LIQUID ABSORPTION SAMPLING METHOD

使用例

Contents

1、Environmental regulations
2、Liquid absorption sampling method
3、Remarks
4、Advantages of Σ-series
5、Exercise

Environment Pollution

Vietnamese Standard

Ambient air environmental standards

(mg/m^3)

		Hourly average	8 hrs average	Daily average
Carbon monoxide	CO	40	10	5
Nitrogen dioxide	NO2	0.4	-	0.1
Sulfer dioxide	SO2	0.5	-	0.3
Lead particle	Pb	-	-	0.005
Ozone	O3	0.2	-	0.06
Suspended particle	SS	0.3	-	0.2

*Analyzing method is mentioned in Vietnamese standard(TCVN)

Standard value of factory exhaust gas

(mg/m^3)

		Standards		
		Vietnam(TCVN5939-1995)		Japan
		A	B	
1	Particulate Organic Matter	400	200	30-250
	Metallic furnace			
	Asphalt factory	500	200	
	Cement factory	400	100	
	Other factory	600	400	
2	Dust	100	50	-
	Silica component			
	Asbestos	none	none	-
3	Antimony	40	25	-
4	Arsenic	30	10	-
5	Cadmium	20	1	1
6	Lead	30	10	10,20,30
7	Copper	150	20	-
8	Zinc	150	30	-
9	Chloride	250	20	-
10	HCl	500	200	80,700
11	Fluoride, HF(any source)	100	10	1-20
12	H2S	6	2	-
13	Copper	1500	500	-
14	SO2	1500	500	K-factor regulation, total amount regulation, concentration
15	Nox (any source)	2500	1000	120-1640
16	NOx	4000	1000	
17	H2SO4 (any source)	300	35	-
18	HNO3	2000	70	-
19	Ammonia	300	100	-

1、Applied for existing facility

2、Applied for new facility

3、From Air Pollution Control Act

4、Depending on type and size of facility

Referential manual in Vietnam (Example)

Designation: D 1607 – 91 (Reapproved 2000)$^{\epsilon 1}$

Standard Test Method for Nitrogen Dioxide Content of the Atmosphere (Griess-Saltzman Reaction)[1]

This standard is issued under the fixed designation D 1607; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

ϵ^1 NOTE—Editorial corrections were made throughout in September 2000.

1. Scope

1.1 This test method[2] covers the manual determination of nitrogen dioxide (NO_2) in the atmosphere in the range from 4 to 10 000 μg/m^3 (0.002 to 5 ppm(v)) when sampling is conducted in fritted-tip bubblers.

1.2 For concentrations of NO_2 in excess of 10 mg/m^3 (5 ppm(v)), as occur in industrial atmospheres, gas burner stacks, or automotive exhaust, or for samples relatively high in sulfur dioxide content, other methods should be applied. See for example Test Method D 1608.

1.3 The maximum sampling period is 60 min at a flow rate of 0.4 L/min.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

D 1357 Practice for Planning the Sampling of the Ambient Atmosphere[5]

D 1608 Test Method for Oxides of Nitrogen in Gaseous Combustion Products (Phenol-Disulfonic Acid Procedure)[5]

D 3195 Practice for Rotameter Calibration[5]

D 3609 Practice for Calibration Techniques Using Permeation Tubes[5]

D 3631 Test Methods for Measuring Surface Atmospheric Pressure[5]

E 1 Specification for ASTM Thermometers[6]

E 128 Test Method for Maximum Pore Diameter and Permeability of Rigid Porous Filters for Laboratory Use[7]

3. Terminology

Japanese air environment standard(Extract)

Environmental standards regarding ambient air pollution

Subject		Regulations
Sulfur dioxide	SO2	Hourly value of daily average must be under 0.04ppm, and its hourly value must be under 0.1ppm(48.5.16)
Carbon monoxide	CO	Hourly value of daily average must be under 10ppm, and its hourly value of 8 hours average must be under 20ppm(48.5.8)
Suspended particle matter	SPM	Hourly value of daily average must be under 0.10ppm, and its hourly value must be under 0.20ppm(48.5.8)
Nitrogen dioxide	NO2	Hourly value of daily average must be under or between 0.04ppm and 0.06ppm(53.7.11)
Photochemical oxidant	OX	Hourly value of daily average must be under 0.06ppm(48.5.8)

Examples of environmental regulations in Japan

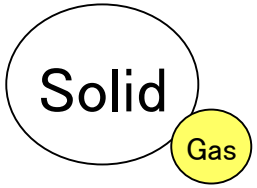
Subject	Law	Standard
Ambient air environment	Air Pollution Control Act	Standard regarding air pollution
Work environment	Industrial Safety and Health Act	Working environment evaluation standard
	Outdoor Work Area Guideline	Working environment evaluation standard
Indoor environment	Guideline for Indoor Air Contamination	Guideline values for indoor air concentration
	Building Maintenance Regulation	The management standard of environmental sanitation for buildings
	Regulation for Ensuring the Quality of Public Works	Comprehensive Assessment System for Building Environmental Efficiency
	School Health Act	Standard for School Environment and Hygiene
Odor	Offensive Odor Control Act	Regulatory Standard of Offensive Odor
Water quality	Water Quality Pollution Control Act	Standard regarding health protection
Soil	Soil Contamination Countermeasures Act	Standard regarding soil contamination

Environmental measurement practiced in Japan

	Sampling subject	Measurement manual	Measuring method
Ambient air pollution	SO2	Manual for regular monitoring system of air pollution	Automatic measurement
	CO		
	SPM		
	NO2		
	OX		
	Hazardous air pollutant	Hazardous air pollutant measurement manual	・ Filtration sampling method ・ Direct samling method ・ Solid absorption sampling method ・ Liquid absorption sampling method
Work environment	Dust	Guidebook for working environment measurement	
	VOC		
	Metal		
	Particular chemicals		
Indoor environment	VOC	Guidebook for working environment measurement	
	Aldehyde		
	Phthalic		
	Agrichemical		
All	All	Sanitation testing	

Sampling method

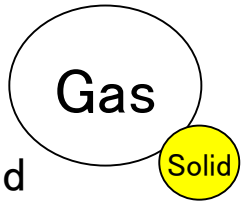
- Filtration sampling method 【Dust, , Asbestos, Metal･･･etc 】
  - Sample particulate and solid matter on the filter



- Liquid absorption sampling method

【Chemical agent, VOC, metal, odor ･･･】

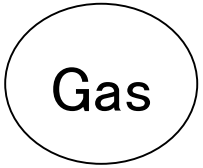
Let the air touch the solution, then sample subject from resolution and reaction



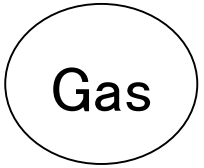
- Solid absorption sample

【Chemical agent, VOC, metal･･･】

  - Sample the air to the gas tube



- Direct sampling method 【Chemical agent, VOC･･･】
  - Sample the air directly to the container



Example of measuring method for liquid absorption sampling

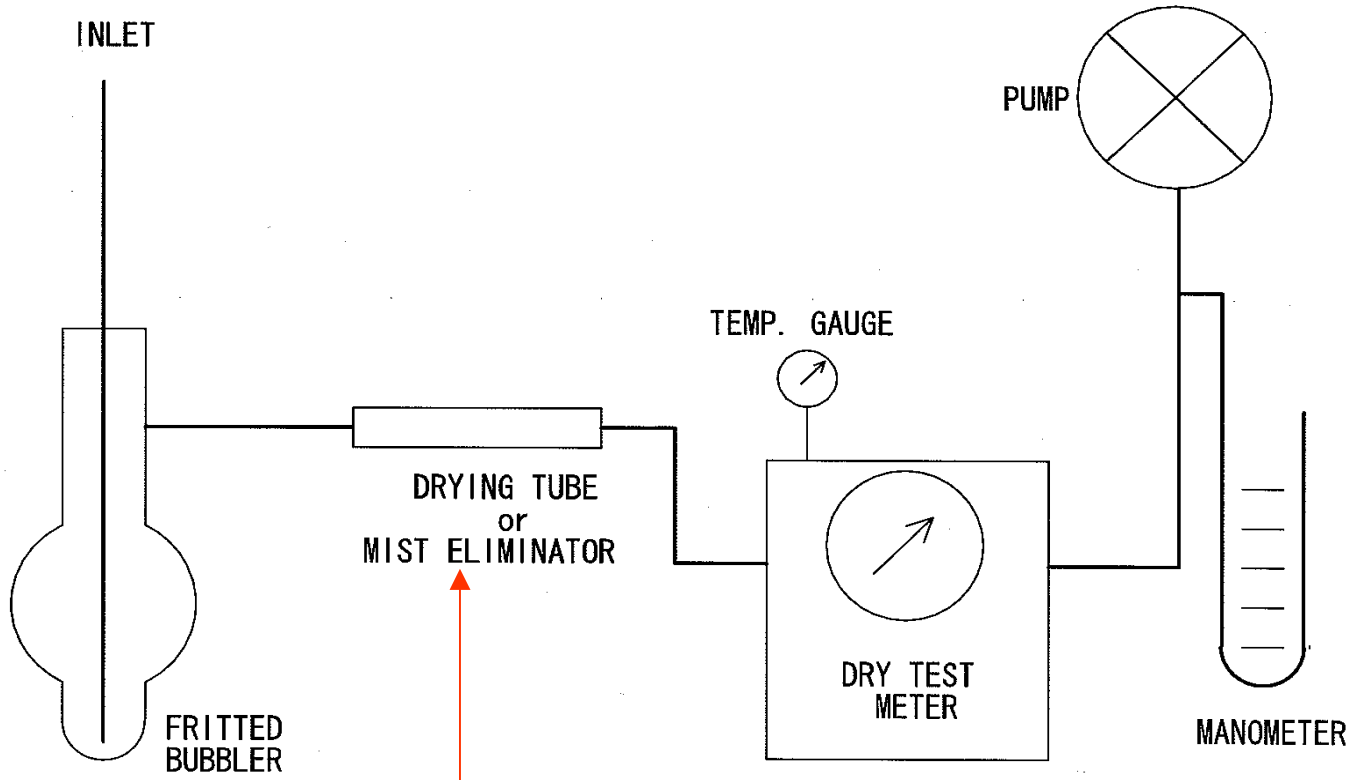
Sampling of sulfur dioxide (SO2) (sanitation testing)

Absorbing reagent	triethanolamine + sodium azide solution
Volume	20ml/min
Absorber	SPC impinger (For sanitation testing regulation)
Glass container	Approx. 200ml
Flow rate	0.3～3L/min

■ Remarks

- Reagent must be added to keep the same quantity if it has been evaporated during sampling
- There are limitations for reagent quantity and the amount of the air to be sampled

Connection flow described in ASTM



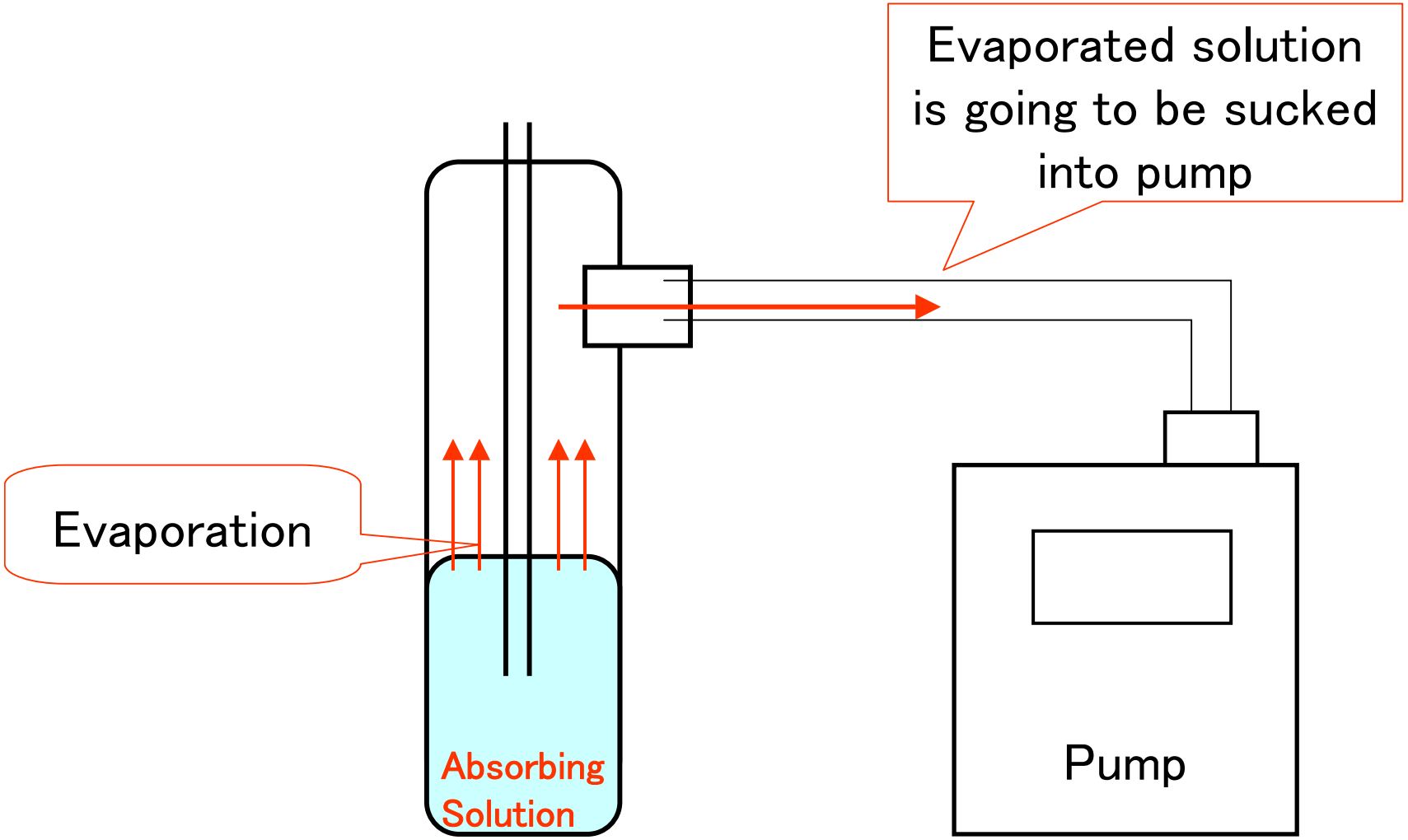
7.3 *Mist Eliminator or Gas Drying Tube*, filled with activated charcoal or soda lime is used to prevent damage to the flowmeter and pump.

From ASTM D1607

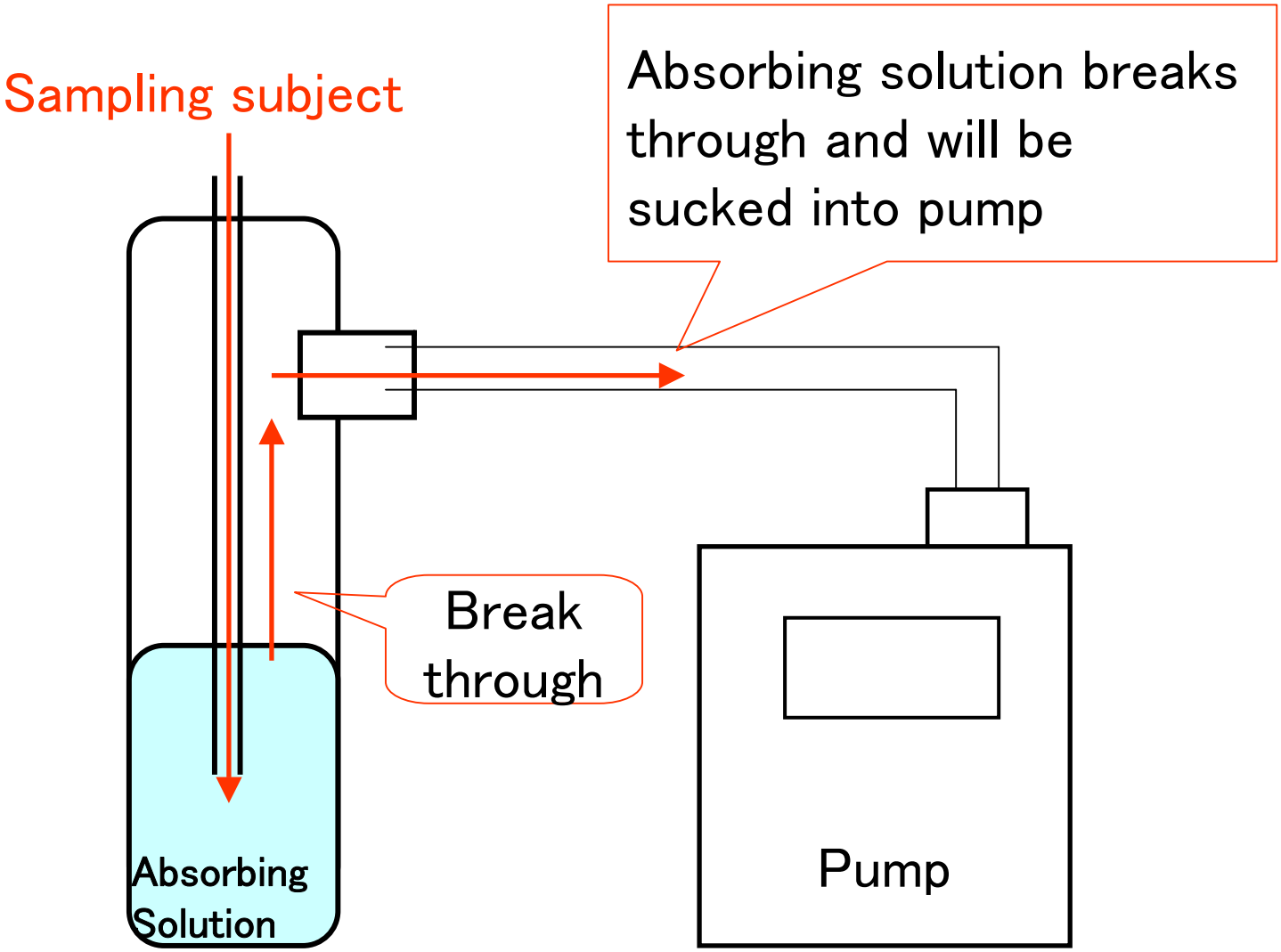
Remarks

- Evaporation of Solution
- Absorbing solution has its absorption limit
- Effect of absorbing quantity & absorbing speed
- Importance of flow connection

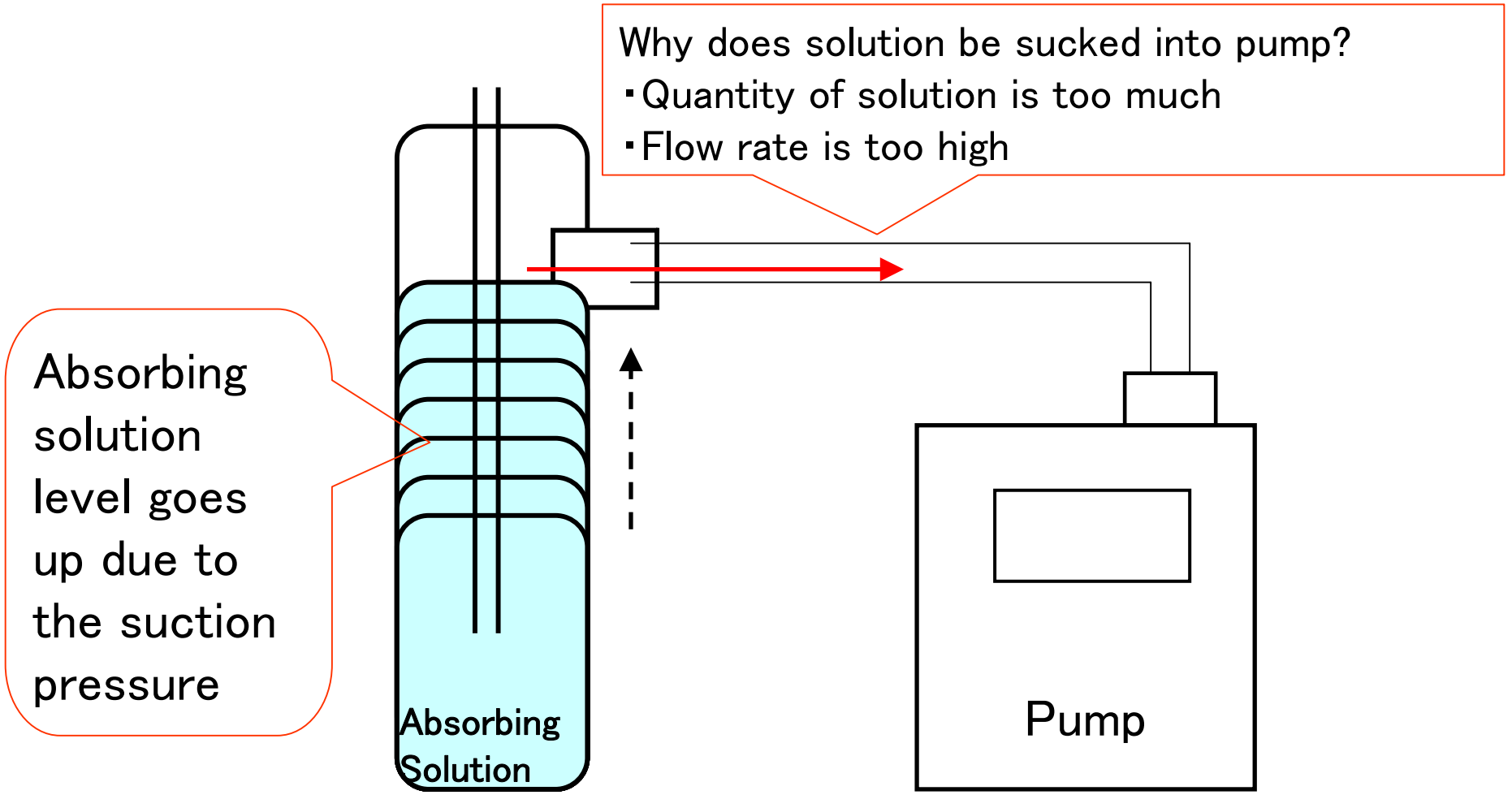
Evaporation of Absorbing solution



Absorbing solution has its *absorption limit*



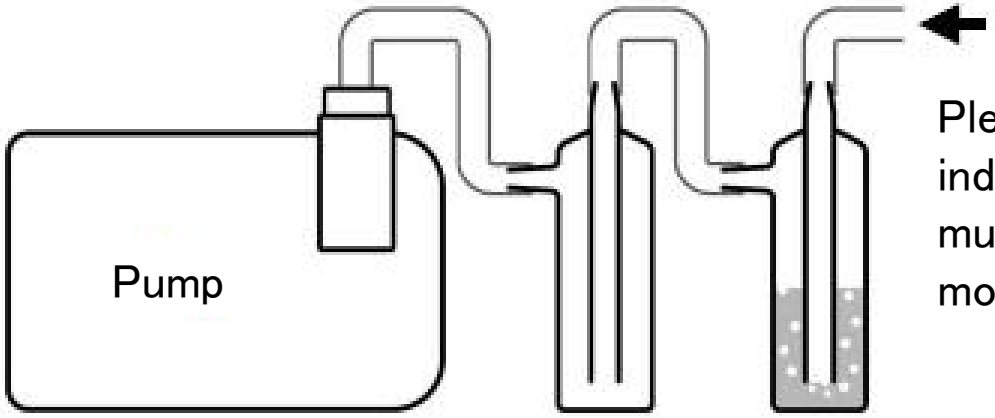
Effect of absorbing quantity & absorbing speed



Importance of flow connection

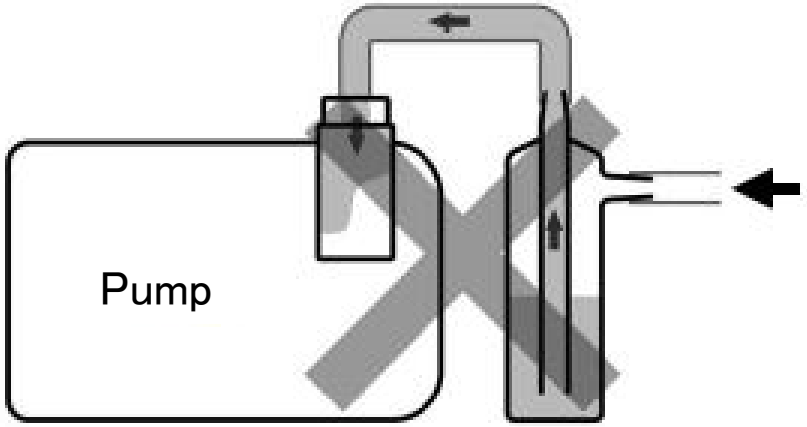
Sampling with impingers

When the connection is not done correctly, pump sucks the solution .
And this will damage your pump. Check the correct way of connection as below.



Please connect impingers indirectly to pump. Use of multiple impingers to catch moisture is recommeded.

Do not connect impingers directly to pump



＊From instruction manual

Importance of pump protection

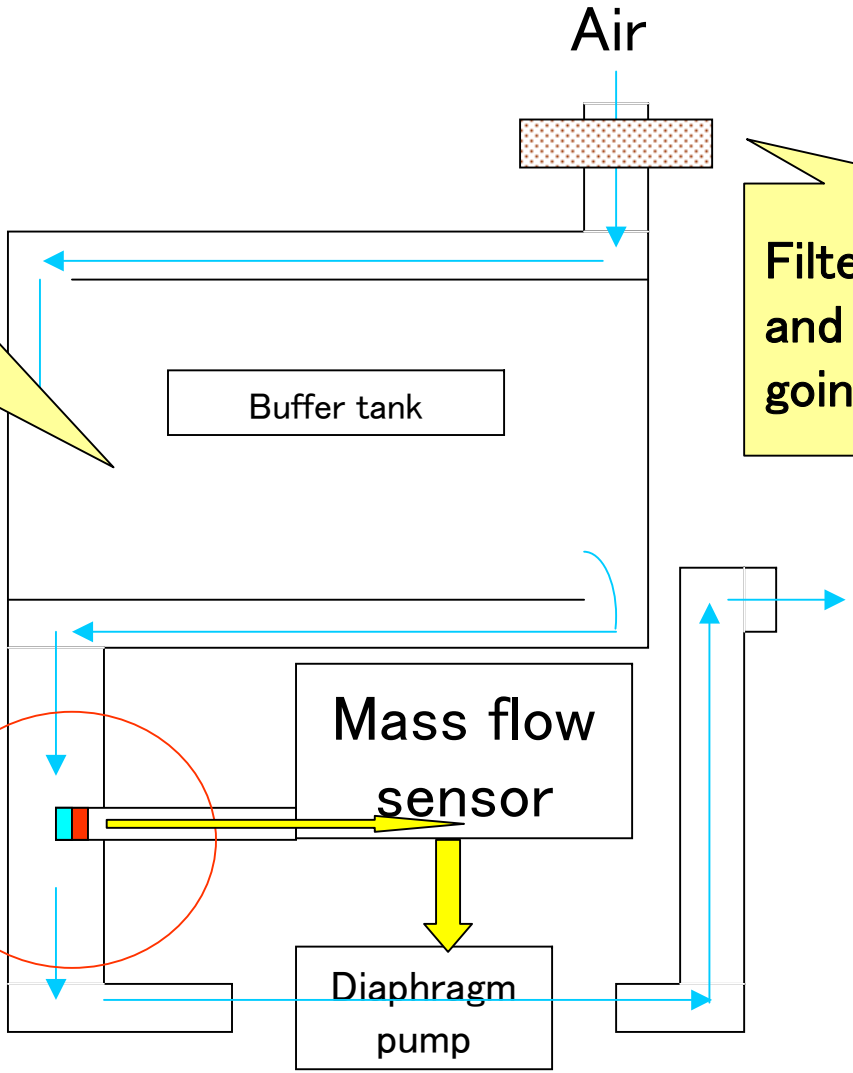
For mini pump Σ -series, high accuracy thermal mass flow sensor detects flow rate .

Flow rate accuracy is very high, and suitable for environmental measuring since it can automatically calculate flow rate at 20℃/25 ℃ and 1 atmosphere.

However, it is precision equipment, therefore the moisture and corrosive gas should be avoided.

MP-Σ structure

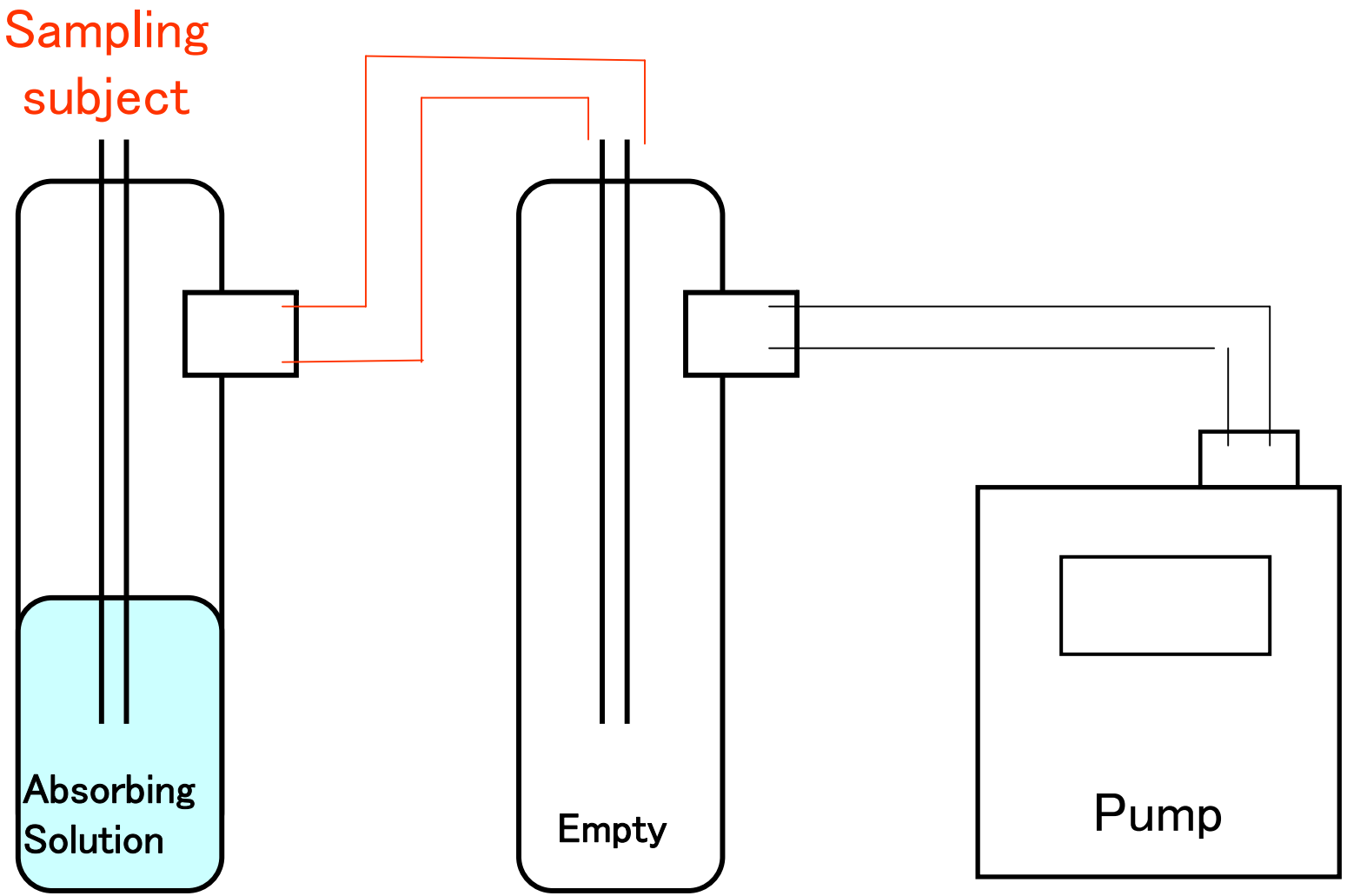
Buffer tank is not for catching moisture to protect pump, but it is the space to hold pulsation.



Filter keeps dust and moisture from going into pump

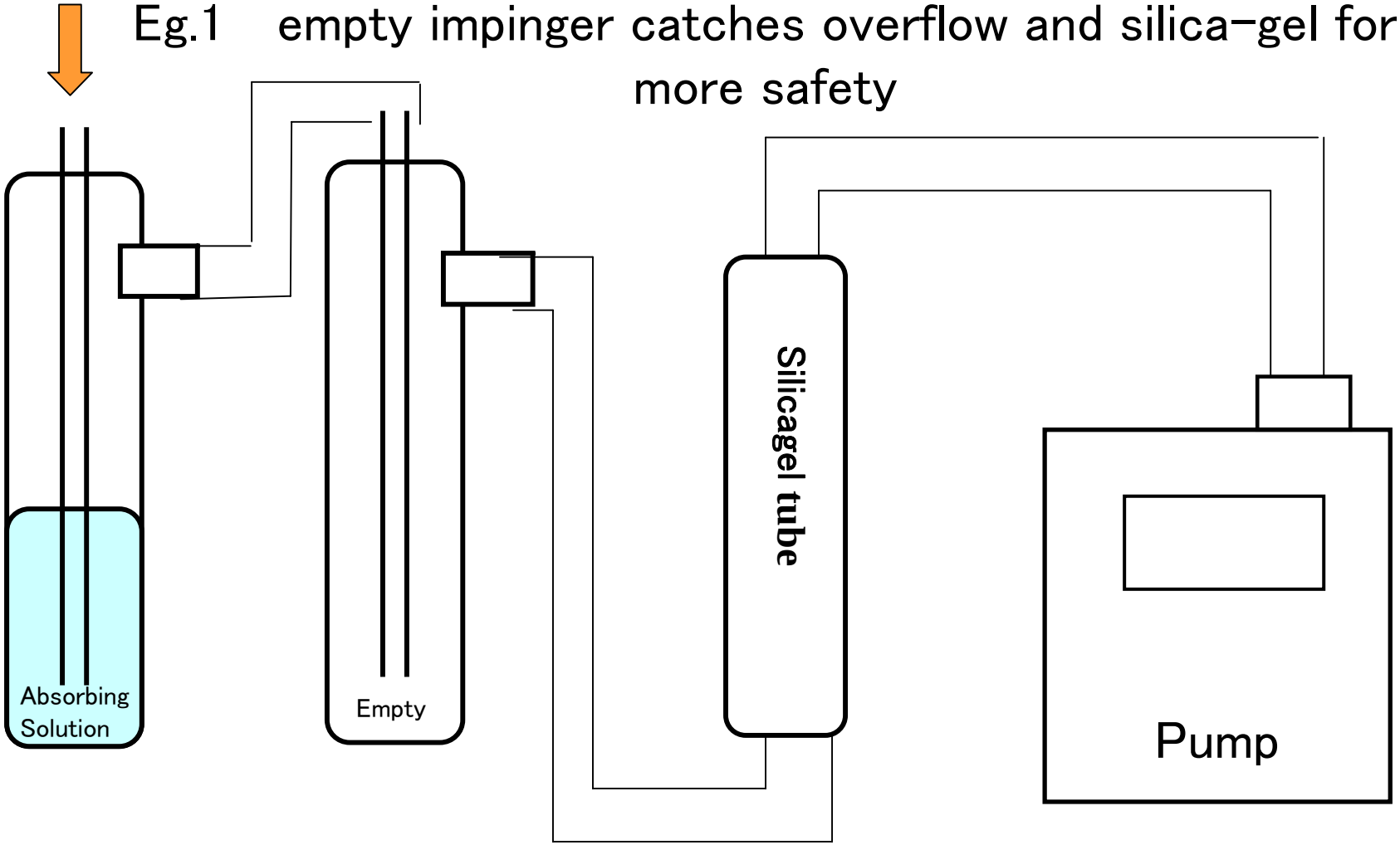
Structure to keep corrosive gas and solution from reaching sensor is needed before suction port.

Protecting pump from moisture



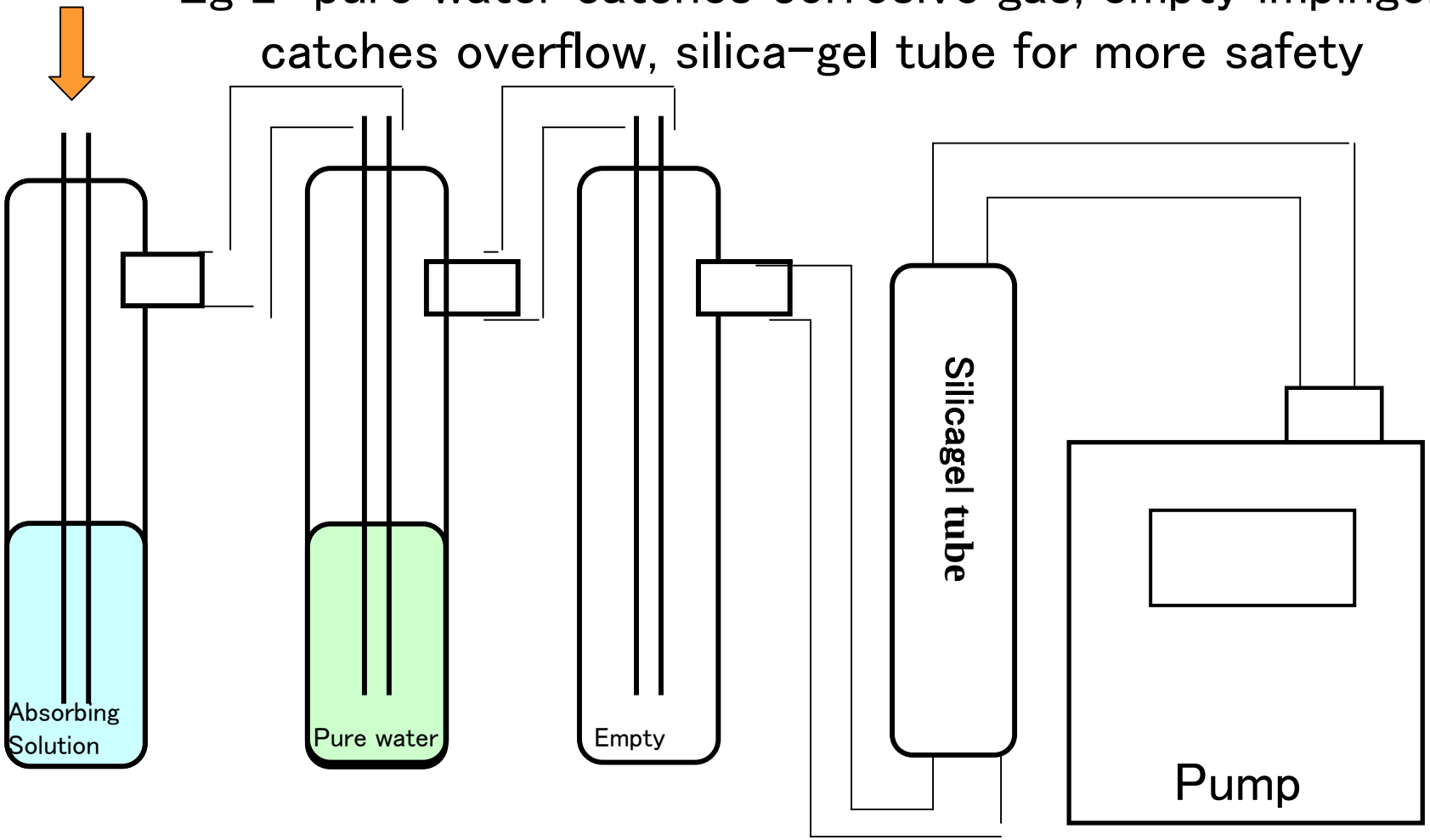
Proper pump protection depending on the type of measurement

Eg.1 empty impinger catches overflow and silica-gel for more safety



Proper pump protection depending on the type of measurement

Eg 2 pure water catches corrosive gas, empty impinger catches overflow, silica-gel tube for more safety



Remarks for pump protection

■ How to catches overflow of solution?

Empty buffer tank is needed.

■Does solution vaporize ？

Proper protection depending on the type of gas is needed.

■What if the sampling subject is corrosive？

Proper protection needed in case solution breaks through

■Are flow rate and solution quantity proper？

Proper type and shape of absorbing container should be used.

Proper adjustment of flow rate, quantity of absorbing solution, and measuring time is important.

■Proper flow connection

Right flow connection is important.

■Are these protection really working？

You need to be careful of breaking through of gas tube for protection.

Solution capacity and flow rate for Sibata products

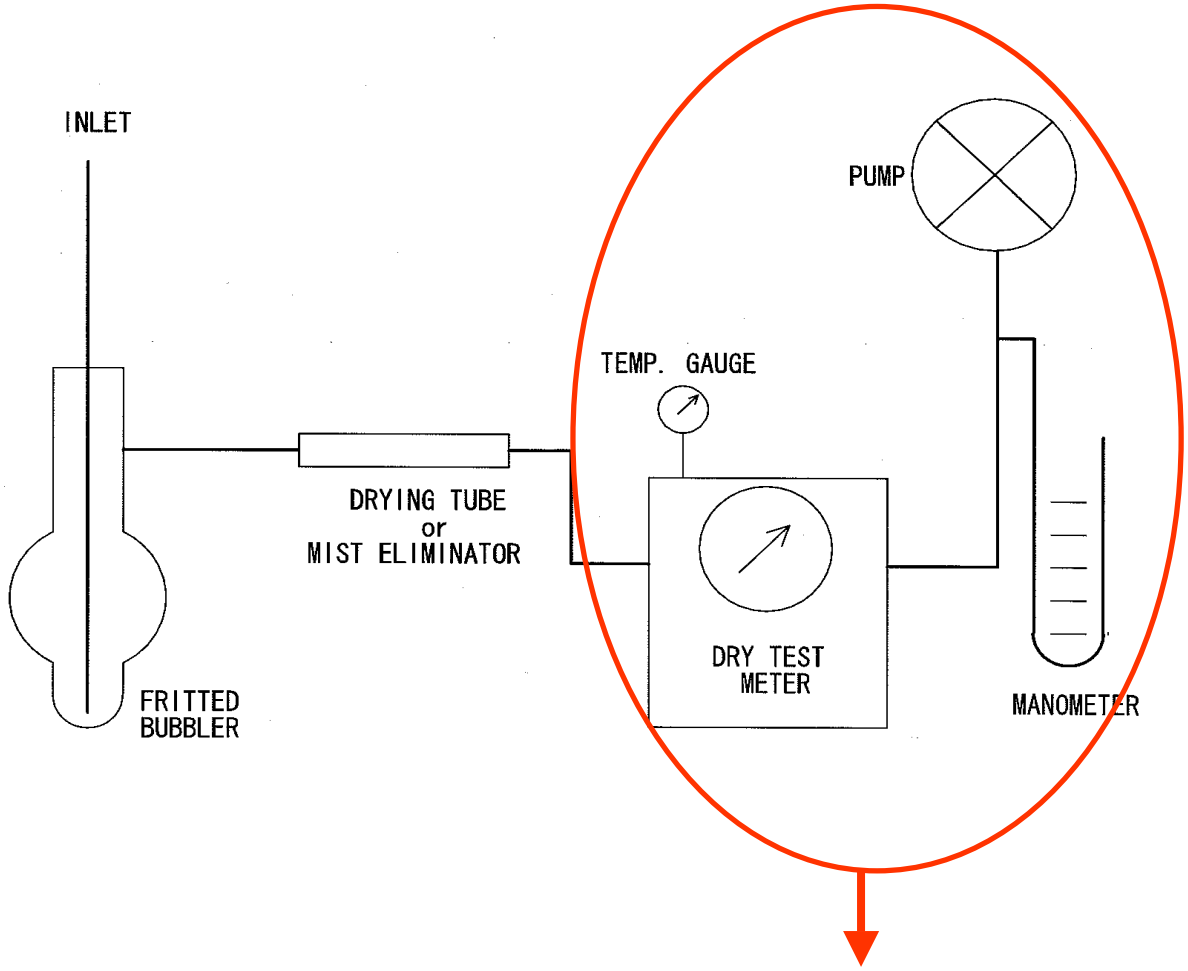
Product	Capacity	Solution Qty.	Flow rate
Impinger for dust	275ml	75ml	30L/min
SPC midget impinger for dust	30ml	5ml	3L/min
SPC midget impinger for gas	30ml	10ml	1L/min
Miniature bubbler	6ml	3ml	0.1L/min
Bubbler	30ml	20ml	1L/min
Miniature Gas Absorber	8ml	5ml	0.1L/min
SPC impinger(for sanitation testing)	Approx. 200ml	20ml	0.3~3L/min
SPC impinger(bubbler for sanitation testing)	Approx. 50ml	20ml	1L/min

（※Usage examples of Sibata products）

Advantages of Σ-series

- Compact size・light
- High accuracy
- Digital display of instant flow rate
- Digital display of integrated flow volume
- Automatic correction of temperature and pressure
- Timer function

Sampling method



Σ -series have all these 4 functions!

Temperature・pressure correction

12.1 *Air Volume*—Convert the volume of air sampled to the volume at standard conditions of 25° C and 101.3 kPA (1 atm), as follows:

$$V_R = [V \times P/101.3] \times [298.15/T] \quad (1)$$

where:

V_R	=	volume of air sampled at standard conditions, L
V	=	volume of air sampled at ambient conditions, L
P	=	average ambient atmospheric pressure, kPa
T	=	average ambient atmospheric temperature, K
101.3	=	pressure of standard atmosphere, kPa, and
290.15	=	temperature of standard atmosphere, K.

Concentration is calculated with the air volume converted at 25℃ and 1 atmosphere for ASTM D1607.

Flow rate of Σ-series are automatically calculated at 25℃ and 1 atmosphere.

MP-Σ series

Old model Σ-series

New model ΣN-series

Features of ∑N-series

- Pump's performance remains the same
  - Fixed flow rate range(suction flow rate & pressure) remains the same.

  ※Only for ∑30, flow rate range changed from 0.05L/min to 0.1L/min. (The reason is that flow rate doesn't stay stable at 0.05L/min)
- It has constant flow rate function and flow rate accuracy is ±5%.
- Flow rate can be corrected at both 20℃ and 1atmosphere, 25℃ and 1atmosphere.
- Lithium-ion battery is used.
  - Continuous operation time is double of old model.
- Easier handling
  - Power switch has changed to siding switch type
  - Filter element can been seen and checked from outside

MP-ΣN Series

Battery Unit
(rechargeable battery)
- Lithium-ion battery enables long operation time
- Charging battery is possible individually.

Charging Connector
(Used for charging battery individually.)

Color label

Operation Panel

Suction Port
- Outside diameter: Ø6/Ø8mm
- Direct connection to DNPH cartridge is possible

Power Switch
(Sliding type)

Exhaust port
- Outside diameter: Ø6/Ø8mm
- (same as suction port)

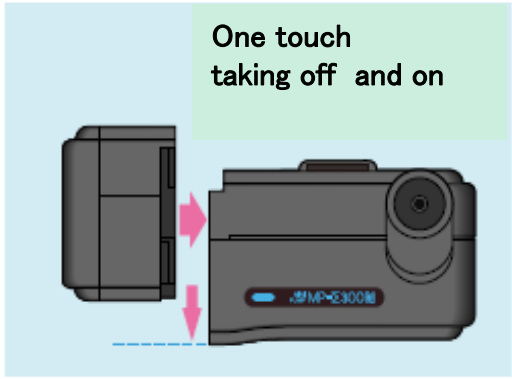
MP-∑N Series

Filter Check Window
Check the time to change to new filter or water leakage

Hook

USB connector
For communication software(option)

Power source connector
For connecting battery charger or AC adapter

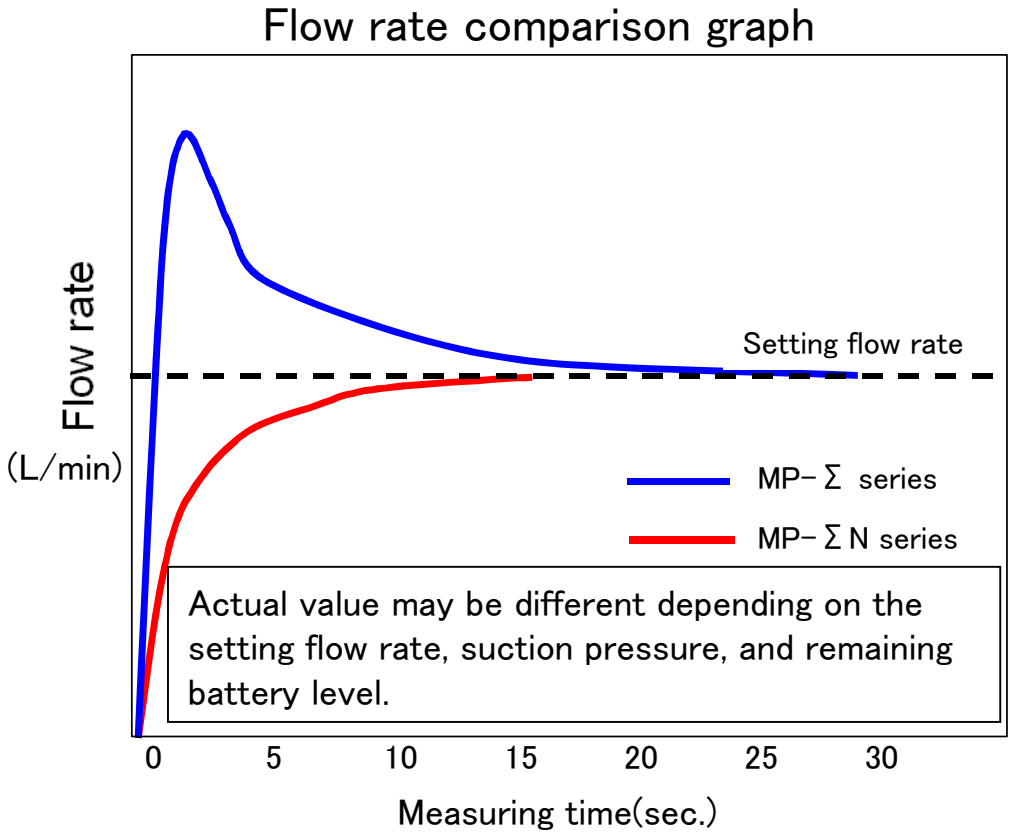


Slide Lock
For taking off battery unit

Tripod Mounting Hole
Changing battery is possible with the pump attached to tripod

➢ Improved flow rate controlling system

- No sharp increase of flow rate at the beginning
- Saving time until it gets stable at setting flow rate
- Controlled pulsation

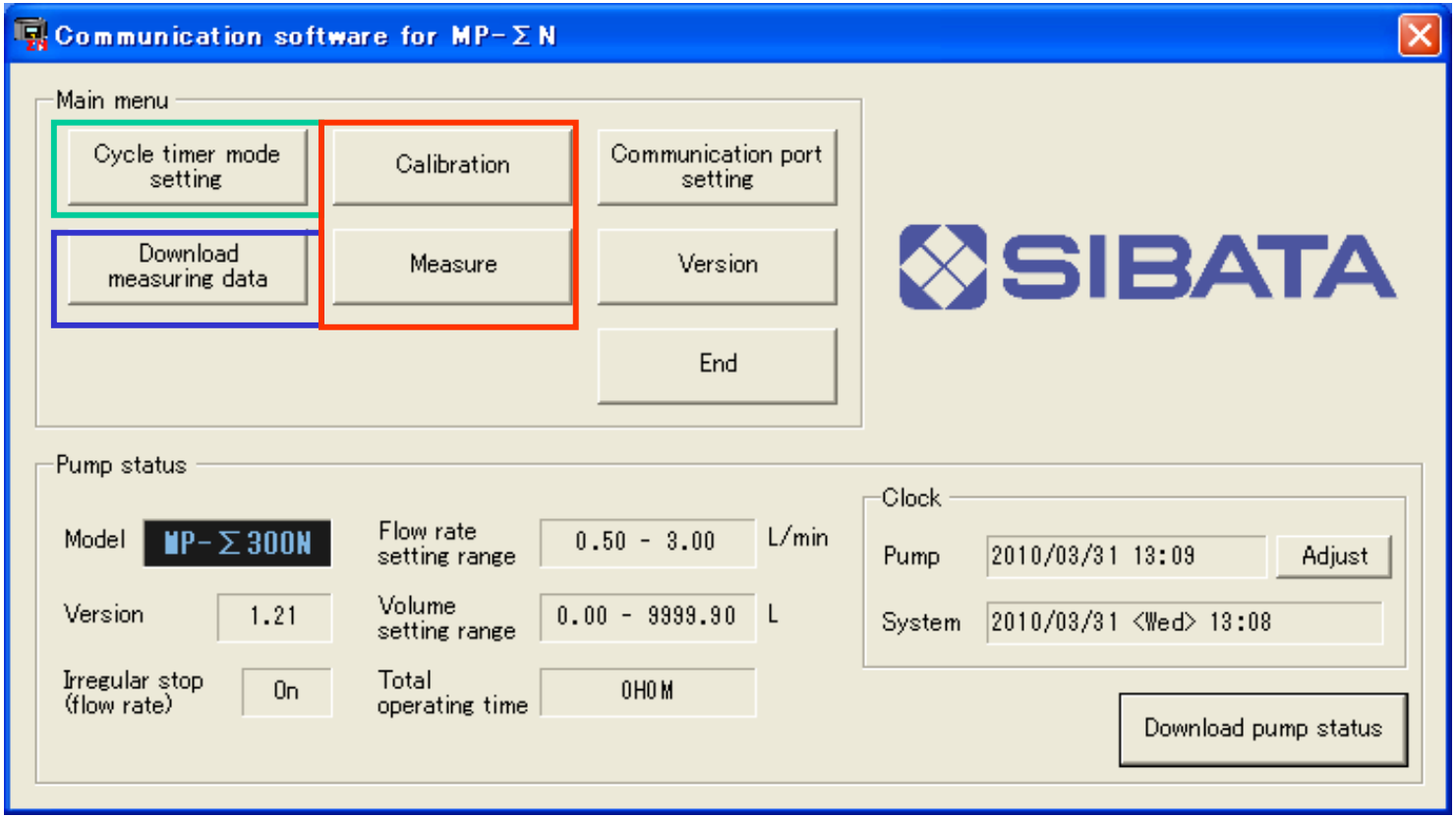


What can we do with communication software(option)?

①Cycle timer setting

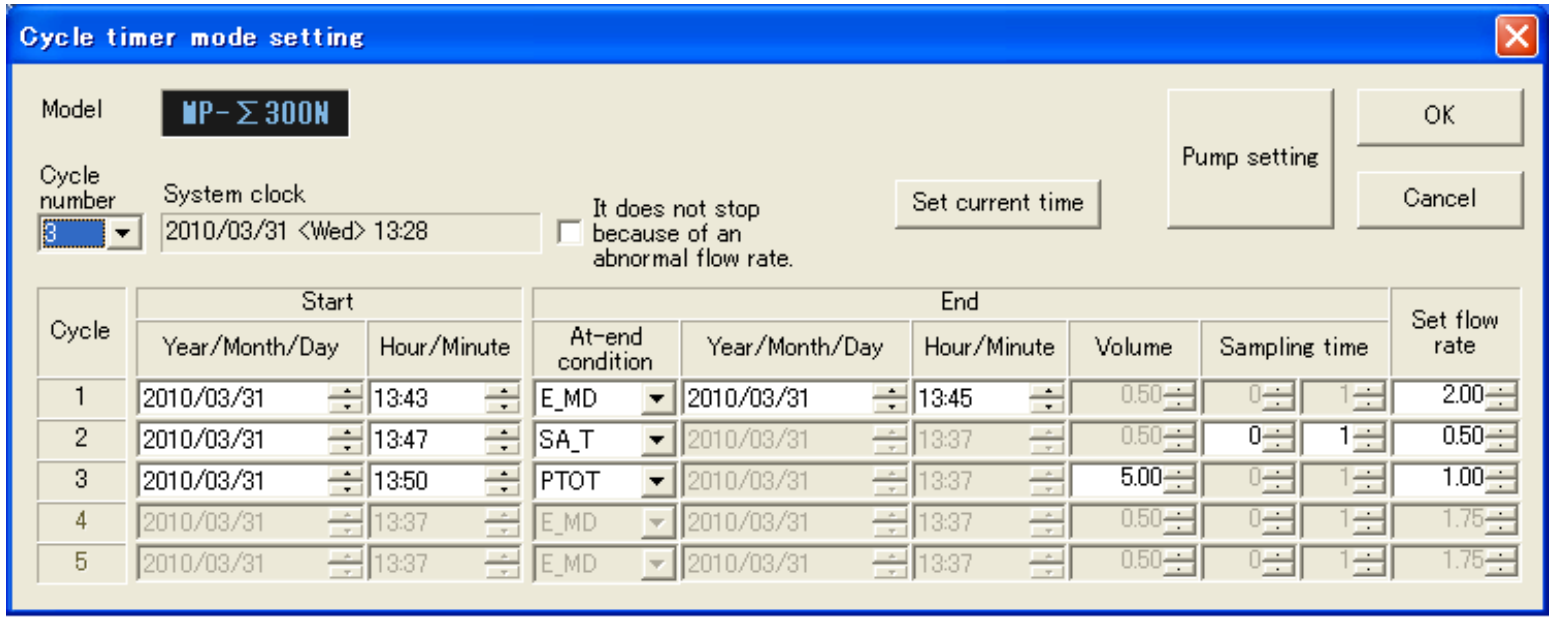
②Measuring data

③Automatic calibration by bubble film flowmeter



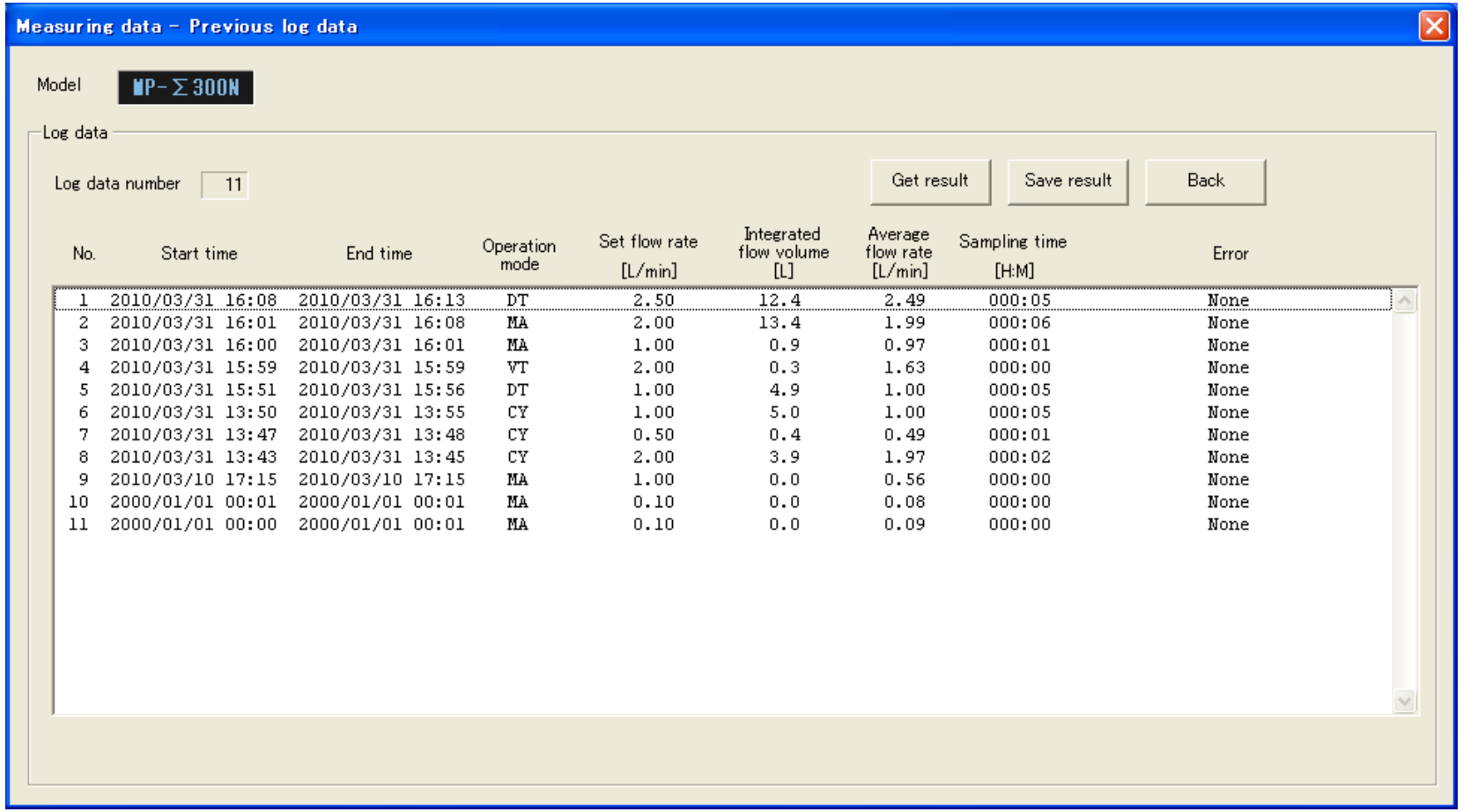
1、Cycle timer function

- Programming possible up to 5 times
- Flow rate, starting time, and finishing condition are programmable
- Measuring starts from cycle timer mode after setting(condition can be checked from pump as well)



2、Measuring data

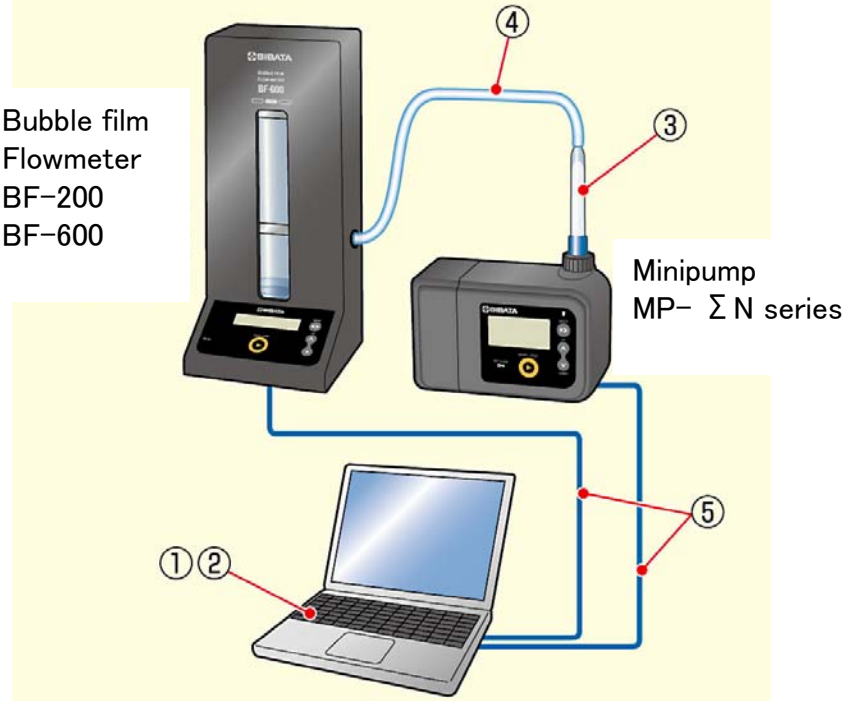
- 99 data can be recorded(Pump itself can record 10data)
- Data can be saved as excel file



No.	Start time	End time	Operation mode	Set flow rate [L/min]	Integrated flow volume [L]	Average flow rate [L/min]	Sampling time [H:M]	Error
1	2010/03/31 16:08	2010/03/31 16:13	DT	2.50	12.4	2.49	000:05	None
2	2010/03/31 16:01	2010/03/31 16:08	MA	2.00	13.4	1.99	000:06	None
3	2010/03/31 16:00	2010/03/31 16:01	MA	1.00	0.9	0.97	000:01	None
4	2010/03/31 15:59	2010/03/31 15:59	VT	2.00	0.3	1.63	000:00	None
5	2010/03/31 15:51	2010/03/31 15:56	DT	1.00	4.9	1.00	000:05	None
6	2010/03/31 13:50	2010/03/31 13:55	CY	1.00	5.0	1.00	000:05	None
7	2010/03/31 13:47	2010/03/31 13:48	CY	0.50	0.4	0.49	000:01	None
8	2010/03/31 13:43	2010/03/31 13:45	CY	2.00	3.9	1.97	000:02	None
9	2010/03/10 17:15	2010/03/10 17:15	MA	1.00	0.0	0.56	000:00	None
10	2000/01/01 00:01	2000/01/01 00:01	MA	0.10	0.0	0.08	000:00	None
11	2000/01/01 00:00	2000/01/01 00:01	MA	0.10	0.0	0.09	000:00	None

3、Automatic calibration by bubble film flowmeter

- Automatic calibration and flow rate checking by MP－ΣN×BF-200/-600
  - Temperature, pressure automatic calibration, for one-point calibration



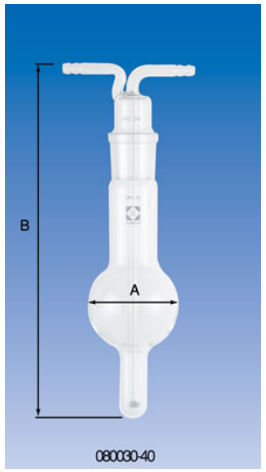
Example of connection for calibration

Composition
- Bubble film flowmeter BF-200, BF-600
- Mini pump MP-ΣN series

1.PC
2.Communication software 1)
3.Absorbing tube(pressure at use) 2)
4.Connection tube
5.USB cable(2 pcs.) 1)

1)Communication software for MP- ΣN series(option)
2)Using without pressure is possible.
*Illustrations may be different from the actual instruments.
The connection is just an example.

We provide variety of instruments for sampling!



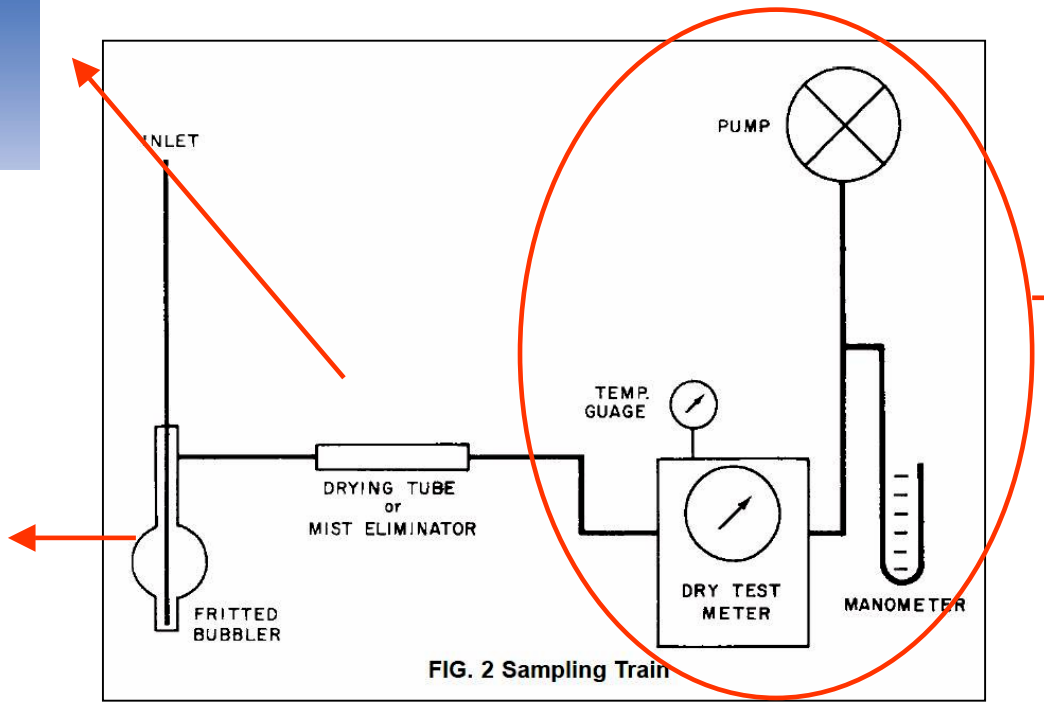


FIG. 2 Sampling Train

VOC gas tube for solid absorption sampling method

Charcoal tube

Product	Infill	Fill ration (Upper/ Lower mg)	Supelco equivalent product
Charcoal tube, standard	coconut husk activated carbon	100/50	ORBO 32 small
Charcoal tube, jumbo	coconut husk activated carbon	400/200	ORBO 32 large

Silica-gel tube

Product	Infill	Fill ration (Upper/ Lower mg)	Supelco equivalent product
Silica-gel tube, standard	Silica-gel	520/260	ORBO 507
Silica-gel tube, small	Silica-gel	150/75	ORBO 52 small

Exercise

Pure water catches corrosive gas, empty impinger catches overflow, silica-gel tube for more safety