PRACTICE REPORT
LABORATORY ANALYSIS
LANGE CUVETTE TEST

LANGE cuvette tests: used by the professionals

The launch of the world's first ready-to-use reagent packages for photometric analysis in the 1960s had a substantial effect on environmental analysis. Today ➔*LANGE cuvette tests* and ➔*photometers* are indispensable elements of ➔*operational analysis*. Innovations such as ➔*10-fold rotational measurement* have simplified analysis even further and made it more reliable. Quality assurance procedures (➔*analytical quality assurance*, ➔*round robin tests*) are carried out and documented. The ➔*correct processing* of used reagents in HACH LANGE's own ➔*certified environment* centre completes the LANGE cuvette test-system.

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- HACH LANGE applications & laboratory products

Quality begins before production

HACH LANGE Expertise
+
Intensive cooperation with users

↓

Product quality
=
High quality products using state-of-the-art technology

- **Precision and accuracy of measurement results**
  Approved for self-monitoring and official monitoring with analytical quality assurance
- **Efficiency**
  For simple, safe and fast work
- **Application**
  Wide spectrum of parameters and measuring ranges
- **Environmental protection**
  Low amounts of reagent with recycling and proper disposal after use

Fig. 1: User and manufacturer expertise is crucial to the quality of the results.

The HACH LANGE measuring system

A good, practical, measurement system consists of more than cuvette tests and a photometer. Naturally these products are important to operational analysis. Just as important are the appropriate accessories, comprehensive service, including user support by qualified personnel. Correct measurement results are not obtained by chance, but depend on a combination of product quality and application quality (Fig. 1).

If photometers or reagents are flawed, the user can do everything correctly and still obtain incorrect results. The reverse is also true. Even the best analysis system cannot compensate for flawed working procedures. Even when the result is correct, it will only be accepted if the necessary quality procedures are performed and documented. This applies to every measurement system, irrespective of whether it is used for reference analysis or operational analysis (for more information see Analytical Quality Assurance data sheet DOC040.52.10003).

Quality checks during production

Product quality begins before production. Comprehensive checks are carried out on suppliers and raw materials, e.g. the empty glass cuvettes are subjected to high voltage tests to detect material flaws (Fig. 2).

Product quality is also a top priority during production. Special machinery is used to ensure the highest quality and reliability, eg, sorting the caps (Fig. 3). Product quality should be totally transparent, and HACH LANGE ensures it is. Certificates of analysis are downloadable at www.hach-lange.co.uk.

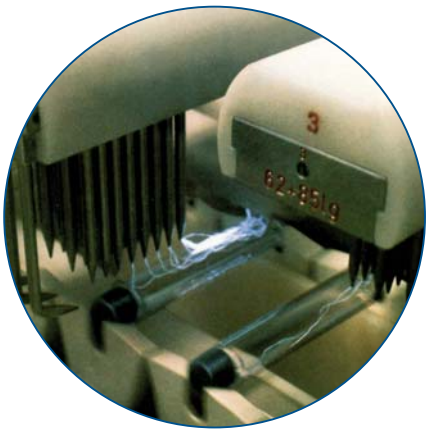

Fig. 2: Checks: Each cuvette is inspected for glass flaws before it is filled.

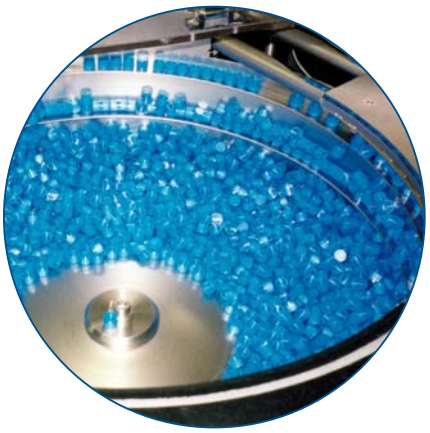

Fig. 3: Preparation of the cuvette caps in the control and sorting drum.

Wide range of reagents and photometers

Reliability from day one

A special feature of the LANGE cuvette test system is its response to practical requirements. Measurement instruments and reagents are coordinated during the development phase, to ensure maximum reliability. We also take into account user feedback where possible. (see p. 6). The result is photometers and cuvette tests, whose systematic and simple handling is designed to prevent errors from occurring (Figs. 7 + 8).

Diversity of tests

There are now cuvette tests for 50 different parameters – from alcohol to zinc with almost 100 measuring ranges (for an overview see back page, Tab. 1). The diversity of the tests makes them suitable for the analysis of drinking water, wastewater and process water. LANGE cuvette tests cover all the applications for which operational analysis is used, from the field to large-scale laboratories. More information about their characteristics, e.g. automatic test recognition, zeroing and 10-fold rotational measurement, can be found on the following page.

Fig. 4: Cuvette tests use 90% less chemicals than traditional titration methods.

Benefits of the cuvette tests

Ready-to-use cuvette tests:

- ➔ Maximum safety for users, thanks to the closed system and low amounts of reagents (Fig. 4).
- ➔ Convenient and error-free dosing of the reagents without pipetting and reagent contact thanks to DOSICAP (Fig. 5) and DOSICAP ZIP: cuvette caps containing an exactly pre-dispensed amount of freeze-dried reagent.
- ➔ Complete labelling of the individual cuvettes, including barcode label for automatic recognition in the photometer (Figs. 5+10).

Well-thought out package design (Fig. 5):

- ➔ Analysis is easier for beginners, with comprehensive working procedures in each cuvette test package and to make it easy to understand, there are clear instructions on the package lid.
- ➔ Clear danger information (R+S phrases) and danger symbols are shown on each test package. Safety data sheets are available to download at www.hach-lange.com.
- ➔ Differentiation between tests and measuring ranges by means of colour-coding (Fig. 6). Colour-coded measuring ranges:

Fig. 6: Colour-coded packets, cuvettes, etc. indicate the measuring ranges at a glance.

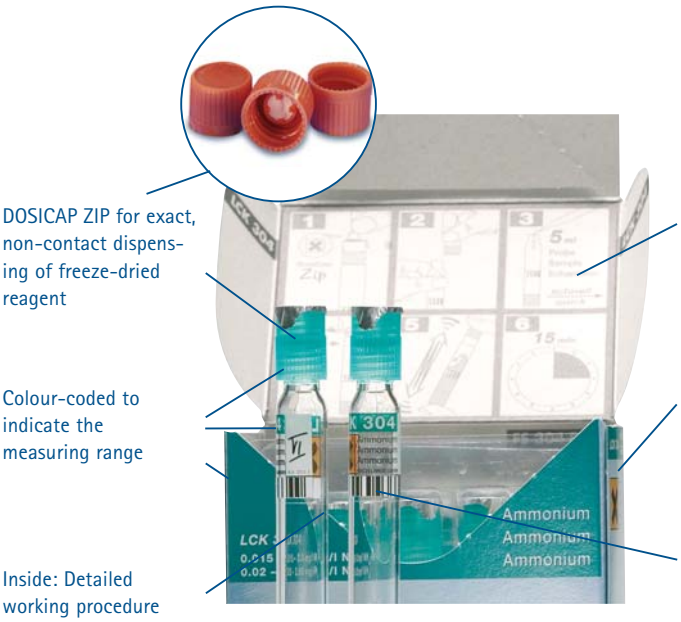

Fig. 5: The LANGE cuvette test package informs users about safety regulations and work steps.

Latest technology: photometer and accessories

Fig. 7: Carrying out a measurement in the field just by pressing a button: the single parameter POCKET Colorimeter II.

Fig. 8: DR 3800 sc spectrophotometer: Simple to use and includes a colour touchscreen.

Fig. 9: HT200S high-temperature thermostat for rapid digestion.

Helps reduce operating errors

The spectrophotometers are configured and precalibrated in the factory, so the measurement result is obtained after just a few steps. All important test data is already stored in the photometer. Potential sources of error are therefore reduced to a minimum.

Reference beam technology (Fig. 10) provides correct and reproducible results. In contrast to single-beam photometers, HACH LANGE photometers have a second beam that serves as a reference standard. This allows the photometer to compensate for potential interference factors such as lamp ageing and power fluctuations, so that they cannot influence the measurement result.

The 10-fold rotational measurement with the integrated barcode reader (IBR) ensures maximum reliability of the results and operator confidence.

The photometer automatically identifies the cuvette test and reads in the associated evaluation factors from the barcode as the cuvette rotates. At the same time, anomalous readings caused by soil or scratches on the cuvette glass are recognised as outliers and eliminated, so that they cannot influence the result.

Sample preparation with shorter digestion times

Besides the “normal” sample digestion with the standard LT200 thermostat, the HT200S can be used to carry out a fast digestion for the parameters COD, P_{tot}, N_{tot} and total heavy metals (Fig. 9). Thanks to the shorter digestion times and automatic rapid cooling, a COD determination, for example, takes only 35 minutes instead of the usual 2.5 hours. For more information see HT200S data sheet DOC062.52.00528.

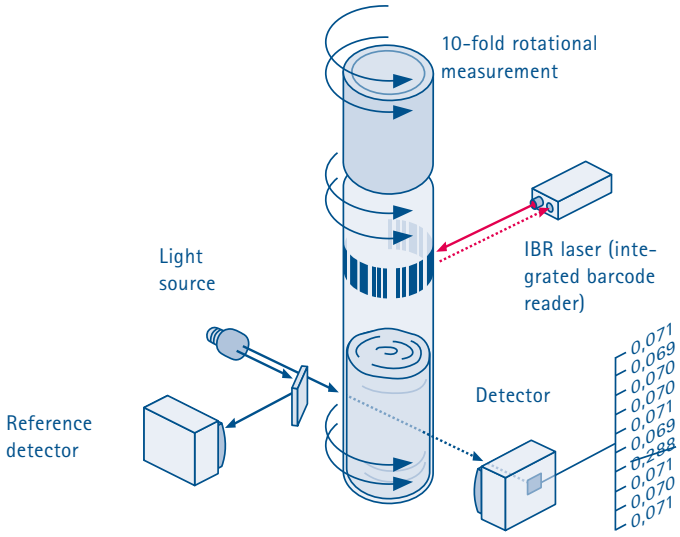

Fig. 10: The rotational measurement of the LANGE cuvette tests enables readings caused by soil or scratches on the cuvette glass to be recognised and eliminated as outliers.

The importance of Analytical Quality Assurance

Standard solutions and round robin tests for reliable results

ADDISTA, the AQA system for LANGE cuvette tests was specially developed to meet the needs of operational analysis (Fig. 11; for more information see DOC062.52.00269).
With the help of the round robin solutions, users can take part in round robin tests, e.g. for nutrient parameters and heavy metals. Large numbers of participants and a success rate of more than 85% verify the analytical work of HACH LANGE users (Fig. 13). There are also independent external round robin tests, allowing HACH LANGE to check users results. One example is the sewage treatment plant round robin test, which has been carried out by the Institute for Sanitary Engineering at Stuttgart University for several years (Fig. 14).

Fig. 11: ADDISTA with standard/spiking solution and two round robin test solutions for checking the results.

Fig. 12: Calibration certificate for the HACH LANGE LZV 537 test filter set for checking the accuracy of the photometer.

"Severn Trent Water has been using the HACH cuvette water testing system for more than 10 years at over 100 sites across central England.
They have clear and concise instructions which help to ensure that we produce good quality results every time.
Before buying the product, the cuvettes were evaluated against laboratory methods to ensure their accuracy and to check that they met the exacting standards required by Severn Trent Water.
The cuvettes are currently used to test for trace amounts of Ammonia, COD, Phosphate, Iron, Volatile acids, Phenol, Nitrates and metals."

Colin Price, Lab Manager, Severn Trent Water

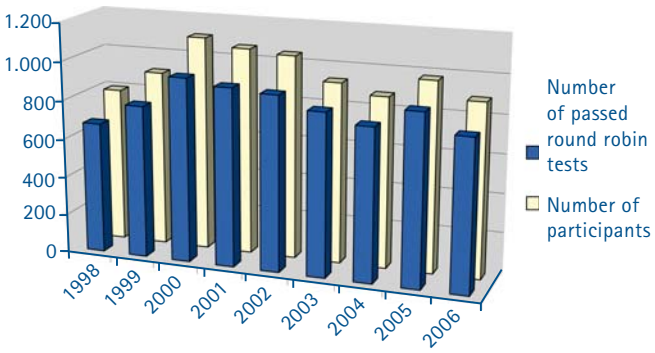

Fig. 13: HACH LANGE round robin tests 1998-2006; unusually high numbers of participants in 2000-2002, due to special additional European round robin tests.

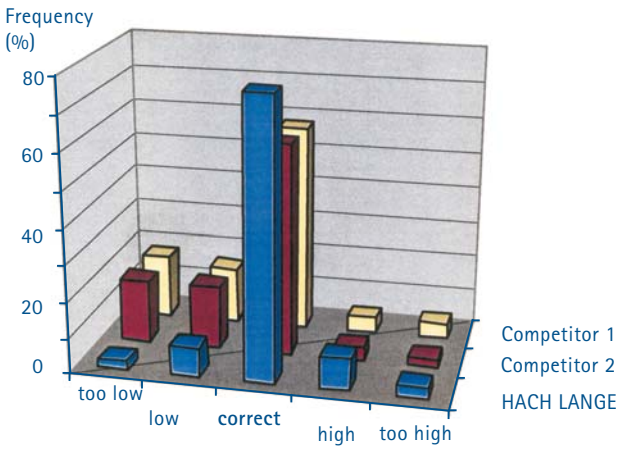

Fig. 14: AQA Baden-Württemberg ring test 2002. In the comparison of NH_4-N methods, LANGE cuvette tests performed well, relative to competing products.

Customer feedback is important

"Analysis is carried out from ALcontrol's state of the art, UKAS accredited, laboratories located throughout the UK and Ireland.

The choice of Cuvettes from HACH LANGE was made only after extensive testing and approvals procedure and ensuring that the product met all the requirements of ISO 15705.

I have tried most of the other products on the market and in my view nobody does COD as well as HACH LANGE.

Over 100,000 LANGE Cuvettes are used each year at the main laboratory in Sheffield to measure COD."

Susan Pratt, Lab Manager, ALcontrol

Contact between user and manufacturer

HACH LANGE listens to its customers. Feedback from users has a lasting effect on continuous product development.

➔ On-site visits
Qualified specialists are familiar with the application on site, they can analyse the situation and provide immediate advice (Fig. 15).

➔ Services for customers
We can provide quotes, technical advice, servicing and warranty. It's easy to contact us, via the phone, fax, email or the website.

➔ Training seminars/workshops
These help to refresh and increase technical knowledge. The seminars are held throughout the UK and usually consist of a theoretical and practical session. They are also a forum for exchanging experiences and answering specific questions (Fig. 16).

➔ Technical support
We can provide help and advice for analytical or technical problems. Call us on 0161 872 1487 (UK) or 01 46 2522 (IRL).

➔ www.hach-lange.com
HACH LANGE can be reached 24 hours a day, 7 days a week on the Internet. For questions, orders or comments, with up-to-date product information, downloadable user manuals and much more.

Fig. 15: On-site advice is part of HACH LANGE's excellent relationship with its customers.

Fig. 16: Industry related workshops with theory and practical sessions.

More than 20 years of safe disposal and recycling

Looking after the environment

Continuous environmental investment is a high priority in the development of the LANGE cuvette tests. One aspect is the reduction of the amounts of chemicals and harmful substances used. This has brought about developments such as the DOSICAP system (see p. 4, Fig. 5). Since 1978, HACH LANGE has collected used reagents and for proper disposal. It now offers this service throughout Europe. Please contact us for more details.

Thanks to the special reagent processing techniques applied in the HACH LANGE Environment Centre, (Figs. 17, 18 and 19), more than 75% of all returned test components are fed back into the production and material cycles.

"The NLS provides an analytical service to the Environment Agency which requires consistently high standards of accuracy. HACH LANGE was selected, based on our assessment of analytical performance, price, quality, and environmental impact."

Rob Carter,
Team Leader at The National Laboratory Service,
Environment Agency

Fig. 17: HACH LANGE's own Environment Centre has been a certified disposal specialist for more 10 years.

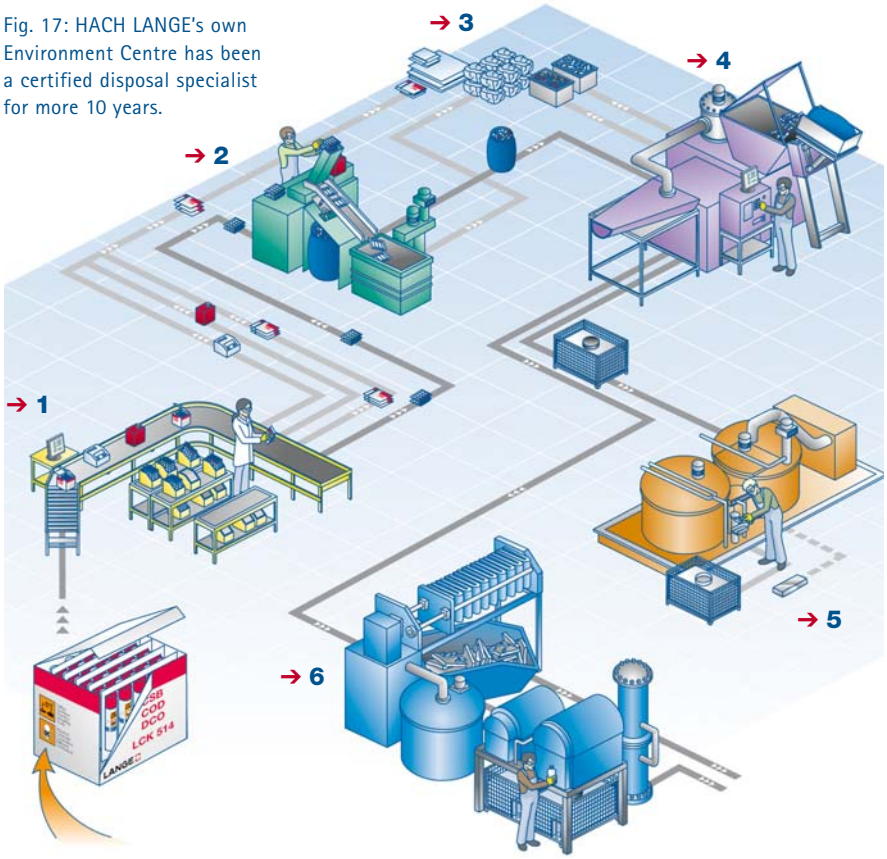

Fig. 18: Processing stages in the HACH LANGE Environment Centre: 1) Sorting, 2) Deblistering, 3) Recycling of packaging material, 4) Cuvette shredder, 5) Electrolysis, 6) Wastewater treatment + Incineration of domestic waste.

Fig. 19: Silver bars are a product of COD recycling (5).

Parameters and measuring ranges for each application

PARAMETER	MEASURING RANGES
Alcohol	0.01 – 0.12 g/l
Aluminium	0.02 - 0.5 mg/l
Ammonium	0.015 –130 mg/l NH_4-N
AOX	0.005 – 3 mg/l
Bitter units	≥ 2 BU
Lead	0.1 – 2 mg/l
Boron	0.05 – 2.5 mg/l
BOD_5	0.5 – 1,650 mg/l
Cadmium	0.02 – 0.3 mg/l
Carbonate, CO_2	55 – 550 mg/l CO_2
Chlorine/Ozone	0.05 – 2 mg/l Cl_2/O_3
Chloride	1 – 1,000 mg/l
Chromium (III + VI)	0.03 –1 mg/l
COD	5 – 60,000 mg/l
Cyanide	0.01 – 0.6 mg/l
Iron, Iron (II/III)	0.2 – 6 mg/l
Fluoride	0.1 – 1.5 mg/l
Formaldehyde	0.5 – 10 mg/l
Hardness, Hardness residual (Ca + Mg)	0.1 – 100 mg/l Ca 0.15 – 50 mg/l Mg
Potassium	8 – 50 mg/l
Copper	0.1 – 8 mg/l
Copper baths (acidic)	2 – 100 g/l Cu
Magnesium	0.5 – 50 mg/l
Molybdenum	3 – 300 mg/l
Nickel	0.1 – 6 mg/l

PARAMETER	MEASURING RANGES
Nickel baths (acidic)	5 – 120 g/l
Nitrate	0.23 – 35 mg/l NO_3-N 1 – 155 mg/l NO_3
Nitrite	0.015 – 6 mg/l NO_2-N 0.05 – 20 mg/l NO_2
Organic acids	50 – 2,500 mg/l acetic acid
Phenol	0.05 – 200 mg/l
Phosphorus (ortho)	1.6 – 30 mg/l PO_4-P 5 – 90 mg/l PO_4
Phosphorus (ortho + total)	0.05 – 20 mg/l PO_4-P 0.15 – 60 mg/l PO_4
Acid capacity KS 4.3	0.5 – 8.0 mmol/l
Sludge activity	-
Silver	0.04 – 2,500 mg/l
Starch	2 - 150 mg/l
Nitrogen (total)	1 – 100 mg/l TN
Sulphate	40 – 900 mg/l
Surfactants (cationic or anionic)	0.2 – 2 mg/l
Surfactants (nonionic)	0.2 – 20,000 mg/l
TOC	2 – 3,000 mg/l
Vicinal diketones	0.015 – 0.5 mg/kg diacetyl
Zinc	0.2 – 6 mg/l
Tin	0.1 – 2 mg/l

Table 1: Wide range of parameters and measuring ranges of the LANGE cuvette tests from A to Z for drinking water, wastewater and process water applications.

PHOTOMETER	POCKET II	DR 2800	DR 3800 SC	DR 5000
Wavelength; VIS, UV-VIS	VIS; 1 fixed wavelength	VIS 340-900 nm	VIS 340-900 nm	UV-VIS 190-1,100 nm
Optical system, photometer type	Filter	Spectral	Spectral	Spectral
Scan			Yes	Yes
Pre-programmed tests	1-2 (partially programmable)	Approx. 220	Approx. 230	Approx. 230
User methods programmable		Yes	Yes	Yes
GLP compliant documentation; barcode reader		Yes	Yes	Yes
Display with touchscreen		Yes	Yes, coloured	Yes
Protection rating	IP 67	IP 42	IP 3x	IP 31
Other	Portable	Portable	Control of SC process data online in the laboratory	Sipper, cuvette carousel

Table 2: Overview of HACH LANGE photometers for LANGE cuvette tests.

HACH LANGE Services

Ordering, information and advice:
UK: +44 (0)161 872 14 87
IRL: +353(0)1 460 25 22
EU: +49 (0)211 52 88-0

On site technical support.

Seminars and workshops:
Practical and hands on training.

Quality assurance, complete with standard solutions, instrument checks and test solutions.

Service packages and extended warranty up to 5 years.

www.hach-lange.com
Up to date and secure, with downloads, information and e-shop.

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