Technical Description

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Industrial Process Analyzer - **IPA**® titrimetric

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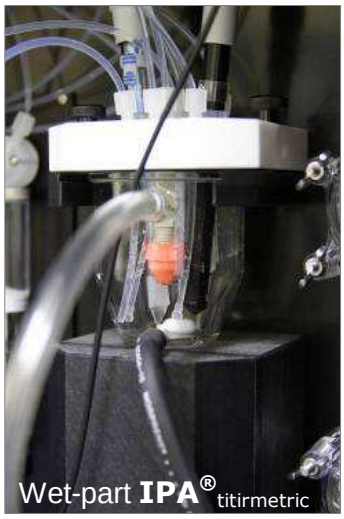
The on-line Industrial Process Analyzer - **IPA**®titrimetric is a single parameter versatile wet chemical analyzer suitable for chemical analysis and monitoring of Industrial process solutions.

For each application and depending of the measuring range, the most suitable methodology is chosen in the Industrial Process Analyzer - **IPA**®: colorimetric-, ionometric- or titrimetric analysis.

1. DESIGN on-line Industrial Process Analyzer - **IPA**®titrimetric:



The on-line Industrial Process Analyzer - **IPA**®titrimetric is designed having two completely separated compartments that are easily accessible:

- ➲ compartment for the chemical analysis (wet part)
- ➲ compartment for the electronics and the built-in Industrial PC

The Process Analyzers have an ergonomic, corrosion resistant fiberglass analyzer housing, designed for operation in Industrial environments. The housing can be equipped with a built-in leak detection warning in case of risk of any liquid spill.

Purging with instrument air is possible in case of risk of accumulation of corrosive gases or extreme humidity. The hardened glass door assures instant visual inspection of the wet-chemical part.
Even with the wet-part front door open, the analyzer has a IP55 protection rating. The batch-wise operating principle guarantee you following advantages:

- ➲ allows you to program the analysis sequence according to your needs.
- ➲ limited loading of the electrodes.
- ➲ rinsing and cleaning after each analysis cycle

The on-line Industrial Process Analyzer - **IPA**®titrimetric has an outstanding reliability and accuracy thanks to the use of first class and robust wet-part components such as precision micro- and low-speed peristaltic pumps, stepper mo tor driven dispensers and measuring vessel configuration.

A user-friendly 5 3/4” color touch screen Industrial computer guarantees stable operation and a superior human interface.

2. ADVANTAGES on-line Industrial Process Analyzer - **IPA**®titrimetric:

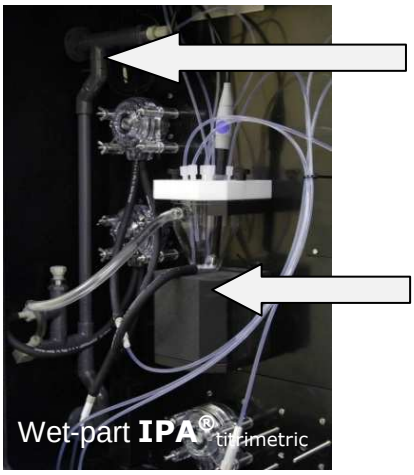
➲The Industrial Process Analyzer **- IPA**®titrimetric is purged with instrument air

➲ built-in **ModuPlex**® stream selection allows analysis for up to 3 different streams

➲Special analysis low-volume analysis vessel design.
→ results in a low consumption of chemicals and a relatively long autonomy.

➲The Industrial Process Analyzer - **IPA**®titrimetric wet-part has automatic cleaning
→ The user can program the sequence and interval of the analysis and Cleaning cycles
➲The Industrial Process Analyzer **- IPA**®titrimetric wet-part has automatic validation
→ The user can program the sequence and interval of the analysis and Validation cycles. A validation can be performed with a validation solution with known concentration in order to check the analysis program and the analyzer.

➲The Industrial Process Analyzer **- IPA**®titrimetric has a gas-tight vent & drain collector
➲The Industrial Process Analyzer **- IPA**®titrimetric has an adjustable stirrer speed



gas tight vent & drain collector

NO vapors in Wet-part

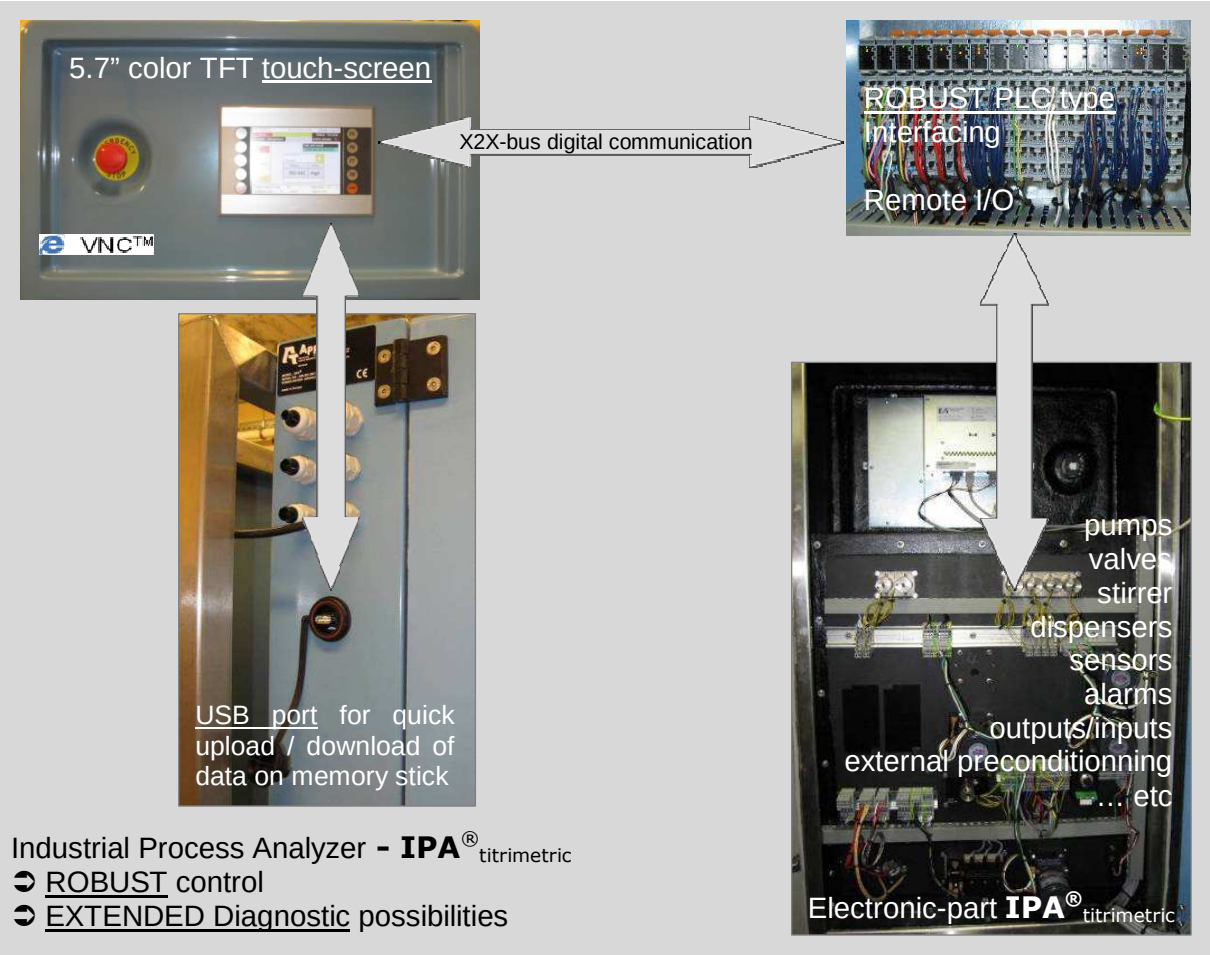
adjustable stirrer speed

➲The Industrial Process Analyzer **- IPA**®titrimetric has a fiberglass reinforced, corrosion resistant Wet-part housing (IP55)

➲The Industrial Process Analyzer **- IPA**®titrimetric has a fiberglass reinforced, steel epoxy coated, corrosion resistant Electronic-part housing (IP55)

➲The Industrial Process Analyzer - **IPA**®titrimetric Wet-part has a leak detector (OPTION)

3. UNIQUE on-line Industrial Process Analyzer - **IPA**® titrimetric HUMAN INTERFACE:



The Industrial touch-screen PC with flash disc that is incorporated in the instrument controls the Industrial Process Analyzer **- IPA**® titrimetric and memorizes trends, alarms, results and data log files.

specifications Industrial touch-screen PC:

- Ethernet 10 M (RJ45) NE 2000 compatible, Compact flash slot,
- IP65 flat screen → diameter 210 x 160 mm (5,7") **color TFT touch screen**
- 1 x USB port for memory stick access

ⓘ REMARK:

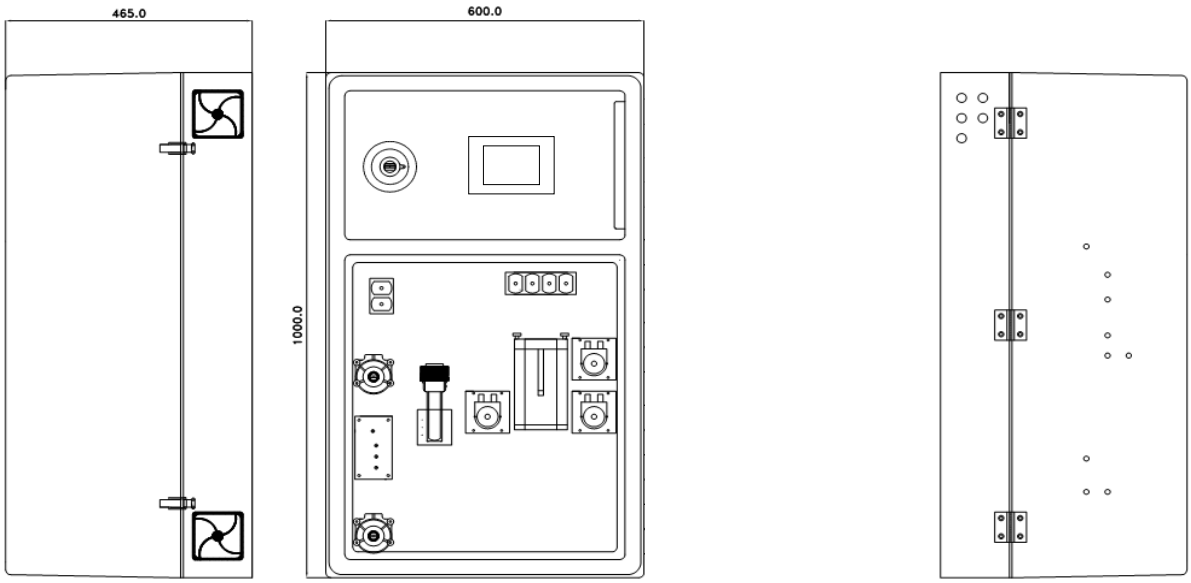
on-line Industrial Process Analyzer **- IPA**® titrimetric Needs NO External PC. The results can be recorded on a memory stick and used in a spreadsheet program such as Excel or any other data processing software

➲ Result & Alarm data export(1.000 results including sample stream, date & time)
➲ data curve export (last 30 analysis curves)
➲ **IPA**® program up- & download

ⓘ REMARK:

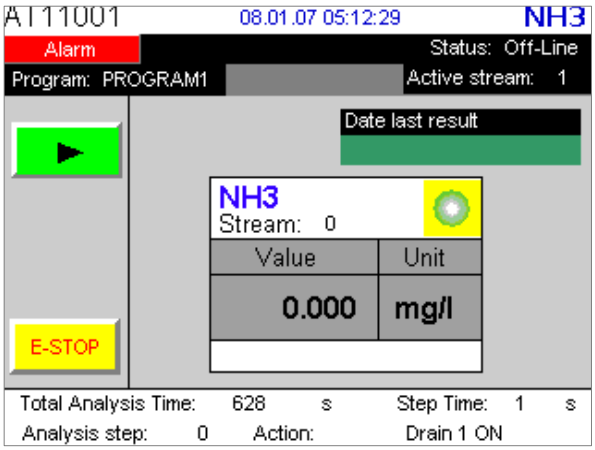
The control of the on-line Industrial Process Analyzer **- IPA**®titrimetric touch screen can remotely be taken over by another PC over a Local Area Network (LAN) using commonly available VNC™ Ethernet software.

4. DIMENSIONS on-line Industrial Process Analyzer - **IPA**®titrimetric:

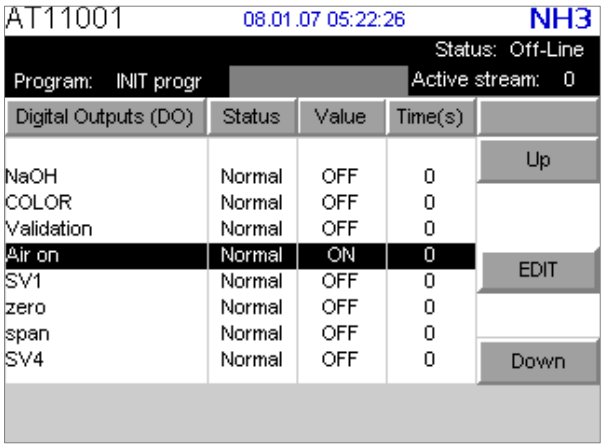


5. UNIQUE Software Features on-line Industrial Process Analyzer - **IPA**® titrimetric:

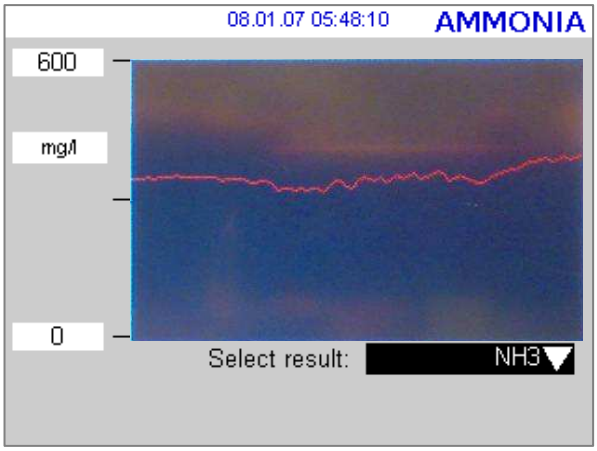
General Software features		
USB port	result & alarm data export (1.000 results including sample stream, date & time)	
	IPA® program upload	
Emergency STOP	Hardware "reset push button" or on touch screen	
Parameters	Maximum 1	
REMOTE touch screen take-over	The control of the **IPA**® analyzer touch screen can remotely be taken over by another PC over a Local Area Network (LAN) using commonly available VNC™ Ethernet software.	
Built-in PC	Flat color touch screen / diameter 210 x 160 mm (5,7") / IP65 Compact flash disk (128 MB) incorporated	
If/then programming	start an action based on a threshold condition	
Main screens	Values sub-screen	actual values of calculated results Visualization of the analyzer actions User level selection
	Results graph sub-screen	trending last 80 analysis results in graph on screen
Status screens (User level protected)	F2 DO sub-screen	manual control (ON / OFF) of wet part components
	F3 AO sub-screen	manual output simulation control 2 x Analog outputs (4 - 20mA)
	F4 Sensors sub-screen	actual value and manual calibration (up to 2 different sensors)
	F5 DI sub-screen	Status visualisation of the 4 digital inputs
	F6 Dispenser sub-screen	manual action control: "FILL" / "DOSE" / "RECYCLE" / "INIT" / "PRIME" (max. 2 dispensers) ⓘ `REMARK: dispensers are speed and time (volume) programmable`
	F7 Values sub-screen	Showing the inflection values of titrimetric analysis or from direct measurements
	F8 Program screen	3 different programs: Analysis/Validation-Calibration/Cleaning Analysis program: stream selection (up to 3 different sample streams)
GOptions screen (User level protected)	Date and time	Settings for date and time
	Ethernet	Configuration of Ethernet settings
	Automatic cleaning	Programming cleaning cycle
	Automatic calibration	Programming of the calibration parameters
	Screen calibration	
	Result	Configuration of result: signal output (4-20mA), Graph, …
	Calibration data	History of calibration results
	Titration graph	**IPA**Titrimetric® on-line analyzer single graph showing two curves simultaneous: titration curve: pH or mV = f (dosed titrant volume) threshold curve: threshold = f (dosed titrant volume)
	Results data	logging list of last 1.000 results including date-time/results
Maximum configuration:		➲ configuration of max. 18 digital outputs Alarms / pumps / contacts / stirrer / micro pumps / sampling ➲ configuration of max. 4 digital inputs Leak detection …etc. ➲ configuration of 2 dispensers max. ➲ configuration of 2 sensors max. ➲ configuration of 2 analog outputs max.



"VALUES" screen



"PROGRAM" screen



"RESULT-Graph" screen

6. ANALYSIS methods on-line Industrial Process Analyzer - **IPA**®titrimetric:

The titrimetric analysis is a quantitative analysis carried out by determining the volume of a solution with a known concentration (titrant) which is used to react quantitatively with a known volume of a solution which contains the component that has to be measured.
The titrant is added very accurately to the sample until the reaction with the component is completed. The point at which this occurs is the equivalence point or endpoint.
The inflection point or endpoint is detected automatically by recording the change of the potential signal (pH or mV) in relation with the dosed amount of titrant solution.

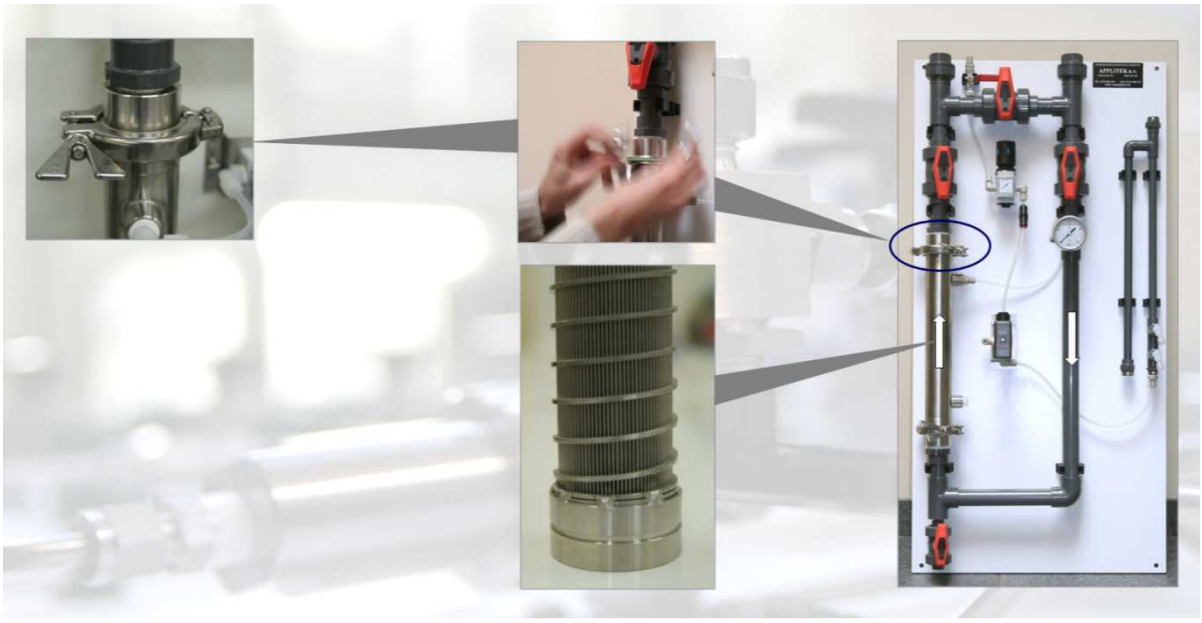
As indication of this pH or mV change, a suitable electrode is used. There are several types of titrations:

- acid-base titration: based on the neutralization reaction between the analyte and a basic or acidic titrant solution.
  - ➲ end point titration
  - ➲ titration using self finding inflection points (drift or time controlled)
- redox titration: based on an oxidation-reduction reaction between the analyte and the titrant solution.
  - ➲ titration using self finding inflection points
- precipitation titration**:** based on the formation of a precipitation.
  Titration using self finding inflection points
- complexometric titration**:** based on the formation of a complex between the analyte and the titrant solution.
  Colorimetric or Ionometric
  - ➲ titration using self finding inflection points
- Karl Fisher titration:
  - ➲ special end point titration

7. General SPECIFICATIONS on-line Industrial Process Analyzer - IPA® titrimetric			
Analysis method		Titrimetric analysis	
Sample requirements	Pressure	Sample pump:	atmospheric pressure
		Sample valve:	0.1 – 0.5 bar (0 – 500 kPa)
		⇒ higher sample pressures on request by external pressure adjustment available (please contact Sales)	
	Flow rate	between 10 and 30 ml/min	
	Temperature	between 5 and 60 °C	
Reagent requirements	Temperature	between 20 and 25 °C (± 3 °C)	
Hardware	General	Rinse, Drain & Cleaning pumps, Reagent addition micro pumps, Sampling with Level pump or dispenser (range dependent), Analysis vessel with magnetic stirrer,	
	Titration Electrodes	Precision Dispensers for titration, pH, Pt,…	
Connections	Pumps	1/8" O.D. tubing	
	Micro pumps	1/8" O.D. tubing	
	Valves	1/8" O.D. tubing	
	Drain	3/8" O.D. tubing	
	Dispensers	1/8" O.D. tubing	
	Instrument air	1/4" O.D. tubing	
Built-in PC		Compact flash disk (128 MB) incorporated to process the results and transmit them	
	Memory	Log files with 1000 values/result are stored Up to 30 titration curves can be stored	
	Screen	TFT Color touch screen 145 mm (5 ¾ ") IP65	
	USB Serial port	for memory stick access	
	Network interface (Ethernet)	to communicate with other remote PC in a LAN (Local Area Network)	
Communication output		Ethernet (standard)	RS232, MODBUS (optional)
Alarms		Malfunctioning Alarm (potential free contact)	
		Result Alarm (potential free contact)	
Status signals		Maintenance Contact (potential free contact) Remote/Local Contact (potential free contact) Analysis ready (potential free contact)	
Analog inputs	(max. 2 inputs)	For electrodes, temperature, conductivity,…	
Analog outputs	Analysis results	(500 Ohm max. load) active 4-20 mA (galvanic s*IPA*rated) (up to 2 Analog output sources available)	
Digital inputs		Remote Start/Stop (option) (potential free contact) Leak Alarm (option) (potential free contact) (up to 4 Digital input sources available)	
Digital outputs	Dig. Outputs 24VDC	For activation of internal valve, pumps,… (up to 12 Digital output sources available)	
	Dig. Outputs 220VAC	For activation of external valves, pumps, motors,… (up to 6 Digital output sources available)	
	Dig. Outputs (pot. free)	For activation of Analysis Ready signal, Sample Flow signal,… (up to 10 Digital output sources available)	
Ambient conditions		suitable for general purpose, clean, indoor	
	Relative Humidity	5 – 95% (non condensing)	
	Temperature	10 – 30 °C (± 4 °C deviation)	
Enclosure		Protection class IP55 (per DIN40050)	
Dimensions		Width: 600 mm (23 ½") x Depth: 4650 mm (18 1/3") x Height: 1000 mm (39 ¼")	
Footprint	Without tubing	Width: minimum 1000 mm (39 ¼ "); Depth: minimum 850 mm (33 ½ ")	
Shipping weight		65 kg (144 lbs)	
Mounting		Wall mounting	
Utilities	Power supply	220/240 VAC, 50/60 Hz, 110/120 VAC (on request)	
	Instrument air	Dry & oil free according to ISA-S7.0.01-1996 quality standard for instrument air	
	Drain	Atmospheric pressure, vented, minimum 64 mm pipe	
	De-mineralized water	For rinsing and dilution purpose	
	Earth connection	clean earth pole that provides a good earth quality (low impedance < 1 ohm) using an earth cable of > 2.5mm²	
Included		Remote Start/Stop	
Options		RS232, MODBUS	
		Level detection for reagent containers	
		Sample presence detector	
		Leak detection	
Certification		Certified to CE conformity	

8. Sample Preconditioning FILTRATION (OPTIONAL):

8.1. **ModuSize**® Self Cleaning (Blow-back) Filtration System:

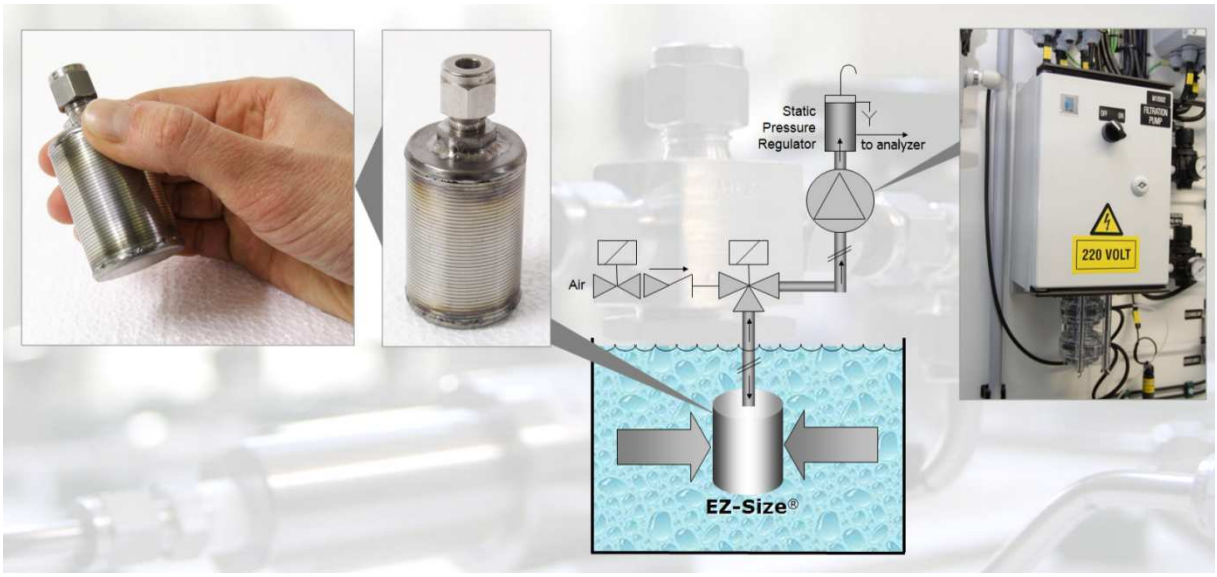


The **ModuSize®** is an in-line self-cleaning filter system. This filter element is installed in the fast loop and has the same internal diameter as the fast loop (d 32 mm). The sample flows parallel with the filter element with a velocity of 2 m/sec to obtain a self cleaning effect. A small part of the sample (necessary for the analysis) flows at a straight angle through the filter element into a Static Pressure Regulator (SPR). The **IPA**® analyzer takes the filtered sample from this SPR. Every 5 minutes (interval duration is freely programmable) the filter element is automatically cleaned by a solenoid controlled air or water blow that removes the entrapped particles from the conical shaped filter perforations.

Specifications:

Material filter element:	SS316L
Material filter housing:	SS316L
Filter pore size:	50, 100, 200µm, 2mm
Fittings to replace filter element:	Tri – clamp
Manometer:	on Fast Loop
Connections to fast loop tubing:	1” BSPF
Air pressure reducer:	Instrument Air
Solenoid valve:	Sample/Rinse
Drain valve:	for emptying the system

8.2. **EZ-Size**® Self Cleaning (Blow-back) Filtration System:



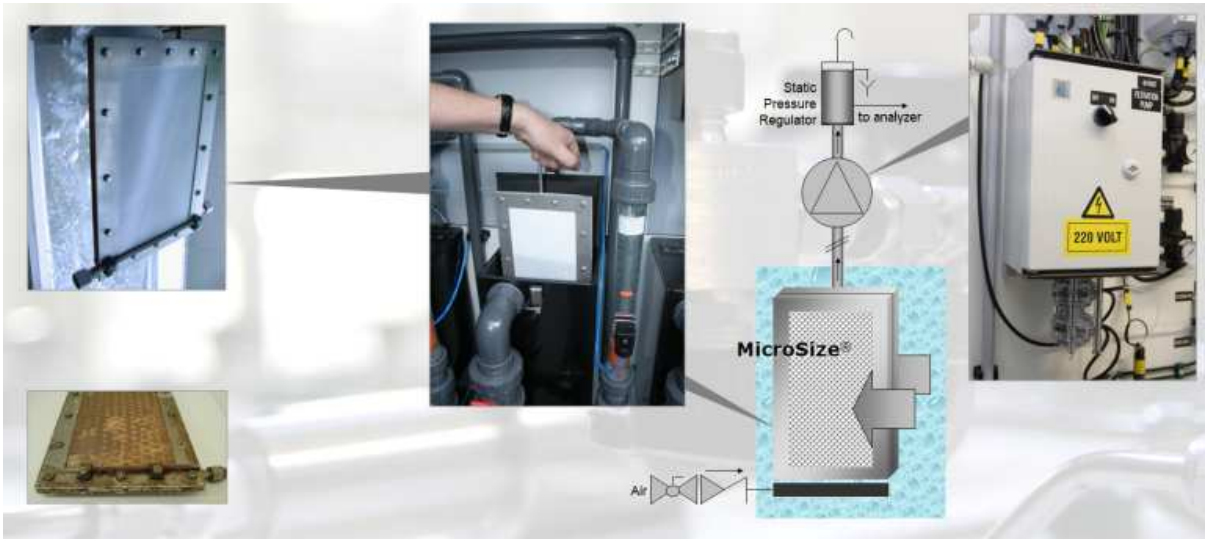
The filter element of the **EZ-Size**® Self Cleaning (Blow-back) Filtration System is inserted in the non-filtered section of the Fast Loop or in a container. Every 5 minutes (interval duration is freely programmable) the filter element is automatically cleaned by a solenoid controlled air or water blow that removes the entrapped particles from the filter element.

Specifications:

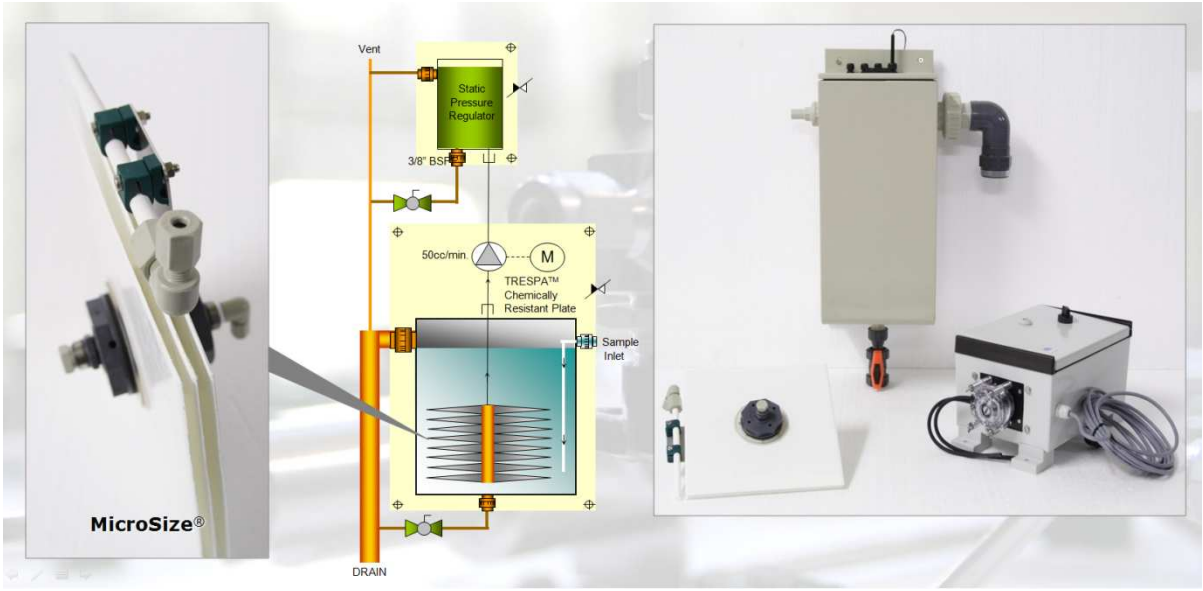
Material filter element:	SS316L
Filter pore size:	50, 100, 200µm, 2mm
Air pressure reducer:	Instrument Air
Solenoid valve:	Sample/Rinse

8.3. **MicroSize**® Self Cleaning MICRO Filtration System:

Configuration 1: 2 different types of membranes available depending on sample matrix



Configuration 2: 1 type of membranes available

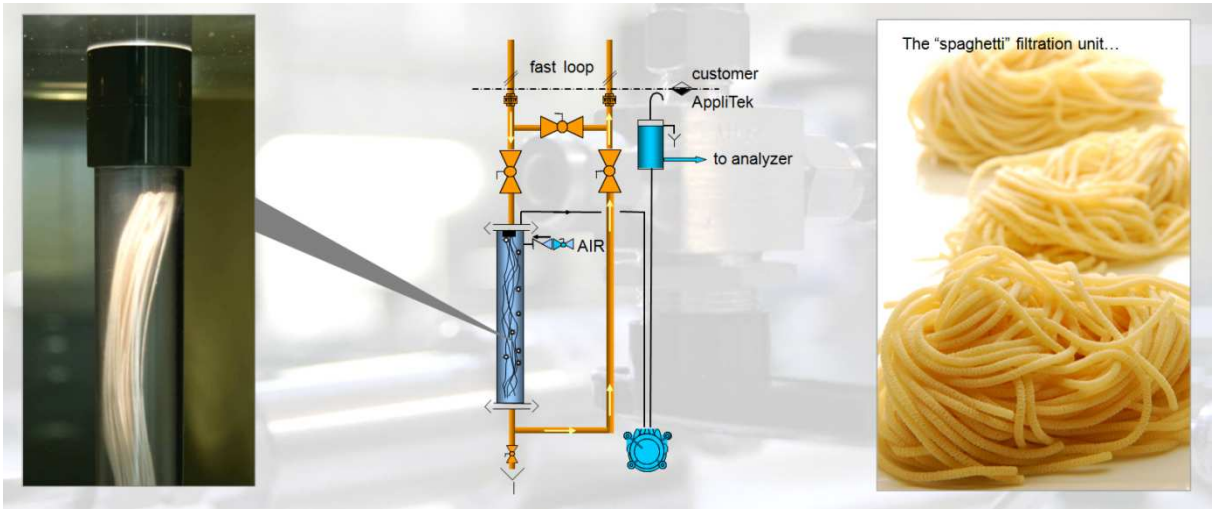


The peristaltic pump sucks the sample from in between the membranes and pumps it towards the analyzer. The outside of the filter screen is continuously rinsed with air. This filter element is submersed in the waste water pond or in a waste water container. The maximum distance between the membrane filter and the analyzer is 15 meter.

Specifications:

Membrane size:	200 mm x 300 mm
Membrane pore size:	0.25 µ
Pump flow:	± 50 cc/min

8.4. **UltraSize**® Self Cleaning ULTRA Filtration System:



The sample flows, parallel with the filter element, with a high velocity so that a self-cleaning operation is obtained. The filter membrane exists of moving fibers that separate the suspended solids from the solution (depending on molecular weight). The moving fibers also assure that pigments with a molecular weight larger than 100.000 cannot pass through the membrane.
By using a peristaltic pump a vacuum is applied to the main space of the fiber bundle. Liquid is drawn into the hollow fibers, solids bigger than 0.4 microns will be removed and filtrate will be delivered to the analyzer. Instrument air is injected continuously causing turbulence on the membranes. The dirt loosens from the membrane and will be removed in the fast loop flow.

Specifications:

Membrane pore size:	0.4 µ
Pump flow:	± 20 cc/min

9. **AnaShell**® **protective cabinet or shelter** (OPTIONAL):

9.1. **AnaShell**® Corrosion Resistant Protective Cabinet:

9.2. **AnaShell**® Protective Shelter:

9.3. **AnaShell**® Desert-proof Protective Shelter:

9.4. **AnaShell**® Corrosion Resistant Protective Shelter:

9.5. **AnaShell**® Explosion-proof Protective Shelter:

Conform European - ATEX or USA - NEC500 standard

ATTACHMENT 1: List of Feasible Process Parameters & Wet–chemical Methodologies								
Component	Metal Surface	Metal Mining	Semi Conductor	Chemical Industry	Food	Pulp, paper, Textile	Power	Water
ABC analysis	■	■	■	■	■	■		
Acetic acid			■	■				
Acidity				■	■	■		
Acrylonitrile				■		■		
Alkalinity (OH^-, CO_3^{2-})		■	■	■	■	■		■
Aluminium	■ ■	■ ■						
Ammonia		■ ■ ■	■ ■ ■	■ ■ ■				■
Ammonia/Nitrate				■ ■				■ ■
Aniline				■				
Anion active detergents				■				
Blended acid			■					
Boric acid	■			■			■	■
Bromide						■		
Bromine index						■ ■		
Cadmium	■	■		■				
Calcium				■ ■ ■		■ ■ ■		■ ■ ■
Carbonate	■	■		■		■		■
Caustic	■		■	■				
Chlorate				■		■		
Chloride	■ ■			■ ■	■ ■			■ ■
Chlorine				■ ■				■ ■
Chromium (Cr^{3+}, Cr^{6+})	■ ■	■ ■		■ ■				■ ■
Citric acid					■			
Cobalt		■		■				
COD				■ ■		■ ■		■ ■
Copper (Cu^{1+}, Cu^{2+})	■ ■	■ ■	■ ■	■ ■		■ ■		■
Cyanide	■ ■ ■	■ ■		■ ■ ■				■ ■ ■
EDTA	■	■	■				■	
Fatty acid					■			
Ferric	■ ■	■ ■		■ ■				■
Ferrous	■ ■	■ ■						■
Fluoride			■ ■	■ ■				■ ■
Formaldehyde			■	■				
Glucose					■			
Hardness								■ ■
Hydrazine							■	
Hydrochloric acid	■	■	■	■				
Hydrogen fluoride	■		■					
Hydrogen peroxide	■		■	■		■		
Hydroxylamine				■				
Hypochlorite						■ ■		■
Hypophosphite	■		■					
Iodide					■			
Lactic acid					■			
Leuco Indigo						■		
Lime				■		■		
Magnesium				■ ■				■ ■
Manganese								■
Metabisulphite				■	■			
Nickel	■ ■	■ ■		■ ■				■
Nitrate				■ ■	■ ■			■ ■
Nitric acid	■		■	■				
Nitrite								■
Oleum				■				
Oxalic acid					■			■
P & M number								■
Peracetic acid					■			■
Permanganate				■				■
Persulphate				■				
pH	■	■	■	■	■	■		■
Phenol				■ ■				■
Phosphate				■ ■	■ ■			■
Phosphoric acid	■		■	■				
Potassium				■	■			■
Potassium hydroxide				■				■
Potassium Iodide				■				

Phthalic acid				■				
Silica			■	■			■	■
Silver	■	■						
Sodium					■		■	■
Sodium dithionite						■		
Sulphate				■		■		
Sulphide				■ ■		■ ■		■ ■
Sulphite				■	■			
Sulphonic acid	■			■				
Sulphuric acid	■	■	■	■				
Thiocyanate						■		
TMAH			■					
Total Nitrate (TN)				■				■
Total Phosphate (TP)				■				■
Zinc	■ ■	■ ■		■ ■		■ ■		■
Zinc phosphate	■							

LEGEND: ■ titrimetric ■ colorimetric ■ Ionometric

ATTACHMENT 2: AppliTek on-line Analyzer Portfolio:

ATTACHMENT 3: Applicable Definitions:

1. Average (Mean):

Quantity obtained by dividing the sum of replicate measurements by the number of measurements in the set:

$$\bar{x} = \frac{\sum_{i=1}^{N} x_i}{N}$$

2. Median:

Is the middle result when replicate data in order of size

3. Variance (= s^2):

$$s^2 = \frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{(N-1)}$$

4. Standard Deviation (= s):

5. Precision or Repeatability:

Precision describes the repeatability of the measurements (= the closeness of results that have been obtained in exactly the same way).

Precision/repeatability = s (units of data)

Relative Standard Deviation (RSD) or coefficient of variation (CV) = $\frac{s_i}{\bar{x}_i}$ x 100 %

Repeatability (Full Scale) = $\frac{s_i}{\bar{x}_{span}}$ x 10 % $\qquad \bar{X}\,span$ = FSR

Repeatability = Precision

6. Accuracy:

Accuracy indicates the closeness of the measurement (x_i) to its true or accepted value (x_t) and is expressed by the error.

Absolute Error (E) = $x_i - x_t$
Relative Error (E_r) = $(x_i - x_t)/x_t$ x 100% (expressed in percent)
Accuracy (Full Scale) = $(x_i - x_t)$/FSR x 100%

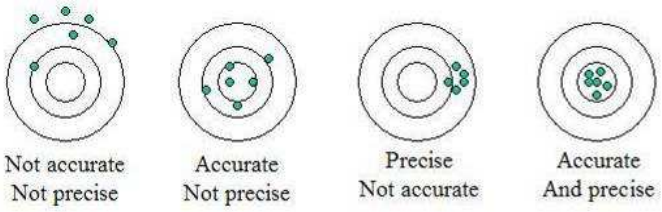


Figure:
Precision and Accuracy illustrated

ⓘREMARK:

All result specifications are guaranteed on standard solutions only. To guarantee an optimal functionality of the described analysis method, a complete filled in questionnaire is required!

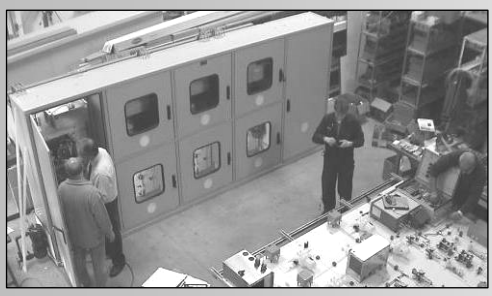
Single Source Responsibility Program

In-house application LABORATORY

- Advice of best analysis method for customer analysis needs, since 1985
- In-house feasibility studies & application development.
- Danger Assessment Studies
- In-house customer & product training

In-house ENGINEERING

- In-house **CAD ExPert team**
- In-house **Ex Proof (ATEX/NEC500) ExPert team**
- In-house **Software/PLC** expert team
- In-house Preconditioning EX-Pert team
- Cost planning
- Basic & Detailed engineering



In-house CONSTRUCTION & INTEGRATION

- In-house quality & safety control
- VCA* Certified
- Flexibility in changes of scope of supply
- Project & Site Management
- Factory Acceptance Test (FAT) by customer prior to shipment, guaranteeing full compliance.
- NEW fully equipped workshop

INTERNATIONAL SERVICE

- FAT prior to shipment, guaranteeing full spec compliance
- Site Acceptance Test (SAT)
- Start up & Training
- Operator / Product training
- Maintenance (contracts)

ⓘREMARK:

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