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**Dust Sampling and measuring Instrument**

# RESPICON 2 TM

**Technical Description and Instruction Manual**


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# Contents

# 1. Introduction

The measuring principle of the RESPICON 2 TM is a combination of inertial classification and concentration enrichment using a virtual impactor, filter sampling and aerosol photometry. It is a compact and easy to use instrument. Using only one sampling head, RESPICON 2 TM collects and monitors three size ranges according to the new European Standard EN 481- Size fraction definitions for measurement of airborne particles - workplace atmospheres -

RESPICON 2 TM measures simultaneously five health related size fractions.Three of these are measured directly. They are sampled simultaneously and monitored on - line.

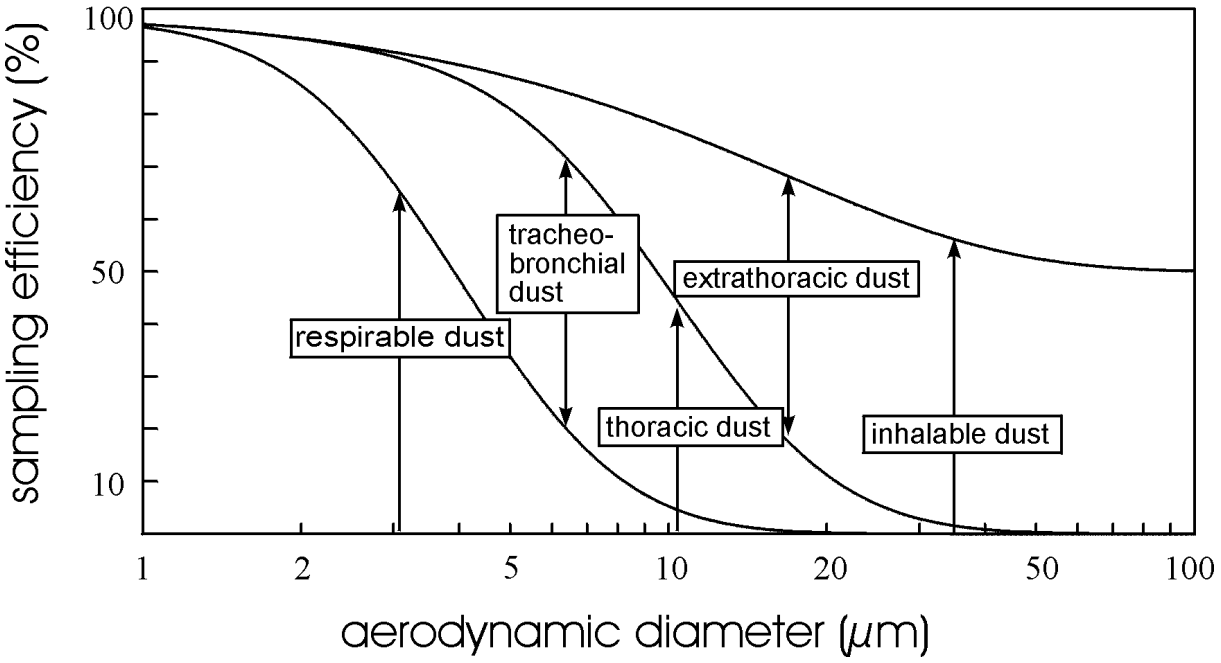
The three size fractions are:

- inhalable: representing the aerosol fraction that enters the nose and/ore mouth during breathing (50% cut-point at 100µm).
- thoracic: representing the subfraction of inhalable aerosol that penetrates into the respiration tract below the (50% cut-point at 10µm).
- respirable: representing the subfraction of inhalable aerosol that penetrates to the alveloar region of the lung. (50% cut-point at 4µm.)

Two additional fractions are derived from the above.

- extrathoracic fraction
- tracheobronchial fraction

RESPICON 2 TM was developed in cooperation with the Fraunhofer -Institute of Toxicology and Aerosol Research, Hannover, Germany. It has been designed for use at workplaces and may be used to characterize dust content and thus get a better medical evaluation of any possible hazards present in time with the convention for the collection and monitoring of health related dust fractions according to international standards.




Definitions of size fractions of the airborne dust for health oriented dust sampling.

There exist several standards defining health oriented dust measurements at work places: the German MAK list (list of maximum work place concentrations), the ISO-standard 7708-1996 (International Standardization Organization), and the European standard EN 481 (Definition of size fractions for the measurement of airborne dust at work places). Different dust fractions which are determined by the particle size dependent probability of inspiration, penetration and deposition of particles in the human respiratory system, are defined in these standards. The figure above shows the definition curves of three (respectively five) relevant size fractions according to the European standard EN 481. These curves are also adopted by the German MAK Commission.

The curve for the inhalable fraction represents the average probability of particles to enter the respiratory system via the nose or the mouth as a function of the aerodynamic particle diameter. Thus, the total area below this curves is the inspired fraction of the total suspended particulate mass. The thoracic fraction covers all inspired particles that pass the larynx and penetrate into the conducting airways (trachea, bifurcations) and the bronchial region of the lung. All particles entering the non ciliated region of the lung belong to the so called alveolar fraction. Two additonal fractions can be defined: The extrathoracic and the tracheo-bronchial fraction

obtained by substracting the inhalable and the thoracic, respectivly the thoracic and the alveolar fraction. Particles belonging to this fraction will pass the larinx but will not enter the alveolar region of the lung.

The above classification of the airborne dust accounts for the different potential health effects related to particles of different sizes.

The RESPICON 2 TM measures all five dust fractions simultaneously. The **alveolar**, the **thoracic** and the **inhalable** fraction are sampled on filters, and the respective concentrations are determined. From these data, the concentrations of the **extrathoracic** and the **tracheobronchial** fraction are calculated. Thus, the RESPICON 2 TM samples the airborne dust in accordance with both, the MAK list prescribing the measurement of alveolar and inhalable dust, as well as the EN standard encountering also the thoracic fraction.

The instrument can be used for stationary and for personal dust monitoring.

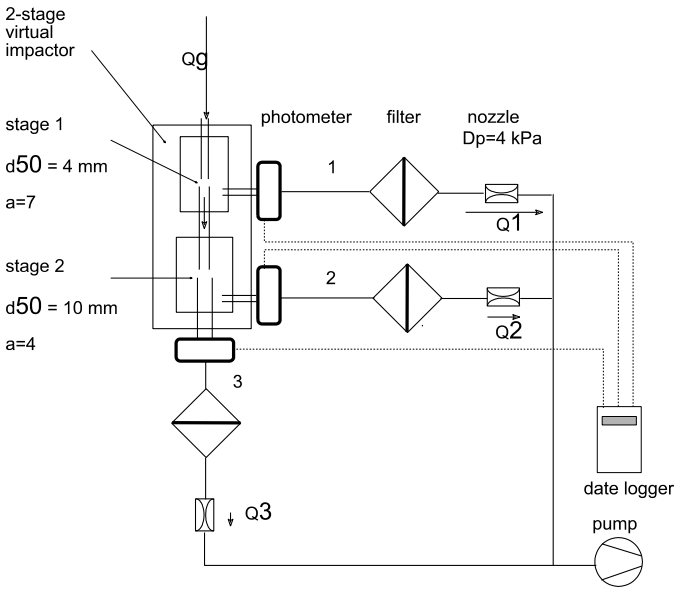
## 2. Measurement Principle

The RESPICON 2 TM consists of a two stage, virtual impactor which, together with filters, are in a symmetrical-rotation, concentric configuration. The airborne dust is drawn in through a ring gap and into the RESPICON 2 TM via a 3 stage flow divider. Coarse particles pass straigth through to the lower collector while other particles are aerodynamically separated. Particles of smaller diameter follow flow paths and are distributed into channels according to their flow characteristics. The first virtual impactor stage separates out the respirable fraction with a separation diameter of 4 µm. The second stage addresses the thoracic fraction with a separation diameter of 10 µm. Both these fractions are separated out through the re-directed air streams and the concentrically arranged filters. The coarse particles with an aerodynamic particle diameter larger than 10 µm are to be found on the last filter.

The aerosol fractions passing the 3 stages are measured by scattered light photometers continuously and simultaneously. Photometer 1 measures the respirable fraction. Photometer 2 and 3 measures the coarse dust fractions enriched by the factors 7 and 28. This enrichement increases the sensitivity of the photometers concerning coarse dust.

The sampling instrument is a two stage virtual impactor as shown in lower figure. The three sampling filters and the impactor are assembled in a concentric unit with cylindrical symmetry. The aerosol enters the instrument via an annular slit. Inside the instrument the total flow (flow rate of 6.2 l/min) is divided into three individual streams

with flow rates $Q_1$=5.32, $Q_2$=0.66, and $Q_3$=0.22 l/min. In each of the two stages of the virtual impactor the air flow is split up into one stream with a large and one stream with a small flow rate. The flow separation takes place occurs in the region of a virtual stagnation flow between two opposing nozzles. The major flow is deflected by 90°. The minor flow enters the lower nozzle. Suspended dust particles are classified with respect to their aerodynamic size. All particles with an aerodynamic diameter larger than a critical value, determined by the nozzle diameter and the flow velocity, do not follow the streamlines of the major flow and go straight into the nozzle of the minor flow. Thus, the major flow contains no suspended coarse particles. The small particles with low inertia follow the stream lines.




Schematic working principle of the Respicon 2 TM

## 3. Operating the instrument


The dust sampling and measuring instrument, RESPICON 2 TM, consists of a mantle unit with a tube fitting to connect the sampler with the suction pump; an inlet head; three units to support the filter cassettes and the impactor nozzles (1); and a assembling cylinder and a disk (2) helping to assemble and disassemble the instrument. The flow rates can be measured using the flow checker (3) in together with the corresponding adapter (4) (default parts).

### *3.1 Preparation for sampling*

First disassemble the instrument. Open the lock by slightly pressing on the inlet head and turning it counter clock wise. Place the instrument on top of the assembling cylinder.

The pin on the underside of the body unit must be put into the corresponding groove of the assembling cylinder.

Put the disk on the sampling instrument. Press steadily on the disk. The filter supports will come loose and the mantle can be pushed down


Label the filters (glass fibre filters with central hole: part number 001.0085.007, glass fibre filters without central hole: part number 001.0001.014) before loading the instrument. Determine the weight of the plain filters and store weights and filter ID numbers using the data evaluation form on page 22.

Proceed following the figures and the instructions below:

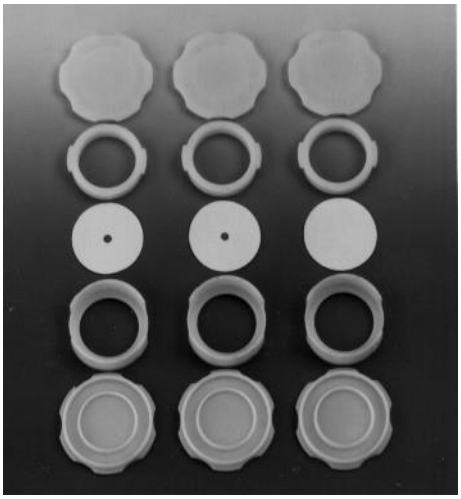
Top lid of the transport case

Top ring of the filter cassette

Filter with hole, without hole

Bottom ring of the filter cassette

Bottom lid of the transport case



Insert the filter in the cassettes (part number: 001.0001.017). Then put the filter cassettes containing the filters with hole into the supports #1 and #2, respectively, and put the filter cassette containing the filter without hole into the support #3.
See page 13.


The filters must be carefully centered in relation to the filter-cassettes and filter - supports no. 1 and no. 2. For that reason first insert the filter-cassettes into the filter-supports. Than insert (center) the filter to the filter-cassettes and lock each filter-cassette with the top ring (coverlid) of the filtercassette.
Make sure that the O-rings of the filter supports fit properly in the respective grooves.
*Important notice! During the storage of the RESPICON 2 TM the three filter supports should be taken out in order to protect the O-rings.*

Each of the filter support units is labeled by one or several carved rings on the upper section of its mantle.

Support #1: one ring

Support #2: two rings

Support #3: three rings

*Filter support unit 1-3, filter cassettes, filters and light trap adapter on top.*

Before starting the sampling procedure assemble the filter supports loaded with cassettes and filters as follows: put support #2 on top of support #3, and support #1 on top of support #2. The ring labels of the supports must be at the top.
After assembling, close the filter supports with light trap adapter,
articelnr.: 01
1.8703.0).

Now put the mantle of the instrument over the assembling cylinder.

Stack up the filter supports loaded with cassettes and filters on the assembling cylinder. Make sure that they are in the right order, i.e. #3 at the bottom, #1 at the top.
The pin on the underside of the body unit must be put into the corresponding groove of the assembling cylinder.

Now lift the mantle so that it loosely covers the supports.

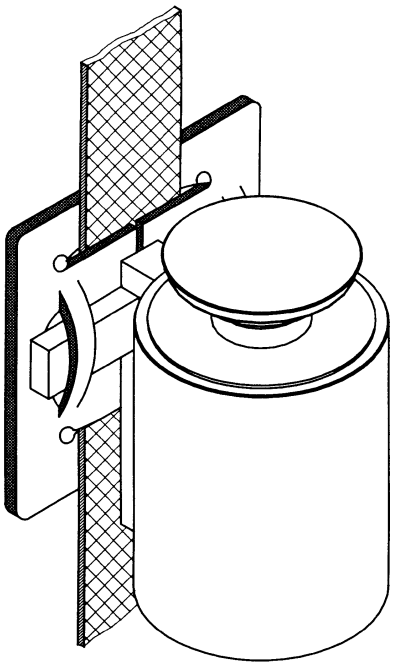
Make sure that the O-rings are clean when introducing the filter supports into the mantle. Remove the instrument from the assembling cylinder

Now press the filter stages into their final position inside the mantle. Use the assembling cylinder to press the stages firmly into the mantle. Make sure that there is no remaining gap between filter stage #3 and the mantle.

Then, screw the inlet head into the thread on top of the mantle.

### *3.2 Taking samples*

For personal sampling connect the instrument to the carrying belt by first fixing the adapter at the belt and then inserting the instrument into the adapter (as shown in the drawing). For taking stationary samples mount on top of a tripod.



Now use the silicon tube to connect the suction pump with the sampling instrument. Set the pump flow rate to 6.2 l/min. The internal flows are adjusted automatically by three capilary nozzles inserted in the instrument mantle. The pressure drop of each nozzle is 4kPa. When you do not use one of the pumps recommended in the Appendix make sure that the pump is able to maintain a flow rate of at least 6.2 l/min at a pressure drop of 4.4 kPa. The pressure drop of the (first) sampling filter is approximately 400 Pa

The pressure drop may increase during sampling due to the dust deposit. The suction pump has to compensate for this.

### *3.3 Unloading the instrument*

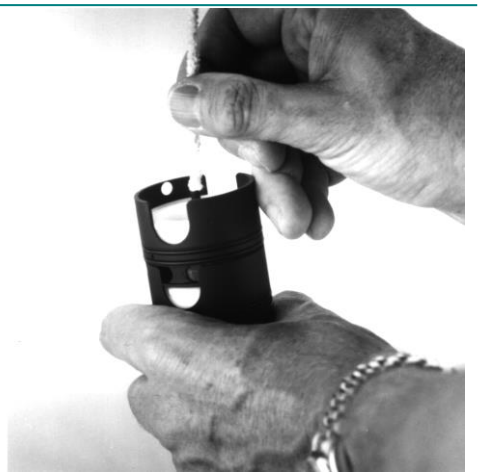
Open the sampling instrument by pressing on the inlet head and turning it counter clock-wise. Now put the instrument on the assembling cylinder.

Put the flat disk on the sampling instrument. Press steadily on the disk. The filter supports will come loose and the mantle can be pushed down.


Now remove the filter cassettes and put them into the transport containers.

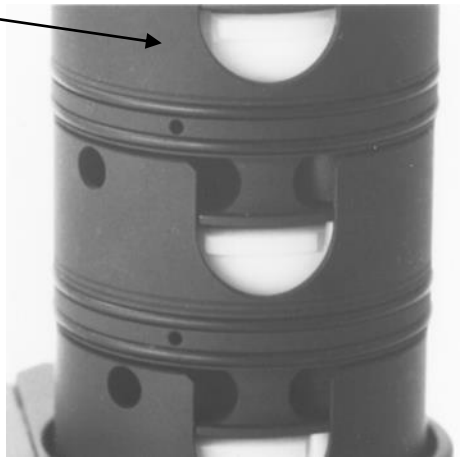
**Attention:** Label the cassettes containing the filters with the central hole in order not to mix up the cassettes #1 and #2.

### *3.4 Cleaning the instrument*



Remove any deposits in the impactor nozzles using the pipe cleaner (default part). Clean the inlet head with dry pressurized air or rinse it in a water stream. In this case dry the inlet head thoroughly. Eventually use dry pressurized air. Similar procedure is recommended to clean each filter support fine flow capillaries.

Cleaning the lenses: Blow out any dust particles with compressed air. Then clean the lenses using a Q-tip. Don´t use any kind of agressive liquids or materials.



**Attention:** Don´t scratch or damage the black coatings of all internal pieces. Failures can have influence regarding the photometer measurement.

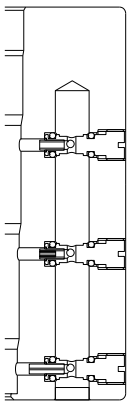
Colour-Code of exchangeable oriffices of RESPICON 2 TM

Top side RESPICON 2 TM

white

blue

black



Basement of RESPICON 2 TM

### *3.5 Measuring the internal flow rates*

You will find a flow checker in your instruments kit (part#: 001.0085.002).

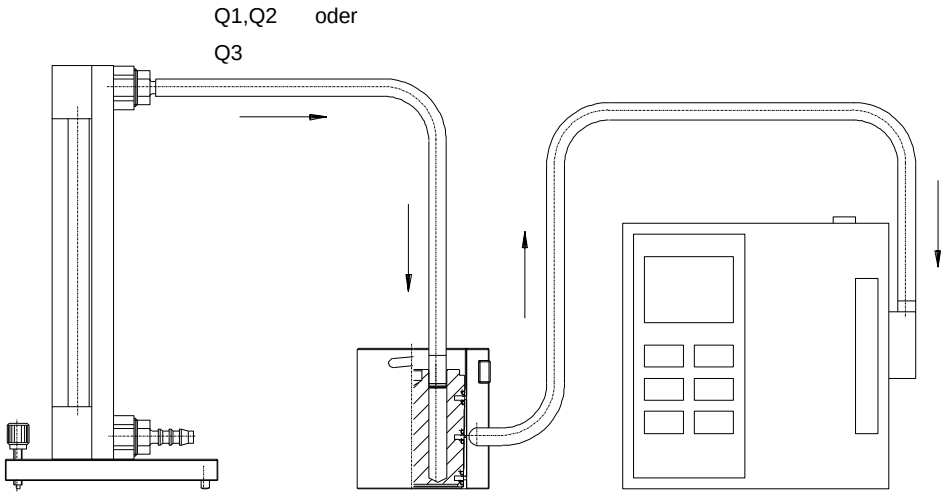
In order to measure the internal flow rates insert the flow checker instead of the filters into the mantle.


Press it completely into the mantle. Eventually use the inlet head or the tube adapter.


Turn on the pump adjusted to 6.2 l/min so that air is drawn through the flow checker. Now measure the internal flow rates $Q_1$,$Q_2$, and $Q_3$ following the instructions below:

To measure the internal flow $Q_1$, plug the fitting into the corresponding opening of the flow checker (labeled $Q_1$). Now connect the flow checker with the outlet of the rotameter #1 (measuring range 0-4000 ml/min) using the flexible tube.

The flow rate Q1 can be read directly.
Follow the same procedure to measure the internal flow rates $Q_2$ and $Q_3$. However, use rotameter #2 (measuring range 0-380 ml/min) instead of rotameter #1.




Rotameter

RESPICON 2 TM with flow check adapter for Q1, Q2 and Q3

constant volume sampling pump

The total flow rate, $Q_G$, can also be measured directly. Remove the fitting from the flow checker and put the tube adapter (part #: 001.0085.005) on the flow checker. Make sure that there are no leaks.


Connect the tube adapter with the outlet of the rotameter #1 and read the total flow rate $Q_G$.

These measurements can also be done with the instrument loaded with filters. Simply remove the flow checker and insert the filters and filter supports following the instruction of section 2.1. However, close the instrument with the tube adapter instead of the inlet head.

Note the following: the rotameters are calibrated under STP-condition (standard temperature and pressure conditions; see also calibration sheets of the rotameters). Deviations from STP-condition can be corrected for by measuring temperature and pressure or by measuring the flows using a bubble flow meter (part# see Appendix).

The difference between the measured flow rates from the intended values should be no more than shown at page 27. If this is not the case, check the internal nozzle for impurities using the flow checker. If necessary, unscrew the orifices, clean the nozzles by blowing oil and particle free pressurized air through them. If there is no improvement ship the instrument for factory check-up to your local supplier or directly to Hund, Wetzlar. Fluctuation of the total flow rate by ±5% caused by the control circuit of the suction pump can be tolerated. These fluctuation do not affect the ratios of the internal flows.

# 4. Data Analysis

## Important Information!

The mass loadings of the three filters are not completely independent from each other. This is due to the way the virtual impactor works. When $m_1$ is the mass loading of the first filter, the second and third filter shoud at least have loadings corresponding to:
$m_2 = 0.124\ m_1$
$m_3 = 0.04\ m_1 + 0.33\ (m_2 - 0.124\ m_1)$
You should use these values in the evaluation spread sheet when $m_1$ can be safely determined but the mass loadings of filter 2 and filter 3 are below the detection limit. Never use zero for $m_2$ and $m_3$ when $m_1$ is not zero.

The mass concentration of the aerosol size fractions can be calculated from the aerosol masses, $m_1$, $m_2$, $m_3$ (in mg), deposited on the filters, the sampling time, $t_s$ (in min), and the volume flow rates, $Q_1$, $Q_2$, $Q_3$ (in l/min), according to the following algorithm:

Concentration of the alveolar fraction:

| | | | | |
|---|---|---|---|---|
| $c_R$ | = | $m_1 * 1000 / (Q_1 * t_s)$ | in | mg/m$^3$ |

Concentration of the thoracic fraction:

| | | | | |
|---|---|---|---|---|
| $c_{Th}$ | = | $(m_1 + m_2) * 1000 / ([Q_1 + Q_2] * t_s)$ | in | mg/m$^3$ |

| | | | | |
|---|---|---|---|---|
| $c_i$ | = | $(m_1 + m_2 + m_3) * 1000 / ([Q_1 + Q_2 + Q_3] * t_s)$ | in | mg/m$^3$ |

Concentration of the extra-thoracic fraction:

| | | | | |
|---|---|---|---|---|
| $c_{exth}$ | = | $(c_i - c_{Th}) * 1.5$ | in | mg/m$^3$ |

Concentration of the inhalable fraction:

| | | | | |
|---|---|---|---|---|
| $c_I$ | = | $(c_{Th} + c_{exth})$ | in | mg/m$^3$ |

Concentration of the tracheobronchial fraction:

| | | | | |
|---|---|---|---|---|
| $c_{tb}$ | = | $(c_{Th} - c_R)$ | in | mg/m$^3$ |

The concentration of the inhalable fraction, $c_I$, is obtained by adding the concentration of the thoracic fraction, $c_{Th}$, and the extrathoracic fraction, $c_{exth}$.

## RESPICON 2 TM Data Evaluation Form

| | |
|---|---|
| Organization/company:: | Sampling location: |
| Date: | Operator: |
| Label of filter set: | Working area: |

| | |
|---|---|
| Start: | End: |
| Sample time $t_S$ in min.: | Rem..: |

| Filter label\|stage # - # | mass plain (mg) | mass with deposit (mg) | mass deposit (mg) | cumulative mass (mg) | sampling volume (l) |
|---|---|---|---|---|---|
| | | | $m_1$= | $m_1$= | $V_1$=5.32 $t_S$ = |
| | | | $m_2$= | $m_1+m_2$= | $V_2$=5.98 $t_S$ = |
| | | | $m_3$= | $m_1+m_2+m_3$= | $V_3$=6.2 $t_S$ = |

| Dust fraction | Concentration (mg/$m^3$) |
|---|---|
| $c_R = m_1 * 10^3/V_1$ | |
| $c_{Th} = (m_1+m_2) * 10^3/V_2$ | |
| $c_i=(m_1+m_2+m_3)* 10^3/V_3$ | |
| $c_{exth} = (c_i-c_{Th}) * 1.5$ | |
| $c_I = c_{Th}+c_{exth}$ | |
| $c_{tb} = c_{Th}-c_R$ | |

## 5. Calibration of the flow rates using the bubble flow meter

### *5.1 General remarks*

A bubble flow meter is a primary method for the measurement of volume flow rates. Within the measuring range of the tube the measuring error is smaller than 1 %. The air can either be sucked or pushed through the tube. For the Respicon the air is sucked through the measuring tube. Bubbles are generated by squeezing the ball filled with a soap solution. The bubbles are entrained by the air flow. Using a stop-watch one measures the time that the bubbles need to pass the two most distant labels on the tube wall. By repeating the measurments a small error margin can be achieved. The volume flow rate, Q, for the actual pressure and temperature conditions is calculated from:

$$Q=V/t.$$

V is the tube volume between the two measuring labels, and t is the corresponding travelling time of the bubbles.

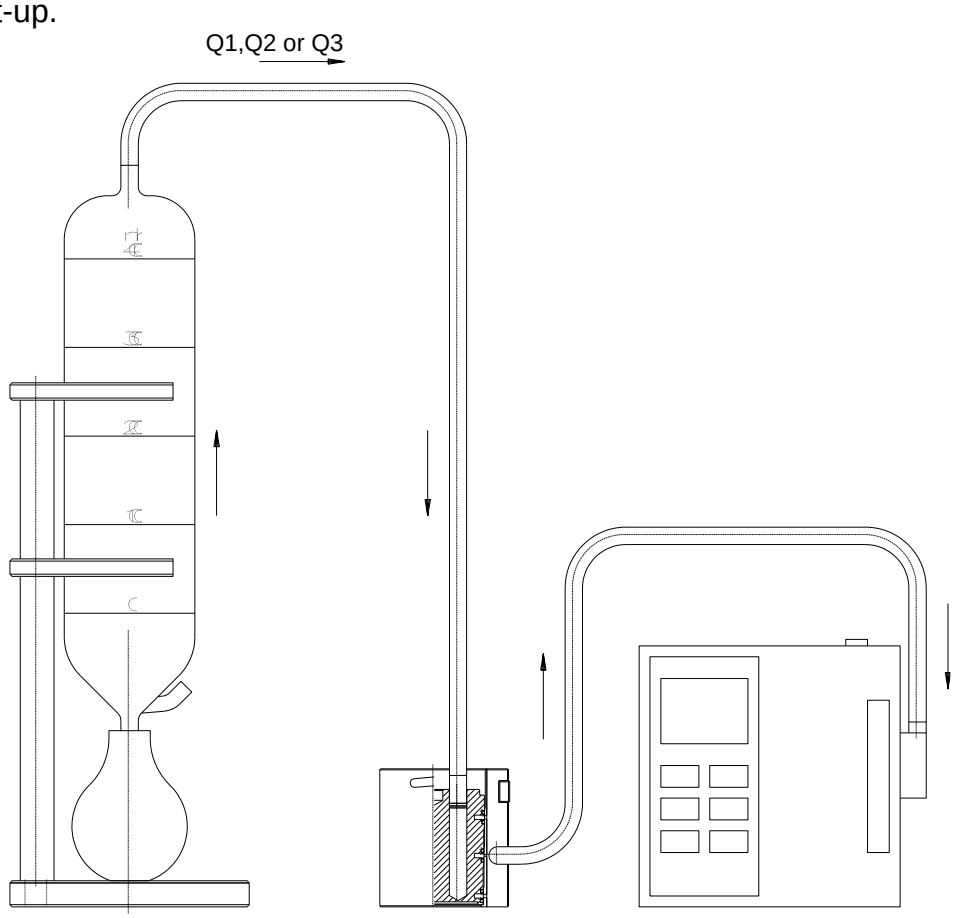
For field measurements, the temperature and the pressure values should deviate no more than 15°C, respectively, 10 mbar, from those for the calibration. Otherwise, the internal and the external flow meters should be recalibrated.

Limit values for the dust concentration are generally defined in terms of miligrams per unit volume of air not corrected for temperature, pressure and relative humidity. Since the bubble flow meter measures the volume flow rate for the prevailing atmospheric condition it provides a calibration standard in accordance with the existing guidelines for dust sampling.

### *5.2 Checking the total flow rate, $Q_G$.*

(should be done before each dust measurement)

Fig1: Set-up.




1) Connect the bubble flow meter, the RESPICON 2 TM and the pump according to Fig.1. Use the flexible tubes (inner diameter 5 mm, length 70 cm).
2) Turn on the pump and generate several bubbles to wetten the inner surface of the measuring tube.
3) Measure the time, $t_G$, for a bubble to pass two labels defining a certain volume, $V_G$, of the tube and calculate the total volume flow, $Q_G$:

$$Q_G=V_G/t_G$$

Compare the measured and the intended flow rate. Eventually, readjust the flow rate setting of the pump (see corresponding instruction manual) and repeat the measurement.

The tolerable flow rate margins are given in the table below:

| | | | | | | | Min. l/min | Max. l/min |
|---|---|---|---|---|---|---|---|---|
| $Q_G$ | - | nominal | = | 6.222 | l/min | ± 2% | 6.0976 | 6.3464 |
| $Q_1$ | - | nominal | = | 5.332 | l/min | ± 3% | 5.1187 | 5.5453 |
| $Q_2$ | - | nominal | = | 0.666 | l/min | ± 8% | 0.6127 | 0.7193 |
| $Q_3$ | - | nominal | = | 0.222 | l/min | ± 12% | 0.1954 | 0.2486 |

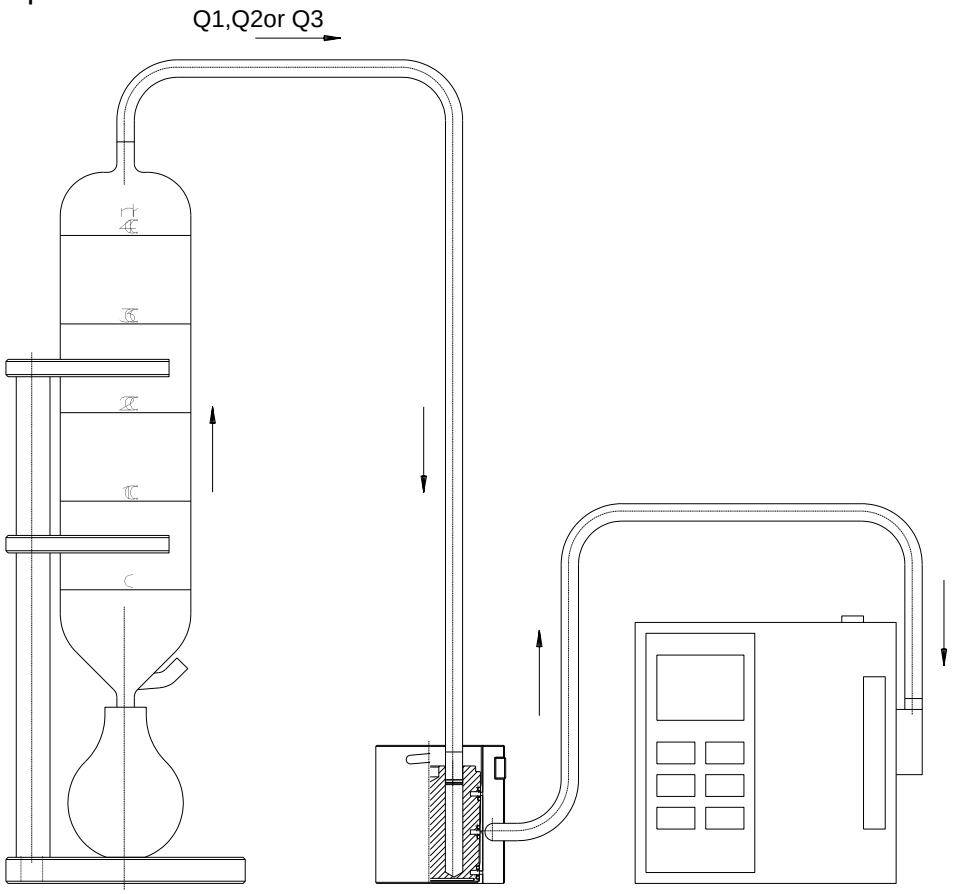
The flow rate check is completed when the measured values are inside the margins. Since all other flow rate values depend on $Q_G$ ( $Q_G = Q_1 + Q_2 + Q_3$) make sure that the $Q_G$ meets the intended flow rate as closely as possible.

In order to achieve a high accuracy in your flow rate measurements use a large measuring volume ( for example 400 ml) for $Q_G$ and $Q_1$ and a smaller one (100 ml) for $Q_2$ and $Q_3$.

### *5.3 Measuring the flow rates, $Q_1$,$Q_2$, $Q_3$.*

(should be done after 10 dust measurements)

Fig.2: Set-up.




bubble flow meter

RESPICON 2 TM with flow check adapter to measure Q1, Q2 and Q3

constant volume sampling pump. Keep flow setting constant!

Remove the filter and impactor stages from the RESPICON 2 TM and insert the flow checking element. Make sure that the flow checker is completely inside the mantle connect pump, flow checker and bubble flow meter according to fig.1. Do not change the flow rate setting of the pump. To measure the flow rate Q1 connect the bubble flow meter with the outlet of the flow checker labeled Q1. Use the fitting. Measure the flow rate according to section 5.1. Repeat this procedure for $Q_2$ and $Q_3$.

### *5.4 Possible reasons for incorrect flow rates.*

When the flow rates of the RESPICON 2 TM deviate from their intended values, please first check all o-ring sealings of the flow checker for damage and replace them if necessary. Also check the capillaries (controling $Q_1$, $Q_2$, and $Q_3$) for dust deposit. The unscrewed orifices and nozzles can be cleaned by blowing dry and oil free compressed air through them, or weep off dirt by using a weak brush. Under no circumstances use a needle to clean the nozzles ore unscrewed orifices. This may lead to irreversible damage. Repeat the flow rate check after the cleaning procedure. Make sure that the pump is operating correctly.

If you don't achieve a proper matching of the measured flow rates with the intended values, please ship the RESPICON TM or a general check-up to your local dealer or directly to Hund, Wetzlar.

From time to time the total flow rate should be checked using the flow checker (according to Fig. 2) as well as using the complete instrument (according to Fig 1). Both methods should give the same results. Deviations are generally due to damaged O-ring sealings. Please, replace the sealings of the respective components for which the lower flow rate value was obtained. The sealings of the inlet head should be checked frequently since they suffer the biggest abrasion.

## 6. Maintenance

**Overview**

The RESPICON 2 TM is a very low maintenance instrument. Maintenance consists almost entirely of cleaning the instrument and checking flow rates.

maintenance Schedule

The maintenance schedule for the RESPICON 2 TM is largely determined by useage patterns. If the instrument is used in very dusty, dirty conditions, it will obviously require more frequently cleaning than if used in relativly clean conditions. The table below summarizes the recommended procedures and frequency.

**Recommended Maintenance before Each Use**

| Item | Frequency |
|---|---|
| Check O-Rings | Before each use |
| Clean impactor nozzels | Before each use |
| Perform total flow check | Before each use |

**Recommended Maintenance: Every Fifth Use**

| | |
|---|---|
| Perform stage flow check | Every fifth use (more often for dirty conditions) |

**Recommended Maintenance: Non-Routine**

| | |
|---|---|
| Clean orifices | Quaterly, or if unable to obtain correct flow on each stage |
| Clean filter stages, body unit | As needed |
| Clean inlet head | As needed |
| Replace O-rings | Only if damaged |
| Replace orifices | Only if damaged |

**Check O-rings**

The RESPICON 2 TM contains 13 O-rings; each one of them is important for Maintaining good seals and correct flowrates within the instrument. The user should become familiar with the location of each O-ring and should routinely inspect them prior to assembly of the instrument. The following list details the size and location of each O-ring. It also identifies those O-rings which need special attention, due to their importance or special conditions.

**List of O-rings**

| Location | Diameter | Special Concerns |
|---|---|---|
| Pertimeter of inlet head | 42mm | Subject to frequent twisting; may distort or tear |
| Underside of inlet head; underside of 1 st and 2nd filter stage (x3) | 32mm | May become dislodged |
| Top of each filter stage (x3) | 32mm | N/A |
| Perimeter of each filter stage (x6) | 42mm | N/A |

Note: Do not use or grease or other lubricant on the O-rings, as this may cause the flow orifices to plug.

## 7. Troubleshooting

The table below list the symtoms, possible causes and recommended solutions for common problems encounterd with the RESPICON 2 TM

| Symptom | Possible Cause | Corrective Action |
|---|---|---|
| When using totale flow checker or stage fow checker, flow rates are incorrect. | Leak | Check connection for leaks.Make sure tubing is correct size and tightly fitting.<br><br>Check O-rings. Make sure all O-rings are properly installed; not twisted or torn.<br><br>Tighten adapter (turn clockwise) |
| | Dirty impactor nozzle. | Clean virtual impactor orifices and capillaries using pipe cleaner or compressed air |
| | Dirty orifice(s). | Unscrew and remove orifice(s). Clean with compressed air or mild soap solution. Blow dry with clean compressed air. DO NOT INSERT OBJECT INTO ORIFICE! Reinstall. |
| | Pump setting is incorrect. | Using the total flow checker, set the pump flow rate to 6.2 Lpm. Once total flow is incorrect, verify individual flows. |

| | | |
|---|---|---|
| Incorrect flow rate, continued. | Pump not able to maintain proper flow rate. | Verify operating parameters on pump; make sure pump is rated for this application.<br><br>Make sure batteries are fully charged (or operate with AC adapter). |
| | Flow checking components are connected incorrectly. | Verify that rotameter, RESPICON 2 TM flow checker and sampling pump are connected in correct manner. |
| | Wrong filters installed (filters may have too high pressure drop) | Use only HUND approved filters in RESPICON 2 TM, ask for filters recommended |
| There is no measurable deposit on the first filter stage (respirable fraction) or negativ mass weighted | Improper scale used for weighing filter. | Use scale with microgram resolution (scale with milligram resolution may not be adequate to measure small amounts of particles). |
| | Samle period was too short; insufficient particles deposited upon filter. | Sample for longer period of time (preferable 8 hour minimum). |
| | Air contains very low concentrations of aerosol. | No solution. |

# 8. Technical Data

## *8.1 Components of RESPICON 2 TM*

2-stage virtuel cascade impactor (base unit)
Data logger
Software
Filter cassettes
Consumables, filters, accessoires

## *8.2 Sampling system*

| | |
|---|---|
| system: | dust sampling system for 3 dust fractions |
| measured dust fractions: | - inhalable fraction<br>- thoracic fraction<br>- alveolar fraction |
| calculated fractions: | - tracheo bronchial fraction<br>- extra thoracic fraction |
| mode of operation: | - personal sampling<br>- stationary sampling |
| mechanism of the size classification: | two-stage virtual impactor |
| filters: | - glass fiber filter<br>- membrane filter with pore sizes > 2 µm<br>- see recommended filterlist |
| height: | 82 mm |
| width: | 60 mm |
| weight: | approx. 230 g |
| thread for tripod: | WHITWORTH W ¼'' on filter cassette support No. 3 |

### *8.3 Sampling pump requirements*

| | | |
|---|---|---|
| operation time: | min 8 hours battery power | |
| flow rate: | 6.2 | l/min, adjustable |
| pressure drop: | 4 | kPa |

flow rate feed back control

battery power for at least 8 h sampling duration

automatic switch off after preset sampling time

### *8.4 Scattered-light photometer*

Three photometric dust sensors

| | |
|---|---|
| Measuring range: | 0- 10mg/ $m^3$ for DEHS particles1µm (Diethylhexasebacate) |
| Detection limit: | about 30 µg/$m^3$ for DEHS particles |
| Signal output voltage: | 0-4 V each stage |

Data proccessing, averaging, storing of the three output signals via portable data logger.

## 9. Warranty

The warranty period for HUND dust measuring instruments shall be 12 months from passing of risk.

Parts proven as defective shall be repaired (HUND has three attempts) or replaced by HUND at his discretion and at its own expense. HUND shall not be liable for consequential, indirect or incidental damages, including without limitation loss of profit and production.

The Buyer shall notify HUND in writing immediately on occurrence of a defect informing HUND in detail of the nature and the probable cause of the defect.

Parts subjected to wear and tear, improper use and external factors are excluded.

The warranty period for goods not produced by HUND (goods of trade) will be the period provided by the original manufacturer of these goods.

## 10. Waste Disposal Remark

**European Union (EU) Waste of Electrical and Electronic Equipment (WEEE) directive**

The European Union's WEEE directive requires that products sold into EU countries must have the crossed-out trashbin label on the product (or the package in some cases). As defined by the WEEE directive, this crossed-out trashbin label means that customers and end-users in EU countries should not dispose of electronic and electrical equipment or accessories in household waste. Customers or end-users in EU countries should contact their local equipment supplier representative or service center for information about the waste collection system in their country.

## 11. Safety Remark

The Respicon 2 TM works on infrared diode lasers that are only activated during the actual measurement or in the "Show data" mode. From its intrinsic design, their radiation will always remain inside the device. It is therefore a Class-1 laser product according to EN 60285-1. **On principle, the Respicon 2 TM should NEVER be operated without stage inserts and inlet head! NEVER open the device during a measurement because in this situation, it will correspond to laser class 3R or above.**

## 12. Copyright



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