

**FUNKE  
GERBER**

Laboratory catalogue ■ for milk analysis



## Laboratory catalogue

for milk analysis



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Dear ladies and gentlemen,

This jubilee catalogue has been published to mark the 100th anniversary of our company's existence. In this catalogue, we have dispensed with the usual company chronicle; instead we would refer to our jubilee script "Funke-Gerber from 1904 to 2004", which was brought out in April, 2004. We have included a number of new items in our product range. Our newly developed milk analysis appliances "CRYOSTARautomatic", "Lactostar" and "Lactostarmini" particularly deserve attention.

Our standard manufacturing program embraces the entire range of analytical milk chemistry. But if you have any special requirements which go beyond our product range, please do not hesitate to approach us with your respective enquiries. We will promptly respond by submitting an attractive proposal.

We look forward to being of service to you!

A handwritten signature in blue ink, appearing to read "K. Schaefer". The signature is fluid and cursive.

*K. Schaefer, graduate engineer and Managing Director*

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## Tradition, Progress, Continuity

**Funke-Dr.N.Gerber Labortechnik GmbH**  
**Partners in dairy farming since 1904**

Since 1904, Funke-Gerber has been an important player in dairy farming, both at home and abroad. The production of laboratory apparatus for the testing of milk and foodstuffs is among its crowning achievements.

The manufacture of centrifuges together with butyrometers and other appliances for fat determination according to Dr.N.Gerber continues to occupy a central place in the company's business activity. Over and above this classical field, the company develops and produces the most modern electronic devices for milk analysis.

"CryoStar" appliances for freezing-point determination are highly regarded on account of their precision and reliability and have been in use in many dairies and institutes for years.

A new era in routine laboratory analysis has been opened by the new "LactoStar" and "LactoStarmini" appliances. The application of know-how and continuous further development make Funke-Gerber an important player in dairy farming.



Decades of trusting co-operation have given our company the necessary global presence to ensure the provision of products to customers, in association with the numerous business partners who represent Funke-Gerber in their countries.

Since 1904, the name Funke-Gerber has been a byword for quality, reliability and continuity.

### Products:

The company develops, manufactures and markets the following equipment worldwide:

- All equipment and accessories for "Fat determination according to Gerber": centrifuges, water baths, reading lamps and butyrometers.
- The "CryoStar" freezing point determination unit.
- The "LactoStar" analyzer for milk constituents.
- Colony counters, dirt samplers.
- General laboratory equipment.



### Activities:

Turnkey installation or the design of complete laboratories in the following specialist fields:

- The milk-processing industry
- Dairies, milk-collecting centres
- Cheese dairies, butter works, ice-cream, condensed milk and powdered milk factories.

### Company profile

Founded: 1904

Managing director: Dipl.-Ing. Konrad Schaefer

Authorised signatory: Dipl. oec Georg Hoernle

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**Milk sampler**

of nickel-plated brass, with valve for automatic drainage

3000 1 ml

3001 2 ml

3003 5 ml

3004 10 ml

3007 20 ml

3008 40 ml

3010 50 ml

3011 100 ml

**Milk stirrer**

stainless steel, perforated disk,  
Ø 160 mm, 750 mm long

3021

**Dipper**

handle ca. 50 cm long

3030 125 ml aluminium with spout

3031 250 ml aluminium with spout

**Scoop**

3033 130 ml stainless steel, 300 mm long

3034 250 ml stainless steel, 400 mm long

3035 450 ml stainless steel, 400 mm long

**Milk sample bottle**

60 ml, PE without metal bottom (for rubber stopper, see 3050)

3040



**Milk sample bottle**

50 ml, PE without metal bottom (see for 3510, 3250)

3041

---

3042 Rubber stopper

---

**Rubber stopper**

for 3040

3050

---

**Cleaning brush**

for 3040, 3041

3080

---

**Wire cradle**

of plastic-coated wire, for 50 bottles, each 50/60 ml  
for 3040/3041

3091

---

**Cheese trier**

chrome-nickel steel, with plastic handle

3120 110 x 9 x 13 mm

---

3121 125 x 14 x 19 mm

---

3122 140 x 17 x 21 mm

---

**Low-cost cheese trier**

120 x 11 x 14 mm, with metal handle

3124

---



---

**Milk-powder collector**

nickel-plated brass, approx. 28 x 385 mm, ca. 230 ml

3125

---

**Butter trier**

of chrome-nickel steel, with metal handle

3130 240 mm bore length

---

3131 300 mm bore length

---



---

**Laboratory blender**

with two speeds and 1–60 sec. timer, 230 V/50 Hz

3135 with 1.2 l glass container

---

3136 with 1 l stainless steel container

---

**BagMixer 400**

capacity: 80–400 ml, 220/50 Hz,  
40 x 22 x 24 cm

3140

---

**Disposable plastic bags**

3141 400 ml, sterile for 3140

---

3142 Filter bags, 400 ml, sterile

---

3143 Bag clasps

---

3144 Stand for 12 bags

---

## Butyrometric Determination of the Fat Content in Milk according to Gerber

Dipl.-Chem. Alfred Toepel

The butyrometric determination of the fat content in milk (the Gerber method) was developed in 1892 by Dr.N.Gerber and was incorporated in official regulations as a sulphuric acid process in 1935. The rapid method of testing appears both in German standards (e.g. DIN 10310) and international standards (e.g. ISO 2446 or IDF 105).

The butyrometric determination of the fat content in milk according to Gerber is a quick method of testing and is still used today despite the introduction of automated methods of determining the fat content of milk in rapid- test dairy laboratories. The advantages of the Gerber method over the modern quick-test methods are:

- Removal of the need for time-consuming calibration of the measuring gauge;
- Relatively low investment costs and hence low costs in performing quick tests on individual samples;
- It can be used for all types of milk.

The disadvantages are in the use of the very corrosive, concentrated sulphuric acid, which make it necessary to observe special precautions, and the need to later dispose of the sulphuric acid mixture in an environmentally suitable way.

### The principles of the method

The method involves running off the fat into a special measuring vessel separate from the butyrometer and determining its volume as a percentage by mass. The fat is present in the milk in the form of small globules of various diameters, from 0.1 to 10 micrometers. The globules of fat form a consistent emulsion with the milk liquid. The globules of fat are surrounded by a protective coating, the fat globule membrane of phosphoglycerides, a fat globule coat protein and hydrate water. This protein coating around the fat globules prevents them from coalescing and stabilizes the emulsified state.

In order to separate off the fat completely, the protective coating around the fat globules must be destroyed. This is done with concentrated sulphuric acid of 90 to 91 % by mass. The sulphuric acid oxidizes and hydrolyzes the organic components in the protective sheath around the fat globules, the lactoprotein fractions and the lactose. This produces a large heat of reaction, in addition to the heat of dilution. The butyrometer gets quite hot. The oxidation products turn the resulting solution

brown. The released fat is then separated off by centrifuging, whereby the addition of amyl alcohol facilitates easier phase separation and a sharp delineation is produced between the fat and the acid solution. The fat content of the milk can be read off as a mass percent content on the scale of the butyrometer.

### Application

The process can be used for untreated milk as well as pasteurized milk with a fat content of 0-16 %, for milk that contains a suitable preservative as well as for homogenized milk.

### The chemicals needed

Sulphuric acid, H<sub>2</sub>SO<sub>4</sub>

Requirements:

A density of (1.818 ± 0.003) g. per ml<sup>-1</sup> at 20 °C

colourless or only slightly discoloured and free from any substances which might influence the outcome.

Hazard symbol



Hazard rating

C<sub>2</sub> R 35

S 2 - 26 - 30

Please note:

The required density corresponds to 90 to 91 % by mass. Stronger or weaker concentrations are to be avoided. At 65 °C, more highly concentrated sulphuric acid attacks the amyl alcohol, causing dehydration with the formation of olefines which influence the result. Weaker concentrations reduce the oxidation effect. Destruction of the fat globule sheath is incomplete and this can lead to the formation of lumps.

Amyl alcohol for the determination of fat content according to *Gerber*

An isomer mixture of 2-methylbutane-1-ol and 3-methylbutane-1-ol

Requirements:

Density at 20 °C – (0.811 ± 0.003) g. per ml<sup>-1</sup>

Boiling range: 98 % (by volume) has to distil over at a temperature of between 128 °C and 132 °C at 1 bar.

The amyl alcohol must not contain any substances which could influence the result.

A substitute can be used instead of amyl alcohol, provided that it will bring about the same test result as would be achieved using amyl alcohol.

**Note:**

The isomers of amyl alcohol have different boiling points: 2-methylbutane-1-ol at 128 °C and 3-methylbutane-1-ol at 132 °C.

Of the 8 known isomers of amyl alcohol, only this mixture is suitable for the Gerber method.

Contamination with the other isomers of amyl alcohol, particularly with tertiary amyl alcohol 2-methylbutane-2-ol, produces false results. The fat content result obtained is too high.

Hazard symbol                      Hazard rating



Xn R 10-20  
S 24/25  
VbF A II

**Required apparatus:**

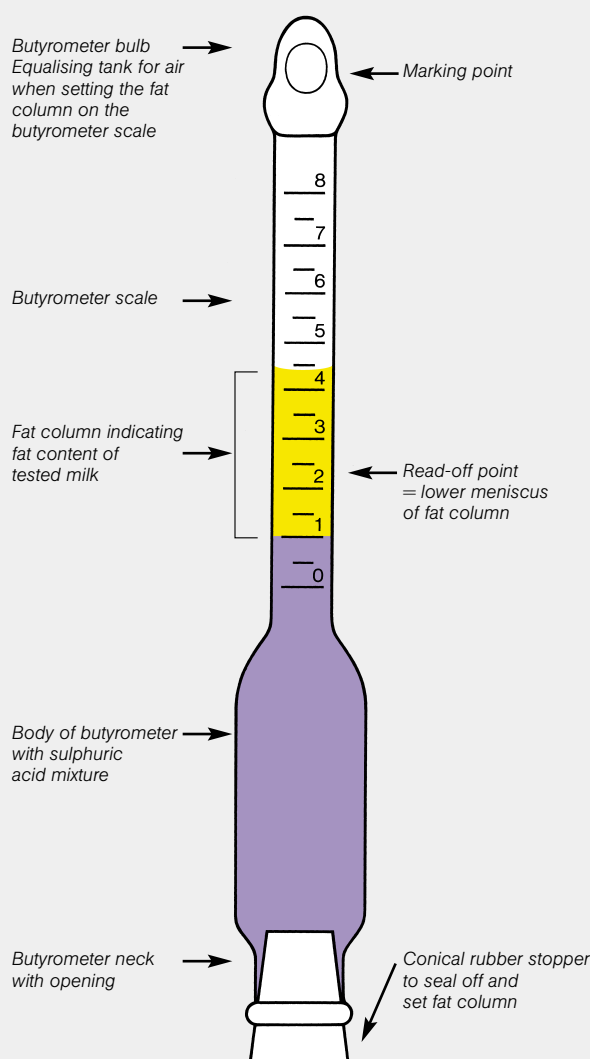
1. Calibrated butyrometer with suitable stopper in accordance with DIN 12836-A 4, DIN 12836-A 6, DIN 12836-A 8 and DIN 12836-A 5.
2. Pipette DIN 10283-p for milk, or pipette DIN 12837-A for milk.
3. Pipette DIN 12737-B or 10 ml measuring tap for sulphuric acid (Fig. 3).
4. Pipette DIN 12837-C or measuring tap with 1 ml calibrations for amyl alcohol.
5. Centrifuge for determining fat content, heatable, with rpm counter. When used under full load, this centrifuge must be capable of producing a centrifugal force of  $(350 \pm 50) g$  on the inside of the butyrometer stopper within 2 minutes at the most. With a rotation radius of e.g.  $(26 \pm 0.5) cm$  up to the inside of the butyrometer stopper, which is the distance between the point of torque and the butyrometer stopper, this centrifugal acceleration is reached at a rotor speed of  $(1100 \pm 80) min^{-1}$ .
6. Tempering device for butyrometers, e.g. a water bath  $(65 \pm 2) ^\circ C$   
With a heated centrifuge, a centrifuge bushing can be used to attach the butyrometer in the water bath. The read-off temperature must be  $(65 \pm 2) ^\circ C$ .

**Preparation of the test specimen**

The milk in the specimen bottle is heated up to 20 °C and thoroughly mixed by giving it a careful shake. This

is to bring about an even distribution of fat and to prevent frothing and any tendency of the milk to form butter.

*Milk fat is lighter than water and creams if allowed to stand. A layer rich in fat accumulates on the surface. Stirring and careful shaking restore the original distribution.*



*Butyrometer in compliance with DIN 12836 for determining fat content according to Gerber*

If the layer of cream cannot be evenly distributed in this way, the milk should be slowly heated to 35–40 °C and gently swirled around until a homogeneous fat distribution is achieved. The milk is then cooled to 20 °C before being drawn up into a pipette.

*Foam breaks open the coating of fat globules. The milk may begin to turn to butter when stirred and uniform distribution of the fat is then no longer possible.*

*The fat liquefies at 35–40 °C and the process of distribution is speeded up.*

After the temperature has been set, the milk is allowed to stand for 3 or 4 minutes so as to allow any pockets of air to disperse.

*The volumeters are calibrated at 20 °C. Any variations in temperature will influence the volume. Air pockets reduce the density and hence also the mass of milk measured.*

**Conducting a test = work procedures**

The same milk specimen must be tested twice.

1. Place two butyrometers in a clamp (butyrometer stand). With the aid of the measuring tap, introduce 10 ml of sulphuric acid into the butyrometer, without wetting the neck of the butyrometer (see Fig. 1).



Fig. 1  
*Protective goggles and rubber gloves must be worn when handling sulphuric acid*

2. Carefully turn the bottle with the specimen of milk upside down three or four times and then immediately pipette 10.75 ml of milk into the butyrometer so that the milk does not come into contact with its neck and so that the milk is not allowed to mix with the sulphuric acid. This is done by leaning the tip of the butyrometer laterally as deeply as possible on the wall of the butyrometer so that the milk forms a layer on top of the sulphuric acid. (Fig. 2)



Fig. 2  
*10.75 ml of milk are pipetted into the butyrometer*

*When the Gerber method was first introduced, 11 ml of milk were used. By reducing the quantity of milk to 10.75 ml, the determined fat content agrees more closely with the results of the reference method. If the neck of the butyrometer is wetted with milk, residues may cling to it.*

*A clear dividing line between the acid and the milk, without a brownish-coloured edge, is the sign of good layering.*

3. 1 ml of amyl alcohol is pipetted on to the milk, or introduced by means of the measuring tap.

*Owing to the low density of amyl alcohol, the two liquids do not mix.*

4. The butyrometer is closed with the stopper without mixing the two liquids.

*As a rule, the lower end of the stopper comes into contact with the liquid.*

5. The butyrometer is placed in the butyrometer casing with the bulb downwards. Shake the butyrometer quite vigorously until the two liquids are completely mixed. Keep your thumb firmly pressed down on the butyrometer stopper. Turn the butyrometer up and down several times in order to enable the sulphuric acid that is still in the bulb to disperse. (Fig. 3)

When the liquids are mixed, a considerable amount of heat is given off. The gas built up in this way can cause the stopper to shoot out, or the butyrometer may even break. The butyrometer casing is intended merely as a safety precaution. Instead of using a butyrometer casing, the butyrometer can be wrapped in a cloth. Too lax shaking of the butyrometer or unnecessarily holding it in a slewed position inhibits quick mixing and therefore also the rapid oxidation of the whole of the liquid and can thus ruin the careful work done trying to get the layering right.



Fig. 3

The butyrometer in the casing is shaken. (Protective goggles and rubber gloves must be worn)

6. Immediately after the mixture has been shaken and turned upside down a few times, the butyrometers, still hot and with the stoppers pointing downwards, are placed in bushings inside the heated Gerber centrifuge, whereby the butyrometers must be placed exactly opposite one another. Beforehand, the stopper should be turned to set the column of fat at the height of the expected level of fat.

After setting the time on the centrifuge, the centrifuge is started. The corresponding speed of  $(1100 \pm 50)$  rpm, which is reached after 1 min. as a rule, should be maintained for 4 minutes after attaining a centrifugal force of  $(350 \pm 50)$  g.



Fig. 4

The centrifuge must be fitted with interlocking lid. After the time set for the centrifuge has been reached, the rotor brake is automatically applied.



Fig. 5

The butyrometers are brought to the exact reading temperature in a water bath

7. The butyrometers are now removed from the centrifuge, taking care not to tilt them, and are placed for 5 minutes with their stoppers downwards, in a water bath heated to 65 °C. (Fig. 5)

*It is important to maintain an exact temperature so as to obtain accurate results. Only a read-off at 65 °C will ensure an exact result. If the temperature is too low, the volume of the column of fat is reduced and a fat content reading that is too low will be indicated.*

8. After the butyrometer has been removed from the water bath, it should be held in a vertical position at a height where the meniscus of the column of fat is at eye level. With the help of the stopper, marks the demarcation line between the residual mixture and fat on a whole sub-division of the butyrometer scale and read off the height of the fat column at the lowest point of the meniscus. If the reading takes too much time, the butyrometer must be placed in the water bath again. (Fig. 6 and 7)



Fig. 6

*Measured values can be reliably and accurately read off with the aid of a safety reading lamp*

*A wrong reading caused by parallax may be the result if your eye and the meniscus are not at the same level.*

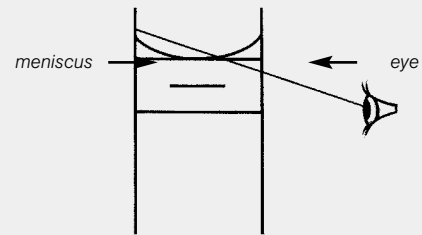


Fig. 7

### Result and degree of accuracy

The result should be read off to half a scale point, i.e. to 0.05%. It is not possible to obtain a more accurate result with whole milk butyrometers. If the meniscus touches the graduation mark, then the result is accepted as such (Fig. 7a). If the meniscus intersects the graduation mark, then the lower value is taken (Fig. 7b).

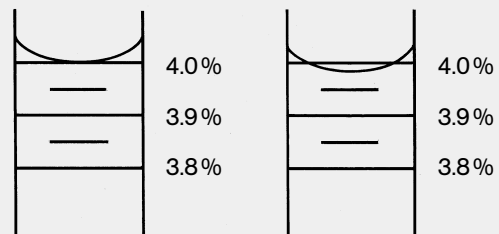


Fig. 7a a 4.0% reading

Fig. 7b a 3.95% reading

The difference between the readings from both butyrometers must not be greater than 0.10%, i.e. the reproducibility amounts to 0.10%.

When recording the result you must add the note "Fat content according to Gerber". If the two specimens differ by 0.1%, then the mean value of both readings is taken.

Specimen 1: 4.20 %

Specimen 2: 4.30 %

Correct result: 4.25 % fat content

However, if the two readings are 4.20% and 4.25% fat, then the lower value 4.20% is taken – on the principle that it is better to err on the side of caution.

### Determination of the fat content of homogenized milk according to Gerber

Treated milk is homogenized in order to prevent creaming. This involves reducing the globules of fat, which vary in size, to a fairly uniform diameter of 1–2 micrometers. However, in the centrifuging process, the separating effect is considerably lessened. Accordingly, the specimen have to be kept longer in the centrifuge in order to completely separate off the released fat.

Steps 1 to 8 are carried out similarly to the test for non-homogenized milk and the result is noted. Then the butyrometer is once again heated to 65 °C for at least 5 minutes in a water bath, and finally centrifuged for another 5 minutes. This result can then also be read off.

If the value obtained after centrifuging for a second time lies more than 0.05% above the value for the first centrifuging, then reheating and centrifuging have to be repeated two times at most. But if the value has increased by only 0.05% or less with respect to the first value, the highest value obtained in testing applies.

**Example:**

Readings of 3.55% and 3.60% were obtained after centrifuging for the first time and after centrifuging for a second time, they were 3.60% and 3.65%. The indicated value for the fat content of homogenized milk is therefore 3.65%.

If there is a greater difference than 0.05% after the last two repeats, i.e. after the third and fourth centrifuging, then this particular test result has to be discarded.



*Dipl.-Chem. Alfred Toepel has been a lecturer at the School of Dairy Farming in Halberstadt since 1960. He has been in charge of training at the MLUA institute in Oranienburg since 1992. He is also author of the technical instruction book "The Chemistry and Physics of Milk"*

## Butyrometric fat determination

**Special products: cream, ice-cream, cheese, etc.**

**Preface:** The butyrometric fat determination of milk has been and is being replaced to an increasing extent by other routine tests (with appliances such as LactoStar, for example, or infrared spectrometers). To be sure, dairy products such as cheese, ice-cream, etc. cannot be tested with such equipment, or can be tested only after the expensive preparation of samples. Butyrometric methods are a good alternative for routine analysis in the case of such products.

### 1.0 Field of application

The fat determination of milk and various milk products.

### 2.0 Volumina

Unless otherwise stated, the following quantities of chemicals and test samples are used:

Sulphuric acid:	10.0 ml (20°C + 2°C)
Amyl alcohol:	1.0 ml (20°C + 2°C)
Milk or milk product:	10.75 ml (20°C + 2°C)

## Condensed instructions for the butyrometric determination of fat:

### 3.1 ... in milk (according to Gerber):

Perfectly clean milk butyrometers, particularly free from fat residues, are filled in the following order: sulphuric acid, milk and amyl alcohol. The milk and amyl alcohol are filled in layer upon layer so they do not mix before shaking. After closing the butyrometer, the content is thoroughly mixed by shaking and turning the butyrometer upside down several times. Careful adjustment of the stopper ensures that the butyrometer scale is filled without any liquid entering the bulb. The butyrometer is then centrifuged in the heated centrifuge and placed for 5 minutes in the water bath preheated to 65°C. The parting line between the sulphuric acid mixture and the column of fat is set at a complete subdivision mark, and the upper end of the column of fat is read off at the lower meniscus.

### 3.2 ... in homogenized milk

As above, but centrifuge three times, each for 5 minutes. The butyrometers are heated for 5 minutes to 65°C in the water bath between centrifuging stages.

### 3.3 ... in skim milk and whey

Skim-milk butyrometers with a narrowed scale acc. to Sichler should be used.

Centrifuge twice and, between centrifuging, place the butyrometers in the water bath at 65°C for 5 minutes.

### 3.4 ... in condensed milk (sugar-free)

First heat the condensed milk to 50°C, allow to cool and then mix with water in a ratio of 1:1. This dilution is tested like milk, according to Gerber. The fat content = read value x 2.

### 3.5 ... in buttermilk (modification according to Mohr and Baur)

Pipette 10 ml of buttermilk instead of 10.75 ml, and 2.0 ml amyl alcohol. Shake the butyrometer after closing and centrifuge immediately. This prevents annoying blockages. The reading should be taken after centrifuging for the second time. The fat content = the read-off value x 1.075.

### 3.6 ... in powdered milk acc. to Teichert

Powdered milk butyrometers according to Teichert should be used.

The butyrometer is charged with 10 ml sulphuric acid. On to this, 7.5 ml water and 1 ml amyl alcohol are added, layer by layer. Weigh 2.5 g of powdered milk in a weighing boat and transfer to the butyrometer through a funnel, using a fine brush. Close the butyrometer and shake thoroughly, while placing it into the water bath at 65°C several times in between times. Centrifuge for 2 x 5 min. and read off the value after placing it into the water bath (for 5 min.).

### 3.7 ... in cream, acc. to Roeder (weighing method)

Use of the cream butyrometer according to Roeder.

5 g of cream are weighed in the glass beaker located in the stopper and introduced into the butyrometer. Run sulphuric acid through the upper opening of the butyrometer until it reaches the upper edge of the glass beaker. After closing the butyrometer, place it in a water bath at 70°C and shake it from time to time until the protein is completely dissolved. Sulphuric acid and a further 1 ml of amyl alcohol are added until the beginning of the scale is reached. Then the butyrometer is closed, shaken and placed for a further 5 minutes in the water bath at 70°C. Centrifuge for 5 minutes and temper in a water bath at 65°C. The reading is taken at 65°C, the column of fat is adjusted to the zero point and the value is read off at the lower meniscus.

**3.8 ... in cream acc. to Schulz-Kley (weighing method)**

Use of the cream butyrometer according to Schulz. Differential weighing of 10 ml sulphuric acid, 5 ml water and 5 g of cream is carried out using a syringe or weighing pipette attached to the balance, or cream weighed in a weighing pipette, and these are successively introduced into the butyrometer. 1 ml of amyl alcohol is added. After closing the butyrometer, its contents are mixed by shaking and turning it upside down. Centrifuge the butyrometer in a heated centrifuge for 5 min. and read off after tempering in a water bath at 65°C for 5 min. The read value is converted to 5 g of the weighed material or is corrected according to the cream correction table by Schulz. Do not allow more than 15 min. between overlaying with water and shaking owing to a possible reduction in the heat of reaction caused by the addition of water. The dissolution process must be completed within 60 sec.

**3.9 ... in cream acc. to Koehler (measuring method)**

Use of the cream butyrometer according to Koehler. First fill the cream butyrometer with 10 ml sulphuric acid ( $d^{1820}$ ), then 5 ml of cream, 5 ml of water and 1 ml of amyl alcohol. When using the cream syringe, rinse it with water several times before introducing the 5 ml of water. Then close the butyrometer, and shake and centrifuge for 5 minutes. Read off after a tempering time of 3 min. in a 65°C water bath. The value is read off from the zero point.

**3.10 ... in cheese acc. to van Gulk**

(please refer to ISO 3433)

Use of the cheese butyrometer according to van Gulk. Some 15 ml of sulphuric acid ( $d^{1.52}$ ) and 3 g of cheese are introduced into the van Gulk butyrometer, which must be closed at the scale end, by means of a weighing boat and a fine brush. The feed opening is then closed. Pasty cheese samples have to be weighed in a glass beaker that has van Gulk perforations and introduce into the butyrometer. The closed butyrometer is then placed in a water bath at 70–80°C. The scale must be upwards and shaking must be performed repeatedly until the cheese is completely dissolved. Then add 1 ml amyl alcohol through the scale opening and add sulphuric acid up to about the 15% mark on the scale. Then close the butyrometer, mix the contents, temper for 5 minutes in a 65°C water bath, centrifuge for 5 minutes, place again in the water bath at 65°C, adjust the fat column to the zero point and read off the absolute fat content. The reading is taken from the lower end of the meniscus.

**3.11 ... in ice-cream acc. to Koehler (measuring method)**

Use of the ice-cream butyrometer according to Koehler. Remove icing or other rough particles (e.g. fruit, etc.) if there are any. Mix the ice-cream thoroughly after it has reached room temperature. Air pockets must be removed almost completely by evacuation, if there are any.

Introduce the following into the ice-cream butyrometer: first, 10 ml of sulphuric acid ( $d^{1.820}$ ), then 5 ml of ice-cream, 5 ml of water and 1 ml amyl alcohol. If a cream syringe is used, rinse it several times before introducing the 5 ml of water. If the butyrometer is not sufficiently filled, add 2 ml of water. Close the butyrometer, shake and centrifuge for 5 minutes. Read off after tempering for 5 minutes in a water bath at 65°C.

**3.12 ... in ice-cream according to Roeder (weighing method)**

Use of the ice-cream butyrometer according to Roeder. Weigh in 5 g of thoroughly mixed ice-cream in the glass beaker located in the stopper and then run these into the butyrometer. Introduce sulphuric acid ( $d^{1.53}$ ) through the upper opening of the butyrometer up to the upper edge of the glass beaker. After closing the butyrometer, place it in a water bath at 70°C and shake it from time to time until the protein is dissolved. Add 1 ml of amyl alcohol and run in sulphuric acid up to the 10% mark. Close the butyrometer, shake it and place it for another 10 minutes in the water bath at 70°C. Shake repeatedly during this time. Then centrifuge (for 7 min!) and temper in a water bath at 65°C, adjust the column of fat to the zero point, and read off at the lower meniscus.

**3.13 ... in butter acc. to Roeder (weighing method)**

Use of the butter butyrometer according to Roeder. Weigh in 5 g of butter into the glass beaker located in the stopper and introduce into the butyrometer. Run in sulphuric acid through the opening of the butyrometer up to the upper edge of the glass beaker. After closing the butyrometer, shake it repeatedly until the protein is completely dissolved, and place it in a water bath at 70°C. Sulphuric acid and a further 1 ml of amyl alcohol are added until they top the upper edge of the glass beaker. After closing the butyrometer, shake it and place it in the water bath for a further 5 minutes. Then centrifuge for 5 minutes and temper in a water bath at 65°C (for about 5 min.). Finally, read off at 65°C, using the lower meniscus for the reading.

## The butyrometer

The basic implement used in the GERBER process is the butyrometer. The ORIGINAL FUNKE-GERBER butyrometers manufactured by us are regarded as reliable precision instruments all over the world. Since Dr. N. Gerber brought out the butyrometer named after him in 1892, we systematically improved on it until it assumed its current flat design. We now manufacture flat butyrometers and ensure they are subjected to very strict standards of quality control. The high accuracy of the scale setting and the body content guarantee accurate test results.

Funke-Gerber butyrometers are high-precision instruments with a flattened scale section and are manufac-

tured from acid-resistant glass in compliance with German and international standards (DIN, BS, IDF, ISO, etc.). Our experience of producing butyrometers goes back over 95 years and enables us to produce high-quality instruments at highly competitive prices. These butyrometers can be provided both for milk as well as for other milk products.

In Germany and in some other countries, butyrometers must be officially calibrated. They are then marked "(E) officially calibrated". Indeed, all other butyrometers are not officially calibrated, but are produced in exactly the same way and meet the same high standards of quality.

All butyrometers come in standard packs of 10.

So when placing your order, please set out your requirement in units of 10.

### Precision butyrometer

for drinking milk and vat milk, frosted wall behind scale,  
tolerance 0.025%

3150 0–4%: 0.05 (accessory: 3280)

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### Butyrometer for milk

3151 0–5%: 0.1 (accessory: 3280)

3152 0–6%: 0.1 (accessory: 3280)

3153 0–7%: 0.1 (accessory: 3280)

3154 0–8%: 0.1 (accessory: 3280)

3155 0–9%: 0.1 (accessory: 3280)

3156 0–10%: 0.1 (accessory: 3280)

3157 0–12%: 0.1 (accessory: 3280)

3158 0–16%: 0.2 (accessory: 3280)

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### Skim-milk butyrometer

according to *Sichler*, with round scale and open bulb

3160 0–1%: 0,01 (accessory: 3280 + 3290)

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### Skim-milk butyrometer

according to *Kehe*

3161 0–4%: 0,05 (accessory: 3280)

3162 0–5%: 0,05 (accessory: 3280)

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### Skim-milk butyrometer

according to *Siegfeld*

3164 0–0.5%: 0,02 (accessory: 3280)

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**Milk-powder butyrometer**

according to *Teichert*

3170 0–35%: 0.5 (accessory: 3310)

3171 0–70%: 1.0 (accessory: 3310)



**Butyrometer for ice-cream and condensed milk**

weighing method according to *Roeder*

3180 0–6–12%: 0.1 (accessory: 3290, 3300, 3320)

3181 0–15%: 0.2 (accessory: 3290, 3300, 3320)



**Cream butyrometer**

measuring method, for ice-cream

3189 0–15%: 0.2 (accessory: 3280)

3190 0–20%: 0.2 (accessory: 3280)



**Cream butyrometer**

weighing method according to *Roeder*

3200 0– 5–40%: 0.5 (accessory: 3290, 3300, 3320)

3201 0–30–55%: 0.5 (accessory: 3290, 3300, 3320)

3202 0–50–75%: 0.5 (accessory: 3290, 3300, 3320)

3203 0– 5–70%: 1.0 (accessory: 3290, 3300, 3320)



**Cream butyrometer**

weighing method according to *Schulz-Kley*, with closed bulb

3208 0–5–40%: 0.5 (accessory: 3280)

**Cream butyrometer**

measuring method according to *Köhler*

3210 0–40%: 0.5 (accessory: 3280)

3211 0–50%: 1.0 (accessory: 3280)

3212 0–60%: 1.0 (accessory: 3280)

3213 0–70%: 1.0 (accessory: 3280)

3214 0–80%: 1.0 (accessory: 3280)

**Butter-Butyrometer**

weighing method according to *Roeder*

3220 0–70–90%: 0.5, (accessory 3290, 3300, 3323)

**Cheese butyrometer**

weighing method according to *van Gulik*

3230 0–40%: 0.5, (accessory 3290, 3300, 3321)

**Curd butyrometer**

weighing method

3240 0–20%: 0.2 (accessory: 3290, 3330, 3321)

**Food butyrometer**

weighing method according to *Roeder*

3250 0–100%: 1.0 (accessory: 3290, 3330, 3320)

**Free-fat butyrometer**

for determining free fat in milk and cream,  
complete with screw cap, scale 0.002 g.

3252

**Babcock bottle**

0–8% for milk

3254

**Babcock bottle**

0–20% for cream

3256

**Babcock bottle**

0–60% for cream and cheese

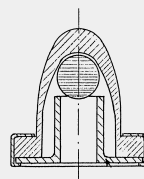
3258



**Patent closure FIBU**

for all measuring butyrometers  
(Illustration with adjusting key 3270)

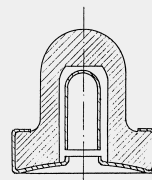
3260 FIBU without adjusting key



**Patent closure GERBAL**

for all measuring butyrometers

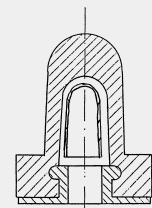
3261



**Patent closure NOVO**

for all measuring butyrometers

3262



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**Adjusting key**

for the FIBU patent closure

3270

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**Adjusting key**

for the GERBAL patent closure

3271

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**Adjusting key**

for the NOVO patent closure

3272

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**Rubber stopper, conical**

for all measuring butyrometers, 11 x 16 x 43 mm

3280

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**Rubber stopper**for sealing the bulbs of all types of  
weighing butyrometers, 9 x 13 x 20 mm3290

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**Rubber stopper, with hole**

for all weighing butyrometers, 17 x 22 x 30 mm

3300

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**Rubber stopper, without hole**

for milk-powder butyrometers, 17 x 22 x 30 mm

3310

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**Glass nail**

for milk-powder butyrometers

3315

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**Weighing beaker for cream, without holes**

for ice-cream and condensed milk butyrometers  
and cream butyrometers according to *Roeder*

	Overall length:	ca. 75 mm
	Outer diameter of body:	ca. 15 mm
3320	Outer diameter of stem:	ca. 5 mm

**Weighing boat for cheese, with holes**

for butyrometers according to *Van Gulik*

	Overall length:	ca. 75 mm
	Outer diameter of body:	ca. 15 mm
3321	Außendurchmesser Stiel:	ca. 5 mm

**Weighing boat for butter**

for butyrometers according to *Roeder*

	Overall length:	ca. 75 mm
	Outer diameter of body:	ca. 15 mm
3322	Outer diameter of stem:	ca. 5 mm

**Butter beaker with 2 holes**

	Overall length:	ca. 75 mm
	Outer diameter of body:	ca. 15 mm
3323	Outer diameter of stem:	ca. 5 mm

**Cleaning brush**

3324	for butyrometer body
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**Cleaning brush**

3325	for graduated stem of butyrometer
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**Butyrometer rack**

3330 (of PP), for 36 samples

3331 (of PP), for 12 samples

**Shaking rack**

3332 (of PP), for 12 samples

**Protective shaking hood**

3340 (of PP) for 36 samples

3341 (of PP) for 12 samples



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**Pour plate**

of plastic

3350 for 36 samples

3351 for 12 samples

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**Automatic dispenser, permanent**

with ground-in measuring chamber and stopper,  
one spout in accordance with DIN 10282

3390 10 ml sulphuric acid

3391 1 ml amyl alcohol

**Stand for permanent automatic dispenser**

consisting of positioning board, stem and retaining ring  
with sleeve

3400 10 ml for 1 permanent automatic dispenser

3401 1 ml for 1 permanent automatic dispenser

3402 10 + 1 ml for 2 permanent automatic dispensers



**Automatic tilt measure, Superior**

with rubber stopper and dispensing bottle, 500/250 ml



3420 10 ml sulphuric acid

3421 1 ml amyl alcohol

**Volumetric pipettes**

with one ring mark

3430 10 ml sulphuric acid

3431 10.75 ml milk

3432 11 ml milk

3433 1 ml amyl alcohol

3434 5.05 ml cream

3435 5 ml water

3436 5 ml cream

3437 50 ml short type

3438 25 ml short type

**Syringes**

nickel-plated brass

3440 10.75 ml milk

3441 10.75 ml milk rep. exch.

3442 5.05 ml cream

3443 5.05 ml cream, rep. exch.

3450 11 ml milk

3452 5 ml cream



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**Pipette stand**

PVC, for pipettes of various sizes



3460

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**Cleaning brush**

for pipettes

3470

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**Laboratory goggles**

3480

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**LactoStar**

Newly developed appliance for the routine testing of milk. Fat, protein, lactose, SNF, freezing point. Please see P.38 for a more detailed description.

3510 including accessories

Accessories:  
thermal printer, type 7151  
milk sample bottle, type 3041

Replacement part:  
3560-023 pump head



**LactoStar<sub>mini</sub>**

Newly developed appliance for routine milk analysis.

Fat, SNF, (fat-free dry mass).

For further details, see P. 38



3520

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**Shaking water bath**

stainless steel with cover, shaker rack and 18 sleeves.

**Technical data:**

PID controller with PT-100 temperature sensor

Settings: in 0,1 °C steps

Accuracy:  $\pm 0,1$  °C

Connection values: 230 V / 8,7 A / 2000 W

Volume: 22 l

Internal dimensions: 350 mm x 290 mm x 220 mm

External dimensions: 578 mm x 436 mm x 296 mm

Weight: Ca. 17 kg net.

3550

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## Protein and nitrogen determination according to Dumas

Analyzer for the nitrogen/protein and CN analysis of macro samples up to 1 g according to the Dumas method, which offers the following advantages:

### vario MACRO CN

- the analysis takes only a few minutes
- no corrosive acids or other chemical which harm the environment
- the use of just one calibration for the achievement of the highest degree of accuracy and precision for different substances over months and years
- easy requirements for installation and low costs per analysis

If required, it can be equipped for simultaneous sulphur analysis, in addition to N/protein and CN.

3580



### vario MAX CN

In comparison with the vario MACRO, sample handling is further simplified in particular for liquids by the utilisation of open and re-usable analysis vessels and the analysable sample quantity is yet greater.

It can likewise be equipped to measure sulphur.

3585



**Butyrometer buckets**

of pressure-cast light metal,  
Accessories for the SuperVario-N (3680)

3631 1 piece

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3631-12 set with 12 buckets

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3631-24 set with 24 buckets

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3631-36 set with 36 buckets

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**Babcock bucket**

Accessory for the SuperVario-N (3680) centrifuge

3632

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**Bucket for ADMI tubes**

Accessory for the SuperVario-N centrifuge (3680)

3633

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**Solubility index tube**

ADMI, 50 ml glass, graduated  
from 0 to 20 ml and mark at 50 ml,  
see SuperVario-N (3680)

3634

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**Stand**

for 6 (3634) buckets

3636

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**Special solubility index tube**

fit in butyrometer tubes for use in the "Nova Safety" bench  
centrifuge (3670)

3637

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**Centrifuge tube**

with 2 stoppers, according to *Friese*

3638

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**Replacement butyrometer tube**

for Nova Safety (3670) brass,  
with flanged edge,  
can also be used as a water-bath insert (3717)

3641

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**Nova Safety**

Reliable and tested bench centrifuge with angular rotor for fat  
determination according to Dr. N. Gerber.

**Properties:**

Automatic lid interlocking  
Automatic brake (braking time <8 sec.)  
Digital centrifugation timer  
Heating, thermostatically set at 65°C  
Filling capacity: max. 8 butyrometers

3670

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## Milk laboratory centrifuges

### Centrifuges for butyrometric fat determination according to Dr. N. Gerber

The following points should be observed when acquiring and operating a centrifuge for fat determination according to Dr. N. Gerber:

#### Quiet running

In order to avoid glass breakage and to increase the service life of the butyrometers, it is most important that the centrifuge runs with as little vibration as possible. A distinction is made between the following types of centrifuges:

#### Type 1: Centrifuge with flay-lying butyrometer

This way of mounting the butyrometers ensures they will be smoothly treated during centrifugation. However, after centrifuging, these centrifuges tend to give rise to a renewed intermixing of the separated phases after centrifugation.

#### Type 2: Centrifuge with angular rotor:

The angular rotor keeps the butyrometers at a fixed angle. Unfortunately, this position imposes considerable stresses on the long and thin neck of the butyrometer. This type of construction is mostly used in inexpensive small centrifuges.

#### Type 3: Centrifuge with swing-out centrifuge buckets

The flexibly mounted butyrometer buckets enable the butyrometers to swing out horizontally. The butyrometers are stressed solely along their longitudinal axis. For this reason, this type of centrifuge is to be preferred to the other types.

#### Unbalance

The centrifuge should be equipped with an automatic unbalance cut-out. The centrifuge will then automatically switch off in the case of glass breakage (e.g. breakage of a butyrometer) or if the centrifuge is out-of-balance for any other reason.

#### Cover interlocking

Increasingly and for reasons of safety, a cover interlock is stipulated in most European countries for all centrifuges.

#### Heating

The heating of a centrifuge prevents the cooling down of the butyrometers. This also enables the subsequent

tempering time in the water bath to be kept to a minimum and leads to a more reliable analysis. The temperature in the centrifuge bowl must amount to at least 50°C.

#### Rotor speed

The determination of fat according to Gerber specifies a **Relative Centrifugal Acceleration (RCA)** of 350 g with a maximum deviation of  $\pm 50$  g. The RCA does not depend only on the rotor speed, but also on the effective radius. The effective radius is defined as the distance between the centre point of the rotor and the outer end of the butyrometer. For this reason, the rotor speed for the different centrifuge types varies as a function of their respective radii. However, it is important that the rotor speed is constant or changes insignificantly (within the range of tolerance, see above), depending on whether the centrifuge is fully or only partly loaded. The RCA is calculated in the following way:

$$RCA = 1.12 \times 10^{-6} \times R \times N^2$$

$$N = \sqrt{\frac{RCA}{1.12 \times 10^{-6} \times R}}$$

whereby:

$R$  = the effective horizontal radius in mm;

$N$  = the rotor speed in rpm [ $min^{-1}$ ].

Example:

A centrifuge with an effective radius of 260 mm needs a rotor speed of 1100 rpm to be able to reach the specified RCA of 350 g.

#### Mounting

Place the centrifuge on a level and solid surface (e.g. a sturdy table or platform). Air humidity must be kept as low as possible and the ambient temperature should not exceed 30°C.

#### Routine operation/maintenance

The centrifuge should be charged so as to be as evenly balanced as possible, i.e. the butyrometers must be uniformly positioned. In the case of broken glass, the centrifuge must be cleaned immediately after it has stopped. This prevents unnecessary corrosion and ensures a long service life.

Dipl.-Ing. K. Schäfer

# SuperVario-N

## Multi-purpose centrifuge for the dairy industry

This centrifuge is known for its extremely quiet running. Largely free of vibration, the centrifuge employs swing-out butyrometers which all in all favourably effect butyrometer operating time. This ensures correspondingly good results in terms of repeatability and comparability. For these reasons, the SuperVario-N is often used as a pilot centrifuge for calibration purposes.

On account of its flexibility (programmable rotor speed, temperature and running time), the SuperVario-N can be used to perform the following tests:

Type of test	Rotor speed/RCA
1. Gerber fat determination	1,100 / 350 g
2. Babcock-fat determination	750 / 165 g
3. Solubility determination (ADMI)	900 / 172 g
4. Fat determination acc. to Roese-Gottlieb*	600 / 77 g

\* Operation possible only when complying with the respective safety regulations

### Characteristics:

- Stainless steel housing
- Programmable rotor speed from 600 rpm to 1130 rpm in steps of 10 rpm  
(corresponding to a g-value of 77 to 372 g)
- Programmable heating up to 68°C in 1°C steps
- Automatic centrifugation time from 1 to 99 minutes
- Automatic safety interlocking of the cover
- Automatic shut down if out-of-balance
- Automatic brake

### Technical data:

Connected load:	230 V/50 ... 60 Hz/1200 VA
Weight, empty:	26 kg
Total height, inc. cover:	460 mm
Filling height:	370 mm
Rotor speed range:	600 to 1130 rpm**
Temperature range:	ambient temperature up to 68°C

\*\* The fat determination acc. to Gerber specifies a g-value of 350 g ± 50 g. The SuperVario-N complies with the standard specifications in an exemplary manner, having a **Relative Centrifugal Acceleration (RCA)** of 371 g when running on no load, and 323 g when fully loaded.



## Safe centrifuge for fat determination

3680-L according to Roese-Gottlieb

### SuperVario-N

Multi-purpose centrifuge for all butyrometers.  
For a detailed description, see page 33



3680

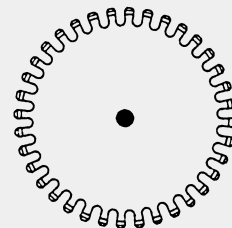
## Accessories for the SuperVario-N

### Head A

Centrifugal head for 36 butyrometers  
or 18 Babcock bottles

3685

Butyrometer hanger: Type No. 3631, page 30  
Butyrometer hanger: Type No. 3632, page 30

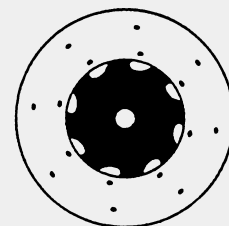


### Head B

Centrifuge head (protection vessel)  
for max. 8 Mojonnier tubes

3686

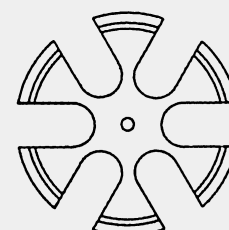
Mojonnier tubes: Type No. 3870, 3871, page 37



### Head C

3687 Centrifuge head C for max. 6 solubility buckets

Holder for solubility index tube: Type No. 3633, page 30  
Solubility index tube (ADMI glass): Type No. 3634, page 30



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**The WB 436-D universal water bath (digital)**

Digital temperature display (actual value), digital nominal temperature control, PT 100 sensor (platinum sensor), stop watch (1 to 99 min., with acoustic signal).

**Specification for WB 436-D**

Stainless steel inner and outer casing.  
External heating – no troublesome heating elements.  
Protection against overheating (even when the vessel is empty). Operation with distilled water is possible.

**Technical data:**

Temperature range: up to 100°C  
Connected load: 230 V/50 Hz ... 60 Hz/1000 W  
Dimensions: 396 mm x 331 mm x 265 mm (L x B x D)  
Volume: ca. 16 l  
Weight: 10 kg

3707 without butyrometer rack (3717)

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**The WB 436-A universal water bath (analogue)**

As item 3707, but with analogue temperature adjustment (turning knob), temperature display with thermometer (included in the scope of delivery), thermostatic heat controller.

**Specification for WB 436-A**

Stainless steel inner and outer casings. External heating – no troublesome heating elements. Protection against overheating (even when the vessel is empty). Operation with distilled water is possible.

**Technical data:**

Temperature range: up to 100°C  
Connected load: 230 V/50 Hz ... 60 Hz/1000 W  
Dimensions: 396 mm x 331 mm x 265 mm (L x B x D)  
Content: ca. 16 l  
Weight: 10 kg

3708 without butyrometer stand (3717)

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## Accessories for the WB 436 water bath

### Butyrometer stand for WB-436

3717 of stainless steel, for 36 butyrometers

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### Mojonnier stand

3718 of stainless steel, for 10 Mojonnier tubes

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### Universal shelf

3727 of stainless steel

---

### Reductase insert

3737 for 99 samples

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3747 **Reductase lid**

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3754 **“Delvotest” insert**

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### Butyrometer tubes, closed,

3766-G brass, for butyrometer stand (item No. 3717)

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### Butyrometer tubes, open,

3766-O brass. for butyrometer stand (item No. 3717)

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## Safety reading lamp

for the safe reading of butyrometers, with anti-glare illumination, lens with protective Plexiglass cover, adjustable height and lens distance, cord-operated switch, 230 V/50...60 Hz

3800

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**Shaking machine**

For the uniform, vigorous and reproducible mixing of the contents of 4 extraction tubes according to *Mojonnier*  
230 V/50 ... 60 Hz

3850 for 4 Mojonnier tubes

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3851 for 6 Mojonnier tubes

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**Extraction tube** with cork stopper

and round bulb

according to *Mojonnier*

3870

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**Extraction tube** with cork stopper

and flat-topped bulb

according to *Mojonnier*

3871

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**Wooden stand**

for 12 extraction tubes

3875

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# LactoStar/LactoStar<sub>mini</sub>

The new generation of appliances

The two new appliances, "LactoStar" and "LactoStar<sub>mini</sub>", supersede the previous milk analysis equipment that has been installed for years in countless laboratories at home and abroad. As a result, we shall be able to meet the demand for a simple, inexpensive device as well as the growing demands in milk analysis, e.g. for determination of protein, lactose, minerals and freezing points.

The measuring technology has been significantly improved in a number of ways with both appliances:

- Measuring cells have been optimised in order to avoid dirt contamination as well as to improve thermal characteristics.
- All of the electronic boards have been reworked using SMD technology.

The simple operation of the former devices, which was exemplary in their time, has been further improved: The appliances have been provided with a user-friendly 5-key operating system, instead of the 3-key one. Information is shown on an LCD graphics display. New: A complete documentation of the measured results is effected with the aid of an incorporated clock/calendar.

## Measurement principle:

**LactoStar und LactoStar<sub>mini</sub>** (item No. 3520)

The milk sample (12 ml to 20 ml, adjustable) is sucked into the measuring cell by means of a pump. Both the fat content as well as the fat-free dry mass are determined by using thermal measurement effects.

## LactoStar<sub>mini</sub> (Art.-Nr. 3250)

Device for determining the two most important constituents of milk:  
fat content/fat-free dry mass

Constituent	Measuring range	Reproducibility
Fat:	0.00% bis 35.00%	± 0.02%*
SNF: (fat-free dry milk)	0.00% bis 15.00%	± 0.04%

\* The reproducibility amounts to 0 to 8%, fat 0.02% in the higher measuring range, of 8 to 35% fat, the reproducibility amounts to ± 0.02%.

The measuring resolution amounts to 0.01%.

## Product types:

Twenty different types of products (e.g. milk from cows, unpasteurized milk, skim milk, sheep's milk, cream, etc.) can be calibrated and stored.

## Operation:

Operation is easy and clear because it is menu-assisted and employs 5 keys.

## Calibration:

Two-point calibration: The unit is calibrated with reference to two reference milks. Calibration takes place automatically.

## Technical data:

Connected loads:	230 V/180 VA 50–60 Hz 12 V DC
Sample throughput:	Up to 40 samples per hr.
PC connection:	serial interface, 9,600 Baud, the software is included in the scope of delivery
Printer:	parallel interface
Dimensions:	25 x 36 x 19 cm (W x L x D)
Weight:	ca. 8.5 kg

## LactoStar (item No. 3510)

**Milk analysis device with fully automatic cleansing/flushing and fully automatic zero-point calibration**

Protein, lactose and minerals are determined in addition with the aid of a second measuring cell that is equipped with a combined impedance/ turbidity sensory technology. The freezing point is computed on the basis of the measured values that are ascertained.

**The following milk constituents can be rapidly and reliably determined with this device:**

Constituent	Measuring range	Reproducibility
Fat:	0.00% bis 35.00%	± 0.02%
Protein:	0.00% bis 10.00%	± 0.03%
Lactose:	0.00% bis 10.00%	± 0.03%
SNF: (fat-free dry milk)	0.00% bis 15.00%	± 0.04%
Minerals/lead:	0.00% bis 5.00%	± 0.02%
Freezing point:	Computer value	± 0.002°C

\* The reproducibility amounts to 0 to 8%, with 0.02% fat. In the higher measuring range of 8 to 35% fat, the reproducibility amounted to ± 0.2%.

The measuring resolution amounts to 0.01%.

Comparability with the reference method depends on the respective calibration.

**Operation:**

Operation is simple and clear cut: 5-key operation, menu-assisted.

**Calibration:**

Two-point calibration: The device is calibrated with two reference milks. Calibration is effected automatically.

**Maintenance:**

Everyday maintenance work, such as cleaning, flushing and zero-point calibration are effected fully automatically. The timing of this maintenance work is selected by the operator, e.g. during night hours. Such a procedure lasts about 20 minutes.

**Appliance characteristics:****1. Products**

The LactoStar can store 20 different sets of calibration data. Various types of milk, e.g. full-cream milk, skim milk, cream, etc. can be analysed. You can change from one product to another without having to undertake a new calibration.

**2. Interfaces****2.1. Parallel interface**

The LactoStar has a parallel interface for connecting up a normal commercial printer. For example, a thermal recording printer can be connected up. The 6-V terminal for this is located at the rear of the device.

**2.2. Serial interface**

A PC can be connected to the serial interface. In this case, the measured results can be recorded and can be provided with additional information (date, time of day, delivery vehicle, special delivery numbers, etc.) Data recorded in this way can afterwards be further processed in appropriate programs (e.g. for table calculation or company-owned software, etc.) Moreover, the calibration data can be stored or processed. It is also possible to transfer the calibration profile from one device to another one, or to read this from a device and then to store it.

**The software that is necessary for this is included in the scope of delivery.**

**Technical data:**

Connected loads: 230 V/180 VA 50–60 Hz  
12 V DC connection

Sample throughput: up to 40 samples per hr.

PC connection: serial interface, 9,600 Baud  
The software is included in the scope of delivery.

Printer: parallel interface

Dimensions: 44 x 44 x 20 cm (W x L x D)

Weight: ca. 15.5 kg



**Laboratory pH meter**

Electrodes are not included in the scope of delivery

**The Knick 766**

Easy-to-use measuring appliance for pH, mV and °C: adjustment and monitoring of the electrode, self-diagnostic, automatic temperature compensation, recorder output, calibrated data memory

4310

**The Knick 765** plus Rs 232 interface for computer and printer

4311



**Battery/pocket pH meter**

Electrodes are not included in the scope of delivery

**Knick 911**

highly developed measuring instrument for pH, mV and °C, which is protected against dust, water and impact, with mounting clips for use on a table: automatic calibration, identification of buffer solution and temperature compensation, self-diagnostic.

4315

4316 **Knick 912** plus data measurement storage

**Knick 913** plus data memory and interface for computer and printer

4317

4319 Pt 1000 temperature sensor for pH 911, 912 and 913



**Laboratory pH meter**

**inoLab pH 720**

Routine laboratory pH / mV meter with automatic temperature compensation, calibration system, battery and mains operated

4320

**inoLab pH 730**

precision pH / mV meter plus Rs 232 interface for computer and printer

4321



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## Pocket pH meters

### WTW 330

Robust and water-proof pH/mV meter with data memory, automatic calibration and automatic temperature compensation.

4330

### WTW 330-SET

Measuring instrument in smart case with integrated measuring set, holding clip, pH 4, pH 7 and pH 10 buffer solution and KCl solution, without electrode

4331

### WTW 340

Measuring instrument with additional RS 232 analogue and digital outlets

4334

Temperature sensor with clip

4335

for WTW 330 and 340



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## Combined electrode for milk

Inlab 408, suitable for milk and other liquids, fixed cable with DIN plug

4350

## Electrodes

Inlab 427 for puncture measurements

4360

with cable and DIN plug

4361

Inlab 427 without cable

SE 104 for insertion measurements in cheese, meat and sausage, fixed cable with DIN plug

4370

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## Combined electrode with temperature sensor

Combined SE102 electrode with integrated Pt 1000 temperature sensor, fixed cable with DIN plug

4380

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## Buffer solutions

in 250 ml PE bottles

4390

pH 4.00

4391

pH 7.00

4392

pH 9.00

**KCl solution**

250 ml in a PE bottle

4400 3 mol/l+AGCl

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**Electrode stand**

250 ml in a PE bottle

4420 AG-Cl-diaphragm cleaner, thiourea solution

4421 Protein solvent, pepsin-hydrochloric acid

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**Reactivation solution**

30 ml hydrofluoric acid in a PE bottle

4422

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**Acidity determination****STANDARD titration equipment**

Complete with storage bottle, rubber stopper, burette with automatic zero adjustment, sodalime tower with ascending tube, rubber pressure bulb, burette tip with pinchcock, one pipette each for 1 and 25 ml, a 200 ml Erlenmeyer flask.

4500 for milk: 0–25° SH

4501 for cream: 0–40° SH

for curd: 0–250° SH  
with porcelain pestle and mortar, 2 ml pipette  
(without 1 ml and 25 ml pipette, without Erlenmeyer

4510 flask)

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**Acidity determination****SIMPLEX titration apparatus**

for milk and cream, complete with a polyethylene bottle on a plastic base, burette with automatic zero-point adjustment, precision titration by button control, one pipette 1 ml and 25 ml, a 200 ml Erlenmeyer flask.



4520 for milk: 0–25° SH

4521 for cream: 0–40° SH

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**SIMPLEX titration apparatus**

for general titration purposes as above,  
but without accessories

4530 with burette 0–10 ml : 0.05

4540 with burette 0–25 ml : 0.1

4550 with burette 0–50 ml : 0.1

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**Protein titration apparatus**

with storage bottle, for use with 25 ml milk, special burette with automatic zero adjustment, soda-lime tower with ascending tube, rubber bulb, outlet tip, pinchcock, one transfer pipette 1 ml, 5 ml and 25 ml, 2 short beakers, 250 ml, 2 measuring pipettes 1 ml: 0.01

4660 0–6 ET: 0.02

**Rapid burette**

acc. to *Dr. Schilling*, Schellbach stripes, complete with storage bottle and base, with automatic zero- point calibration

4680 10 ml: 1/20

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4681 25 ml: 1/10

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4682 50 ml: 1/10

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**Acidity tester**

for determining the fresh state of unpasteurized milk.



4705

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**Salt tester for butter and cheese**

see item No. 4530 and No. 4540, but with brown storage bottle

4760 10 ml: 0.05 for butter

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4770 25 ml: 0.1 for cheese

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**SEDILAB sediment tester**

manual sediment tester for easy use, with clamp for tables, stainless steel, for 500 ml milk



4800

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**SEDILAB-E sediment tester**

for serial testing at reception speed, approx. 800 samples per hour, sharply defined sediment images, 220 V/50 Hz for 500 ml milk.

4810

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**ASPILAC sediment tester**

pump type for direct suction from milk can, Plexiglass casing for original filter papers, for 500 ml milk

4905

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**Filter papers**

4910 1000 pieces, with area for records

**Filters, round**

4911 32 mm, 1000 pieces

**Reference table**

4920 with 3 purity grades, German standard

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**Reductase test tubes**

with ring mark

5040 10 ml and 21 ml

5041 10 ml

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**Rubber stopper**

for reductase test tubes

5060

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**Pipetting syringes**

for determining nutrient and dye solutions,  
self-priming, can be sterilized

5110 adjustable to 1 ml

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5111 adjustable to 2 ml

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5112 adjustable to 5 ml (for 10 ml, see item No. 8170)

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**Methylene blue tablets**

5140 50 tablets

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**Resazurine tablets**

5150 for LOVIBOND comparator, 100 tablets

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**LOVIBOND comparator 2000**

for resazurine tests, housing for 2 test tubes for colour  
comparison with colour disk

5160

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**Colour disk**

5161 for resazurine 4/9 with 7 standard reference colours

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**Test tube**

5162 set of 4 tubes

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**Dry-matter calculator**

according to *Ackermann*, for milk

5360

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**Butter-melting beaker**

5400 aluminium, 30 g

5401 aluminium, 50 g

**Tongs**

5420



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**Glass stirrer**

pestle type, 140/6 mm

5430

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**Double-ended spatula**

pure nickel, 150 mm

5440

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**Butter test spoon**

of Plexiglas

5450



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**Crystal quartz sand**

washed and calcined

5460 1 kg

5461 3 kg

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**Aluminium foil**

150 x 190 mm, 1000 pieces

5470

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**Weighing dish**

aluminium, Ø 75 x 30 mm, with lid (numbered on request)

5490



**Bunsen burner**

for propane gas (other gas types on request)

5550

**Safety gas burner schütt flammy**

for natural gas or propane/butane, respectively

- ignition by foot switch or sensor
- stainless steel casing, flame-resistant
- very durable flame with automatic re-ignition
- discharge conduit for protection against spilt liquids
- short-term and continuous operation
- inclined position on request

**Technical data**

Dimensions (W x L x D):	93 x 90 x 160 mm
Weight:	ca. 1000 g
Connection voltage, mains unit:	230 V or 114 V AC, +/- 5%, 50-60 Hz
Schuett flammy connection voltage:	12 V / DC, 5 VA
Operating pressure for natural gas:	18-25 mbar
Operating pressure for propane/butane:	47.5-50 mbar
Nominal heat load, natural gas:	1000 W
Nominal heat load, propane/butane gas:	1300 W
Filling quantity, gas cartridges:	- CV 360: 52 g butane gas - C 206: 190 g butane gas

5551 schuett flammy S with foot switch and mains unit, 230 V

5552 schuett flammy L with sensor and mains unit, 230 V



**Infrared burner, up to 750 °C**

suitable for fast, contact-free heating  
(0.9 kg – 100 x 100 x 100 mm)

5571

5572 Output regulator



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### Spirit lamp

5580 Glass

5581 Metal

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### Water paper

for the determination of the moisture distribution in butter,  
40 x 78 mm, 1 box = 50 strips

5600

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### Butter cutter

wire gauge 0.5 mm

5605

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### Pocket refractometer

inc. case, for measuring the degree of evaporation of milk  
and determining concentration in various fields of application.  
The internationally approved Brix scale permits the weight  
percentage of dry mass to be directly determined.

5610 0–32% Brix: 0.2%, for milk, fruit juice, soft drinks

5612 28–62% Brix: 0.2%, for concentrated fruit juices

5613 45–82% Brix: 0.5%, for honey

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### Digital hand refractometer

0–45%: 0.1% Brix, can be switched to 1.3330–1.4100 nD;  
Resolution 0.1%/0.0001 nD  
Automatic temperature compensation from 10–40°C

5614

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**Digital Abbe refractometer**

1.3000 – 1.7200 nD: 0,0001 nD, 0–95 %: 0.1 % Brix  
0–99 °C: 0.1 °C, LED display 590 nm,  
RS-232 and RS 422 serial interfaces,  
115/230 V, 50/60 Hz ( 5 kg – 140 x 275 x 300 mm)

5620

**Humidity measuring device MLB 50**

for the fully automatic determination of the moisture content  
of the dry substance. 30 g: 0.01 %, RS 232 C data interface  
(5.5 kg – 217 x 283 x 165)



5670

**Accessories for the MLB 50 humidity measuring device****Aluminium specimen dish**

5671 92 mm diameter, packs of 80 pieces

**Circular glass fibre filter**

5672 for splashing or caking specimens

5673 **Matrix needle printer****Reference drier RD-8**

For determining the moisture content of milk powder in  
accordance with ISO/DIN 5537, IDF 26 standards.

8 samples can be simultaneously dried under precisely  
defined conditions (87 °C / 33 ml/min. airflow).

Connections: a) 230 V / 115 V, 520 W  
b) Compressed air: 2.5 bar ... 7.5 bar

Temperature range: adjustable, up to 110.0 °C  
stability: +/- 0,3 °C



5700

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**Accessories for the RD-8 reference drier**

**Specimen dish**  
5701 of PP, 20 pieces

**Lid for specimen dish**  
5702 of PP, 20 pieces

**Cap closure**  
5703 of PP, 20 pieces

**Filter**  
5704 100 pieces

**Loading arm**  
5705 of acrylic material, for easy and exact positioning  
of the filter in the sampling vessel

5706 **Weighing stand**

5707 **Stand for lids and sealing caps**

**Flowmeter**  
5708 ADM 1000



**Foil press**5711

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**Aluminium round foil**5712 130 x 0.03 mm, 1000 pieces

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**Analytical balance**

GLP/ISO protocol option, piece counting, formulation memory, percentage determination, RS 232 C interface, under-floor weighing, dust and splash-proof, complete with calibration weight.

5810 120 g : 0.1 mg

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5811 220 g : 0.1 mg

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**Precision balance**

piece-counting, formulation memory, percentage determination, RS 232 C interface, splash-proof, complete with calibration weight.

5820 810 g : 0.01 g

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5821 620 g : 0.01 g

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5830 410 g : 0.001 g

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## Universal ovens

Equipment type/fittings	Model	External dimensions (B/H/D) [mm]	Internal dimensions (B/H/D) [mm]	Volumes [litres]	Supporting ribs/ push-in plates	Watts/Volts	Kg (net)	Order number
<b>Universal oven "UNB"</b> Natural air convection For standard tempering tasks with a set temperature Digital (switch-off) clock, 99 hours, 59 min.	<b>UNB 100</b>	470/520/325	320/240/175	14	2/1	600/230	20	<b>6000</b>
	<b>UNB 200</b>	550/600/400	400/320/250	32	3/1	1100/230	28	<b>6001</b>
	<b>UNB 300</b>	630/600/400	480/320/250	39	3/1	1200/230	30	<b>6002</b>
	<b>UNB 400</b>	550/680/480	400/400/330	53	4/2	1400/230	35	<b>6003</b>
	<b>UNB 500</b>	710/760/550	560/480/400	108	5/2	2000/230	50	<b>6004</b>
<b>Universal oven "UFB"</b> forced airflow (fan) For standard tempering tasks with a (setpoint) temperature. Digital (switch-off) clock, 99 hours, 59 min.	<b>UFB 400</b>	550/680/480	400/400/330	53	4/2	1400/230	35	<b>6008</b>
	<b>UFB 500</b>	710/760/550	560/480/400	108	5/2	2000/230	50	<b>6009</b>

## Incubators

Equipment type/fittings	Model	External dimensions (B/H/D) [mm]	Internal dimensions (B/H/D) [mm]	Volumes [litres]	Supporting ribs/ push-in plates	Watts/Volts	Kg (netto)	Order number
<b>Incubator "INE"</b> Natural air convection Electronic temperature control, "Fuzzy-PID", with two integrated clocks (running time 1 min. to 999 hours and weekly program timer) and triple thermal safety fuse. Air turbine speed governor	<b>INE 200</b>	550/600/400	400/320/250	32	3/1	440/230	28	<b>6035</b>
	<b>INE 300</b>	630/600/400	480/320/250	39	3/1	500/230	30	<b>6036</b>
	<b>INE 400</b>	550/680/480	400/400/330	53	4/2	800/230	35	<b>6037</b>
	<b>INE 500</b>	710/760/550	560/480/400	108	5/2	900/230	50	<b>6038</b>
	<b>INE 600</b>	950/920/650	800/640/500	256	7/2	1600/230	87	<b>6039</b>
	<b>INE 700</b>	1190/1080/650	1040/800/500	416	9/2	1800/230	121	<b>6040</b>
	<b>INE 800</b>	1190/1605/750	1040/1200/600	749	14/2	2000/230	170	<b>6041</b>

## Sterilizers

Equipment type/fittings	Model	External dimensions (B/H/D) [mm]	Internal dimensions (B/H/D) [mm]	Volumes [litres]	Supporting ribs/ push-in plates	Watts/Volts	Kg (netto)	Order number
<b>"SNB" Sterilizer</b> Natural air convection For standard tempering tasks with a (setpoint) temperature Digital (switch-off) timer to 99 hours, 59 min.	<b>SNB 100</b>	470/520/325	320/240/175	14	2/1	600/230	20	<b>6047</b>
	<b>SNB 200</b>	550/600/400	400/320/250	32	3/1	1100/230	28	<b>6048</b>
	<b>SNB 300</b>	630/600/400	480/320/250	39	3/1	1200/230	30	<b>6049</b>
	<b>SNB 400</b>	550/680/480	400/400/330	53	4/2	1400/230	35	<b>6050</b>

## Refrigerated incubator with compressor cooling

Equipment type/fittings	Model	External dimensions (B/H/D) [mm]	Internal dimensions (B/H/D) [mm]	Volumes [litres]	Supporting ribs/ push-in plates	Watts/Volts	Kg (netto)	Order number
<b>Refrigerated "ICP"</b> PID process controller, from 0 to +60 °C, programmable, serial and parallel interfaces, motor- driven inner air circulation	<b>ICP 400</b>	558/967/486	400/400/330	53	4/2	500/230	68	<b>6070</b>
	<b>ICP 500</b>	718/1047/556	560/480/400	108	5/2	500/230	87	<b>6071</b>
	<b>ICP 600</b>	958/1335/656	800/640/500	256	7/2	700/230	144	<b>6072</b>
	<b>ICP 700</b>	1198/1495/656	1040/800/500	416	9/2	750/230	178	<b>6073</b>
	<b>ICP 800</b>	1198/1895/756	1040/1200/600	749	14/2	1200/230	227	<b>6074</b>

### Laboratory furnaces

Heating and incineration up to 1100°C, stainless steel furnace casing, high-grade insulation, short heating-up period, 230 V / 50 Hz

6220 Internal dimensions: 160 x 140 x 100 mm, 1.2 kW  
(18 kg – 340 x 340 x 420 mm)

6222 Internal dimensions: 240 x 250 x 170 mm, 3.0 kW  
(39 kg – 430 x 530 x 570 mm)

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### Discharge viscometer

Easy-to-use viscometer for the in-house measurement of the viscosity of yogurt, sour milk, sour cream, kefir and other products. The stop-watch time required for discharge is taken as a measure of the viscosity.

6520 With stand and two different discharge nozzles

6521 **Glass plate**

6522 **Stop-watch**

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### Viscotester VT6R Haake

Rotary viscometer for measurements pursuant to ISO 2555 and ASTM (the Brookfield method).

- measuring range 20 ... 13.000.000 mPas (cP)
- acoustic warning for measuring range
- RS 232C interface
- set of 6 spindles

6530 The stand and carrying case are included  
in the scope of delivery



### Inhibitor detection

6570 **Delvotest SP** for 100 samples

6571 **Delvotest SP plate test**, each for 96 tests

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### Lactodensimeter

Lactodensimeters are frequently used with an official calibration, or officially calibrated with certificate. Please refer to our price list or contact us in this connection.

### Lactodensimeter

for milk according to *Gerber*, large model, negative scale  
1.020–1.040: 0.0005 g/ml, with thermometer in stem  
T = 20°C, 10–40°C, approx. 300 x 28 mm

6600 standard model

6602-E officially calibrated, thermometer 10–30°C

6603-ES officially calibrated, with certificate,  
thermometer 10–30°C

### Lactodensimeter

for milk acc. to *Gerber*, small model, negative scale  
1.020–1.035: 0.0005 g/ml, T = 20°C, with thermometer in  
body, 0–40°C, approx. 210 x 17 mm

6610 standard model

6612-E officially calibrated, thermometer 10–30°C

6613-ES officially calibrated, with certificate,  
thermometer 10–30°C

### Hydrometer

for milk, in conformity with the former DIN 10290 standard,  
without thermometer,  
1.020–1.045: 0.0005 g/ml, T = 20°C, approx. 350 x 25 mm

6620 standard design

6621-E officially calibrated

6622-ES officially calibrated, with certificate



### Lactodensimeter

for milk acc. to Quevenne, 15–40: 1,0,  
with coloured triple scale, T = 20°C

6630 with thermometer 0–40°C, approx. 290 x 22 mm

6631 without thermometer, approx. 210 x 22 mm



**Hydrometer for buttermilk serum**

DIN 10293, 1.014 – 1.030: 0.0002 g/ml, T = 20 °C,  
without thermometer, approx. 240 x 21 mm

6640 standard model

6641-E officially calibrated

6641-ES officially calibrated, with certificate

---

**Buttermilk tester**

according to *Dr. Roeder*, 10 – 30: 1.0, with thermometer in stem  
T = 20 °C, approx. 210 x 25 mm

6650

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**Hydrometer for condensed milk**

without thermometer, T = 20 °C, reading at top

6660 1.000 – 1.240: 0.002 g/ml, approx. 310 x 19 mm

6661 1.040 – 1.080: 0.001 g/ml, approx. 230 x 21 mm

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**Hydrometer for yogurt and chocolate milk**

thermometer incorporated in body, T = 20 °C,  
approx. 220 x 16 mm, reading at top

6670 1.030 – 1.060: 0.001 g/ml

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**Hydrometer for brine/Beaumé**

0 – 30 Bé: 0,5, T = 15 °C, approx. 240 x 17 mm

6680 without thermometer

6681 with thermometer, 0 – 40 °C

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**Hydrometer for boiler water**

DIN 12791, M 100, 0,5 T = 20 °C, without thermometer,  
1.000 – 1.100: 0.002 g/ml, ca. 250 x 20 mm

6690

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**Hydrometer for boiler feed water**

acc. to *Dr. Ammer*, –1.2 bis +2: 1/10 °Bé, 300 x 22 mm

6700

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**Alcoholmeter**

with thermometer, 0 – 100 Vol.‰: 1.0,  
T = 20 °C, approx. 290 x 16 mm

6710

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**Hydrometer for amyl alcohol**

in compliance with DIN 12791, without thermometer, T = 20 °C, M 50, 260 x 24 mm

6720 0.800 – 0.850: 0.001 g/ml

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**Hydrometer for sulphuric acid**

in compliance with DIN 12791, without thermometer, T = 20 °C, M 50, 270 x 24 mm

6730 1.800 – 1.850: 0.001 g/ml

6731 1.500 – 1.550: 0.001 g/ml

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**Hydrometer**

in compliance with DIN 12791, for various liquids,  
M 50, without thermometer, T = 20 °C, 270 x 24 mm

6740 1.000 – 1.050: 0.001 g/ml

6741 1.050 – 1.100: 0.001 g/ml

6742 1.100 – 1.150: 0.001 g/ml

6743 1.150 – 1.200: 0.001 g/ml

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**Jar**

for lactodensimeters, 265 x 35 mm Ø (inside)

6800

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**Stand**

tripod with cardanic suspension and hanging cylinder  
210/22 mm for lactodensimeter Nos. 6610 – 6613

6810

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**Stand**

with cardanic suspension, hanging cylinder with overflow,  
suitable for all lactodensimeters and hydrometers,  
incl. drip tray, tubes and pinchcock



6830

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**Dairy thermometer**

with loop

7000 0 – 100°C: 0.1, mercury filling, blue

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**Dairy thermometer**

with loop

7001 0 – 100°C: 0.1, alcohol filling, red

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**Dairy thermometer**

in plastic case, with loop, resistant to boiling  
and impact, floatable

7030 0 – 100°C: 0.1, mercury filling, blue

---

**Dairy thermometer**

in plastic case with loop, resistant to boiling  
and impact, floatable

7031 0 – 100°C: 0.1, alcohol filling, red

---

**Dairy thermometer**

Replacement for item No. 7030, mercury filling, blue

7040

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**Dairy thermometer**

alcohol filling, red, as replacement for item No. 7031

7041

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**Universal thermometer**

mercury filling, blue

7045 -10 bis +100°C: 1.0

---

**Universal thermometer**

alcohol filling, red

7046 -10 bis +100°C: 1.0

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**Refrigerator thermometer**

alcohol filling, blue,  
in plastic case with loop and hook

7060 -50 bis +50°C: 1.0

---

**Control thermometer**

0 bis +100°C: 1.0, mercury filling, blue, 305 x 9 mm

7070-ES officially calibrated with certificate

7071 uncalibrated

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**Low-temperature laboratory thermometer**

mercury filling, 280 x 8 x 9 mm

7081 -38 bis +50°C: 1.0

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**Maximum-minimum rod thermometer**

mercury filling, blue, 220 mm long

7095 -35 bis +50°C: 1.0

7096 -10 bis +100°C: 1.0

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**Psychrometer**

lacquered wooden board approx. 250 x 120 mm,  
water container, 2 thermometers with translucent  
glass scale ready for calibration, with humidity table.

7100 Psychrometer (-10 + 60 : 0.5°C)

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**Polymer**

(hair hygrometer) for measuring relative humidity and tempe-  
rature, measuring range 0–100% RH, 0–30°C,  
with scale for water-vapour saturation pressure.

7110

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**Digital second-reading thermometer 926**

(Fig. with insertion/immersion sensor 7122)  
for daily temperature measurements in the food industry.  
Measuring range: -50 to + 350°C: 0.1°C (1°C from 200°C),  
high precision, ISO calibration certificate against extra price.



7120

---

**Insertion/immersion sensor**

7122 Robust precision sensor, dia. 4 mm x 110 mm

7123 Stainless steel sensor for food, dia. 4 mm x 125 mm

Needle sensor without visible pinhole

7124 for fast measurements, dia. 1.4 mm x 150 mm

Sensor for frozen goods, screws in without

7125 pre-drilling, dia. 8 mm x 110 mm

**TopSafe**

7127 Protective cover against contamination, water and impact

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## Freezing-point determination

– a key subject for the

**Funke-Dr.N.Gerber Labortechnik GmbH**

*Dipl.-Ing. K. Schäfer, Dipl.-Phys. W. Spindler*

### History

The German chemist Beckmann, who is known for the thermometer named after him, began to determine the freezing point of milk as early as 1895 in order to detect whether it had been adulterated with water. The American Hortvet applies this method very intensively in 1920 and improved on some essential features of it. The first thermistor-cryoscopes were brought on to the market in the sixties. However, they had to be operated entirely by hand. The first automatic thermistor-cryoscopes became available at the beginning of the seventies. With this development it was possible to determine the freezing point automatically – at the touch of a button.

A decisive improvement in thermistor-cryoscopy was made at the “FoodTec 1984” trade fair when Funke-Gerber presented the first device with automatic calibration. This successful, intensive development work culminated in a further crowning achievement at “FoodTec 1988”, where Funke-Gerber presented a fully automatic freezingpoint determination installation with a capacity of 220 samples per hour.

By introducing indirect measuring of the freezing point (e.g. LactoStar) to routine laboratory analysis, interest was mainly focused on reference devices that measured the freezing point according to the applicable standards and regulations. These devices have to meet strict requirements with regard to measuring accuracy, because they are used to calibrate routine laboratory appliances. This is why Funke-Gerber has developed a freely programmable cryoscope with a resolution of 0.1 m °C. This device has already proven its precision and reliability in countless laboratories all over the world. Meanwhile, the supply schedule has been expanded by the addition of a multi- sample device (the CryoStar<sub>automatic</sub>).

### The freezing point:

The freezing point of pure water is the temperature at which ice and water are in equilibrium.

If soluble components are added to this liquid, the freezing point decreases (it becomes colder), because this reduces the ability of the water molecules to escape

from the surface. Fat does not influence the freezing point because it is not soluble in water.

### Measuring principle:

Milk is cooled down to  $-3^{\circ}\text{C}$  (sub-cool) and crystallisation is induced by mechanical vibration. As a consequence of this freezing process, the temperature rapidly increases owing to the released lattice energy. It stabilizes at a particular plateau which corresponds to the freezing point.

### Measuring procedure:

The freezing point of liquids is not just any kind of temperature, but it is exactly the temperature at which a part of the sample is in the liquid state and another part of the sample is in the frozen state, while both parts are in equilibrium.

In order to measure the freezing point, the sample has to be in precisely this state. A specific procedure is necessary to bring this about, and is as follows:

First, the sample is cooled down to below its real freezing point, while stirring. Stirring is necessary for 3 reasons:

- The sample is kept in motion so that it cannot freeze on its own.
- The sample is thoroughly mixed so that all parts of it exhibit the same temperature.
- The heat in the sample is conveyed to the outside, where it can be carried off by the cooling device.

If a liquid is colder than its freezing point, this state is not stable. This condition is called “metastable”. Even such trivial actions as e.g. tapping on the glass wall with a hard object, cause freezing. And this continues like an avalanche until the latent heat released on freezing increases the temperature of the sample until the freezing point of the sample is reached and the frozen parts of the sample are in equilibrium with the not yet frozen parts of the sample.

This means that a cryoscope has to induce freezing when the sample is sufficiently colder than its actual freezing point. But what does “sufficiently colder” mean? Well, the aim is to form so much ice during the freezing process that there are crystals throughout the whole sample which are of normal size, but without freezing up the sample too much. During the course of time, it has transpired that milks can be optimally induced to freeze between about  $-2^{\circ}\text{C}$  to  $-3^{\circ}\text{C}$ .

After freezing has been initiated, the temperature of the sample rises because latent heat is released during the freezing process. This then stabilises at a certain value which is called “the plateau”. The cooling bath withdraws more and more heat from the sample, and further parts of the sample freeze as this happens, releasing their latent heat. Hence the temperature remains the same – at least as long as parts of the sample are in the liquid phase. This plateau lasts for a few minutes. The cryoscope determines the freezing point from the measured temperature values of the plateau. There are rules and regulations for this.

#### **Possible sources of error in making measurements**

A certain procedure has to be adhered to when making measurements for freezing point determination, whereby errors can occur at every stage of this procedure.

#### **Errors on cooling down:**

If the heat withdrawn from the sample is too little, cooling down takes too long. The cause of this is either the cooling bath or the stirring rod. The cooling bath must be at least  $-6^{\circ}\text{C}$  cold, and there must be good circulation in order to conduct heat away from the sample. The stirring rod must stir uniformly with an amplitude of 3–4 mm. In the event of cooling errors occurring, first of all the cooling bath temperature must be checked with a thermometer, then the circulation of the cooling bath should be checked with an empty sample flask. After this, it should be ascertained whether the stirring rod can swing freely and that it does not knock or rub against anything. Then the amplitude of the stirring rod must be checked. The appliance has a special menu for this. But the guiding value is not provided by any number on the display – this is just an approximate value. The tip of the oscillating stirring rod has to be observed and adjusted so that the points of regression are about 3–4 mm apart. Then a sample flask is filled with 2.5 ml water and this is held from below at the thermistor so that the stirring rod stirs the water. Finally, the rod should be checked to ensure that it oscillates properly in the water.

After all these things have been checked and adjusted, one makes a test measurement with water, while observing the temperature shown on the display. The time needed by the device to cool down the sample to room temperature ( $20^{\circ}\text{C}$ ... $25^{\circ}\text{C}$ ) to  $-2^{\circ}\text{C}$  should amount to 1 minute, to be fairly accurate. If so, the cooling bath and the stirring rod have been properly adjusted.

If the cooling period takes less than 45 seconds, the cooling bath is too cold or the stirring rod setting is too harsh.

If the cooling period takes more than 75 seconds, the bath is too warm, or the circulation is incorrect, or the stirring rod has been given a too weak setting.

If, after the cooling bath and the stirring rod have been checked for their correct operation, the signal “Error on cooling” is given, then it is necessary to check the thermistor and the calibration of the device. If the device has been poorly calibrated, it will not adopt the correct temperature scale and therefore will be unable to measure the correct temperature.

#### **Frozen too early:**

A sample is not in a stable condition if it is colder than its freezing point. Consequently, it may so happen that a sample freezes by itself or because of unintended influences, before the device initiates the freezing process. There are several different reasons for this: If the stirring rod is set to engage too strongly or if the stirring rod is rubbing against something somewhere, vibrations may occur which trigger freezing.

#### **Not frozen:**

As soon as the set temperature for subcooling is reached (the “trigger temperature”), the device beats against the glass wall of the sample flask to initiate freezing. Now the temperature should rise. A criterion for this is a temperature increase of at least  $0.1^{\circ}\text{C}$ . This is always the case with water or calibration solutions, if the stirring rod is set so that it will beat strongly against the glass wall. This is not always the case with milks. There are milks that are difficult to freeze. If this occurs just occasionally with individual samples of milk, then heat the respective milk sample up to about  $40^{\circ}\text{C}$  again, allow it to cool and perform the measurement again. On the other hand, if this error occurs quite frequently within a certain region, then it is better to reduce the trigger temperature so that the samples are more strongly cooled and therefore more easily freeze. If this error also occurs with calibration solutions, the calibration of the device is incorrect, or else cooling bath liquid has got into the sample.

#### **Plateau not found:**

This error can occur only if the “Plateau Search Method” according to IDF is used for determining the freezing point. With this method, the plateau value temperature has to be within a predetermined range for a certain period of time. It can so happen that a certain sample of

milk does not meet this criterion. Then a second sample of the milk has to be measured. If this error suddenly starts to make a frequent appearance, although the device has otherwise been working properly, the problem lies either with the thermistor, or is the result of disturbance caused by external interference.

#### **Uncalibrated or defective thermistor:**

The device tests the actual thermistor value when commencing a measurement of calibration. As is well known, its electrical resistance is a function of the temperature. This electrical resistance is translated into a number by an analogue-digital converter (ADC) and this value is further processed by the device. Now if the thermistor has a short circuit or is interrupted, its resistance is zero or infinite, both of which conditions are impossible for a properly working thermistor. In this case, the thermistor will not commence with the measurement.

The device will also fail to commence measuring if the actual thermistor value, together with the calibration constants stored in the device, produce a result that is lower than +1 °C (which cannot happen if the thermistor is positioned in a new, i.e. still warm, sample).

#### **Identifying operational errors**

Most of the errors that are made when using the device result from faulty calibrations. The calibration of a cryoscope is an essential condition for its use. For technical reasons relating to measurements, it is necessary to use a thermistor for measuring the temperature of the sample. Thermistors are sensitive to a wide range of temperatures and this sensitivity is necessary for a resolution of more than 1 m°K. Unfortunately, fluctuations in the resistance values of these components are so great that the zero temperature point (0 °C) usually has to be determined by pre-calibration before the device can be calibrated with a new thermistor.

It must be assumed that an A-calibration cannot be performed successfully after a thermistor has been exchanged. The reason for this is that the device must first of all reach the set knocking temperature and then, after knocking, has to identify an increase in temperature (as an indication that freezing has begun). But this is not the case, because the new thermistor values result in the wrong temperatures being given when calculated according to the calibration constants of the old thermistor. This is why a so-called pre-calibration is necessary, in which the device ignores the temperatures and follows a purely time-controlled measuring proce-

dure. After this, the calibration constants must be adapted to the new thermistor characteristics so that both the A-calibration and the B-calibration can be performed successfully.

Unfortunately, it often so happens that sample flasks filled calibration solutions are mixed up, or that the wrong menu item is selected.

#### **Mix-up: confusing solution A with solution B:**

To begin with, the A-calibration goes as expected. But when it comes to the B-calibration, the device reports the error "uncalibrated or defective thermistor" and it remains in the uncalibrated state. With older versions of firmware, the device retains the wrong values and is henceforth not prepared to perform a measurement. It is advisable to carry out a new pre-calibration, followed by a proper calibration, in any case.

#### **Mix-up: taking the A-calibration instead of the B-calibration**

This results in the displacement of the entire temperature scale of the device. Re-measuring of the calibration solutions gives reversed values and a reversed sign. For example:

Calibration A with 0.000  
Calibration A with 0.000  
Calibration B with -0.557  
Calibration A with -0.557 (faulty operation)  
Re-measuring solution B: results in 0.000  
Re-measuring solution A: results in 0.557

#### **Defective thermistor**

This is the most common source of errors. There are two possibilities here:

1. The thermistor is (was) broken. This can be recognised because the display constantly shows a negative value that does not change.
2. The thermistor bonding is porous. This results in extremely unstable measurements. The reproducibility is very poor, e.g. there are variations of about +0.1 °C.

The thermistor must be exchanged in either case.

**Stirring rod defects**

The stirring rod does not oscillate freely. It has to be able to move freely in the slot provided. And it must not touch the thermistor at any place. The following points should be observed when exchanging the thermistor:

- The stirring rod amplitude is not high enough: Cooling of the sample is not effected uniformly and takes significantly longer than 1 minute. When the stirring rod is correctly adjusted, the cooling time is almost exactly 1 minute. The stirring rod amplitude should amount to 3 – 4 mm. If need be, the stirring rod must be adjusted accordingly.
- The stirring rod amplitude is too large: Premature freezing of the sample occurs quite often.

**Special applications/cream measurement**

It is recommended that the sample volume of cream be increased to approx. 3 ml, as the relevant liquid for freezing point determination only occupies 60% of the sample volume in the case of cream with a fat content of ca. 40%.

# CryoStar<sup>automatic</sup>

**Automatic freezing point determination  
Reference measurement pursuant to ISO/DIS 5764**

In terms of measuring technology, the appliance is in accordance with the well-known and widely used "CryoStar 1" single-sample device. In addition, the "CryoStar<sup>automatic</sup>" is equipped with a circular magazine for 12 samples. Consequently, 12 samples can be simultaneously measured at the press of a button.

## Some important features at a glance:

- **Forward-looking and flexible:** fixed-time measurement, plateau-search and maximum search features are available. All relevant parameters can be freely programmed. Of course, these are also recorded. This makes CryoStar<sup>automatic</sup> adjustable to all national and international parameters (also future ones).
- **Easy-to-use:** Operation is menu-assisted in the language of your choice. At present the following languages are available: German, English, French, Greek, Italian, Polish, Spanish, Turkish and Hungarian.
- **Efficient:** A new cooling system (patent application submitted) provides swift operational readiness even at high ambient temperatures (up to ca. 32 °C).
- **Fast:** Up to 40 samples per hour can be measured, depending on the setting.
- **Multifunctional:** The CryoStar 1 has a parallel connection (for standard printers), and a serial interface to connect it to a PC. Accordingly, it is possible to display and store the freezing-point graph during the measuring process. A powerful zoom function completes the comprehensive design. The necessary software is included in the scope of delivery.
- **User-friendly:** The device is easy to use. The percentage of water admixture is immediately indicated and printed out. Calibration is carried out automatically. All settings and calibration values are permanently saved by a non-volatile memory.

## Technical data:

Mains supply:	230 V/115 V AC (50...60 Hz) 180 W, and 12 V DC
Measurement resolution:	0.0001 °C
Reproducibility:	± 0.002 °C
Measuring range:	0.000 °C to -1.500 °C
Sample volume:	2.0 ml to 2.5 ml
Recommended value:	2.2 ml
Sample throughput:	up to 40 per hr. typically 30 per hr.
Interfaces:	1 x parallel, 1 x seriell (RS232)
Dimensions:	44 x 44 x 20 cm (W x H x D)
Measuring head:	24 cm (H)
Weight:	14.6 kg



**CryoStar 1 (single sample appliance)**

Automatic cryoscope

Reference method pursuant to ISO/DIS 5764

Technical data: see CryoStar<sub>automatic</sub>

The device differs solely with respect to the sample feed system of "CryoStar<sub>automatic</sub>".



7150 without thermal printer

**CryoStar<sub>automatic</sub> (multi-probe device)**

Automatic cryoscope, fitted with an additional circular magazine for 12 samples.

Please refer to the detailed description on page 65



7160 with thermal printer

**Accessories/Consumables****Thermal printer**

Recording printer (6 V DC) for direct connection to CryoStar 1 and LactoStar (3510, 3520), which take matching rolls of thermal paper.

7151 See item 7157 .

**Spare thermistor**

for CryoStar 1 and CryoStar<sub>automatic</sub>

7152 pursuant to ISO/DIS 5764, PVC, white

**Software**

7156 for CryoStar (included in the scope of supply)

**Roll of thermal paper**

7157 for thermoprinter 7151

**Connecting cable (12 V DC)**

7159 for CryoStar, 12-Volt connection

**Calibration Standard "A"**

7165 0.000 °C, 250 ml in PE bottle ( $\Delta \pm 0.00^\circ\text{H}$ )



**Calibration standard "B"**

7166  $-0.557^\circ\text{C}$ , 250 ml in PE bottle ( $\Delta \pm 0.577^\circ\text{H}$ )

**Sample tube**

7167 with marking at 2.0 ml, 50 pieces

**Sample rack**

7168 of PPH material, for 27 sample tubes

**Cooling bath liquid**

7169 500 ml in a PE bottle



**Sampling pipette**

7174 adjustable between 1.0 ml and 5.0 ml

**Pipette tips**

7175 for item 7174



**Calibration standard A**

7186  $-0.408^\circ\text{C}$ , 250 ml in PE bottle ( $\Delta \pm 0.422^\circ\text{H}$ )



**Calibration standard B**

7187  $-0.600^\circ\text{C}$ , 250 ml in PE bottle ( $\Delta \pm 0.621^\circ\text{H}$ )

**Control standard C**

7188  $-0.512^\circ\text{C}$ , 250 ml in PE bottle ( $\Delta \pm 0.530^\circ\text{H}$ )



**Lactometer**

Easy-to-use hand refractometer  
for the factory determination of SNF .

7500

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**Solubility index mixer**

in conformity with ADMI and DLG regulations, with special  
motor, glass mixing bowl, stainless steel impeller, timer and  
continuous operation switch

7610

7620 Replacement glass, mixing bowl

7621 Replacement impeller

7622 Replacement drive belt

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**Reference table**

ADMI "Scorched Particle Standards 7650 of Dry Milks", 4 stages

7650

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**Jolting volumeter**

Type STAV 2003 for the determining of the jolting volume of  
powdered milk, white plastic case, high gloss, with single-  
phase AC motor 220 V/50 Hz, with worm drive and capacitor,  
jolting mechanism with taper lock for the measuring cylinder,  
5-digit electronic pre-selection counter, On/Off switch with  
control lamp, red control panel (silk mat). The 250 ml measur-  
ing cylinders are standardised by weight and graduation in  
conformity with DIN 53194.

7660 Jolting volumeter

7661 Replacement measuring cylinder

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**Evidence of short-time heating –  
Determination of alkaline phosphatase**

7820 Lactognost original pack with  
reference table for 100 samples, 1 small spoon

7821 Lactognost refill pack with  
reagents 1, II and III for 100 samples

7822 Testing strips Phosphatesmo M1, pack of 50 strips

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**Evidence of high-temperature heating / UHT test  
determination of peroxidase**

7825 Peroxtesmo MI, pack of 100 testing strips

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**Process control for milk****RQflex reflectometer****Evaluation device for the following test strips**

7830 see items 7831 and 7835

7831 Reflectoquant alk. phosphatase test in milk

7832 Reflectoquant urea test in milk

7833 Reflectoquant Lipase test

7834 Reflectoquant lactic acid test

7835 Reflectoquant peroxide test

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**Fore-milk cup**

of plastic

7910



**California mastitis test (Schalm test)**

for the rapid determination of an increased cell content in milk, from which conclusions may be drawn about possible mastitis infection.

2 test trays with 4 dishes, 1 injection flask 250 ml.

7920

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**CMT test liquid**

7930 1 litre

7931 5 litres

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**LOVIBOND comparator 2000**

for the determination of chlorine, nitrate and nitrite, DB 410

8010

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**Test tube**

thick-walled, 160 x 15 x 16 mm, 100 pieces

8100

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**Rubber stopper**

with glass tube and cotton wool

8110

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**Coli tube**

20 x 10 mm, 100 pieces

8120

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**Durham tube**

40 x 8 mm, 100 pieces

8130

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**Coli test rack**

stainless steel, sterilizable



8140

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**Metering syringe**

10 ml, for nutrient solutions, sterilizable, see also items 5110, 5111 and 5112

8170

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**Sterilization box of stainless steel**

8190 300 x 65 mm, for pipettes

8191 420 x 65 mm

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**CAP-O-TEST seal**

various colours



8200

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**Kapsenberg cap**

various colours



8201

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**Swabchecks**

8210 Coliform Swabcheck

8211 Hygiene Swabcheck

8212 Listeria Swabcheck

**Dilution flask**

borosilicate glass 3.3, 250 ml, sterilizable

8290 with glass rod and silicon stopper

8291 flask only

**Dilution pipettes**

8300 1.1 : 0.1 ml

8301 1.0 + 1.1 ml, acc. to Demeter, with 2 ring marks

8302 1.0 + 2.0 + 2.1 + 2.2 ml, acc. to Demeter, with 4 ring marks

8303 1.0 + 1.1 + 1.2 ml, acc. to Demeter, with 3 ring marks

**Petri dishes**

glass, 100 x 20 mm

8310

**Petri dishes**

of plastic (disposable), sterile packing

8312 Ø 55 x 15 mm, 1620 pieces, without vent cams

8313 Ø 94 x 16 mm, 480 pieces, with vent cams

8314 Ø 94 x 16 mm, 480 pieces, without vent cams

**Sterilizing box**

with insert, stainless steel, for glass Petri dishes  
250 x Ø 120 mm

8320



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**Wire cages**

for sterilization

8330 100 x 100 x 100 mm

8331 140 x 140 x 140 mm

8332 200 x 200 x 200 mm



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**Smear needle**

rectangular bend

8340

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**Spatula, Drigalsky type**

glass

8350

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**Inoculation wire**

stainless steel, 1 m

8370

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**Burri loop**

platinum, calibrated

8380 0.001 ml

8381 0.01 ml

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**Needle holder**

for inoculation wire loop

8382

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**Slide**

76 x 26 mm, half white, cut edges, 50 pieces

8400

**Cover glass**

18 x 18 mm

8401

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**Tweezers for slides**

8410

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**Staining stand**

according to *Bongert*



8420

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**Staining cuvette**

rectangular



8430

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**Wire mesh**

8440 with ceramic centre

8441 without ceramic centre

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**Tripod**

for Bunsen burner

8450

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**ColonyStar bacterial colony counter**

easy-to-clean plastic casing, adjustable in height, with directly or indirectly illuminated area of 145 mm Ø, glare free, frosted glass and clear glass plate with cm<sup>2</sup> and 1/9-cm<sup>2</sup> graduation, and electrical contact pin with felt pen for marking. Petri dishes up to 145 mm Ø can be used. In the case of smaller diameters, the supplied reducing insert can be used. 220 V/50 Hz, 25 x 23 x 7.5 cm. 1.7 kg.

8500 ColonyStar with accessories (8501, 8503, 8504, 8505)

8501 Magnifying glass with sturdy base and flexible arm

8502 ColonyStar without accessories

8503 Automatic contact pin for counting

8504 Felt refill, replacement part for item 8503

8505 Clear glass plate with dark field



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**Aerobic germ collector**

Determination of germs in production and filling

8506



**Bench autoclaves  
with electromagnetic controls**

8510	<b>1730 ML</b>	170 x 300 mm,	7.5 l,	220–240 V,	1.3 kW
8512	<b>2540 ML</b>	250 x 420 mm,	23 l,	220–240 V,	2.2 kW
8513	<b>3850 ML</b>	380 x 510 mm,	62 l,	380–400 V,	4.0 kW
8514	<b>3870 ML</b>	380 x 690 mm,	85 l,	380–400 V,	4.8 kW
8515	<b>5050 ML</b>	500 x 500 mm,	110 l,	380–400 V,	4.8 kW
8516	<b>5075 ML</b>	500 x 750 mm,	160 l,	380–400 V,	7.2 kW

**Bench autoclaves with microprocessor controls**

8517	<b>1730 EL</b>	170 x 300 mm,	7.5 l,	220–240 V,	1.3 kW
8518	<b>2540 EL</b>	250 x 420 mm,	23 l,	220–240 V,	2.2 kW
8519	<b>3850 EL</b>	380 x 510 mm,	62 l,	380–400 V,	4.0 kW
8520	<b>3870 EL</b>	380 x 690 mm,	85 l,	380–400 V,	4.8 kW
8521	<b>5050 EL</b>	500 x 500 mm,	110 l,	380–400 V,	4.8 kW
8522	<b>5075 EL</b>	500 x 750 mm,	160 l,	380–400 V,	7.2 kW



**Stand autoclaves  
with electromagnetic controls**

8523	<b>2540 MLV</b>	250 x 400 mm,	23 l,	220–240 V,	2.2 kW
8524	<b>3850 MLV</b>	380 x 490 mm,	62 l,	380–400 V,	6.0 kW
8525	<b>3870 MLV</b>	380 x 690 mm,	85 l,	380–400 V,	6.0 kW
8526	<b>5050 MLV</b>	500 x 500 mm,	110 l,	380–400 V,	9.0 kW
8527	<b>5075 MLV</b>	500 x 750 mm,	160 l,	380–400 V,	9.0 kW




### Upright autoclaves with microprocessor controls

8528	<b>2540 ELV</b>	250 x 400 mm, 23 l, 220–240 V, 2.2 kW
8529	<b>3850 ELV</b>	380 x 490 mm, 62 l, 380–400 V, 6.0 kW
8530	<b>3870 ELV</b>	380 x 690 mm, 85 l, 380–400 V, 6.0 kW
8531	<b>5050 ELV</b>	500 x 500 mm, 110 l, 380–400 V, 9.0 kW
8532	<b>5075 ELV</b>	500 x 750 mm, 160 l, 380–400 V, 9.0 kW

### Portable bench autoclave

with screwed-on control thermometer, for the rapid and efficient steam sterilization at 140°C/2.7 bar or 125°C/1.4 bar. Also suitable for autoclaving small amounts of culture media.

Special valves can be supplied for 115°C/0.7 bar and 121°C/1.1 bar. A stainless steel instrument board (Ø 215 mm) and a stainless steel tripod are included with the instruments. 220 – 230 Volt, 50 – 60 Hz, 1.6 kW to 1.75 kW, aluminium silk gloss, polished, thermostatic temperature control, tested safety 

CV-EL 12 L GS

Volumen 12 l volume, weight 6.1 kg, diameter 24 cm, internal height 24 cm, useful diagonal 32 cm

8541

CV-EL 18 L GS

18 l volume, weight 7.7 kg, diameter 24 cm,

8542 internal height 38 cm, useful diagonal 43 cm

8543 Sieve basket

Instrument board, stainless steel 18/10, Ø 215 mm,

8544 without tripod



### Culture cultivating appliance

for the cultivation of individual dairy-farm cultures.

8 different sizes from 1 x 5 l to 4 x 20 l, stainless steel culture vessels, 5 l with cover and mixer.

PP casing, microprocessor controlled.

8610 1 x 5 l vessel, 2 x 0.5 l starter culture flasks

8611 2 x 5 l vessel, 2 x 0.5 l starter culture flasks

8612 4 x 5 l vessel, 4 x 0.5 l starter culture flasks

8613 1 x 10 l vessel, 2 x 0.5 l starter culture flasks

8614 2 x 10 l vessel, 2 x 0.5 l starter culture flasks

8615 4 x 10 l vessel, 4 x 0.5 l starter culture flasks

8616 2 x 20 l vessel, 2 x 0.5 l starter culture flasks

8617 4 x 20 l vessel, 4 x 0.5 l starter culture flasks

### Magnetic stirrer MONO Direct

- without heating
- directly operated
- speed range 130 – 1,000 U/min
- automatic starting device for safe stirring rod speed-up
- up to 3,000 ml capacity
- PP stainless steel housing, grey
- mains appliance with stirrer performance pre-selection to minimise own heat
- LED display during operation



8690

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### The MONOTHERM magnetic stirrer

- with heating
- directly operated
- speed range 130 – 1,000 U/min
- up to 3,000 ml capacity
- heater plate temperature up to +300 °C
- fast, power-saving heating up by a fully insulated heater plate
- no overshooting the plate temperature by innovative electronic controls
- compact aluminium casing



8691

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### Standard laboratory microscope

Binocular transmitted light. Sliding beak rotatable by 360°, continuously adjustable halogen lamp (10 W), N.A 0.65 condenser with iris diaphragm, quadruple revolving nosepiece, coaxial coarse and fine focusing control, specimen traverse, plug connection and protective cover.

Achromatic objectives: 4/0.10; 10/0.25; 40/0.65; 100/1.25 eyepieces WF 10 x/18; 1x with pointer, 1x without pointer.

8760

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### Professional laboratory microscope

easier to use and improved focusing control by virtue of the stationary mechanical stage and N.A. 1.2 condenser with iris diaphragm.

8761

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### Trinocular microscope

is in addition to the Professional model and comes with a trinocular sliding beak.

8762

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### Automatic water distillation apparatus

for the generation of distilled water with a conductivity under 2.3  $\mu\text{S}$  per cm at 20°C. Efficient energy consumption by using cooling water heated to 80°C. The apparatus is fabricated completely from stainless steel 1.4301 and is delivered with a wall mount fixture as well as water supply and discharge hoses.

Distillation volume: 4 l. per hr.  
Storage container: 4 l  
Cooling water consumption: 50 l. per hr.  
220 V/50 Hz; 3.2 kW  
Dimensions: 510 x 460 x 230 mm

8771 Weight: 13 kg

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Distillation volume: 7 l. per hr.  
Storage container: 7 l  
Cooling water consumption: 70 l. per hr.  
220 V/380 V/50 Hz; 4.8 kW  
Dimensions: 670 x 500 x 340 mm

8772 Weight: 19 kg

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### Water distillation apparatus, Mono, glass

Distillation volume: 3.5 l. per hr.  
Cooling water consumption: 45 l. per hr.  
Conductivity: 0.85  $\mu\text{s}$   
ca. 600 x 200 x 180 mm, 4 kg

8775

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**Water bath**

7 l with gable cover

240 x 210 x 140 mm, ca. 11 kg

8786

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**Water bath**

22 l with gable cover

350 x 290 x 220 mm, ca. 17 kg

8788

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**Beaker**

short, borosilicate glass, with markings and spout

8800 50 ml

8801 100 ml

8802 250 ml

8803 400 ml

8804 600 ml

8805 800 ml

8806 1000 ml

**Beaker**

tall, borosilicate glass, with markings and spout

8808 50 ml

8809 100 ml

8810 250 ml

8811 400 ml

8812 600 ml

8813 800 ml

8814 1000 ml

8815 2000 ml

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### Erlenmeyer flasks

narrow neck, borosilicate glass, with markings DIN 12380

8817 50 ml

8818 100 ml

8819 200 ml

8820 250 ml

8821 300 ml

8822 500 ml

8823 1000 ml

8824 2000 ml



### Erlenmeyer flasks

wide necked, borosilicate glass, with markings DIN 12385

8826 50 ml

8827 100 ml

8828 200 ml

8829 250 ml

8830 300 ml

8831 500 ml

8832 1000 ml

8833 2000 ml

### Measuring cylinder, tall

glass, with spout

8850 50 ml : 1/1

8851 100 ml : 1/1

8852 250 ml : 2/1

8853 500 ml : 5/1

8854 1000 ml : 10/1



**Measuring cylinder, tall**

PP, blue graduation

8855 50 ml : 1/1

8856 100 ml : 1/1

8857 250 ml : 2/1

8858 500 ml : 5/1

8859 1000 ml : 10/1

8860 2000 ml : 20/1

**Mixing cylinder**

AR glass, round stem, with NS-PE stopper

8862 100 ml : 1/1

8863 250 ml : 2/1

**Measuring flask**

borosilicate glass, with ring mark, DIN 12664, calibrated to "in"

8870 25 ml

8871 50 ml

8872 100 ml

8873 250 ml

8874 500 ml

8875 1000 ml

**Glass funnel**

AR glass, smooth, short stem with oblique end, DIN 12445

8876 55 mm Ø

8877 100 mm Ø

8878 150 mm Ø

8879 200 mm Ø



### Measuring pipettes

colour code, AR glass

8882 1 ml : 1/100

8883 2 ml : 1/50

8884 5 ml : 1/10

8885 10 ml : 1/10

8886 25 ml : 1/10

8887 50 ml : 1/5



### Volumetric pipettes

colour code. AR glass

8888 1 ml

8889 2 ml

8890 5 ml

8891 10 ml

8892 20 ml

8893 25 ml

8894 50 ml

8895 100 ml



### Laboratory bottles

borosilicate glass, with ISO threads, graduated,  
with PPN screw cap and PPN pouring ring (blue)

8970 100 ml

8971 250 ml

8972 500 ml

8973 1000 ml

8974 2000 ml



**Reagent bottles, wide neck**

AR glass, white with standard ground and joint stopper

8980 50 ml, NS 24/20

8981 100 ml, NS 29/22

8982 250 ml, NS 34/35

8983 500 ml, NS 45/40

8984 1000 ml, NS 60/46

8985 2000 ml, NS 60/46

**Reagent bottles, narrow neck**

AR glass, white with standard ground and joint stopper

8990 50 ml, NS 14/15

8991 100 ml, NS 14/15

8992 250 ml, NS 19/26

8993 500 ml, NS 24/29

8994 1000 ml, NS 29/22

8995 2000 ml, NS 29/32

**Culture tubes**

DURAN glass, straight rim  
16 x 160 mm, 100 pieces

9050

**Culture tubes**

AR glass, sterilisable, with ISO thread and screw cap

9054 16 x 100 mm, 100 pieces

9056 16 x 160 mm, 100 pieces

**Test tubes**

9080 DURAN glass, 16 x 160 mm, without rim, 100 pieces

9081 DURAN glass, 16 x 160 mm, with rim, 100 pieces

9090 Test tube brush with wool head

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**Weighing dishes**

low shape, with knob lid

9120 35 x 30 mm

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9121 50 x 30 mm

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**Digital burette  $\mu$ l 10**

certificated conformity to 100 ml,  
smallest adjustment 10  $\mu$ l.



9190

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**Desiccator**

9201 glass, 250 mm, Novus type, flat flange with knob lid

9211 desiccator plate, porcelain

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**Wash bottles**

polyethylene

9230 100 ml

9231 250 ml

9232 500 ml

9233 1000 ml

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**Funnels**

polyethylene

9235 50 mm Ø

9236 70 mm Ø

9237 100 mm Ø

9238 120 mm Ø

9239 150 mm Ø

**Test tube racks**

plastic, for tubes 160 x 16 mm

9255 12 samples

9256 25 samples, PP, sterilizable to 121 °C

9257 36 samples, wire, plastic coated

**Lyphan stripes**

in plastic box

9360 pH 1 – 11

9361 pH 3.9 – 6.9

9362 pH 4.9 – 7.9

9363 pH 6.9 – 9.9

9364 pH 0 – 14

**Indicator paper**

for freshness of milk, Duplex, pH 7.9 – 11, 200 pieces

9365

**Burette stand**

9400 21 x 13 x 75 cm, plate stand

9401 21 x 13 x 75 cm, tripod stand

**Bosshead**

9405

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**Bosshead**

9406 swivel type

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**Clamps**

9407 25 mm, without bosshead

9408 60 mm, without bosshead



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**Retort ring**

160 mm, with bosshead

9409

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**Burette clamps**

9410 single, with bosshead

9411 double, with bosshead

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**Laboratory clock**

0–60 min, with alarm

9440

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**Laboratory vacuum pump/compressor**

electrical, can be used as a vacuum or pressure pump.  
Max. capacity 16 l. per min, max. operating pressure 3.5 bar

9470

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**Apportioning devices**

semi-automatic, for corrosive acids and alkalis,  
without bottle

9480 0,4–2 ml : 1/10

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9481 2–10 ml : 1/5

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9482 10–50 ml : 1/1

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9483 20–100 ml : 2/1

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**Microliter pipettes**

with fixed volumes, in sizes of 5–1000 µl

9490

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**Microliter pipettes**

with variable volumes and disposable tips

9495 10–100 µl

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9496 20–200 µl

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9497 200–1000 µl

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**Pipette tips**

9510 1–200 µl (yellow), 1000 pieces

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9511 50–1000 µl (blue), 1000 pieces

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