Laboratory catalogue ■ for milk analysis

FUNKE GERBER

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!

K. Schaefer, graduate engineer and Managing Director

Contents

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 phospoglycerides, 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 hydrolizes the organic components in the protective sheath around the 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_2SO_4

Requirements:

A density of (1.818 ± 0.003) g. per ml^{-1}

at 20 °C

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

Hazard symbol	Hazard rating
	C_2 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^{-1}

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 in 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.

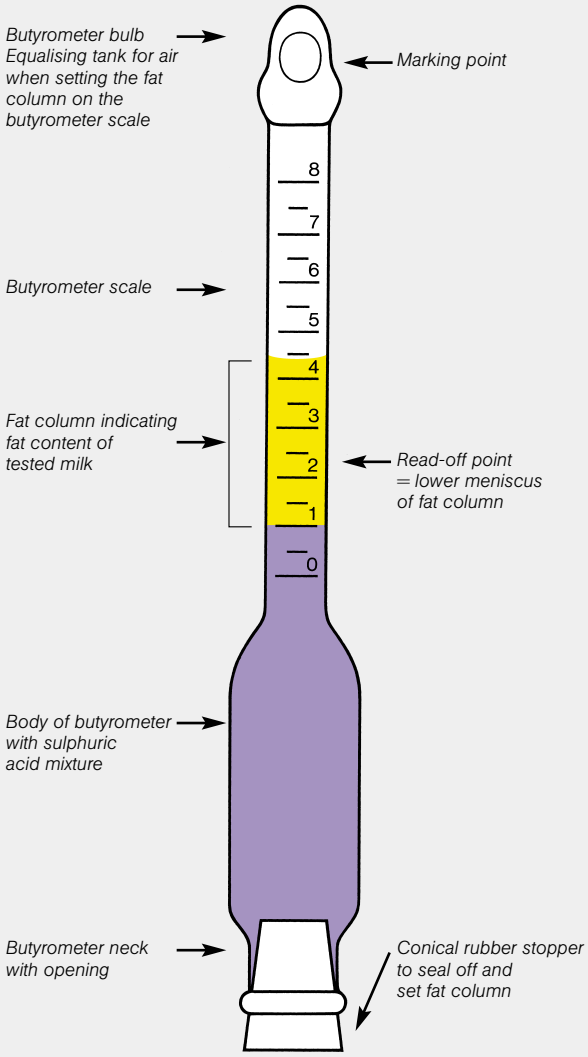
3. Pipette DIN 12737-B or 10 ml measuring tap for sulphuric acid (Fig. 3).

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 ± 50) g on the inside of the butyrometer stopper within 2 minutes at the most. With a rotation radius of e.g. (26 ± 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 ± 80) min^{-1}.

6. Tempering device for butyrometers, e.g. a water bath (65 ± 2) °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 ± 2) °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 possibly 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 ± 50) rpm, which is reached after 1 min. as a rule, should be maintained for 4 minutes after attaining a centrifugal force of (350 ± 50) g.

Fig. 4

The centrifuge must be fitted withan 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 parallaxis may be the result if your eye and the meniscus are not at the same level.

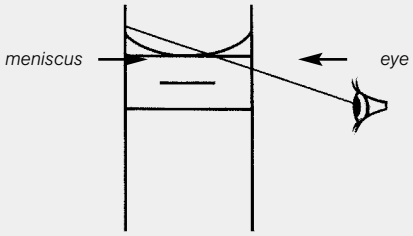


Fig. 7

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).

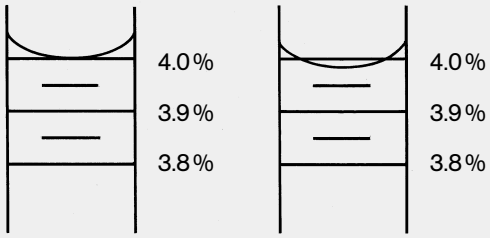


Fig. 7a a 4.0% reading *Fig. 7b a 3.95% reading*

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 spectroscopes). 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 centri- fuge 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 close 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 temp- erature. 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 manufactured from acid-resistant glass in compliance with German and inter- national 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)

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)

Skim-milk butyrometer

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

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

Skim-milk butyrometer

according to *Kehe*

3161	0 – 4 %: 0,05 (accessory: 3280)
3162	0 – 5 %: 0,05 (accessory: 3280)

Skim-milk butyrometer

according to *Siegfeld*

3164	0 – 0.5 %: 0,02 (accessory: 3280)

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

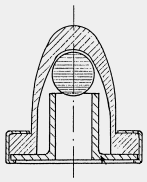
0–60% for cream and cheese

3258

Patent closure FIBU

for all measuring butyrometers
(Illustration with adjusting key 3270)

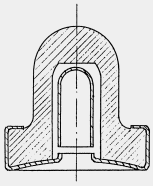
3260 FIBU without adjusting key



Patent closure GERBAL

for all measuring butyrometers

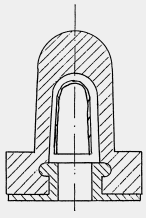
3261



Patent closure NOVO

for all measuring butyrometers

3262



Adjusting key
for the FIBU patent closure

3270

Adjusting key
for the GERBAL patent closure

3271

Adjusting key
for the NOVO patent closure

3272

Rubber stopper, conical
for all measuring butyrometers, 11 x 16 x 43 mm

3280

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

3290

Rubber stopper, with hole
for all weighing butyrometers, 17 x 22 x 30 mm

3300

Rubber stopper, without hole
for milk-powder butyrometers, 17 x 22 x 30 mm

3310

Glass nail
for milk-powder butyrometers

3315

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

Cleaning brush

3325	for graduated stem of butyrometer

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

Pour plate

of plastic

3350	for 36 samples
3351	for 12 samples

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

Pipette stand

PVC, for pipettes of various sizes

3460

Cleaning brush

for pipettes

3470

Laboratory goggles

3480

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$_{mini}$

Newly developed appliance for routine milk analysis.
Fat, SNF, (fat-free dry mass).
For further details, see P. 38

3520

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: ± 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

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.
I can likewise be equipped to measure sulphur.

3585

Butyrometer buckets

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

3631	1 piece
3631-12	set with 12 buckets
3631-24	set with 24 buckets
3631-36	set with 36 buckets

Babcock bucket

Accessory for the SuperVario-N (3680) centrifuge

3632

Bucket for ADMI tubes

Accessory for the SuperVario-N centrifuge (3680)

3633

Solubility index tube

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

3634

Stand

for 6 (3634) buckets

3636

Special solubility index tube

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

3637

Centrifuge tube

with 2 stoppers, according to *Friese*

3638

Replacement butyrometer tube

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

3641

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

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 **R**elative **C**entrifugal **A**cceleration (RCA) of 350 g with a maximum deviation of ± 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 (progammable 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 **R**elative **C**entrifugal **A**cceleration (RCA) of 371 g when running on no load, and 323 g when fully loaded.*

Safe centrifuge for fat determination

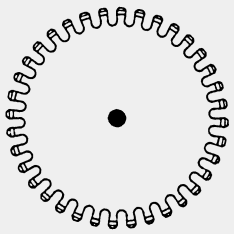
3680-L according to Roese-Gottlieb

SuperVario-N

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

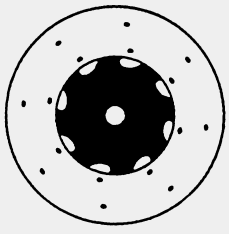
3680

Accessories for the SuperVario-N



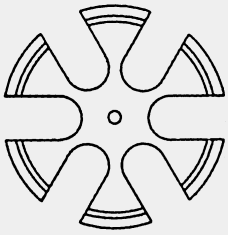
Head A
Centrifugal head for 36 butyrometers
3685 or 18 Babcock bottles

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



Head B
Centrifuge head (protection vessel)
3686 for max. 8 Mojonnier tubes

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

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)

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)

Accessories for the WB 436 water bath

	Butyrometer stand for WB-436
3717	of stainless steel, for 36 butyrometers
	Mojonnier stand
3718	of stainless steel, for 10 Mojonnier tubes
	Universal shelf
3727	of stainless steel
	Reductase insert
3737	for 99 samples
3747	**Reductase lid**
3754	**“Delvotest” insert**
	Butyrometer tubes, closed,
3766-G	brass, for butyrometer stand (item No. 3717)
	Butyrometer tubes, open,
3766-O	brass. for butyrometer stand (item No. 3717)

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

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
3851	for 6 Mojonnier tubes

Extraction tube with cork stopper
and round bulb
according to *Mojonnier*

3870

Extraction tube with cork stopper
and flat-topped bulb
according to *Mojonnier*

3871

Wooden stand

for 12 extraction tubes

3875

LactoStar/LactoStar$_{mini}$

The new generation of appliances

The two new appliances, “LactoStar” and “LactoStarmini” , 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$_{mini}$ (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$_{mini}$ (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

LLaboratory pH meter

Electrodes are not included in the scope of delivery

4310	**The Knick 766** Easy-to-use measuring appliance for pH, mV and °C: adjustment and monitoring of the electrode, self-diagnostic, authomatic temperature compensation, recorder output, calibrated data memory
4311	**The Knick 765** plus Rs 232 interface for computer and printer

Battery/pocket pH meter

Electrodes are not included in the scope of delivery

4315	**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.
4316	**Knick 912** plus data measurement storage
4317	**Knick 913** plus data memory and interface for computer and printer
4319	Pt 1000 temperature sensor for pH 911, 912 and 913

Laboratory pH meter

4320	**inoLab pH 720** Routine laboratory pH / mV meter with automatic temperature compensation, calibration system, battery and mains operated
4321	**inoLab pH 730** precision pH / mV meter plus Rs 232 interface for computer and printer

Pocket pH meters

4330	**WTW 330** Robust and water-proof pH/mV meter with data memory, automatic calibration and automatic temperature compensation.
4331	**WTW 330-SET** Measuring instrument in smart case with integrated measuring set, holding clip, pH 4, p H 7 and pH 10 buffer solution and KCl solution, without electrode
4334	**WTW 340** Measuring instrument with additional RS 232 analogue and digital outlets
4335	Temperature sensor with clip for WTW 330 and 340

Combined electrode for milk

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

4350	

Electrodes

4360	Inlab 427 for puncture measurements with cable and DIN plug
4361	Inlab 427 without cable
4370	SE 104 for insertion measurements in cheese, meat and sausage, fixed cable with DIN plug

Combined electrode with temperature sensor

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

4380	

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

Electrode stand

250 ml in a PE bottle

4420	AG-Cl-diaphragm cleaner, thiourea solution
4421	Protein solvent, pepsin-hydrochloric acid

Reactivation solution

30 ml hydrofluoric acid in a PE bottle

4422	

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
4510	for curd: 0–250° SH with porcelain pestle and mortar, 2 ml pipette (without 1 ml and 25 ml pipette, without Erlenmeyer flask)

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

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

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. Schiling*, Schellbach stripes, complete with storage bottle and base, with automatic zero- point calibration

4680	10 ml: 1/20
4681	25 ml: 1/10
4682	50 ml: 1/10

Acidity tester

for determining the fresh state of unpasteurized milk.

4705	

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
4770	25 ml: 0.1 for cheese

SEDILAB sediment tester

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

4800	

SEDILAB-E sediment tester

for serial testing at reception speed, approx. 800 samples per hour, sharply defined sediment images, 220 V50 Hz for 500 ml milk.

4810

ASPILAC sediment tester

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

4905

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

Reductase test tubes

with ring mark

5040 10 ml and 21 ml

5041 10 ml

Rubber stopper

for reductase test tubes

5060

Pipetting syringes

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

5110	adjustable to 1 ml
5111	adjustable to 2 ml
5112	adjustable to 5 ml (for 10 ml, see item No. 8170)

Methylene blue tablets

5140	50 tablets

Resazurine tablets

5150	for LOVIBOND comparator, 100 tablets

LOVIBOND comparator 2000

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

5160	

Colour disk

5161	for resazurine 4/9 with 7 standard reference colours

Test tube

5162	set of 4 tubes

Dry-matter calculator

according to *Ackermann*, for milk

5360	

Butter-melting beaker

5400 aluminium, 30 g

5401 aluminium, 50 g

Tongs

5420

Glass stirrer

pestle type, 140/6 mm

5430

Double-ended spatula

pure nickel, 150 mm

5440

Butter test spoon

of Plexiglas

5450

Crystal quartz sand

washed and calcined

5460 1 kg

5461 3 kg

Aluminium foil

150 x 190 mm, 1000 pieces

5470

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

Spirit lamp

5580 Glass

5581 Metal

Water paper

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

5600

Butter cutter

wire gauge 0.5 mm

5605

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

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

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

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

5706 **Weighing stand**

5707 **Stand for lids and sealing caps**

Flowmeter
5708 ADM 1000

Foil press

5711	

Aluminium round foil

5712	130 x 0.03 mm, 1000 pieces

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
5811	220 g : 0.1 mg

Precision balance

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

5820	810 g: 0.01 g
5821	620 g: 0.01 g
5830	410 g: 0.001 g

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
Universal oven "UNB" Natural air convection For standard tempering tasks with a set temperature Digital (switch-off) clock, 99 hours, 59 min.	**UNB 100**	470/520/325	320/240/175	14	2/1	600/230	20	**6000**
	UNB 200	550/600/400	400/320/250	32	3/1	1100/230	28	**6001**
	UNB 300	630/600/400	480/320/250	39	3/1	1200/230	30	**6002**
	UNB 400	550/680/480	400/400/330	53	4/2	1400/230	35	**6003**
	UNB 500	710/760/550	560/480/400	108	5/2	2000/230	50	**6004**
Universal oven "UFB" forced airflow (fan) For standard tempering tasks with a (setpoint) temperature. Digital (switch-off) clock, 99 hours. 59 min.	**UFB 400**	550/680/480	400/400/330	53	4/2	1400/230	35	**6008**
	UFB 500	710/760/550	560/480/400	108	5/2	2000/230	50	**6009**

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
Incubator "INE" 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	**INE 200**	550/600/400	400/320/250	32	3/1	440/230	28	**6035**
	INE 300	630/600/400	480/320/250	39	3/1	500/230	30	**6036**
	INE 400	550/680/480	400/400/330	53	4/2	800/230	35	**6037**
	INE 500	710/760/550	560/480/400	108	5/2	900/230	50	**6038**
	INE 600	950/920/650	800/640/500	256	7/2	1600/230	87	**6039**
	INE 700	1190/1080/650	1040/800/500	416	9/2	1800/230	121	**6040**
	INE 800	1190/1605/750	1040/1200/600	749	14/2	2000/230	170	**6041**

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
"SNB" Sterilizer Natural air convection For standard tempering tasks with a (setpoint) temperature Digital (switch-off) timer to 99 hours, 59 min.	**SNB 100**	470/520/325	320/240/175	14	2/1	600/230	20	**6047**
	SNB 200	550/600/400	400/320/250	32	3/1	1100/230	28	**6048**
	SNB 300	630/600/400	480/320/250	39	3/1	1200/230	30	**6049**
	SNB 400	550/680/480	400/400/330	53	4/2	1400/230	35	**6050**

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
Refrigerated "ICP" PID process controller, from 0 to +60 °C, programmable, serial and parallel interfaces, motor-driven inner air circulation	**ICP 400**	558/967/486	400/400/330	53	4/2	500/230	68	**6070**
	ICP 500	718/1047/556	560/480/400	108	5/2	500/230	87	**6071**
	ICP 600	958/1335/656	800/640/500	256	7/2	700/230	144	**6072**
	ICP 700	1198/1495/656	1040/800/500	416	9/2	750/230	178	**6073**
	ICP 800	1198/1895/756	1040/1200/600	749	14/2	1200/230	227	**6074**

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)

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**

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

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	

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

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

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

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	

Hydrometer for boiler feed water

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

6700	

Alcoholmeter

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

6710	

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

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

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

Jar

for lactodensimeters, 265 x 35 mm Ø (inside)

6800	

Stand

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

6810	

Stand

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

6830

Dairy thermometer

with loop

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

Dairy thermometer

with loop

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

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

Dairy thermometer

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

7041	

Universal thermometer

mercury filling, blue

7045	−10 bis +100 °C: 1.0

Universal thermometer

alcohol filling, red

7046	−10 bis +100 °C: 1.0

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

Low-temperature laboratory thermometer

mercury filling, 280 x 8 x 9 mm

7081	−38 bis +50 °C: 1.0

Maximum-minimum rod thermometer

mercury filling, blue, 220 mm long

7095	−35 bis +50 °C: 1.0
7096	−10 bis +100 °C: 1.0

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)

Polymeter

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

7110	

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
7124	Needle sensor without visible pinhole for fast measurements, dia. 1.4 mm x 150 mm
7125	Sensor for frozen goods, screws in without pre-drilling, dia. 8 mm x 110 mm
7127	**TopSafe** Protective cover against contamination, water and impact

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$_{automatic}$).

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 °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 °C to –3 °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 at 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 °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 is 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 °C...25 °C) to −2 °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 °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 °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 thismethod, 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 procedure. 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 amplitiude should amount to 3 – 4 mm. If need be, the stirring road 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 automatic

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$_{automatic}$" 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 CryoStarautomatic 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$_{automatic}$
The device differs solely with respect to
the sample feed system of “CryoStar$_{automatic}$”.

7150	without thermal printer

CryoStar$_{automatic}$ (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/Comsumables

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$_{automatic}$

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 (≙ 0.00 °H)

Calibration standard “B”
7166 –0.557 °C, 250 ml in PE bottle (≙ -0.577 °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 °C, 250 ml in PE bottle (≙ -0.422 °H)

Calibration standard B
7187 –0.600 °C, 250 ml in PE bottle (≙ -0.621 °H)

Control standard C
7188 –0.512 °C, 250 ml in PE bottle (≙ -0.530 °H)

Lactometer

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

7500

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

Reference table

ADMI “Scorched Particle Standards 7650 of Dry Milks”, 4 stages

7650

Jolting volumeter

Type STAV 2003 for the determing 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 measuring cylinders are standardised by weight and graduation in conformity with DIN 53194.

7660 Jolting volumeter

7661 Replacement measuring cylinder

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

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

7825	Peroxtesmo MI, pack of 100 testing strips

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

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

CMT test liquid

7930 1 litre

7931 5 litres

LOVIBOND comparator 2000

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

8010

Test tube

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

8100

Rubber stopper

with glass tube and cotton wool

8110

Coli tube

20 x 10 mm, 100 pieces

8120

Durham tube

40 x 8 mm, 100 pieces

8130

Coli test rack

stainless steel, sterilizable

8140

Metering syringe

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

8170

Sterilization box of stainless steel

8190 300 x 65 mm, for pipettes

8191 420 x 65 mm

CAP-O-TEST seal

various colours

8200

Kapsenberg cap

various colours

8201

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	

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

Smear needle
rectangular bend

8340	

Spatula, Drigalsky type
glass

8350	

Inoculation wire
stainless steel, 1 m

8370	

Burri loop
platinum, calibrated

8380	0.001 ml
8381	0.01 ml

Needle holder
for inoculation wire loop

8382	

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

8400	

Cover glass

18 x 18 mm

8401

Tweezers for slides

8410

Staining stand

according to *Bongert*

8420

Staining cuvette

rectangular

8430

Wire mesh

8440 with ceramic centre

8441 without ceramic centre

Tripod

for Bunsen burner

8450

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^2 and 1/9-cm^2 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

Aerobic germ collector

Determination of germs in production and filling

8506	

Bench autoclaves
with electromagnetic controls

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

Bench autoclaves with microprocessor controls

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

Stand autoclaves
with electromagnetic controls

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

Upright autoclaves with microprocessor controls

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

8541	CV-EL 12 L GS Volumen 12 l volume, weight 6.1 kg, diameter 24 cm, internal height 24 cm, useful diagonal 32 cm
8542	CV-EL 18 L GS 18 l volume, weight 7.7 kg, diameter 24 cm, internal height 38 cm, useful diagonal 43 cm
8543	Sieve basket
8544	Instrument board, stainless steel 18/10, Ø 215 mm, 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

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

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 course, 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

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

Trinocular miscroscope

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

8762

Automatic water distillation apparatus

for the generation of distilled water with a conductivity under 2.3 µS 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

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

Water distillation apparatus, Mono, glass

Distillation volume: 3.5 l. per hr.
Cooling water consumption: 45 l. per hr.
Conductivity: 0.85 µs
ca. 600 x 200 x 180 mm, 4 kg

8775

Water bath

7 l with gable cover
240 x 210 x 140 mm, ca. 11 kg

8786	

Water bath

22 l with gable cover
350 x 290 x 220 mm, ca. 17 kg

8788	

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

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	

Cutlure 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

Weighing dishes

low shape, with knob lid

9120	35 x 30 mm
9121	50 x 30 mm

Digital burette µl 10

certificated conformity to 100 ml,
smallest adjustment 10 µl.

9190	

Desiccator

9201	glass, 250 mm, Novus type, flat flange with knob lid
9211	desiccator plate, porcelain

Wash bottles

polyethylene

9230	100 ml
9231	250 ml
9232	500 ml
9233	1000 ml

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	

Bosshead

9406	swivel type

Clamps

9407	25 mm, without bosshead
9408	60 mm, without bosshead

Retort ring

160 mm, with bosshead

9409	

Burette clamps

9410	single, with bosshead
9411	double, with bosshead

Laboratory clock

0 – 60 min, with alarm

9440	

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	

Apportioning devices

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

9480	0,4 – 2 ml : 1/10
9481	2 – 10 ml : 1/5
9482	10 – 50 ml : 1/1
9483	20 – 100 ml : 2/1

Microliter pipettes

with fixed volumes, in sizes of 5 – 1000 µl

9490	

Microliter pipettes

with variable volumes and disposable tips

9495	10 – 100 µl
9496	20 – 200 µl
9497	200 – 1000 µl

Pipette tips

9510	1 – 200 µl (yellow), 1000 pieces
9511	50 – 1000 µl (blue), 1000 pieces

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