

# The AutoAnalyzer 3

fra  
SEAL

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*SEAL = Bran+Luebbe = Technicon*

## Over 50 års erfaring med CFA

1954	CFA invented
1957	AutoAnalyzer 1
1969	AutoAnalyzer 2
1986	TRAACS
1997	AutoAnalyzer 3
2004	QuAAtro

Mer enn 11 000 CFA systemer innstallert.

# *SEAL = Bran+Luebbe = Technicon*

BRAN+LUEBBE

1932: Founded in Germany

1940: First On-line Monitors

TECHNICON INSTRUMENTS

1945: Founded in USA

1955: First AutoAnalyzer

**1987: BRAN+LUEBBE ANALYTICS**

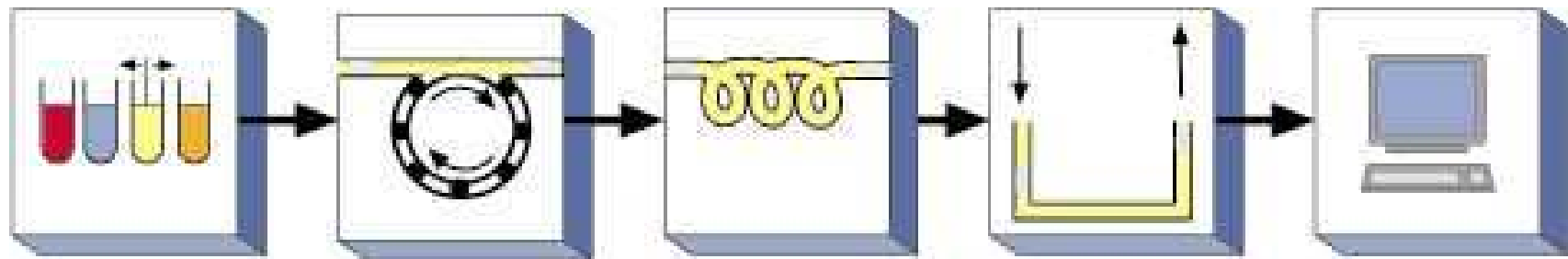
1989: New production facility and state-of-the-art R&D centre established in Germany

**2006 : SEAL Analytica**



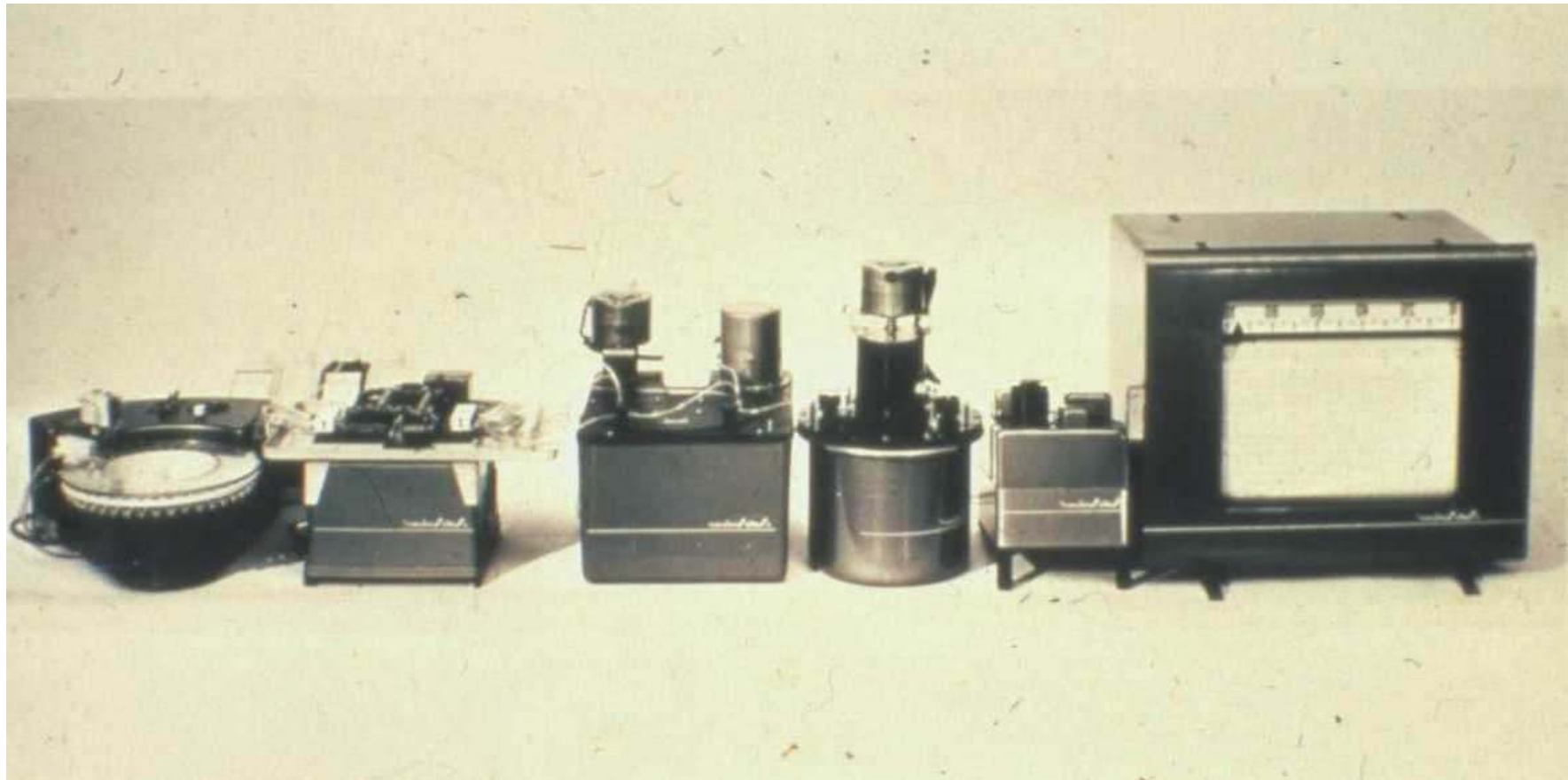
## *A brief history*

A reminder of the principle of CFA



## *A brief history*

# How it started: the AA1



## *A brief history*

# AutoAnalyzer 3



# *A brief history - The AutoAnalyzer 3*

## A history of innovation

- |                            |  |
|----------------------------|--|
| 1957 AutoAnalyzer AAI      | 1990 Dual-range methods                      |
| 1966 AutoAnalyzer AAI      | 1991 Dual-range dialyzer methods             |
| 1968 Continuous digestion  | 1992 Ultra-low range methods                 |
| 1972 Solvent extraction    | 1993 Data handler AACE                       |
| 1973 Solid sampler         | 1994 XYZ sampler                             |
| 1974 On-line distillation  | 1995 Distillation and UV multitests          |
| 1977 UV digestion          | 1996 Compact sampler                         |
| 1979 Data handler AAIC     | 1997 Windows 95 / NT software                |
| 1982 Data handler GTPC     | <b>1998 AutoAnalyzer 3</b>                   |
| 1983 Multi-test methods    | 1999 ISO methods                             |
| 1985 Link to HPLC          | 2000 Interface for external detectors        |
| 1987 Random access sampler | 2001 Improved blank correction               |
| 1988 Autodilution          | 2002 LED photometer                          |
| 1989 Reagent sequencing    | 2004 500 mm flowcell                         |
|                            | 2005 AA3 High Resolution Digital Colorimeter |

# *The AutoAnalyzer 3*

The development of AA3

Design objectives

- Compatible with AAI methods
- Higher automation
- Higher performance
- Lower cost

# *Samplers*



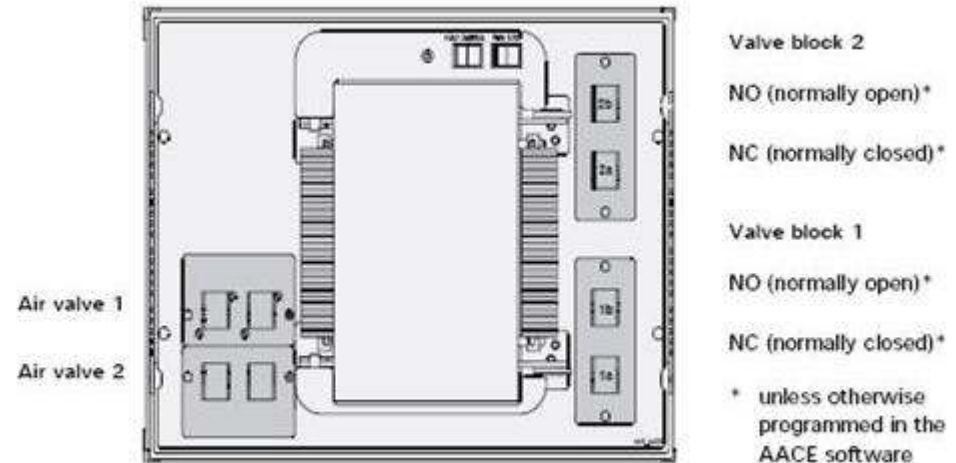
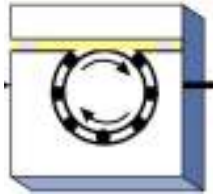
**XY2 Sampler**  
(Max. 180 prøvekopper)



**XY3-Sampler med pumpe for skylleløsning**  
(Max 270 prøvekopper)

# Pump IV

Med 2 luftventiler samt 2 reagensventiler for automatisk innkobling av reagens / vask. Ventilene styres fra systemprogrammet AACE.



**Air injection**

opto - electric

**Motor**

2-speed

**Control**

manual or PC

**Intermittent mode**



**Integrated tray**



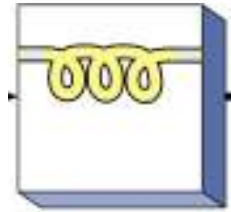
**Dilution valves**



**Valves: Reagent-switch**



# *Manifold*



## Kjemimodul

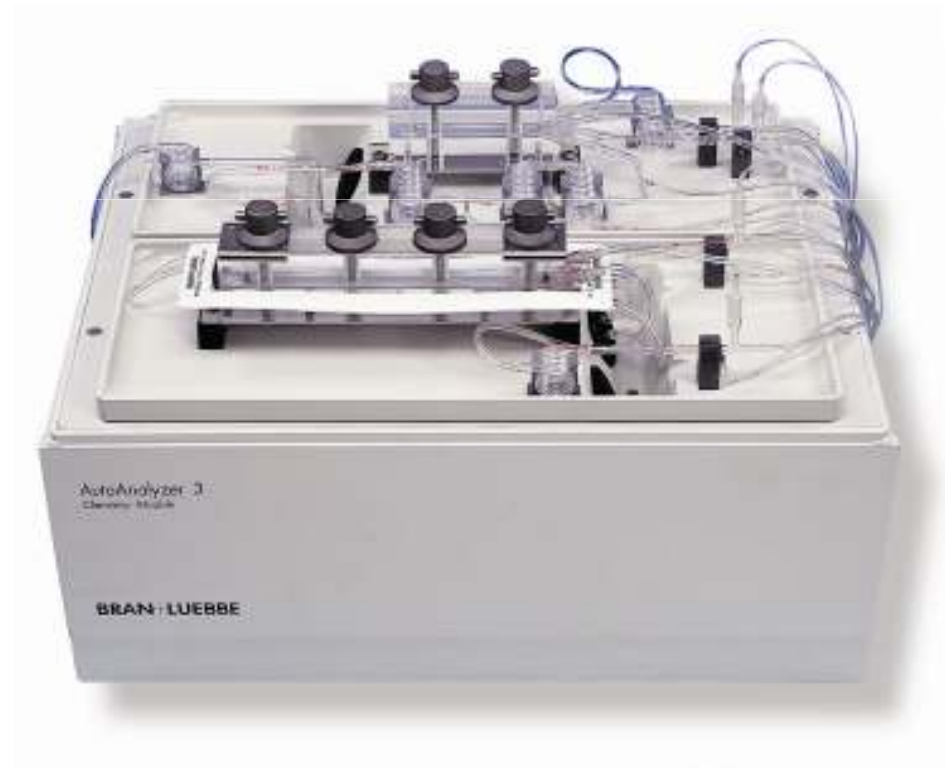
Rommer 2 analysekassetter.

Utformet slik at såvel nye som alle 700 dokumenterede AutoAnalyzer II metoder enkelt kan bygges opp.

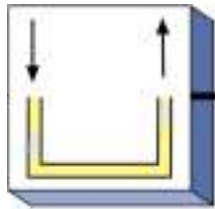
Nytt varmebad med høypresisjons termostatering og utbyttbar spiral.

Lekkasje deteksjon

Deksel for isolering



# Colorimeter



High Resolution photometer with 10 mm flowcell and krypton lamp light source.

**Control**

auton

**No. of channels**

2

**Output**

digital

**Leak detector**



**Flowcell**

10 mm

**Max. sensitivity**

0.01 AUFS

**Resolution**

2,000,000

**Debubbling**

software



## *Hydraulic improvements*

**Internal diameter 2.4 / 2.0 / 1.6 / 1.0 mm**

- *lower reagent consumption*

**Internal diameter more constant**

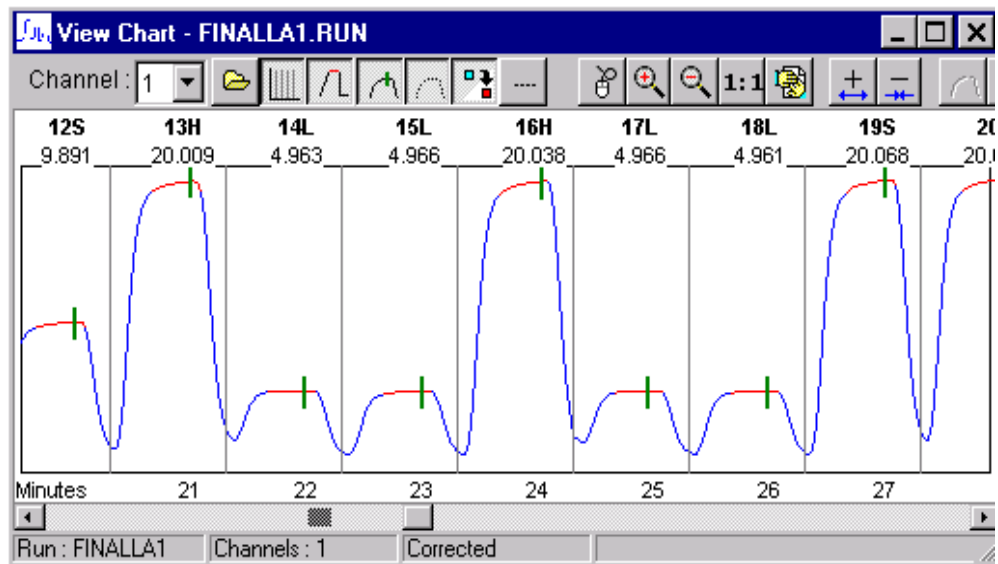
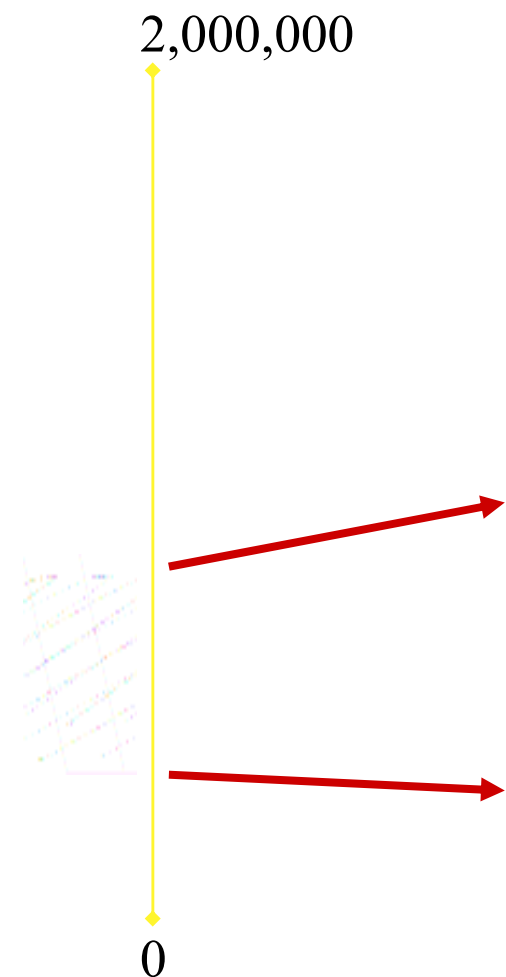
- *lower dispersion, improved reproducibility*



# Electronics

## High Resolution Digital Colorimeter

AA3: full digital range is available, viewing window is fitted to peak



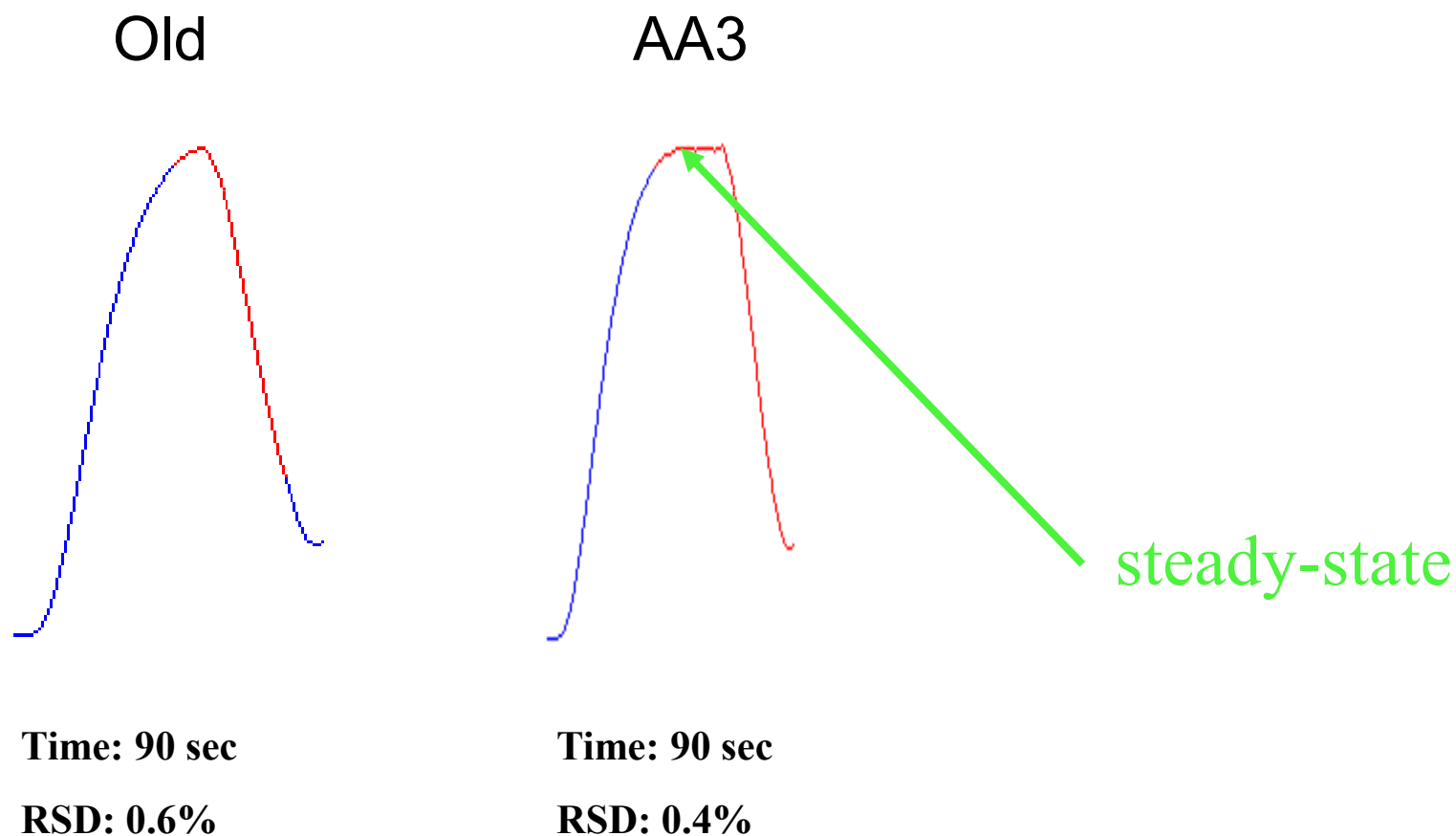
## *Hydraulics*

The result:

Improved Reproducibility

or

Higher analysis rate and Lower reagent consumption

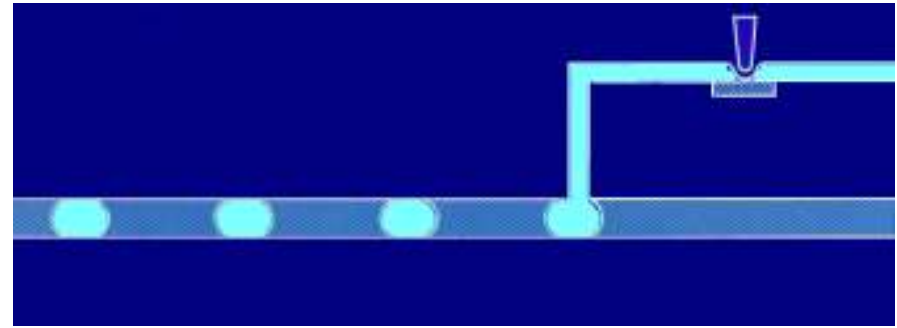
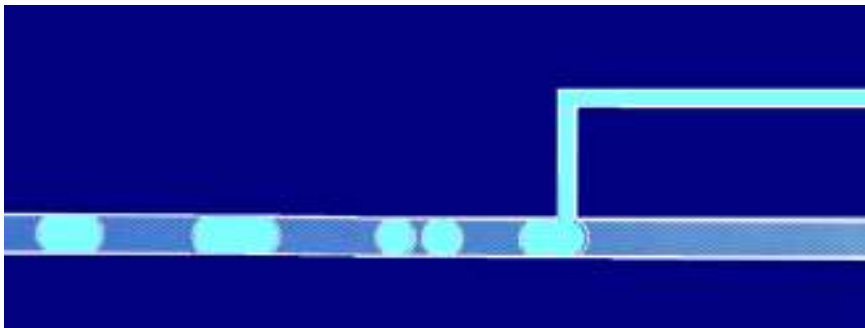


## *Hydraulic improvements*

**Regular bubble injection, synchronized with pump**

*every liquid segment contains the same volume of reagents and sample*

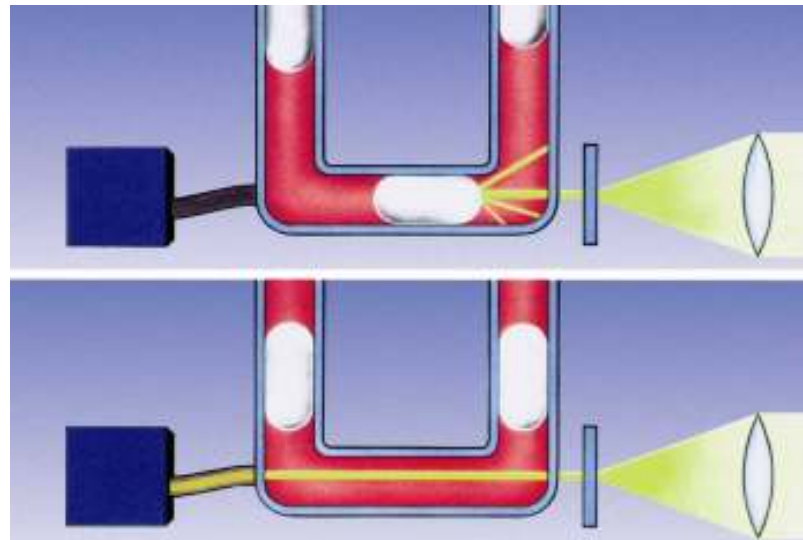
→ *improved reproducibility*



# *Hydraulic improvements*

## **Electronic debubbling in the flowcell**

- *lower dispersion*
- *higher analysis rate*
- *simpler design*



# *The AutoAnalyzer 3*

## Advantages

### **Higher sampling rate**

*30 => 40 => 50 samples / hour*

### **Lower reagent consumption**

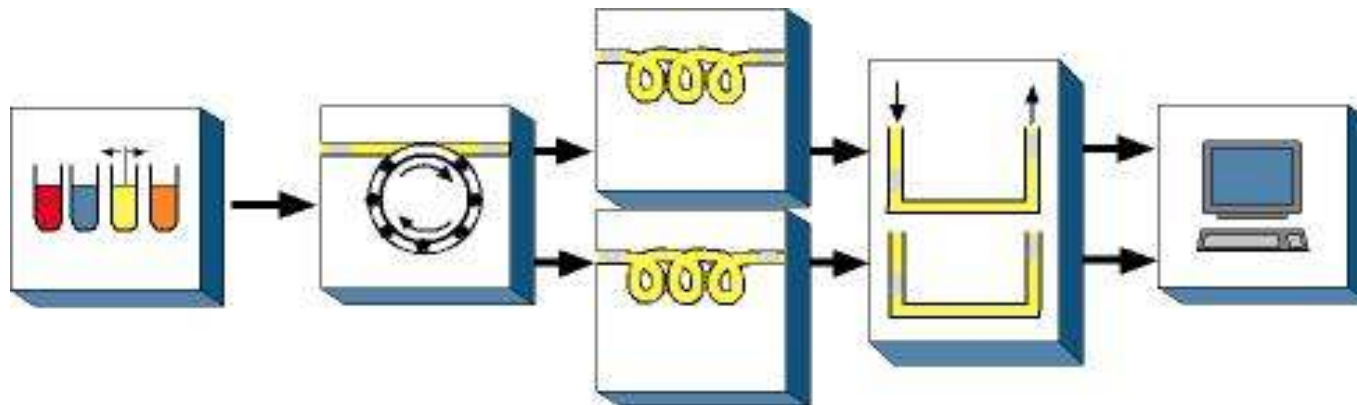
*500 ml => 300 ml => 240 ml for 100 samples*

### **Lower Relative Standard Deviation**

*1% => 0.4%*

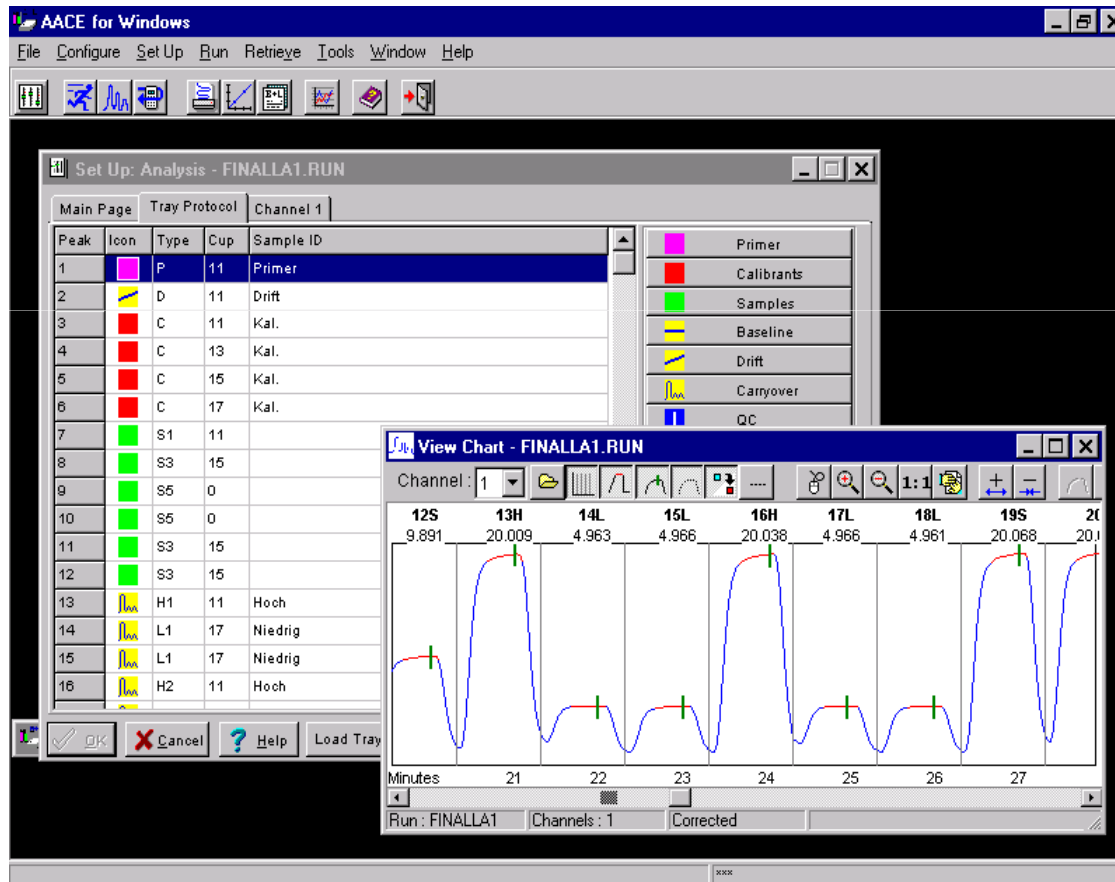
# *The AutoAnalyzer 3*

2-channel system



# AAACE Software

## AutoAnalyzer Control and Evaluation software



- Easy to learn
- Easy to use
- Peak evaluation
- Results calculation
- Quality Control charts
- LIMS connection

## Easy to Learn

**Set Up: Analysis - 020123A.run**

Analysis: Allakanaler Run Name:

Description: AmmoniumNitrit+ NitratFosfatKisel

Samples per Hour: 60 Sample Time (s):

Sample to Wash: 5.0 Wash Time (s):

Statistics:  Batch Report:  Reduce Pump speed at

Channels:	Method	Unit	Info
	1 Ammonium	µg/l	System num
	2 Nitritnitra	µg/l	No. of cups:
	3 Fosfat	µg/l	No. of samp
	4 Kisel	µg/l	XYZ Sample

Auto Dilution: None Valve Syringe Select ...

Dilution Analysis : Späd\_4kanal.anl

OK Cancel ? Help

**AACE On-line Help**

Datei Bearbeiten Lesezeichen Optionen ?

Inhalt Index Zurück Drucken << >> Glossary

### Entering Main Page Information

At the top of the Set Up: Analysis window, click the Main Page tab.

**Enter the following information:**

- Analysis:** If this is a new Analysis, type in a name. This will usually be the name of the type of sample, such as Sea Water, Waste Water etc.  
After having saved the Analysis once (by clicking **OK**), the name cannot be changed any more and will appear dim.
- Description:** This field is optional. You can type in a comment to provide more information about the Analysis.
- Save as Auto Dilution Analysis (AA3 and TRAACS only):** If you are creating a new Analysis, select this additional check box if the current Analysis will be used as Auto Dilution Analysis (see also [Automatic Dilution Analyses](#)).
- Run Name:** If you are creating a new run, this additional field will be provided where you can enter a run name. If the Run Name Generator in *Configure - Software - General* was activated, a name will be automatically entered.
- Samples per Hour:** This field indicates the sampling rate. The default is 100. Check your method description if a different rate is recommended for your method and change the value if required. For multi-channel systems, use the smallest rate given for the methods.  
If you increase the rate, the sample and wash time will decrease, and vice versa.  
Note that this is the parameter which has the greatest effect on inter-sample carryover. The higher the sampling rate, the higher the risk of

Click on the Help button...

# AAACE Software

## Easy to Use

The screenshot shows the 'Set Up: Analysis - 020123A.run' window. It features a table with columns for Peak, Icon, Type, Cup, and Sample ID. The table contains 16 rows of data. To the right of the table is a vertical list of symbols and their corresponding names. A green arrow points from the 'QC' symbol in the list to the 'QC1' entry in the table.

Peak	Icon	Type	Cup	Sample ID
1	■	P	1	Primer
2	↘	D	2	Drift
3	■	C	1	Cal.
4	■	C	2	Cal.
5	■	C	3	Cal.
6	■	C	4	Cal.
7	■	C	5	Cal.
8	■	C	6	Cal.
9	⌋	H1	1	High
10	⌋	L1	5	Low
11	⌋	L1	5	Low
12	■	QC1	10	Quality Cup
13	■	S	11	no2
14	■	S	12	det
15	■	S	13	det
16	■	S	14	det

The symbol list on the right includes: Primer (pink square), Calibrants (red square), Samples (green square), Baseline (yellow square), Drift (blue square), Carryover (blue square with wavy line), QC (blue square with '1'), Null (black circle with '0'), Spiked Sample (green square), Pause (red circle with 'STOP' and pink square), End (red circle with 'STOP'), Row 1, Row 2, Insert, Overwrite, Move, Fix, Delete..., and ID Generator ...

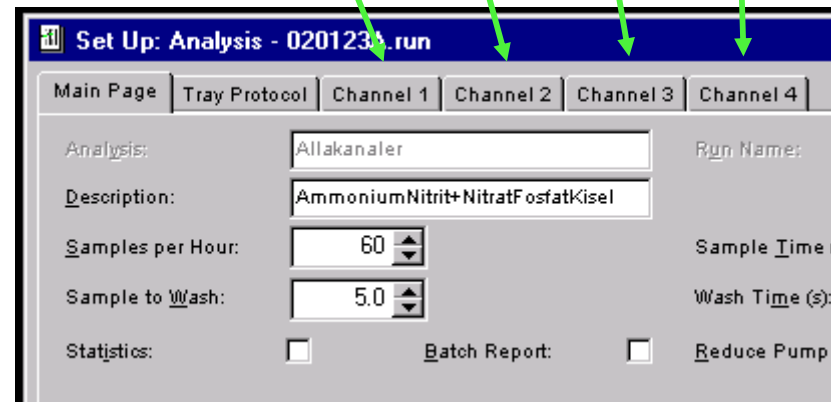
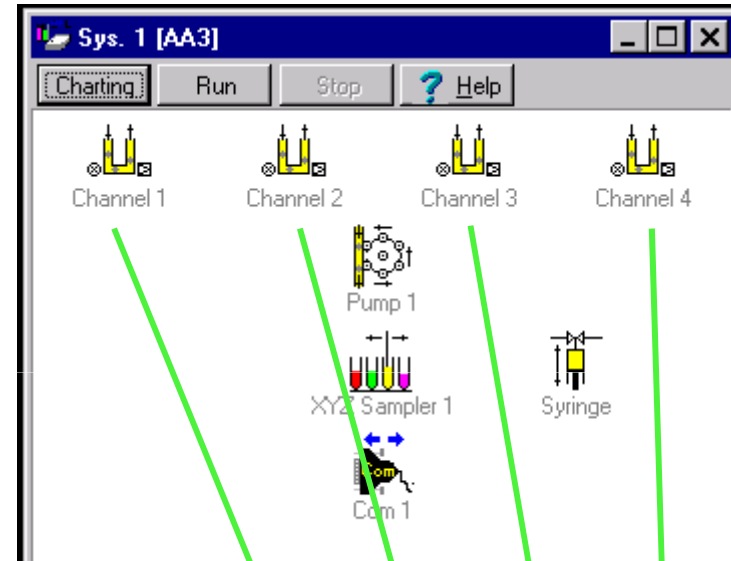
Just click on a symbol...

To add a cup to the analysis list

# AACE Software

## Easy to Use

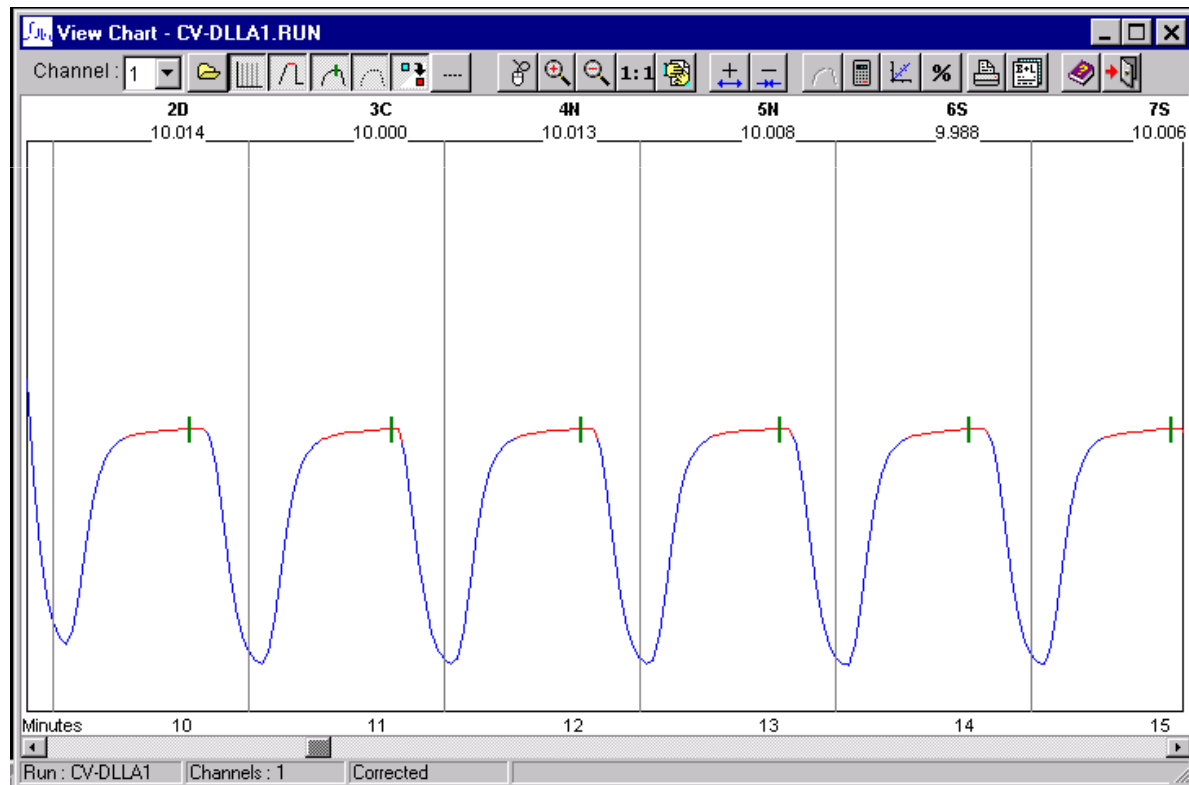
Only the modules and options in Your system appear on the screen



# *AACE Software*

## Peak Evaluation

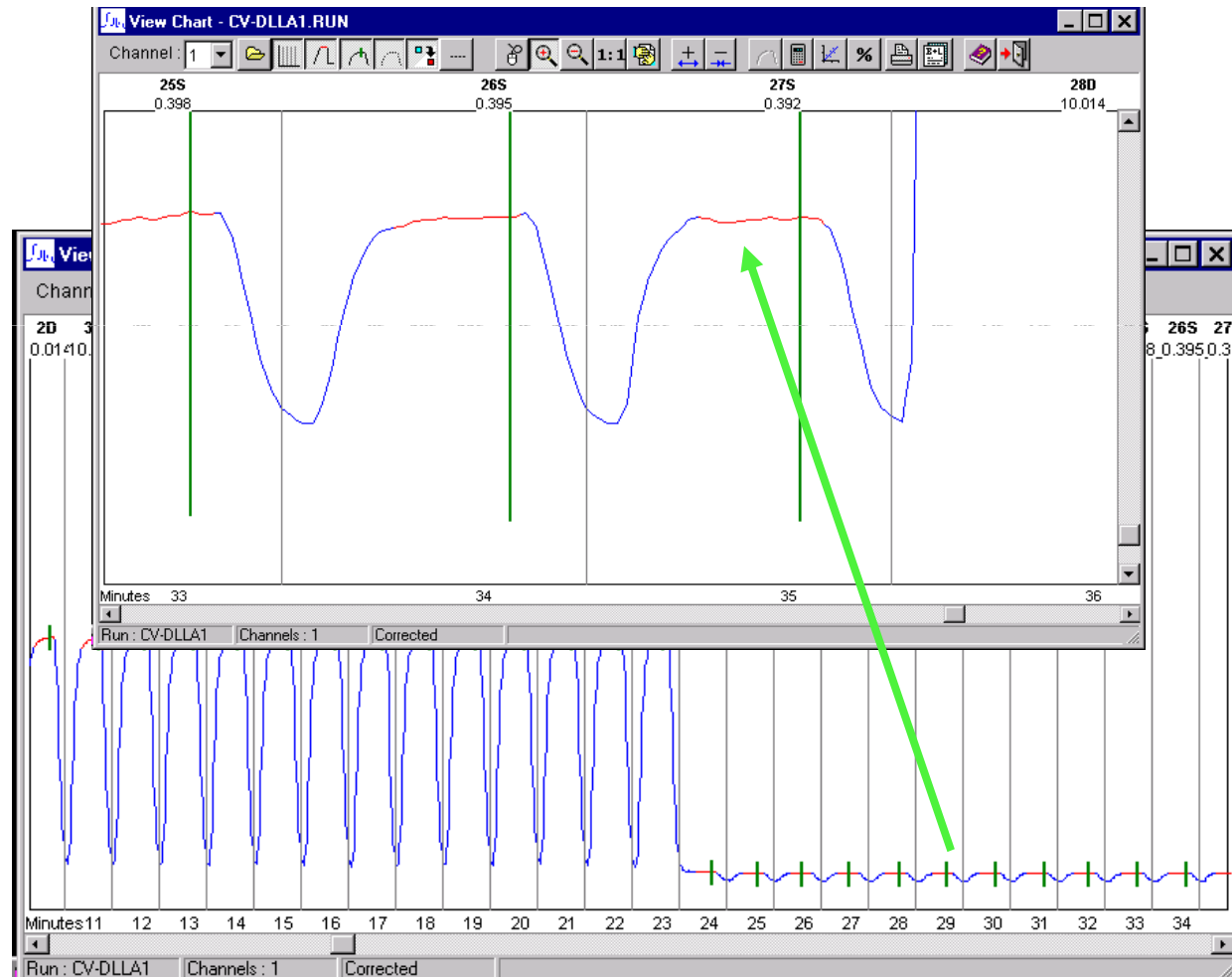
Specially  
designed to read  
steady-state  
peaks accurately



## Peak Evaluation

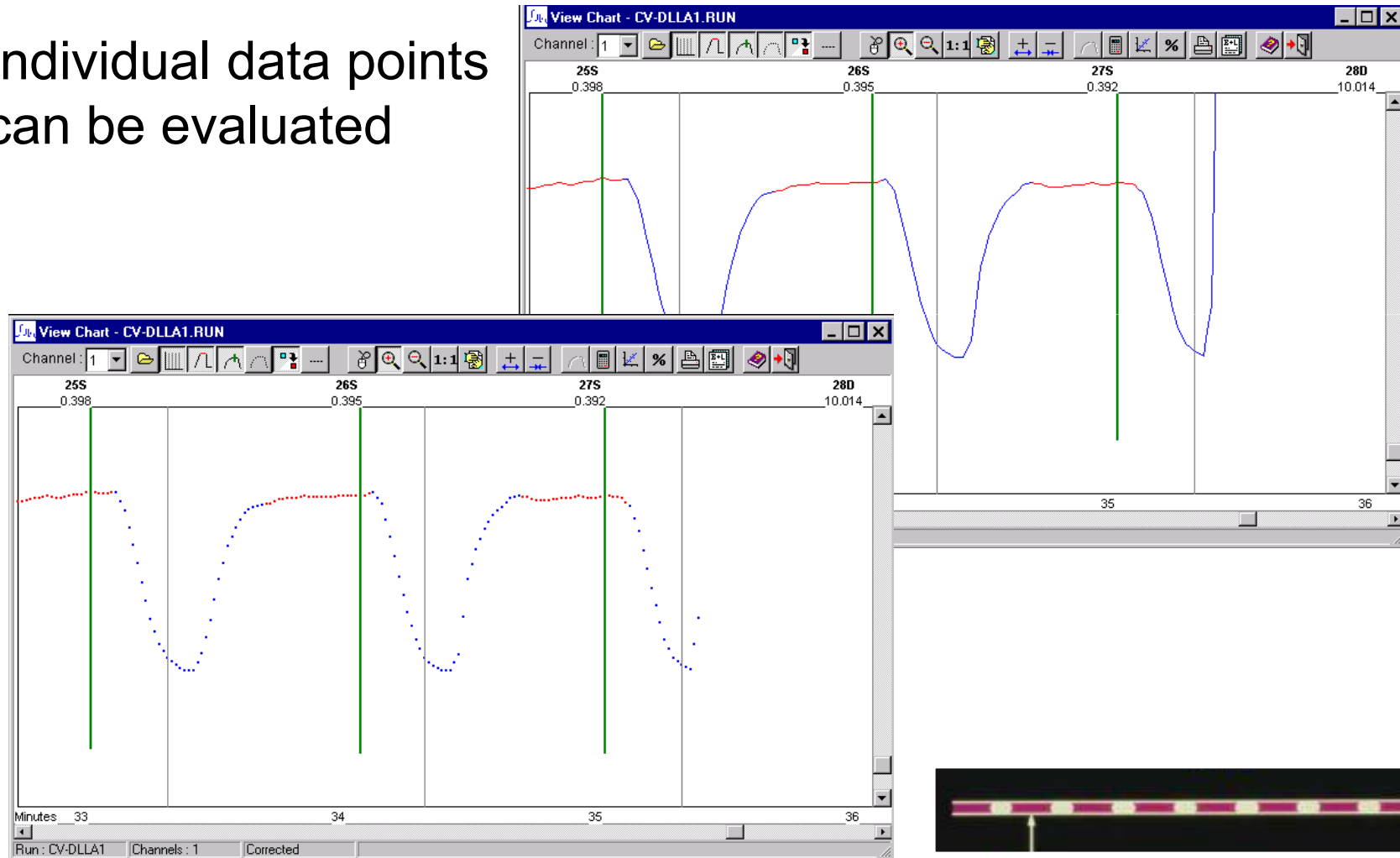
Display can  
be  
compressed  
to see a  
whole run...

... or  
expanded to  
show details  
of low peaks.



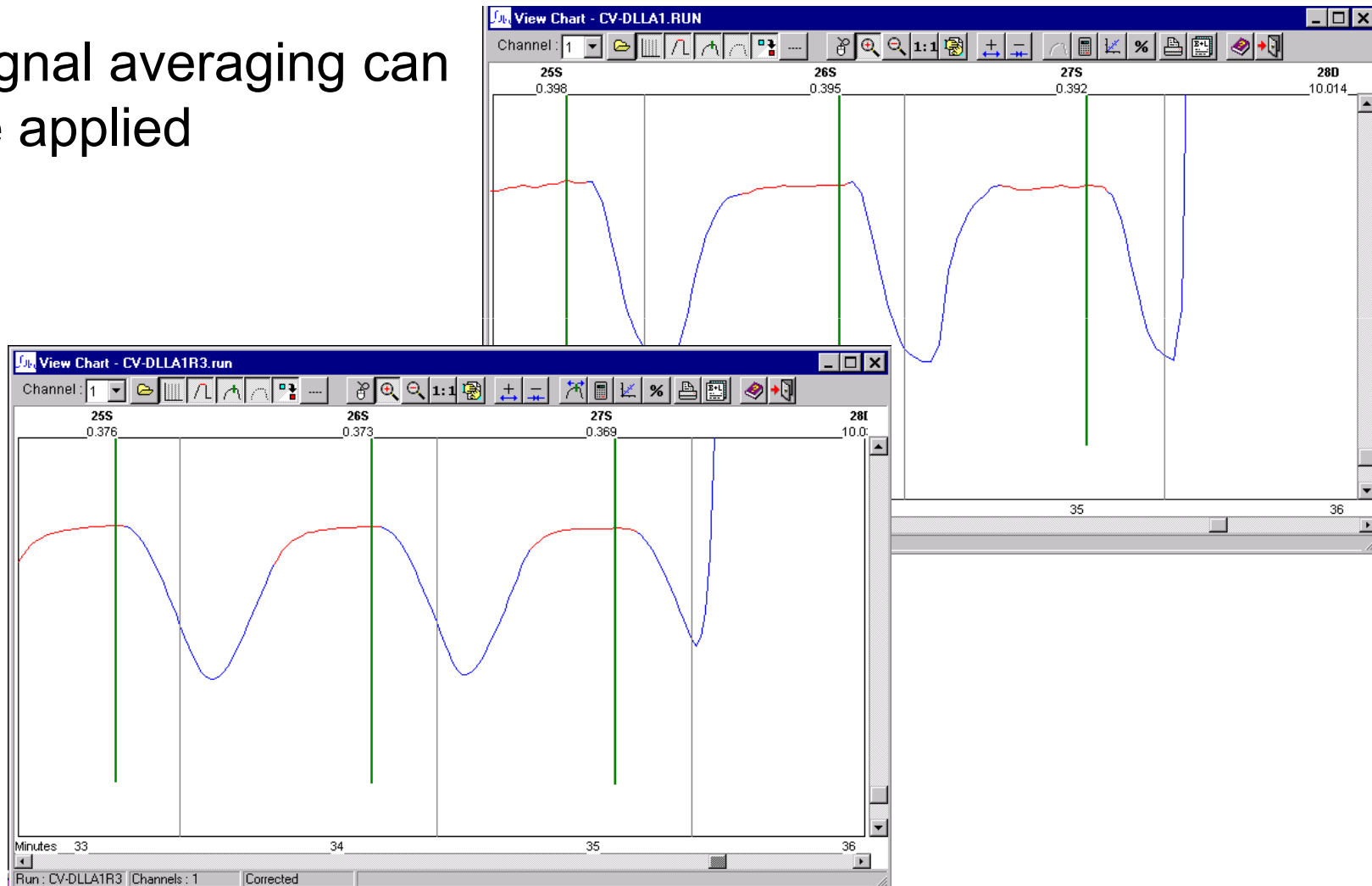
## Peak Evaluation

Individual data points can be evaluated



## Peak Evaluation

Signal averaging can be applied



## Results Calculation

Report  
contains  
system  
performance  
information:

Calibration  
accuracy

Sensitivity

BRAN+LUEBBE AACE 5.40 alpha 12 Post-run Report

### Stockholm Water Company

Drinking Water Analysis Report

Name of Run : 020219AR1 Name of Analysis : Stephentest.ANL  
Date of Report : 22.02.02 System No. : 1  
Date of Run : 19.02.02 Type of System : AA3  
Operator : Start/Stop time : 10:13 - 11:10  
Comment : Recalculate from Run020219A.run  
SCC

---

Channel	1	2	3	4
Method	NH4-N	N032-N	P04-P	Si
Unit	µg/l	µg/l	µg/l	µg/l
Calibr. Fit	Linear	Linear	Linear	Linear
Corr. Coeff.	0.9998	1.0000	1.0000	0.9999
Base	-17345	-20815	413	-14324
Gain	21	22	31	22
Sensitivity	0.3857	0.3760	0.2788	0.3820
Sample Limit 1				
Sample Limit 2				

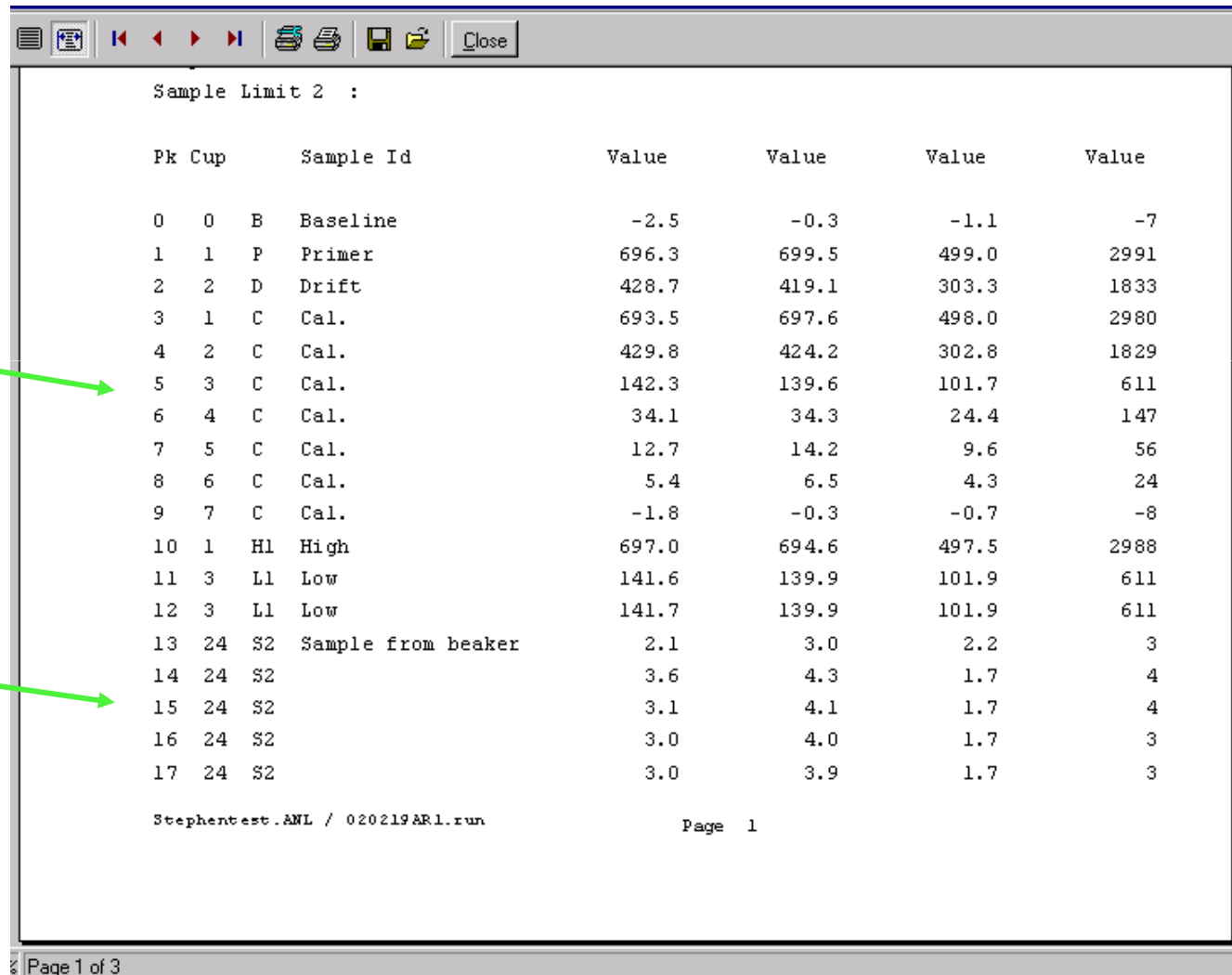
Pk Cup	Sample Id	Value	Value	Value	Value
0 0 B	Baseline	-2.5	-0.3	-1.1	-7
1 1 P	Primer	696.3	699.5	499.0	2991

Page 1 of 3

## Results Calculation

Calibration  
report

Sample  
results



The screenshot shows a software window titled "Sample Limit 2 :". The window contains a table with columns for "Pk Cup", "Sample Id", and four "Value" columns. The data is as follows:

Pk	Cup	Sample Id	Value 1	Value 2	Value 3	Value 4
0	0	B Baseline	-2.5	-0.3	-1.1	-7
1	1	P Primer	696.3	699.5	499.0	2991
2	2	D Drift	428.7	419.1	303.3	1833
3	1	C Cal.	693.5	697.6	498.0	2980
4	2	C Cal.	429.8	424.2	302.8	1829
5	3	C Cal.	142.3	139.6	101.7	611
6	4	C Cal.	34.1	34.3	24.4	147
7	5	C Cal.	12.7	14.2	9.6	56
8	6	C Cal.	5.4	6.5	4.3	24
9	7	C Cal.	-1.8	-0.3	-0.7	-8
10	1	H1 High	697.0	694.6	497.5	2988
11	3	L1 Low	141.6	139.9	101.9	611
12	3	L1 Low	141.7	139.9	101.9	611
13	24	S2 Sample from beaker	2.1	3.0	2.2	3
14	24	S2	3.6	4.3	1.7	4
15	24	S2	3.1	4.1	1.7	4
16	24	S2	3.0	4.0	1.7	3
17	24	S2	3.0	3.9	1.7	3

Stephentest.ANL / 020219AR1.run Page 1

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## Results Calculation

### Performance statistics

#### STATISTICS

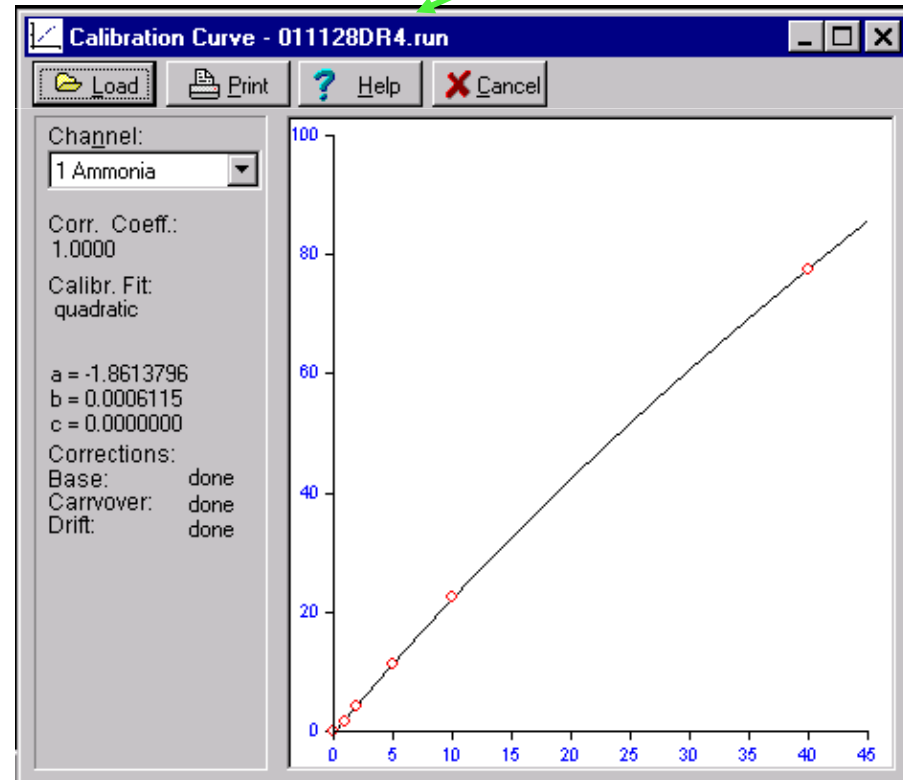
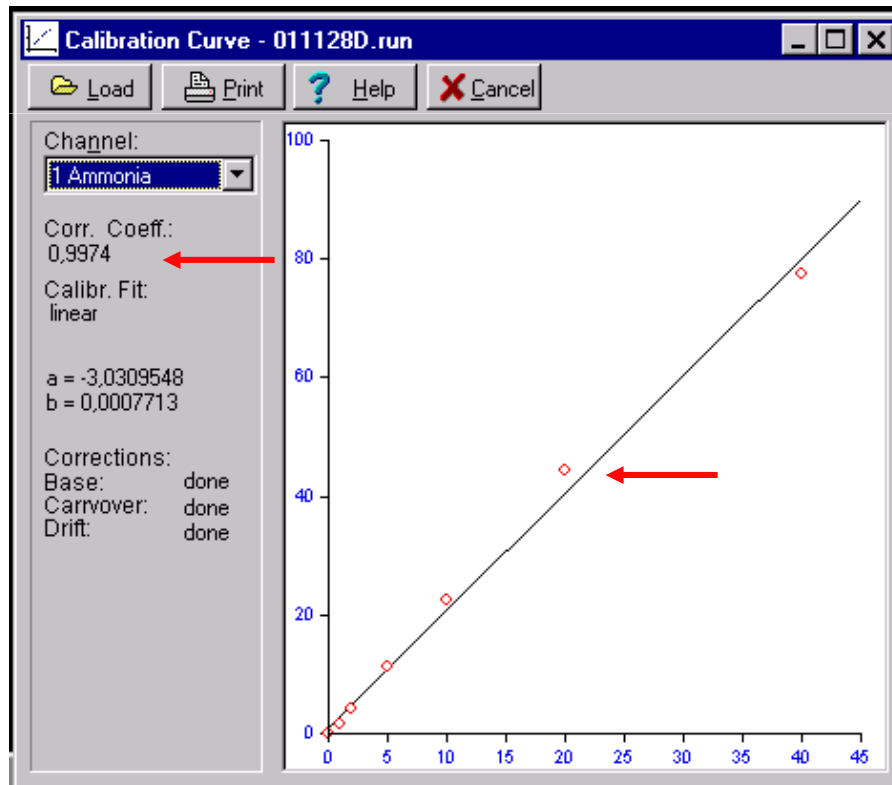
Channel :	1	2	3	4
Group 2 Mean	3.3	3.8	1.9	3
Std. Deviation	0.5	0.3	0.1	0
Coeff.of Variation [%]	16.8	8.8	6.8	14
No. of Samples	12	12	12	12
Min	2.1	3.0	1.7	2
Max	4.3	4.3	2.2	4
Detection Limit	1.5	0.9	0.3	1

# AAE Software

## Results Calculation

Faulty calibration  
can be corrected

New results are copied:  
old results are retained

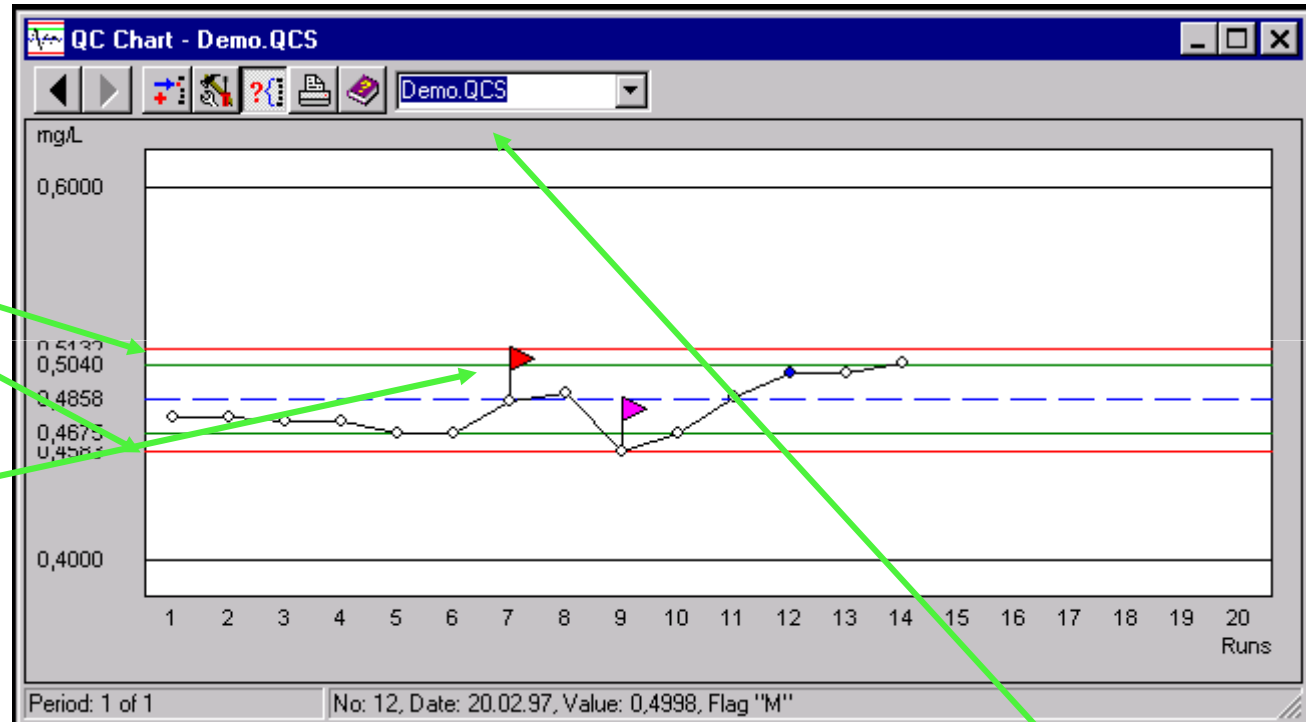


## Quality Control Charts

User-defined  
or automatic  
limits

Automatic  
warning flags

9 different QC  
levels can be  
defined

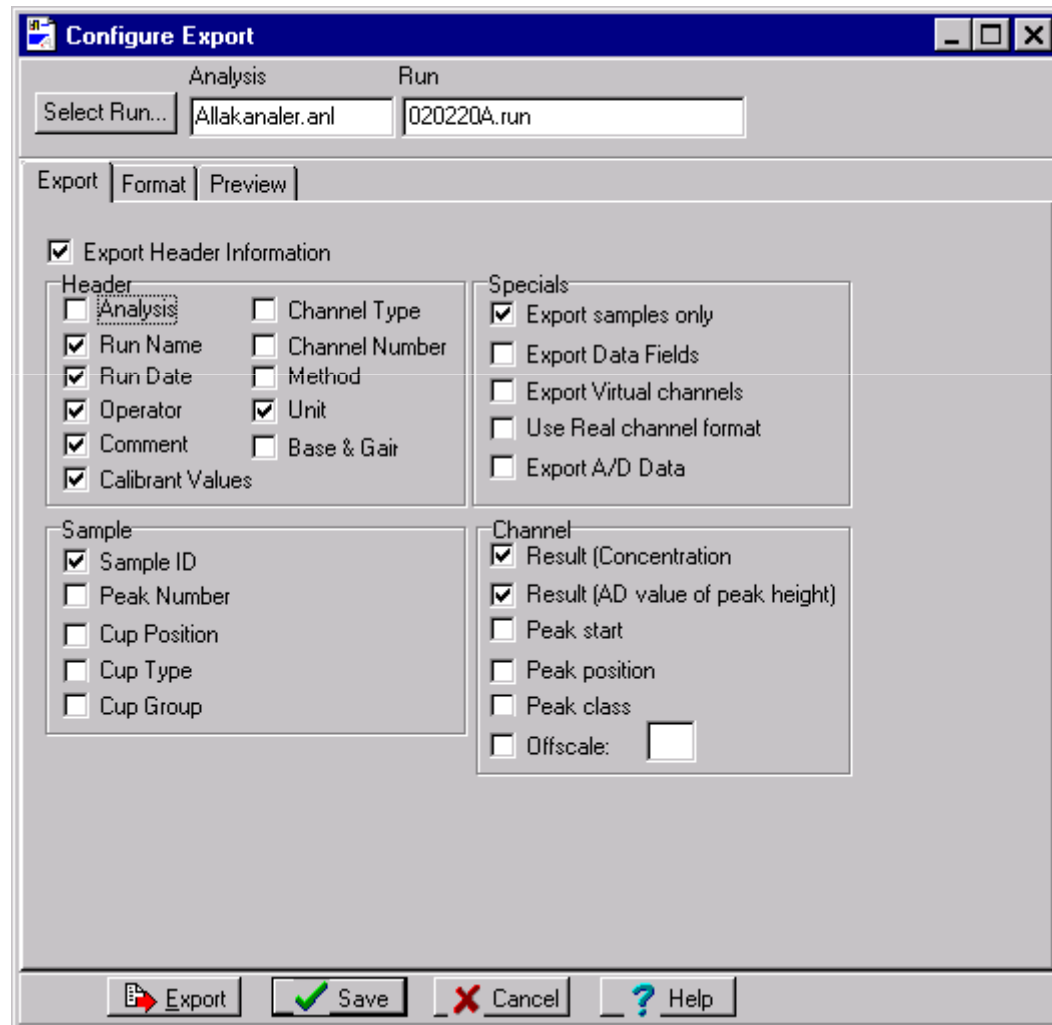


Values for each data point

Automatic  
data transfer

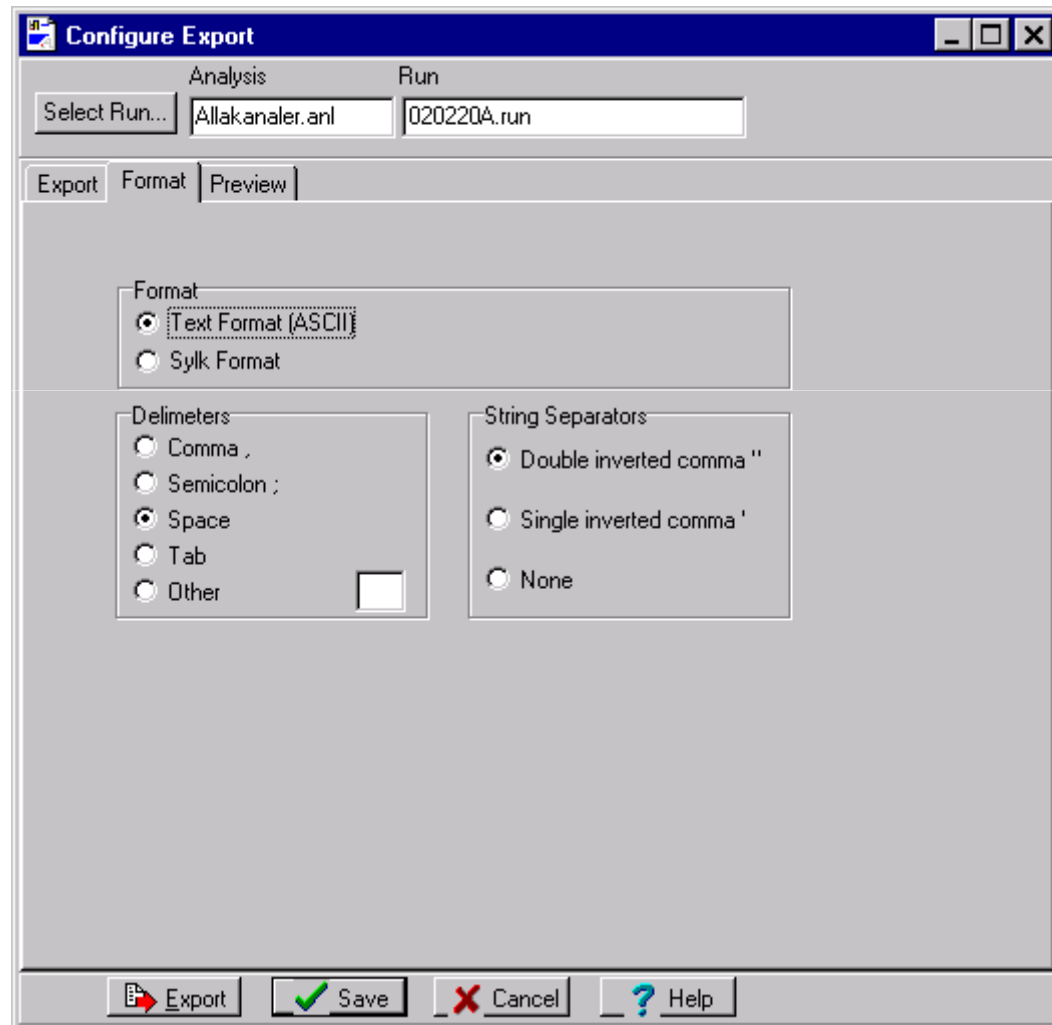
## Data Export to LIMS

1. Select data to export



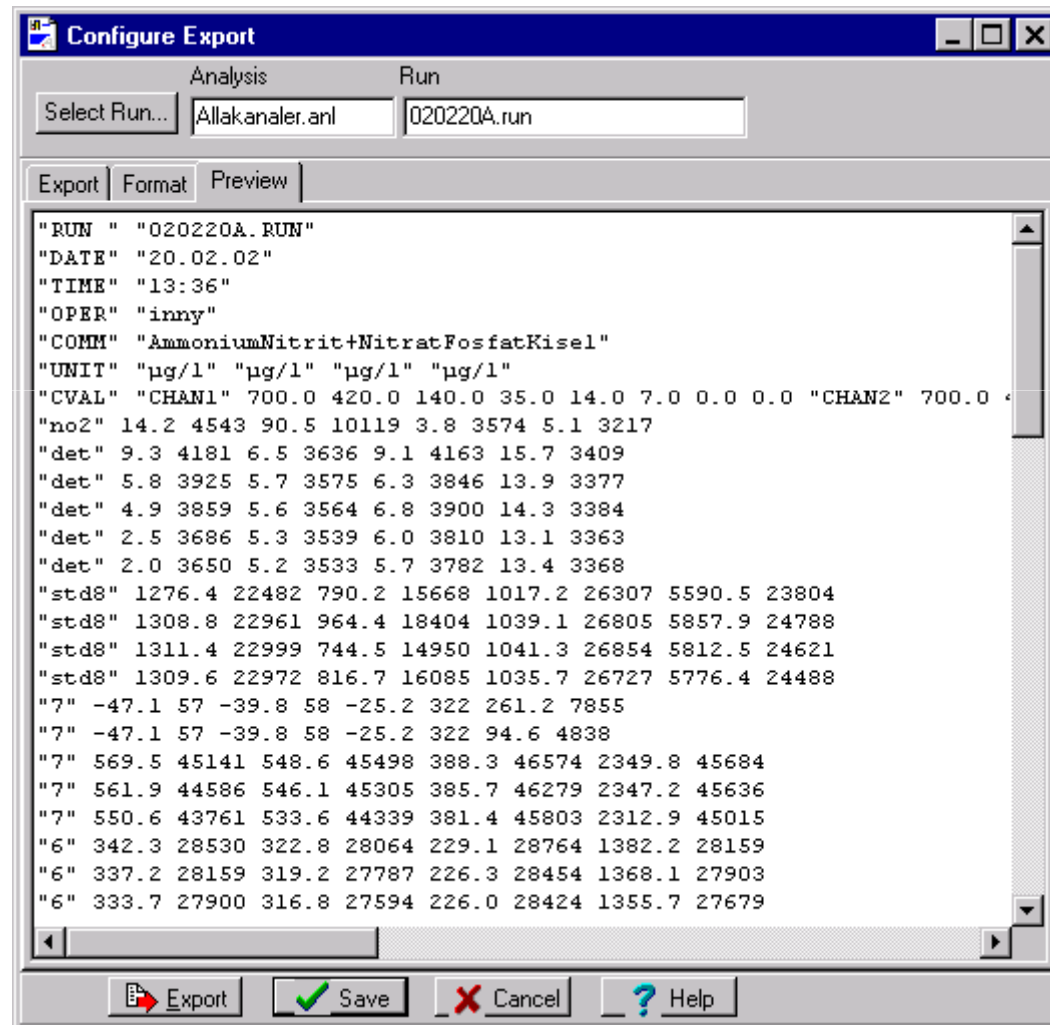
## Data Export to LIMS

### 2. Select data format



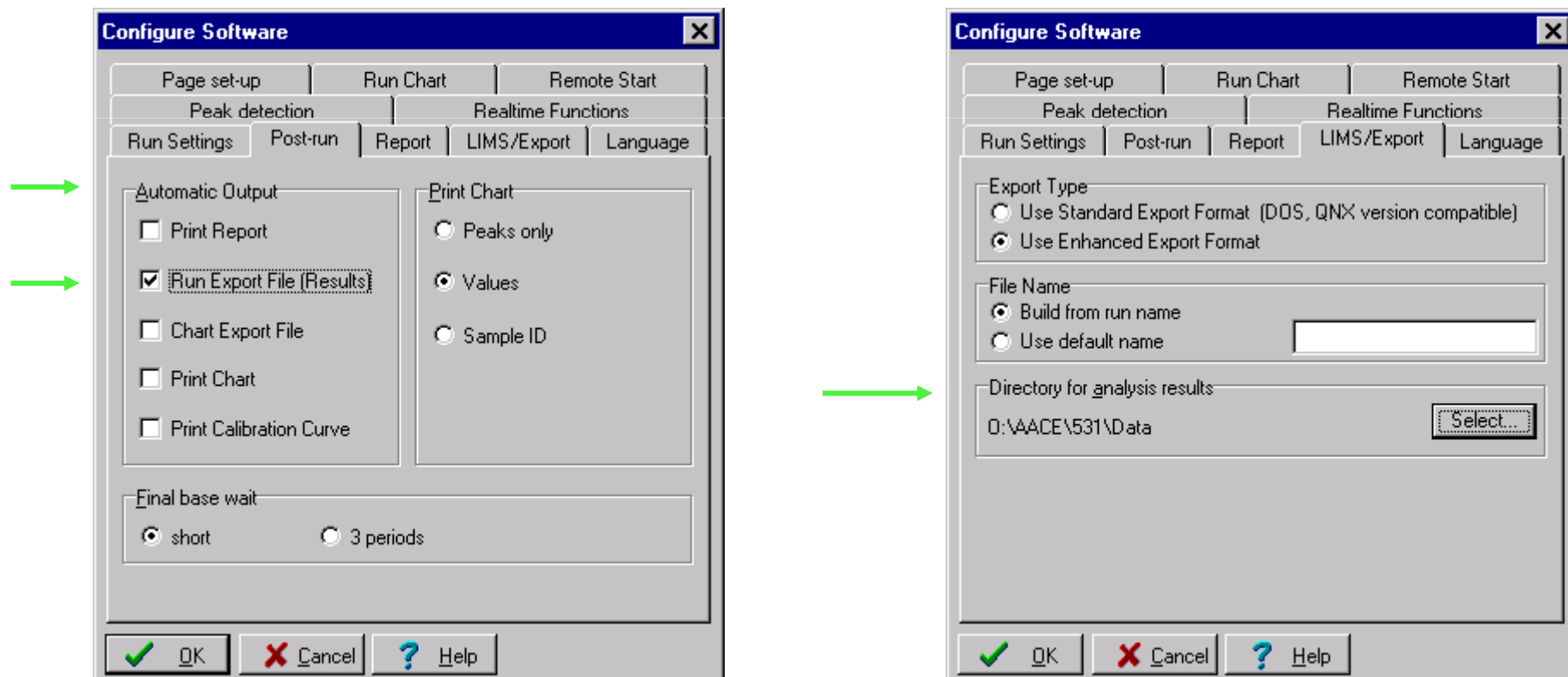
## Data Export to LIMS

### 3. Preview export file



## Data Export to LIMS

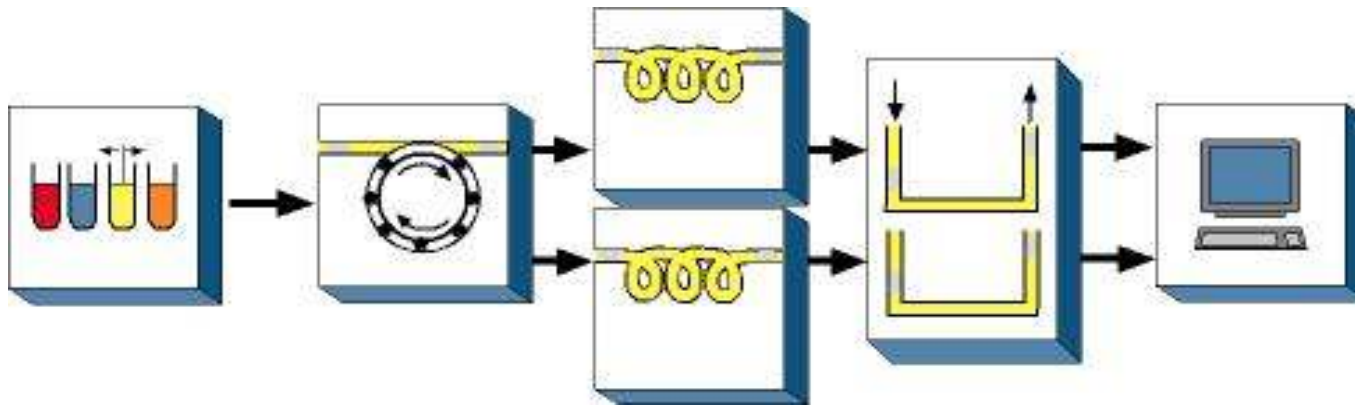
Results can be exported automatically after each run



# *Methods*

## MULTITEST METHODS

How to analyze several parameters?

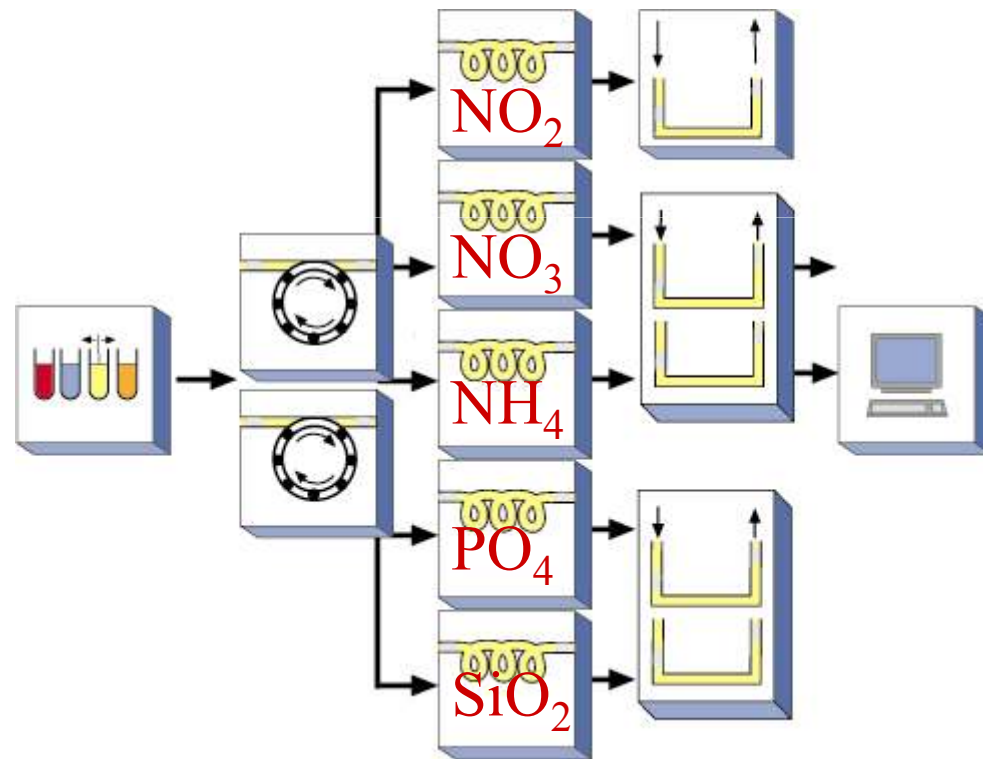


## *Methods*

Different ways of measuring 5 parameters.

A 5-channel system with 5 manifolds

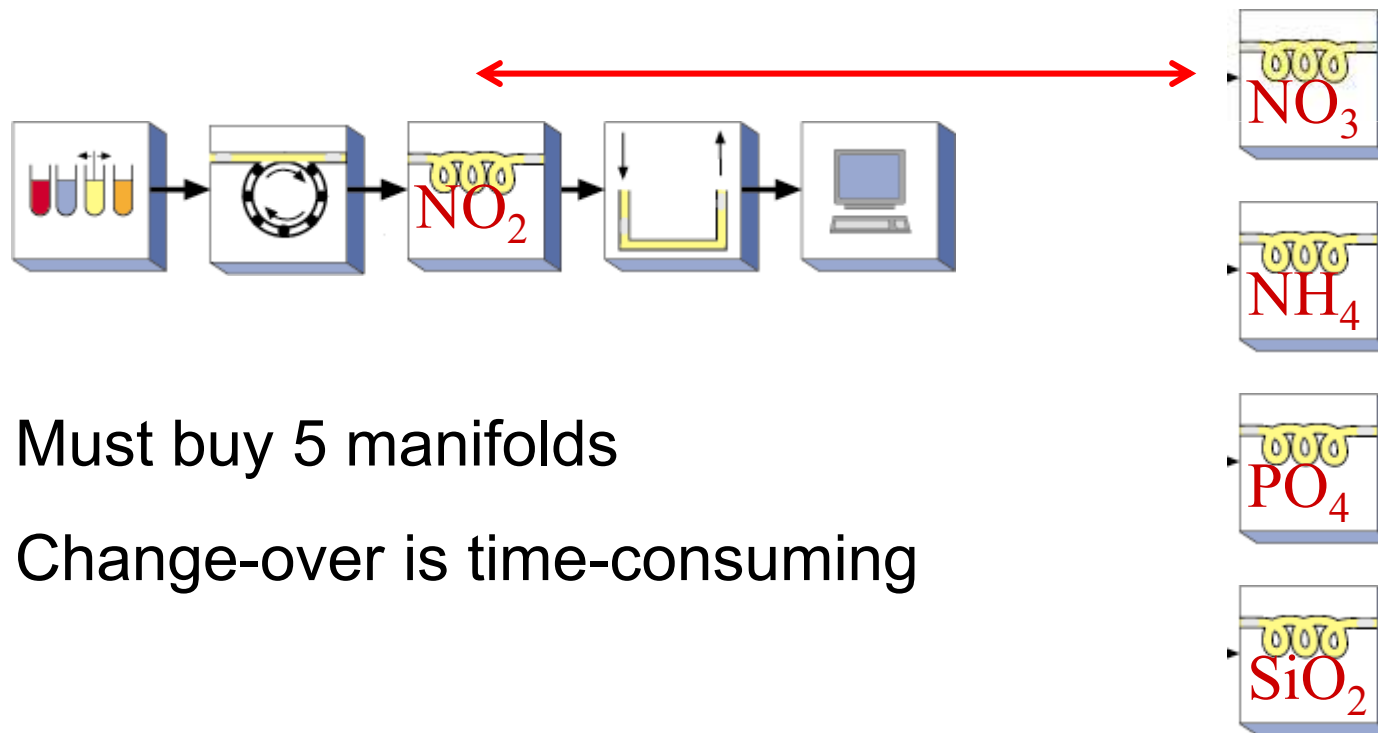
Fast,  
but  
large and expensive



## *Methods*

Different ways of measuring 5 parameters.

A 1-channel system with 5 manifolds



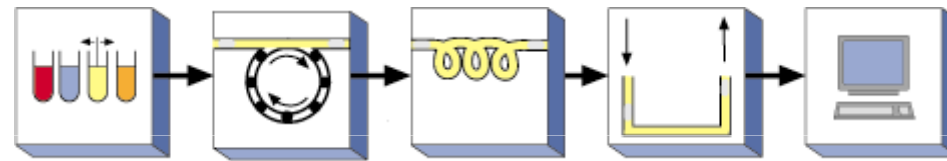
Must buy 5 manifolds

Change-over is time-consuming

## *Methods*

Different ways of measuring 5 parameters.

A system with **1** multi-test manifold



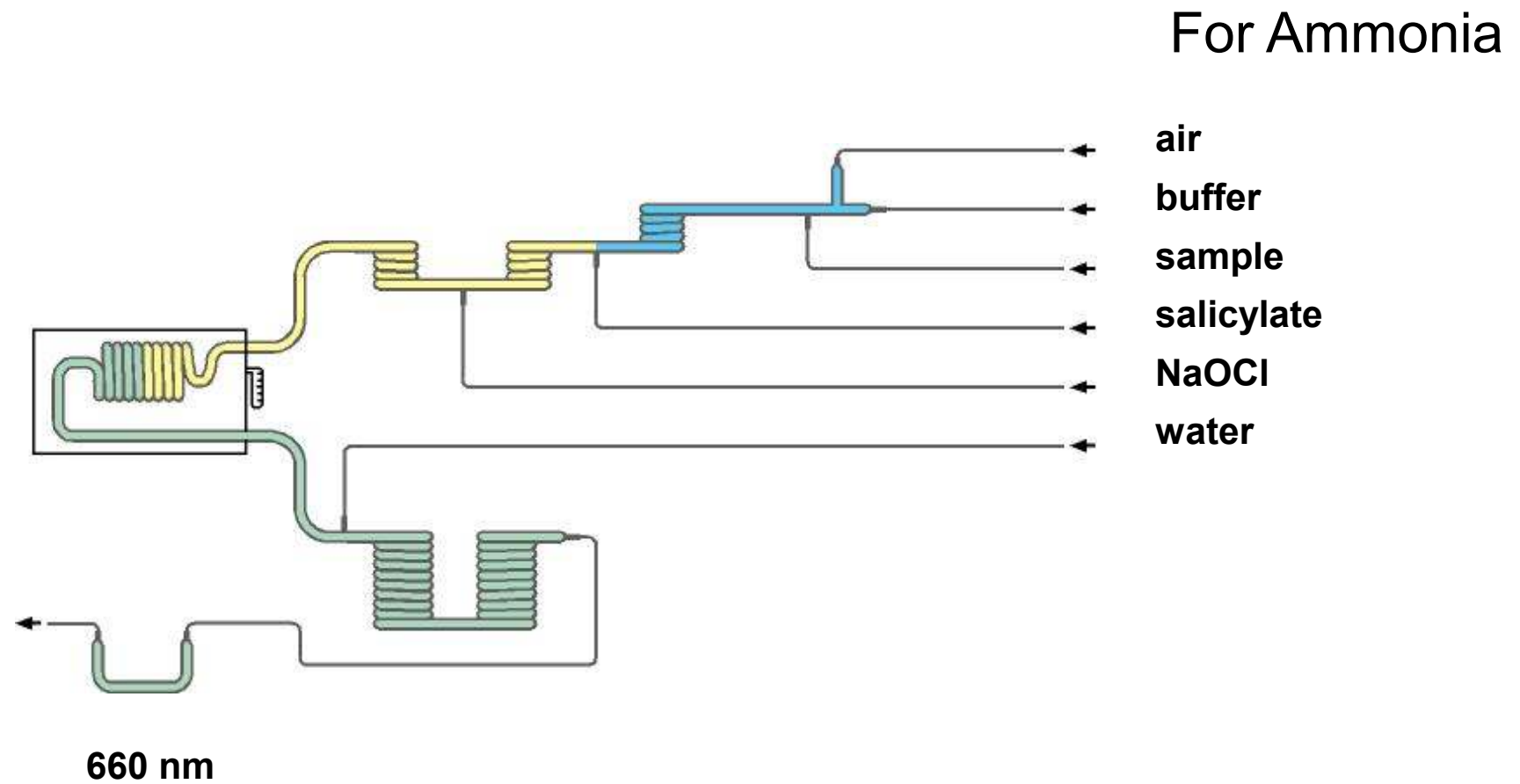
NO<sub>2</sub>  
NO<sub>3</sub>  
NH<sub>4</sub>  
PO<sub>4</sub>  
SiO<sub>2</sub>

Economical and flexible.

Invented by B+L.

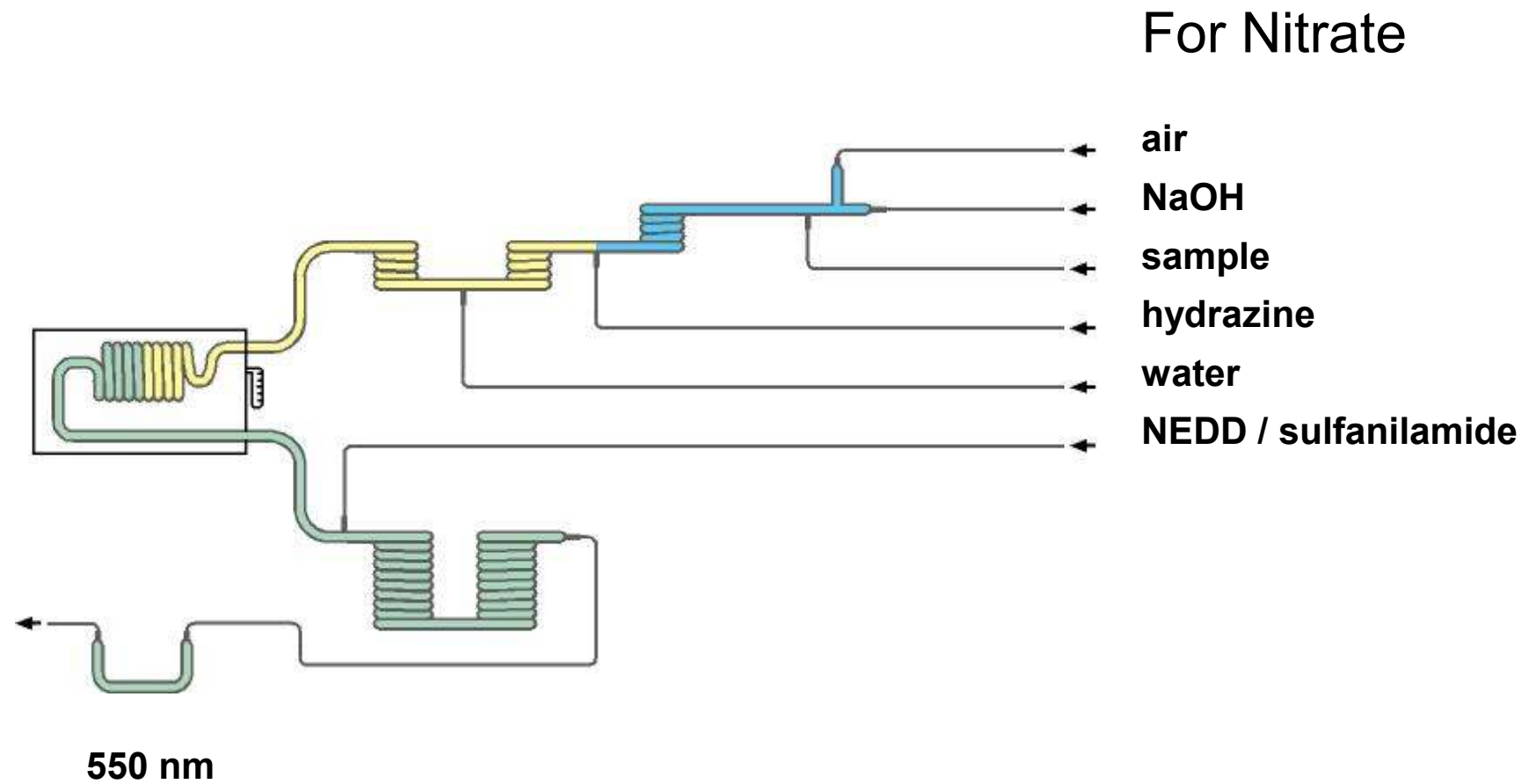
# Methods

## Multitest: how it works



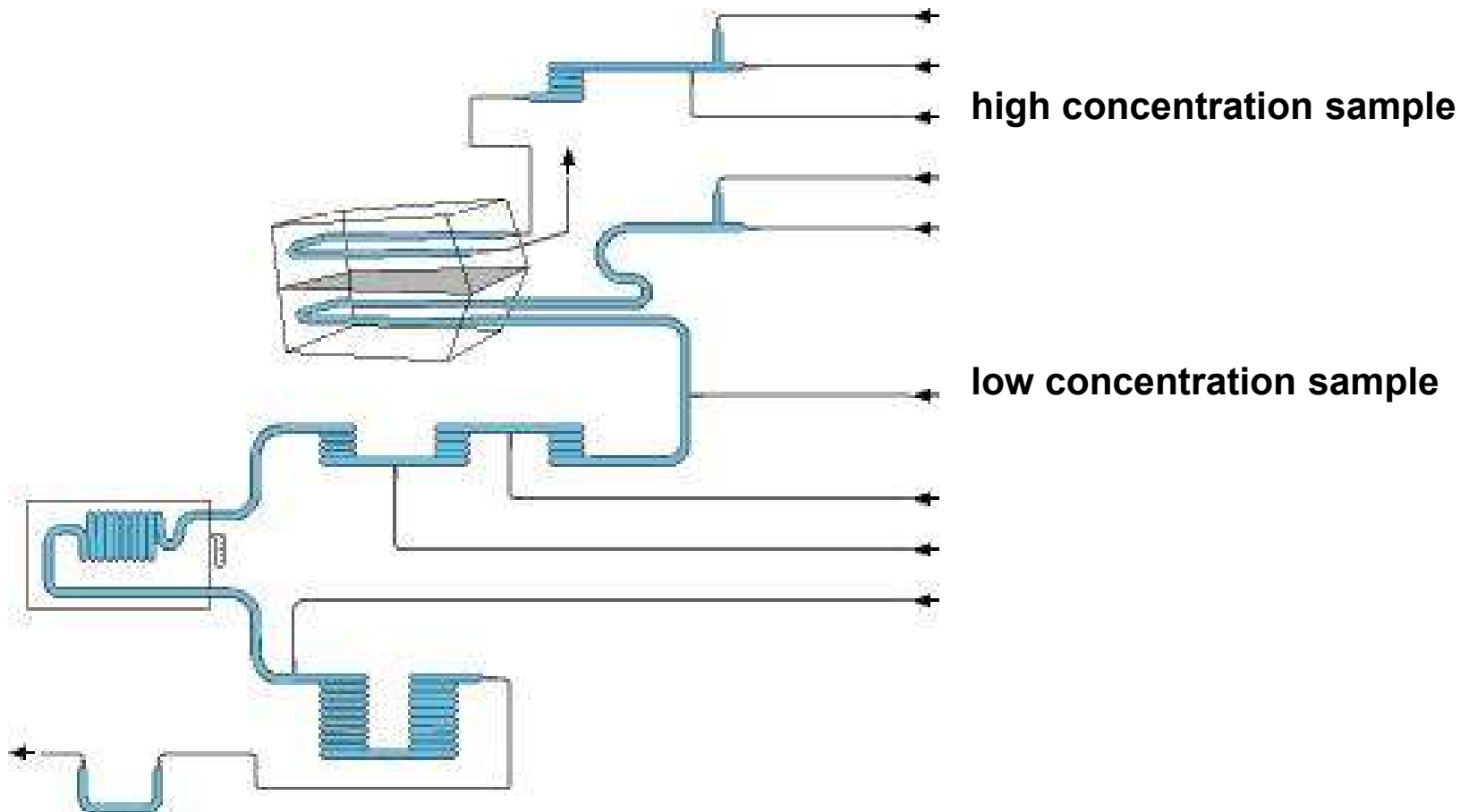
# Methods

## Multitest: how it works



# *Methods*

## Multitest and multi-range...



# Methods

## 27 water and soil methods with **one** manifold **MT7** for water, waste water, soil and plant extracts, fertilizer, etc.

Dual-range with dialyzer for high range. Dialyzer + heating bath 37°

Alkalinity	G-148-95	0-300 to 0-500 mg/L as CaCO <sub>3</sub>		550
Ammonia (salicylate)	G-102-93	0-0.25 to 0-5 mg/L	0-2.5 to 0-25 mg/L as N	660
Ammonia (phenate)	G-102-93	0-0.5 to 0-5 mg/L	0-2.5 to 0-20 mg/L as N	630
Boron	G-214-98	0-2 to 0-15 mg/L	0-10 to 0-90 mg/L	420
Bromide	G-301-04	0-10 to 0-100 mg/L	0-25 to 0-250 mg/L as Br	600
Calcium	G-209-98	0-12 to 0-100 mg/L Ca		570
Chloride	G-133-95	0-10 to 0-100 mg/L	0-25 to 0-250 mg/L	480
Chromium (6+)	G-284-02	0-1 to 0-10 mg/L	0-5 to 0-45 mg/L	550
Fluoride	G-383-08	0-2 to 0-6 mg/L		620
Hardness	G-244-00	0-400mg/L CaCO <sub>3</sub>		520
Iron	G-210-98	0-1.5 to 0-15 mg/L	0-14 to 0-140 mg/L Fe	560
Iodide	G-300-01	0-20 to 0-150 µg/L	0-100 to 0-300 µg/L as I	420
Magnesium	G-315-05	0-1.5 to 0 – 3 mg/L	0-10 to 0-15/90 mg/L	510
Manganese	G-314-05	0-3.75 to 0-30 mg/L		480
Nicotine	G-217-98	0-400 to 0-4000 mg/L	0-2 to 0-10 g/L	460
Nitrate	G-109-94	0-0.3 to 0-2.75 mg/L	0-1 to 0-11 mg/L as N	550
Nitrite	G-109-94	0-0.3 to 0-2.75 mg/L	0-1 to 0-11 mg/L as N	550
Nitrogen, total (NH <sub>3</sub> + NO <sub>3</sub> only)	G-305-04	0-25 to 0-160 mg/L		660
Nitrogen, total Kjeldahl	G-188-97	0-1 to 0-8 mg/L	0-3.5 to 0-25 mg/L as N	660
Phenol	G-360-06	0-2 to 0-20 m/L		510
Phosphate	G-103-93	0-1.7 to 0-7.5 mg/L	0-10 to 0-50 mg/L as P	660
Phosphate (molybdovanadate)	G-304-04	0-30 to 0-300 mg/L	0-200 to 0-2000 mg/L	420
Phosphorus, total Kjeldahl	G-189-97	0-1.7 to 0-6 mg/L	0-6 to 0-50 mg/L as P	660
Potassium	G-184-96	0-100 mg/L	0-200 mg/L as K <sub>2</sub> O	flame
Silicate	G-147-95	0-6 to 0-60 mg/L	0-30 to 0-300 mg/L as SiO <sub>2</sub>	660
Sodium	G-184-96	0-100 mg/L	0-200 mg/L as Na	flame
Sulfide	G-213-98	0-0.5 to 0-4 mg/L	0-2.0 to 0-12 mg/L as S	660

high range can be extended by factor 3 with smaller sample pump tube

# Methods

## 15 Seawater and low level water methods with **one** manifold

Heating bath + Cd column for nitrate

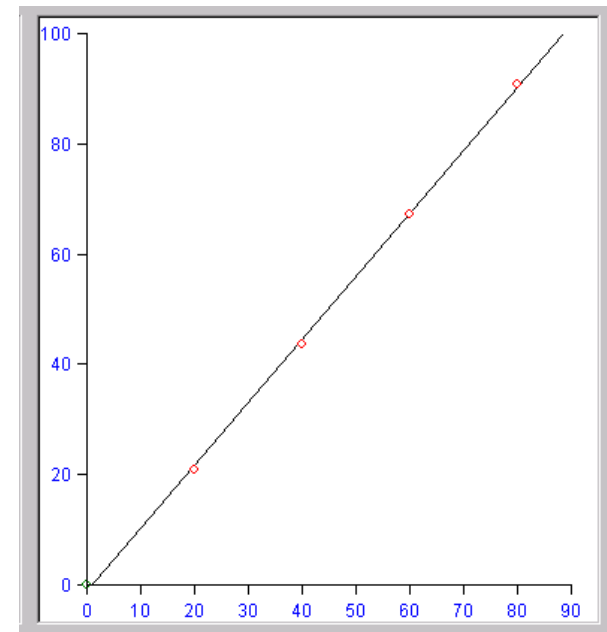
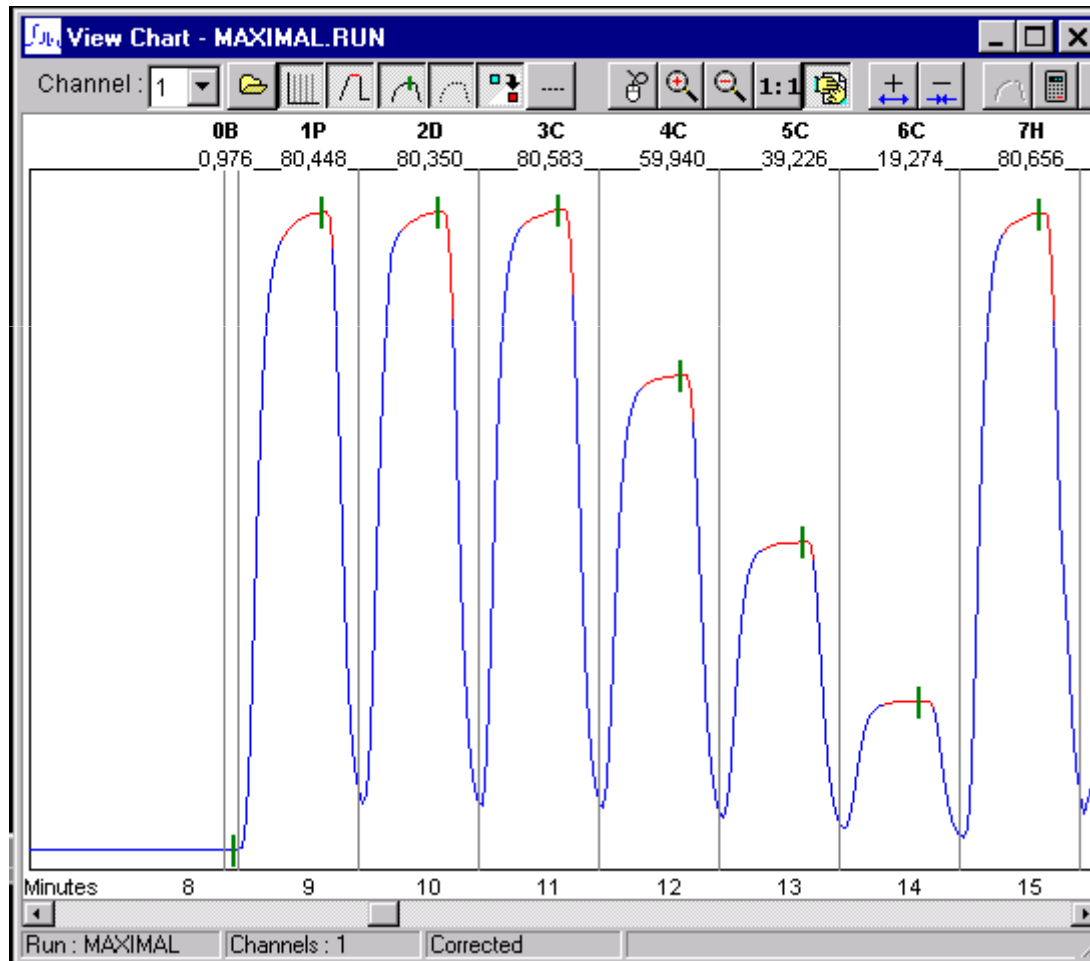
### MT19 for seawater and low level water

Heating bath + Cd column for nitrate

Aluminium	G-381-07	0-0.1 to 0-0.8 mg/L	0-1 to 0-8 mg/L	600
Ammonia	G-171-96	0-42 to 0-380 µg/L	0-0.35 to 0-4.2 mg/L as N660/630	
Colour	G-302-04	0 - 70 to 0-250 Pt units		440
Chloride	G-279-01	0-6 to 0-40 mg/L	0-60 to 0-400 mg/L	480
Copper	G-311-04	0-1 to 0-4.5 mg/L		480
Iron (acidified samples)	G-290-03	0 - 0.1 to 0 - 4.4 mg/L		
	550			
Manganese	G-303-04	0-0.3 to 0-7.5 mg/L		480
Nitrate	G-172-96	0-40 to 0-650 µg/L	0-700 to 0-7000 µg/L as N	550
Total N in persulfate digests	G-172-96	0-40 to 0-650 µg/L	0-700 to 0-7000 µg/L	550
Nitrogen, total Kjeldahl	G-225-99		0 - 2.2 to 16.8 mg/L	660
Phosphate	G-297-03	0-50 to 0-500 µg/L as P		880
Phosphorus, total Kjeldahl	G-371-07		0 – 5 to 0 – 15 mg/L	880
Silicate	G-177-96	0-0.5 to 0-6 mg/L	0-7 to 0-60 mg/L as SiO <sub>2</sub>	820
Sulfide	G-372-07	0-0.15 to 0-1.5 mg/L	0-1.5 to 0-15 mg/L as S	660
Zinc	G-316-05	0-20 to 0-60 mg/L		630

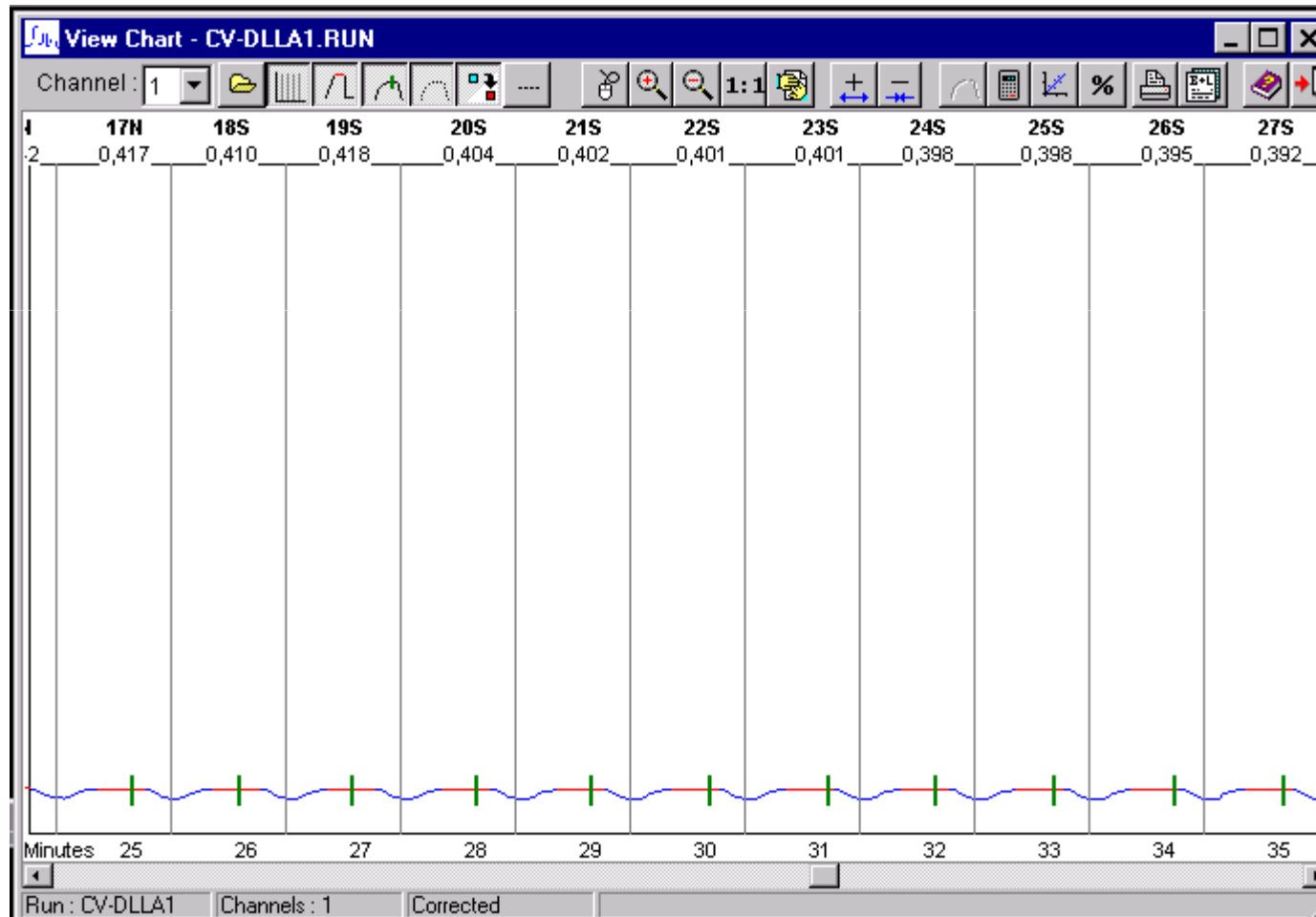
# Performance

**High concentration:** Chloride in saturated salt solution, 250 g/L



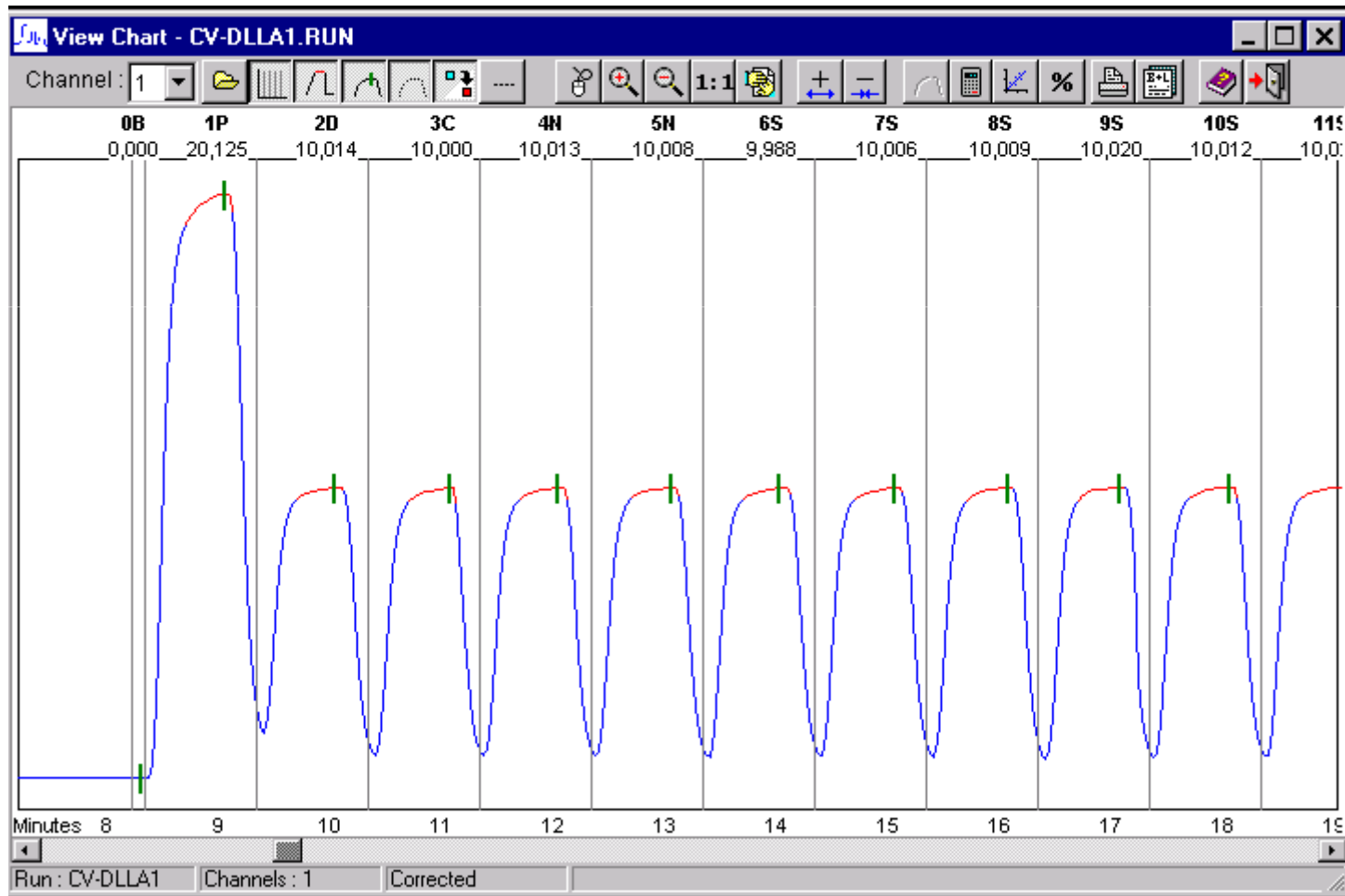
# Performance

**Low concentration:** Nitrite in seawater, detection limit 14 ng/L



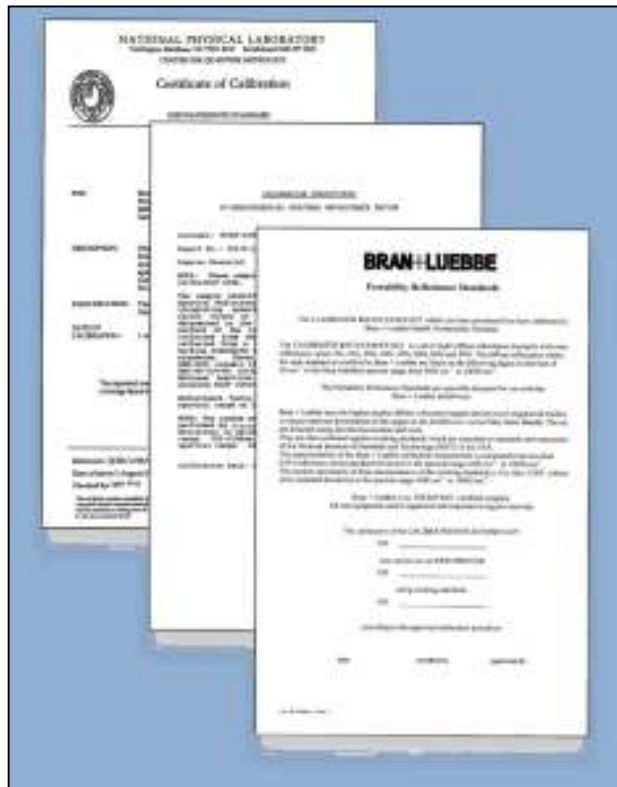
# Performance

**Reproducibility:** Phosphate in fertilizer: RSD 0.2%



# Performance

## Officially-approved methods for AA3

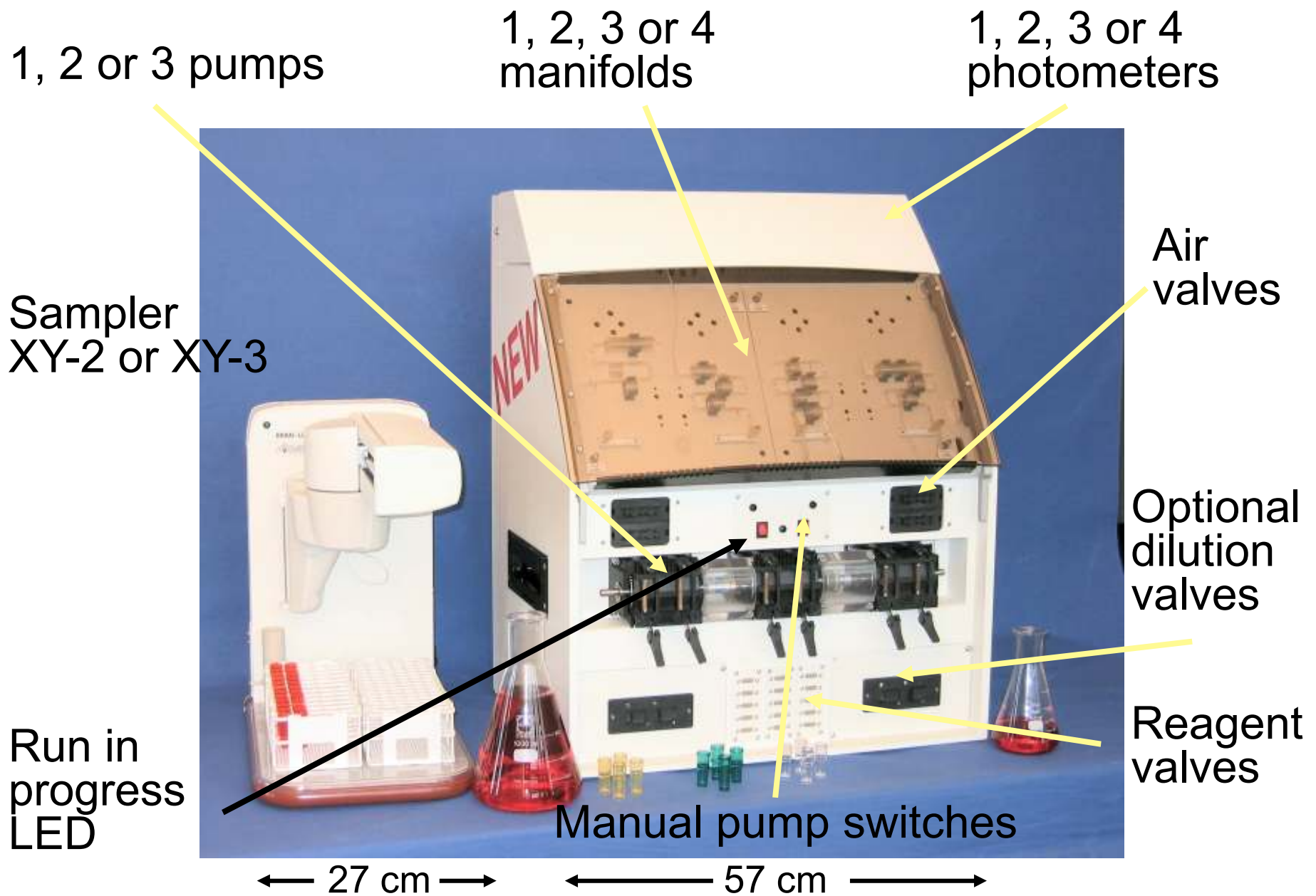


# QUAATRO

**a higher level of automation**

- **Results are more reliable**
- **Reproducibility is higher**
- **Detection limits are lower.**

# *QUAATRO is... Compact*



*QUAATRO is... Easily transportable*



*QUAATRO is... Built to last*



# *High Automation - Before the analysis*

## **Pre-run performance checks**

**Colorimeter energy**

**Baseline stability**

**Bubble pattern**

**Noise**

**Drift**

*High Automation - During the analysis*

## **QUAATRO Run-Time Monitor**

**Checks and logs these  
critical performance parameters**

**Bubble pattern**

**Calibration coefficients**

**Baseline drift**

**Sensitivity drift**

**Carryover**

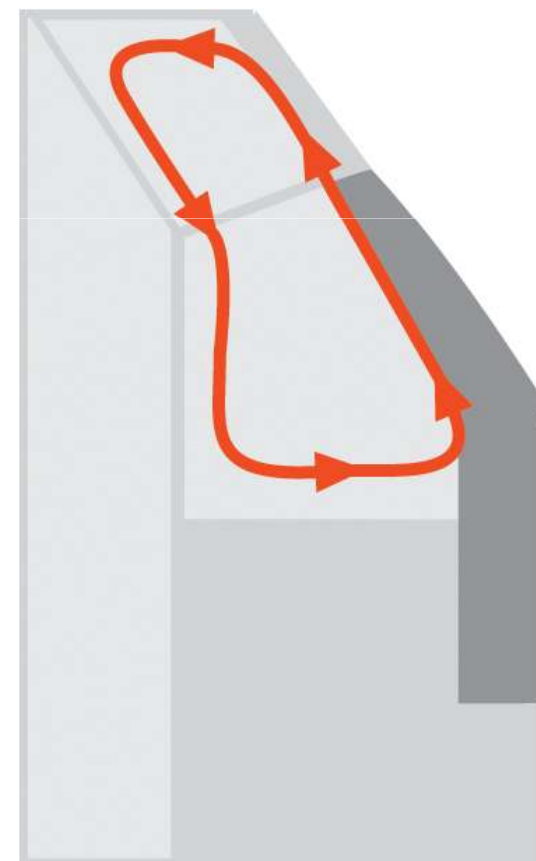
# *High Performance*

The entire analytical system is thermostatically controlled  
**Warm air circulates over manifold and photometers**

## **Software-controlled heating**

Viewed and set from the PC

- Controls heating baths and warm air
- 1000 Hz proportional control gives an accuracy of 0.01°C
- Reaction stream and flowcell are at the same temperature
- Changes in lab temperature do not affect the results.
- Automatic "analysis in progress" indicator.



*Highest Performance*

## **High Performance Photometer**

### **Low-noise digital photometer**

- New electronics, optics and software
- 30 mm and 50 mm flowcell options with bubble-through
- LED option

# *Highest Performance*

## **Programmable air injection**

**Bubble frequency is software-selectable  
to 1, 2, 3 or 4 seconds**

- Reduces flow elasticity
- Delivers more stable results
- Enables 1 mm flowcells
- Enables bubble-through with long flowcells