Precision pressure meter maPress II

Manual
9/ 2006
V 0.6

1. MAINTANANCE

1.1. Power sypply

The instrument uses 4 AA type batteries (1.5 V) or Ni/Cd / NiMH (1.2V) rechargeable batteries.

If the instrument is not in use for some time, then the battery will nevertheless be consumed since certain circuits are permanently in use. For this reason the state of charge of the batteries should be checked monthly at least.

1.2. Errors

The instrument has a self-check function. Should an error occur it will be shown on the screen *CONTROL LIST*.

2. OPERATION

2.1. Use of the keyboard

Description of the keys

- Left function key. Carries out the function shown on the display whilst the instrument is switched on.

- Right function key. Carries out the function shown on the display whilst the instrument is switched on.

- Centre function key. Carries out the function shown on the display when the instrument is switched on. Switches the instrument on.

- Starts a printout.

- Switches the instrument off.

- On a results screen calls the option *Chart*, in text mode shifts the cursor to the left.

- On a results screen calls the option *Menu*, in text mode shifts the cursor to the right.

- Moves the cursor upwards in a menu. In text mode increases the value. On a results screen chooses the next screen.

- Moves the cursor downwards in a menu. In text mode decreases the value. On a results screen chooses the next screen.

Entering numbers

Numbers are entered as follows:

and   - move the cursor backwards or forwards to the digit to be changed.

and   - increases/decreases the value of the marked digit.

2.2. Basic operation

Getting started

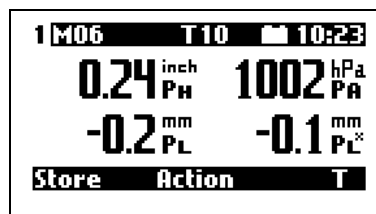Connect the temperature, pressure or the humidity probe to the device.

Zero calibration

The instrument performs a zero calibration of the pressure sensor immediately after being switched on. The calibration process is essential for the accuracy of the pressure measurement.

```
            ▀▄              12:03:55
        Initial calibration
                110
           Please wait...
```
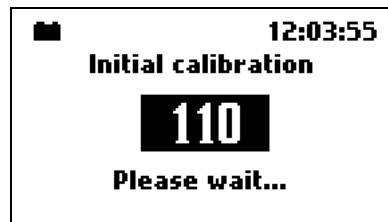
It is important not to change the position of the instrument during the pressure measurement, especially when high resolution is used. Changes of position will lead to a drift of the zero point.

Results screens

The function keys *Data* or *Esc* will automatically call up the results screen from any point. Below is an example of a results screen.

```
  1 M06       T10    □ 10:23
      0.24 inch    1002 hPa
           PH           PA
      -0.2 mm    -0.1 mm
           PL           PL×
  Store    Action          T
```

The Info bar

The Info bar is at the top of the screen. The signs have the following meanings:

- The number **1** stands for the first results screen. Four results screens can be defined. These can be called up using the up and down keys.
- **M06** shows how many memory spaces are still available. In this case, 2 of the 16 reports are still empty.
- **T10** shows the set averaging time. This can be programmed in fixed steps between 2 and 180 seconds.
- **Battery:** this shows the state of charge of the battery.

- **10:23** shows the current time as set in the analyser.

The menu bar

The menu bar at the base of the display shows the use of the function keys. The possibilities are explained under "MENU".

Results

All the results of measurements and calculations are shown as averaged values. Averaging time is chosen by the user under *Parameter* from 2 – 10 – 20 – 30 – 60 – 120 – 180 seconds, for example, the choice of 60 seconds means that the average of the last 60 seconds is shown on the display.

The user can define the content of the individual results screens. The necessary software, "PCGA12plus", is to be found on the utility disk. There are also a few examples of the possibilities there (ResScreens_1.bin ...ResScreens_4.bin).

Here is a list of all measured or calculated variables that can be shown on the results screens:

- temperature T_1 – measured by the resistance sensor in the 20 - 100°C range with the 0,1°C resolution

- temperature T_2 – measured by the termocouple In the 20 - 1000°C range with the 0,1°C resolution

- atmospheric pressure P_{abs} In the 70 - 1200hPa range

- differential pressure P_{lo} in the -15 - +15hPa range with the resolution of 0,1Pa

- differentia pressure P_{hi} in the -500 - +500hPa range with the resolution of 0,1hPa

- flow velocity measured with use of the Pitot tube connected to the P_{lo} inlets with the maximum level of 70m/s and the resolution of 0,1m/s

- humidity rH in the 5 - 95% range with use of the digital probe

- bartery voltage

3. MENU

From the results screens the following options can be activated with the keyboard:

- *Store* – the left function key.
- *Action* – the centre function key.
- *T* (Averaging time) – the right function key.
- *Chart* – the arrow left key.
- *Menu* – the arrow right key.
- *Print* – the printer key.
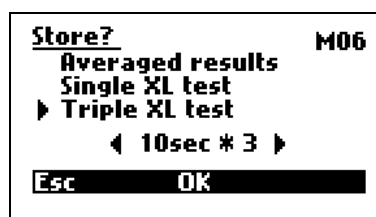- *Switch off* – Pressing the round, red key will switch the instrument off completely.

3.1. Storing results

The option *Store* can be reached from any results screen by pressing the left function key. The results on the screen are stored in a buffer and remain there until stored permanently.

The results are stored in the form of reports. This is a collection of all the results.

If the report should also include the chimney draught, or the soot content then this measurement must be carried out before storing the results.

Opening the option calls up the following screen:

```
Store?                M06
  Averaged results
  Single XL test
▶ Triple XL test

     ◀ 10sec * 3 ▶
Esc          OK
```

Results can be stored in three different ways:

Averaged results

The averaged results will be stored. The averaging times that can be set on the T (Averaging time) screen chosen from 2, 6, 10, 20, 30, 60, 120 and 180 seconds.

Single XL test

The averaged results will be stored. The term XL (extra long) is used for the formation of especially long averages. XL test time can be set via **T** screen or on current screen by the use of the keys: ◁ and ▷ .

Available times: 10sec, 20sec, 30sec, 1min, 2min, 5min, 10min, 15min, 20min, 30min.

Triple XL test

This will automatically store three consecutive single XL Tests.

During storage of XL test, battery charge icon is replaced with the number of current test (X1, X2, X3) and the clock counts down the time, till the end of test. During the XL test the analyser beeps every two seconds.

In the top-right corner the number of available reports is shown.

If the memory of analyser is full, and no more reports can be stored the following screen is shown when the storage is attempted.

```
Report building
!
      No free reports!
 Overwrite oldest one?
Esc        Yes
```
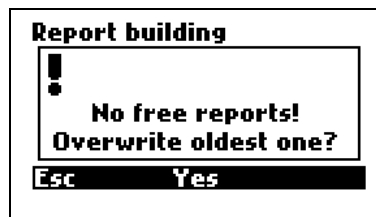
ESC

The storing of results will be stopped and the instrument returns automatically to the results screen.

YES

The oldest report(s) will be deleted and the new one(s) stored instead.

If the results are to be stored, then the instrument will request a customer number (identification number of the report). This number will appear on the report.

```
Report building
 Enter customer number
       0666
        ▲
Esc        OK        C
```

When the number has been entered and confirmed with **OK**, the following screen will appear momentarily.

```
  ┌─────────────────────────┐
  │  ╻                       │
  │  ┃                       │
  │       Report saved...    │
  │           #00063         │
  └─────────────────────────┘
```

This completes the storing of the results and the instrument will return automatically to the results screen.
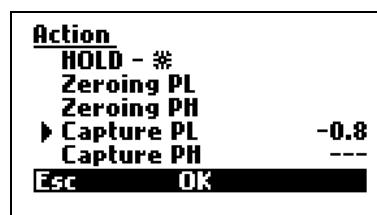
There is a possibility of stopping and shortening the XL test.

If the function key ◣ is pressed during the single XL test or during the X1 test (the first test of tripple XL test) then the measurement is stopped and result is not stored. If the function key ◣ is pressed during the X2 or X3 test, the measurement is disrupted but it's result will be stored.

During the XL test, its result can be viewed. Pressing the ▯ key during displaying the results screen, for a few seconds, the XL test results' will be shown (avareged for the period of time since the beginning of the test).

3.2. Action

Pressing the centre function key ▯ on the results screen will open **Action** screen.

```
  ┌─────────────────────────┐
  │ Action                   │
  │    HOLD - ✳              │
  │    Zeroing PL            │
  │    Zeroing PH            │
  │  ▶ Capture PL       -0.8 │
  │    Capture PH        --- │
  │ ▐Esc      OK▌            │
  └─────────────────────────┘
```

HOLD - ▯

The present measurement values are frozen and the screen will spring automatically to the frozen values. Pressing the centre function key again will end the freezing of the values. Hold mode is signalised by flashing ▯ sign over the central function key.

Zeroing PL/ Zeroing PH

Zeroes the pressure value

Capture PL/Capture PH

The moment the user enters the *Action* menu the device stores the values last seen on the results screen. The values can be saved with use of the *Capture* option. It will be then displayed in the *Action* menu and can be used when storing the measurement results or printing the report. In both cases the stored information will be lost. If the user decides to capture the new value the previous one will also be lost.

3.3. Chart

The instrument can display the measurement results for the last 190 seconds. The most recent value is on the right-hand side of the chart. The ◁ and ▷ keys are used to scroll the marker enabling one to read the exact value at each point of the chart.
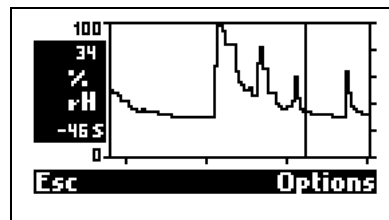
the values on the left have the following meanings:

- Maximum value of the Y axis (here 100).
- Current value or, when the marker is activated, the marker value (here 34).
- The unit (here %). This appears automatically with the variable.
- The variable (here rH). The arrow up/down keys can be used to scroll through the variables.
- Marker time (here –46s). This means the marker stands on the value that was recorded 46 seconds earlier.
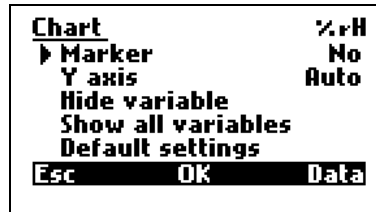- Minimum value of the Y axis (here 0)

The menu bar:

ESC

Leaves the *Chart* and returns to the results screen.

Option

This opens the window for the *Chart settings*. The following screen appears:

```
Chart              %rH
▶ Marker            No
  Y axis            Auto
  Hide variable
  Show all variables
  Default settings
 Esc       OK      Data
```

The changes to the following settings can be made when the cursor points at the particular parameter with use of the *OK* key.

Marker

Switches the marker on or off.

Y Axis

The scale system for the Y-axis can be set. These are the options:

- *Auto* (automatic scale) – the instrument chooses according to the measured values.
- *Manual* – can be set by the user with the PCGA12plus.exe programme.
- *Full* – done according to the measurement range of the variable

Hide variable

After confirmation with *OK* the variable will no longer be shown on the chart. Can be re-activated using Show all variables or with the PCGA12plus.exe programme.

Show all variables

After confirmation with *OK* the instrument will show all measured and calculated variables on the chart.

Default settings

After confirmation with *OK* the instrument will show some important measured and calculated results: O2, CO, ETA, Lambda, Tgas.
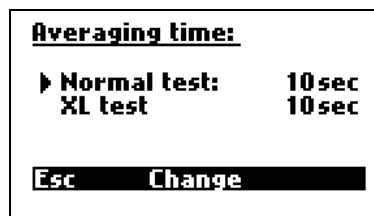
The instrument will inform the user that the changes has been made by displaying the following note:

```
 ┌─────────────────────────┐
 │ •                       │
 │ i                       │
 │           Done!         │
 │                         │
 │                         │
 └─────────────────────────┘
```

3.4. Averaging time

The Averaging time screen can be accessed from any of the results screens with use of the *T* key.

The following menu appears:

```
┌─────────────────────────┐
│ Averaging time:         │
│                         │
│ ▶ Normal test:    10 sec │
│   XL test         10 sec │
│                         │
│ Esc      Change         │
└─────────────────────────┘
```

Normal test

With the help of the arrow keys ◁ and ▷ the user is able to decrease/increase the averaging time value in the 2 - 180s range.

XL test

Using the *Change* key or ◁ and ▷ key allows the user to set the XL test time. The following values are available:

10sec - 20sec - 30sec - 1min - 2min - 5min - 10min - 15min - 20min - 30min

3.5. Menu

From the results screen the *Menu* option is available after the use of the ▷ key.

```
┌─────────────────────────┐
│ Menu             11:43  │
│ ▶ Settings              │
│   Reports               │
│   Clock                 │
│   Service               │
│                         │
│ Esc      OK      Data   │
└─────────────────────────┘
```

3.5.1. Settings

```
Settings
  Unit PH              cmH2O
  Unit PL              mmH2O
  Resolution PL           Hi
  Temp. unit              °F
  Resolution T            Hi
 Esc       Change      Data
```

The **Settings** menu can be used for changing the following parameters:

Unit PH/ Unit PL

There are five pressure units available: hPa, Pa, mmH_2O, inH_2O and cmH_2O.
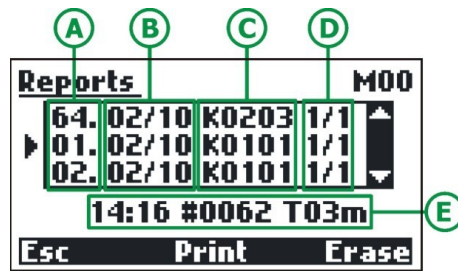
Resolution PL/Resolution T

There are two options to choose from. If the option Hi is chosen the measurement results will be displayed with the resolution of 0,1Pa; Lo – refers to the 1Pa resolution.

Temp. unit

Two temperature units are available: °F i °C.

3.5.2. Reports

This option is used to administrate the stored reports.

The fields have the following meanings:

A. The report number (1..64).

B. The creation date of the report. Displayed in the format defined in the menu Clock.

C. The customer's number.

D. These numbers inform the user of whether the report is a single one; or the first/second or the third of the three reports of a triple XL test – 1/3, 2/3, 3/3

E. In this field the additional information on the marked report will be displayed. This includes the exact creation time of the report – 14:16, the serial number of the report registered by the analyser #0062 and the averaging time – in this case three minutes.

In the right-hand upper corner the information on how many memory spaces are still available is displayed.

The user can preview the report contents by pressing the arrow right key when the cursor points on the chosen report. Each of the report contains of two screens which can be evoked by pressing the right function key. The bar on the top of the screen informs the user whether the chosen report is a single one (1/1) or the first, the second or the third one of the triple XL test (1/3; 2/3; 3/3). In the left column the measurement results of the chosen test appear. The middle column contains the information on the averaged results of the triple XL test. (If the report concerns the single measurement the two columns will not differ). Pressing the centre function key (1-2-3) enables the user to switch between the three reports of the triple XL test. The right function key ↑↓ displays the other screen with the contents of the chosen report.

```
 1  2/3    Triple          2  2/3    Triple
      -0.0      -0.0 mmPL      108.2    108.2 °FT1
       0.1       0.1 mmPž      ---      ---   °FT2
       0.1       0.1 cmPH      108.2    108.2 °CTi
       0.0       0.0 m/sž      991      991   hPaPa
 Esc      1-2-3     ↑↓     Esc      1-2-3     ↑↓
```

Pressing the *Esc* key while in the *Reports* menu returns to the *Menu*. To erase the report use the *Erase* button; the confirmation screen will be displayed.

```
 Reports erasing
 ▌
 ▪           #01

    Erase this report?
 Esc       All       Yes
```

Pressing *Esc* returns to previous menu. Pressing *Yes* will erase the chosen report, pressing *All* will delete all stored reports.

After pressing the *Print* key the following screen will appear:

```
 Report printout
 ?
 ▪           #01

    Start printing?
 Esc       No        Yes
```
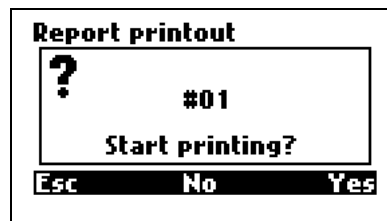
Using *Esc* or *No* returns to the previous screen, choosing *Yes* starts painting. If the chosen report is a one from the triple XL test report, the following screen is displayed:

```
 Report printout
 ?
 ▪           #06

    Start printing?
 Esc       Triple    Yes
```

Choosing *Triple* causes averaging and printing all three parts of triple report as a whole.

Check if the printer is on and it's receiver is near the upper edge of the analyser.
It is also possible to define printing format. This can be done only in the window *Print.*

3.5.3. Clock

In the *Clock* menu options the following settings (as shown in the picture) can be changed:

```
Clock
▶ Time          12:40:13
  Date          02/15/06
  Date format      m/d/y


Esc    Change      Data
```
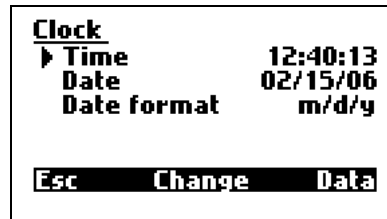
Time

The time displayed by the inner clock can be set.

Date

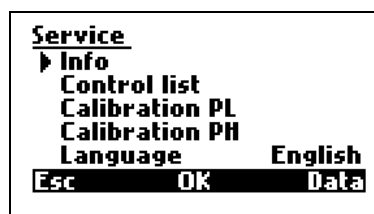The date indicated by the inner calendar can be set.

Date format

Two date representation formats are available. The user can choose between:

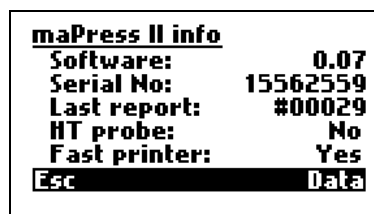**Day – Month – Year** and **Month – Day – Year date** format

3.5.4. Service

The following screen appears when the option is opened:

```
Service
▶ Info
  Control list
  Calibration PL
  Calibration PH
  Language      English
Esc       OK       Data
```

3.5.4.1. Info

On the *Info* screen the information concerning the configuration of the instrument are displayed.

```
maPress II info
  Software:         0.07
  Serial No:    15562559
  Last report:    #00029
  HT probe:           No
  Fast printer:      Yes
Esc                 Data
```

3.5.4.2. Control list

The option **Control list** shows all measured signals. This is of great use when searching for possible defects. The content of the **Control list** is displayed on the two screens numbered 1, 2.

```
1 Control list          2 Control list
T1  108.2      0.0 32767   PL'                1189
T2  ---          0 32767   PL    -0.9          -97
Tc  108.2 1314.0  4529   PH     1.1           11
Ti  108.2                Ub   6.304        11210
PA  1002            22356   RH    ---             0
Esc        ↑↓    Data   Esc        ↑↓    Data
```

The ↑↓ key is used to change between the consecutive screens of the **Control List**.

3.5.4.3. Calibration PL/Calibration PH

The pressure calibration is available only to the service staff. To carry out the calibration process it is necessary to have a precise pressure source.

Each incorrect change of the calibration value will cause an irreversible loss of the previous values thereby the instrument will become of no use for the further pressure measurement. The calibration should be therefore carried out only by the qualified staff of the service.

After choosing the pressure calibration option the following screen will appear:

```
CALIBRATION WARNING!
┌─────────────────────┐
│ ┇                   │
│        ARE YOU SURE?│
│                     │
└─────────────────────┘
Esc        Yes
```

After confirmation the following screen will be displayed (if the Calibration PL has been chosen; a similar screen appears for the Calibration PH).

```
Calibration PL
              Signal    Pa
Measured       -40    -3.8
Stored       15660  1500.0
▶ Pressure            1500
Esc    Change       OK
```

The fields on the screen have the following meaning:

Measured

The signal currently supplied by the pressure sensor and the pressure measured by the instrument.

Stored

The previously stored signal and calibration pressure.

Pressure

Calibration pressure in [Pa].

The calibration process

Apply the calibration pressure to the instrument. With the ***Change*** key fill in the value of the calibration pressure. Press ***OK*** to store the value of the calibration pressure.

3.5.4.4. Language

The instrument is pre-programmed with a number of languages. There is also a possibility of downloading an additional language through PCGA12plus.exe programme. In case of an accidental language change (when having problems with finding the proper setting in the analyser's menu) it is possible to restore the default language by keeping the key ◁ pressed when starting the analyser. The choice of the default language is made in PCGA12plus.exe programme.

3.6. Print

```
Print?
▶ Averaged results          4
  Stored report             3
  Last screen

Esc           OK         Data
```
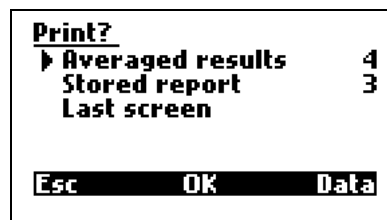
Using the arrow left/right keys for given line will cause the change of the printing format. There are four default, set at the factory formats, the other four can be defined by the user with the help of the PCGA12plus.exe program.

Averaged results

The last measured temporary values will be printed.

Stored report

Report printout. After choosing this command the window of administrating the reports will be displayed.

Last screen

The content of the last screen displayed will be printed.

4. FLOW VELOCITY MEASUREMENT

The GA12 analyser is able to measure the differential pressure of the flue gases and can be equipped with a Pitot tube with which the flow velocity measurement can be performed. This value is necessary when calculating the mass flow velocity and the mass of pollutants emitted by the source in a particular period of time. The system calculates the values using the formula:

$$v\left[\frac{m}{s}\right] = 1.291 * \sqrt{\frac{T_{gas}[K]}{289} * \frac{100000Pa}{100000Pa + P_{stat}[Pa]} * P_{dif}[Pa]}$$
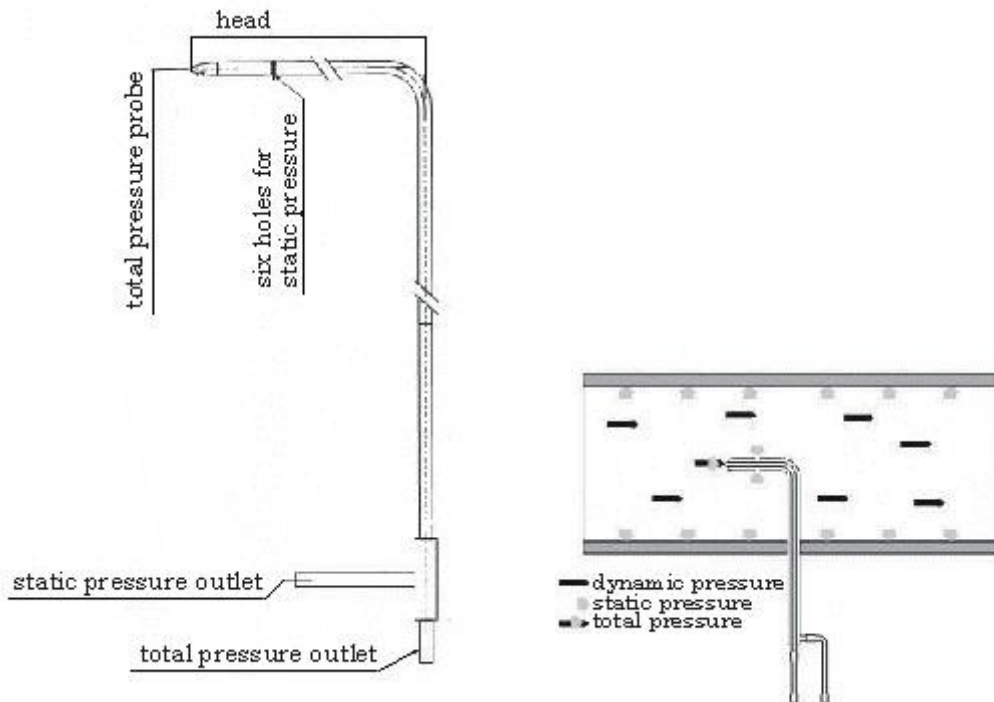
v – flue gas velocity [m/s]

1.291 – coefficient of the Pitot tube

T$_{gas}$ – flue gas temperature [K]

P$_{stat}$ – static pressure [Pa]

P$_{dif}$ – differential pressure [Pa]

The Pitot tube consists of two concentric tubes with one end bent at a right angle. The total pressure inlet is situated at the very end of the tube. The flue gases flow parallel to the bent end of the tube. The holes used for measuring the static pressure value are situated at the circumference of the transverse section of the bent end of the tube (see the picture above) which means they are perpendicular to the direction of the flue gas flow. The static pressure measurement can be performed as the flue gas flow causes a negative pressure to occur in the static pressure holes.

The tube must be connected to the analyser inlets (the total pressure outlet of the tube – to the analyser's differential pressure sensor inlet (+) and the static pressure outlet of the tube to the analyser's differential pressure sensor inlet (-)).

The GA12 analyser measures the difference between the values of the total and the static pressure (which means the differential pressure) and calculates the flue gas velocity on the basis of these measured values. The calculated value can be displayed on the results screen.

The results of the measurement performed with the use of a Pitot tube are correct provided that the analyser position is not changed after the beginning of the sensor zeroing process and both the device and the tube are held in the same (described above) position throughout the measurement process.

This measurement will only provide the flow velocity at a single point in the cross section of the flue gas channel, but at normal flue gas flow rates the velocity profile will be reasonably constant across the cross section. With use of the cross sectional area of the flue gas channel, the volume and hence mass flow rates can be calculated.