



TUNCAL Program Ver. 6.3.

User's Guide

Wind Tunnel for Calibration of Low Velocity Anemometer Probe

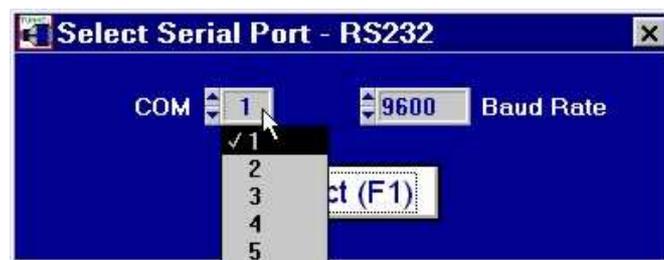
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Program Features

- calculation flow velocity
- automatic velocity control
- automatic calibration and measurement report creation
- automatic conversion file creation for system HT-400
- communication with SensoAnemo transducers of AirDistSys 5000 measuring system
- automatic dynamic response test

First Running of the TUNCAL Program

After first starting the TUNCAL Program appears a window is coming in with choice of the number of a serial port. It is very important not to start up the program before the RS232 cable is connected both to the PC serial port and the tunnel (Main Measuring Module) and the main supply is turned on. The user has to select the serial port number under which the RS232 cable is physically connected to the Main Measuring Module.



The TUNCAL Program communicates only at the speed 9 600 BPS. When the 'Select' button is pressed the program starts to establish the communication with the wind tunnel. If there is no communication with the wind tunnel the program will not start.

In order to restore the correct running of the program one must first eliminate the cause of the error.

The cause of this error may be that:

- the RS232 cable is not connected
- the power supply to the Main Measuring Module is off
- a wrong COM number is selected

If the TUNCAL Program successfully communicates with the wind tunnel it starts to search for following connected components:

- main measuring module
- internal analog input unit
- external micromanometer
- dynamic module

While finding particular additional components the program displays successive messages (below as an example) informing of their activation and next he is going for setting parameters of the analog input (see to chapter 'Analog Input Configuration')



In the end, the main window will be displayed and the program will be ready to use. Otherwise, it shows the window 'Communication Error' giving the information on the reason for the error (an example presented below).



In the case when component is not connected the program inactivates appropriate component-related options and at the same time gives a suitable message. The user can activate component after the reasons for the error of communication are eliminated, by selecting the proper component from the menu item 'Communication'.

The following is example:

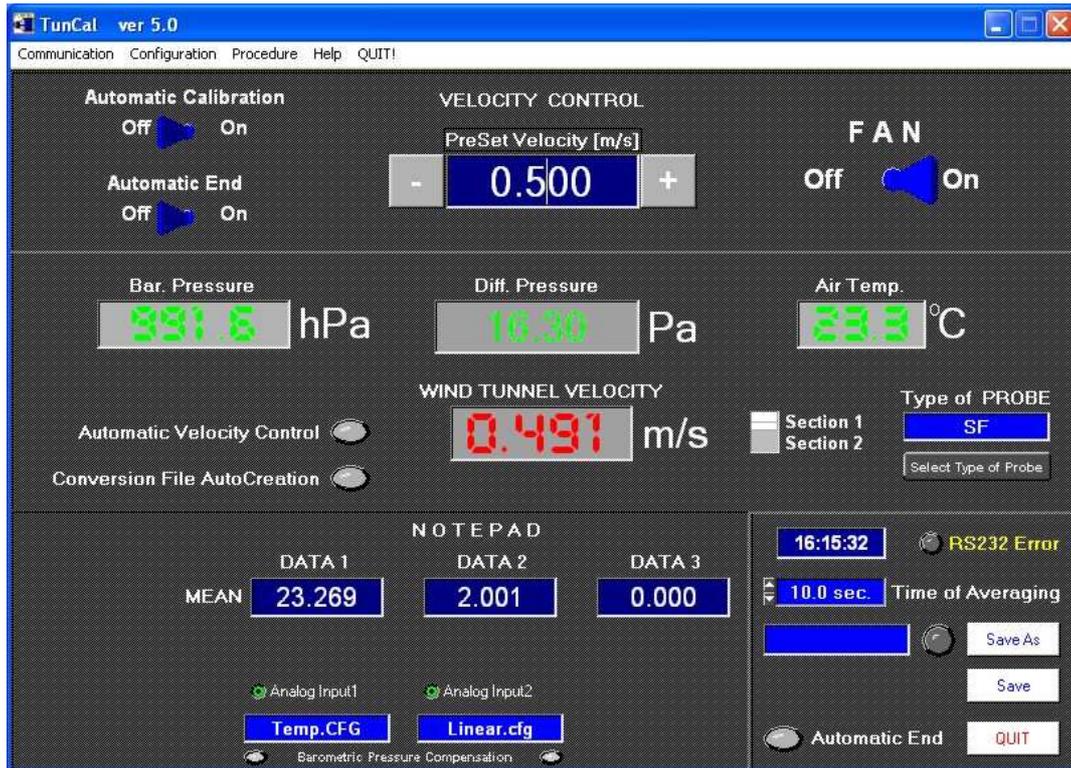
- when there is no or faulty communication with the micromanometer the option 'automatic velocity control and automatic calibration' is inactivated about which the program informs displaying the shown below window:



Note: At its first run the program memorizes the connection configuration (the selected COM port and status ON/OFF for connected components) in the configuration file named tunnel.cfg. If at the next startups the connection configuration does not change the program does not inform any more about the communication error with a component the status of which is 0. What remains is only the message of the inactivation of the option related to the lack of that component.

Main Window

The main window is divided into three parts. A control for setting the wind tunnel velocity 'Preset Velocity [m/s]' is in the upper part. Green displays of barometric pressure, differential pressure and air temperature, which are needed for calculate the velocity in the wind tunnel are placed in the central part. The wind tunnel velocity is displayed in red. The value of velocity depends on the choice of the number of measuring sections and the type (geometric dimensions) of probe used for calibration.



The lower part contains a so-called NOTEPAD. There are three displays DATA1, DATA 2 and DATA3 which their properties are changing depending on the chosen option in menu item “Configuration”.

- for activated analog inputs

DATA1 and DATA2 display values from two analog inputs (Input 1 and Input 2) when the button-indicator Analog Input1 and Analog Input2 are switched on. Data3 changes into the control, where the user can write his data. Those values can be also transformed by any conversion files (compatible with HT-400 Measuring System) selected by using the ‘Analog Input’ from the menu item ‘Configuration’. The name of the file selected is displayed in the text indicators at the bottom. The green indicator ‘Barometric Pressure Compensation’ is automatically turned on the basis of index NoCP placed in a conversion file.

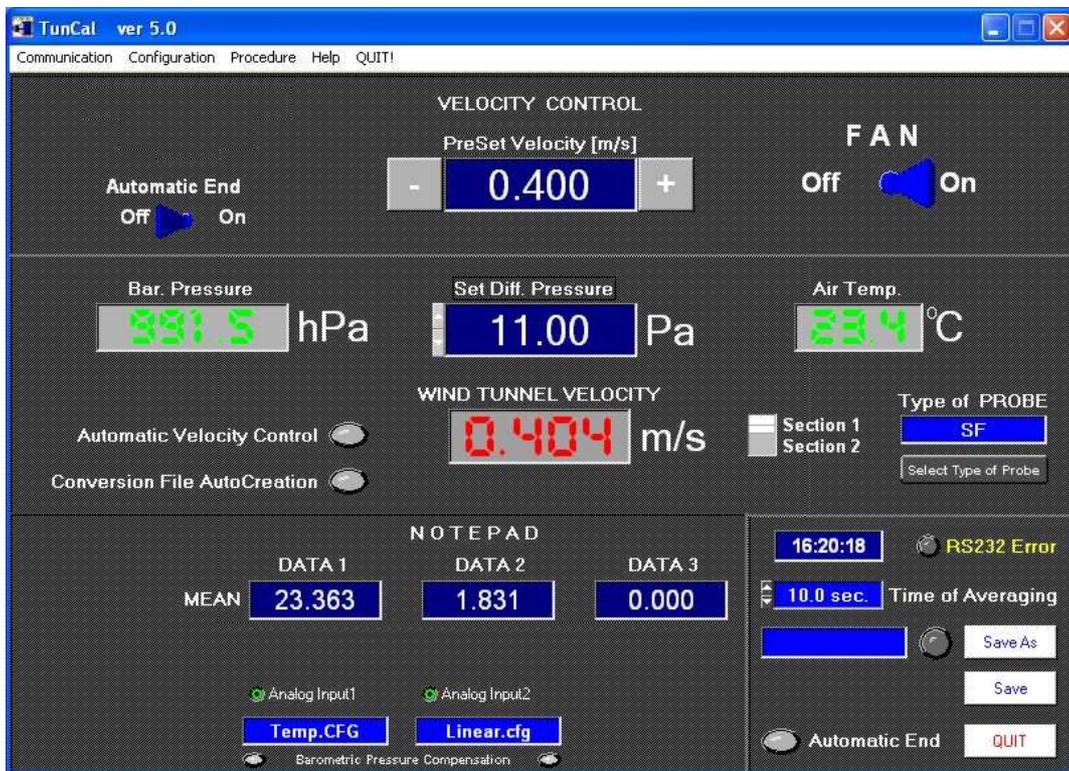
It is possible to change Data1 and Data2 displays into the controls (for manual data writing) by pushing the button-indicator.

- for activated digital input (compatible with SensoAnemo transducers)

Data1, Data2 and Data3 display temperature, velocity and voltage from SensoAnemo transducers. The switch ‘Barometric Pressure Compensation’ enables to turn on the automatic compensation for the pressure.

Each of the three displays of the NOTEPAD has the default name DATA1, DATA2 and DATA3. The user can – according to their needs and for their convenience – change these names when selecting a file for recording. The user can select the averaging time of displayed values in the control ‘Time of Averaging’ placed in the right lower part.

In the situation where no micromanometer is connected the main window changes its look into the one below; then, the indicator of differential pressure change into the manual entry control 'Set Diff. Pressure' and the switch of automatic calibration disappears (is disabled).



Presetting the Flow Velocity in the Wind Tunnel

In order to preset of the flow velocity one should:

- choose the type of calibrated probe by pushing the button 'Select Type of Probe'
- write the value of velocity in the control 'PreSet Velocity [m/s]' and accept either with the ENTER key (on the keyboard) or pushing the button + or -.

The presetting of the velocity value is preliminary and rough. The fan motor is adjusted by a switch converter, by means of a variable-frequency command signal. The velocity value being set is converted to the frequency of the converter control pulses according to the equation for frequency of fan motor converter calculation. The coefficients of this equation are achieved during the calibration of the tunnel and are put in the configuration files *.ctf in the folder COEFF. These files have names appropriate to names for type of probes i.e. SF.ctf for spherical probe, CL.ctf for cylindrical probe. The fan-produced flow in the tunnel does not reflect possible changes in motor power supply parameters and air density. Thus, the velocity value set can significantly differ under some extreme conditions from the real value, particularly when the tunnel is supplied with power from a network of parameters unlike the ones used in the calibration (e.g. 120V/60Hz) or when the tunnel is used at a different mean air density. The user is able to correct the equation coefficients, thereby reducing the difference between the velocity value initially set and real one. The new coefficients must be calculated (an example by means of the attached by producer the spreadsheet CalcFreqConv.xls in the folder TOOLS) so that they govern the relation between velocity and frequency after the following polynomial approximation:

$$FREQUENCY = FreqCoef3 \times Velocity^3 + FreqCoef2 \times Velocity^2 + FreqCoef1 \times Velocity + FreqCoef0$$

where: *FREQUENCY* is the converter frequency given in each data logging file in its first column under the name Conv.Freq, and *Velocity* is the real velocity value in the tunnel given in the column named Tunnel Velocity.

The real, accurate flow velocity is read in the indicator 'WIND TUNNEL VELOCITY'. It appears either automatically when the differential micromanometer FC0510 with an active RS232 output is connected or after the differential pressure is manually introduced into the control 'Set Diff. Pressure *). The real flow velocity is calculated upon the following equation:

$$VELOCITY = VelCoef0 + VelCoef1 \times \left(\frac{dP}{Ro}\right)^{0.5} + VelCoef2 \times \left(\frac{dP}{Ro}\right) + VelCoef3 \times \left(\frac{dP}{Ro}\right)^{1.5}$$

where: dP – measured pressure difference [Pa]

Ro – air density [kg/m³]

and

$$Ro = \frac{DenCoef1 \times Bar Pressure \times (1 + DenCoef2 \times AirTemp.^2)}{273 + AirTemp.}$$

where: DenCoef1 = 0.34722

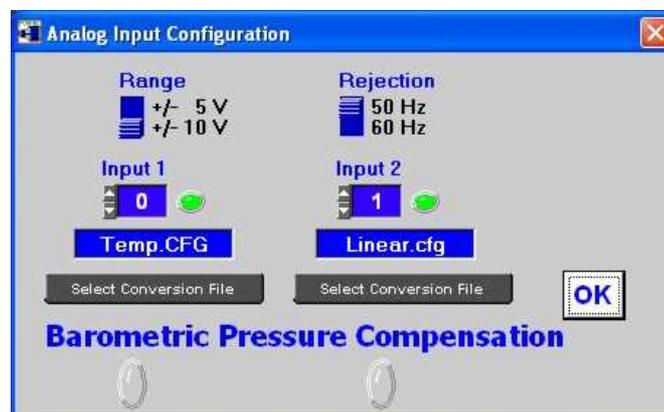
DenCoef2 = -2.1117E-5

The coefficients VelCoef0... VelCoef3 are also put in the configuration files *.ctf. The coefficients DenCoef1 and DenCoef2 are put in file named tunnel.cff. They must not be corrected since they are obtained during the calibration of the tunnel and their change will cause errors of the tunnel velocity. They are only allowed to be changed after recalibrating the tunnel.

*) if no micromanometer FC0510

Analog Input Configuration

In order to set up the Analog Input Configuration, select 'Analog Input' from the menu item 'Configuration'. Then the window appears shown in the following figure.



In this window, it is possible to set voltage range and frequency of the rejection. After pushing the button 'Select Conversion File' the shown next window appears. The user selects a conversion file in this window.



Digital Input Configuration

The program enables to calibrate the SensoAnemo transducers of AirDistSys 5000 system. In order to set up the Digital Input Configuration, select 'Digital Input' from the menu item 'Configuration'. Then the window appears in which one should write the number ID of the transducer. After pressing the key OK the program is establishing communication with the transducer. The user can test the correctness of the chosen ID number pressing the key Test.

Conversion Files

The conversion files are text files with the extension cfg placed in a separate folder CONVERS. They are compatible with the conversion files of the program HT-400 and can be directly edited by the user. The conversion file always contains the equation coefficients of a probe characteristic. The equations can be linear (type 0) or polynomial (type 3). For each channel, a default conversion file with a linear equation (type 0) with factors $X0=0$ and $X1=1$ is assumed.

Equation of type 0

$$\text{Volt}[V] = X0 + X1 * U[V]$$

Equation of type 3

$$\text{if } Uv < Uo \quad Vnom = 0 \text{ [m/s]}$$

$$\text{if } Uv < Uc \quad Vnom = [A0 + A1 * (Uv)^2 + A2 * (Uv)^4 + A3 * (Uv)^6 + A4 * (Uv)^8]^{1/2} \text{ [m/s]}$$

$$\text{if } Uv \geq Uc \quad Vnom = [B0 + B1 * (Uv)^2 + B2 * (Uv)^4 + B3 * (Uv)^6 + B4 * (Uv)^8]^{1/2} \text{ [m/s]}$$

Beside the equation coefficients, the following can be contained in the conversion files:

- index #NoCP
- index #CT
- correction table

Index NoCP comprises the information on the status of barometric pressure compensation. If NoCP=1 the values are not compensated. If NoCP=0 or the index is missing in the conversion file then the program compensates the velocity values in respect of barometric pressure according to the following formula:

$$V = V_{nom} * P_{nom} / P_b$$

V_{nom} - velocity [m/s] at nominal barometric pressure $P_{nom} = 1013.0$ [hPa]
 V - velocity [m/s] at actual barometric pressure P_b [hPa]

This calculation option is useful when the conversion file contains the equation coefficients of a probe characteristic as being referred to nominal barometric pressure value.

Index CT comprises the information on the status of the Correction Table. If CT=0 or the index is missing then the Correction Table is not taking into account while calculating the values. If CT=1 the program corrects the velocity values in such a way that adds the correction coming from the Correction Table to each of them.

Correction Table comprises the list of corrections for some (determined) velocity values. An example of the structure of the Correction Table in the conversion file is presented below.

```
-----
# CT = 1
# Corr = 0.05 0.00
# Corr = 0.10 0.01
# Corr = 0.20 0.04
# Corr = 0.30 0.05
# Corr = 0.50 0.10
# Corr = 1.00 0.20
-----
```

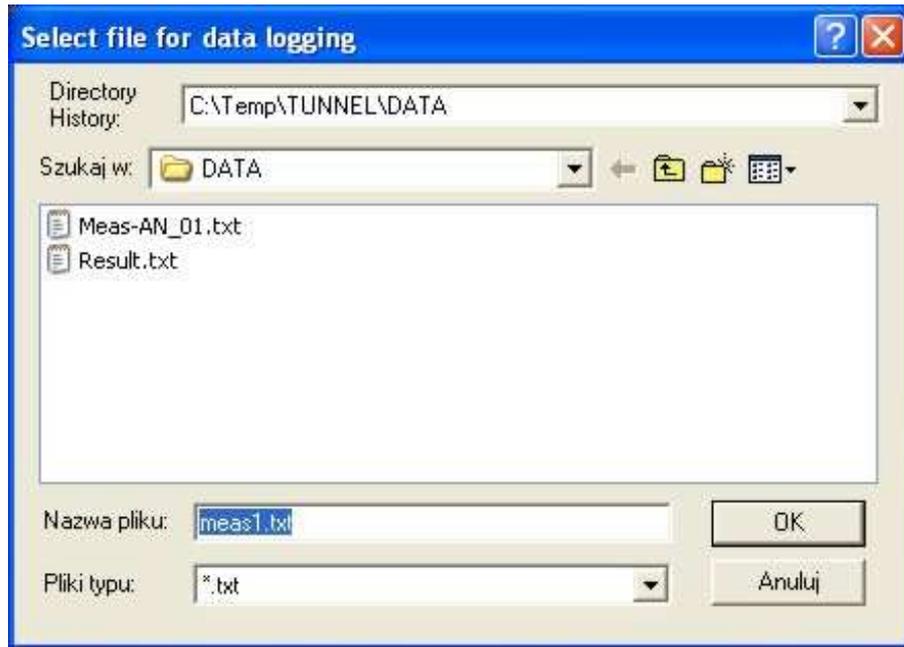
The program adds the correction situated in the second column to the appropriate value (of velocity) corresponding to the index #Coor from the first column, e.g. the correction 0.04 will be added to the velocity value 0.20, the correction 0.05 will be added to the velocity value 0.30. If the value of velocity is between two values corresponding to the index #Corr in the first column then the program will calculate the correction according to a linear function ranging between those two limiting values, e.g. for velocity value 0.75 the added correction will be 0.15.

Data Logging Files

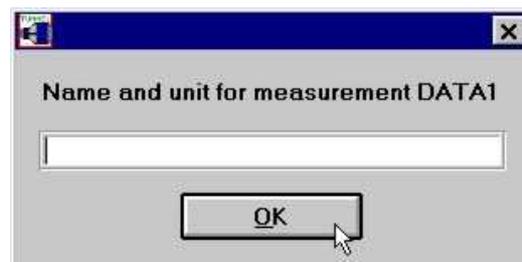
The parameters of the tunnel operation and the values of the displays DATA1, DATA2 and DATA3 are saved in the data logging files. All the data logging files have headings in which the following items of information are placed:

- label of the data logging file, e.g Measurement Results File or Automatic Calibration Measurement Results File,
- date and time of the start of logging,
- name and path of the file with tunnel velocity coefficients name and path of the conversion file or number of the digital transducer
- information about on/off status of barometric pressure compensation.

When 'Save as' is selected the 'Select file for data logging' window appears and the user should choose one of the existing files (the default name is 'meas1.txt') or write the name of a new file for data logging. In the case of the selection of an existing file all new data will be placed at the end of the file.



Next, there appears a new window in which the user can enter any comment up to 75 characters. This comment will be placed at the beginning of the results. Then the windows are shown in which the user can change the names DATA1, DATA2 and DATA3 for others.



Next records can be done by selecting the 'Save' button.

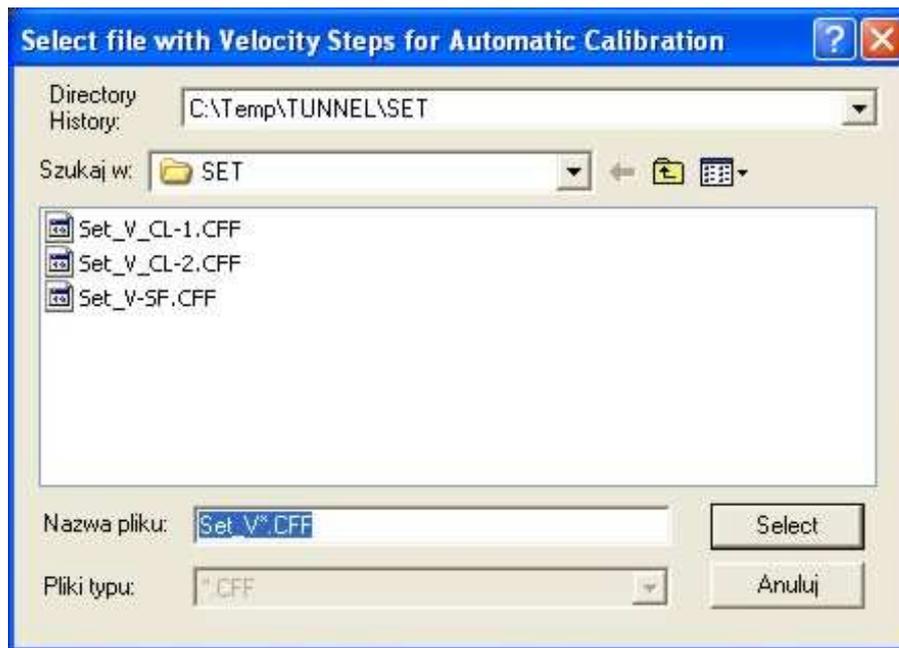
Automatic Calibration

This procedure is available only when the micromanometer is connected (enabled) and then it makes it possible to select previously programmed velocity values. The parameters of the tunnel operation and measurement results from the notepad displays are registered in the data logging file during the automatic calibration.

After turning on the procedure with the switch Automatic Calibration there appears the following window of the selection of the file in which velocity steps values are put. Each such a file is a text file of the type Set_V*.cff and is located in the separate folder SET. The user can edit it by oneself and write the successive values of velocity for automatic calibration.

When the file is selected and accepted by the button 'Select' next windows appear that enable the user to select the data logging file, write a comment and change the default names of the measurement columns. Next the program goes to the automatic calibration mode.

When the option 'Automatic End' is on, the program will shut down automatically after the calibration procedure.



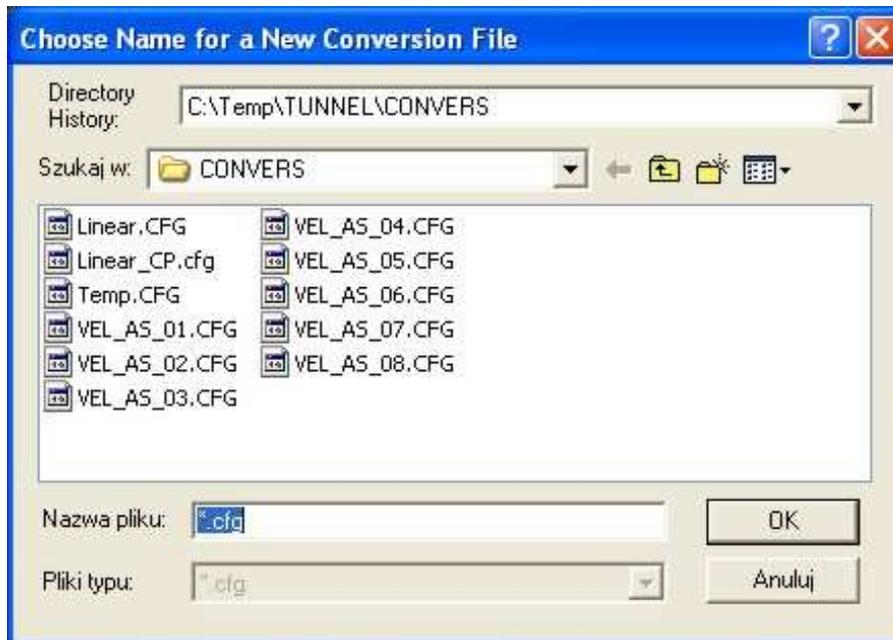
Automatic Calibration of the SensoAnemo transducers

- Connect the SensoAnemo transducers to one of the double socket “Digital Input” of the Control Module
- Choose the Digital Input from the Configuration Menu.
- Write the number ID of transducer and push button test.
- If the ID number is correct, the diode indicator will be shining on green.
- Push button OK.
- The temperature, velocity and input voltage of A/D converter will appears on the notepad panel.
- Set the switch of “Automatic Calibration” on the position ON and select file with velocity steps named Set_V-WZ_SF.CFF for spherical probe or Set_V-WZ_CL.CFF for cylindrical probe.
- Next create file for data logging (an example: recal_01.txt)
- The automatic calibration procedure is in progress.

Conversion File AutoCreation for HT-400 system

The program enables to create Conversion Files compatible with measuring system HT-400. It is available when the micromanometer is connected with the tunnel (Automatic Calibration is enabled) and absent. The tested (recalibrated) anemometer should be connected to the Analog Input 2. The old conversion file appropriate to recalibrated transducer should be chosen for Analog Input2 in ‘Analog Input Configuration’ window (select Analog Input from the menu item ‘Configuration’).

In order to turn on the procedure one should select 'Conversion File AutoCreation' from the menu item 'Procedure'. Then the shown below window 'Choose Name for a New Conversion File' will appear in which the user should choose one of the existing conversion files or write the new name of a file.



Next the program will create a new conversion file in which there will be the equation coefficients of a probe characteristic from the old conversion file set in the Analog Input 2. It is the file, where a new correction table will be inserted during the calibration. One should remember that when the existing conversion file is selected for a New Conversion File, the old correction table will be lost.

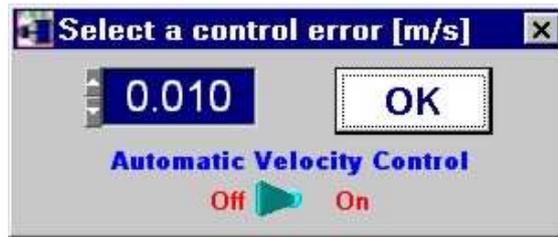
Turning on the procedure is signaled by the shining of the indicator 'Conversion File AutoCreation' in the main window of the program. At the same time, the displays names of the NOTEPAD are changed from DATA2 to Tested Anemo and from DATA3 to TestAn - CT. On the Tested Anemo display are presented the velocity value with the old correction, on the TestAn-CT display are presented the velocity values without correction.

After starting the procedure 'Automatic Calibration' the program calculates the new velocity corrections in each calibration step and writes them down into the new correction table in the new conversion file that has been selected when starting the procedure 'Conversion File AutoCreation'. When the procedure 'Automatic Calibration' is finished the program ends to create of the new conversion file and informs, through the message shown below, that the procedure 'Conversion File AutoCreation' has been shut down.

The program enables to create the correction table also in the situation when is using another micromanometer than Furness Control FC510 (Automatic Calibration is disabled). Then, it is necessary to manually write the differential pressure value to the control 'Set Diff. Pressure' obtained from another micromanometer for each velocity step and push the button 'Save' to record the measurement result in the selected data logging file.

Automatic Velocity Control

The procedure is active only when the micromanometer is connected with tunnel (enabled). It allows performing the automatic control of the velocity set in the control 'PreSet Velocity'. The procedure is useful in the cases when it is necessary to maintain a strictly defined tunnel velocity for a long time. The fixing (adjustment) of the set value can take even up to a few minutes, particularly at a small control error being set. When 'Automatic Velocity Control' is selected from the menu 'Procedure' the shown below window appears in which it is possible for the user to assign the control error and turn on the procedure.



The control error determines the allowable maximum deviation of the velocity in the tunnel from the set velocity. The on-state of the procedure is signaled by the shining of the indicator in the main window of the program. The procedure is automatically shut down after switching on 'Automatic Calibration'.

Note

If the user faces any troubles or difficulties while using the TunCal Program they are encouraged to open the window 'About' from the menu item 'Help', then find contact with us and inform us about their problem. We will be pleased to help you in any case.