

Testing Apparatus according to EN 29053 for determining of flow resistance PA-SW



Operating Manual

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Safety instructions



Make sure that no liquids get on cable connections or inside the electrical device!
Danger of electric shock!



Operate the test apparatus only on a properly electrical installation of your building.
Danger of electric shock!



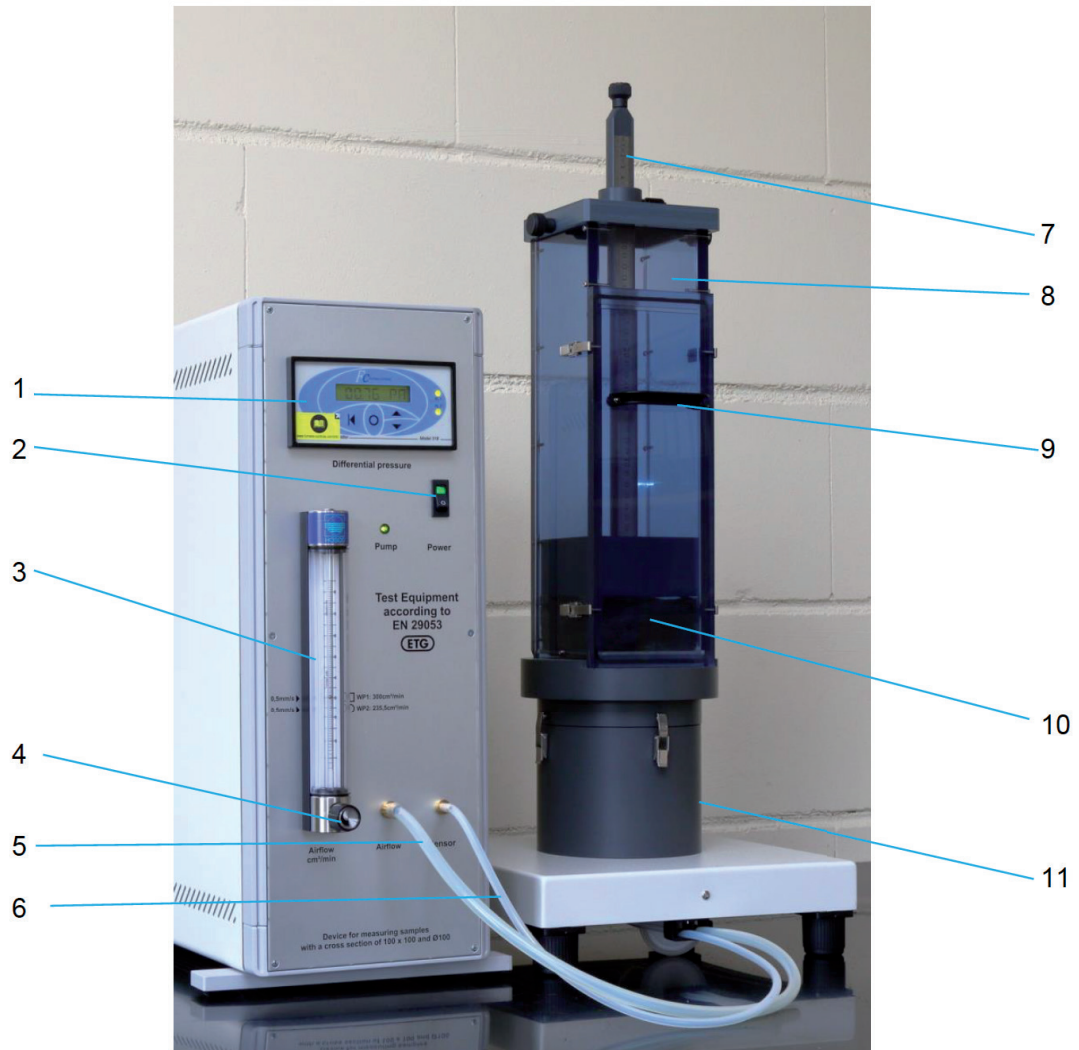
Always unplug the power cable before opening the device!
Danger of electric shock!

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1 Structure of Device

Workplace Example



- 1Differential Pressure Transmitter Model FCO 318
- 2Main plug
- 3Flowmeter Koniflux GRV-150GK0087K
- 4Needle valve for flow adjustment
- 5„Air-flow“ hose connection
- 6„Sensor“ hose connection
- 7Clamping piston with thickness indicator
- 8Sample container for cuboidal samples, cutting 100 mm x 100 mm
- 9Cover plate with 4 clamps for closing the sample container
- 10Material sample
- 11Holding table with sample holder and 4 clamping locks for coupling

2 Scope of Delivery

The testing apparatus consists of the following parts:

- 1 piece Measuring device (including differential pressure gauge, flow meter and pump)
- 1 piece Holding table with sample holder and 4 clamps for connecting
- 1 piece Sample container for cuboidal samples, cutting 100 mm x 100 mm, completed with cover grill and tensioning piston with thickness indicator
- 1 piece Sample container for annular and flat samples
- 1 piece Cover ring
- 1 piece Round cover plate
- 3 pieces Quick knurled nuts
- 1 Satz distance piece for sample thickness from 30 mm to 100 mm, stepped every 10 mm, 3 pieces each
- 2 pieces Silicon hose, Ø 8 x 3 (Inner diameter x wall thickness), one of them fixed on the holding table)
- 2 pieces Silicon hose, Ø 4 x 2, (Inner diameter x wall thickness), one of them fixed on the holding table)
- Optional (must be ordered separately):
 - 1 piece sample container for cylindrical samples and loose fibers, complete with cover grille, cover and clamping element and piston with thickness indicator and sample ejector

Also delivered spare parts:

- 1 Piece O-Ring 115 x 4 Si 820
- 1 Piece Foam rubber cord EP 580 (closed cell) - (sold by the meter)

Documents:

- Operating manual Testing Apparatus according to EN 29053
- Documentation differential pressure transmitter FCO318
- (Userguide Issue 8)
- www.furness-controls.com/info
(Brochures, user guides, utilities)
- Calibration certificate FCO318
- Product information flowmeter GRV-150GK
- USB-stick with summary of informations

3 Definitions

Flow resistance R

$$R = \Delta p / q_v \text{ in Pa s/m}^3$$

Δp ... Pressure difference on both sides of the sample body in Pa

q_v ... flow in m^3/s

Specific Flow resistance R_s

$$R_s = R \cdot A \text{ in Pa s/m}$$

R ... Flow resistance in Pa s/m^3

A ... Cross-sectional area of the sample in m^2

Flow resistance, related to length r

$$r = R_s / d \text{ in Pa s/m}^2$$

R_s ... Specific flow resistance in Pa s/m

d ... Thickness of the sample in m

Linear flow velocity u

$$u = q_v / A \text{ in m/s}$$

q_v ... flow in m^3/s

A ... Cross-sectional area of the sample in m^2

4 Assembly

4.1 Setting up and connecting the devices

1. Select a location for the device where environmental influences (loud noises, draughts and air pressure fluctuations) will not falsify your subsequent measurement results.
2. Place the measuring device and holding table on a flat, level surface.
3. If necessary, adjust the holding table with the aid of the height-adjustable feet of the device.
4. Connect the silicon hoses from the holding table to the "air flow" and "sensor" hose couplings on the front of the measuring device.
5. Ensure that the power switch on the front of the measuring device is in the "0" position.
6. Connect the measuring device to the power supply.

4.2 Complementing with accessories

The holding table can be complemented with the accessory elements according to the application concerned.

For this purpose, please refer to the overview in appendix B.

5 Operation



Please follow the Operating Manuals supplied for the small flow meter and for the differential pressure indicator FCO318.



The limiting value and hysteresis are set in the works so that the pump switches off at pressure differences $> \pm 50$ Pa. This is essential in order to protect the pressure sensor of the measuring device from overload.

Please also avoid the possibility of pressure impulses being applied to the test chamber by external manipulations, as long as the sensor hose is connected to the measuring instrument. (E.g. by quickly compressing the sample by means of the thickness measurement setting on the sample holder!)

5.1 Checking the Zero-point on the pressure transmitter

Ensure that there is no pressure difference when taking the zero point. In order to ensure this, the flow meter must be closed and the sample holder on the holding table must be empty.

A warm-up period of at least 30 minutes is required so that the temperature in the enclosure can stabilise. This is the only way to achieve accurate measurement results.

1. Switch the measuring device on with the power switch. The power switch and the control light for the pump light up.
2. Close the needle valve of the flow meter. To do this, turn the knurled knob to the right as far as it will go. The sample holder is not yet filled, or the tube to the olive „sensor“ on the meter has been removed.
3. After the heating-up time has expired, check the zero point indicator in the operating panel display. If there are tolerances then it is necessary, to touch the „Zero“-key in the operating panel display (model 318).

The measuring device is now ready for operation. No other settings are required in the operating panel of the measuring device. The device is calibrated for using optimal. If you want to make another calibration anyhow, then please note the enclosed using instructions of Furness Controls pressure transmitter model 318.

You can measure the gage pressure between - 50 Pa to + 50 Pa. Is the pressure out of this range, then the internal pump switches off automatically, and the color of the LED on display is changing from green to red.

Appendix G contains a list with the prepared parameters of the device model 318.

5.2 Loading the holding table

Always ensure that the holding table and the underside of the holding vessel or holding element are free of dirt. This is the only way to ensure a leakproof connection. Clean the surfaces, e.g. with a clean cloth.

Take care when cleaning with compressed air or a vacuum cleaner! Before cleaning, disconnect the hose connections to the "air flow" and "sensor" hose couplings.

Otherwise the differential pressure gauge may be destroyed!

When loading the holding table, please take note of the overview in the Appendix B.

Use the holding element for cuboidal samples, cutting 100mm x 100mm

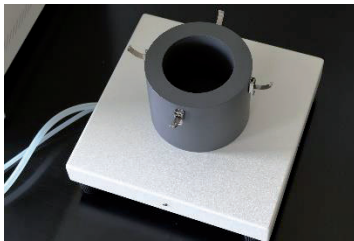
- Prepare the sample according to EN 29053 for recording.

The cut sample should be slightly larger than the cross-section of the sample holder.

For sample holder 100mm x 100mm: Cutting with edge lengths approx.

101mm ... 103mm, depending on the sample density

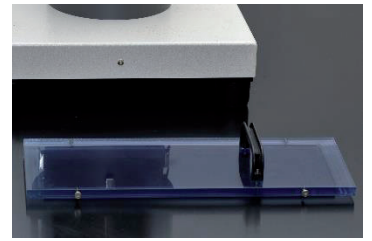
- Now fill the sample holder:



Holding table with sample holder



Storage vessel with cover plate



Cover plate



Clamping elements on Thickness measurement of sample, holding table



Receptacle with tensioning piston and toggle screw



Thickness measurement of sample, holding table fixed with toggle screw

- Place the receptacle on the receiving table and tighten it.
- Loosen the clamp on the clamping piston by loosening the toggle screw and push the clamping piston so far upwards that the sample fits into the holder, fix it there first.
- Open the 4 clamping elements on the cover plate and remove the cover plate.
- Put the sample in the vessel. Make sure that you do not puncture the sample and that the sample does not deform. Close the device by replacing the cover plate and closing it with all four clamping elements. The sample should rest evenly on the walls of the receptacle with its lateral surface, so that no air flow can flow past between the wall and the sample.

- Now loosen the toggle screw of the clamping piston and let it down until it touches the sample or press the sample together with it to the desired thickness.
- Fix the tensioning piston by tightening the toggle screw.

Use the receptacles for cylindrical samples

- Prepare the sample for recording according to EN 29053. The cut sample should be slightly larger than the cross-section of the sample holder.

Sample holder Ø100mm:


Cutting Ø 101 mm ... 103 mm,
depending on the sample density

- Now fill the sample holder:
 - Place the receptacle on the receiving table and tighten it.
 - Place the sample in the container and place the cover on the sample.
 - Loosen the clamp on the clamping element by turning the knurled screws to the left.
 - Insert the clamping element until it rests flush on the cover grille.
 - Fix the clamping element by tightening the knurled screws.

Using the receiving element for annular and flat samples

- Prepare the sample for recording according to EN 29053. Optimum recording of flat samples is guaranteed up to a diameter of approx. 150 mm. Larger samples must be provided with 3 holes. You can use the cover plate as a template.

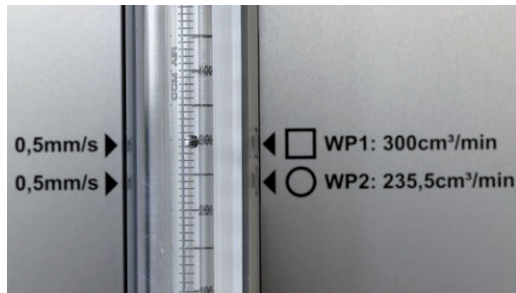
- Now fill the sample holder:
 - Place the pick-up element on the pick-up table and tighten it.
 - Place the sample on the receiving element.
 - Slide the appropriate spacers onto the bolts.

 To ensure a uniform contact pressure, always use the spacers for specimens up to 150 mm in diameter

- Place the desired cover plate on the sample.
- Fix the sample holder with the quick release knurled nuts.

5.3 Performing a measurement

Proceed as described in DIN EN 29053. The desired air flow is set on the flow meter by turning the needle valve. Select the flow required for the sample cross-section. (Working points see also in Annex C)



By turning the jacket tube of the flow meter, the scale can be increased.

Sample holder for rectangular samples 100 mm x 100 mm

When using the sample holder for rectangular samples with a surface area of 100 mm x 100 mm, set the needle valve of the flowmeter so that a flow rate of 300 cm³/min can be read off the scale. This corresponds to a linear flow velocity of 0.5 mm/s or a volume flow of 5,000 mm³/s for this sample geometry.

On the differential pressure gauge, now you can read the measured value for the differential pressure. To read the display with good contrast, please look vertically at the display. The best is, to work sitting in front of the device.

When setting the air flow, make sure that the resulting differential pressure does not exceed the limit value (red LED in the display). Please also note the tables and overviews in Appendix C - F.

If the displayed measured value is not stable, please ensure that there is no air movement in the room (e. g. drafts). If necessary, set the parameter "Filter" on the differential pressure gauge slightly larger (see Operating Instructions Model 318)

Sample holder for cylindrical samples Ø100

When using the sample holder for cylindrical samples with circular area Ø 100 mm, please adjust the needle valve of the flowmeter so that a flow of **235 cm³/min** is readable. This corresponds to a linear flow velocity of 0.5 mm / s or a volume flow of 5,000 mm³/s for this sample geometry.

Now you can read the measured value for the differential pressure on the differential pressure gauge, To read the display with good contrast, please look vertically at the display. It's best to work sitting in front of the device.

When setting the air flow, make sure that the resulting differential pressure does not exceed the limit value (red LED in the display). Please also note the tables and overviews in Appendix C - F.

If the displayed measured value is not stable, please ensure that there is no air movement in the room (e. g. drafts). If necessary, set the parameter „filter“ on the differential pressure gauge slightly larger (see Operating Instructions Model 318)

5.4 Finishing and removing the samples

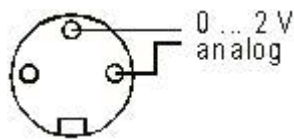
If you do not want to carry out any further measurements, switch off the device with the mains switch.

After you have loosened the clamping elements, you can remove the samples. To remove samples from the cylindrical sample holder, use the ejector (optional).

5.5 Analog Output 0 ... 2 V

The DIN socket located on the back of the device supplies a linear analog voltage between 0 V and 2 V dependent on the display value. The device is configured so that a voltage of 0 V is applied at -50 Pa and a voltage of 2 V is applied at + 50 Pa. Other configurations are adjustable. Please observe the instructions in the operating instructions of the differential pressure measuring instrument Model 318.

The voltage is between PIN 2 and 3 at the DIN socket.



6 Maintenance

6.1 Care and Maintenance



When carrying out care and maintenance, make sure that no liquids get on the cable connections or inside the electrical device! Danger of electric shock!



Always unplug the device before opening the device!
Danger of electric shock!

Receiving vessel and receiving element



Be careful when cleaning with compressed air or a vacuum cleaner! **First** disconnect the hose connections to the olives „airflow“ and „sensor“. In the other case, the differential pressure gauge may be destroyed.

Clean the holding table and the bottom of the receptacle or the sample container regularly, for instance with a clean cloth..

Please do not use alcohol or to clean the plastic parts of the sample holder other solvents, just plain water or a mild soapy solution.

Check the sealing ring on the underside of these accessories regularly.

6.2 Customer service

If there are any errors on your test equipment, please always contact theCustomer service:

ETG

Entwicklungs- und Technologie Gesellschaft mbH

Am Eichicht 1 A

D - 98693 Ilmenau

Germany/Deutschland

Tel.: +49 (0) 3677 46 12 0

Fax: +49 (0) 3677) 46 12 29

Email: info@etg-ilmenau.de

Web: www.etg-ilmenau.de

Appendix A

Technical data

Nominal voltage:230 V AC, 50/60 Hz

Nominal electrical power:15 W

Dimensions (L x W x H):approx. 600 mm x 550 mm x 600 mm

Ambient temperature:10 °C - 40 °C

Measuring ranges:

Differential pressure:± 50 Pa (digital)

Differential pressure transmitter FCO 318
with Signal output (differential pressure) 0 - 2 V DC
optional RS 232


Flow:0 – 870 cm²/min (Air)

(Vibration anchor pump SP 402-SA)

Sample geometrie:

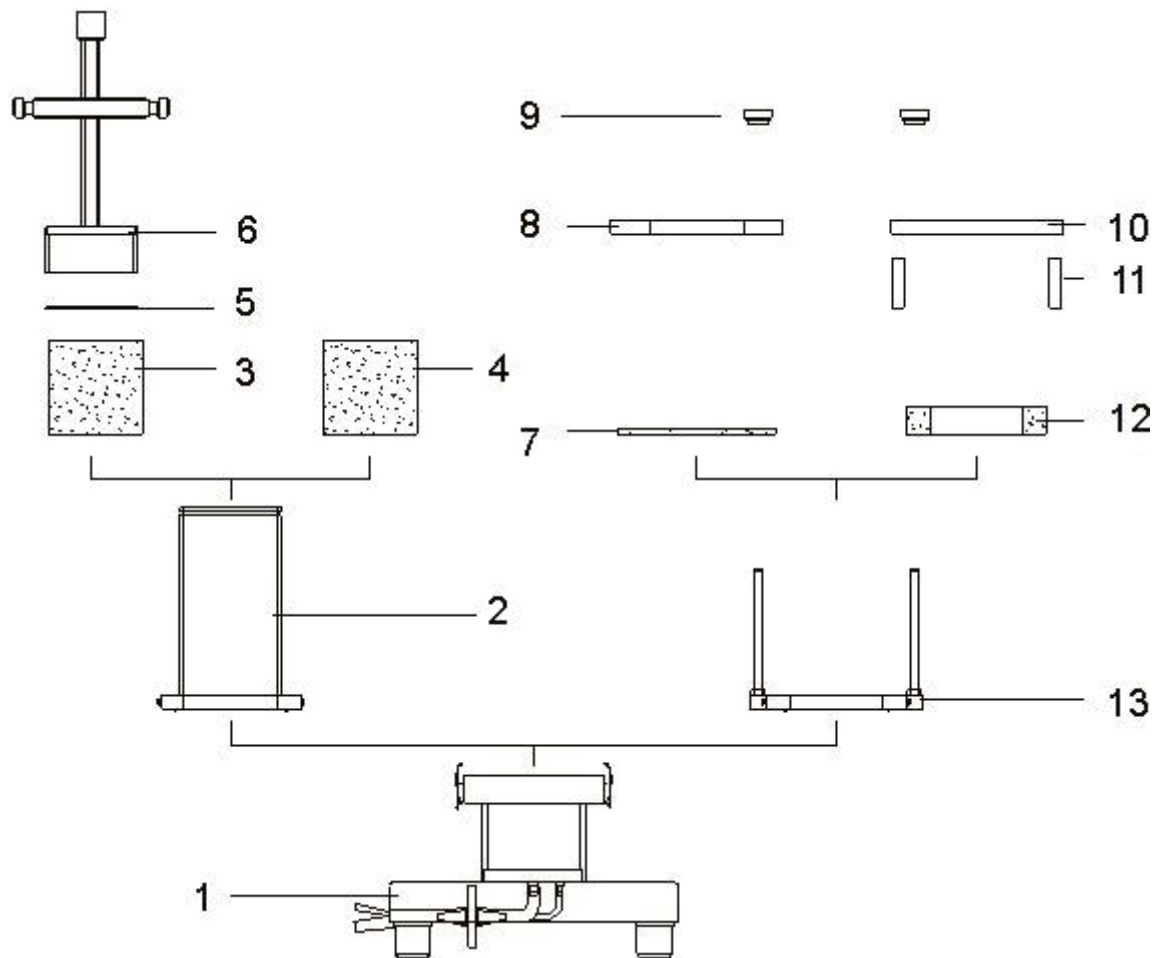
 rectangular samples:Edge length 100 mm
Height 0 - 300 mm

Option:

 cylindrical samples:Ø 100 mm
Height: 0 – 300 mm

Appendix B

Overview – Special accessories - Completion



- 1Holding table with sample holder and 4 clamping locks for coupling
- 2Sample container for cuboidal samples (cross-section 100mm x 100mm)
option: Sample container for cylindrical samples Ø 100mm
- 3cuboidal sample with cross-section 100mm x 100mm
- 4cylindrical sample Ø100mm or loose fibrous material
- 5Cover grill
- 6Clamping element and piston with thickness indicator
- 7flat sample
- 8Cover ring
- 9Quick tightening knured nuts
- 10Cover disc
- 11Stand off
- 12annular sample
- 13Holding element for ring-shaped and flat samples

Appendix C1

Relationship between volume flow and flow velocity depending on sample cross section

According to DIN EN 29053 (depending on the sample geometry), the following operating points apply where the measurements are to be carried out.

a) For cuboidal samples

Cross-section of sample container: 100 mm x 100 mm

Volume flow to be set: **0,300 l/min**

This results in a flow velocity of 0.5 mm/s in the sample

b) For cylindrical samples

Cross-section of sample container: Ø 100 mm

Volume flow to be set: **0,235 l/min**

This also results in a flow velocity of 0.5 mm/s in the sample

Depending on their bulk density and overall dimensions, the samples should be cut approx. 1 mm to 3 mm larger than the dimension of the cross-section of the sample holder so that bypass flows do not occur on the sides of the sample.

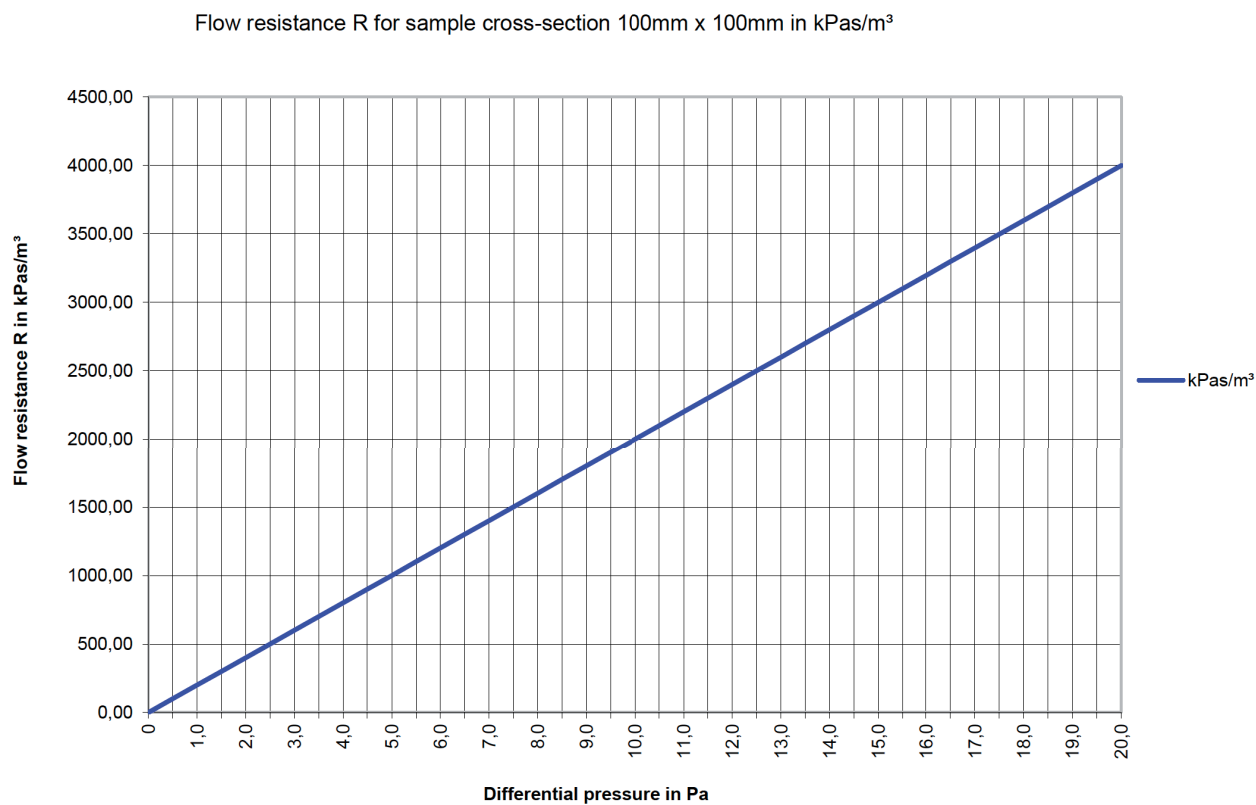
Appendix C2

Conversion qv to u for Sample container 100mm x 100mm						
for rectangular samples cross-section 100 mm x 100 mm						
Scale on the flow meter (40 ... 870 Ncm³/min)						
flow qv		flow rate u	comment	flow qv		flow rate u
Scale		cross-section A = 10.000 mm² (100 mm x 100 mm)		Scale		Cross-section A = 10.000 mm² (100 mm x 100 mm)
Ncm³/min	mm³/s	mm/s		Ncm³/min	mm³/s	mm/s
0	0,0	0,00		460	7666,7	0,77
40	666,7	0,07		470	7833,3	0,78
50	833,3	0,08		480	8000,0	0,80
60	1000,0	0,10		490	8166,7	0,82
70	1166,7	0,12		500	8333,3	0,83
80	1333,3	0,13		510	8500,0	0,85
90	1500,0	0,15		520	8666,7	0,87
100	1666,7	0,17		530	8833,3	0,88
110	1833,3	0,18		540	9000,0	0,90
120	2000,0	0,20		550	9166,7	0,92
130	2166,7	0,22		560	9333,3	0,93
140	2333,3	0,23		570	9500,0	0,95
150	2500,0	0,25		580	9666,7	0,97
160	2666,7	0,27		590	9833,3	0,98
170	2833,3	0,28		600	10000,0	1,00
180	3000,0	0,30		610	10166,7	1,02
190	3166,7	0,32		620	10333,3	1,03
200	3333,3	0,33		630	10500,0	1,05
210	3500,0	0,35		640	10666,7	1,07
220	3666,7	0,37		650	10833,3	1,08
230	3833,3	0,38		660	11000,0	1,10
240	4000,0	0,40		670	11166,7	1,12
250	4166,7	0,42		680	11333,3	1,13
260	4333,3	0,43		690	11500,0	1,15
270	4500,0	0,45		700	11666,7	1,17
280	4666,7	0,47		710	11833,3	1,18
290	4833,3	0,48		720	12000,0	1,20
300	5000,0	0,50	Working point	730	12166,7	1,22
310	5166,7	0,52		740	12333,3	1,23
320	5333,3	0,53		750	12500,0	1,25
330	5500,0	0,55		760	12666,7	1,27
340	5666,7	0,57		770	12833,3	1,28
350	5833,3	0,58		780	13000,0	1,30
360	6000,0	0,60		790	13166,7	1,32
370	6166,7	0,62		800	13333,3	1,33
380	6333,3	0,63		810	13500,0	1,35
390	6500,0	0,65		820	13666,7	1,37
400	6666,7	0,67		830	13833,3	1,38
410	6833,3	0,68		840	14000,0	1,40
420	7000,0	0,70		850	14166,7	1,42
430	7166,7	0,72		860	14333,3	1,43
440	7333,3	0,73		870	14500,0	1,45
450	7500,0	0,75				
Working point according to EN 29053:						
Please set the flow on the needle valve of the flowmeter for sample dimension 100mm x 100mm to 300 cm³/min.						
This corresponds to a flow rate of 0.5mm/s. (Operating point according to EN 29053)						

Appendix C3

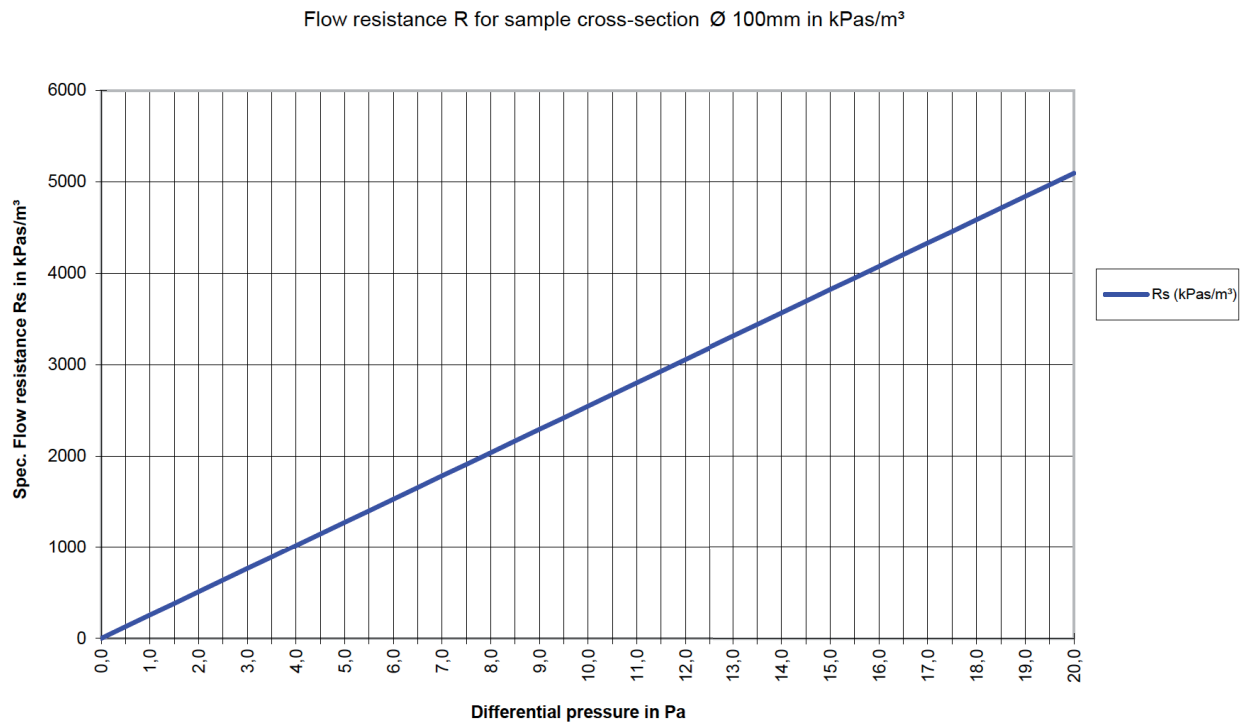
Conversion qv to u for Sample container Ø 100mm						
for cylindrical samples Ø 100 mm						
Scale on the flowmeter (40 ... 870 Ncm³/min)						
flow qv		flow rate u	comment	flow qv		flow rate u
Scale		Cross-section A = 7.854 mm² (Ø 100 mm)		Scale		cross-section A = 7.854 mm² (Ø 100 mm)
Ncm³/min	mm³/s	mm/s		Ncm³/min	mm³/s	mm/s
0	0,0	0,00		450	7500,0	0,95
40	666,7	0,08		460	7666,7	0,77
50	833,3	0,11		470	7833,3	0,78
60	1000,0	0,13		480	8000,0	0,80
70	1166,7	0,15		490	8166,7	0,82
80	1333,3	0,17		500	8333,3	0,83
90	1500,0	0,19		510	8500,0	0,85
100	1666,7	0,21		520	8666,7	0,87
110	1833,3	0,23		530	8833,3	0,88
120	2000,0	0,25		540	9000,0	0,90
130	2166,7	0,28		550	9166,7	0,92
140	2333,3	0,30		560	9333,3	0,93
150	2500,0	0,32		570	9500,0	0,95
160	2666,7	0,34		580	9666,7	0,97
170	2833,3	0,36		590	9833,3	0,98
180	3000,0	0,38		600	10000,0	1,00
190	3166,7	0,40		610	10166,7	1,02
200	3333,3	0,42		620	10333,3	1,03
210	3500,0	0,45		630	10500,0	1,05
220	3666,7	0,47		640	10666,7	1,07
230	3833,3	0,49		650	10833,3	1,08
235	3916,7	0,50	Working point	660	11000,0	1,10
240	4000,0	0,51		670	11166,7	1,12
250	4166,7	0,53		680	11333,3	1,13
260	4333,3	0,55		690	11500,0	1,15
270	4500,0	0,57		700	11666,7	1,17
280	4666,7	0,59		710	11833,3	1,18
290	4833,3	0,62		720	12000,0	1,20
300	5000,0	0,64		730	12166,7	1,22
310	5166,7	0,66		740	12333,3	1,23
320	5333,3	0,68		750	12500,0	1,25
330	5500,0	0,70		760	12666,7	1,27
340	5666,7	0,72		770	12833,3	1,28
350	5833,3	0,74		780	13000,0	1,30
360	6000,0	0,76		790	13166,7	1,32
370	6166,7	0,79		800	13333,3	1,33
380	6333,3	0,81		810	13500,0	1,35
390	6500,0	0,83		820	13666,7	1,37
400	6666,7	0,85		830	13833,3	1,38
410	6833,3	0,87		840	14000,0	1,40
420	7000,0	0,89		850	14166,7	1,42
430	7166,7	0,91		860	14333,3	1,43
440	7333,3	0,93		870	14500,0	1,45
Working point according to EN 29053:						
Please set the flow on the needle valve of the flowmeter for sample dimension Ø 100mm to 235 cm³/min.						
This corresponds to a flow rate of 0.5mm/s. (Operating point according to EN 29053)						

Appendix D1



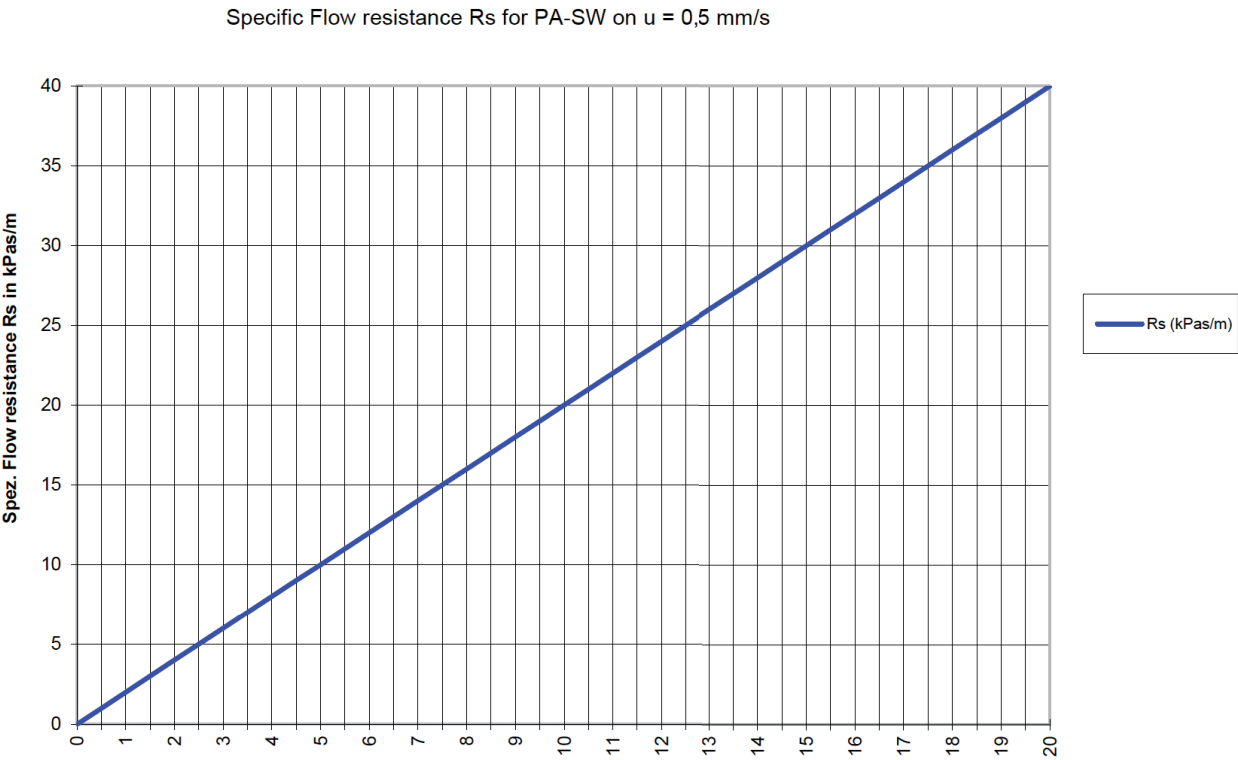
Curve Flow resistance R for apparatus PA-SW with sample container 100mm x 100mm

Appendix D2



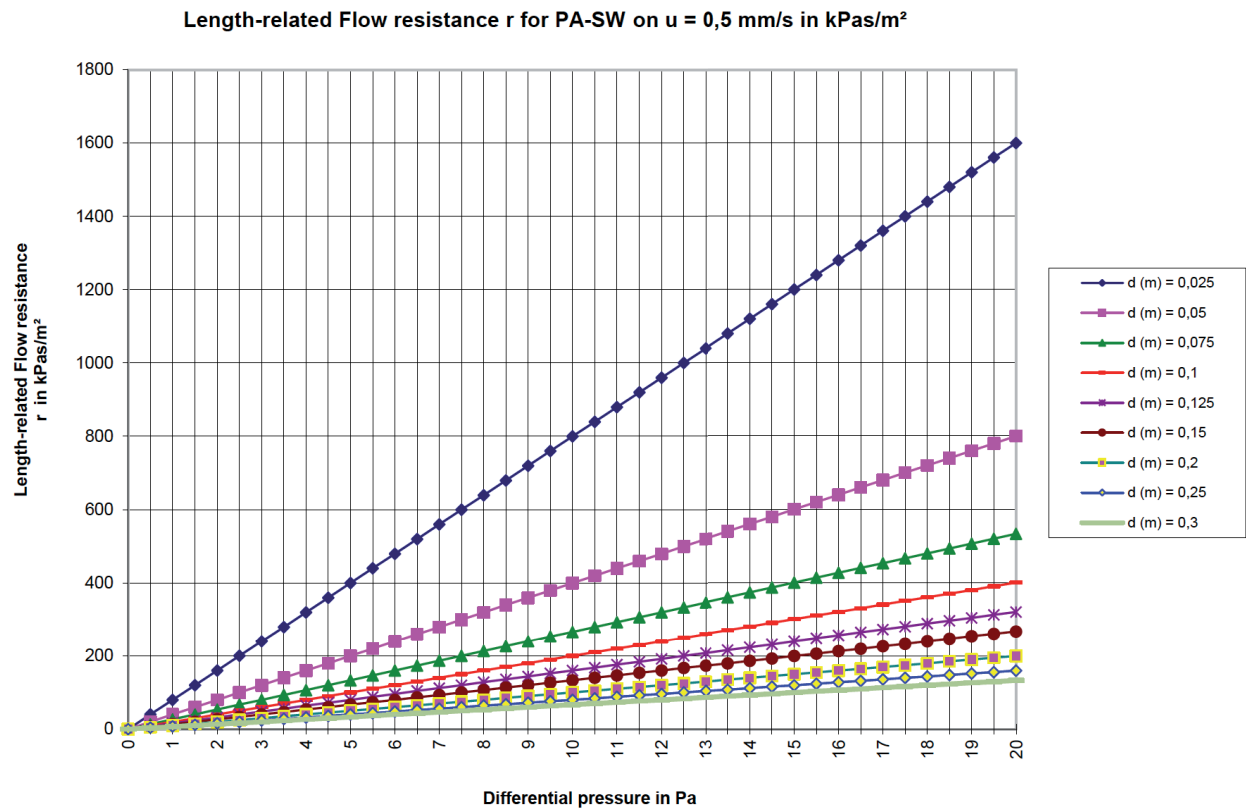
Curve Flow resistance R for apparatus PA-SW with sample container Ø100mm

Appendix E



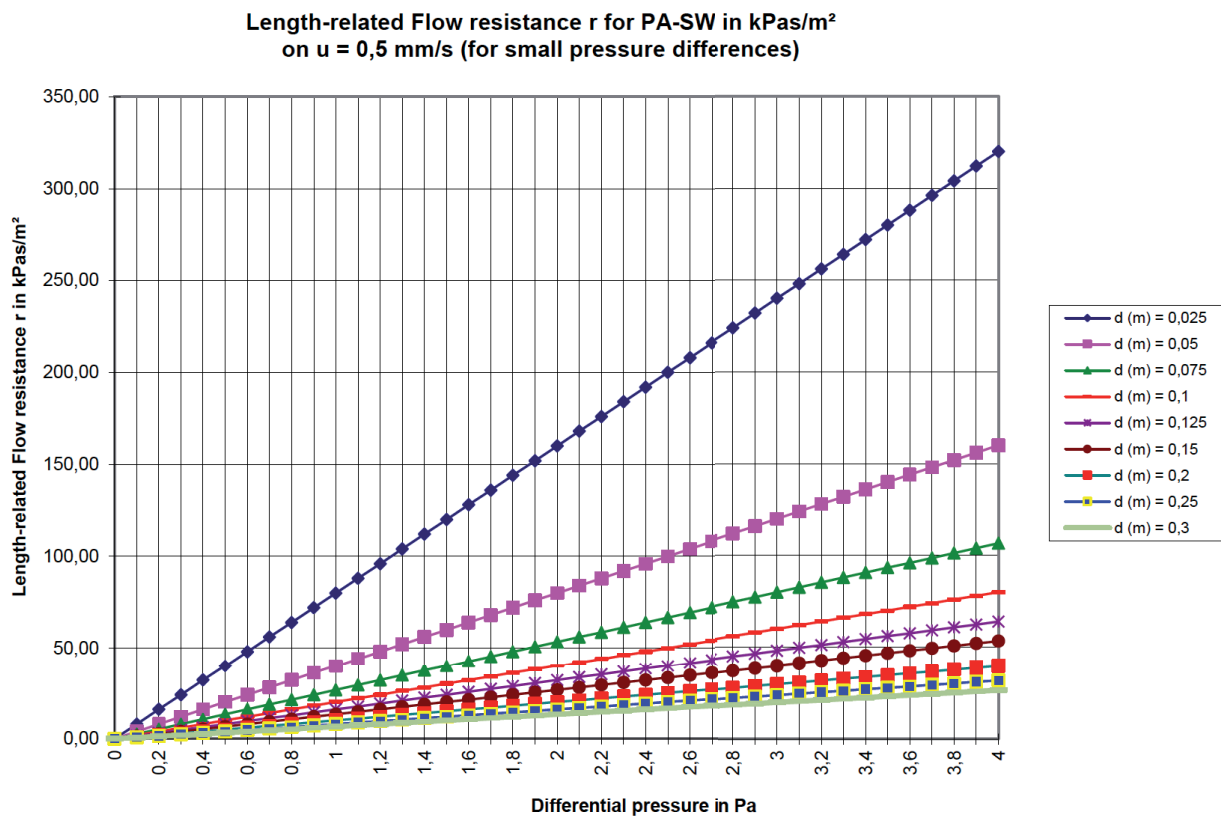
Specific Flow resistance for apparatus PA-SW on linear flow rate $u = 0,5 \text{ mm/s}$

Appendix F1



Length-related Flow resistance for apparatus PA-SW on $u = 0,5 \text{ mm/s}$,
Parameter: Sample thickness d

Appendix F2



Length-related Flow resistance for apparatus PA-SW on $u= 0,5$ mm/s
(for small pressure differences), Parameter: sample thickness d

Appendix G

Parameter setting for differential pressure transmitter FCO318

PIN	0000
Set PIN	0000
Filter	000,5
Display	0000
Units	0000
CST Unit	0000
DP low	-50,00
DP high	50,00
DEC PNT	0001
DSP low	-50,00
DSP high	50,00
RL1 ON	-49,00
RL1 OFF	-50,00
RL1 Dly	0000
Disp RL1	-0001
RL2 ON	49,00
RL2 OFF	50,00
RL2 Dly	0000
Disp RL2	-0001
AZ Delay	0000
Unit ID:	
Test	0000
Fail:	0000

for Device PA-SW, S.-No.