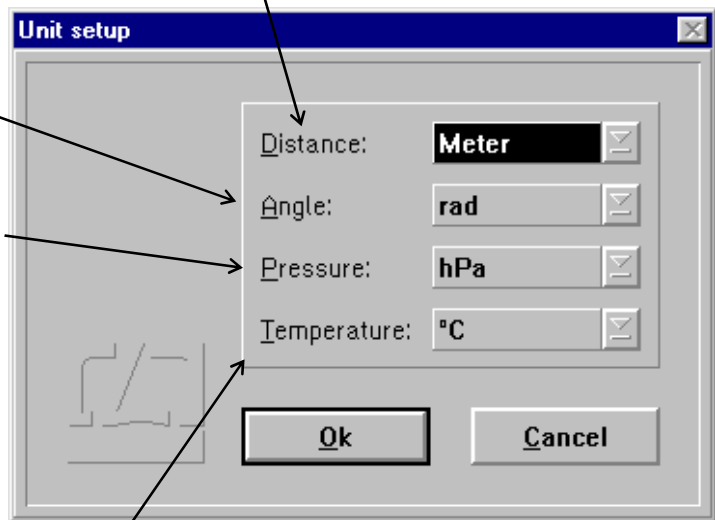
Units of distance, atmospheric pressure and temperature can be selected in the "**Unit setup**" dialog box.

Open this box by clicking the  button or selecting the "**Units**" option of the "**Measure**" menu.

The program can show distances and quantities derived from them in either metric (metre) or imperial (Inch) measure. Switch between them in the "**Distance**" list box.

In the „Angle“ module you only need to select the angle unit (rad, degrees, minutes or seconds of arc)

In the "**Pressure**" list box you can select between "Hectopascal" and "Millimetre mercury".
(1000 hPa = 100 kPa = 1000 mbar,
and
1 mmHg = 1 torr)



In the "Temperature" list box you can select between "Degree Celsius" and "Degree Fahrenheit".

I 2.4 Preparation for a measurement

In preparation for a measurement you need to specify

- the positioning method to be used,
- the number of readings to be taken at each position,
- the type of event by which a reading is to be triggered, and
- the required mode of compensation for environmental influences.

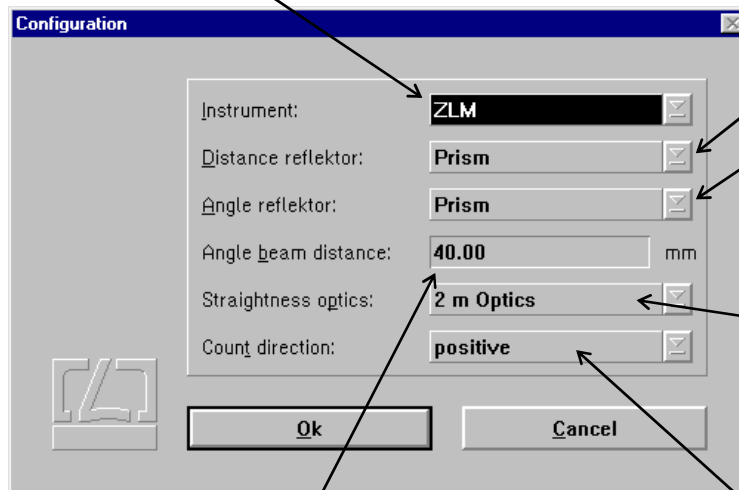
For this purpose, use the "Parameters" and "Environment" dialog boxes to enter general settings acting on all channels.

Use the "Parameters" dialog fields to enter specific settings for each channel.

I 2.4.1 Channel settings

In the "Measure" menu, select the "Setup channel 1", "Setup channel 2" ... options in order to open a "Parameters" dialog box for the respective measuring channel.

In the "Instrument" list box you can tell the program which kind of measuring system is connected.




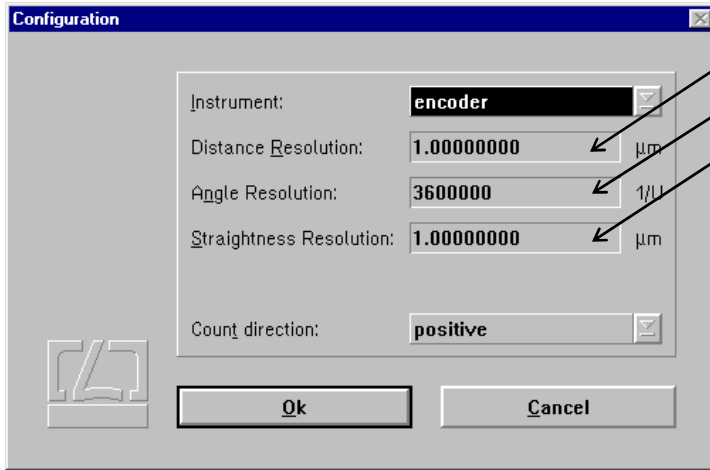
In the "Distance reflector" or "Angle reflector" list box you need to specify which kind of interferometer is used for a distance or angle measurement. Select "Prism" in case of a corner cube interferometer, "Mirror" in case of a plane mirror interferometer. See the "Manual of multi-axis laser interferometers" for suitable interferometer arrangements.

In the "Straightness optics" list box you need to select which set of optical straightness measuring components is used, if you want to measure transverse displacements with straightness optics.

In angle measurements, you need to specify in the "Angle beam distance" text input box the reflector distance as a basis for angle computation. If you use channel "n" for an angle measurement by way of forming the difference between two measuring axes, the reflector distance must be entered in the n-th field of the axis setting dialog.

In the "Count(ing) direction" list box you can reverse the sign. A sign set here becomes effective before any positions are being computed from the readings.

A sign reversal made by clicking the  button in the display field becomes only effective after the positions have been computed.



In case you use an incremental shaft encoder, you need to tell the program the resolution (least count) of the encoder. For an incremental shaft encoder divided into 1000 increments without interpolator, e.g., enter 4 x 1000 r.p.m. = 4000 r.p.m., as the software evaluates both flanks each of the 0° and 90° signals.

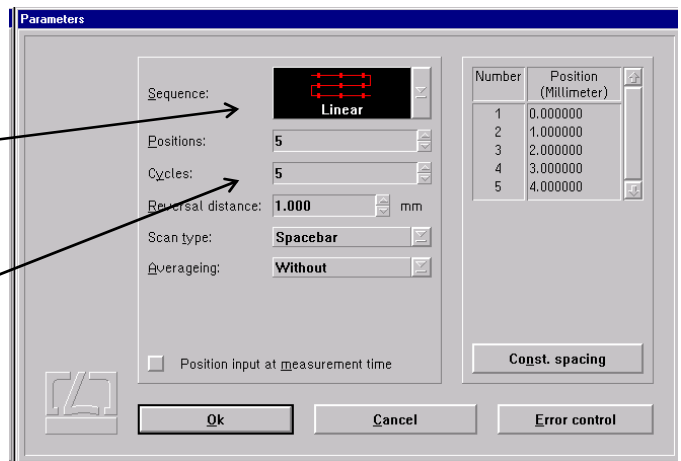
I 2.4.2 Parameter setting for measurement data acquisition

Access the "Parameters" dialog box by opening the "Measure" menu and choosing the "Configuration" option or by clicking the  button.

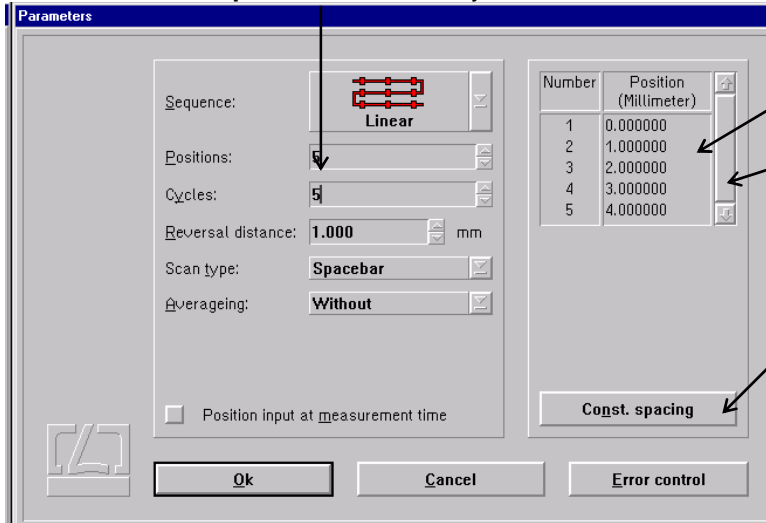
In the "Method" list box you can select between the four positioning methods described in section I 1:

- Linear
- Unidirectional linear
- Pendulum-step (Oscillation) and
- Quasi-pilger step (Quasi-pilgrim)

In the "Cycles" text box you can enter the number of times each position is to be travelled to from one direction.



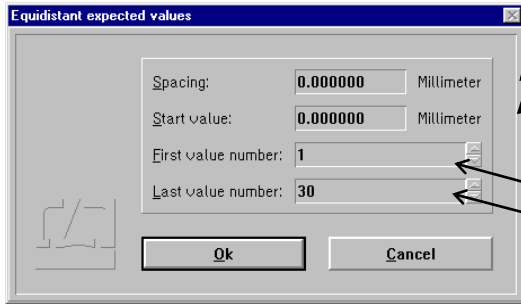
In the "Number of positions" text box you can enter the number of nominal positions to be measured.



In the right column of this dialog box you can enter the individual nominal positions.

Use the vertical scroll bar on the right margin to access positions not visible in the list.

If you want to have the nominal positions equally spaced, use the "Constant spacing" button for fast setting.



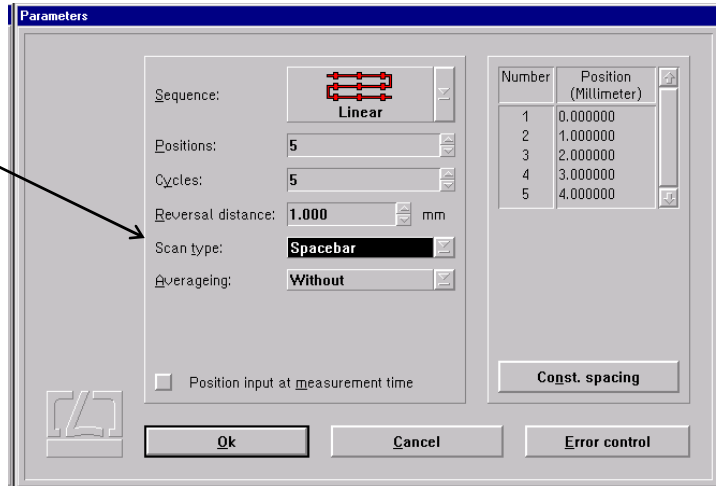
Clicking the "Constant spacing" button opens a dialog box headed "**Equidistant expected values**", in which you can enter the constant interval and the start position.

If you want a certain range of positions rather than all positions to be constantly spaced, you can specify this range in the boxes headed "**First value number**" and "**Last value number**".

In the "**Scan type**" list box you can select the event which is to trigger data acquisition.

This setting also determines whether the nominal positions have to be preset as linear (distance) or angular values.

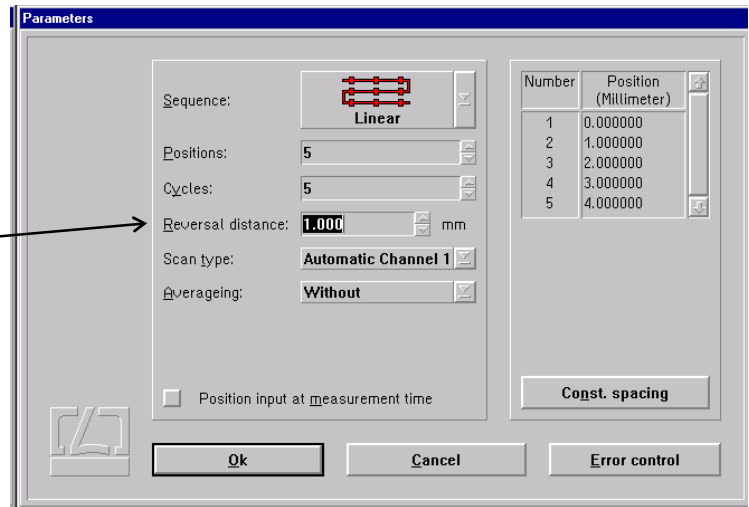
The table below explains the entries in this list box.



Entry	Explanation
"Space bar"	Data acquisition takes place when you press the Space bar of the computer keyboard after starting the measurement. Nominal positions are preset as distances.
"External"	Data acquisition is triggered by pressing a remote (cable-connected) pushbutton or by a TTL signal. See Annex I for information where to connect the respective signal line. Nominal positions are preset as distances.
"Space bar / Angle"	Data acquisition takes place when you press the Space bar of the computer keyboard after starting the measurement. Nominal positions are preset as angles.
"External / Angle"	Data acquisition is triggered by pressing a remote (cable-connected) pushbutton or by a TTL signal. Nominal positions are preset as angles.
"Automatic, channel ..."	With this entry selected, the program recognizes when the object under test is at standstill and automatically effects data acquisition at this moment. Thus the measurement can be completely automated, provided that the object tested has a control system that allows the execution of a control program for the selected positioning sequence. To recognize standstill, the program only uses the readings of the channel specified. Nominal positions are preset as required by that channel.
"Encoder, channel ..."	If a special counter is used for a channel, data acquisition can be triggered by the hardware at the moment when actual and nominal positions are found to be equal. This method is useful if a lot of data are to be acquired in a short time and can be correctly obtained without requiring the object to stop moving. Nominal positions are preset as required by that channel.

If your setting in the "Scan type" list box specifies distances as nominal positions, these nominal positions will be subtracted from the measured value of each channel set for "Distance". If angles are specified as nominal positions, these positions will be subtracted from the measured value of each channel set for "Angle".

A problem involved in automatic data acquisition is the recognition of standstill at such positions in the programmed sequence that are travelled to immediately before the tested object reverses the direction of its movement. Therefore, you can tell the program in the "**Reversal distance**" text box what is the minimum travel of the tested object between the last nominal position and the reversing point.



When using automatic data acquisition, you are confronted with one of two cases:

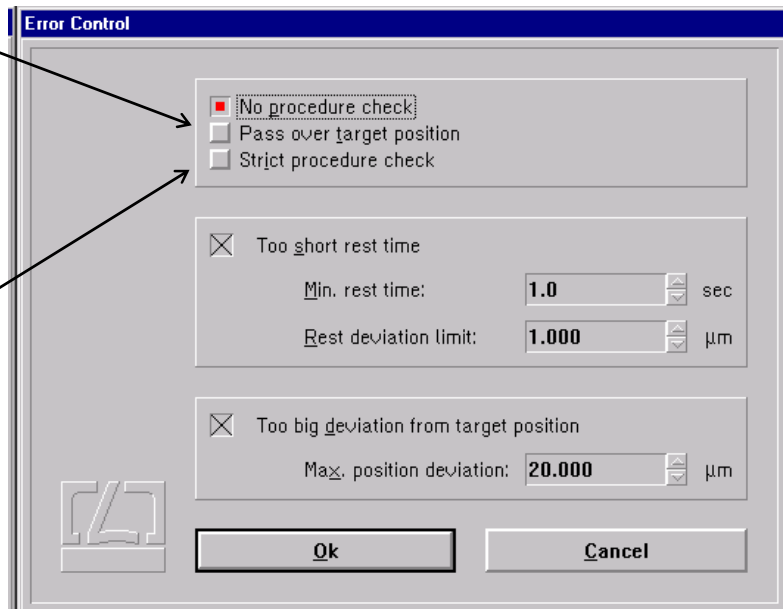
1. You want to make a successful measurement with the least possible number of positions.
2. You want to be informed about any problem cropping up during the measurement as early as possible by means of an error message.

Therefore you can select which errors the program is to recognize and display.

Clicking the "**Error control**" button in the bottom right corner of the "Parameters" dialog box opens the "Error control" dialog box. When you start the program for the first time, all error messages are switched off, and during a measurement the program will try to find the measuring positions under any circumstances.

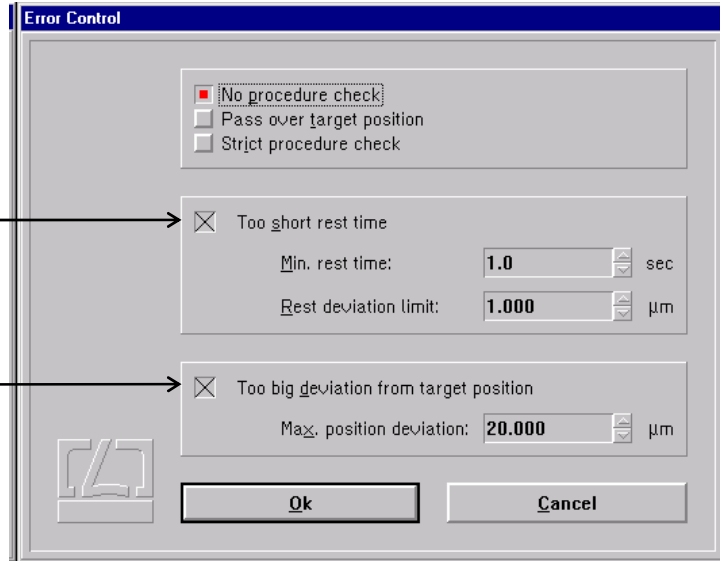
If you select "**Passed over target position**", an error message will appear if a position has been reached prematurely, i.e. before its scheduled place in the positioning method selected. This error is an indication that probably the correct target position has not been recognized.

If you select "**Strict procedure check**", the program additionally checks whether the tested object travels in the correct direction according to the positioning method chosen, and whether it performs the correct return loops.



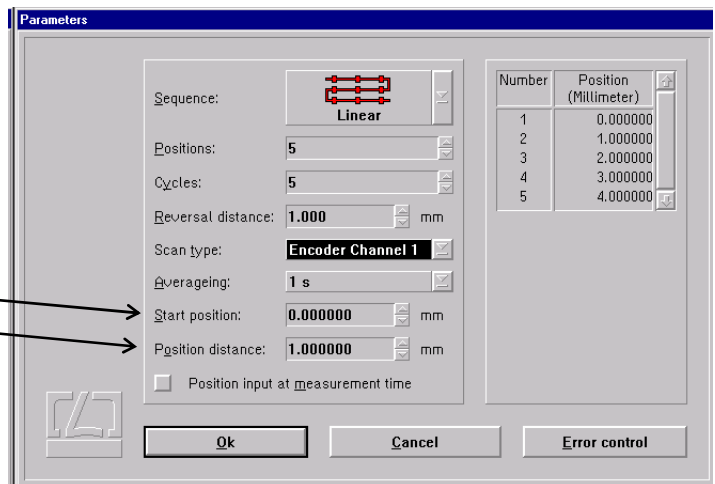
If you want to make sure that readings are only taken if the tested object moves not farther than a certain distance over a given time, you can activate the "**Rest time too short**" switch and enter the maximum permissible standstill error and the minimum permissible dwell time.

If you expect the tested object to satisfy a certain accuracy, you can enter a maximum deviation of the readings from the nominal positions and have an error message displayed if the maximum is exceeded.



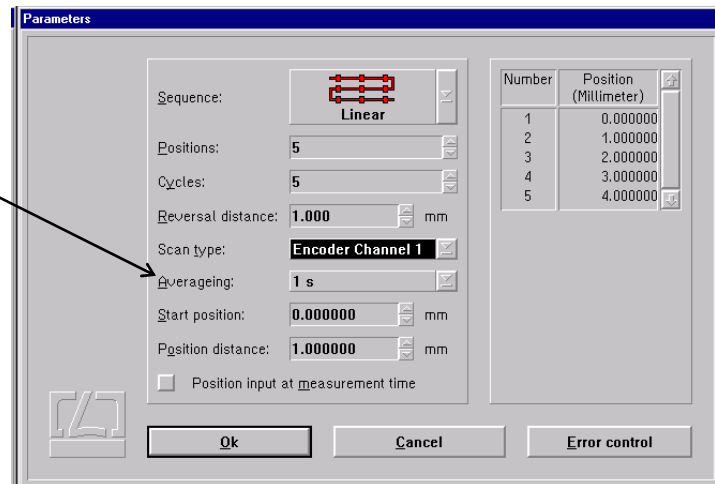
In measurements triggered by "Encoder, channel ..." (hardware comparison), nominal positions must be equidistant.

Therefore, enter the start position and the constant interval (position distance).



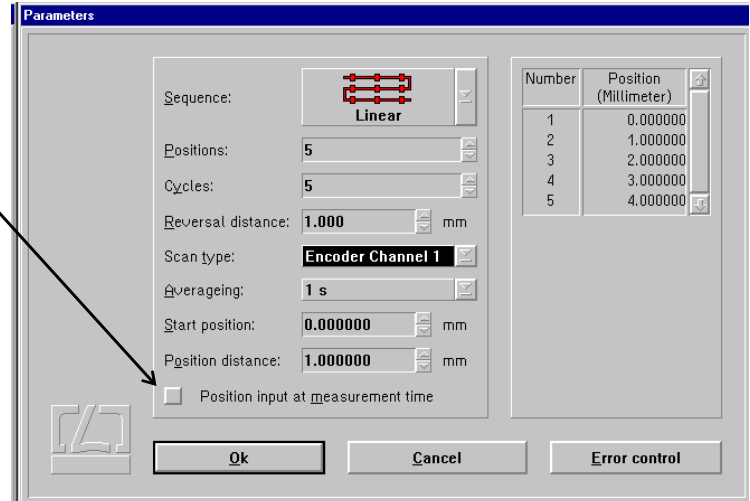
The program can filter out vibrations during a measurement by time averaging. The time over which an average is to be obtained can be set in the "**Short term averaging**" list box.

In a measurement with automatic data acquisition, the optimum entry is 0.1 s, because during standstill the program takes a reading every 0.1 s and then forms the average of these readings. Longer times for averaging might create problems in standstill recognition.



With the "Space bar" and "External" data acquisition triggering modes, select a time that is somewhat shorter than the standstill period to be expected of the tested object.

With some objects it is not possible without unreasonable effort to travel to a nominal position so that the object itself indicates this position (e.g., certain one-coordinate length measuring machines). If you activate the button **"Position input at measurement time"**, a text box will appear during the measurement immediately after each reading, in which you can enter the value indicated by the object as the nominal position.




I 2.4.3 Compensation of environmental influences

The accuracy of a distance measurement made with a laser interferometer depends on whether the refractive index of the ambient air is known and allowed for. The program can compute the refractive index from properties of the atmospheric environment and correct the measurements accordingly.

The software can further allow for the thermal expansion of the test object as a function of its temperature, and correct the measured data so that they represent the readings that would have been obtained with the test object having a temperature of 20 °C.

The necessary settings can be made in the **"Environment"** dialog box.

This is accessible by opening the **"Measure"** menu and choosing the **"Environment"** option, or by

clicking the  button.

All settings made here will be effective in data acquisition, numerical display and the real-time diagram.

Angle measurements and measurements using the straightness optics do not need environmental compensation, as its effect would be far below the system's resolution.

I 2.4.3.1 Atmospheric properties

In the top part of the "Environment" dialog box you can choose how to compensate for the effects of atmospheric properties on the refractive index and thus on the measured result.

Manual Correction Choose the "**Manual**" option of the pull-down list box "**Correction type**". You will have to enter the atmospheric properties in the respective text boxes.



Keys that facilitate inputs:

Coarse setting -  and 

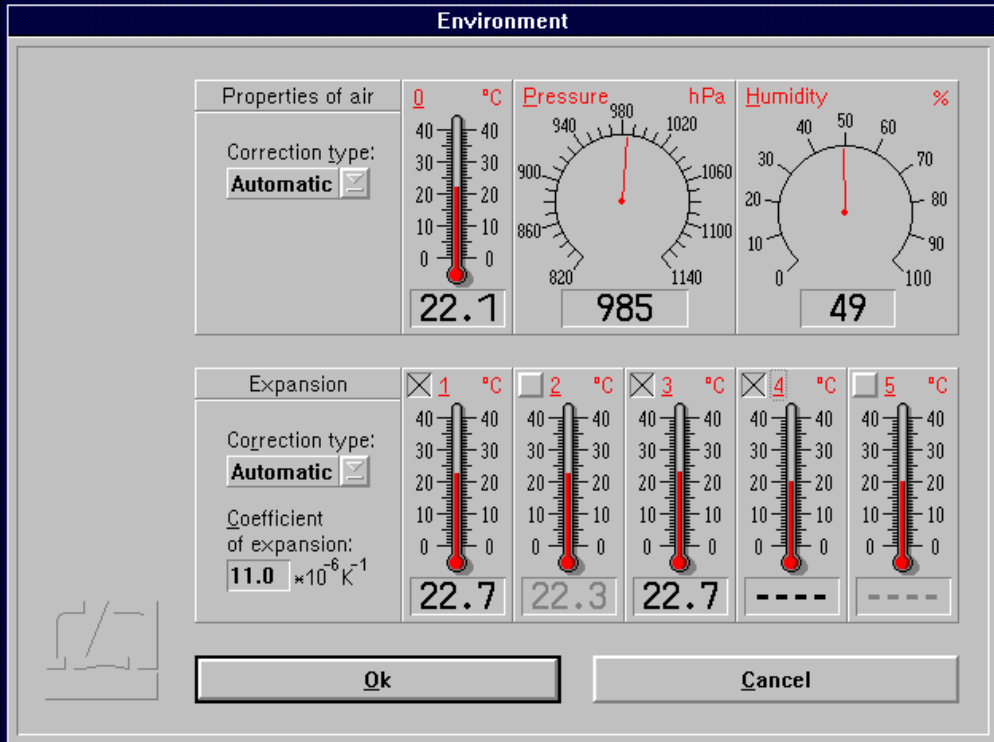
Fine setting -  and 



1. Move the mouse pointer to the field where you want to make an entry.
2. Press the left mouse button and keep it depressed.
3. Drag the mouse until the thermometer column or the pointer indicates the desired value.
4. Release the mouse button.

Consult Annex III for information about the accuracy required for the measurement and entry of atmospheric properties.

Automatic Correction When you use the AUK 500 Automatic Environment Detector to measure the atmospheric properties, choose the option "**Automatic**" of the pull-down list box "**Correction type**".



The screenshot shows the "Environment" dialog box with the following settings:

- Properties of air:**
 - Correction type: **Automatic**
 - Temperature: 22.1 °C
 - Pressure: 985 hPa
 - Humidity: 49 %
- Expansion:**
 - Correction type: **Automatic**
 - Coefficient of expansion: 11.0 $\times 10^{-6} \text{K}^{-1}$
 - Expansion 1: 22.7 °C
 - Expansion 2: 22.3 °C
 - Expansion 3: 22.7 °C
 - Expansion 4: --- °C
 - Expansion 5: --- °C

Buttons: **Ok** and **Cancel**

I 2.4.3.2 Material temperature

In the bottom part of the "Environment" dialog box you can choose whether and how the measured values are to be corrected for thermal expansion (material temperature). With correction activated, the readings are converted into readings that would be obtained at a material temperature of 20 °C.

Without correction If you want to work without this correction, choose the option "**None**" of the pull-down list box "**Correction type**".

Manual correction If you want to enter the material temperature manually, choose the option "**Manual**" of the pull-down list box "**Correction type**".

In the text box "**Coefficient of expansion**" type in the linear expansion coefficient of the test object.

The material temperature can be entered in the same way as the manual entry of atmospheric temperature (see Section I 2.4.2.1 "Atmospheric properties").

Automatic correction If you want to use the AUK 500 Automatic Environment Detector for compensating the errors due to material expansion, choose the option "**Automatic**" of the pull-down list box "**Correction type**".

In the temperature display boxes, temperature sensors that are not connected are indicated by "---". In the figure, material temperature sensors 4 and 5 are not connected.

You have the possibility to select from the available sensors those you want to use for the correction. For this purpose, every temperature display field has a button at the top left.

Button is not checked:

The respective material temperature sensor is excluded from correction and - on colour screens - the temperature value is displayed in grey instead of in black colour. In the figure, material temperature sensors 2 and 5 are not included in the correction of material expansion.

Button is checked:

The sensor reading enters the correction if the sensor is connected.

With automatic correction activated, the program reads the data of the material temperature sensors once per second. The program computes the mean value of all the measured values of the sensors that are connected and activated via the respective button of the display field. This value is used by the program to correct the data for material expansion.

If none of the sensors is connected and activated, the measured values are not corrected. In the example shown in the figure, the mean value of the temperatures detected by sensors 1 and 3 is used for the correction. Sensors 4 and 5 are not connected. Sensor 2 is deactivated.