

Manual for Swema 3000



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1. Overview



Display

Description of Function keys

Function keys

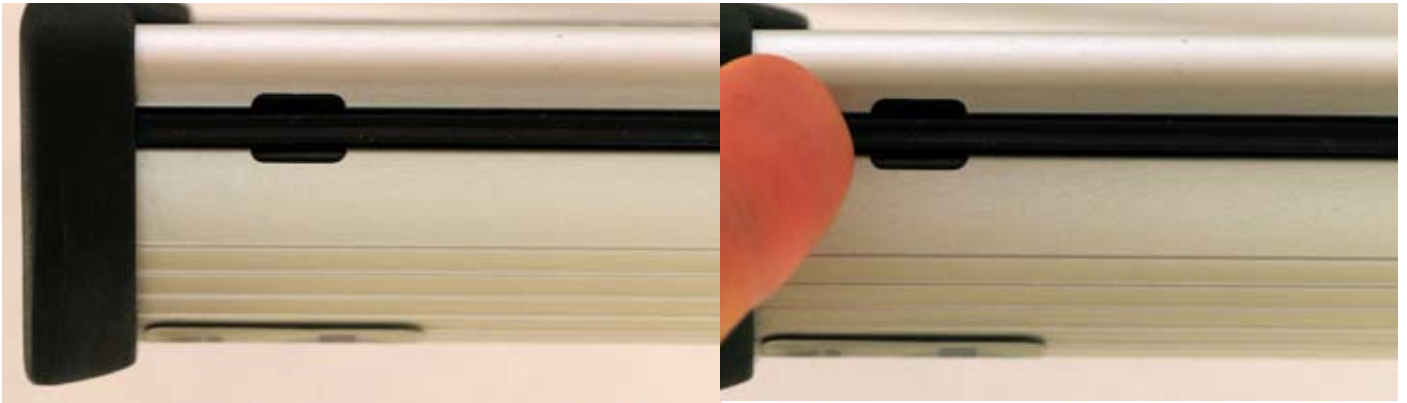
Arrow Key

Enter Key

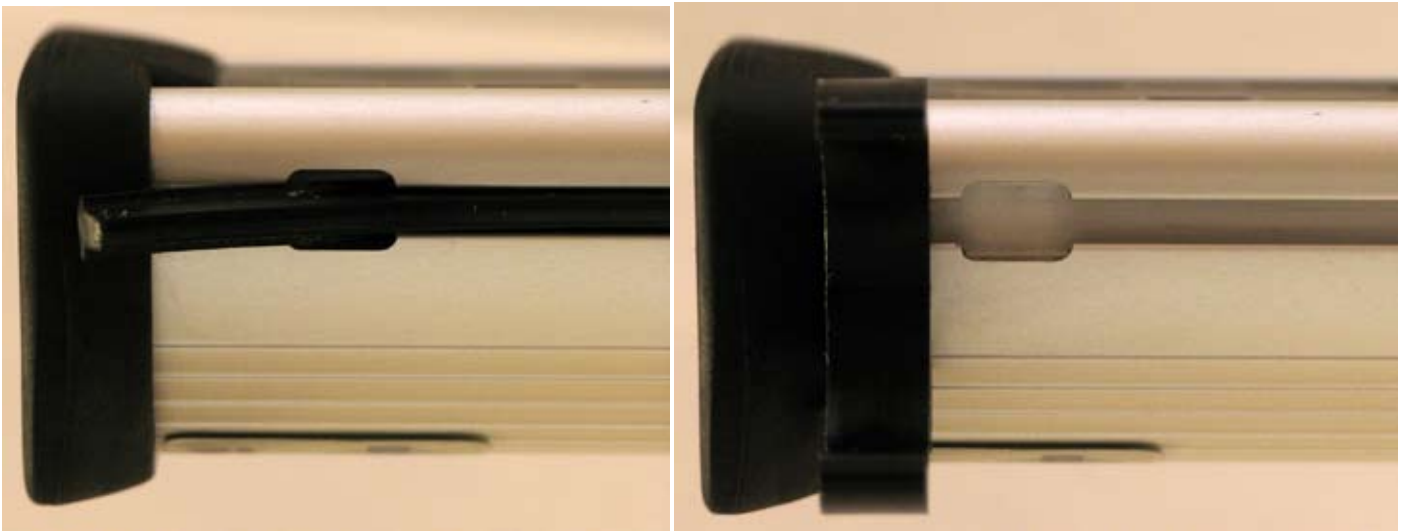
Display

On / Off

2. Mounting of holder



Start by remove the rubber list by grabbing it with the fingers. Push the list approximately 1 cm to the opening and pull out the list.



Remove the the list by pull it out. When the list has been removed you can place the holders by placing it in the opening and pull them to a suitable place.



Now, you can place the sensor. (The image shows a SWA 10 with a holder)

3. Read this before you start

Swema 3000 is an universal instrument for measurement of air speeds, air flows, drafts, air humidity, temperatures and differential pressure. Swema 3000 has a large computing capacity and you are able to store single or calculated measurement in the memory for print to PC.

Models:

Swema 3000: Basic model

Swema 3000md: Built-in differential pressure transmitter (-300... 1500 Pa) as well as Built-in barometer & thermo couple contact. Type-k for density compensating.

Swema 3000mdH+: As Swema 3000md but with a larger differential pressure area (± 10.000 Pa).

Start-up of Swema 3000:

At switch-on of the instrument, it shows an information box within some seconds. Where it shows which model of Swema 3000 it is, which software version (Firmware) the instrument has as well as the battery voltage (less than 2.0V the instrument will shut down itself). If you have a sensor connected, you will also see which type of sensor it is when the calibration comes out as well as the serie number on the probe (does not apply relative humidity/temp sensor). If you would like to see the information box, a longer time than the seconds shown, then hold the on/off key while switch-on, the window disappears when the key is released.

Sensor:

Swema 3000 has totally replacable sensors which is and separately is, individually calibrated.

When you switch on the instrument with a sensor connected, the Swema 3000 shows the measurements for the current sensor.

When you have or for the first time connected a sensor the instrument does always choose the default program to the current sensor. Furthermore, the Swema 3000 reads in the calibration and only does the program available which is current for this particular sensor. Swema 3000 has a memory for the two last probe types and the intern probe. It remembers which setting you lastly used when you were using the probe with, in other words mode, time constant and the number of decimals are the same as the last time you used the probe.

Switch between built-in and extern sensor:

With the Swema 3000md/mdH+ it is able to change between an extern built-in sensor and the built-in differential pressure sensor with the **EXT/INT-key** (Function-key to the far left, see image to the right).

When you are using the built-in differential pressure sensor is "EXT." going to be shown on the display, where it means that if you would like to measure with the extern connected sensor should the EXT-key be pressed. The key will now change name to "INT." (Intern), press it to measure with the built-in differential pressure sensor.

If an extern sensor is connected, the instrument will always go to its measuring position at start-up, if you would like to come to the built-in differential pressure sensor directly, the extern sensor has to be connected before the start of the instrument.

13:33:22	%RH	13:33:22	%RH
	30.0		30.0
	20.4 °C		20.4 °C
Dew Point	1.5 °C	Dew Point	1.5 °C
Mix Ratio	4.20 g/kg	Mix Ratio	4.20 g/kg
	%RH °C		%RH °C
Avg	28.7 20.2	Avg	28.7 20.2
Max	28.7 20.2	Max	28.7 20.2
Min	28.7 20.2	Min	28.7 20.2
1 pts		1 pts	
CLEAR	SAVE	CLEAR	SAVE

Modes:

Swema 3000 helps you to calculate and work in the correct way when you use the different modes. The different sensors that exist to Swema 3000 have sometimes their own modes, e.g. for the differential pressure sensor the measurement mode DPF (Differential Pressure air Flow). Swema 3000 knows which sensor is connected and suits the modes so it is suitable to that sensor type, e.g. DPF is not (Differential Pressure air Flow) available for a hot wire anemometer. There are different general modes that you can use in every single sensor: AP (not SWA 03), AS and LOG.

Function-buttons:

The lower part of the display is divided into 3 squares, and precisely under these squares do 3 function-buttons exist. The function of the buttons depends and this is described in the 3 squares above.

Change setting and movements in the Menu

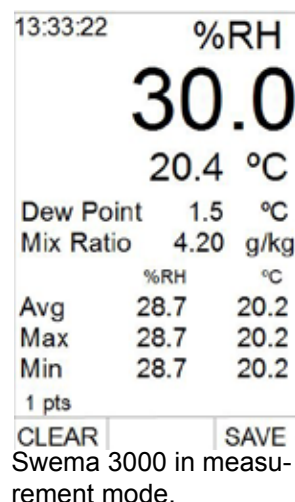
To change mode or setting press Menu1 (Function key to the right in mode). Swema 3000 has 3 different menus for different settings. Use UP/DOWN-arrows to move in the Menus and to switch between the alternatives you have if you would like to change something. If something should be changed press ENTER, right ARROW or SELECT (right Function-button). Use UP/DOWN arrows to change/set alternative. If you would like to reset main settings, press MAIN (middle Function-button). When your setting is complete press ENTER, left ARROW or EXIT (left Function button). To come back to measure mode press EXIT.

Measure with Swema 3000:

If a sensor is connected to the Swema 3000, it will always be directed to mode after start-up of the instrument. In the mode (i.e. that you are not inside one of the menus to change setting) it is shown the actual mode from the sensor on the display.

By pressing the ENTER-key a measurement can start and depending on which installed mode, it will save the mode to a temporarily memory, a calculation is made or a start of a logging of measurement values.

At mode where measurement points are collected, the Swema 3000 shows mean-, max-, min-value and total measurement points collected. To take another measurement to e.g. see mean calculation press ENTER again.



The screenshot shows the Swema 3000 display in measurement mode. At the top left, the time is 13:33:22. The main display shows %RH (Relative Humidity) at 30.0 and 20.4 °C (Temperature). Below this, it shows Dew Point at 1.5 °C and Mix Ratio at 4.20 g/kg. A summary table shows Avg, Max, and Min values for %RH and °C, all at 28.7 and 20.2 respectively. At the bottom, it indicates 1 pts (point) and has CLEAR and SAVE buttons.

13:33:22	%RH
	30.0
	20.4 °C
Dew Point	1.5 °C
Mix Ratio	4.20 g/kg
	%RH °C
Avg	28.7 20.2
Max	28.7 20.2
Min	28.7 20.2
	1 pts
CLEAR	SAVE

Swema 3000 in measurement mode.

Save measurements:

When all the measurement values have been collected, you can choose to save them (press SAVE) or delete the measurement (press CLEAR).

If it saves the instrument's measurement will the measurement be stored in the first available memory place in "Note Book". Swema 3000 gives a short signal and shows which memory place the measurement was saved. (see **Note Book, Loggings and Files** for more information).

OBS! If Swema 3000d/md/mdH+, with built-in barometer and thermo couple will the values be in mean, max & min calculated from what the temperature and the barometer were at every single measurement point. If you later save the measurement values, only the mean will be saved from the temperature and the air pressure. The mean is used later to correct the values who is shown in the protocol.

4. MENU 1

Time constant, in other words the decrease or the inertia on the instrument (see **Time constant and Filter** for more information).

Atmospheric pressure is used when Swema 3000 does calculations for air velocity and air flow.

Swema 3000 is available in three different models, Swema 3000d with a built-in barometer, Swema 3000md with built-in barometer and differential pressure probe or Swema 3000 without barometer and differential pressure sensor.

In Swema 3000, the atmospheric pressure can be set manually by moving the marker to "Atmos.P" with the UP/DOWN-arrow key. Press ENTER or SET and set the atmospheric pressure with the UP/DOWN-arrow and with the LEFT/RIGHT-arrow key. Confirm your choice with ENTER or EXIT.

Swema 3000md / mdH+ automatically compensates for the air density. To turn of the automatically compensation for the barometric pressure and set it manually set "Atmos.P" to "M" (Manual) instead of "A" (Automatic).

Temperature is used when Swema 3000 does calculations for air velocity and air flow at calculation with a differential pressure sensor. Swema 3000d/md/mdH+ has the ability to connect an extra temperature sensor (termometer sensor type-K).

If a termometer sensor is connected does it reach the built-in differential pressure sensor in Swema 3000md/mdH+. It is used so it compensates Swema 3000 automatically for the temperature the termometer sensor measure.

OBS! The Termometer sensor must be connected at start-up of the instrument. If it is not connect at start-up, the instrument will not find the termometer sensor. If the termometer sensor is disconnected while the instrument is on, the temperature will show -270°C until the instrument is restarted and the risk of error compensation occurs.

If no termometer sensor is connected or at calculating with Swema 3000 (has no termoelement connector) the temperature can be manually installed by moving the mark to "Temp." with the UP/DOWN-arrows. Press ENTER or SELECT and choose temperature with the arrows. Confirm your choice with ENTER or EXIT.

Note! When a sensor with an own temperature sensor is connected (hot wire anemometer, air flow, or relative humidity & temperature), Swema 3000 will always use that temperature to compensation. If a thermo couple is connected or the temperature is changed manually, that will not affect the measurement result.

Menu 1		
Mode		APF
Time Constant		2s
Ø		
H x W		400x600mm
Area		
Unit		m ³ /h
Atmos. P A		1008.4 hPa
Temp.		20.0 °C
Note Book		1
File		0/(0)
EXIT	MENU2	SET

Highlight the parameter you want to change and press Enter or SET.

Menu 1		
Mode		APF
Time Constant		2s
Ø		
H x W		400x600mm
Area		
Unit		m ³ /h
Atmos. P A		1008.4 hPa
Temp.		20.0 °C
Note Book		1
File		0/(0)
EXIT	MENU2	SET

Change the parameter with the arrow keys and press Enter or EXIT to confirm.

Menu 2

Swema Twin	ON or OFF Only when you use SwemaTwin, set ON at your master unit
Communication	USB or RS232 Communicate via USB (cable 764.430) or RS232 (cable 759.030) to your PC.
Baud Rate	2400, 4800, 9600, 19200 or 57600 Normally 4800 for SwemaTwin, 9600 for PC-transfer (RS232 cable).
Add Flow	ON or OFF If set to ON. Swema 3000 will add the flow from each measurement in one file and present a total flow.
Protocol	SHORT or LONG Here you specify if you want a long or short protocol (note) at PC-printout.
1 Unit Decimal	0, 1, 2, 3 or 4, Select number of decimals for the big digits. The number of decimal on the display will be according to what you choose here until a fifth digit is needed. The display can only show four big digits on the same row at the same time. Because of this one decimal will disappear. When saving a measured value the number of decimal will be the same as shown on the display.
2 Unit Decimal	0, 1 or 2, Select number of decimals for the small digits
Auto Zero	ON or OFF When you have a SWA 10 pressure probe connected or uses a Swema 3000md you can choose automatic zeroing when you collect values.
K2 Factor	ON or OFF Set ON if you want Swema 3000 to calculate with a k_2 -factor. See APF mode. ON: Flow = air velocity * k_2 * area OFF: Flow = air velocity * area
Exponent	Change exponent (ϵ) in the formula for K factor measurement. $q = k \cdot \Delta P^\epsilon$

Menu 2	
Swema Twin	Off
Communication	RS232
Baud Rate	9600
Add Flow	Off
Protocol	Short
1 Unit Decimals	1
2 Unite Decimals	1
Auto Zero	On
K2-factor	On
EXIT	MENU3
SET	

Move in the menu with the up/down arrow keys. Press Enter, Set or right arrow key to select.

Menu 3

Time/Date	Set clock/date
Adjust Clock	Set a value to compensate the clock error
Auto off	Set the automatic shut down time
Unit System	SI or US Set which units you want to use Metric (SI) or American (US).
Contrast	Set display constast
Print Out	Select if you want comma or point separation at PC-print out. Excel uses either comma or point.
Language	English, German, Swedish, Finnish, French, Danish, Norwegian, Dutch or Polish. Set the language you wuold like to use.

Menu 3		
Time	16:55:10	
Date	2008-02-29	
Adj-Clock	0.00 s/d	
Auto off	Off	
Unit System	SI	
Contrast	2	
Print Out	Point	
Language	English	
EXIT	MENU1	SET

Change with the up/down arrow keys.

The different probes for Swema 3000

Hot Wire Anemometers

SWA 31 or SWA 31E. Ø 8...10mm, 66 cm long,

SWA 31E extendable up to 116 cm.

0...10 m/s (option 10...30 m/s) and temperature -20...80°C.

Possible measuring modes: AP, APF, AS, ASF, LOG and LOGP.

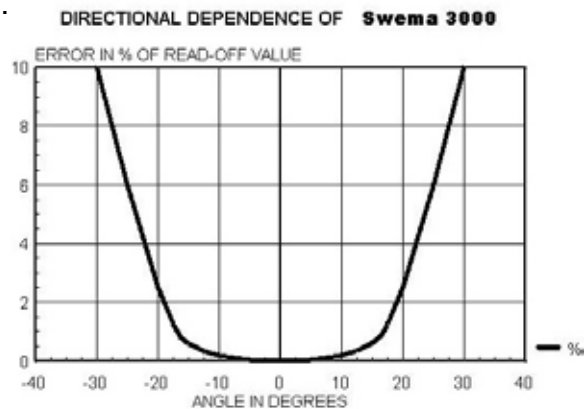
Extend the probe to the desired length.

Both holes must be clear for air to pass.

OBS! Do not pull the cable to close probe.

Orientation advice: Turn the arrow so that the mark on the bottom part of the telescope stem points in the same direction as the arrow.

The air velocity measurement can be influenced by how the holes are located in the flow. See graph.



Differential pressure

SWA 07: ± 7000 Pa,

SWA 10 and Swema 3000md: -100...1500Pa.

SWA 10 has a built in valve that automatically zero checks the pressure.

Possible measuring modes: APF (with pito static pipe), DPF (k-factor), AP, AS and LOG.

It is important to show zero pressure at the actual zero pressure.

Otherwise there will be an offset influencing all measurements.

The differential pressure probes SWA 07 and 10 and Swema 3000md can be zeroed to display zero when no pressure is connected. Press the ZERO button when no pressure is connected.

The probe is zeroed for this position. Do not change position when measuring.

Auto Zero ON with SWA 10 or Swema 3000md/mdH+

SWA 10 and Swema 3000md has an inbuilt zero valve. Auto Zero is set to ON by default.

By the built in valve the zero pressure point is automatically checked every time you take a measurement by pressing "ENTER". When working in this way you never need to calibrate zero manually. Warning: Zeroing may take long time: time constant + 3 sec. If a 4 second time constant is selected it will take 7 seconds to take a measurement.

Auto Zero OFF with SWA 10 or Swema 3000md

With Auto zero Off no zero check is done automatically. The measurement takes shorter time. Due to very stable zero point zero checking is sometimes not needed.

See Menu2 to select Auto Zero ON or OFF

SWA 10 has a small position dependence of $\pm 0,3$ Pa. When you use Auto Zero On and hold the SWA 10 in firm position during zero point checking this error disappears.

The SWA 07 is sensitive to tilting in the longitudinal direction, a 90° tilt producing a change of 4-5 Pa. It is recommended to use the SWA 07 with the magnet holder Art. No. 760.020. SWA 07 is sensitive for temperature shocks. Avoid holding your hand on the SWA 07. Temperature changes of this type will cause zero drift that may take 1-2 minutes to disappear. The temperature compensation works for slow changes. It is possible to log over several hours with minimal zero drift.

Flow captures

SwemaFlow 65: 2...65 l/s,

SwemaFlow 125: 2...125 l/s and

SwemaFlow 2000: 4...900 l/s.

Possible measuring modes: AF, BP (only with SWF 125), AS, LOG and AP.

Draught probe

SWA 03: 0,05...3,0 m/s (omni directional) and 10...34°C.

SWA 03 fulfils ISO 7726.

Possible measuring modes: CO, AS, LOG and LOGP.

Relative humidity and temperature

All probes 0....100%RH

Temperature: HygroClip2-S -40.....200°C depending on sensor

Possible measuring modes: AP, AS and LOG.

Temperature

Black globe, SWA 53, SWT 315, SWT 215 and with temperature handle SWA 25 also SWT 14, 18, 22, 28, 39, 50, 51 and 53.

-50°C to 280°C depending on probe.

Possible measuring modes: AP, AS and LOG.

CO₂

Connect the Airtest to save and log carbon dioxide values.

Possible measuring modes: AP, AS and LOG.

Radio/BlueTooth modem for balancing of ventilation

SwemaTwin transfers measured values on the reference valve from one Swema 3000 to another through radio/BlueTooth modem or 40 meter cable. The flow relation between them is displayed, which makes adjustment according to the proportional method an easy task for just one person.

The different modes used in Swema 3000

Choose mode by pressing the MENU1 and move the marker to "Mode" with the UP/DOWN arrow key. Press ENTER, SET or right ARROW and choose mode with the UP/DOWN arrows. Confirm your choice with ENTER, EXIT or LEFT. Set the parameter for the current modes in the same way. Press EXIT to start measuring.

APF (Average Point air Flow) Measured points are taken with ENTER. Average, max, min and measured points are showed on the display. The Swema 3000 calculates the air flow in l/s or m³/h. Enter the diameter, height x width or area direct. If you choose to indicate the height and width or diameter of the duct, the Swema 3000 calculates the effective area = the actual area times the duct factor k_2 in accordance with the recommended measurement methods. The duct factor can be turned off in MENU2. Use the APF mode for measuring the flow in ducts.

DPF (Differential Pressure air Flow). Available with a differential pressure probe SWA 10 or SWA 07 or with inbuilt manometer on Swema 3000md. The flow in the measurement of pressure drop across devices is directly obtained in l/s or m³/h.

Insert k- factor, and the Swema 3000 calculates the air flow according to the formula: $q = k \sqrt{\Delta P}$. The specific k-factor is supplied by the manufacturer of (exhaust and supply) ventilation valves.

AF (Average air Flow) Only available with SwemaFlow 2000, 125 and 65. Average Flow is calculated during selectable measuring time.

BP (Back pressure (air flow)) Only available with SwemaFlow 125. This mode is for measurement over supply and exhaust valves to compensate the possible drop in air flow created by the flow capture. BP mode calculates the real flow - the flow not influenced by the flow capture.

AP (Average Point). By using the ENTER button the average is formed from measurements with any probe (except SWA03). Average, max, min and number of measured points are shown.

AS (Auto Sampling). The Swema 3000 continuously collects measured values at the interval set by the Sampling Rate. Use AS mode for example if you want to measure average velocity, max, min, and standard deviation at a point.

ASF (Auto Sampling air Flow). Used with SWA 31 to measure in l/s or m³/h through valves. Sweep over openings in laminar flow hoods/cabinet and over rectangular exhaust and supply ventilation grilles. Select and enter the height x width or area direct into the Swema 3000. ASF does not calculate the area with a k_2 reduction - ASF is not intended for measuring in ducts. There we recommend to use APF instead.

CO (Comfort draught of air). Only available with the omni directional draught probe, SWA 03. CO mode measures average velocity, temperature and standard deviation over a selectable period of time. DR (Draught Rating) is presented in the automatic saved note. The DR indicates the percentage of people that would find the draught unpleasant. The DR is based on experiments conducted at the Technical University in Copenhagen, directed by Professor Fanger. DR is included as a measure of undesirable air movements in the ISO 7730 standard adopted for indoor climates. For a complete ISO7730 measurement use the SwemaMultipoint program.

LOG/LOGP Collects readings over a longer time period. Select interval and time constant for LOG. LOGP is especially developed to be used with SWA 03 draught probe to present the draught rate (ISO 7730) but can be used for other probes aswell. During a "Measure Time" the instrument continuously measures with the selected Time Constant. When the measure time has passed it stops and starts again with a new "Measure Time" at the chosen Protocol interval.

8.1. AP (Average Point)

Possible with all probes except SWA 03.

Measures the actual values of the connected probe. Calculates average and display Max and Min.

What different sensors measures in AP

Differential pressure sensor:

Speed (m/s) & Differential pressure (Pa). Speed measurement requires that a PST is connected.

Hot wire anemometer:

Speed (m/s) & Temperature (°C)

Air flow probe:

Air flow (l/s or m³/h) & Temperature (°C)

Temperature sensor:

Temperature (°C)

Humidity sensor:

Relative humidity (%RH) & Temperature (°C)

For relative humidity sensor dew point is also calculated (°C) and water content (g water / kg dry air) if measure value is taken (ENTER).

Carbondioxide sensor:

Carbondioxide level (CO₂)

Setting for measuring with AP

Time constant:

2s is recommended as standard. See **Time constant and Filter** for more information.

Atmos. P:

The atmospheric pressure affects the result for following sensors:

- Differential pressure sensor (speed calculations)
- Hot wire anemometer (speed)
- Air flow probe (air flow)

Temperature:

This temperature only affects the differential pressure sensor (the speed calculation). For other sensors where temperature is affecting the measurement results, is the sensor's own temperature sensor used.

Menu 1

Mode	AP
Time Constant	2s
Atmos. P A	1008.4 hPa
Temp.	20.0 °C
Note Book	1
File	0/(0)

EXIT	MENU2	SET
------	-------	-----

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm your choice with ENTER or EXIT. Set the parameters and press EXIT to start measuring.

13:33:22	%RH	
	30.0	
	20.4 °C	
Dew Point	1.5	°C
Mix Ratio	4.20	g/kg
	%RH	°C
Avg	28.7	20.2
Max	28.7	20.2
Min	28.7	20.2
1 pts		

CLEAR	SAVE
-------	------

When measuring, collect values with the enter button. When values are collected the display will show average-, maximum-, minimum-values and number of measurements.

Measuring with APF (Average Point air Flow)

Possible probes are: SWA 31, SWA 31E or SWA 07 or SWA 10 with pito static pipe or Swema 3000md.

Use the APF mode for measuring the flow in ducts.

Swema 3000 calculates the flow in l/s or m³/h by multiplying the air velocity with the duct area.

OBS! At delivery Swema 3000 is installed with K2-factors ON. The K2-factor reduces the channel area at measurement in channels with APF.

Calculation of Flow: Air flow = air velocity x k₂ x area. According to EN 16211 the flow is reduced by a k₂-factor.

Set the k₂-factor to On in Menu2 in Swema 3000 for an automatic compensation. Set it OFF for not using the k₂-factor compensation. Compensation is needed for presenting the flow correctly, due to friction probe blocking effect in duct. The k₂-factor value is shown in protocol. Press ENTER to make a measurement. select MENU 1. Select Note Book to view measured data together with k₂-factor .

For air velocity measurements connect a Pito static pipe with differential pressure connections. Connect the middle Pito static pipe to the plus on the meter and the side connection to the minus. Swema 3000 calculates the air velocity with the formula:

$$\text{Velocity} = \sqrt{2 \Delta P / \rho}$$

ΔP = dynamic pressure = total pressure - static pressure (Pa)

ρ = density of air = 1,293 x (B x 273)/(1013 x (273 + t)) (kg/m³)

B = barometric pressure (calculated standard value 1013hPa)

t = Air temperature °C (calculated standard value 20°C)

Setting for measuring with APF:

Time Constant:

2s recommended as standard. See **Time constant and Filter** for more information.

Diameter (Ø):

Set the diameter of the duct you want to measure. Move the marker to "Ø" with the up/down arrow key. Press ENTER or SET and choose the diameter. Choose among standard diameters with the up / down arrow key. To set the diameter to your choice press EDIT and change with the arrow keys. Press EXIT or ENTER to confirm.

Height x Width (H x W):

Set the height and width of the duct you want to measure.

Move the marker to "H x W" with the up/down arrow key. Press ENTER or SET and choose height with the arrow keys. Press ENTER or OK and set the width with the arrow keys.

Press ENTER or EXIT to confirm.

Menu 1		
Mode	APF	
Time Constant	2s	
Ø		
H x W	400x600mm	
Area		
Unit	m ³ /h	
Atmos. P A	1008.4 hPa	
Temp.	20.0 °C	
Note Book	1	
File	0/(0)	
EXIT	MENU2	SET

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm with EXIT or ENTER. Set the parameters and press EXIT to start measuring.

10:31:47	l/s	
	1	
	21.2 °C	
	l/s	°C
Avg	67	19.6
Max	87	19.7
Min	43	19.5
3 pts	Ø	315mm
CLEAR		SAVE

When measuring, collect values with the ENTER button. When values are collected the display will show average-, maximum-, minimum-values and number of measurements.

Area:

To measure in a channel with free installed area move the marker to Area and press ENTER. Desirable area can now be installed with the unit m². OBS! At measurement with free installed area no K2 reduction occurs.

Unit:

Select which unit you would like to use Choose between l/s or m³/h.

Atmosphere: The atmospheric pressure affects the measurement result.

Temperature: This temperature affects the measurement result at measurement with a differential pressure sensor and a PST. At measurement with a hot wire anemometer the temperature is used as it has been calculated from the sensor instead.

Measuring

When all parameters are installed, press EXIT to come back to mode. Swema 3000 shows chosen Ø, HxW or Area on the bottom of the display.

At calculation with pressure sensor (PST) pressure and flow are shown.

At measurement with a hot wire anemometer, measured temperature and flow are shown.

Collect measurement values with the ENTER-button. When measurement values are collected Swema 3000 shows mean-, max-, min-value and total measure points. When all measure points are collected you can choose if you would like to save or delete the measure.

17:03:33	l/s	
	0.00	
	23.6 °C	
	l/s	°C
Avg	4.52	23.6
Max	7.24	23.6
Min	3.02	23.6
4 pts	Ø 200mm	
CLEAR		SAVE

When all measure values are collected Swema 3000 shows mean-, max-, min-value och total measure points. Choose if you would like to save or delete the measure.

8.3. DPF (Differential Pressure air Flow) - Air Flow with K-factor

DPF is available with a differential pressure sensor.

DPF is used to measure flows over diffusers and orifice plates with the decompression method. Then the diffuser's K-factor is being used and you put it in the Swema 3000 to give a flow directly to the display. Swema 3000 calculates the flow according to the formula:

$$q = k \cdot \sqrt{\Delta P}$$

The K-factor has been gotten from the supplier of the diffuser. Choose always a K-factor which is used to calculate l/s, later you can choose to show m³/h instead. Here Swema 3000 calculates in m³/h itself.

OBS! If the K-factor for the diffuser is being used to calculate m³/h the K-factor has to be divided with 3.6 before it is inputed in the Swema 3000. If not, the flow value will show 3.6 times bigger.

Settings for measurement with DPF

Time Constant:

2s is recommended as standard. See **Time Constant and Filter** for more information.

K-factor:

Set the K-factor you would like the Swema 3000 should calculate with. Swema 3000 has a memory for 20 K-factors. Choose which memory place (1-20) by using the UP/DOWN arrows. Press SET to change the K-factor. Change with the arrows.

Unit:

Choose which unit you would like to use. Choose between l/s or m³/h.

Atmos. P: The atmospheric pressure affects the measure result.

Temperatur: This temperature affects the measure result.

Measuring

When all parameters are installed press EXIT to come to mode. Swema 3000 shows choosen K-factor, pressure and flow. In mode you can choose between 20 different K-factors that you have added in the memory with the help of the UP/DOWN arrows.

To reset the pressure sensor manually press ZERO at mode.

For automatic reset see **Menu2**.

Collect measure values with ENTER. When these are collected, Swema 3000 will show mean-, max-, min-values and total measure points. When all measure values are collected, you can choose if you would like to save or delete the measure.

Menu 1	
Mode	DPF
Time Constant	2s
K-factor	3.40
Unit	m ³ /h
Atmos. P A	1009.9 hPA
Temp.	20.0 °C
Note Book	0
File	0/(0)

EXIT	DEF
------	-----

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm with EXIT or the ENTER. Set the parameters and press EXIT to start measuring.

12:27:03	m ³ /h	
	14.0	
	1.3 Pa	
	m ³ /h	Pa
Avg	42.6	19.7
Max	80.3	43.1
Min	0.0	0.5
3 pts	K=3.40	

CLEAR	ZERO	SAVE
-------	------	------

When measuring, collect values with the enter button. When values are collected the display will show average-, maximum-, minimum-values and number of measurements.



8.4. DPK (Differential Pressure K-faktor) - K-faktor with Air flow

DPK is available with a differential pressure sensor.

DPK is used to measure flows over diffusers and orifice plates with the decompression method. Then the diffusers K-factor is being used and you put it in the Swema 3000 to give a flow directly to the display. Swema 3000 calculates the flow according to the formula:

$$k = q / \sqrt{\Delta P}$$

OBS! The K-factor shown on the display at DPK measurement is always based on a result in l/s. If m³/h is installed as an unit will the k-factor be calculated on which installed flow equivalent in l/s.

Settings for measurement with DPK

Time Constant:

2s is recommended as standard. See **Time Constant and Filter** for more information.

Flow:

Set the flow you would like Swema 3000 should calculate a k-factor for. Swema 3000 has a memory for 20 flow values. Choose which memory place (1-20) you would like to choose by using the UP/DOWN arrows. Press EDIT to change the flows value. Change with the arrows.

Unit:

Choose which unit (l/s eller m³/h) as installed flow has. Even though the flow is written in as m³/h will the k-factor be calculated for the inscribed m³/h flow which is equivalent in l/s.

Atmos. P: The atmospheric pressure affects the measure result.

Temperature: This temperature affects the measure result.

Measuring

When all parameters are installed press EXIT to come to mode. Swema 3000 shows chosen K-factor, pressure and flow. In mode you can choose between 20 different K-factors that you have added in the memory with the help of the UP/DOWN arrows.

To reset the pressure sensor manually press ZERO at mode.

For automatic reset see **Menu2**.

Menu 1		
Mode		DPK
Time Constant		2s
Flow	3	35
Unit		l/s
Atmos. P A	1019.4	hPA
Temp.	20.0	°C
Note Book		2
File		2/(2)
EXIT	MENU2	SET

2:16:28		K
	13.31	
		1.3 Pa
		F=35
	ZERO	MENU1

8.5 AF (Average Flow) - Air flow with probe

AF is available with air flow probes.

If you use a SwemaFlow 125, we firstly recommend to measure with the mode BP (Back Pressure) to compensate for the pressure drop over the probe.

The mean flow is calculated under choosen time interval och is shown on the display in l/s or m³/h. (time interval = Delay + Measure Time).

Settings for measuring with AP

Start Delay:

Set the time of delay before measuring, 2 seconds are recommended to stabililitze the flow before measuring.

Sampling Time:

Set the time you would like to averaging.

Flow factor:

It is possible to multiply the flow with a flow factor. With flow factor = 1.00 will not the flow change. Warning: The Calibration is only valid at Flow Factor = 1.

Another flow factor is being used to compensate for e.g. leakage.

Unit:

Choose which unit you would like to use. Choose l/s or m³/h.

Atmos. P: The atmospheric pressure affects the measure result.

Temperature: This temperature does not affect the measure result due to the temperature is measured form the sensor instead.

Measuring

When all parameters are installed press EXIT to come to mode.

Collect measure values with ENTER or the button on SwemaFlow 125/2000. When the measure values are collected does Swema 3000 show mean-, max-, min-value and standard deviation. When all measure values are collected, you can choose if you would like to save or delete the measure.

To delete, press CLEAR. To save, press SAVE or hold the button on the SwemaFlow 125/2000.

Menu 1	
Mode	AF
Start Delay	2s
Sampling Time	5s
Unit	m ³ /h
Atmos. P A	1021.7 hPA
Temp.	20.0 °C
Note Book	1
File	0/(0)

EXIT

DEF

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm with EXIT or the ENTER.

Set the parameters and press EXIT to start measuring.

10:19:56	l/s	
	0.0	
	22.7 °C	
	l/s	°C
Avg	4.8	23.1
Max	7.7	23.1
Min	0.0	23.1
Sdev	2.8	0.0
CLEAR		SAVE

When measuring, Start the measuring with the enter button. Then you can choose if you want to clear or save your measurement.

8.6 BP (Back Pressure) - Air flow with compensated probe

BP is available with SwemaFlow 125 or 125D.

At some air flow measurements with probes (primarily with the low pressure drops) is it necessary to correct the measure values for the restrictor of the diffuser that the probe creates. SwemaFlow 125/D can do this correction for you. By measuring 2 times with and without throttle ring, Swema 3000 calculates the flow without restrictor i.e. the flow from the diffuser without probe. In the same way as in the mode AF, is the mode BP used averaging under a chosen time period.

Settings for measuring with BP

Start Delay:

Set the time of delay before measuring, 2 seconds are recommended to stabilize the flow before measuring.

Sampling Time: Set the time you would like to averaging.

Unit: Choose which unit you would like to use. Choose between l/s or m³/h.

Flow Factor:

It is possible to multiply the flow with a flow factor. With Flow Factor = 1.00 will not the flow change. Warning: The Calibration is only valid at Flow Factor = 1.

Another flow factor is being used to compensate for e.g. leakage.

Unit: Choose which unit you would like to use. Choose l/s or m³/h.

Atmos. P: The atmospheric pressure affects the measure result.

Temperature: This temperature does not affect the measure result due to the temperature is measured from the sensor instead.

Measuring

The display shows PO 1. Place the throttle ring on the measure unit and set the probe over the diffuser. Press ENTER to start averaging nr. 1.

When "Point 1" is measured a beep sounds and the display shows PO 2. In a minute you have to measure "Point 2" without the throttle ring, otherwise the instrument returns to "Point 1". Remove the throttle ring and place the probe over the diffuser again. Press ENTER to start averaging nr. 2.

It will be successful without the throttle ring and take the second measure with throttle ring.

The display shows the actual value "True" as well as measure 1 & 2.

If the measure value blinks it is to big difference between point 1 and 2 and the result is not trustworthy.

Menu 1	
Mode	BP
Start Delay	2s
Sampling Time	5s
Unit	m ³ /h
Atmos. P A	1021.5 hPA
Temp.	20.0 °C
Note Book	1
File	0/(0)
EXIT	DEF

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm with EXIT or the ENTER. Set the parameters and press Exit to start measuring.

10:40:28	l/s	10:42:20	l/s
2.2		2.4	
PO 1		PO 2	
PO 1	Start with ↵	PO 2	Start with ↵
	MENU1		CLEAR

The display will show PO 1. Start with the throttle ring on and press Enter to collect the first value, When ready with the first value the display will show PO 2. Remove the throttle ring and collect the second value by pressing Enter. The button on SwemaFlow 125 can also be used as a Enter-button. A long press will save a measurement.

After PO 2 is measured will Swema 3000 calculate the actual value. On the display it says True, Max and Min. Max without throttle ring and Min is with throttle ring and True is the actual value..

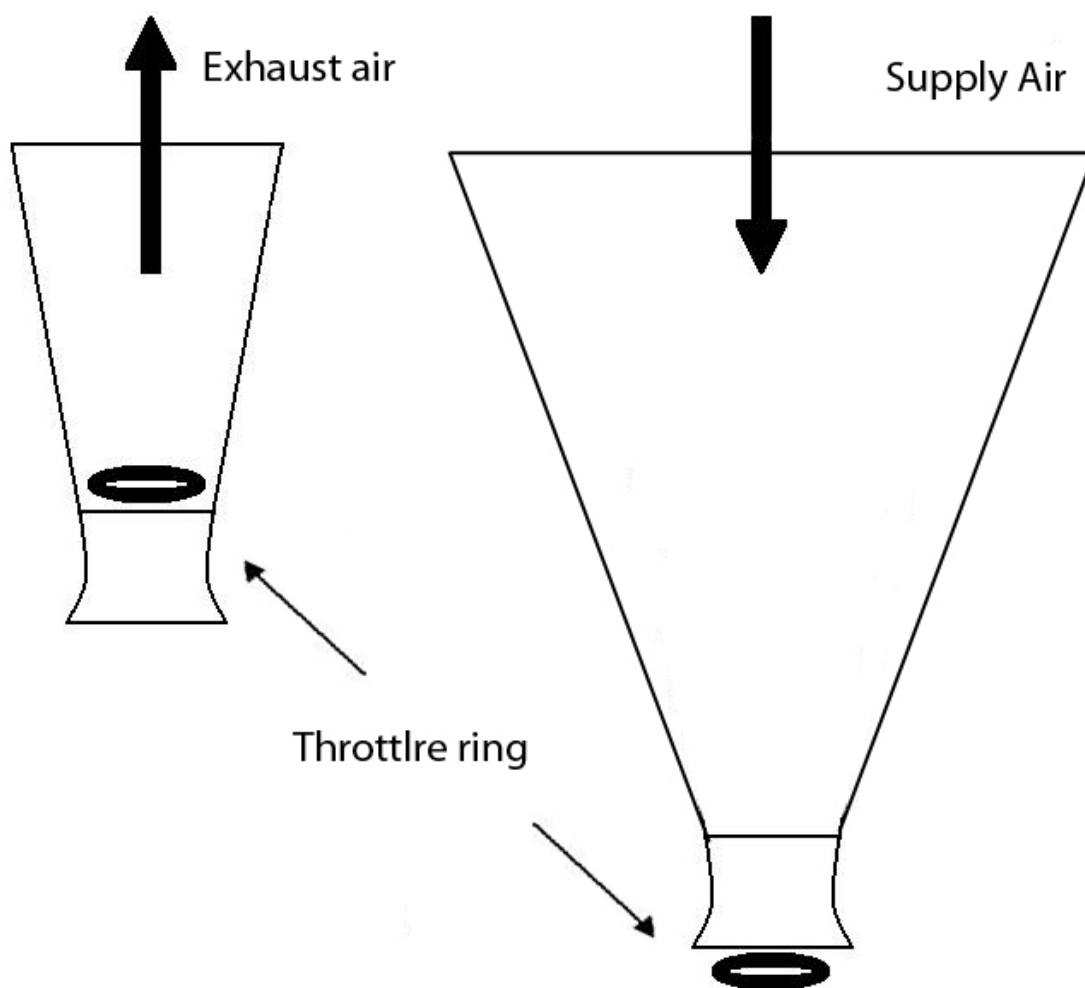
Choose if you would like to save your measurement. To delete, press CLEAR. To save, press SAVE or hold the button on the SwemaFlow 125 / 2000.

10:42:57		l/s	
		2.4	
		True	
Max	2.4		
Min	2.2		
CLEAR			SAVE

Placement of throttle ring

At measurement with a throttle ring should this always be placed after the measure wires with respect on the air flow, i.e. the air should firstly hit the wires, subsequently the throttle ring.

After PO 2 is measured the display will calculate the true value and show it on the display. The display will also show point 1 & 2. Max is without the ring and Min is with the ring. Then you can choose if you want to clear or save your measurement.



8.7 AS (Auto Sampling) - Sampling of measure values

AS is available to all sensors.

Swema 3000 automatically collect measure values. AS does not save all the values instead mean-, max- & min-value is being calculated. Use AS if you e.g. would like to measure mean-, max-, min- velocity and temperature and standard deviation in one point.

Settings for measuring with AS

Sampling Rate:

The time Swema 3000 uses to collect measure values, averaging and showing the value on the display. It is a floating mean which is used i.e. if you have e.g. have a measure frequency at 30s, Swema 3000 collects values 2 times/second within 30 seconds (60 measure values) and shows the mean of them on the display. After 30 seconds the eldest value is replaced by a new and a new mean is calculated and shown on the display etc. In AS, Swema 3000 always collects the measure values 2 times/second if a measure frequency is at 0.5 sec or higher choosen. At a lower measure frequency than 0.5 sec will Swema 3000 collect and update the display according to choosen measure frequency.

Atmos. P:

The atmospheric pressure affects the measure result for the following sensor:

- Differential pressure sensor (Velocity calculation)
- Hot wire anemometer (Velocity)
- Air flow probe (Air flow)
- Tensile sensor (Velocity)

Temperature:

This temperature only affects the differential pressure sensor (velocity calculation). For other sensors where temperature affects the measure result is the sensors own temperature sensor used.

Measuring

Start measurements with ENTER. A second counter for accounting how long time the measurements has been going on will be shown in the lower left corner on the display. Under the measurement are mean, max, min & standard deviation shown for the collected measure values. Stop the measurement with ENTER. When all the measurement values have been collected you can choose to save or delete the measurement.

10:42:57		l/s	
		2.4	
		True	
Max	2.4		
Min	2.2		

CLEAR **SAVE**
Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm your choice with ENTER or EXIT. Set the parameters and press Exit to start measuring.

Bat		m/s	
		1.1	
		-0.7 Pa	
	l/s	°C	
Avg	2.8	15.5	
Max	14.4	124.7	
Min	0.0	- 0.8	
Sdev	4.3	30.5	
146 sec			
CLEAR		SAVE	

Start and stop the sampling by pressing Enter. When the sampling are done you can choose if you want to clear or save your measurement.

8.8 ASF (Auto Sampling air Flow) - Sampling with air flow calculation

ASF is available with hot wire anemometers.

Like AS, but Swema 3000 calculates the flow in l/s or m³/h. Enter the area as height x width or as area directly. In mode ASF does Swema 3000 calculate the area without channel reduction (K2-reduction) because it is not made for channel measurement. Use ASF e.g. over a intake grille or the opening to a fume.

Settings for measuring with ASF

Sampling Rate: Same as AS (see **AS** for more information).

H x W: Set the height and width on the channel you would like to measure.

Area: Set the area directly.

Unit: Choose which unit you would like to use. Choose between l/s or m³/h.

Atmos. P: The atmospheric pressure affects the measure result.

Temperature: This temperature does not affect the measure result where the temperature is measured from the sensor instead.

Measuring

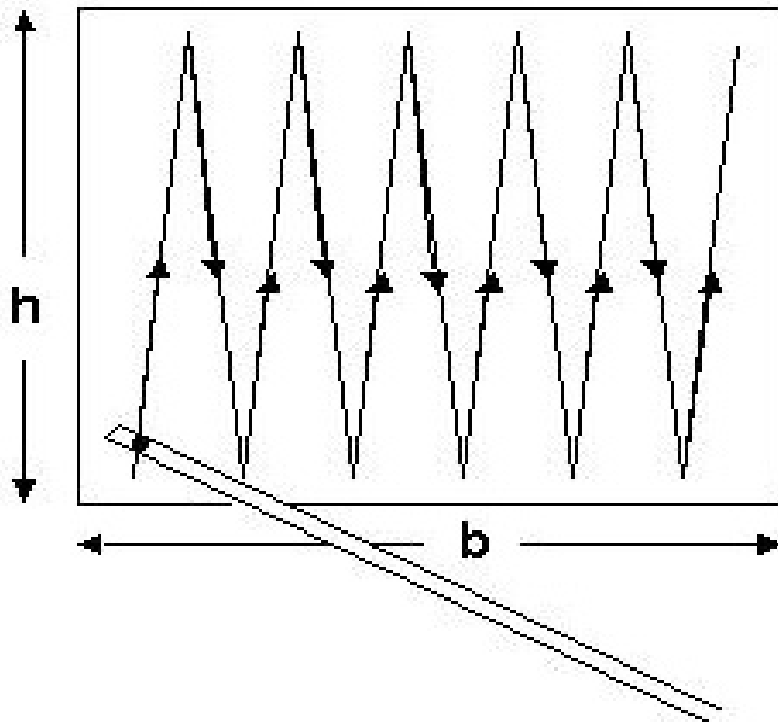
Start measurements with ENTER. A second counter for accounting how long time the measurements has been going on will be shown in the lower left corner on the display. Under the measurement are mean, max and min shown for the collected measure values. Stop the measurement with ENTER. When all the measurement values are collected, you are able to save or delete the measurement .

Menu 1	
Mode	ASF
Sampling Rate	0.1s
H x W	400x 600mm
Area	
Unit	m ³ /h
Atmos. P A	1021.1 hPA
Temp.	20.0 °C
Note Book	1
File	0/(0)
EXIT	DEF

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm your choice with ENTER or EXIT. Set the parameters and press Exit to start measuring.

15:15:11		l/s
		4
		20.7 °C
	l/s	°C
Avg	4	20.7
Max	12	20.8
Min	1	20.7
62 sec Area 1140 cm ²		
CLEAR		SAVE

Start and stop the auto sampling flow by pressing Enter.



By slowly sweeping (traversing) the sensor above the surface. e.g. an intake grille or the opening to a fume, you measure the total flow. Repeat the measurement until you get the same measure values so that you learn the technique.

8.9 CO (Comfort) - Tensile index calculation

CO is only available with the sensor tensile sensor SWA 03.

The CO mode measures mean velocity, temperature and standard deviation over three minutes (chooseable time period). When the measurement is saved, or at print to PC, does Swema 3000 calculate DR (Tensile index). DR indicates how many percent which experiences a tensile. The tensile index is based on an experiment at the Technical University of Denmark in Copenhagen, under the lead of Professor Fanger. DR includes as dimensions on undesirable air movements in the standard ISO 7730 for interior climate.

Settings for measuring with CO

Display Time:

The display can be updated with the interval 0,5, 0,25, or 0,1 seconds.

Measure Time:

Here you set over how long time span you would like to averaging. The measure values always collects internally with a frequency of 0.1s. Of these measure values are mean, max, min, standard deviation and tensile index calculated from. According to ISO 7730 should 3min be used as measure time.

Atmos. P: The atmospheric pressure affects the measure value.

Temperature: This temperature does not affect the measure result where the temperature has been measured from the sensor instead.

Measuring

Start the measurement with ENTER. Swema 3000 measures under a chosen measure time and saves the measurement on the first available memory place in "Note Book". Swema 3000 gives also a short sound and shows the memory place on the display in some seconds. To see tensile index, press MENU1 and mark "Note Book" and press ENTER.

Menu 1	
Mode	CO
Display Time	0.5s
Measure Time	3m
Atmos. P A	1007.7 hPA
Temp.	20.0 °C
Note Book	0
File	0/(0)

EXIT | **MENU2** | **SET**
 Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the up/down arrow key. Confirm your choice with ENTER or EXIT. Set the parameters and press EXIT to start measuring.

15:30:01	m/s	File 1
0.019		Note 1 of (1)
18.5 °C		2008-02-29 15:30:11
		SWA03 S/N: 362369
		Mode CD, TC 0.5 s
		1008 hPa
		Average velocity 0.025 m/s
		Max 0.118 m/s
		Min 0.000 m/s
		Average temp. 18.5 °C
		Measuring Time 55 s
		Std. deviation 0.021 m/s
		Draught Rating 0.0 %
45 sec		
CLEAR	SAVE	EXIT PRINT ERASE

The measurement is automatically saved in the note book. To see the draft rate, press the MENU-key and move the marker to Note Book and press enter.

8.10 LOG - Logging of measure values

LOG is available with all sensors.

Collecting measure values according to chosen interval. Use LOG mode to measure under a longer time span (E.g. variations in air flow, temperature or pressure under 24 hours). Use mains adapter if you would like to log more than 12 hours a row.

Settings for measuring with LOG

Time Constant:

Set time constant i.e. the decrease or slowness on the instrument (see **Time Constant and Filter** for more information).

Interval:

Set how often Swema 3000 should save a new measure value. The measure mode who has been saved is the value that is going to be shown at the display at the middle point.

At LOG with SWA 10 or the built-in differential pressure sensor the pressure resets between the log points. Interval more is 10 sec & "Auto Reset" turned to ON requires for this. If faster interval than 10s is desired the "Auto Reset" has to be turned to Off, no reset of the pressure sensor will then be made during the logging.

Tips! If you are interested in seeing a mean for the interval instead of the instantaneous measure value which is shown on the display at the end of the interval (then a log point will be saved) then set the time constant to the same value as the interval.

E.g. "Time Constant" & "Interval" are set to 15s. A time constant at 15s means that the measure value on the display is a mean over the latest 15 seconds which when the loggings are saved gives you a mean during the whole interval.

Atmos. P: The atmospheric pressure affects the measure result at loggings with hot wire anemometers (velocity), air flow probes (air flow) and tensile sensors (velocity).

Temperature: This temperature does not affect the measure result. If the thermo couple is connected (only Swema 3000d/md/mdH+ has this ability) and you log differential pressure, the temperature measured with the thermo couple will also be logged.

Log Book

Start and stop the logging with ENTER. Swema 3000 logs under chosen time span and saves the logged measure values in a new file. When the logging is done press ENTER or SAVE, Swema 3000 gives you a short signal and shows during some second the file number on the display. To see the latest logged values go to "Log Book". To see other logging files could log file be chosen in "Files". If an interval is installed on 10 seconds or more, will the time be shown for the next logging on the display.

Menu 1	
Mode	LOG
Time Constant	0.5s
Interval	10m
Atmos. P A	1007.8 hPA
Temp.	20.0 °C
Log Book	0
File	0/(0)

EXIT

DEF

Choose mode by pressing the MENU1-KEY and move the marker to "Mode" with the up/down arrow key. Press ENTER or SET and choose mode with the Up/down arrow key. Confirm your choice with ENTER or EXIT. Set the parameters and press Exit to go to measuring position.

15:47:35	m/s
0.05	
20.9 °C	
LOG 1 New 15:56:16	
	SAVE

Start and stop the log with the ENTER-button.

8.11 LOGP - Logging of protocol

LOGP is available to differential pressure sensor, hot wire anemometer & tensile sensor.

Unlike from LOG you get in LOGP not only individual measure values without a whole serie with values who have been compiled in a protocol containing max, min, mean, standard deviation etc. You choose how long every serie should be (Measure Time) and how often Swema 3000 should do a measure serie (Protocol interval).

Settings for measuring with LOGP

Time Constant, i.e. the decrease or slowness on the instrument (see **Time Constant and Filter** for more information).

Measure Time:

The length on the measure series. Swema 3000 calculates later standard deviation standardavvikelse, max, min and medelvärde during the measure time.

Protocol Interval:

How often a new measure serie starts. If "Prot. Interval" is set to the same time as "Measure Time", the measure series will be logged continuously without pauses between them. If installed as the image on the right a measure serie will be done during 5s followed by a paus of 10s (5s Measure Time + 10s paus = 15s Protocol Intervals) before next measure seire will start to be measured.

Atmos. P: The atmospheric pressure will affect the measure result for air velocity.

Temperature: This temperature only affects the differential pressure sensor (velocity calculation). For other sensors where temperature affects the measurement results are the sensor's own temperature sensor being used.

Log Book

Start and stop the logging with ENTER. Swema 3000 is logging during a choosen time span and saves de logged measure values i a new file.

A second counter is shown in the bottom left corner on the display during the measurement of the actual measure serie. If it is installed a paus between the measure series will the text LOGP be shown during that paus.

When the logging is done, press ENTER or SAVE, Swema 3000 gives a short signal and shows in some second the file number on the display. If you save the logging before the first serie is done, no data will be saved. To see the logged protocols go to "Log Book". To see other logging protocols could log file be choosen in "Files".

Menu 1	
Mode	LOGP
Time Constant	2s
Measure Time	3m
Prot. Interval	10m
Atmos. P A	1007.8 hPA
Temp.	20.0 °C
Log Book	1
File	1/(1)

EXIT	DEF	
------	-----	--

In this example:

Each serie is set to 3 minutes. After one serie is finished another one starts after 7 minutes.

15:47:35	m/s
0.05	
20.9 °C	
LOG 1 New	15:56:16
	SAVE

Start and stop the log with the ENTER-button.

9. Measurement units showed for different measurement

Swema 3000 is able to show 2 measurement units at the same time on the display. The measurement units varies depends on which sensor is being connected and which mode who has been choosen. For most of the sensors is the direct measure value shown, but at measurement with a differential pressure sensor and a hot wire anemometer does it exist mode who shows calculated values of the measured value of the sensor.

Differential pressure sensor:

Mätprogram	Enhet 1	Enhet 2
AP <small>Note 1</small>	m/s	Pa
APF <small>Note 1</small>	l/s or m ³ /h	Pa
AS <small>Note 1</small>	m/s	Pa
DPF <small>Note 2</small>	l/s or m ³ /h alt. Pa (if k = 0)	Pa
DPK	k-factor	Pa
LOG <small>Note 3</small>	Pa	-
LOGP	m/s	Pa

Note 1: Velocity/flow calculation requires that a PST is being used.

Note 2: If a k-factor is set to "0.00" then only Pa will be shown on the display and then on Unit 1's place

Note 3: If there is a Swema 3000md/mdH+ which has a barometer and a thermo couple, the measure values will be shown on the display requires that "Atmos. P A" is set to "A" (see Menu1) and that a thermo couple is connected.

Hot wire anemometer:

Mode	Unit 1	Unit 2
AP	m/s	°C
APF	l/s or m ³ /h	°C
AS	m/s	°C
ASF	l/s or m ³ /h	°C
LOG	m/s	°C
LOGP	m/s	°C

Air flow probes:

Mode	Unit 1	Unit 2
All	l/s or m ³ /h	°C

Tensile sensor:

Mode	Unit 1	Unit 2
All	m/s	°C

Temperature sensors:

Mode	Unit 1	Unit 2
All	°C	-

Realtive humidoty sensor:

Mode	Unit 1	Unit 2
All	%RF	°C

10. Note Book, Log Book and Files

To access the Note Book or Log Book press "MENU1".

To access "Note Book" select one of the following modes: AP, APF, AS, ASF, DPF or CO.

To access "Log Book" select mode LOG or LOGP.

Note Book / Log Book

To see the Notes (measurements) in the active file, move the marker to "Note Book" or "Log Book" with the UP/DOWN arrows. Press Enter, Set or right arrow. Browse between your measurements with the UP/DOWN arrow keys. Connect a PC-cable. To transfer a note or log file to a PC just press Print. A long press on print will transfer the complete log book or note book. For software's see SwemaTerminal and Swema Multipoint. Erase with the ERASE-button. If you erase in "Note Book" you can choose to either erase the Note or the whole File, in "Log Book" you always erase the whole File. Exit with the EXIT-button.

Files

The files are used if you would like to group your measurements. In "Files" you can choose to start a new file or investigate the saved measurements in the different files. To access files move the marker to "Files" with the UP/DOWN arrows and press ENTER or SELECT.

Switch between your files with UP/DOWN arrows. When the file has been chosen press EXIT. Now, you are able to see the measurements or loggings by going to "Note Book" or "Log Book" as described above.

To create a new file for "Note Book", press ENTER when you are in "Files". New files for "Log Book" is created when a new logging is done with LOG or LOGP.

To print a full file, press PRINT when you are in "Files". Switch between your files with the UP/DOWN arrows. To print all files, hold PRINT.

The device is able to delete all files or the last file. To delete the last file, press ERASE when you are in the last file in "Files". Choose "OK" to delete the file or "ALL" to delete all files. If you choose "OK" will the latest file be empty until new measurements have been done, therefore the display will show "New empty file N". Where N is the number of the deleted file. If you would like to delete another file will file N disappear completely and file N-1 will be empty.

Press EXIT to exit "Files".

File 2
Note 1 of (1)
2008-02-29 16:13:23
SWA 31 S/N: 390989
Mode ASF, TC 2 s
1008 hPa
Area: 40x60 cm 0.24 m2
Average flow 330 l/s
Average velocity 1.37 m/s
Max 11.31 m/s
Min 0.00 m/s
Average temp. 21.9 °C
Measuring Time 55 s

EXIT	PRINT	ERASE
------	-------	-------

Open your Note or Log files by moving the marker to "Note Book" or "Log Book" with the arrow keys and press Enter.

File 3		
Note 3 of (3)		
2008-02-29 16:26:03		
SWA 31 S/N: 390989		
Mode AP, TC 2 s		
1008 hPa		
Average velocity 6.79 m/s		
Average temp. 23.3 °C		
No	m/s	dgC
1	0.950	23.27
2	5.303	23.27
3	14.579	23.35
4	6.335	23.32

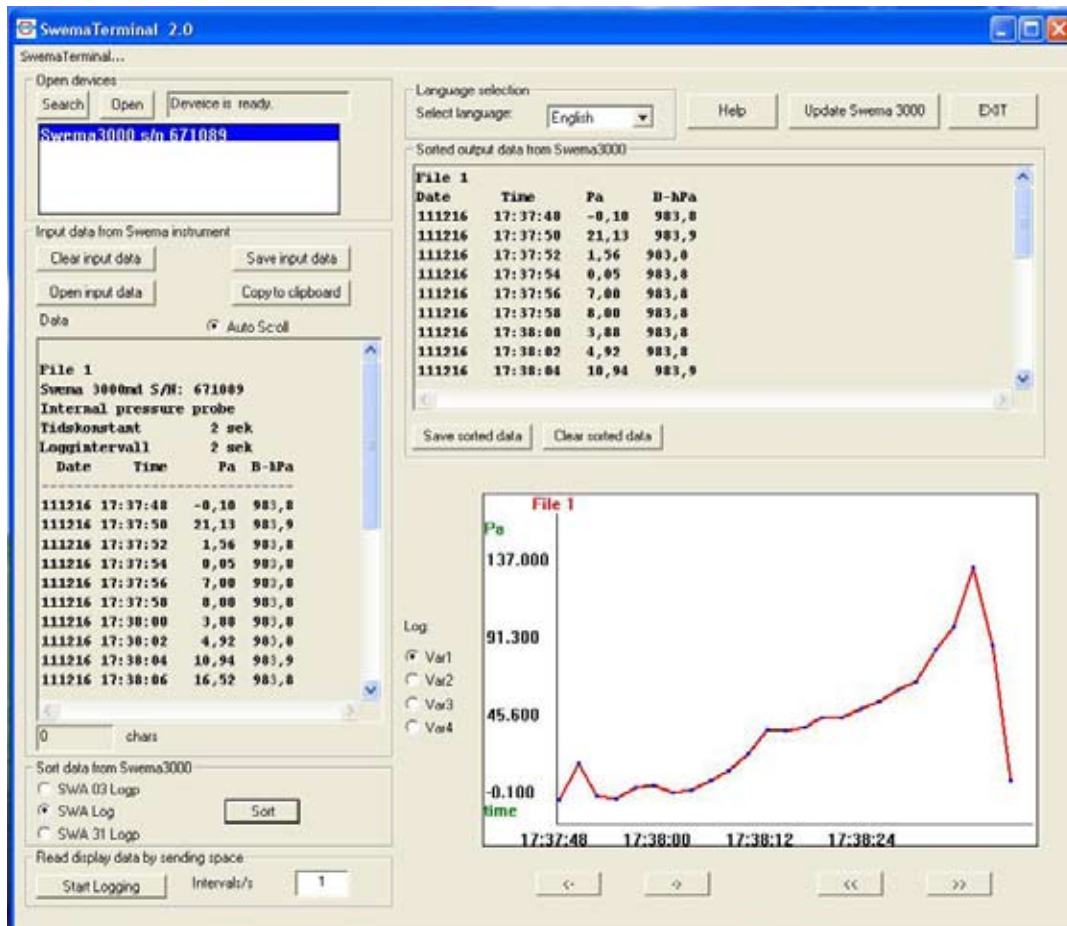
EXIT	PRINT	ERASE
------	-------	-------

In the Note Book or Log Book: Alter between your notes with UP/DOWN arrow keys.

This is also how the note will look like on the PC.



11. SwemaTerminal 2 (PC-Program)



SwemaTerminal 2 is a free PC-program that you can use to download and update the software of Swema 3000 (visit www.swema.com or contact Swema for available updates). SwemaTerminal 2 as well as driver for USB-communication is delivered on CD together with Swema 3000 (even available for download at www.swema.com).

Follow the instruction on the CO to follow how the program and the USB drive should be installed. Subsequently, connect the USB-cable with the instrument Swema 3000 and the computer. Turn on the instrument, open MENU2 and set "Communication" on "USB". Subsequently, start the program SwemaTerminal 2. Firstly, the contact has to be complete with Swema 3000 by clicking "Search" in SwemaTerminal 2, and "Swema 3000" is shown in the box beneath. Press "Open", to the right of the "Search" button, and the text "Device is ready" will now show that Swema 3000 is connected to SwemaTerminal 2.

The saved measure values in Swema 3000 can now be written to the computer as described in the chapter "Note Book, Log Book and Files". The data from the instrument is read and printed in the bottom of the text box to the left. The text can now furtherly be read, copied to clipboard, or cleared. To add, there is a possibility to open earlier saved data. The data can also be edited in this window.

The right part (sorts and graphs) of SwemaTerminal 2 is able to be used to sort Log-files and SWA03/31 Logp-files. Clear the screen by clicking "Clear input data". Thereafter choose the file you would like to use (either SWA Log, SWA03 Logp or SWA31 Logp). Primarily, print the Log- or Logp-file who has been choosen and later press "Sort".

The button in bottom left corner "Start Logging" instruct Swema 3000 to use the values on the istrument's display in the choosen interval, lowest interval possible is 10Hz (0,1s).

Press "Enter" on the computer's keyboard and the calibration protocol for the built-in probe to send to the computer.

Press "Space" on the computer's keyboard and the shown values will be printed.

Press "V" on the computer's keyboard and the protocol for the instrument to print.

12. Time Constant and Filter

Swema 3000 always measures continuously with a sampling frequency at 40Hz. The time constant is the decrease on the shown values.

All sensors at measurement in LOG and LOGP (does always apply for the pressure sensor)

The display shows the mean for the measured values during chosen time constant (rectangular filter). The pressure sensors have a rectangular filter with under pressure of noise at low pressures, i.e. noise reduction. At logging with LOG and LOGP will all probes get rectangular filter, the pressure sensors will keep the noise reduction.

Noise reduction: For differential pressure under 0.4Pa or time constant at 0.25 seconds, that the actual time constant is 4 seconds.

Under 0.4Pa and a time constant between 0.5 - 8 seconds, that the actual time constant is 8 seconds.

All sensors when you measure in LOG and LOGP (except the pressure sensors)

The calculated values are filtrated (Bessel) before they are shown on the display. After a period on a time constant will 90% be shown of the change against the end value. After 1.5 time constants will 99% be shown of the change against the end value. After 1.8 time constant will 99.9% be shown of the change against the end value.

Generally

The Display's value is updated twice a second except when the time constant is 0.25 or 0.1 seconds when the display is updated with 0.25 respectively 0.1.

The showed values is also used to calculate mean, max, min, standard deviation in AP, APF, DPF, LOG and LOGP mode.

In CO mode is always 0.1 second value used to do these types of calculations. (independent of what the time constant is set)

13. Display view and saving of measured values

Small & Big numbers

In mode can both big and small numbers be used. Big numbers are shown normally but sometimes the display is not enough, therefore small numbers are shown instead. Small numbers are shown when the time constant is installed at 0.1 seconds as well as when the whole number does not fit in, i.e. at a natural number with more than 5 significant figures or a negative whole number with more than 4 significant figures.

Number of decimals

The number of decimals shown in the display is according to what chosen in Menu 2 until a fifth number is needed, subsequently a decimal disappears because the display is only available to show 4 numbers in the normal mode. At saving of the measure value, the same number of decimals will be saved as it was during the showing.

Saving of measure values (APF & DPF)

If Swema 3000 with built-in barometer and thermo couple (Swema 3000d & Swema 3000md) is used will the values in mean, max & min be calculated correspondent for what the temperature and the barometer were at every single measure point. Subsequently, you save the measure values, only will the mean of the temperature and the air pressure be saved. The mean values will be later used to correct the values that have been shown in the protocol.

14. Technical Data

The uncertainty of measurement for each probe is stated below as the uncertainty for the probe together with a calibrated Swema 3000. The uncertainty is stated with coverage probability of 95%. Included in the uncertainty for each probe is the uncertainty for Swema 3000, interchangeability, calibration, temperature dependence, hysteresis and repeatability.

The user should correct the measured values with the correction on the probe calibration protocol to obtain stated accuracy.

Swema 3000 instrument:

Instrument temperature:	0...+50°C
Memory capacity, Note book - Log book:	approx. 1 600 notes or 14 000 pairs of values or 20 000 single values
Interchangeability accuracy:	Negligible in relation to accuracy of probes.
Digital Output:	RS232, send "." or "Space". Swema 3000 sends the displayed value (big digits) or (big and small digits) Transmitting rate max 10 times/second (Time constant 0.1s) USB
Battery:	2 x 1,5V AA
Battery life with SWA 31 at 1 m/s:	13 hours with NiMH, 17 hours with alkaline Use the 230V-adaptor (764.610) for continuous operation.
Battery with backlight on:	5,5 hours with NiMH, 8,5 hours with alkaline
Instrument Calibration:	Recommended every 5 year
Only on Swema 3000d part no. 764.201 and Swema 3000dm part no. 764.202	Barometer 600...1200hPa, $\pm 2,5$ hPa Thermo couple Type K -270...1370°C $\pm 0,3$ °C at -10...70°C

Draught probe, SWA 03:

Measuring range of velocity	0,05...3,0 m/s at +10...+34°C
Measuring media	Non condensing, non moist air, <80%RH, non aggressive gases
Accuracy (m/s) at 23°C:	$\pm 0,03$ m/s at 0,05... 1,00 m/s $\pm 3\%$ read value at 1,00...3,00 m/s
at 10...34°C:	$\pm 0,04$ m/s at 0,05... 1,00 m/s $\pm 4\%$ read value at 1,00...3,00 m/s
Response time of velocity sensor:	0,2 sec.
Measuring range of temperature:	+10...+40°C
Accuracy (°C):	$\pm 0,3$ °C at 20°C $\pm 0,5$ °C at 10...+40°C
Probe Calibration:	Recommended every 6 months.

Air velocity sensor, SWA 31:

Ø8mm at the top, Ø10mm first step on the telescopic handle

Measure range velocity: 0,1...10 m/s, option 10...30 m/s at - 10...+ 45°C

Measure media: Not condensed, no moist air, less than 80% relative humidity, no aggressive gases

Uncertainty: At 20°C: 0,10...1,33 m/s 0,04 m/s
1,33...30 m/s 3% of read value
Otherwise: 0,10...1,10 m/s 0,05 m/s
1,10...30 m/s 4,5 % of read value

Measure range temperature: - 20...+ 80°C
Uncertainty: ± 0,3°C at 20°C
± 1,0°C - 20...+ 80°C

Calibration: Recommended every 12th month.

Pressure sensor:

	Swema 3000md	Swema3000mdH+	SWA 10	SWA 07
Measuring range	-300... 1500 Pa	± 10 000 Pa	-300... 1500 Pa	± 7 000 Pa
Uncertainty at 20°C	±0,3% read value, lowest ±0,3Pa	±1% read value, lowest ± 2,5 Pa	±1% read value, lowest ±0,3Pa	After Reset: ±0,3Pa ±2% read value
Max load	± 50 000 Pa	± 50 000 Pa	± 20 000 Pa	± 35 000 Pa
Temp dependent:	0,2 Pa/°C	0,2 Pa/°C	0,2 Pa/°C	0,4 Pa/°C
Working temperature:	0... 50°C			
Long-time stability	0,1 %FSO/year			
Zero point:	0,1 %FSO/year			
Total measure area:	0,1 %FSO/year			
Measure media	Not condensed, no moist air, less than 80% relative humidity, no aggressive gases			
Calibration	Recommended every 12th month.			

Temperature sensor (SWT sensor):

Measuring range (sensor dependant): -50...280°C
Interchangeability accuracy: max ±0.1°C

Sensors at 20°C: 1DIN 43760 ca ±0.4°C or 1/2DIN 43760 ca ±0.2°C

Total uncertainty at 20 °C: 1DIN 43760 ca ±0.6°C or 1/2DIN 43760 ca ±0.4°C

Calibration: Recommended every 24th month, with Swema 3000 for the best result.

Measure probe, SwemaFlow 125

Measure range flow:	2-125 l/s (7 - 450 m ³ /h). The Instrument shows always zero if the flow is lower than 2 l/s (7m ³ /h).
Measure media:	Not condensed, no moist air, less than 80% relative humidity, no aggressive gases
Uncertainty:	± 3% read value, minimum ± 1 l/s
Measuring range temperature:	-10...+50 °C
Uncertainty At 20°C:	± 0,3 °C
-10...+50 °C:	± 0.5 °C
Calibration:	Recommended every 6th month

The Battery:

SwemaFlow 125 contains loadable batteries of the type nickel-methal hydride (NiMH). A fully charged battery is enough for a normal working day. However, this is controled of which flow measured, the more the higher consumption.

Warning if the battery is about to end.

When the battery is about to end in SwemaFlow 125 will the battery sign start to blink. When the battery is fully exhausted will the Swema 3000 automatically shut down.

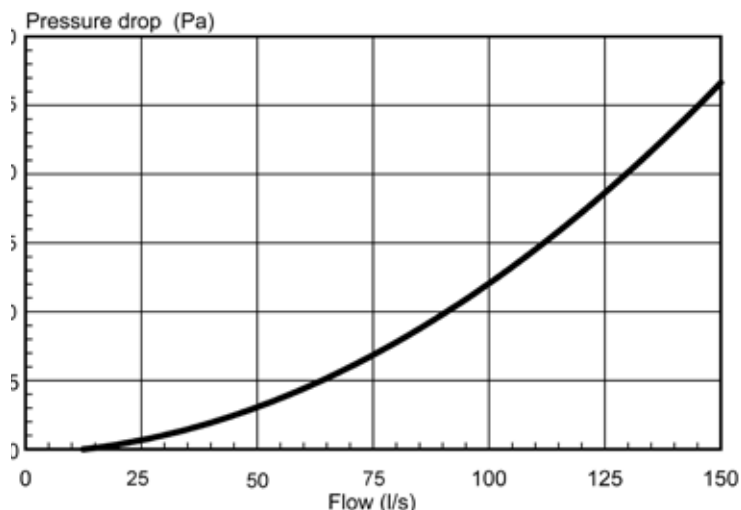
Charge the battery, you can charge it when it suits you.

When you should load the battery you should use the charger that comes with the SwemaFlow 125, to use other chargers causes danger. Connect the charger to the power supply, subsequently the SwemaFlow 125, a red lamp will be lightened beside the contact on the SwemaFlow 125. If the red light starts to blink directly, the contact should be connected again. When the battery is fully charged will the red light start to blink.

If you have Swema 3000 connected to SwemaFlow 125 should Swema 3000 not be on when you charge SwemaFlow 125.

The battery is secured by an electric circuit as it makes it possible to charge it whenever it suits you without any damage. It takes approximately 1 hour to charge the battery full when it is empty. At charging should the instrument's temperature be between. 10 - 45 °C.

When the battery in Swema 3000 is going out starts the battery sign to light up. When it is totally empty the Swema 3000 will shut down automatically.



Relative Humidity & Temperature:

Measure area humidity: 0...100%RF
Accuracy SWA 13 & 16 at 23°C: $\pm 1,6\%$ RF at 10...90%RF, otherwise $\pm 2,6\%$ RF
HC2-S & SWHP28_HC2 at 23°C: $\pm 0,8\%$ RF at 0...100%RF

Measure area temperature:
SWHP 28: -40...85°C
SWA 13: -20...60 °C
SWA 16: -20...150°C
Hygroclip2-S (other models): -40...85°C (-50...200°C)
Accuracy temperature: ± 0.3 °C

Calibration: Recommended every 12th month

Calculations: Dew point and water content (g water / kg dry air)

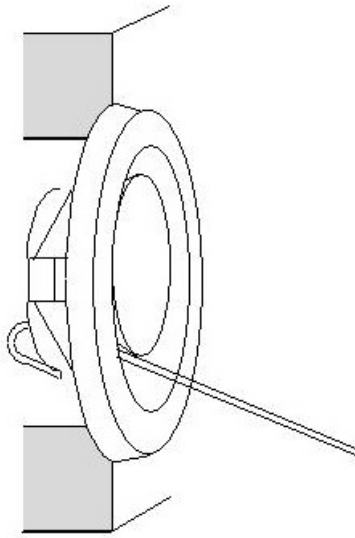
Analogic cable with output

Analogic cable with a volt signal for each Swema 3000 sensor. Also gives an output for the built-in differential pressure sensor in Swema 3000md and Swema 3000mdH+. Same cable suits for all sensors. Connected to Swema 3000 left contact. The other end has loose cable ends.

Swema3000md, SWA10: 1mV/Pa, 1,0V = 0Pa
Swema3000mdH+, SWA07: 0,1mV/Pa, 1,0V = 0Pa
SWA31: 100mV/m/s, 5...10mV = 0m/s
SWA03: 1V/m/s, 5...10mV=0m/s
SWA25 Ni100: 10mV/°C, 1,0V=0°C
Pt100-sensor: 1mV/°C, 1,0V=0°C
CO2-cable: 1mV/ppm, 5...10mV=0ppm
SwemaFlow 65, 125, 2000 10mV/l/s, 5...10mV=0l/s
Humidity sensor: 10mV/%RF, 5...10mV=0%RF

15. Theory

15.1 K-factor calculation



Use the k-factor to calculate the air flow. Some suppliers calculate the correction formula accordingly:

$$q = \sqrt{I_k \Delta P}$$

In this case you have to calculate: $k = \sqrt{I_k}$ Put in the calculated k in Swema 3000.

If the supplier has not stated a K-factor, you can by yourself calculate in if you have a pressure drop diagram :

$$q = k \sqrt{\Delta P} \rightarrow k = q / \sqrt{\Delta P}$$

Go into the diagram for e.g.:

$$\Delta P = 100 \text{ Pa} \rightarrow \sqrt{\Delta P} = \sqrt{100} = 10$$

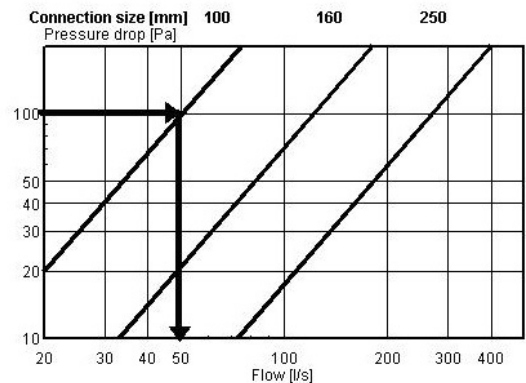
So, for Ø 100 → 100Pa corresponds 50 l/s

Use the connection above for k: $k = 50/10 \rightarrow 5,0$

In this case the k-factor was 5.0. Set k=5,0 in Swema 3000 then you will get the flow directly in l/s, m³/h or CFM.

If the diagram does not reach 100 Pa, then choose e.g.

25 Pa
($\sqrt{25} = 5$)



15.2 Necessary straights before and after measure plans

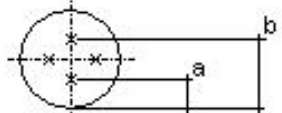

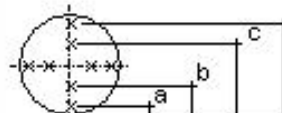
(According to T22 Methods for measurement of air flow in ventilation systems)

	Round channels	Rectangular channels
Before measure plan	$a \geq 5 \times D$	$a \geq 6 \times Dh$
After measure plan	$a \geq 2 \times D$	$a \geq 2 \times Dh$

Dh= Hydraulic diameter (diameter from corner to corner for rectangular channels)

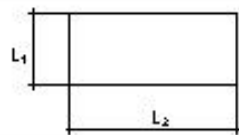
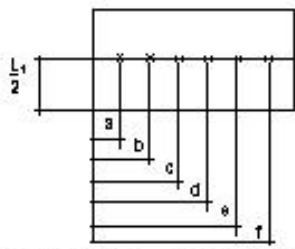


15.3 Recommended measure points channel measurements

From T22 "Methods for measurement of air flow in ventilation installations", of the Nordic Ventilation Group and Building Research Council, 1998, ISBN 91-540-5827-9.

Nominell diam = D [mm]	Mätplan	a	b	c	d
100 } 125 } ¹⁾ 160 }	 $b=0.71D$ $a=0.29D$	29 36 46	71 89 114		
200 250 315 400	 $c=0.9D$ $b=0.5D$ $a=0.1D$	20 25 32 40	100 125 160 200	180 225 283 360	
500 630 800 100 1250	 $d=0.957D$ $c=0.71D$ $b=0.29D$ $a=0.043D$	22 27 34 43 54	145 185 230 290 360	355 445 570 710 890	478 603 766 957 1196

¹⁾ Prandtlrörets diameter bör inte överstiga 1/30 av kanaldiametern.
Vid kanaldimensioner < 200 mm bör prandtlrör med diameter 3-4 mm användas.

Rektangulärt tvärsnitt: ^{*)} Stående kanal [$L_1 > L_2$] $\Rightarrow k_2 = 0.94$
Liggande kanal [$L_1 < L_2$] $\Rightarrow k_2 = 0.98$
Kvadratisk tvärsnitt $\Rightarrow k_2 = 0.96$

	Enligt ny kanalstandard SIS 82 72 04													
Två dim områden för L_2	I $150 < L_2 \leq 300$ II $400 < L_2 \leq 2000$													
För område I gäller att:	$a = 0.08L_2$, $b = 0.43L_2$, $c = 0.57L_2$, $d = 0.92L_2$													
För område II gäller att:	$a = 0.060L_2$, $b = 0.235L_2$, $c = 0.430L_2$, $d = 0.570L_2$, $e = 0.765L_2$, $f = 0.940L_2$													
Tre mätfall för kanalhöjden L_1 :														
1 $100 < L_1 \leq 400$	2 $400 < L_1 \leq 800$	3 $800 < L_1 \leq 2000$												
														
För mätfallen 1, 2 och 3 erhålls då följande mätpunktspacering beroende på kanalbredden L_2														
L_2	150	200	250	300	400	500	600	800	1000	1200	1400	1600	1800	2000
a	13	16	20	25	25	30	35	50	60	70	85	95	110	120
b	65	85	110	130	95	120	140	190	235	280	330	375	420	470
c	85	115	140	170	170	215	260	345	430	515	600	690	775	860
d	137	184	230	275	230	285	340	455	570	685	800	910	1025	1140
e	—	—	—	—	305	380	460	610	765	920	1070	1225	1380	1530
f	—	—	—	—	380	470	565	750	940	1130	1314	1505	1690	1880

15.4 Values of K2-factor

Values of K2-factor which is used in Swema 3000:

PST

Circular channels:

$$\varnothing \leq 160 \text{ mm} \gg k2 = 0.89$$

$$160 < \varnothing \leq 400 \text{ mm} \gg k2 = 0.95$$

$$400 < \varnothing \leq 1250 \text{ mm} \gg k2 = 0.98$$

Rectangular channels:

$$\text{Height} > \text{Width} \gg k2 = 0.94$$

$$\text{Height} < \text{Width} \gg k2 = 0.98$$

$$\text{Height} = \text{Width} \gg k2 = 0.96$$

Hot wire anemometer

Circular channels:

$$\varnothing \leq 160 \text{ mm} \gg k2 = 0.92$$

$$160 < \varnothing \leq 400 \text{ mm} \gg k2 = 0.96$$

$$400 < \varnothing \leq 1250 \text{ mm} \gg k2 = 0.98$$

Rectangular channels:

$$\text{Height} > \text{Width} \gg k2 = 0.94$$

$$\text{Height} < \text{Width} \gg k2 = 0.98$$

$$\text{Height} = \text{Width} \gg k2 = 0.96$$

Source: Methods for measurement of air flows in ventilation installations (T09) with the right from NBI's report north test Proj. 1463-99 rev. 23-05-01.