OPTION
Gas flow measurement

VARIO*luxx*
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MGA*prime*

USER MANUAL

MRU AIRfair since 1984
EMISSION MONITORING SYSTEMS

9452EN-OPT

Edition: 2018-08-14, V01

Content

1 Gas flow measurement

This option allows the user to determine the gas velocity at a single poin by means of a pitot tube (order separately). Based on the differential pressure between the ports of the pitot tube and the absolute pressure, the gas velocity is calculated. The gas density as measured by the instrument is taken into account.

Assuming the measured gas velocity is represenative for the gas flow in a duct, the flow rate is calculated as the product of the measured velocity and the duct's cross section area which can be inserted accordingly.

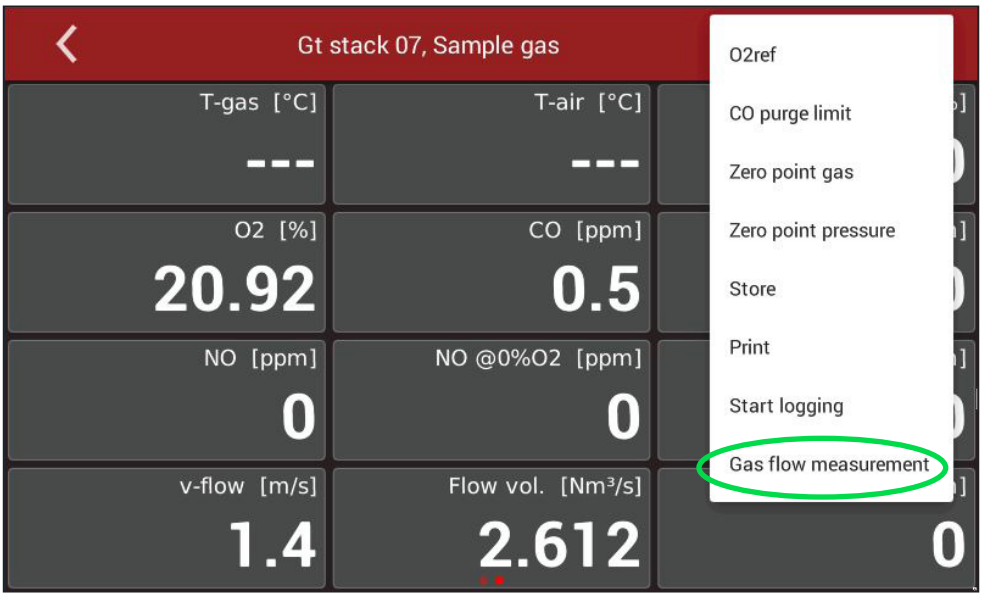
1.1 Setting the parameter

Before measuring you must enter all parameters for the gas flow measurement in the menu **Measure**.

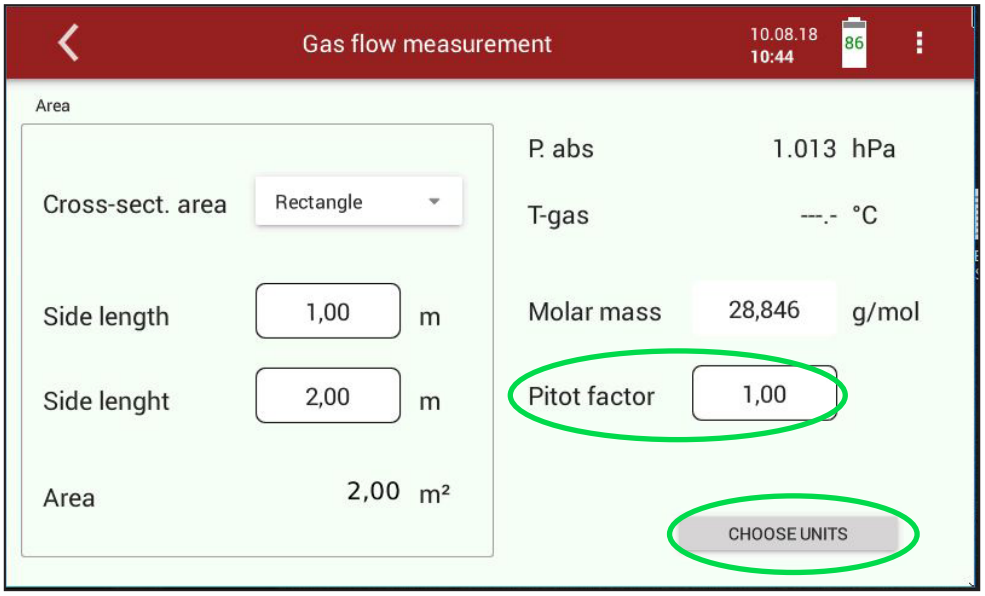
1.1.1 Assign a measured value

▶ Double touch the value field.
⇨ A list with of all available measured values is displayed.
▶ Choose the wanted value and “replace” or "insert".

1.1.2 Set parameters



▶ Select in the context menu **Gas flow measurement.**

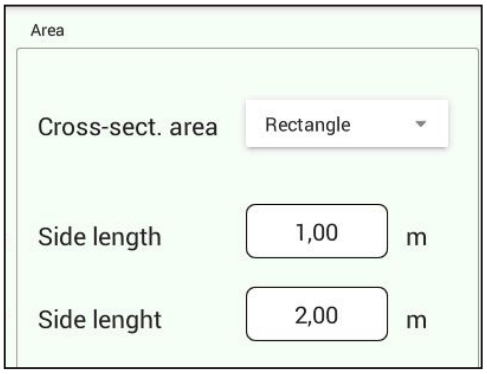


▶ Enter the value „Pitot factor". Please take the value from the documentation of the used pitot tube.

▶ Select **CHOOSE UNTIS**

▶ Select the wanted units fpr the measurements

Cross-section area
For measuring the gas flow must be known the cross-section area.



- ▶ Select the geometry of the cross-section area, circle, square or rectangle.
- ▶ Enter the required value.

⇨ The cross-section area will be calculated.
After returning to the measuring menu, the measurement starts automatically.
If necessary, you can zeroing via the context menu.

1.1.3 Store the measurement results

The measured values can be stored in a site via the context menu / Store menu entry.
The measurement itself continues until switch off of the analyzer

1.1.4 Continuous data logging

A continuous measurement logging is possible via the context menu / "Start logging".

With "Start Logging", the currently measured values are stored in a site every 10 seconds.

End the data logging with "Stop logging".

1.1.5 Export der Messung auf SD-Karte

In the menu **Contacts** you can export the measurements by the exchange format CSV on a SD-card.

2 Appendix

2.1 Calculating the molar mass

The molar mass of a gas depends on the gas proportions. This will be calculated on the equation 1

Equation 1: molar mass

$$M = 0.00001 * (32*[O_2] + 44*[CO_2] + 18*[H_2O] + 16*[CH_4] + 28*[N_2])$$

$[O_2]$: oxygen in [%]
$[CO_2]$: carbon dioxide in [%]
$[CH_4]$: methane in [%]
$[H_2O]$: water in [%]
$[N_2]$: nitrogen in [%]

Unit of molar mass $M = [\frac{Kg}{mol}]$

2.2 Calculating the gas density

The gas density is calculated on the equation 2:

Equation 2: gas density

$$\rho = \frac{P_{abs} * M}{RT_{gaz}}$$

p: **gas density** ir $[\frac{Kg}{m^3}]$

$P_{abs:}$ indicated the absolute pressure in [Pa]

M: molar mass in $[\frac{Kg}{mol}]$

R: gas constant, amounts 8.134 $[\frac{J}{mol * K}]$

T_{gaz}: gas temperature in Kelvin

2.3 Calculating the current Flow velocity

The flow velocity by pitot tube will be determined by means of the measured pressure and density (see equation 3).

Equation 3: flow velocity

$$\tilde{v} = \sqrt{\frac{2 * \Delta P}{\rho}}$$

$\tilde{v}$: flow velocity in [m/s]

ΔP : pressure difference in [Pa]

$\overline{\Delta P} = \frac{\sum_{i}^{m} \Delta P}{m} \cdot \Delta P$: mean value of pressure difference in [Pa]

p: density of gas in $[\frac{Kg}{m^3}]$

The geometry of the used pitot tube will be considered by the pitot factor.

Equation 4: flow velocity with pitot factor

K_{pitot} : pitot factor

2.4 Calculating the current volume flow

The current volume flow is, the current Flow velocity multiplied by the cross-section area.

Equation 5: volume flow

$$q_{v,mom} = v_{mom} * A$$

$q_{v,mom}$: current volume flow in [m^3/s]

v_{mom}: current Flow velocity in [m/s]

A: cross-section area in [m^2]

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