# BLAUBRAND®

## Volumetric Instruments and Density Bottles

### Testing Instructions (SOP)

**March 2015**

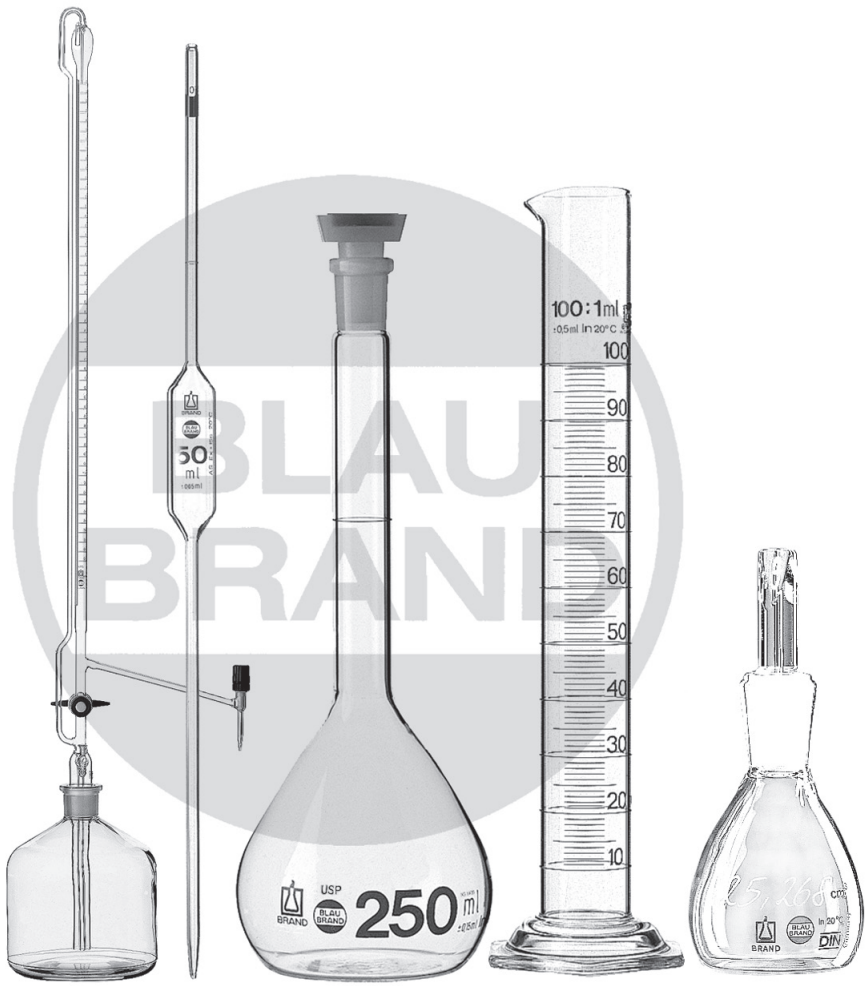
## 1. Introduction

The standard DIN EN ISO 4787 describes both the design and the testing of the volumetric instruments of glass. The following Testing Instructions describe how to apply the ISO standard in practice.

We recommend a testing every 1-3 years. The interval depends on the using of aggressive media and the cleaning procedure.

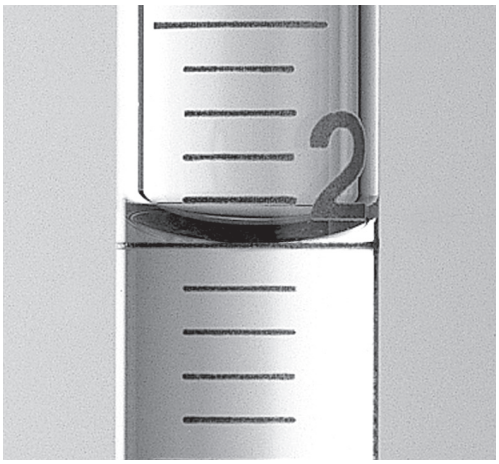
These Instructions may also be used as a basis for the supervision of testing devices to DIN EN ISO 9001, DIN EN ISO 10012 and DIN EN ISO/IEC 17025.

The test of the Density Bottles was effected on the basis of DIN EN ISO 4787.



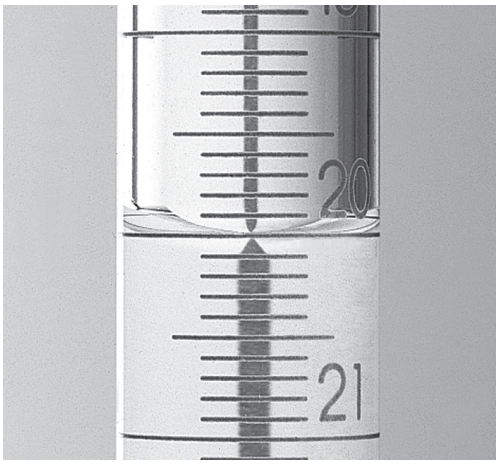

BRAND

# Meniscus adjustment with BLAUBRAND® Volumetric Instruments




**Meniscus adjustment with ring mark**

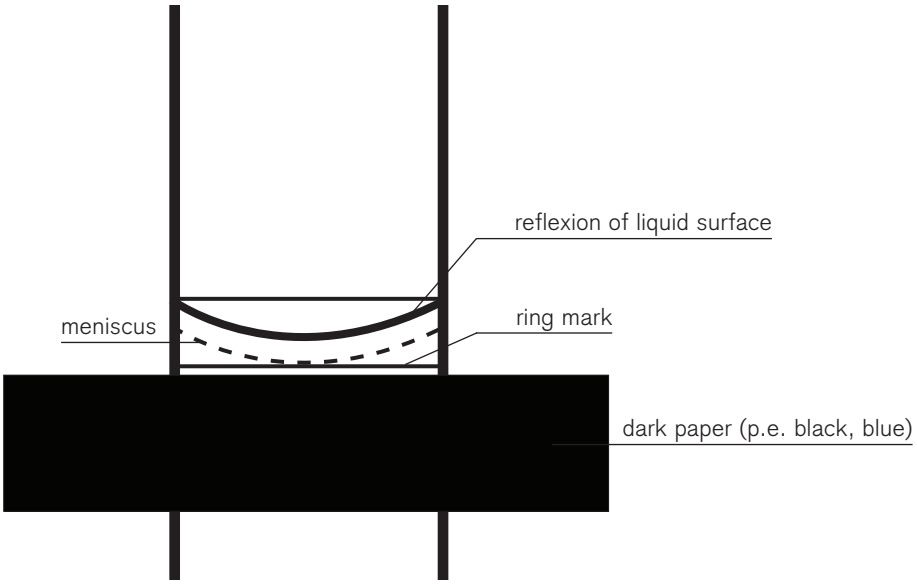
Read at the lowest point of the meniscus.




**Meniscus adjustment with Schellbach stripe**

Read at the point where the two arrows touch.

**Meniscus adjustment**



# 2. Preparation for testing

## 2. Clear identification of the volumetric instrument to be tested

Batch number, individual serial number, trademark, nominal volume and tolerances are directly printed on every BLAUBRAND volumetric instruments.

⇒ The test starts with a clear identification of the volumetric instrument in the test record.

### 2.1 Copy Test Record

(see page 13)

### 2.2 Serial number/Identification number ⇒ Enter into Test Record

All BLAUBRAND® volumetric instruments always carry a batch number, e.g., 13.04, or an individual serial number in the case of individual certificates, e.g., 13.040371 (year of production 2013, Batch No. 4, Serial No. 0371). Calibrated density bottles are supplied with a individual certificate and have a serial number. The stoppers and thermometers are marked with a unique matching identification number.

### 2.3 Trademark ⇒ Enter into Test Record

BLAUBRAND® or BLAUBRAND® USP (blue enamel imprints)
BLAUBRAND® ETERNA (amber stain imprints)
BLAUBRAND® amber glass (white enamel imprints)
Volumetric instrument of plastic

### 2.4 Type of instrument ⇒ Enter into Test Record

**Volumetric instruments calibrated 'In' (to contain)**

- **Volumetric flasks**
  - Trapezoidal volumetric flasks
  - Standard volumetric flasks
  - Amber-glass volumetric flasks
  - Flanged-rim volumetric flasks
  - PUR Plastic coated volumetric flasks
- **Graduated cylinders**
- **Mixing cylinders**
- **Graduated pipettes**, calibrated to contain (0.1 and 0.2 ml)
- **Density Bottles**

**Volumetric instruments calibrated 'Ex' (to deliver)**

- **Bulb pipettes**
  - One mark
  - Two mark
- **Graduated pipettes**
  - Graduated pipettes, total delivery, nominal volume at the top (type 2)
  - Graduated pipettes, partial delivery, zero point at the top (type 1)
  - Graduated pipettes, total delivery, zero point at the top (type 3)
- **Burettes**
  - Burettes, lateral needle-valve stopcock
  - Burettes, lateral glass stopcock
  - Burettes, straight needle-valve stopcock
  - Burettes, straight glass stopcock
  - Micro burettes, lateral needle-valve stopcock
  - Micro burettes, lateral glass stopcock
  - Micro burettes, straight needle-valve stopcock
  - Micro burettes, straight glass stopcock
  - Compact burettes (dismountable)

## 2.4 Type of instrument (continued) ⇒ Enter into Test Record

- **Automatic burettes**
  - Automatic burettes with intermediate stopcock and needle-valve stopcock
  - Automatic burettes with intermediate stopcock and glass stopcock
  - Automatic burettes without intermediate stopcock and with needle-valve stopcock
  - Compact automatic burettes (dismountable)

## 2.5 Nominal capacity: subdivision ⇒ Enter into Test Record

In case of graduated instruments, specify the subdivision,
e.g., 20 : 0.1 ml.
In case of density bottles enter the volume specified on
the bottle.

## 2.6 Error limits (tolerances) ⇒ Enter into Test Record

Read inscriptions on the instrument.
In case of density bottles enter the error limit.
For density bottle with stopper it is ± 10 µl,
for those with thermometer and side capillary it is ± 15 µl.

## 2.7 Material ⇒ Enter into Test Record

- **Soda-lime glass (AR-GLAS®)**
  Bulb pipettes and graduated pipettes
- **Borosilicate glass 3.3 (Boro 3.3)**
  Volumetric flasks, graduated cylinders, burettes and density bottles
- **Plastic materials**
  e.g., PP, PMP, PFA

## 2.8 Customer-specific markings ⇒ Enter into Test Record

Read any customer-specific markings and record them.

# Entries so far (e.g.):

| | |
|---|---|
| **Serial No/Identification number:** | 13.040371 |
| **Trademark:** | BLAUBRAND® |
| **Calibration:** | 'Ex' (to deliver) |
| **Type of instrument:** | Graduated pipette, total delivery, nominal volume at the top (type 2) |
| **Nominal capacity/Subdivision:** | 2 : 0.02 ml |
| **Error limits:** | ± 0,010 ml |
| **Material:** | AR-GLAS® |

# 3. Visual examination

## 3.1 Cleanness

To obtain the stated volumetric accuracy, the glass surface must be clean and grease-free. If drops adhere to the glass wall, or if the meniscus does not form evenly, the instrument is not clean and must be cleaned with a low alkaline detergent (e.g., Mucasol®). Rinse subsequently with tap water and finally with distilled or deionised water.
For especially stubborn residues also a alkaline potassium permanganate solution can be used. Mix a 1-M-sodium hydroxide solution with the same quantity of a solution consisting of 30 g/l potassium permanganate. After an immersion time of approx. 1 hour remove any $MnO_2$ residues with diluted oxalic acid. Rinse subsequently with tap water and finally with distilled or deionised water.

## 3.2 Inscriptions

All inscriptions must be clearly legible, e.g., conformity certification, class A/AS marking, nominal capacity, error limit, reference temperature, calibration 'In'/'Ex', batch/serial number, and volumetric markings.

## 3.3 Damages

The instrument must not show any significant damages such as scratches or breakages. Especially the tip orifice of pipettes and burettes must not show any damages. Burette stopcocks must close tightly, smoothly and easily. (Within 60 seconds, no drop must form at the tip.)

# 4. Required equipment for testing

- Volumetric Instruments for testing
- **Bottle** (at least 500 ml) filled with distiled or deionised water (according to ISO 3696, at least quality 3, room temperature). ⇒ Match temperature of water and room.
- **Recipient** (e.g., Erlenmeyer flask, narrow-mouth) filled with some water. ⇒ Bottom of vessel should be covered.
- **Thermometer** with a measuring error of maximum: ± 0.1 °C
- Place the instrument into the testing room for at least 1 hour (unpacked!). ⇒ Allow instrument to adjust to room temperature.
- **Balance,** recommended specifications:

| Selected volume[a] under test<br>V | Resolution<br>mg | Standard deviation (Repeatability)<br>mg | Linearity<br>mg |
|---|---|---|---|
| 100 µl < V ≤ 10 ml | 0,1 | 0,2 | 0,2 |
| 10 ml < V < 1000 ml | 1 | 1 | 2 |
| 1000 ml ≤ V ≤ 2000 ml | 10 | 10 | 20 |
| V > 2000 ml | 100 | 100 | 200 |

[a] For practical purposes, the nominal volume may be used to choose the balance.

## Testing equipment and accessories (continued)

- **Testing setup**
  For the testing of pipettes and burettes calibrated 'Ex' (to deliver), a support for vertical mounting of the instrument is required.

- **Stopwatch**
  To keep track of the waiting time, accuracy ± 1 s.

- **Lint-free tissue**
  For wiping

- **Pipetting aid**
  e.g., macro pipette controller from BRAND

- **Barometer**
  For testing the atmospheric pressure, accuracy ± 1 kPa

**Traceability of test results to national standards**
Through the use of calibrated testing devices (balance and thermometer), the requirement of DIN EN ISO 9001, DIN EN ISO 10012 and DIN EN ISO/IEC 17025 to refer the test to the national standard is fulfilled. The calibration of the balance e.g. can be carried out either by DKD (DAkkS) calibration or official certification of the balance, or by calibrating the balance with appropiate weights that are traced to the national standard. The calibration of the thermometer can also be carried out by DKD (DAkkS) calibration or official certification, or by a comparison with thermometers that are traced to the national standard (under defined conditions).

# 5. Gravimetric test

## 5.1 Volumetric instruments calibrated 'In' (to contain)

### 5.1.1 Volumetric flasks, graduated cylinders and mixing cylinders (Boro 3.3 resp. PP, PMP or PFA)

- Determine temperature of testing water ⇒ **Enter temperature into Test Record**
- Determine empty weight of the dry volumetric instrument. ($W_1$) ⇒ **Enter value into Test Record**
- Fill the instrument with testing liquid to approx. 5 mm above the ring mark.
  - The glass wall must not be wetted above the meniscus. If this happens, wipe it dry with tissue.
- Adjust the meniscus precisely to the ring mark by removing liquid with a pipette.
  - The lowest point of the meniscus must be aligned with the upper edge of the mark. Read without parallax; i.e. your eye must be at the same level.
- Determine the weight of the filled instrument. ($W_2$) ⇒ **Enter value into Test Record**

### 5.1.2 Graduated pipettes, calibrated to contain (AR-GLAS®)

- Determine temperature of testing water ⇒ **Enter temperature into Test Record**
- Determine empty weight of the dry volumetric instrument. ($W_1$) ⇒ **Enter value into Test Record**
- Hold the graduated pipette almost horizontally, and let its tip touch the water surface in a glass beaker filled with testing liquid up to the rim.
  - The pipette will fill itself by capillary action.
- Fill the pipette with testing liquid, exactly to the nominal capacity ring mark.
  - The lowest point of the meniscus must be aligned with the upper edge of the mark. Read without parallax; i.e. your eye must be at the same level.
- Dry the outside of the pipette tip with tissue.
- Determine the weight of the filled instrument. ($W_2$) ⇒ **Enter value into Test Record**

### 5.1.3 Density Bottles

- Determine temperatur of testing water ⇒ **Enter temperature into Test Record**
- Determine empty weight of the dry density bottle. ($W_1$) ⇒ **Enter value into Test Record**
- Fill density bottle bubble-free with testing liquid. The socked should be filled to 1/3.
- Put the stopper or the thermometer carefully onto the density bottle matching the markings of density bottle and stopper or thermometer. The capillary fills and some testing liquid runs out.
- Surface of stopper or capillary and the outside of the density bottle must be carefully dried.

  **Note**: Avoid contacting the capillary with the tissue. The testing liquid must exactly level with the upper end of the capillary.
- Determine the weight of the density bottle. ($W_2$) ⇒ **Enter value into Test Record**

## 5.2 Volumetric instruments calibrated 'Ex' (to deliver)

### 5.2.1 Bulb pipettes and graduated pipettes (AR-GLAS®)

- Determine temperatur of testing water ⇒ **Enter temperature into Test Record**
- Determine weight of weighing vessel. ($W_1$) ⇒ **Enter value into Test Record**
- Clamp the pipette vertically to the support.
- Using a pipetting aid, fill the pipette to approx. 5 mm above the top mark (nominal capacity).
- Dry the outside of the pipette tip with tissue.
- Adjust the meniscus precisely by releasing liquid.
  - The lowest point of the meniscus must be aligned with the upper edge of the mark. Read without parallax; i.e. your eye must be at the same level.
  - If a drop still adheres to the tip, wipe it off.

### 5.2.1 Bulb pipettes and graduated pipettes (AR-GLAS®) (continued)

- Allow the liquid to run off into the weighing vessel, while the pipette tip touches the inclined wall of the vessel. At the moment that the meniscus comes to a standstill inside the pipette tip, start to count the waiting time.
- After 5 seconds waiting time (use stopwatch), wipe off the tip against the inside of the vessel.
  - If a drop still adheres to the tip, wipe it off against the inner wall of the weighing vessel.
- Determine weight of the weighing vessel again. ($W_2$) ⇒ **Enter value into Test Record**

**Note:**
In case of pipettes graduated for partial delivery, let the water run out until approx. 10 mm above the lower mark, while the pipette tip touches the inclined wall of the weighing vessel. After 5 seconds waiting time, adjust the meniscus precisely to the mark.

### 5.2.2 Burettes and automatic burettes (Boro 3.3)

- Determine temperature of testing water. ⇒ **Enter temperature into Test Record**
- Determine weight of weighing vessel. ($W_1$) ⇒ **Enter value into Test Record**
- Clamp the burette vertically to the support.
- Fill the burette to approx. 5 mm above the zero mark. To bleed the burette stopcock, let liquid run off not further than to nominal capacity mark.
  - After the first filling, a small air bubble may remain in the burette stopcock. To remove this bubble, hold the burette at an angle and tap a finger against the location of the bubble.
- Fill the burette to approx. 5 mm above the zero mark.
  - The glass wall must not be wetted above the zero mark. (If this happens, wipe it dry with tissue.)
- Set to zero precisely by releasing liquid.
  - The lowest point of meniscus and the upper edge of the mark must be at the same level. Read without parallax.
  - Burettes with Schellbach stripe: the point where the two arrows touch must be aligned with the zero mark. Read without parallax; i.e. your eye must be at the same level.
- Let the liquid run off into the weighing vessel until approx. 5 mm above the nominal capacity mark. The burette stopcock is completely opened and the burette tip must not touch the wall of the vessel!
- After 30 seconds waiting time (use stopwatch), adjust the meniscus precisely to the nominal capacity mark, and wipe off the tip against the inside of the vessel.
  - If a drop still adheres to the tip, wipe it off against the inner wall of the weighing vessel.
- Determine weight of the weighing vessel again. ($W_2$) ⇒ **Enter value into Test Record**

# 6. Evaluation

The necessary number of tests depends primarily upon the skill of the tester. Generally, one test should suffice in the case of all volumetric instruments calibrated 'In' (to contain). In case of instruments calibrated 'Ex' (to deliver), to be on the safe side, it is advisable to use the mean value resulting from 3 measurements. The scatter of the individual results should not be greater than 1/3 of the admissible error limit (tolerance) of the measuring instrument. (Example: error limit of a 10 ml bulb pipette is ± 0.020 ml. The scatter of measuring results must be below ± 0.0067 ml. If the scatter is greater, we recomend the testing procedure should be revised, and the test should be repeated.)

The standard DIN EN ISO 4787 describes the gravimetric testing of volumetric instruments and provides the following general equation for calculations:

$$V_{20} = (W_2 - W_1)\left(\frac{1}{\rho_W - \rho_L}\right)\left(1 - \frac{\rho_L}{\rho_G}\right)\left(1 - \gamma(t - 20\,°C)\right)$$

Since this equation is rather cumbersome to work with, requiring a multitude of tables, we are providing a simplified calculation by factor Z. Only the gravimetric testing method is to be used for the volumetric instruments described in this SOP.

**Monitoring of measuring instruments, made easy:**

$$V_{20} = (W_2 - W_1) \cdot Z$$

The parameters are:

| | |
|---|---|
| $V_{20}$ [ml]: | volume of the instrument at 20 °C |
| $W_1$ [g]: | weight of the empty instrument/respectively weight of weighing vessel before delivery |
| $W_2$ [g]: | weight of the filled instrument/respectively weight of weighing vessel after delivery |
| Z [ml/g]: | factor resulting from united parameters (see Tables) |

To simplify the list of measuring instruments even further, we recommend to use DE-M marking BLAUBRAND® volumetric instruments marked with batch number or individual serial number. The initial testing of certified volumetric instruments can be omitted since the testing results are already confirmed in the certificate.

## 6.1 Factor "Z"

Factor "Z" takes the following parameters into account:

- **Density of the calibration weight of the balance ($\rho_G$):**
  - 8 g/ml (see specifications provided by the balance manufacturer)
- **Air density in relation to atmospheric pressure, temperature and relative air humidity of 40-90% ($\rho_L$):**
  - For all volumetric instruments (except volumetric flasks > 250 ml) the influence of atmospheric pressure in relation to the stated error limits is relatively small. Therefore, Factor "Z" should generally be read from the table "Medium atmospheric pressure range." For volumetric flasks > 250 ml, select the appropriate table for lower, medium or upper atmospheric pressure range, according to the present conditions. To determine the appropriate table, measure the atmospheric pressure, or inquire at a local metereological station! (The atmospheric pressure, related to sea-level, has to be couverted into local level.)
- **Density of water ($\rho_W$) in relation to temperature**
- **Cubic expansion coefficient of the volumetric instrument in relation to its material:**
  - Boro 3.3: $\gamma = 9.9 \times 10^{-6}\ °C^{-1}$
  - AR-GLAS®: $\gamma = 27 \times 10^{-6}\ °C^{-1}$
  - PP: $\gamma = 450 \times 10^{-6}\ °C^{-1}$ (Manufacturer's information, average value of $\gamma = 300 \times 10^{-6}\ °C^{-1}$ to $\gamma = 600 \times 10^{-6}\ °C^{-1}$)
  - PMP: $\gamma = 351 \times 10^{-6}\ °C^{-1}$ (Manufacturer's information: Mitsui)
  - PFA: $\gamma = 330 \times 10^{-6}\ °C^{-1}$

## 6.2 Calculate Volume $V_{20}$

Example:

| | |
|---|---|
| Serial No/Identification No: | 13.040371 |
| Trademark: | BLAUBRAND® |
| Type of instrument: | Standard volumetric flask |
| Calibration: | 'In' (to contain) |
| Nominal capacity/subdivision: | 100 ml |
| Error limit: | ± 0.1 ml |
| Testing temperature: | 23 °C |
| Material: | Boro 3.3 |
| Customer-specific marking: | Test Lab FT |

| | |
|---|---|
| Empty weight of volumetric flask: | $W_1$ = 25.456 g |
| Weight of filled volumetric flask: | $W_2$ = 125.124 g |

Factor "Z" from Table 1, medium atmospheric pressure range, since capacity of volumetric flask ≤ 250 ml:
$Z_{23\ °C,\ Boro\ 3.3}$ = 1.00348 ml/g

$$V_{20} = (W_2 - W_1) \cdot Z = (125.124\ g - 25.456\ g) \cdot 1.00348\ ml/g$$
$$= 100.01\ ml$$

## 6.3 Tables for Factor "Z"

- **Table 1**
  - Table 1 gives Factor "Z" for the temperatures from 15 °C to 30 °C and atmospheric pressures from 980 hPa to 1040 hPa for glass types AR-GLAS® and Boro 3.3.
  - For factor Z for other temperatures and atmospheric pressures please see DIN EN ISO 4787.

- **Table 2**
  - If volumetric instruments made of plastic are also to be tested, Table 2 provides Factor "Z" for PP, PMP and PFA.

# Testing of volumetric instruments
# Factor "Z" [ml/g]

## Table 1

| | **Lower atmospheric pressure range 980 to 1000 hPa** | | **Medium atmospheric pressure range 1000 to 1020 hPa** | | **Upper atmospheric pressure range 1020 to 1040 hPa** | |
|---|---|---|---|---|---|---|
| | Type of glass | | Type of glass | | Type of glass | |
| Testing temperature [°C] | **Boro 3.3** | **AR-GLAS®** | **Boro 3.3** | **AR-GLAS®** | **Boro 3.3** | **AR-GLAS®** |
| | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] |
| 15 | 1.00200 | 1.00208 | 1.00202 | 1.00211 | 1.00204 | 1.00213 |
| 15.5 | 1.00207 | 1.00215 | 1.00209 | 1.00217 | 1.00211 | 1.00219 |
| 16 | 1.00214 | 1.00221 | 1.00216 | 1.00223 | 1.00218 | 1.00225 |
| 16.5 | 1.00222 | 1.00228 | 1.00224 | 1.00230 | 1.00226 | 1.00232 |
| 17 | 1.00230 | 1.00235 | 1.00232 | 1.00237 | 1.00234 | 1.00239 |
| 17.5 | 1.00238 | 1.00242 | 1.00240 | 1.00245 | 1.00242 | 1.00247 |
| 18 | 1.00246 | 1.00250 | 1.00248 | 1.00252 | 1.00251 | 1.00254 |
| 18.5 | 1.00255 | 1.00258 | 1.00257 | 1.00260 | 1.00260 | 1.00262 |
| 19 | 1.00264 | 1.00266 | 1.00266 | 1.00268 | 1.00268 | 1.00270 |
| 19.5 | 1.00274 | 1.00275 | 1.00276 | 1.00277 | 1.00278 | 1.00279 |
| 20 | 1.00283 | 1.00283 | 1.00285 | 1.00285 | 1.00287 | 1.00287 |
| 20.5 | 1.00293 | 1.00292 | 1.00295 | 1.00294 | 1.00297 | 1.00296 |
| 21 | 1.00303 | 1.00301 | 1.00305 | 1.00303 | 1.00307 | 1.00305 |
| 21.5 | 1.00313 | 1.00311 | 1.00316 | 1.00313 | 1.00318 | 1.00315 |
| 22 | 1.00321 | 1.00318 | 1.00323 | 1.00320 | 1.00325 | 1.00322 |
| 22.5 | 1.00335 | 1.00331 | 1.00337 | 1.00333 | 1.00339 | 1.00335 |
| 23 | 1.00346 | 1.00341 | 1.00348 | 1.00343 | 1.00350 | 1.00345 |
| 23.5 | 1.00358 | 1.00352 | 1.00360 | 1.00354 | 1.00362 | 1.00356 |
| 24 | 1.00369 | 1.00362 | 1.00371 | 1.00364 | 1.00373 | 1.00366 |
| 24.5 | 1.00381 | 1.00373 | 1.00383 | 1.00375 | 1.00385 | 1.00377 |
| 25 | 1.00393 | 1.00384 | 1.00395 | 1.00386 | 1.00397 | 1.00389 |
| 25.5 | 1.00405 | 1.00396 | 1.00408 | 1.00398 | 1.00410 | 1.00400 |
| 26 | 1.00418 | 1.00408 | 1.00420 | 1.00410 | 1.00422 | 1.00412 |
| 26.5 | 1.00431 | 1.00420 | 1.00433 | 1.00422 | 1.00435 | 1.00424 |
| 27 | 1.00444 | 1.00432 | 1.00446 | 1.00434 | 1.00448 | 1.00436 |
| 27.5 | 1.00457 | 1.00444 | 1.00459 | 1.00447 | 1.00461 | 1.00449 |
| 28 | 1.00471 | 1.00457 | 1.00473 | 1.00459 | 1.00475 | 1.00461 |
| 28.5 | 1.00485 | 1.00470 | 1.00487 | 1.00472 | 1.00489 | 1.00474 |
| 29 | 1.00499 | 1.00483 | 1.00501 | 1.00485 | 1.00503 | 1.00487 |
| 29.5 | 1.00513 | 1.00497 | 1.00515 | 1.00499 | 1.00517 | 1.00501 |
| 30 | 1.00527 | 1.00510 | 1.00529 | 1.00512 | 1.00531 | 1.00514 |

**Note:**
Intermediate values can be linearly interpolated easily. Tables based on other atmospheric pressure ranges are available on request.

# Testing of volumetric instruments
# Factor "Z" [ml/g]

## Table 2

| Testing temperature [°C] | Lower atmospheric pressure range 980 to 1000 hPa | | | Medium atmospheric pressure range 1000 to 1020 hPa | | | Upper atmospheric pressure range 1020 to 1040 hPa | | |
|---|---|---|---|---|---|---|---|---|---|
| | Type of plastic | | | Type of plastic | | | Type of plastic | | |
| | **PP** | **PMP** | **PFA** | **PP** | **PMP** | **PFA** | **PP** | **PMP** | **PFA** |
| | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] | Z [ml/g] |
| 15 | 1.00420 | 1.00371 | 1.00360 | 1.00423 | 1.00373 | 1.00362 | 1.00425 | 1.00375 | 1.00365 |
| 15.5 | 1.00406 | 1.00361 | 1.00351 | 1.00408 | 1.00363 | 1.00353 | 1.00410 | 1.00365 | 1.00356 |
| 16 | 1.00391 | 1.00351 | 1.00343 | 1.00393 | 1.00353 | 1.00345 | 1.00395 | 1.00355 | 1.00347 |
| 16.5 | 1.00376 | 1.00342 | 1.00334 | 1.00379 | 1.00344 | 1.00336 | 1.00381 | 1.00346 | 1.00338 |
| 17 | 1.00362 | 1.00332 | 1.00326 | 1.00364 | 1.00334 | 1.00328 | 1.00366 | 1.00337 | 1.00330 |
| 17.5 | 1.00348 | 1.00324 | 1.00318 | 1.00351 | 1.00326 | 1.00320 | 1.00353 | 1.00328 | 1.00322 |
| 18 | 1.00335 | 1.00315 | 1.00311 | 1.00337 | 1.00317 | 1.00313 | 1.00339 | 1.00319 | 1.00315 |
| 18.5 | 1.00322 | 1.00307 | 1.00303 | 1.00324 | 1.00309 | 1.00305 | 1.00326 | 1.00311 | 1.00308 |
| 19 | 1.00308 | 1.00298 | 1.00296 | 1.00310 | 1.00301 | 1.00298 | 1.00313 | 1.00303 | 1.00301 |
| 19.5 | 1.00296 | 1.00291 | 1.00290 | 1.00298 | 1.00293 | 1.00292 | 1.00300 | 1.00295 | 1.00294 |
| 20 | 1.00283 | 1.00283 | 1.00283 | 1.00285 | 1.00285 | 1.00285 | 1.00287 | 1.00287 | 1.00287 |
| 20.5 | 1.00271 | 1.00276 | 1.00277 | 1.00273 | 1.00278 | 1.00279 | 1.00275 | 1.00280 | 1.00281 |
| 21 | 1.00259 | 1.00269 | 1.00271 | 1.00261 | 1.00271 | 1.00273 | 1.00263 | 1.00273 | 1.00275 |
| 21.5 | 1.00247 | 1.00262 | 1.00265 | 1.00249 | 1.00264 | 1.00267 | 1.00251 | 1.00266 | 1.00269 |
| 22 | 1.00233 | 1.00253 | 1.00260 | 1.00235 | 1.00255 | 1.00262 | 1.00237 | 1.00257 | 1.00264 |
| 22.5 | 1.00225 | 1.00250 | 1.00255 | 1.00227 | 1.00252 | 1.00257 | 1.00229 | 1.00254 | 1.00259 |
| 23 | 1.00214 | 1.00243 | 1.00250 | 1.00216 | 1.00245 | 1.00252 | 1.00218 | 1.00247 | 1.00254 |
| 23.5 | 1.00203 | 1.00238 | 1.00245 | 1.00205 | 1.00240 | 1.00247 | 1.00207 | 1.00242 | 1.00249 |
| 24 | 1.00192 | 1.00232 | 1.00240 | 1.00194 | 1.00234 | 1.00243 | 1.00196 | 1.00236 | 1.00245 |
| 24.5 | 1.00182 | 1.00227 | 1.00236 | 1.00184 | 1.00229 | 1.00238 | 1.00186 | 1.00231 | 1.00240 |
| 25 | 1.00172 | 1.00222 | 1.00232 | 1.00174 | 1.00224 | 1.00234 | 1.00176 | 1.00226 | 1.00234 |

**Note:**
Tables based on other atmospheric pressure ranges are available on request.

# Test Record for Volumetric Instruments

## 1. Volumetric instrument, Class A/AS, DE-M marking

Serial No: _____

Trademark:
- ❑ BLAUBRAND®
- ❑ BLAUBRAND® USP
- ❑ BLAUBRAND® ETERNA
- ❑ BLAUBRAND® amber glass
- ❑ _____

Calibration: ❑ 'In' (to contain) ❑ 'Ex' (to deliver)

Type of instrument: _____

Nominal capacity: Subdivision _____ ml

Error limits: ± _____ ml

Material:
- ❑ AR-GLAS®
- ❑ Boro 3.3
- ❑ PFA
- ❑ _____

Customer-specific markings:l _____

## 2. Damages:

❑ None

❑ Type of damage_____

_____

## 3. Testing conditions:

Testing temperature: _____ °C

atmospheric pressure range: ❑ lower ❑ medium ❑ upper

Balance: _____ Instrument No. _____

Thermometer: _____ Instrument No. _____

## 4. Calculation:

$V_{20} = (W_2 - W_1) \cdot Z$

## 5. Evaluation:

| Weighing values | Value $W_2$ [g] | Value $W_1$ [g] | Factor "Z" [ml/g] | Volume $V_{20}$ [ml] |
|---|---|---|---|---|
| $X_1$ | | | | |
| $X_2$ | | | | |
| $X_3$ | | | | |
| | | | **Mean value:** | |

❑ **Test passed** (within error limits)

❑ **Test <u>not</u> passed** (not within error limits)

_____ _____

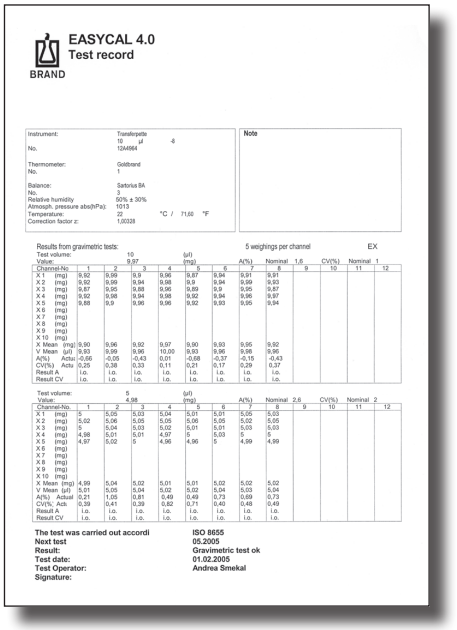
**Date** **Tester**

Cut out and copy!

# 7. EASYCAL™ Software – advanced calibration technology

## 7.1 For liquid handling instruments and glass or plastic volumetric instruments

EASYCAL™ simplifies the tedious task of calibrating liquid handling instruments and glass or plastic volumetric instruments to DIN EN ISO 9001, DIN EN ISO 10012, DIN EN ISO/IEC 17025 and GLP standards. The procedures are outlined step-by-step, and all calculations are performed automatically. Reports are generated to document the calibration. All you need is an analytical balance, a PC Windows® 98/2000/NT (SP6)/XP/ME, Vista, 7, printer (optional) and EASYCAL™ software.



EASYCAL 4.0
Test record

BRAND

| | | | |
|---|---|---|---|
| Instrument: | Transferpette | | |
| | 10 | µl | -8 |
| No. | 1244984 | | |
| Thermometer: | Goldband | | |
| No. | 1 | | |
| Balance: | Sartorius BA | | |
| No. | 3 | | |
| Relative humidity | 50% ± 30% | | |
| Atmosph. pressure abs(hPa): | 1013 | | |
| Temperature: | 22 | °C / 71,60 | °F |
| Correction factor z: | 1,00328 | | |

Note

Results from gravimetric tests: 5 weighings per channel EX

Test volume: 10 (µl)
Value: 9,97 (mg)

| Channel-No. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | A(%) | Nominal | 1,6 | CV(%) | Nominal | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X 1 | (mg) | 9,92 | 9,99 | 9,9 | 9,96 | 9,87 | 9,94 | 9,91 | 9,91 | | | | | | | | | | |
| X 2 | (mg) | 9,92 | 9,99 | 9,94 | 9,98 | 9,9 | 9,94 | 9,99 | 9,93 | | | | | | | | | | |
| X 3 | (mg) | 9,87 | 9,95 | 9,88 | 9,96 | 9,89 | 9,9 | 9,95 | 9,87 | | | | | | | | | | |
| X 4 | (mg) | 9,92 | 9,98 | 9,94 | 9,98 | 9,92 | 9,94 | 9,96 | 9,97 | | | | | | | | | | |
| X 5 | (mg) | 9,89 | 9,9 | 9,99 | 9,96 | 9,92 | 9,93 | 9,95 | 9,94 | | | | | | | | | | |
| X 6 | (mg) | | | | | | | | | | | | | | | | | | |
| X 7 | (mg) | | | | | | | | | | | | | | | | | | |
| X 8 | (mg) | | | | | | | | | | | | | | | | | | |
| X 9 | (mg) | | | | | | | | | | | | | | | | | | |
| X 10 | (mg) | | | | | | | | | | | | | | | | | | |
| X Mean | (mg) | 9,90 | 9,96 | 9,92 | 9,97 | 9,90 | 9,93 | 9,95 | 9,92 | | | | | | | | | | |
| V Mean | (µl) | 9,93 | 9,99 | 9,96 | 10,00 | 9,93 | 9,96 | 9,98 | 9,96 | | | | | | | | | | |
| A(%) | Actu | -0,65 | -0,05 | -0,43 | 0,01 | -0,68 | -0,37 | -0,15 | -0,43 | | | | | | | | | | |
| CV(%) | Actu | 0,25 | 0,38 | 0,33 | 0,11 | 0,21 | 0,17 | 0,29 | 0,37 | | | | | | | | | | |
| Result A | | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | | | | | | | | | | |
| Result CV | | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | | | | | | | | | | |

Test volume: 5 (µl)
Value: 4,98 (mg)

| Channel-No. | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | A(%) | Nominal | 2,6 | CV(%) | Nominal | 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| X 1 | (mg) | 5 | 5,05 | 5,03 | 5,04 | 5,01 | 5,01 | 5,05 | 5,03 | | | | | | | | | | |
| X 2 | (mg) | 5,02 | 5,06 | 5,05 | 5,05 | 5,06 | 5,05 | 5,02 | 5,05 | | | | | | | | | | |
| X 3 | (mg) | 5 | 5,04 | 5,03 | 5,02 | 5,01 | 5,01 | 5,03 | 5,03 | | | | | | | | | | |
| X 4 | (mg) | 4,98 | 5,01 | 5,01 | 4,97 | 5 | 5,03 | 5 | 5 | | | | | | | | | | |
| X 5 | (mg) | 4,97 | 5,02 | 5 | 4,96 | 4,96 | 5 | 4,99 | 4,99 | | | | | | | | | | |
| X 6 | (mg) | | | | | | | | | | | | | | | | | | |
| X 7 | (mg) | | | | | | | | | | | | | | | | | | |
| X 8 | (mg) | | | | | | | | | | | | | | | | | | |
| X 9 | (mg) | | | | | | | | | | | | | | | | | | |
| X 10 | (mg) | | | | | | | | | | | | | | | | | | |
| X Mean | (mg) | 4,99 | 5,04 | 5,02 | 5,01 | 5,01 | 5,02 | 5,02 | 5,02 | | | | | | | | | | |
| V Mean | (µl) | 5,01 | 5,05 | 5,04 | 5,02 | 5,02 | 5,04 | 5,03 | 5,04 | | | | | | | | | | |
| A(%) | Actual | 0,21 | 1,05 | 0,81 | 0,49 | 0,49 | 0,73 | 0,69 | 0,73 | | | | | | | | | | |
| CV(%) | Act. | 0,39 | 0,41 | 0,39 | 0,62 | 0,71 | 0,40 | 0,48 | 0,49 | | | | | | | | | | |
| Result A | | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | | | | | | | | | | |
| Result CV | | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | i.o. | | | | | | | | | | |

**The test was carried out accordi** ISO 8655
**Next test** 05.2005
**Result:** Gravimetric test ok
**Test date:** 01.02.2005
**Test Operator:** Andrea Smekal
**Signature:**

- Suitable for instruments from all manufacturers.
- Specifications of many instruments preloaded.
- Testing according to DIN EN ISO 4787, DIN EN ISO 8655, etc.

## 7.2 Data Entry

- Connect PC and balance (optional), then start the EASYCAL™ software.
- 100 common balances are preprogrammed for ease of installation.

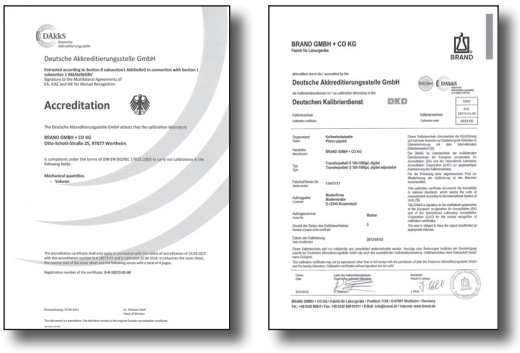
## 7.3 Documentation – clearly arranged

The calibration certificate contains all important test data on one page.

# 8. DAkkS-Calibration Service for Volumetric Instruments at BRAND

## 8.1 DAkkS – Deutsche Akkreditierungsstelle GmbH and DKD

The German Calibration Service (DKD) was founded in 1977 as a joint task of state and economy and constitutes the link between the measuring equipment in industrial and research laboratories, testing institutions and authorities and the national standards of the PTB (the German Institute of Physics and Metrology). It effectively supplements the existing verification system which serves above all the purposes of consumer protection. Based on the legal requirements the DKD Accreditation was successively transformed to the DAkkS Accreditation (Deutsche Akkreditierungsstelle GmbH), starting from 2010. BRAND has been accredited by the DAkkS since Apr. 23, 2013, with the certificate number D-K-18572-01-00.




## 8.2 DAkkS-Calibration Certificate and Calibration Symbol

The DAkkS-Calibration Certificate documents officially on a high level the traceability of measuring results to national and international standards and to international SI-units, as required by standards as DIN EN ISO 9001 and DIN EN ISO/IEC 17025 for monitoring of measuring devices.

DAkkS-Calibration Certificates are issued when calibrations of an accredited laboratory are requested, when high level calibrations are necessary, when national and international standards are demanded and when reference instruments have to be calibrated.

## 8.3 DAkkS – A member in the International Accreditation Network

DAkkS is a member of the **International Laboratory Accreditation Cooperation (ILAC),** the highest level international institution for laboratory calibration, and is a signatory to the MRA – Mutual Recognition Agreements.

The accreditation bodies that are signatories to the ILAC mutual recognition agreements (MRAs) recognize their mutual equivalence, and the equivalence of the calibration certificates issued by those same signatories. Likewise, signatories are obliged generally to promote and recommend recognition of the calibration certificates of other signatories (excluding factory calibration certificates).

The DAkkS is a member of the EA (European Co-operation for Accreditation), which again is a member of the ILAC (International Laboratory Accreditation Cooperation). A multilateral agreement assures obligatory recognition of the DAkkS calibration certificate in a variety of countries.

## 8.4 DAkkS-Calibration Laboratory at BRAND

In 1998 a calibration laboratory for volumetric instruments at BRAND has been accredited by the German Calibration Service according to DIN EN ISO/ IEC 17 025. Our calibration laboratory is therefore authorized to issue DAkkS-Calibration Certificates (in several languages) for the volumetric instruments listed below. Furthermore we offer adjustment and – for BRAND Liquid Handling instruments – repair and maintenance.

For ordering information on DAkkS-Calibration Certificates for volumetric instruments please consult our General Catalog.

## 8.5 Volumetric instruments for which BRAND issues DAkkS Calibration Certificates

BRAND calibrates the following volumetric instruments (new or already in use and regardless of their make):

- **Piston-operated pipettes,** from 0.1 µl to 10 ml
- **Multichannel piston-operated pipettes,** from 0.1 µl to 300 µl
- **Piston-operated burettes,** from 5 µl to 200 ml
- **Dispensers, Dilutors,** from 5 µl to 200 ml
- **Volumetric instruments of glass,** calibrated to contain (TC, In) from 1 µl to 10000 ml
- **Volumetric instruments of glass,** calibrated to deliver (TD, Ex) from 100 µl to 100 ml
- **Volumetric instruments of plastic,** calibrated to contain (TC, In) from 1 ml to 2000 ml
- **Volumetric instruments of plastic,** calibrated to deliver (TD, Ex) from 1 ml to 100 ml
- **Density bottles of glass,** from 1 $cm^3$ to 100 $cm^3$

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