Competence in volume measurement

EXCELLENCE IN MEASUREMENT ACCURACY

VITLAB®
Competence in Labware

Volumetric instruments

Volume measurement is of fundamental importance in the laboratory. Volumetric flasks, graduated cylinders, burettes and pipettes are standard equipment in any analytical laboratory. VITLAB is one of the leading manufacturers of plastic laboratory products and liquid handling instruments, and offers decades of experience in the development and production of products for volume measurement.

Basically, volumetric instruments can be made from plastic or glass, and fall under accuracy class AS, A or B. It is important for the user to be clear about the accuracy required for the application. Accurate measurements require more than just precision measurement instruments - proper handling is also necessary. For this reason, the most important classification terms and their correct usage are explained in the following. If you have any additional questions on the topic volume measurement, please do not hesitate to contact us.

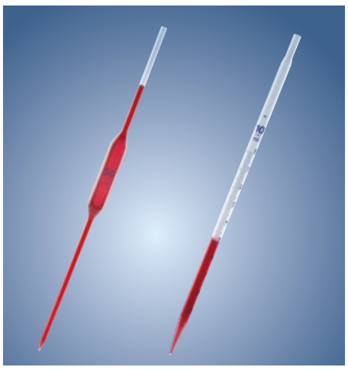
What are volumetric instruments?

Glass and plastic labware for measuring liquid volumes are the most frequently used apparatus in the laboratory. There is a big difference between volumetric instruments for exact measurements, including volumetric flasks, volumetric and graduated pipettes, graduated cylinders and burettes, on the one hand, and apparatus in which the scale is intended solely as an approximate guide.
This second type of apparatus includes graduated beakers, Griffin beakers, Erlenmeyer flasks, etc. The scale here is made to the same precision as in graduated cylinders, for example, but the larger diameter leads to larger reading errors.
This relationship between the error limits, and the inner diameter of the instrument at the meniscus that is formed by the liquid to be measured, is described in ISO/DIS 384:2013.
The draft standard defines the basic and metrological requirements for the construction and design of the volumetric instruments, and describes three accuracy classes (AS, A and B).

VITLAB volumetric instruments

Volumetric flasks

Graduated cylinders



Pipettes

Burettes

Materials

Plastic volumetric instruments

Plastic products from VITLAB offer many advantages:

- The high break resistance significantly reduces the risk of injury (none of the sharp edges as when glass breaks) and ensures a long service life
- Excellent chemical resistance (e.g., even against NaOH, KOH, and HF)
- The light weight makes it easier to use
- Modern manufacturing techniques yield plastics with very smooth surfaces, which together with their hydrophobic properties make cleaning easy
- Only pure, approved plastics are used - no additives that can lead to interferences in lab work
- Many of the products made of polypropylene are approved for use with food

Manufacturing the blanks

Only the highest quality plastic granulates are used in manufacturing our products, which guarantees that the instruments produced down the line will have the desired properties. Thus, polymethylpentene (PMP) is used exclusively for instruments of accuracy class A (volumetric flasks and graduated cylinders). This high-performance plastic offers near-glass transparency, and very good dimensional stability after the production process. These are two of the critical requirements for producing Class A products. Moreover, PMP exhibits very good chemical and thermal resistance.

Polypropylene (PP) is used for the Accuracy Class B products, as well as volumetric and graduated pipettes, graduated beakers, Griffin beakers and Erlenmeyer flasks. This material has a good dimensional stability after the production process, and also exhibits good chemical and thermal resistance.

The fluoroplastic PFA is a special case. Although this fluoroplastic copolymer doesn't have the excellent transparency of PMP, it offers by far the best chemical and thermal resistance. Fine workmanship likewise offers outstanding dimensional stability, thus enabling application in the manufacture of Class A volumetric flasks.

High-quality blanks and strict statistical testing of the required quality characteristics are fundamental in producing high-quality volumetric instruments. For example, the blanks must withstand thermal stresses from controlled heating and cooling. This is a pre-requisite for achieving the best possible mechanical strength, with a volume that remains constant during subsequent thermal stresses.

Scales and labeling

Techniques

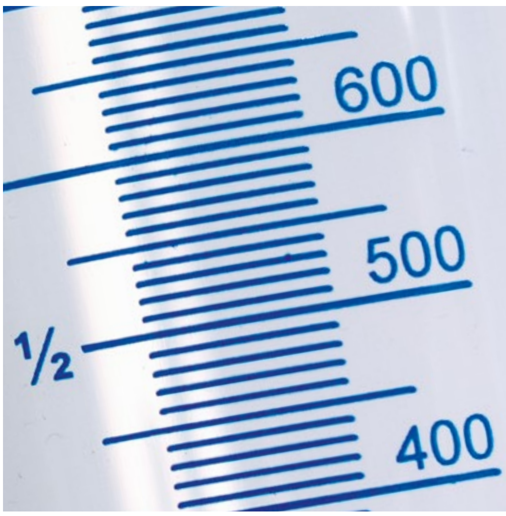
Various techniques are used for the labels on our products and for imprinting the scales. Volumetric flasks and pipettes are imprinted by standard methods using high-quality inks, but PFA is an exception because of its surface structure. A special process makes it possible to apply the ring mark in color, but imprinting within acceptable quality limits cannot be done for PFA products due to their completely smooth and highly inert surfaces.

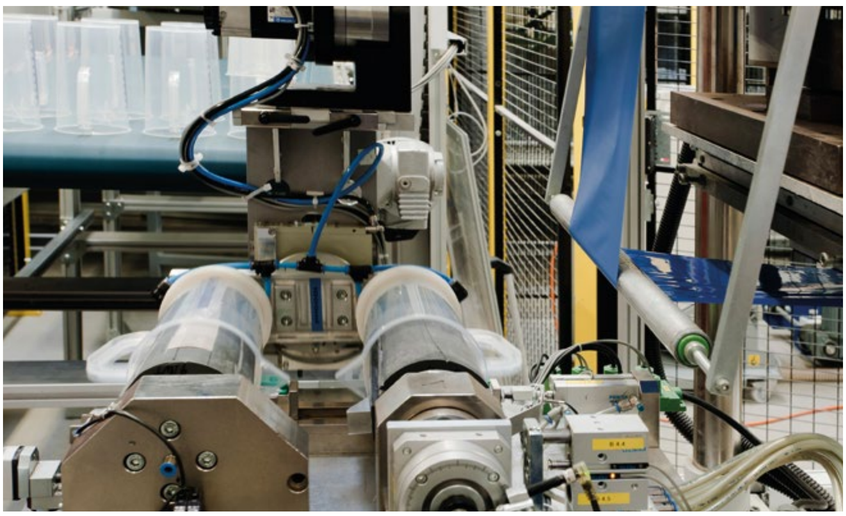
Thus, the labels are engraved on the volumetric flask surface using a laser. This labeling method is thus extremely durable. The color dyes used for PMP and PP products are matched individually to the plastic, and are applied using a silk screen printing or hot stamping process.

Cleaning

To maintain the long-term readability of the scale, do not clean imprinted volumetric instruments at temperatures exceeding 60 °C. Obviously, laboratory dishwashers can be used. These are gentler than immersion baths. Due to the low weight, we recommend using washing nets.

If aggressive cleaning methods (higher temperatures, more concentrated detergents) are to be used, we recommend products with raised scales without inks. Compared to glass, the wall thickness of an injection-molded plastic exhibits only very small differences. This is due to the high pressures employed in injection molding, whereby products can be produced with highly accurate surface contours and volumes.

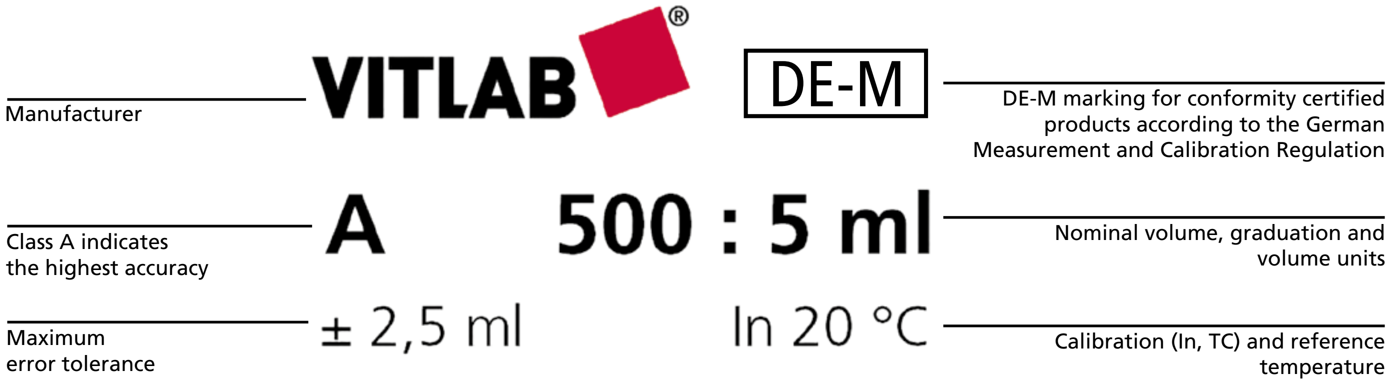




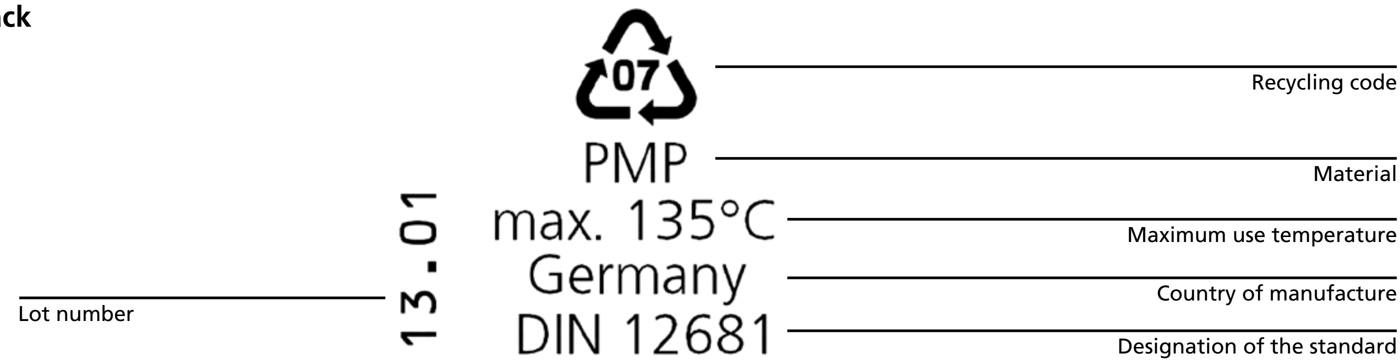
Labeling of volumetric instruments

Example for a graduated cylinder

Front



Back



The labeling below must be printed on every volumetric instrument:

- Nominal volume
- Units symbol: ml or cm³
- Reference temperature: 20 °C
- Calibration: Ex (TD) or In (TC)
- Class: A, AS or B
- Waiting time (if necessary): in the format "Ex + 5 s"
- Manufacturer's name

Moreover, VITLAB imprints the following additional information, for example, on graduated cylinders:

- Country of manufacture
- Error limit
- Trademark
- Standard, e.g., DIN 12681
- Lot number

Certificates

Quality certificate

The quality assurance developed according to DIN EN ISO 9001 forms the basis for issuing factory calibration certificates, which serve as the quality certificates. These VITLAB factory test certificates are normally available in the form of a lot certificate, and an individual certificate can be obtained upon request. All test results are documented and archived for at least 7 years, so that individual results for any production times during this period can be accessed when the lot number or serial number is known.

Lot certificate

Quantity shipped per packing unit.

The following information is included:

- Lot number, e.g. 13.01 (production year/lot)
- Mean volume and standard deviation for the lot
- Date of issue

Individual certificate

Obtainable upon request prior to ordering.

The following information is included:

- Lot number and individual serial number, e.g., 13.02.1234 (year/lot/serial number)
- Measured volume and measurement uncertainty
- Date of issue

Certificate of conformity

Conformity for volumetric instruments means: Compliance of an instrument with the authorization for the legally regulated area in accordance with the German Measurement and Calibration Regulation. The DE-M marking certifies that the device meets the demands of the German Measurement and Calibration Regulation. This eliminates the need for a written Declaration of Conformity. Since there are no longer any DIN/EN/ISO standards for some of the plastic products, such as volumetric flasks, VITLAB uses the standards for the corresponding glass products.

Calibration

Calibrations for volumetric measurements are basically of two types: "In" (TC) and "Ex" (TD):

Type "In": The contained quantity of liquid corresponds to the volume printed on the instrument (volumetric flasks and graduated cylinders).

Type "Ex": The delivered quantity of liquid corresponds to the volume printed on the instrument (pipettes and burettes).

Due to the hydrophobic properties of the materials, the measured and dispensed volumes are substantially the same in plastic volumetric instruments (i.e., "In" = "Ex").

VITLAB calibrates every volumetric flask individually "to contain" (In, TC). Thus, a defined amount of water is precisely measured in, and the ring mark is applied at the highest point of the meniscus. The goal during production is to ensure that volumetric instruments are manufactured with a minimal deviation from the target value (accuracy) and little scatter in the individual values (coefficient of variation).

The standard reference temperature, i.e., the temperature at which the volumetric instruments are calibrated, is 20 °C. If a calibration or measurement is to be carried out at a different temperature, the measured values must be corrected accordingly.

Accuracy classes

Volumetric instruments fall into two accuracy classes:

Class AS/A: Volumetric instruments of Class AS/A offer the highest accuracy. For class AS volumetric instruments, calibrated to deliver (TD, Ex), the additional 'S' means swift delivery (concerns pipettes and burettes).

Class B: Volumetric instruments of Class B have twice the error tolerance of Class A.

Meniscus setting

Comparison of meniscus settings

The meniscus refers to the curvature of the liquid surface. The meniscus can curve either downwards or upwards. The shape of the curvature results from the interaction between adhesion and cohesion forces. If the liquid molecules are attracted more strongly to the vessel wall than to one another (adhesion), then the meniscus curves downward. This is true in the example of glass walls and aqueous solutions. If the cohesion forces of a liquid are greater than the adhesive forces of the vessel wall (cohesion), the meniscus will curve upward. This occurs, for example, with glass walls and mercury. In contrast to glass products, the meniscus in plastic containers curves upward, even with aqueous solutions.

Concave meniscus

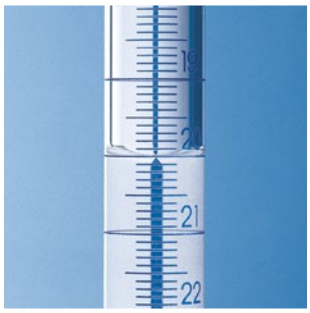
A downward curved meniscus is read at the lowest point of the liquid level.
The lowest point must cover the top edge of the graduation.
Example: Aqueous solution and glass wall

Convex meniscus

The liquid volume with an upward curved meniscus is read at the highest point of the liquid level. The highest point of the meniscus should touch the upper edge of the graduation.
Example: Aqueous solution and plastic wall

Reading aid: Schellbach stripes

The Schellbach stripe is a narrow blue strip that is imprinted on a white background. Light refraction at the liquid surface produces an apparent constriction in the blue stripe. The meniscus can then be read between the arrowheads.



Reading the volume

Accurate reading

During experiments, the volume of a liquid frequently must be read very carefully, because the accuracy of the measurement depends on correctly reading the liquid level on the scale. Important factors for the correct reading are:

Level surface
The measuring instrument should be secured on the level surface. Burettes should be attached to a tripod and aligned perpendicularly.

Avoid liquid droplets
It is important to ensure that no liquid droplets adhere to the wall of the instrument, since they can flow downward and thus raise the liquid level. Note: With volumetric flasks, liquid can be trapped between the stopper and the vessel wall after mixing. Thus, the liquid level can end up below the calibration mark. In this case, do not re-make the volume up to the mark since this would distort the results.

Temperature
Temperature documentation, since measuring instruments are usually calibrated to a reference temperature of 20 °C.

Cross-section
The smaller the cross-section of the instrument at calibration point, the more accurate the volume will be (e.g., Griffin beakers thus have a lower accuracy).

Parallax-free reading
Keep the volumetric instrument vertical. The eye of the user must be positioned at the level of the meniscus.

Volumetric flasks

Working with volumetric flasks

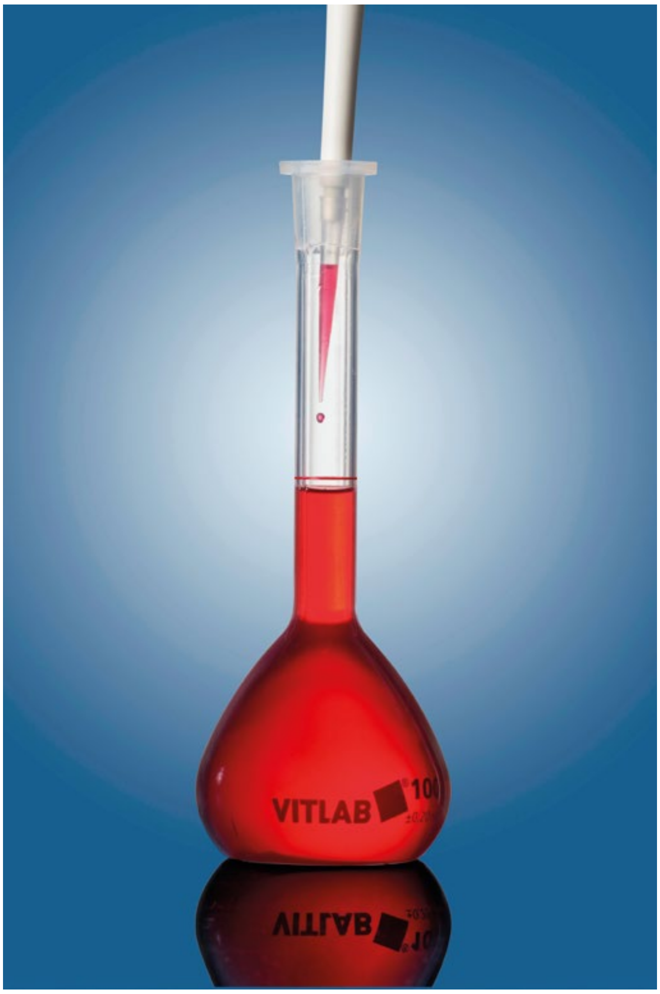
Volumetric flasks are mainly used in volumetric analysis for the preparation of solutions of accurately known concentration (standard solutions), and for use in the preparation of calibration series and dilutions. For this reason, volumetric flasks are calibrated "In" (TC). They don't have subdivided scales, but rather have a single ring mark that identifies the nominal volume. After Class A pipettes, they are the most accurate volume measuring instruments in the laboratory due to the slender neck diameter. In addition to volumetric flasks with the standard joint stoppers, VITLAB also offers volumetric flasks with a screw cap.

Note: Since volumetric flasks are calibrated at 20 °C, heating them leads to a loss of measurement accuracy.

Example: Preparation of a standard solution

Steps for the preparation of a standard solution using a volumetric flask:

- Introduce the accurately weighed amount of substance, or rinse in a standard liquid concentrate
- Fill the flask approximately halfway, e.g., with distilled water, and swirl the flask to dissolve the solids or thoroughly mix the contents
- Fill the volumetric flask, e.g., with distilled water, to just below the ring mark
- Using a wash bottle or pipette, make up the remaining volume until the meniscus is set at the ring mark. During this procedure, ensure that the meniscus is at eye level and that the vessel wall is not wetted by the liquid
- Then, shake the stoppered volumetric flask to mix thoroughly, turning upside down and back



VITLAB® volumetric flasks

Volumetric flasks, PFA, Class A

The tolerances correspond to Class A according to DIN EN ISO 1042. The PFA screw cap guards against contamination. Outstanding chemical resistance, can be used with strong oxidants, highly concentrated acids and alkalis, hydrocarbons, and ketones. Thermal stress up to 121 °C (autoclaving) does not permanently exceed the tolerance limit. Available with a screw cap in 6 different sizes from 10 to 500 ml.

Volumetric flasks (PMP), Class A

The tolerances correspond to Class A according to DIN EN ISO 1042. With an individually calibrated "In" (TC) ring mark, and a printed lot number and quality certificate. Thermal stress up to 121 °C (autoclaving) does not permanently exceed the tolerance limit. Available with an NS stopper (PP) in 7 different sizes from 10 to 1,000 ml.

Volumetric flasks (PMP), Class B

The tolerances correspond to Class B according to DIN EN ISO 1042. Thermal stress up to 121 °C (autoclaving) does not permanently exceed the tolerance limit. Available with a screw cap (PP) or an NS stopper (PP) in 7 different sizes from 10 to 1,000 ml.

Volumetric flasks (PP), Class B

The tolerances correspond to Class B according to DIN EN ISO 1042. Thermal stress in excess of up to 60 °C does not permanently exceed the tolerance limits. Available with a screw cap (PP) or an NS stopper (PP) in 7 different sizes from 10 to 1,000 ml.

Volumetric flasks VITLAB® opaque

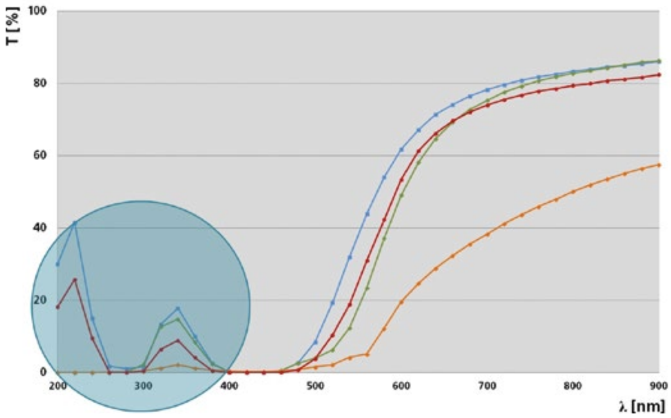
VITLAB® opaque volumetric flasks, PMP, Class A
UV-absorbent to protect light-sensitive substances. The tolerances correspond to Class A according to DIN EN ISO 1042. With printed lot number and batch certificate. Thermal stress up to 121 °C (autoclaving) does not permanently exceed the tolerance limit. Available with a screw cap (PP) or an NS stopper (PP) in 7 different sizes from 10 to 1,000 ml.

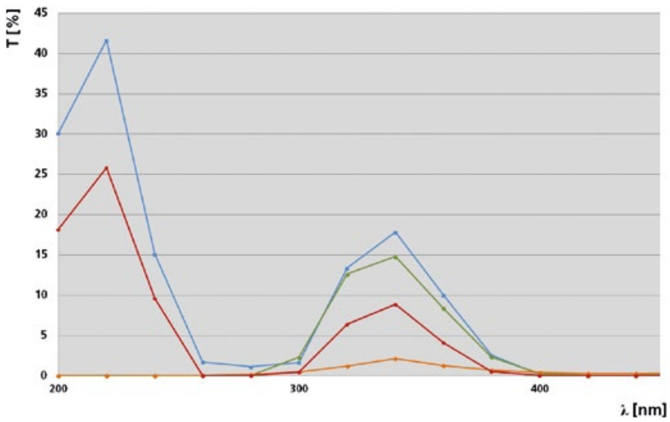
The alternative to brown glass

Light-sensitive substances require protection from the effects of light and particularly UV light so that they can have a longer usable lifetime. Starting in 2008, VITLAB was the world's first manufacturer of VITLAB® opaque volumetric flasks, developed from specially pigmented plastic. The special pigments safely protect samples from the effects of light, while still maintaining high transparency to enable volumes to be set accurately.

The opaque volumetric flasks and reagent bottles safeguard the contained substances with a light protection factor of virtually 20. The absorption spectrum properties exhibited by the products are significantly better over the entire spectral range of 200-900 nm versus comparable brown glass products. VITLAB® opaque reagent bottles are especially effective below 560 nm. They have a maximum of 5% transmission at 560 nm, and less than 2.5% transmission measurable at or below 520 nm. The pigments in the opaque products exhibit a brilliant characteristic shine in the UV range starting at 400 nm.

In the UV range from 280 nm and in the upper visible range from 580 nm, VITLAB® opaque reagent bottles and volumetric flasks are thus significantly better than even high-quality brown glass containers. The differences between reagent bottles made of VITLAB® opaque and those of brown glass bottles can be more or less pronounced depending on the type of the glass, since the brown glass bottles are subjected to significantly greater production fluctuations.





Light transmission diagram: Comparison of results for the measurement of transmission (T%) between VITLAB® opaque and brown glass in volumetric flasks and bottles, in the wavelength range of λ = 200 bis 900 nm.
VITLAB® opaque provides better protection of the container contents from the effects of light, particularly in the UV range (see lower diagram).

- Brown glass volumetric flasks
- Brown glass flasks
- VITLAB® opaque bottle
- VITLAB® opaque volumetric flasks

VITLAB® graduated cylinders

For manufacturing, VITLAB uses exclusively high-quality plastics with excellent chemical resistance. The reinforced cylinder edge gives high dimensional stability. In addition, the hexagonal base with bottom studs gives high stability. The raised scales are formed during the injection molding process. They remain visible even after daily cleaning in the dishwasher or autoclave sterilization. VITLAB offers graduated cylinders with a blue raised scale (for PP) or a red printed scale (for PMP). The color also makes it easy to read off the volume.

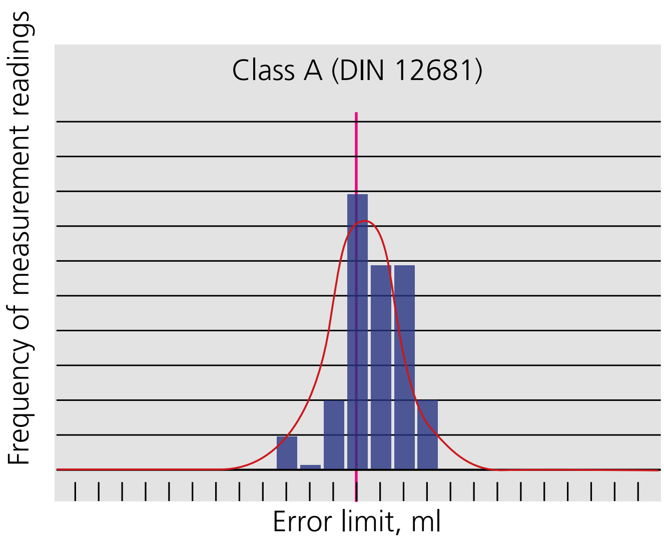
The graduated cylinder tolerances correspond to Class A or Class B. They are based on a "In" (TC) calibration (i.e., they indicate the contained volume exactly) at a reference temperature of 20 °C. However, graduated cylinders are frequently used in the laboratory just like the measuring instruments that are calibrated to "Ex" (TD). Measurements with water in glass cylinders show that the dispensed volume is reduced by approximately the amount of the graduated cylinder's error limit, due to the residues from wetting. Here, due to the hydrophobic properties of the material, graduated cylinders made of plastic offer the advantage that the measured volume corresponds to the dispensed volume.

Handling

- Pour in the liquid
- Set the meniscus to the desired ring mark
- The vessel wall above the mark must not be wetted with the liquid
- Read the meniscus at eye level
- The indicated volume corresponds to the quantity of liquid contained

Error limits

Class A graduated cylinders are characterized by very low scatter in the measured values (see example graph below). The Class A error limits were maintained after 20 washes and 10 autoclaving cycles. DIN 12 681 requires 10 washes and 3 autoclaving cycles.



Graduated cylinders, PMP, Class A, DE-M marked

With raised or red printed scale and ring marks at the major graduations. The tolerances correspond to Class A according to DIN 12681 and ISO 6706. The lot certificate supplied bears the lot number and the actual nominal value ascertained under the test conditions. The lot number and year of manufacture are engraved with a laser or printed. Thermal stress up to 121 °C (autoclaving) does not permanently exceed the tolerance limit. For autoclaving, we recommend the design with raised graduations. Available in 8 different sizes from 10 to 2,000 ml.

Graduated cylinders, PP, Class B

With a raised or raised blue scale and ring marks at the major graduations. The tolerances correspond to Class B according to DIN 12681 and ISO 6706. Thermal stresses up to 80 °C do not cause any permanent deviations beyond the tolerance limits. To preserve markings, it is recommended not to clean at temperatures exceeding 60 °C. Available in 8 different sizes from 10 to 2,000 ml.

Graduated cylinders, SAN, Class B

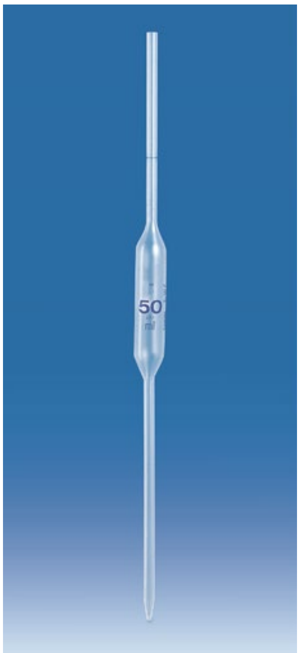
With a raised scale and ring marks at the major graduations. The tolerances correspond to Class B according to DIN 12681 and ISO 6706. Thermal stress up to 60 °C does not permanently exceed the tolerance limits. Available in 8 different sizes from 10 to 2,000 ml.

Graduated cylinders, PP and SAN, Class B, short shape

With a raised scale and ring marks at the major graduations. Thermal stresses up to 80 °C (PP) or 60 °C (SAN) do not permanently exceed the tolerance limit. Available in 6 different sizes from 25 to 1,000 ml.

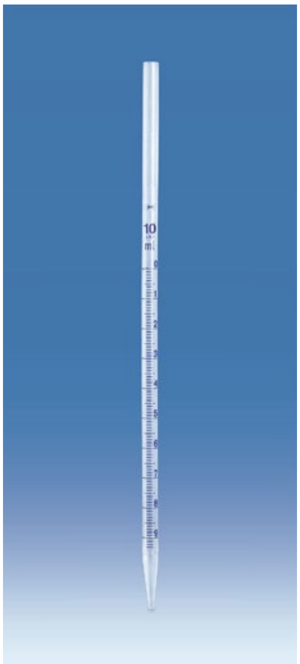
Pipettes

Pipettes are volumetric instruments calibrated for "Ex" (TD) that are used for measuring liquid volumes. The pipettes are individually measured volumetrically during production, and are provided with one or more calibration marks. Generally, a distinction is made between volumetric and graduated pipettes.



Volumetric pipettes:

Volumetric pipettes offer higher accuracy compared to graduated pipettes. The type used most frequently is the "Ex" (TD) calibrated volumetric pipette, which is intended for complete run-out. Since there is no standard for plastic pipettes, VITLAB depends on the corresponding standard for glass pipettes (DIN EN ISO 648). The error limits correspond to class B.



Graduated pipettes:

In contrast to the volumetric pipettes, graduated pipettes have scaling that allows the reading of partial volumes. There are basically three different types of graduated pipettes:

Type 1 – Nominal volume at bottom, partial run-out for all volumes

Type 2 – Nominal volume at top, complete run-out also for partial volumes

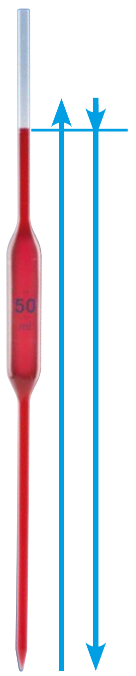
Type 3 – Nominal volume at bottom, complete run-out only for the nominal volume

The VITLAB® graduated pipettes are type 3 in accordance with the glass pipette standard, and correspond to Class B in accordance with DIN EN ISO 835 in terms of error tolerance.

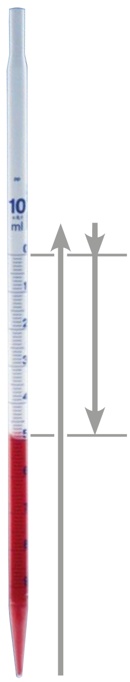
Working with pipettes

Proper pipetting with volumetric pipettes (here, nominal volume: 50 ml) and type 3, Class B graduated pipettes (here, partial volumes: 5 ml), that are calibrated for "Ex" (TD, to deliver). Accessories: Pipette helper (see page 18).

Filling:



The pipettes with a pipette helper are filled to slightly above the desired volume mark (about 5 mm).
Wipe the outside of the pipette tip dry with cellulose.
Adjust the meniscus using the pipette helper.
Wipe off any drops remaining on the tip.



When using type 3 graduated pipettes (zero point at top), the meniscus must initially be set to zero. Next, drain the liquid until the level is just over the desired partial volume. Then, adjust the meniscus to the desired volume a second time.

Emptying:

- Hold the pipette vertically, hold the outlet tip at an angle against the wall of the collecting vessel, and drain the contents. During this, do not move the pipette tip away from the wall of the vessel!
- Then, raise the pipette tip up approx. 10 mm and wipe it off on the vessel wall. This drains part of the residual liquid.

Note:

The pipettes are calibrated so that the residual liquid remaining in the tip has already been taken into account. This residual liquid should not enter the vessel or be added to the sample, e.g., by blowing.

Working with pipette helpers

Motorized pipette helpers

Pipette helpers are indispensable for working with pipettes. Pipetting by mouth or with a hose and a mouthpiece is prohibited because the risk of injury or infection is too high. Thus, the use of pipette helpers is recommended.

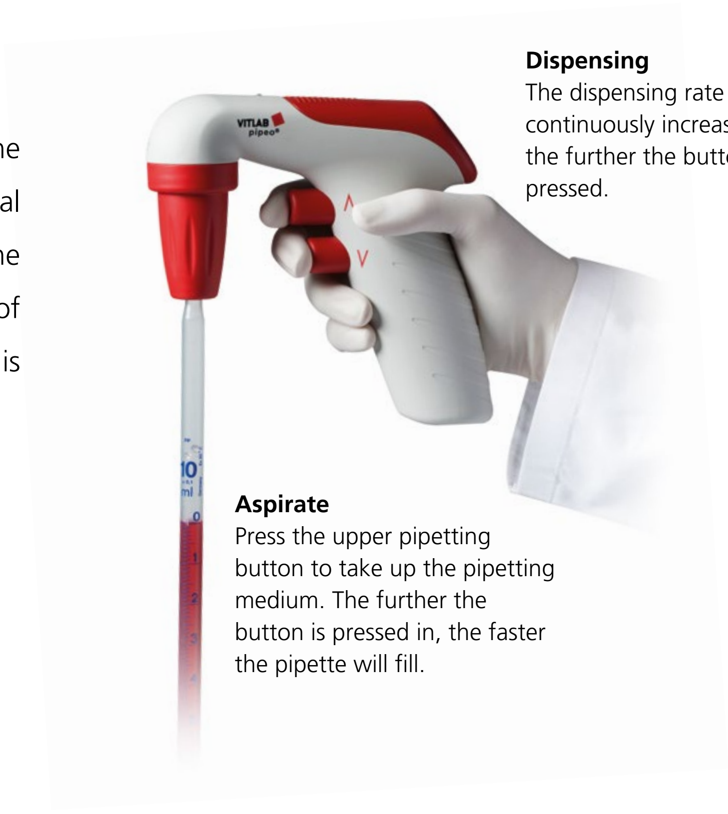
A basic distinction is made between manual and motorized pipette helpers. A motorized pipette helper such as the VITLAB pipeo® is particularly suitable for pipetting larger series (e.g., in cell culture).

Liquid discharge: Free delivery or blow out?

Selection of the delivery mode depends on the application. The primary mode employed in analytical laboratories is "free delivery". In microbiology, the focus is on the uniform and rapid measurement of nutrient solutions. Thus, the "blow-out" mode is preferred in this field of application.

The special valve system in the VITLAB pipeo® facilitates the continuous and highly exact adjustment of the pipetting rate through the operation of two buttons with just one hand, making highly sensitive operation possible.
In addition, an integrated non-return valve together with a membrane filter effectively protects against the penetration of liquids.
The VITLAB pipeo® can be used for all pipettes from 0.1 to 200 ml.

Handling: Pipetting is controlled through two large function buttons:



Manual pipette helper

Manual pipette helpers, for example, such as the VITLAB maneus®, are for pipetting small volumes, and are used especially in chemical laboratories. The special valve system that enables the instrument to be used by left- and right-handed personnel makes the operations easy and fatigue-free with all standard pipettes from 0.1 to 200 ml, and also makes sensitive and exact adjustment of the meniscus possible.

Handling:

Creating a vacuum

Press the suction bellows together.

Filling

Move the pipetting lever upwards. The farther up the lever is pressed, the faster the pipette will fill.

Adjusting the meniscus / Dispensing by "free delivery"

Move the pipetting lever gently downwards. The meniscus decreases. Release the lever, and the meniscus stops. For emptying, move the lever all the way down.
To comply with Class A accuracy, do not blow out the residual liquid.

Blowing out

When pipetting viscous media with "free delivery", the pipette tip frequently does not empty completely. In these cases, empty the remaining residues by pressing on the blow-out button.

Pipette filler bulbs - the classic standard pipette helpers

Handling

1. Attaching the pipette.
2. Press "A" and compress the bulb (creating a vacuum).
3. Press "S" and aspirate the liquid to approximately the desired mark.
4. Press "E" to drain the liquid up to the desired mark, or allow to drain completely.

Blowing out

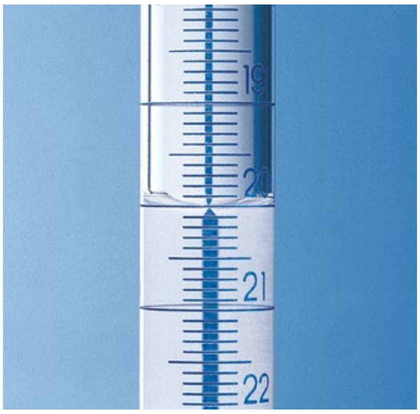
To blow out viscous media, close the side opening and compress the small bulb.

Note well!
Do not store the pipette bulb in the deflated state, and make sure that no liquid has been drawn in.

Burettes

Working with burettes

Burettes are glass volumetric instruments calibrated for "Ex" (TD) that are used for titrations in volumetric analysis. In contrast to pipettes, the entire nominal volume is not consumed in the titration. In the vicinity of the color change, the standard solution is added dropwise to avoid over-titration.



Rinse the burette with the standard solution being used, and orient it so that the burette tube stands upright.
Use only standard solutions that are completely homogeneous.
There must be no turbidity, flocculation, or deposits present.

Fill the burette to just above the zero mark. To purge the burette stopcock, drain the burette all the way to the nominal volume. However, if a small air bubble is present in the burette, hold it at an angle and gently knock against it with your finger at the place where the bubble is located.

Then, fill with standard solution up to approximately 5 mm above the zero mark. In addition, do not wet the glass wall. Drain the liquid to adjust it exactly to the zero point.

The reading must be at eye level on a parallax-free plane.

Titration systems are likewise to be filled up to approx. 5 mm above the zero point. This is adjusted automatically after ventilation.

Wipe off any drops adhering to the discharge tip.

Open the burette stopcock, and slowly add the standard solution to the sample solution (plus indicator). The burette stopcock should not touch the vessel wall during this.

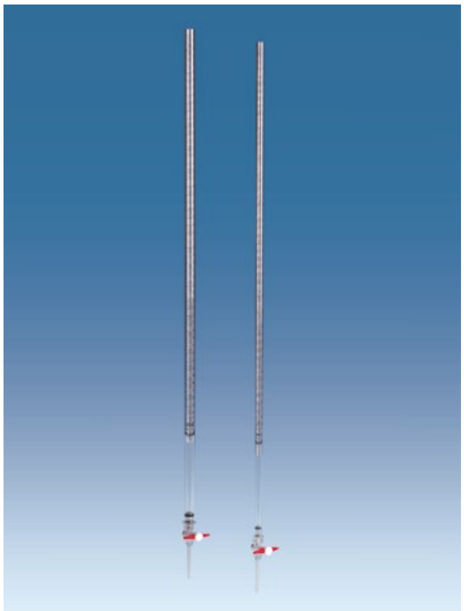
Gently swirl the receiving vessel with the sample solution during the dropwise addition of the titrant, or place it on a magnetic stirrer. For better detection of the color change, the receiving vessel should be placed on a white surface.

Close the burette stopcock when the color change is reached. The titration is finished.

Read the dispensed volume at eye height.
Any drops remaining on the tip of the stopcock should be wiped against the vessel wall and rinsed down. They belong to the titrated volume.

Before performing additional titration, reset the zero point and carry out the titration procedure from the zero point.

VITLAB® Dr. Schilling burettes
Burettes made of 3.3 borosilicate glass, with Class B tolerances according to DIN ISO 384. With high-contrast, black imprinting. Calibrated to deliver ‘Ex’. Automatic zero setting. The burette stopcock turns easily and enables fine titration. The holding device for the riser pipe serves as additional shock-proofing.



Burettes, borosilicate glass 3.3
Plastic-coated burettes made of 3.3 borosilicate glass, with Class B tolerances according to DIN ISO 384. With Schellbach stripe (blue/white) and high-contrast black printing. Calibrated to deliver ‘Ex’. The burette stopcock turns easily and enables fine titration. The temperature-stable plastic coating on the tube provides splinter protection.

Practical aids for volume measure

Graduated beakers

Graduated beakers remain a fixture in everyday laboratory practice for filling and simultaneous measurement of liquid quantities. VITLAB® graduated beakers have ergonomic handles and can therefore be held firmly. This facilitates lab work, and provides greater confidence in dealing with a variety of liquids. The custom-made spout ensures an optimum flow behavior and significantly reduces bothersome dripping.

High-quality manufacturing processes ensure that VITLAB® graduated beakers have very accurate scaling. They fall well within the DIN 7056 tolerance of ± 10% allowed for Griffin beakers. They are calibrated "to contain" (In, TC) at a reference temperature of 20 °C. The measurement accuracy with PP is maintained even after autoclaving at 121 °C with a residence time of 20 minutes. Due to the anti-adhesive properties of the materials used to manufacture VITLAB® graduated beakers, the measured volume (In, TC) is the same as the dispensed volume (Ex, TD).

Graduated beakers (PP), raised scale
Highly transparent. With a raised scale and stable, easy-grip handle. Autoclavable at 121 °C (2 bar) according to DIN EN 285. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Available in 8 different sizes from 50 to 5,000 ml.

Graduated beakers (PP), raised blue scale
Highly transparent. With easily readable, embossed blue scale, and stable, easy-grip handle. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Available in 8 different sizes from 50 to 5,000 ml.

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Graduated beakers (SAN), raised scale
Crystal clear. With a raised scale and stable, easy-grip handle. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Available in 5 different sizes from 250 to 3,000 ml.

Color up your lab

The end of laboratory monotony is here! VITLAB adds variety, and brings colorful accents into the laboratory with this new product line. The high-quality colors serve to help ensure the distinction between the materials used, and support the visual recognition.

In addition, the high-contrast colors are a welcome highlight in any laboratory.

Graduated beakers (PP), stackable
Highly transparent. With a sturdy handle, and easy-to-read scale printed in black on both sides. The volume can thus be read with equal ease by left- and right-handed personnel. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Available in 5 different sizes from 250 to 3,000 ml.

Graduated beakers (PP), colored, stackable
Transparent. With easily readable, printed blue scales and stable handles. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Available in four different colors in the sizes 500 ml and 1000 ml, also as mixed sets.

Versatile for everyday laboratory

Griffin beakers

Griffin beakers are among the most commonly used vessels in the laboratory. Graduated beakers without handles have many possible applications. Whether for stirring or mixing, they are very useful items for daily laboratory use. VITLAB uses only the highest-quality plastics in manufacturing Griffin beakers, making them suitable for nearly any use.

Griffin beakers are also referred to as the "wide" type of laboratory beaker: the height to diameter ratio is about 1.4. The "high" version has a height equal to approximately twice the diameter, and is called the "Berzelius Beaker".

Griffin beakers (PFA), with raised scale
Transparent. Excellent chemical resistance, and very high thermal stability from -200 to +260 °C. They can be used with strong oxidising agents, highly concentrated acids and alkalis, hydrocarbons, and ketones. Autoclavable at 121 °C (2 bar) according to DIN EN 285. Available in 6 different sizes from 25 to 1,000 ml.

Griffin beakers (ETFE), with a black imprinted scale
Transparent. With easily readable, printed scale. Very good chemical resistance, and thermal stability from -100 to +150 °C. Available in 8 different sizes from 25 to 1,000 ml.

uses

Griffin beakers (PMP), with a red imprinted scale
Crystal clear. With easily readable, printed red scale. According to ISO 7056. Because of the printing, we recommend the version with raised graduations for autoclaving. Available in 13 different sizes from 10 to 5,000 ml.

Griffin beakers (PMP), with raised scale
Crystal clear. With a raised scale. According to ISO 7056. Autoclavable at 121 °C (2 bar) according to DIN EN 285. Available in 12 different sizes from 25 to 5,000 ml.

Griffin beakers (PP), raised blue scale
Highly transparent. With easily readable, raised, embossed blue scale. According to ISO 7056. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Available in 13 different sizes from 10 to 5,000 ml.

Griffin beakers (PP), with raised scale
Highly transparent. With a raised scale. According to ISO 7056. Suitable for contact with foodstuffs according to EC Directive No. 10/2011. Autoclavable at 121 °C (2 bar) according to DIN EN 285. Available in 12 different sizes from 25 to 5,000 ml.

Test equipment monitoring

What is testing equipment?

Testing equipment includes all of the measuring devices that are used to verify the declared product properties. In every analytical laboratory, the accuracy of the testing equipment must be well managed to be able to obtain reliable results. This is especially true for laboratories working according to GLP guidelines, accredited according to DIN EN ISO/IEC 17 025, or certified according to DIN EN ISO 9001.
With regard to testing equipment monitoring, the accuracy and measurement uncertainty of all testing equipment must be known and documented before they are released for use.

When, how often, and by what method is the examination done?

All volumetric instruments must undergo periodic inspection at specified intervals (approximately every 3-12 months for plastic volumetric instruments, and every 1-3 years for glass volumetric instruments; sometimes more frequently depending on the application), since the accuracy of volumetric instruments can be altered, for example, due to the use of aggressive chemicals, as well as the type and frequency of cleaning.

The testing of volumetric instruments is done gravimetrically, in which these volumetric instruments are tested according to ISO 4787, while the standard for liquid handling equipment is ISO 8655. Many factors must be considered when carrying this out.

Must DE-M marked volumetric instruments also be checked?

All testing equipment must undergo this testing equipment monitoring. Whether initial assessment can be omitted for these is not clearly described. This decision is the responsibility of the user. However, for safety purposes, it is recommended to carry out the initial testing on a representative sample. This also serves to document the initial status for subsequent testing. If need be, an alternative is volumetric instruments with an individual certificate.

Adjustment / Calibration

Adjustment is the correction of deviations in the measured values from the nominal values. Calibration refers to the determination of the actual volume. The corresponding VITLAB testing instructions are available for download on the website at: www.vitlab.com

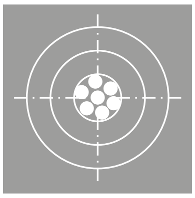
Accuracy

What do “tolerance, accuracy, coefficient of variation, and precision” mean in volumetric measurements?

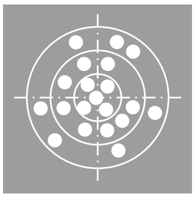
Graphic illustration of precision and accuracy

The dart board simulates the volume range around the centred nominal value, the white dots simulate the different measured values of a specified volume.

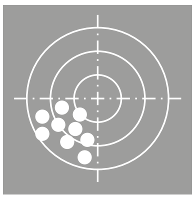
Good accuracy: All hits are near the centre, i.e., the nominal value.
Good precision: All hits are close together.
Result: The manufacturing process is well controlled by an accompanying quality assurance program. Minimal systematic deviations and a narrow variance in products. The permissible limits are not exceeded. There are no rejects.



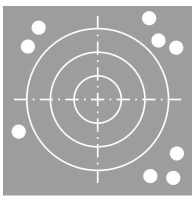
Good accuracy: On average, the hits are evenly distributed around the centre.
Poor precision: No substantial errors, but hits widely scattered.
Result: All deviations are “equally probable”. Instruments exceeding the permissible tolerance should be rejected.



Poor accuracy: Although all hits are close together, the centre (nominal value) is still missed.
Good precision: All hits are close together.
Result: Improperly controlled production, with systematic deviation. Instruments exceeding the permissible tolerance should be rejected.



Poor accuracy: The hits are far removed from the centre.
Poor precision: The hits are widely scattered.
Result: These volumetric instruments are of inferior quality.



Calculation formulae

The accuracy of glass volumetric instruments is commonly defined by “Tolerance Limits”, whereas for liquid handling instruments the statistical terms “Accuracy [%]” and “Coefficient of Variation [%]” have been established.

Tolerance

$$\text{Tol.} \geq | V_{meas.} - V_{nom.} |$$

The term “tolerance” (tol.) in the corresponding standards defines the maximum permissible deviation from the nominal value.

Accuracy

$$A[\%] = \frac{\overline{V} - V_{nom.}}{V_{nom.}} \cdot 100$$

Accuracy (A) indicates the closeness of measured mean volume to the nominal value, i.e., systematic measurement deviation. Accuracy is defined as the difference between the measured mean volume ($\overline{V}$) and the nominal value ($V_{nom.}$), related to the nominal value in percent.

Coefficient of Variation

$$CV[\%] = \frac{s \cdot 100}{\overline{V}}$$

The coefficient of variation (CV) indicates the closeness of values from repeated measurements, i.e., random measurement deviation. The coefficient of variation is defined as standard deviation in percent, related to the mean volume.

Partial volumes

$$A_{part.}[\%] = \frac{V_{nom.}}{V_{part.}} \cdot A_{nom.} \%$$

(analogous to $CV_{part.}$ %)
Generally, A and CV are based on the nominal volume ($V_{nom.}$). These data in percent must be converted to partial volumes ($V_{part.}$). By contrast, there is no conversion for partial volumes if A and CV are stated in volume units (e.g. ml).

Tolerance from A and CV

$$\text{Tol.} \geq \frac{| A\% | + 2CV\%}{100\ \%} \cdot V_{nom.}$$

To a good approximation, the tolerance, e.g. for the nominal volume ($V_{nom.}$), can be calculated from the accuracy and coefficient of variation.

Precision

If the variance in the individual measurement results about the mean volume $\overline{V}$ is given in units of volume, this relates to precision.

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