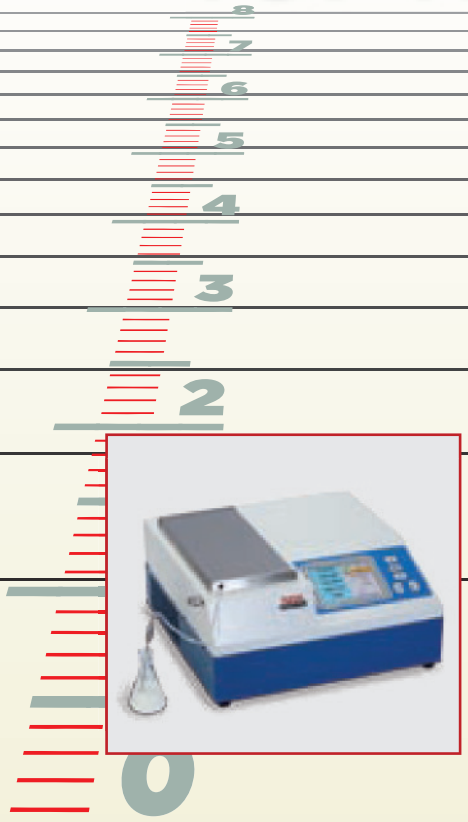
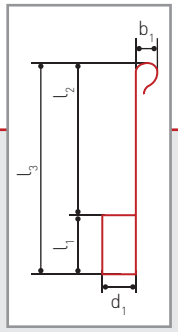
FUNKE GERBER

LABORATORY CATALOGUE

for milk analysis

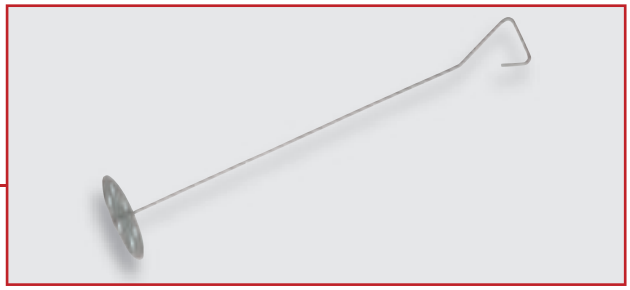


Milk sampler
stainless steel,
with valve for automatic drainage

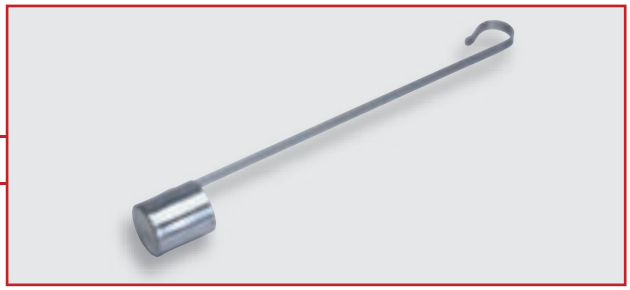


3000	**1 ml**	l_3 = 375 mm, l_2 = 343 mm, l_1 = 32 mm, b_1 = 31 mm, d_1 = 10 mm
3001	**2 ml**	l_3 = 405 mm, l_2 = 355 mm, l_1 = 50 mm, b_1 = 35 mm, d_1 = 10 mm
3003	**5 ml**	l_3 = 290 mm, l_2 = 235 mm, l_1 = 55 mm, b_1 = 31 mm, d_1 = 14 mm
3004	**10 ml**	l_3 = 305 mm, l_2 = 235 mm, l_1 = 70 mm, b_1 = 31 mm, d_1 = 18 mm
3007	**20 ml**	l_3 = 315 mm, l_2 = 240 mm, l_1 = 75 mm, b_1 = 35 mm, d_1 = 30 mm
3008	**40 ml**	l_3 = 335 mm, l_2 = 235 mm, l_1 = 100 mm, b_1 = 32 mm, d_1 = 28 mm
3010	**50 ml**	l_3 = 365 mm, l_2 = 240 mm, l_1 = 125 mm, b_1 = 32 mm, d_1 = 28 mm
3011	**100 ml**	l_3 = 370 mm, l_2 = 235 mm, l_1 = 130 mm, b_1 = 32 mm, d_1 = 38 mm

Milk stirrer
stainless steel, perforated disk,
3021 Ø 160 mm, 770 mm long



Dipper
aluminium with spout, handle aprox. 50 cm long



3030	**125 ml**	l_3 = 625 mm, l_2 = 540 mm, l_1 = 85 mm, b_1 = 53 mm, d_1 = 43 mm
3031	**250 ml**	l_3 = 620 mm, l_2 = 540 mm, l_1 = 80 mm, b_1 = 53 mm, d_1 = 65 mm

Scoop
stainless steel

3033	**130 ml**	l = 350 mm, inner scoop Ø = 79 mm
3034	**250 ml**	l = 465 mm, inner scoop Ø = 97 mm
3035	**450 ml**	l = 480 mm, inner scoop Ø = 118 mm

Milk sample bottle
80 ml, PE without metal bottom
(e.g. for art. no. 3510, 3530)
3040 (for cap see art. no. 3043)

Milk sample bottle

3041	**50 ml,** PP with metal bottom (e.g. for art. no. 3510, 3530)
3042	**Stopper** with groove (for art. no. 3041)
3043	**Cap** (for art. no. 3040)

Rubber stopper

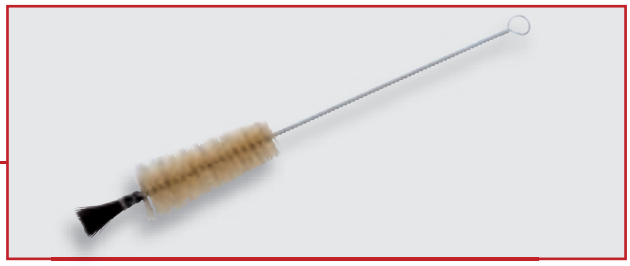
for special solubility index tubes art. no. 3637

3050	19 x 24 x 25 mm

Cleaning brush

(for art. no. 3040, 3041, 3637)

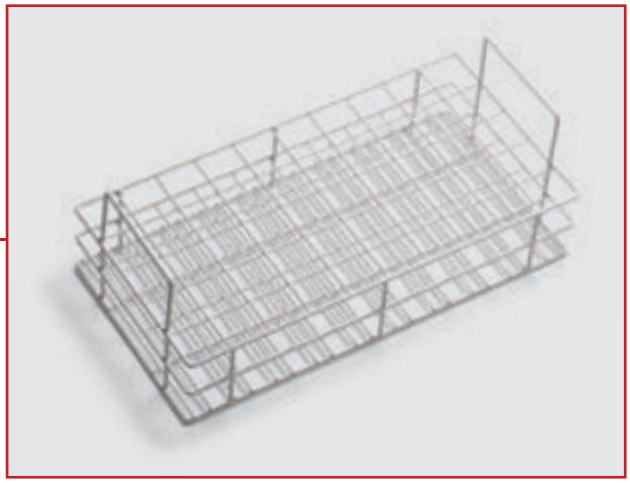
3080	length: 300 mm



Wire cradle

plastic-coated wire, for 50 bottles,

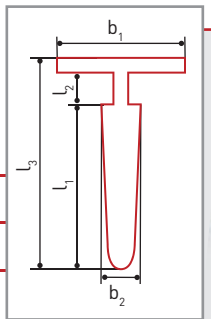
3091	each 50 ml (for art. no. 3041)



Cheese trier

chrome-nickel steel, with plastic handle

3120	l_1 = 125 mm, l_2 = 60 mm, l_3 = 190 mm, b_1 = 85 mm, b_2 = 13 mm
3121	l_1 = 140 mm, l_2 = 48 mm, l_3 = 205 mm, b_1 = 80 mm, b_2 = 19 mm
3122	l_1 = 150 mm, l_2 = 75 mm, l_3 = 225 mm, b_1 = 80 mm, b_2 = 21.5 mm



Cheese trier
100% stainless steel

3124 l_1 = 125 mm, l_2 = 40 mm, l_3 = 165 mm, b_1 = 65 mm, b_2 = 15 mm

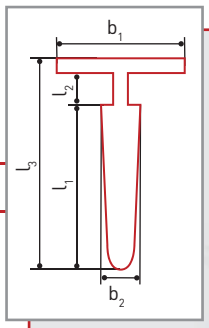
Milk powder collector
stainless steel for aprox. 230 ml,

3125 exterior aprox. Ø = 28 mm, fill length = 375 mm

Butter trier
chrome-nickel steel, with metal handle

3130 l_3 = 343 mm, l_2 = 73 mm, l_1 = 255 mm, b_1 = 82.5 mm, b_2 = 23 mm

3131 l_3 = 410 mm, l_2 = 75 mm, l_1 = 320 mm, b_1 = 80 mm, b_2 = 22 mm



BagMixer 400 with window
capacity: 80 – 400 ml, 230 V/50 Hz

3139 17 kg, 400 x 270 x 260 mm

BagMixer 400 without window
capacity: 80 – 400 ml, 230 V/50 Hz

3140 17 kg, 400 x 270 x 260 mm

Accessories for BagMixer 400

3141 **Disposable plastic bag** 400 ml, sterile

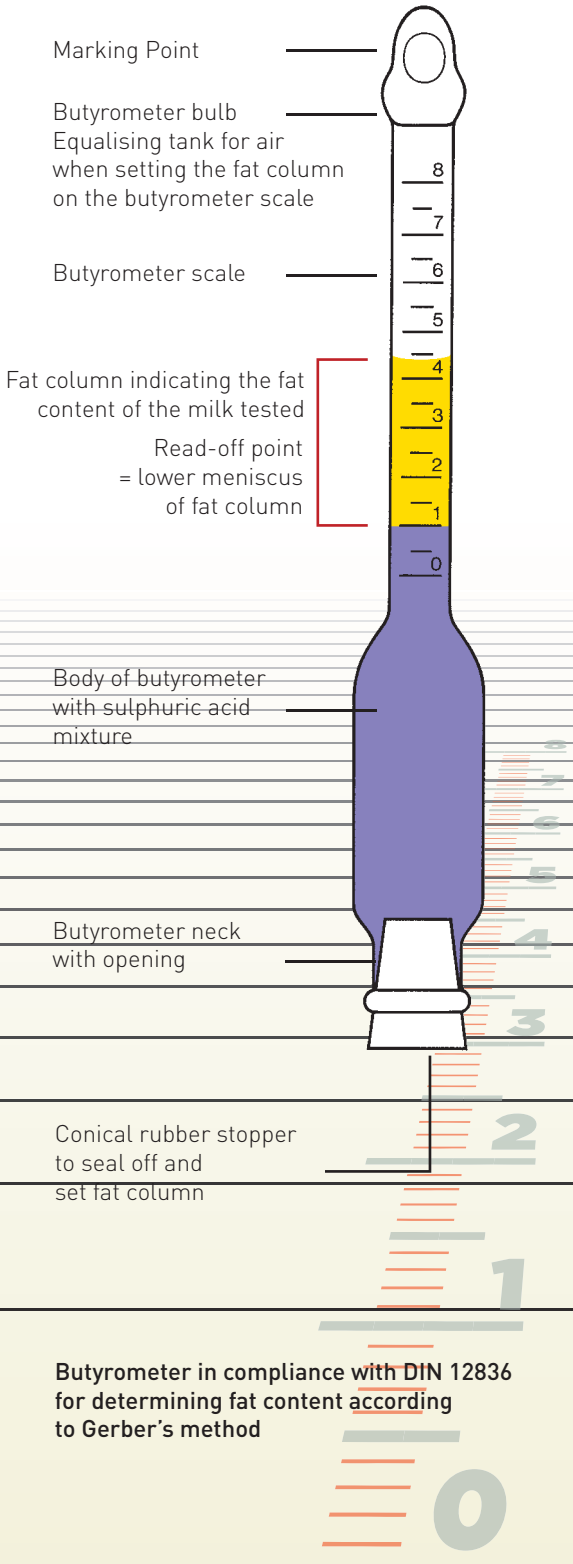
3142 **Filter bag,** 400 ml, sterile

3143 **Bag clasps**

3144 **Stand** for 10 bags

BUTYROMETRIC DETERMINATION OF FAT CONTENT ACCORDING TO GERBER'S METHOD

by graduate chemist Alfred Toepel



Butyrometer in compliance with DIN 12836 for determining fat content according to Gerber's method

BUTYROMETER

The foundation of the Gerber method is the butyrometer. The original butyrometer with the rounded neck, invented by Dr. N. Gerber, was developed into the well-known flat butyrometer under the management of Paul Funke, accompanied by his glassblowers. While the original Gerber butyrometer is hardly employed anymore, the **original FUNKE-GERBER** butyrometers with the flattened scale neck are used almost exclusively. The flattened scale neck increases comfort when reading off values and improves precision.

These flat butyrometers are manufactured to standards of unmatched quality and the highest production control. Each individual butyrometer is individually gauged and correspondingly scaled. The high level of precision in setting the scale divisions and volumes guarantees exact test results.

FUNKE-GERBER butyrometers are precision instruments with a flattened scale section, manufactured from acid-proof glass (borosilicate) in compliance with national (DIN) and international (ISO/IDF etc.) standards. Our over 100 years of production experience and high assembly numbers enable us to offer the highest quality at low prices. You will find a multitude of different butyrometers for various tasks in the following pages of this catalogue.

In Germany and some other countries, butyrometers must be officially calibrated. These butyrometers are labelled with an engraved mark (see adjacent figure). Although all other butyrometers are not officially calibrated, they are manufactured in the same way and meet the same high quality standards.

All butyrometers come in standard packs of 10.
Please place your order in units of 10.

Precision butyrometer

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

3150	0 – 4 %: 0.05 (accessory: 3280)

Milk butyrometer

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's method, with rounded scale

3160	0 – 1 %: 0.01, with open bulb (accessories: 3280, 3290)
3160-G	0 – 1 %: 0.01, with closed bulb (accessory: 3280)

Skim milk butyrometer

according to Kehe's method

3161	0 – 4 %: 0.05 (accessory: 3280)
3162	0 – 5 %: 0.05 (accessory: 3280)

Skim milk butyrometer
according to Siegfeld's method

3164	0 – 0.5 %: 0.02 (accessory: 3280)

Powdered milk butyrometer
according toTeichert's method

3170	0 – 35 %: 0.5, (accessory: 3310)
3171	0 – 70 %: 1.0, (accessory: 3310)

Ice cream and condensed milk butyrometer
according to Roeder's weighing method

3180	0 – 6 – 12 %: 0.1, (accessories: 3290, 3300, 3320)
3181	0 – 15 %: 0.2, (accessories: 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
according to Roeder's weighing method

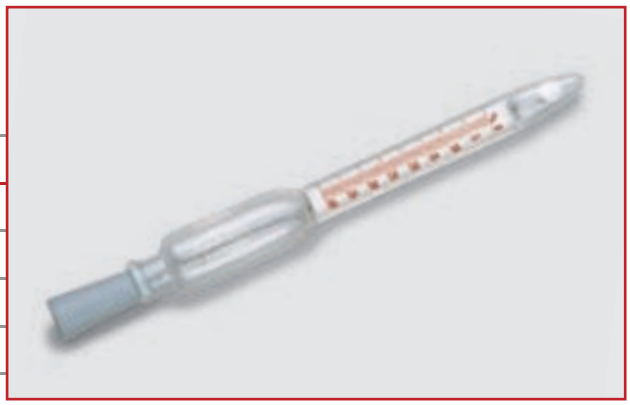
3200	0 – 5 – 40 %: 0.5 (accessories: 3290, 3300, 3320)
3201	0 – 30 – 55 %: 0.5 (accessories: 3290, 3300, 3320)
3202	0 – 50 – 75 %: 0.5 (accessories: 3290, 3300, 3320)
3203	0 – 5 – 70 %: 1.0 (accessories: 3290, 3300, 3320)

Cream butyrometer
according to Schulz-Kley's weighing method
with closed bulb

3208	0 – 5 – 40 %: 0.5 (accessory: 3280)

Cream butyrometer
according to Koehler's measuring method

3209	0 – 30 %: 0.5 (accessory: 3280)
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
according to Roeder's weighing method

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

Cheese butyrometer
according to Van Gulik's weighing method

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

Curd butyrometer
weighing method

3240 0 – 20 %: 0.2 (accessories: 3290, 3300, 3321)

Food butyrometer
according to Roeder's weighing method

3250 0 – 100 %: 1.0 (accessories: 3290, 3300, 3320)

Free fat butyrometer
for determining free fat content in milk and cream,

3252 complete with screw cap, scale 0.002 g

Babcock bottle
without stopper

3254 0 – 8 % for milk, stopper on request

Babcock bottle
without stopper

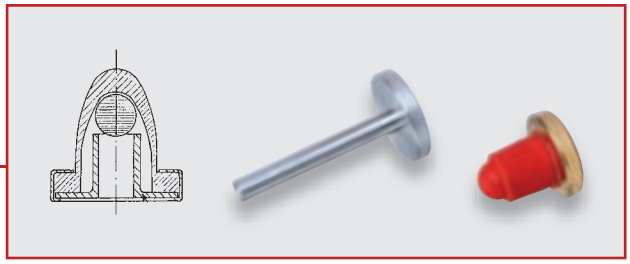
3256 0 – 20 % for cream (accessory: 3290)

Babcock bottle
without stoppper

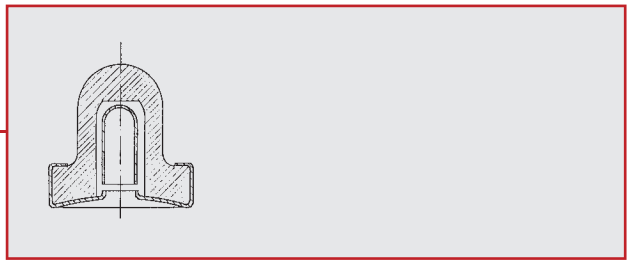
3258 0 – 60 % for cream and cheese (accessory: 3290)

Patent closure FIBU
for all measuring method butyrometers

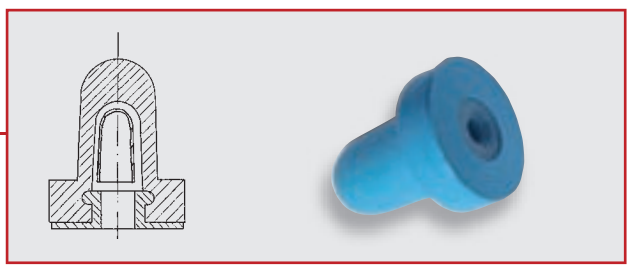
FIBU without adjustment key
3260 (Fig. with adjustment key art. no. 3270)



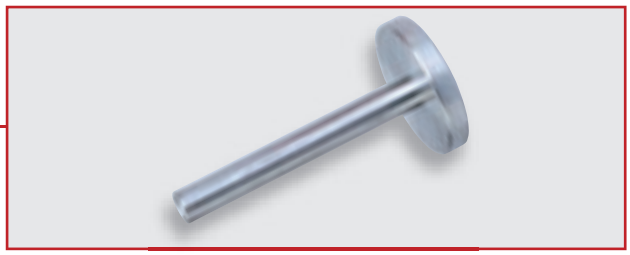
3261 **Patent closure GERBAL**
for all measuring method butyrometers



Patent closure NOVO
3262 for all measuring method butyrometers



3270 **Adjustment key**
for patent closure FIBU



3271 **Adjustment key**
for patent closure GERBAL

3272 **Adjustment key**
for patent closure NOVO

Rubber stopper, conical
for all measuring method butyrometers

3280 11 x 16 x 43 mm

Rubber stopper for sealing the bulbs
of all weighing method butyrometers

3290 9 x 13 x 20 mm

Rubber stopper with hole
for all weighing method butyrometers

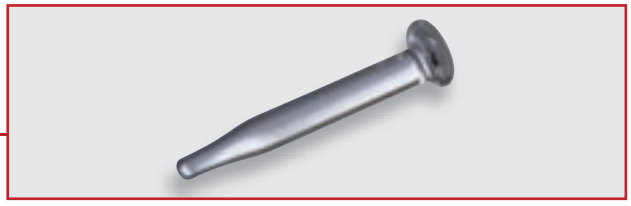
3300 17 x 22 x 30 mm

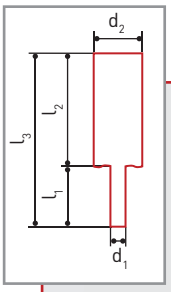
Rubber stopper without hole
for powdered milk butyrometer
(also suitable for the extraction tube acc. to Mojonnier
art. no. 3870, 3871)

3310 17 x 22 x 30 mm

Glass nail
for powdered milk butyrometer

3315 length: 41.5 mm





Cream beaker, unperforated

for ice cream and condensed milk butyrometers and cream butyrometers according to Roeder's method

3320

l_3 = 75 mm, l_2 = 49 mm, l_1 = 26 mm, d_2 = 15 mm, d_1 = 5 mm

Cheese beaker, perforated

for butyrometers according to Van Gulik's method

3321

l_3 = 75 mm, l_2 = 49 mm, l_1 = 26 mm, d_2 = 15 mm, d_1 = 5 mm

Cheese beaker, perforated, short design

for butyrometers according to Van Gulik's method

3321-001

l_3 = 66 mm, l_2 = 38 mm, l_1 = 27.8 mm, d_2 = 15 mm, d_1 = 5 mm

Weighing boat for butter

for butyrometers according to Roeder's method

3322

l_3 = 75 mm, l_2 = 45 mm, l_1 = 30 mm, d_2 = 15 mm, d_1 = 5 mm

Butter beaker with 2 holes

3323

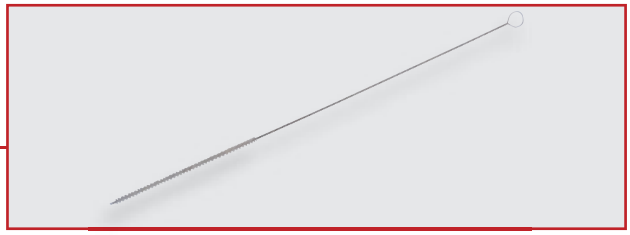
l_3 = 75 mm, l_2 = 48 mm, l_1 = 27 mm, d_2 = 15 mm, d_1 = 5 mm

Cleaning brush
for butyrometer body

3324 length: 270 mm

Cleaning brush
for butyrometer neck

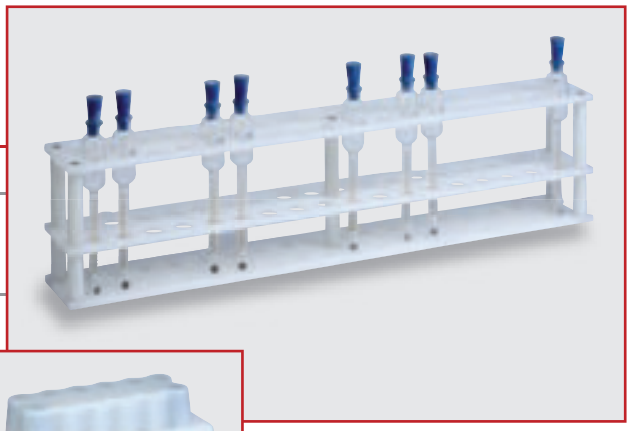
3325 length: 278 mm



Butyrometer stand
(also suitable for special solubility index tubes, art. no. 3637)

3330 for 36 samples (PP plastic)

3331 for 12 samples (PP plastic)



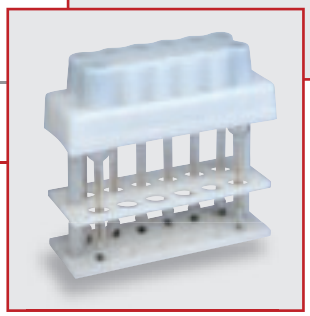
Shaking stand

3332 for 12 samples (PP plastic)

Protective shaking hood

3340 for 36 samples (PP plastic), compatible with art. no. 3330

3341 for 12 samples (PP plastic) compatible with art. no. 3331



Permanent automatic dispenser
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
consists of stand panel, stem and retaining ring with socket

3400 10 ml for 1 permanent automatic dispenser

3401 1 ml for 1 permanent automatic dispenser

3402 10 ml / 1 ml for 2 permanent automatic dispensers

Automatic tilt measure Superior
with rubber stopper and storage bottle 500 ml / 250 ml

3420	10 ml sulphuric acid
3421	1 ml amyl alcohol

Weighing pipettes
curved

3425	**1 ml,** d = 6 mm
3426	**2 ml,** d = 8 mm
3427	**3 ml,** d = 9 mm
3428	**5 ml,** d = 6 mm
3429	**10 ml,** d = 7 mm

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 design
3438	25 ml, short design

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
3460 PVC, for pipettes of various sizes

Cleaning brush
for pipettes

3470 length: 470 mm

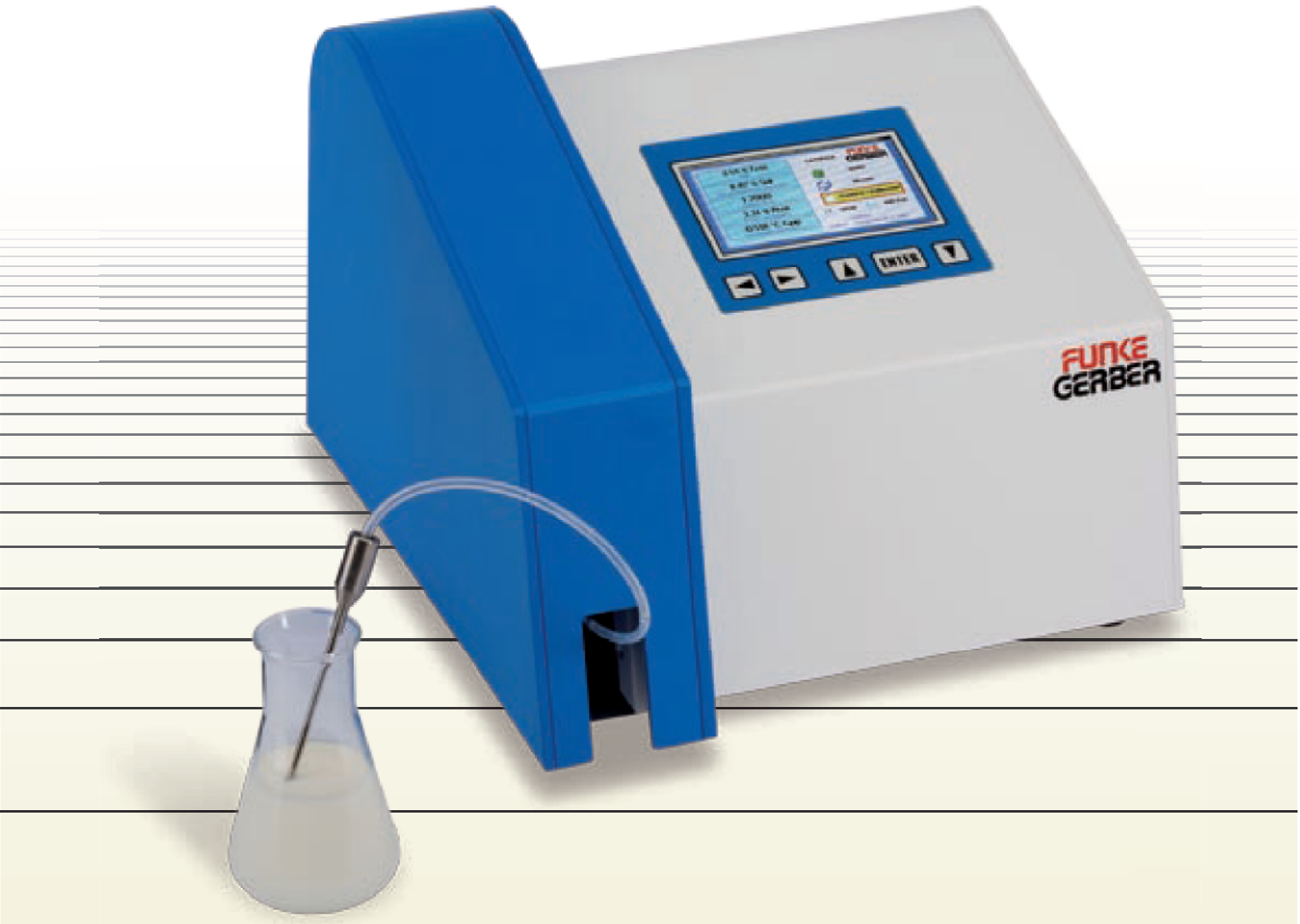
3480 **Safety goggles**

LactoStar

(article no. 3510)

LactoFlash

(article no. 3530)



Inexpensive chemical analysis device for the fast and accurate determination of fat and SNF content

Countless installations in institutes and laboratories all over the world attest to the outstanding quality, reliability and accuracy of this chemical analysis device.

The following parameters can be determined quickly and reliably with just one measurement:

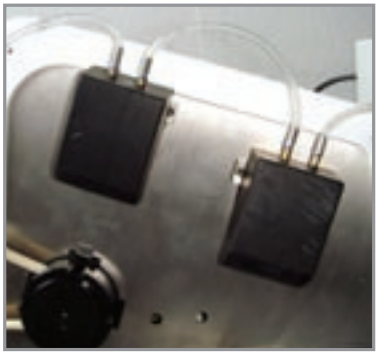
Parameter	Resolution	Reproducibility (r)	Measuring range
Fat:	0.01 %	0.02 % in 0 ... 5 % range 0.2 % in 5 ... 30 % range	0 ... 30 %
SNF:	0.01 %	0.04 %	0 ...15 %

Further parameters are determined based on calculational algorithms:

Parameter	Resolution	Reproducibility (r)	Measuring range
Density:	0.0001	0.001	no limit
Protein:	0.01 %	0.03 %	no limit / calculated value
Lactose:	0.01 %	0.02 %	no limit / calculated value
Gpp:	0.001°C	0.002°C	no limit / calculated value

Quick and easy replacement of pump heads and measuring cells.

The pump head (wear part) can be replaced easily without the use of tools. This is done by removing the blue side cover sheet and pulling off the old pump head by pushing in on both side tabs simultaneously. The new pump head is set on and pressed down on until both tabs snap into place.



If one of the two measuring cells has to be replaced, it can simply be pulled out of the plug connection. The new measuring cell is plugged in.

LactoFlash

Operation

The instrument has 4 arrow keys and an "enter" key. With the "enter" key, the function or action, which has been selected with the help of the arrow keys, is started.

Language selection

Two menu languages are available: German and English.

Calibration

For customer-specific calibration, the already existing basic calibrations are merely adjusted. This is done with a simple two point calibration (A calibration and B calibration). Each parameter is calibrated in only one step. A clear calibration menu simplifies the entry of reference values.

Technical specifications:

Sample capacity:	up to 120/h
Sample volume:	from 12 ml to 20 ml
Interfaces:	1 x parallel, 1 x serial (RS 232 / 9.600 baud)
	6 volt electrical power supply for thermal printer (order no. 7151)
Connection values:	230V / 115V AC (50..60 Hz) 60 W
Dimensions:	30 x 24 x 33 cm (w x h x d)
Weight:	5 kg (net)

Ordering data

Article no.	Description
3530	LactoFlash
7151	Thermal printer, incl. 1 thermal paper roll
3516	Hardware standardisation
3563	Cleaning agent, 500 ml

Accessories (optional)

3040	Milk sample bottle without metal bottom, 80 ml / PE
3041	Milk sample bottle with metal bottom, 50 ml / PP
7157	Thermal paper roll for thermal printer

Spare and wear parts

3530-023	Hose pump, complete
3530-023 A	Pump head (attachment for hose pump)

LactoStar

newly developed instrument
for the routine testing of milk
fat, protein, lactose, SNF, freezing point

see p. 36 for a more detailed description

3510 accessories included

Accessories:

Thermal printer	art. no. 7151
Canister	art. no. 3511
Hardware standardisation	art. no. 3516
Cleaning agent	art. no. 3563

Replacement parts:

3510-023 Hose pump, complete
3510-023A Attachment for hose pump

Canister

space saving design, 5 L

3511 334 x 64 x 334 mm (w x d x h)

Hardware standardisation,

for art. no. 3510, 3530

3516 250 ml

REFERENCE MATERIAL

Reference milk, 1.5 % fat class
The exact values depend on the batch.
3517 *They are included in the delivery.*

Reference milk, 3.5 % fat class
The exact values depend on the batch.
3518 *They are included in the delivery.*

Reference cream, 30 % fat class
The exact values depend on the batch.
3519 *They are included in the delivery.*

Reference milk, 0.1 % fat class
The exact values depend on the batch.
3521 *They are included in the delivery.*

LactoFlash

Chemical analysis device for the fast
and accurate determination of fat and SNF content.
3530 accessories included

Accessories:

Thermal printer:	art. no. 7151
Hardware standarisation	art. no. 3516
Cleaning agent	art. no. 3563

Replacement parts:

3530-023 Hose pump, complete
3530-023A Attachment for hose pump

Shaking water bath

stainless steel with cover,
shaking stand and 18 tubes

Technical specifications:

PID controller with PT-100 temperature sensor

Setting:	in 0.1°C increments
Accuracy:	+/– 0.1°C
Connection values:	230 V / 8.7 A, 2000 W
Volume:	22 L
Internal dimesions:	350 x 290 x 220 mm
External dimensions:	578 x 436 x 296 mm
3550 Weight:	approx. 17 kg net

Butyrometer bucket

pressure cast light metal
accessory for SuperVario-N centrifuge
(art. no. 3680 p. 48)

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

Babcock bucket

accessory for SuperVario-N centrifuge
(art. no. 3680)

3632

Bucket for ADPI tubes

3633 accessory for SuperVario-N centrifuge (art. no. 3680)

Solubility index tube

ADPI, 50 ml, graduated from 0 – 20 ml,
mark at 50 ml

3634 see SuperVario-N (art. no. 3680)

Stand

3636 for 6 tubes (art. no. 3634)

Special solubility index tubes

for determining the solubility of powdered milk
fit in butyrometer tube (art. no. 3641)
for use in the Nova Safety bench centrifuge
(art. no. 3670)

for compatible rubber stoppers, see art. no. 3050

3637 for compatible stand, see art. no. 3331

3638 **Centrifuge tube**
with 2 stoppers according to Friese's method

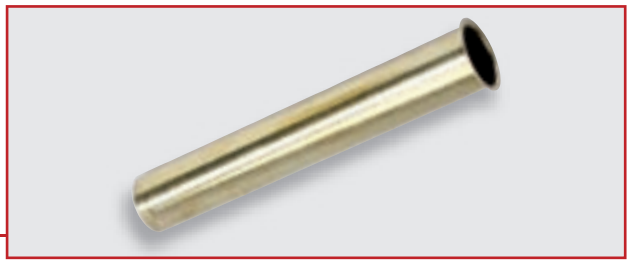
3639 **Homogenisation pipette**
with a mark at 5 ml and 25 ml, incl. stopper

external diameter: 24 mm
length without stopper: 152 mm

3641 **Replacement butyrometer tube**
for Nova Safety art. no. 3670

brass, with flanged edge

external diameter:	27 mm
internal diameter:	25.8 mm
length:	170 mm



3670 **Nova Safety centrifuge**

Thousands of these centrifuges have been installed in laboratories all over the world. They are characterized by extreme robustness and reliability. This table centrifuge with the angular rotor can be used for the determination of fat content according to Dr. N. Gerber's method as well as for the determination of the solubility of powdered milk.

Properties:
Automatic interlocking lid
Automatic brake (braking time < 8 s)
Centrifugation timer (digital)
Heater, thermostatic set point at 65°C
Capacity: max. 8 butyrometer

Technical specifications:

RCF:	350 g +/- 50 g
rpm:	350 U/min
Effective radius:	160 mm
Weight:	13 kg
Dimensions (l x w x h):	470 x 380 x 230 mm

SuperVario-N

MULTIPURPOSE CENTRIFUGE FOR THE DAIRY LABORATORY

This centrifuge stands out due to its exceptional engine smoothness. That it is largely free of vibration and has swing out butyrometer buckets positively effects the life-time of your butyrometers. Correspondingly, good results (reproducibility and comparability) are assured. For these reasons, the SuperVario-N is often used as a reference centrifuge for calibration purposes. Due to its versatility, the SuperVario-N is widely accepted in dairy laboratories. High versatility means free programmability of rpm, temperature and time ("free mode") as well as 4 set programs for the following tests:

Dr. N. Gerber's method (determination of fat content)
Roese-Gottlieb's method (determination of fat content, reference method)*
Babcock's method (determination of fat content)
Solubility (determination of the solubility of powdered milk)

* Operation only possible under observation of respective safety regulations

Properties:

- Stainless steel housing
- Programmable rotor speed from 600 to 1130 rpm in increments of 10 rpm (corresponds to a g-value of 77 to 372 g)
- Programmable heater up to 68°C in 1°C increments
- Programmable centrifugation time from 1 to 99 minutes
- Automatic interlocking safety lid
- Automatic shut down in case of unbalance
- Automatic brake

Technical specifications:

Connection values:	230 V/50 ... 60 Hz/1200 VA
Weight, empty:	26 kg
Total height with lid:	460 mm
Filling height:	370 mm
Rotor speed range:	600 to1130 rpm**
Temperature range:	room temperature up to 68°C

** For the determination of fat content due to Gerber's method, a g-value of 350 g ± 50 g is required. With a **r**elative **c**entrifugal **f**orce **(RCF)** of 365 g in its unloaded state (idle running) and 340 g in its fully loaded state, the SuperVario-N fulfils the standard specifications in an exemplary manner.

MILK LABORATORY CENTRIFUGES

Centrifuges for butyrometric determination of fat content according to Dr. N. Gerber

K. Schaefer, graduate engineer, reports

QUIET OPERATION

In order to avoid glass breakage and to increase butyrometer lifetime, it is very important that the centrifuge operates with the lowest level of vibration possible. The different types of centrifuges are:

TYPE 1: Centrifuge with flat-lying butyrometers

This way of loading butyrometers guarantees that they will be gently treated during centrifugation. However, this type of centrifuge tends to lead to a renewed intermixing of the separated phases after the centrifugal process.

TYPE 2: Centrifuge with angular rotor

The butyrometers are held in the angular rotor at a fixed angle. Unfortunately, this causes the long, thin butyrometer necks considerable stress. This design is predominately found in small, inexpensive centrifuges.

TYPE 3: Centrifuge with swing-out butyrometer holders

The butyrometers swing out horizontally in mounted movable holders. The butyrometers are only stressed along their vertical axis. For this reason, this type of centrifuge is preferable.

These special centrifuges differ from other laboratory centrifuges in several ways. The following points should be taken into consideration when purchasing and using centrifuges for the determination of fat content according to Dr. N. Gerber's method:

UNBALANCE

The centrifuge should be equipped with an unbalance shut-down mechanism. In case of glass breakage (butyrometer breakage) or other types of unbalance, the centrifuge shuts itself off automatically.

INTERLOCKING LID

For safety purposes, more and more centrifuges are being equipped with an interlocking lid.

HEATING

Heating a centrifuge reduces butyrometer cooling. This means that the subsequent tempering time in the water bath can be kept to a minimum and leads to a more reliable realization of the analysis. The temperature in the centrifuge tank should be at least 50°C.

SET-UP

The centrifuge must be set up on a flat, secure surface (e.g. a stable tabletop or platform). The lowest possible humidity and a room temperature of less than 30°C are preferable.

ROUTINE OPERATION/MAINTENANCE

The centrifuge should be loaded in such a way that it is as balanced as possible, i.e. the butyrometers must always be evenly positioned. In case of glass breakage, the centrifuge should be cleaned immediately after standstill is reached. This prevents unnecessary corrosion and guarantees a long lifetime.

RPM

The determination of fat content according to Gerber's method specifies a **"RCF"** (**r**elative **c**entrifugal **f**orce) or 350 g with a maximum variation of ± 50 g. The RCF does not only depend on the rpm but also on the effective radius. The effective radius is defined as the distance between the rotor and the outer end of the butyrometer. For this reason, the rpm of different centrifuge types varies as a function of their respective radii. What is important is that the rpm is constant or only changes negligibly (within the range of tolerance, see above), depending on whether the centrifuge is fully or only partially loaded.

The **RCF** is calculated in the following way:

$$RCF = 1{,}12 \times 10^{-6} \times R \times N^2$$

$$N = \sqrt{\frac{RCF}{1{,}12 \times 10^{-6} \times R}}$$

whereby:
R = effective horizontal radius in mm;
N = revolutions per minute [min^{-1}].

SYNOPTICAL TABLE OF THE DEPENDENCE OF G-FORCE AND RPM

rpm (min $^{-1}$)	Head A (ø=52 cm) g force	Head B (ø=38 cm) g force	Head C (ø=38 cm) g force
600	104.8 g	76.6 g	76.6 g
610	108.4 g	79.2 g	79.2 g
620	111.9 g	81.8 g	81.8 g
630	115.6 g	84.5 g	84.5 g
640	119.3 g	87.2 g	87.2 g
650	123.0 g	89.9 g	89.9 g
660	126.8 g	92.7 g	92.7 g
670	130.7 g	95.5 g	95.5 g
680	134.7 g	98.4 g	98.4 g
690	138.6 g	101.3 g	101.3 g
700	142.7 g	104.3 g	104.3 g
710	146.8 g	107.3 g	107.3 g
720	151.0 g	110.3 g	110.3 g
730	155.2 g	113.4 g	113.4 g
740	159.5 g	116.5 g	116.5 g
750	163.8 g	119.7 g	119.7 g
760	168.2 g	122.9 g	122.9 g
770	172.7 g	126.2 g	126.2 g
780	177.2 g	129.5 g	129.5 g
790	181.7 g	132.8 g	132.8 g
800	186.4 g	136.2 g	136.2 g
810	191.1 g	139.6 g	139.6 g
820	195.8 g	143.1 g	143.1 g
830	200.6 g	146.6 g	146.6 g
840	205.5 g	150.2 g	150.2 g
850	210.4 g	153.7 g	153.7 g
860	215.4 g	157.4 g	157.4 g
870	220.4 g	161.1 g	161.1 g
880	225.5 g	164.8 g	164.8 g
890	230.7 g	168.6 g	168.6 g
900	235.9 g	172.4 g	172.4 g

Drehzahl (min $^{-1}$)	Head A (ø=52 cm) g force	Head B (ø=38 cm) g force	Head C (ø=38 cm) g force
910	241.1 g	176.2 g	176.2 g
920	246.5 g	180.1 g	180.1 g
930	251.9 g	184.1 g	184.1 g
940	257.3 g	188.0 g	188.0 g
950	262.8 g	192.1 g	192.1 g
960	268.4 g	196.1 g	196.1 g
970	274.0 g	200.2 g	200.2 g
980	279.7 g	204.4 g	204.4 g
990	285.4 g	208.6 g	208.6 g
1000	291.2 g	212.8 g	212.8 g
1010	297.1 g	217.1 g	217.1 g
1020	303.0 g	221.4 g	221.4 g
1030	308.9 g	225.8 g	225.8 g
1040	315.0 g	230.2 g	230.2 g
1050	321.0 g	234.6 g	234.6 g
1060	327.2 g	239.1 g	239.1 g
1070	333.4 g	243.6 g	243.6 g
1080	339.7 g	248.2 g	248.2 g
1090	346.0 g	252.8 g	252.8 g
1100	352.4 g	257.5 g	257.5 g
1110	358.8 g	262.2 g	262.2 g
1120	365.3 g	266.9 g	266.9 g
1130	371.8 g	271.7 g	271.7 g
1140	378.4 g	276.6 g	276.6 g
1150	385.1 g	281.4 g	281.4 g
1160	391.8 g	286.3 g	286.3 g
1170	398.6 g	291.3 g	291.3 g
1180	405.5 g	296.3 g	296.3 g
1190	412.4 g	301.3 g	301.3 g
1200	419.3 g	306.4 g	306.4 g

Example:
A centrifuge with an effective radius of 260 mm necessitates an rpm of 1100 in order to reach the required RCF of 350 g.

3680-L

Safety centrifuge for fat content determination

according to Roese-Gottlieb's method

3680

SuperVario-N

multi-purpose centrifuge for all butyrometers

see p. 48 for more details

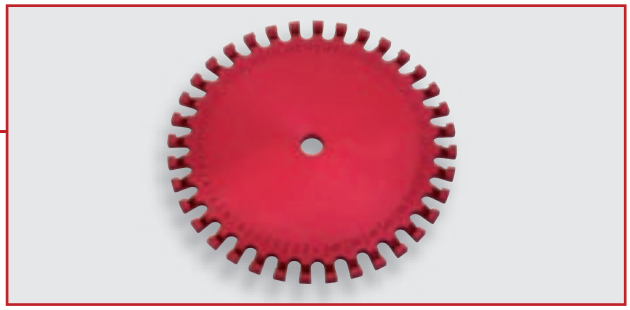
Accessories for SuperVario-N

3685

Head A

centrifuge head for a maximum
of 36 butyrometer buckets or 18 Babcock buckets
Radius of head A: 260 mm

Accessories:
Butyrometer bucket: art. no. 3631, p. 46
Babcock bucket: art. no. 3632, p. 46



3686

Head B

centrifuge head (protective tank)
for a maximum of 8 Mojonnier tubes
Radius of head B: 190 mm

Accessory:
Mojonnier tubes: art. no. 3870, 3871, p. 55

3687

Head C

centrifuge head
for a maximum of 6 buckets for solubility index tubes
Radius of head C: 190 mm

Accessories:
Bucket for solubility index tubes: art. no. 3633, p. 46
Solubility index tube (ADPI glass): art. no. 3634, p. 46

WB-436 D universal water bath (digital)
digital temperature display (actual value)
digital set-point temperature control
PT 100 sensor (platinum sensor)
stop watch (1 to 99 min. with acoustic signal)

stainless steel inner and outer casing
external heating: heating elements are located separately in the casing
protection against overheating (even when tank is empty)
use with distilled water preferable

Technical specifications:

Temperature range:	up to 100°C
Connection values:	230 V / 50 Hz ... 60 Hz / 1000 W
Dimensions (l x w x h):	396 mm x 331 mm x 265 mm
Volume:	16 l
Weight:	10 kg

3707 without butyrometer stand (art. no. 3717)

WB 436-A universal water bath (analogue)
Like art. no. 3707 but with analogue temperature control (adjusting knob), temperature display with thermometer (included in the scope of delivery), thermostatic heat controller

Stainless steel inner and outer casing
External heating: heating elements are located separately in the casing
Protection against overheating (even when tank is empty)
Use with distilled water preferable

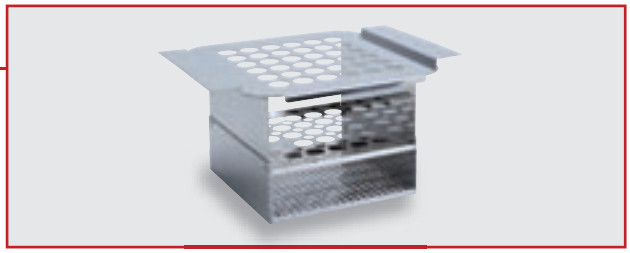
Technical specifications:

Temperature range:	up to 100°C
Connection values:	230 V / 50 Hz ... 60 Hz / 1000 W
Dimensions (l x w x h):	396 mm x 331 mm x 265 mm
Volume:	aprox. 16 l
Weight:	10 kg

3708 without butyrometer stand (art. no. 3717)

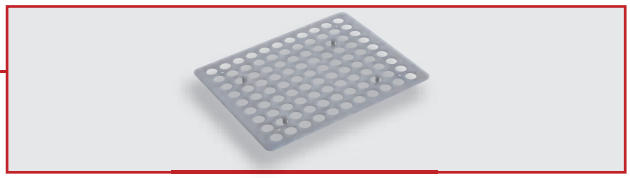
Accessories for water baths WB 436 (art. no. 3707, 3708)

3717 Butyrometer stand for WB-436
stainless steel, for 36 butyrometers



3718 Mojonnier stand
stainless steel
for 10 Mojonnier tubes

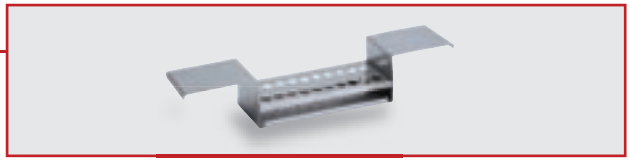
3727 Universal shelf
stainless steel



3737 Reductase insert
for 99 samples

3747 Lid for Reductase test

3754 "Delvo-Test" insert



3766-G **Butyrometer tubes,** closed
brass, for butyrometer stand (art. no. 3717)

3766-O **Butyrometer tubes,** open (for art. no. 3707, 3708)
brass, for butyrometer stand (art. no. 3717)

Safety reading lamp
for safely and precisely
reading of butyrometers

anti-glare illumination, lens with protective Plexiglass cover,
adjustable height and lens distance, cord-operated switch

3800 230 V / 50 ... 60 Hz

Shaking machine
for extraction tubes according to Mojonnier's method

for forceful, uniform and reproducible mixing,
230 V / 50 ... 60 Hz

3850 for 4 Mojonnier tubes

3851 for 6 Mojonnier tubes

Shaking machine
for 36 butyrometers with stand

3852 230 V / 15 Watt, 915 x 270 x 300 mm (l x w x h)

3870 **Extraction tube** with rounded bulb
acc. to Mojonnier's meth. with cork stopper (art. no. 3872)
suitable rubber stopper (art. no. 3310)

3871 **Extraction tube** flattened bulb
acc. to Mojonnier's meth., with cork stopper (art. no. 3872)
suitable rubber stopper (art. no. 3310)

3872 **Cork stopper for extraction tube**
according to Mojonnier's method (art. no. 3870, 3871)

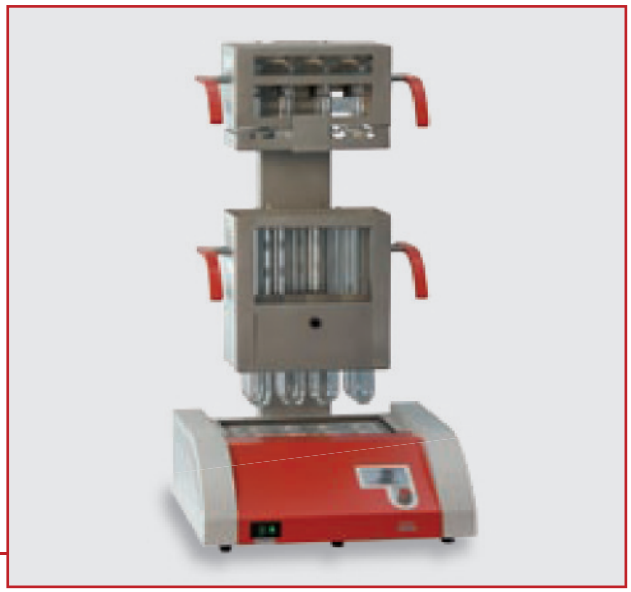
3875 **Wooden stand**
for 12 extractions tubes according to Mojonnier's method

Kjeldahl digestion apparatus K8

Heating block and glass extraction system for 8 samples, for connecting to the Behrosog suction station. Suitable for 250 ml digestion flasks.
The front side of the sample rack is covered. Stable and robust construction. The block casing as well as the extraction hood is made of acid-proof, rust-free stainless steel.

Programmable for up to
10 different temperature steps.
Maximum temperature 450°C,
time adjustment range 0-999 min
230V, 50 Hz, weight: 28 kg

4200 480 x 510 x 765 mm (w x d x h)



Digestion flask

4201 250 ml

Suction station Behrosog 3 with cooler

Extracts aggressive acid vapours during digestion.
In the process, an upstream two-staged pre-filter edulcorates and precipitates the toxic substances.

230 V, 50 /60 Hz,
weight: 18 kg
cuction pump: 40 l/h

4203 80 x 340 x 400 mm (w x d x h)

Kjeldahl distillation apparatus S-3

behind a safety screen,
automatic water vapour production,
manual or automatic addition of H_2O, NaOH.
programmable distillation time and reaction time,
automatic suction of sample remains,
automatic fluid level surveillance of the storage tank.

230 V, cooling water usage: 3 L/min,
weight: 35 kg

4210 410 x 675 x 410 mm (w x d x h)

Automatic titrator STI

The titration station consists of a burette with a digital display and a magnetic stirrer with a custom-fit holder for an Erlenmeyer flask. Result accuracy and reproducibility are enhanced due to a viewing shield which serves as a neutral background.

230 V, 50 / 60 Hz, weight: 3.5 kg

4220 330 x 200 x 600 mm (w x d x h)

Kjeldahl Tabs KT1

4230 consisting of 5 g of potassium sulphate, 0.5 g of copper sulphate

Kjeldahl Tabs KT2

4231 consisting of 5 g of potassium sulphate, 0.105 g of copper sulphate, 0.105 g of titanium dioxide

pH VALUE MEASUREMENT

Anna Politis, graduate engineer of nutrition technology and of biotechnology, reports

The pH value is a measurement of the H^+ activity. Simply put, it is a measurement of the concentration of acid (pH ‹7) or base (pH ›7). The formal definition was formulated by chemist Soerenson:

$$pH = -\log a_{H^+}$$

The pH value is the negative decadal logarithm of the activity of protons a_{H^+} in mol/l. This value is measured by means of a pH meter with a suitable electrode in accordance with DIN 38404-C5. pH meters measure the potential difference between measuring electrodes and reference electrodes. According to the Nernst equation, the potential difference changes by 59 mV per pH unit. The pH meter must be calibrated regularly from time to time. The calibration is carried out by means of standard buffer solutions with defined pH values.
During a 2 point calibration, the zero point is set by an additive correction with the buffer solution (pH=7). Subsequently, the end value (e.g. pH=4.01) is set over a multiplicative correction (transconductance). How often the meter should be calibrated depends on how exact the measurements should be and varies from meter to meter. If the pH meter is not in constant use, it should be calibrated before every measurement. If the electrode is continuously in the storage liquid, it doesn't have to be calibrated as frequently. For each calibration, 20 ml of buffer solution are needed. Solutions should not be used more than once. The bottles containing the buffer solution must be sealed immediately after use. Alkaline calibration solutions are more sensitive. Their pH values change because they absorb CO_2 from the air. A sealed bottle of buffer solution keeps for several months to two years. Between calibrations or measurements, the sensor must be rinsed with distilled water but not wiped off. Excess drops can be dabbed away with a soft cloth.

The pH value is temperature-dependent; therefore the temperature must always be recorded along with the entry of the pH value. Nowadays most pH meters are equipped with a temperature measuring unit. This allows the temperature influence to be compensated during the measurement.

A pH meter requires regular maintenance to measure optimally.

With electrodes with refillable electrolyte, the fluid level of the electrolyte solution must be checked. The level of the reference electrolyte must always be a few cm above the fluid level of the measurement solution. If necessary, the KCl solution 3M must be refilled after removing the seal over the filler hole. During use, the refill hole for KCI should always be open, otherwise the solution cannot be diffused out. If the electrode is no longer needed, it should be quickly rinsed, the refill hole for KCI should be sealed and the electrode should be stored in the 3M KCl solution so that it doesn't dry out.

During transport and storage, KCl solution can leak out of the protective cap, out of which crystallised white potassium chloride is formed. This salt deposit has no effect on measuring accuracy and can be easily washed off with water. If the electrode is dried out, then it must be soaked in 1ML HCl and subsequently reactivated for several hours in 3M KCl.

Should constant deviations be determined during measurements, the electrode must be checked for possible contamination. Depending on the type of contamination, different cleaning measures are recommended.

- *To clean off fat or oil deposits, the membrane must be degreased with cotton which has been soaked in acetone or soap solution.*
- *If protein has settled on the diaphragm, the electrode is soaked in HCl/Pepsin solution for approx. 1-2 hours.*
- *In case of a silver sulphide contamination, the electrode is to be set in a thiocarbamide solution and left to soak.*
- *To remove inorganic films, the electrode is dipped into 0.1 M HCl or 0.1 M NaOH. With 40-50°C solutions, cleaning is more effective.*
- *After every cleaning procedure, the electrode is to be set in a 3M KCl solution about a quarter of an hour a new conditioning and subsequently calibrated once again.*

Battery/pocket pH meter


Laboratory pH meter

pH meters

Laboratory pH meter
electrode not included, with DIN electrode connection,
for compatible single rod electrodes, see art. no. 4336

4310 **Knick 766** easy to use measurement device for pH, mV and °C: electrode adjustment and monitoring self-test, automatic temperature compensation recorder output, calibration data memory

4311 **Knick 765** plus RS 232 interface for computer and printer (GLP documentation)

Battery/pocket pH meter
electrode not included in the scope of delivery
(see art. no. 4370, 4380)

4315 **Knick 911** highly developed measuring device for pH, mV and °C with support for use on a table, protected from dust, water, as well as impact:
automatic calibration, buffer recognition, temperature compensation, self-test, DIN electrode connection

4317 **Knick 913** similar to 911,
but with additional measurement value storage and interface for computer and printer (GLP documentation), with DIN electrode connection

Pt 1000 temperature sensor
for Knick 911, 913 (art. no. 4315, 4317),
4319 with DIN plug

Single rod electrode SE 100
with integrated temperature sensor Pt 1000
compatible with Knick 766, 765 (art. no. 4310, 4311),
4336 with DIN plug

Single rod electrode Inlab Basics
suitable for milk und other fluids
4350 fixed cable with DIN plug

Insertion electrode Inlab Solids
insertion head electrode
4360 with cable and DIN plug

Insertion electrode Inlab Solids
4361 without cable

Single rod electrode SE 104
for insertion measurements in cheese, meat, and sausage,
compatible with Knick 911, 913 (art. no. 4315, 4317)
4370 fixed cable with DIN plug

Single rod electrode SE 102
integrated with temperature sensor Pt 1000
design compatible with Knick 911/913 (art. no. 4315, 4317)
4380 fixed cable with DIN plug

Buffer solutions
in 250 ml PE bottles

4390 pH 4.01
4391 pH 7.00
4392 pH 9.21

KCl solution
in 250 ml PE bottles
4400 3 mol/L

Cleaning agent for single rod electrode
in 250 ml PE bottles
4420 thiocarbamide solution for Ag-Cl diaphragms

Pepsin hydrochloric acid solution
4421 protein solvent

Reactivation solution
hydrofluoric acid
4422 in 25 ml PE bottles

pH Meter "pH 49"
in accordance with guideline 89/336/EWG
Battery type: 9 V
Operation temperature: 0-50°C
Electrode connection: pH / mV: BNC connector
4450 °C: DIN connector

Temperature sensor Pt 100
4451 for pH meter "pH 49"

pH single rod electrode EGA 184
4452 for pH meter "pH 49"

4453 pH single rod electrode with integrated Pt 100

4455 Platinum redox single rod electrode

4460 Buffer solution pH 4.01 / 250 ml
4461 Buffer solution pH 7.0 / 250 ml
4462 Buffer solution pH 9.18 / 250 ml

TITRATION APPARATUS

determination of acid content
to ascertain the degree of freshness

Titration apparatus STANDARD

complete with storage bottle, rubber stopper, burette with automatic zero point adjustment, sodalime with ascending tube, rubber pressure bulb, burette tip with pinchcock, one 1 ml and one 25 ml pipette, one 200 ml Erlenmeyer flask

4500	for milk: 0 - 25° SH
4501	for cream: 0 - 40 °SH
4510	for curd: 0 - 250 °SH with porcelain mortar and pestle, 2 ml pipette (without 1 ml and 25 ml pipette and Erlenmeyer flask)

Titration apparatus SIMPLEX

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

4520	for milk: 0 - 25° SH
4521	for cream: 0 - 40° SH

Titration apparatus SIMPLEX

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

Titration apparatus

with bottle and holder
without accessories

4654	0 - 100° Dornic
4655	0 - 40° Dornic

Protein titration apparatus

with storage bottle,
for use with 25 ml of milk,
special burette with automatic
zero point adjustment,
sodalime with ascending tube, rubber bulb,
outlet tip, pinchcock,
one 1 ml, one 5 ml and one 25 ml volumetric pipette,
two 250 ml short beakers,
two 1 ml: 0.01 measuring pipettes

4660	0 - 6 ET: 0.02

Acidity tester

for determining the degree of freshness
of unpasteurised milk

4705

Salt test

for butter and cheese
see art. no. 4530, 4540,
but with brown storage bottle

4760	for butter 10 ml: 0.05
4770	for cheese 25 ml: 0.1

SEDILAB sediment tester

easy-to-use manual sediment tester,
with clamp for attaching to tables, stainless steel

4800 for 500 ml of milk

SEDILAB-E sediment tester

for serial testing of liquids for particle contamination,
particularly for sediment testing of milk,

splash-proof design, approx. 800 samples per hour,
sharply defined sediment images,
220 V / 50 Hz

4810 for 500 ml of milk

ASPILAC sediment tester

pump design for direct suction from a can,
Plexiglass casing for original filter papers

4905 for 500 ml of milk

4910 **Filter papers**
with area for records, 1000 pieces, Ø 28 mm, 80 x 45 mm

4911 **Filters, round**
32 mm, 1000 pieces

4920 **Reference table**
with 3 purity grades, German standard

Pipetting syringes
for determining out nutrient and dye solutions, self-priming, can be sterilised

5110 adjustable to 1 ml
5111 adjustable to 2 ml
5112 adjustable to 5 ml

5140 **Methylene blue tablets**
for bacteria count estimation
50 pieces

5150 **Resazurine tablets**
for LOVIBOND comparator (art. no. 5160), 100 pieces

LOVIBOND comparator 2000
for resazurine tests,
housing for 2 test tubes
for colour comparisons,
with milk observation stand,
5160 without colour disc (see art. no. 5161)

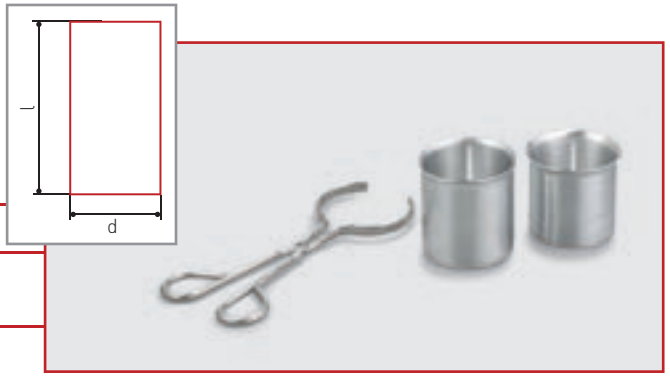
Colour disc
5161 for resazurine 4/9 with 7 standard reference colours

Test tube
5162 set of 4 tubes

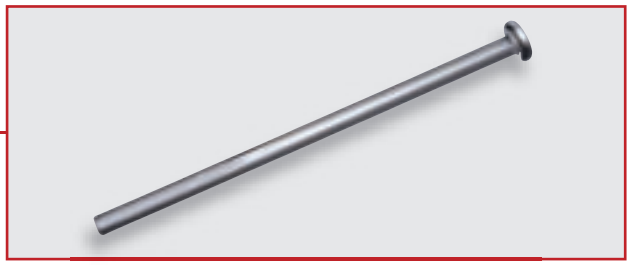
Dry matter calculator
5360 according to Ackermann's method, for milk

Butter melting beaker
for the determination of water content in butter

5400 Aluminium, 30 g; l = 51 mm, d = 60 mm
5401 Aluminium, 50 g; l = 66 mm, d = 64 mm



5420 **Tongs**



Glass stirrer
5430 pestle type, 140/6 mm

Double-ended spatula
5440 pure nickel, 150 mm

Butter testing spoon
5450 Plexiglass

Crystalline quartz sand
0.6-1.2 mm grain size, calcined quality

5460	washed, 1 kg, transport costs available on request
5461	washed, 3 kg, transport costs available on request
5462	washed, 5 kg transport costs available on request
5463	washed, 25 kg transport costs available on request
5464	washed, 10 kg transport costs available on request

Aluminium foil

5470	150 x 190 mm, 1000 pieces

Weighing dish
aluminium, with lid, (numbered on request)

5490	75 x 30 mm

Bunsen burner
for propane gas
(other gas types available on request)

5550	

Infrared burner, up to 750°C
suitable for fast, contact-free heating

5571	0.9 kg, 100 x 100 x 100 mm
5572	**Output regulator**

Wator paper
Indicator paper for determining moisture distribution in butter

5600 40 x 78 mm, 50 pieces

Test tube according to Beckel's method
for determining the acid value in butter

5601 5 ml / 11 ml, PE stand

Butter cutter

5605 wire gauge 0.5 mm

Separating funnel
for extraction

5606 250 ml

Thin layer chromatography chamber

5607 200 x 200 mm

Thin layer chromatography plates
25 silicon dioxide gel plates
with aluminum liner
can be cut with scissors

5608 200 x 200 mm

Pocket refractometer

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

5610	0 – 32 % Brix: 0.2 % for milk, fruit juices, soft drinks
5612	28 – 62 % Brix: 0.2 % for concentrated fruit juice
5613	45 – 82 % Brix: 0.5 % for honey

Digital hand refractometer

can be switched from 1.330 – 1.5318 n_D:
resolution 0.1 % Brix, 0.0001 n_D
automatic temperature compensation from 10 - 40°C

5614	0 - 95 % : 0.1 % Brix

Digital Abbe refractometer

LED display 590 nm, serial interfaces RS-232
and RS 422, 115/230 V, 50/60 Hz
1.3000 – 1.7200 n_D : 0.0001 n_D
5 kg - 140 x 275 x 300 mm

5620	0 - 95 %: 0.1 % Brix, 0 - 99°C: 0.1°C

Humidiy measuring device MLB 50-3
for the fully automatic determination of moisture content or dry substance content
data interface RS 232

5670 5.5 kg - 217 x 283 x 165 mm

Accessories for humidity measuring device MLB 50-3

5671 Aluminium specimen dish
92 mm diameter, packs of 80 pieces

5672 Circular glass fibre filter
for splashing or caking specimens

5673 Matrix needle printer

5674 Specimen dish
aluminium
100 x 7 mm, pack: 100 pieces

Reference drier RD-8

for determining the moisture content of powdered milk in accordance with ISO/DIN 5537, IDF 26

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

Connections:	a) 230 V / 115 V, 520 W b) 2.5 bar ... 7.5 bar
Temperature range:	adjustable, up to 110.0°C
Stability:	+/- 0.3°C

5700

Accessories for reference drier RD-8

5701 specimen container
PP, 20 pieces

5702 Lid for specimen container
PP plastic, 20 pieces

5703 Cap
PP plastic, 20 pieces

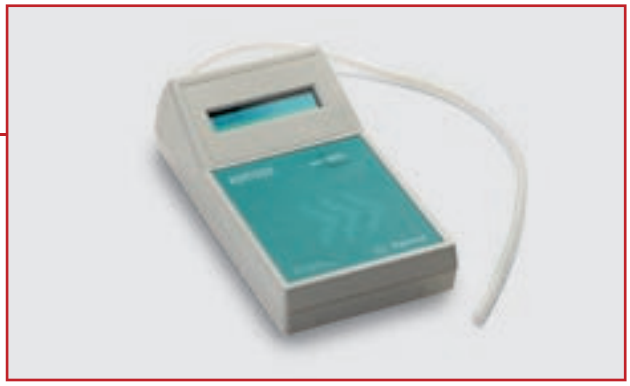
5704 Filter
100 pieces

5705 **Loading arm**
for easy and exact positioning of the filter
in the specimen receptacle, acrylic

5706 **Weighing stand**

5707 **Stand for lids and caps**

5708 **Flowmeter**
for measuring the air flow
in the reference drier RD-8
ADM 1000



5712 **Round aluminium foil**
130 x 0.03 mm, 1000 pieces

Analytical scale

with modern all-glass wind protection,
automatic internal adjustment every 3 hours
or with a temperature change of >0.8°C
display change from piece to weight,
GLP/ISO logging possible,
percentage determination, RS 232 data interface,
under-floor weighing possible,
gauge or calibration certificate for additional charge

weighing plate diameter: 85 mm

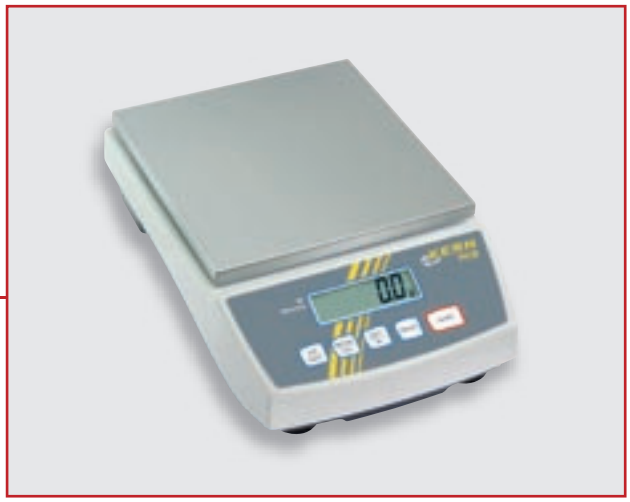
5810	160 g: 0.1 mg
5811	220 g: 0.1 mg

Precision scale

with formulation memory, unit counter,
GLP/ISO logging possible,
percentage determination, RS 232 data interface,
under-floor weighing possible

weighing plate: 130 x130 mm

5820	1600 g: 0.01g



Further scales available on request

HEATING CABINETS UNB

with natural air circulation for standard tempering tasks from 30-220°C

Order no.	Model	Volume (litres)	ext. dimensions w/h/d (mm)	int. dimensions w/h/d (mm)	supporting ribs/ slide-in plates	Watts/ volts	Kg net	Equipment type/fixtures
6000	UNB 100	14	470/520/325	320/240/175	2/1	600/230	20	Digital (switch-off) clock 99 hours 59 min.
6001	UNB 200	32	550/600/400	400/320/250	3/1	1100/230	28	
6002	UNB 300	39	630/600/400	480/320/250	3/1	1200/230	30	

HEATING CABINETS UFB

with forced air circulation for standard tempering tasks from 30-220°C

6008	UFB 400	53	550/680/480	400/400/330	4/2	1400/230	35	Digital (switch off) clock 99 hours 59 min.
6009	UFB 500	108	710/760/550	560/480/400	5/2	2000/230	50	

INCUBATORS INE

with natural air circulation for tempering tasks from 30-70°C

Order no.	Model	Volume (litres)	ext. dimensions w/h/d (mm)	int. dimensions w/h/d (mm)	supporting ribs/ slide-in plates	Watts/ volts	Kg net	Equipment type/fixtures
6035	INE 200	32	550/600/400	400/320/250	3/1	1100/230	28	Excellent Fuzzy PID controller with two integrated clocks (running time 1 min. to 999 hours and weekly program timer) and triple thermal safety fuse, air turbine speed controller
6036	INE 300	39	630/600/400	480/320/250	3/1	1200/230	30	
6037	INE 400	53	550/680/480	400/400/330	4/2	1400/230	35	
6038	INE 500	108	710/760/550	560/480/400	5/2	2000/230	50	

STERILISING OVENS SNB

with natural air circulation for tempering tasks from 30-220°C

Order no.	Model	Volume (litres)	ext. dimensions w/h/d (mm)	int. dimensions w/h/d (mm)	supporting ribs/ slide-in plates	Watts/ volts	Kg net	Equipment type/fixtures
6047	SNB 100	14	470/520/325	320/240/175	2/1	600/230	20	Digital (switch-off) clock 99 hours 59 min.
6048	SNB 200	32	550/600/400	400/320/250	3/1	1100/230	28	
6049	SNB 300	39	630/600/400	480/320/250	3/1	1200/230	30	

REFRIDGERATED INCUBATORS WITH COMPRESSION COOLING ICP

for tempering tasks from 0-60°C

Order no.	Model	Volume (litres)	ext. dimensions w/h/d (mm)	int. dimensions w/h/d (mm)	supporting ribs/ slide-in plates	Watts/ volts	Kg net	Equipment type/fixtures
6070	ICP 400	53	558/967/486	400/400/330	4/2	500/230	68	PID process controller, serial and parallel interfaces, motorised inner air circulation
6071	ICP 500	108	718/1047/556	560/480/400	5/2	500/230	87	
6072	ICP 600	256	958/1335/656	800/640/500	7/2	700/230	144	

further instruments available on request

Laboratory furnaces
heating and incineration at up to 1100°C,
rust-free stainless steel furnace casing,
high-grade isolation, short heating-up time
230 V/50 Hz, 1.2 kW, Volume: 3L

Internal dimensions: 160 x 140 x 100 mm,
6220 External dimensions: 380 x 370 x 420 mm, 20 kg

Discharge viscometer
Easy-to-use viscometer for in-house measurement of the viscosity of yogurt, curdled milk, kefir and other products.

The stop time of the discharge of the measured material serves as a measure of the viscosity.

6520 with stand and two different discharge nozzles

6521 Glass plate

6522 Stop watch

Visco tester VT6R Haake
rotation viscometer for measurements in accordance with 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 stand and case included in the scope of delivery

INHIBITOR DETECTION

6570 Delvotest SP-NT for 100 samples

Delvotest plate test SP-NT
6571 each for 96 samples

LACTODENSIMETER

Lactodensimeters are frequently used with an official calibration, or are officially calibrated with a certificate. Please refer to our price list or contact us for more information.

Lactodensimeter

for milk according to GERBER's method, large model,
negative scale, with thermometer in stem,
1.020 – 1.040: 0.0005 g/ml,
T = 20°C, 10 - 40°C, ca. 300 x 28 mm

6600	standard model
6602-E	officially calibrated, the calibrated range of the thermometer goes from 10°C to 30°C
6603-ES	officially calibrated, with certificate, the calibrated range of the thermometer goes from 10°C to 30°C

Lactodensimeter

for milk acc. to GERBER's meth., small model,
with thermometer in body,
1.020 – 1.035: 0.0005 g/ml,
T = 20°C, 0 - 40°C, ca. 210 x 17 mm

6610	standard model
6612-E	officially calibrated, the calibrated range of the thermometer goes from 10°C to 30°C
6613-ES	officially calibrated, with certificate, the calibrated range of the thermometer goes from 10°C to 30°C

Hydrometer

for milk in accordance with DIN 10290
without thermometer,
1.020 -1.045: 0.0005 g/ml,
T = 20°C, ca. 350 x 25 mm

6620	standard model
6621-E	officially calibrated
6622-ES	officially calibrated, with certificate

Lactodensimeter

for milk according to Quevenne's method,
with coloured triple scale

6630	1.015 – 1.040: 0.001 g/ml, T = 20°C with thermometer 0 - 40°C, approx. 290 x 22 mm
6630-15	1.015 – 1.040: 0.001 g/ml, T = 15°C with thermometer 0 - 40°C, approx. 290 x 22 mm
6631	1.015 – 1.040: 0.001 g/ml, T = 20°C without thermometer, approx. 210 x 22 mm
6631-15	1.015 – 1.040: 0.001 g/ml, T = 15°C without thermometer, approx. 210 x 22 mm

Hydrometer for buttermilk serum

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

6640	standard model
6641-E	officially calibrated
6641-ES	officially calibrated, with certificate

Buttermilk tester

according to Dr. Roeder's method
with thermometer in stem,
approx. 210 x 25 mm

6650	1.010 – 1.030: 0.001 g/ml, T = 20°C

Hydrometer for condensed milk

without thermometer, reading at top

6660	1.000 – 1.240: 0.002 g/ml, T = 20°C, approx. 310 x 19 mm
6661	1.040 – 1.080: 0.001 g/ml, T = 20°C, approx. 230 x 21 mm

Hydrometer for yogurt and chocolate milk

with thermometer incorporated in body,
reading at top
approx. 220 x 16 mm

6670	1.030 – 1.060: 0,001 g/ml, T = 20°C

Hydrometer for brine / Beaumé
0 - 30 / 0.5 Bé, 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
without thermometer,
approx. 250 x 20 mm

6690	1.000 – 1.100: 0.002 g/ml, T = 20°C

Alcoholometer
0 - 100 Vol. %: 1.0, T = 20°C,
approx. 290 x 16 mm

6710	with thermometer
6711	without thermometer

Hydrometer for amyl alcohol
DIN 12791, M 50
without thermometer
260 x 24 mm

6720	0.800 – 0.85: 0.001 g/m, T = 20°C

Hydrometer for sulphuric acid
DIN 12791, M 50
without thermometer
270 x 24 mm

6730	1.800 – 1.850: 0.001 g/ml, T = 20°C
6731	1.500 – 1.550: 0.001 g/ml, T = 20°C

Hydrometer
DIN 12791,M 50
for various liquids,
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

Level gauge for lactodensimeters
internal diameter: 39 mm
6800 length: 265 mm

Stand
tripod with cardanic suspension
and hanging cylinder
for lactodensimeters art. no. 6610 - 6613

6810 265 x 60 mm

Replacement hanging cylinder
for art. no. 6810

6820 210 x 22 mm

Stand
with cardanic suspension,
overflow hanging cylinder,
compatible with all lactodensimeters
and hydrometers, incl. drip tray,
6830 hoses and pinchcock

THERMOMETER/ACCESSORIES

Dairy thermometer
with loop
special red filling
0 -100°C: 1°C

7001 approx. 250 x 17 mm

Dairy thermometer
in plastic case with loop,
boil- and impact-proof, floatable,
special red filling
0 - 100°C: 1°C

7031 approx. 280 x 28 mm

Dairy thermometer
special red filling
replacement for art. no. 7031,

7041 approx. 250 x 17 mm

	Universal thermometer special red filling
7046	-10 to 100°C: 1.0, approx. 260 x 8 mm
	Cooling chamber thermometer special blue filling in plastic holder with loop and hook
7060	-40 to +40°C: 1.0, approx. 200 x 20 mm
	Control thermometer special red filling -10 to +100°C: 1.0, approx. 305 x 9 mm
7070-ES	officially calibrated, with certifiicate
7071	uncalibrated
	Low temperature laboratory thermometer special red filling
7081	-38 to +50°C: 1.0, approx. 280 x 8 x 9 mm
	Maximum-minimum rod thermometer white coating, creosote filling
7095	-35 bis + 50°C: 1.0, approx. 220 x 10 mm
7096	-10 bis + 100°C: 1.0, approx. 220 x 10 mm

The **psychrometer**
Measurement of relative humidity

A hair hygrometer is typically used to measure relative humidity. A strand of hair elongates when it absorbs moisture. The psychrometer functions more accurately. The instrument consists of two exactly matching thermometers (with as little deviation as possible). The mercury receptacle (alcohol is not used due to too high inaccuracy) of one thermometer is wrapped in a damp piece of absorbent cotton or the like. The other thermometer is kept dry and gives the temperature of the surrounding air. At a relative humidity of 100 %, both temperatures show the same temperature. If the humidity is lower than 100 %, the water on the "damp" thermometer evaporates. A lower temperature is shown on the damp thermometer as on the dry thermometer due to evaporation chill (the warmth necessary to evaporate is detracted from the thermometer and the piece of cotton). The humidity can be calculated from the temperature difference.

PSYCHROMETER

water storage tank,
2 calibratable thermometers with translucent glass scale, with humidity table, lacquered wood plate

7100 -10 + 60: 0.5°C, approx. 190 x 12-13 mm

Polymeter (hair hygrometer)

for measuring relative humidity and temperature, with scale for water vapour saturation pressure, thermometer with special filling
Thermometer dimensions: approx. 130 x 12 mm
Hygrometer dimensions: Ø 100 mm

7110 Measuring range: 0 - 100 %, 0 - 30°C,

Humidity/temperature measuring device

with moisture sensor and NTC temperature sensor

Measuring range: -10 - +50°C, 0 - 100 % rH
7115 Accuracy: ± 0.5°C, ± 2.5 % rH

Digital thermometer 826-T4

contact-free measurement and core temperature measurement in foodstuffs with one device

Measuring ranges:
contact-free / IR: -50°C to +300°C, accuracy: ± 2°C
7119 with NTC sensor: -50°C to +230°C, accuracy: ± 1°C

Digital second thermometer 926

for daily temperature measurements in the food industry, for laboratory use
ISO calibration certificate for an additional price

Measuring range: -50 to +400°C: 0.1°C (1°C from 200°C),
7120 Accuracy: ±0.3°C.

INSERTION/IMMERSION SENSORS

Robust **precision sensor**

7122 Ø 4 mm, length 110 mm

Stainless steel sensor for food
stainless steel ,

7123 Ø 4 mm, length 125 mm

Needle sensor
for quick measurements
without visible pinhole,

7124 Ø 1.4 mm, length 150 mm

Frozen goods sensor
screws in without pre-drilling

7125 Ø 8 mm, length 110 mm

TopSafe
protective cover against contamination,
7127 water and impact

FREEZING POINT DETERMINATION

One of the main focuses of Funke - Dr. N. Gerber Labortechnik GmbH

K. Schaefer, graduate engineer, W. Spindler, graduate physician report

HISTORY

The German chemist Beckmann, known for the thermometer named after him, began using the freezing point of milk in as early as 1895 to detect if it had been adulterated with water. The American Hortvet worked intensively with this method in 1920 and improved some of its essential features. The first thermistor cyroscopes were brought to the market in the 1960s. However, they had to be operated entirely by hand. At the beginning of the 1970s, the first automatic thermistor cyroscopes became available. With this development it was possible to determine the freezing point automatically at the push of a button.

A decisive step in the improvement of thermistor cryoscopy was displayed at the "FoodTec" tradeshow in 1984: Funke-Gerber introduced the first device with automatic calibration. This successful and intensive development work reached a new peak at the "FoodTec" in 1988, where Funke-Gerber presented a fully automatic freezing point determination mechanism with a capacity of 220 samples per hour.

With the introduction of an indirect freezing point measurement device (e.g. LactoStar) for routine analysis, interest was focused primarily on reference devices which are able to determine freezing points in accordance with the applicable standards and regulations. These devices must satisfy the strictest requirements with regard to measuring accuracy. For this reason Funke-Gerber developed a programmable cryoscope with a resolution of 0.1 m °C. This instrument has proven its accuracy and reliability in countless laboratories all over the world. The product range has been expanded with a multi-sample device (CryoStar$_{automatic}$). Since January 2007, these instruments have been equipped with a graphic colour display. This makes it possible to show the entire freezing curve, in particular the process of the plateau search, with a patented screen presentation.

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 temperature lowers (becomes colder) because the ability of the water molecules to escape from the surface diminishes. As fat is not water soluble, it has no influence on the freezing point.

MEASURING PRINCIPLE:

The milk is cooled to -3°C (super-cooled) and crystallisation is induced by mechanical vibration. As a result of this freezing process, the temperature increases due to the released lattice energy and stabilises at a certain plateau which corresponds to the freezing point.

MEASURING PROCEDURE:

The freezing point of liquids is not just any temperature, but the exact temperature at which one part of the sample is in a solid state and another part is in a frozen state, whereby the parts are in equilibrium.

To measure the freezing point, the sample must therefore be brought into this state. In order to do this, a certain procedure must be followed, which is carried out in the following way:
First the sample must be cooled to under the actual freezing point while being stirred. Stirring is necessary for 3 reasons:

- The sample is kept in motion so that it can not freeze on its own.
- The sample is thoroughly mixed so that all parts of the sample have the same temperature.
- The warmth contained in the sample is transported out where it can be dissipated by the cooling mechanism.

When a liquid is colder than its actual freezing point, this state is instable. This state is called "metastable". Even the smallest influences, such as the impact of a hard object on the glass wall, cause freezing to set in. This continues like an avalanche until the released fusion heat increases the temperature of the sample so much that the freezing point is reached and the frozen parts of the sample are in equilibrium with the not yet frozen parts of the sample.

A cryoscope must therefore trigger freezing when the sample is sufficiently colder than its actual freezing point. But what is "sufficiently colder"? The aim here is that so much ice builds up during freezing that there are normal-sized ice crystals all throughout the sample but that the sample is not completely frozen. With milk, it has been proved optimal to trigger the freezing at about -2°C to -3°C.

After triggering freezing, the temperature of the sample climbs because the fusion heat created during freezing is released. It stabilises at a certain value, which is called the plateau. The cooling bath continues to pull warmth out of the sample, and to the same degree that this happens, more parts in the sample freeze and release their fusion heat. Therefore the temperature remains the same – at least as long as there are still liquids parts in the sample. This plateau lasts for a few minutes. The cryoscope determines the freezing point from the temperature measurement values of the plateau. There are rules regulating this.

POSSIBLE SOURCES OF ERROR IN THE MEASUREMENT PROCESS

When determining the freezing point, a certain procedure must be adhered to during measurement, whereby errors can occur at every stage of the procedure.

Errors during cooling:

If the heat withdrawn from the sample is too little, the cooling takes too long.

The reason for this is either the cooling bath or the stirring rod. The cooling bath must be at least 6°C and circulate well in order to be able to transfer the heat out of the sample. The stirring rod must stir uniformly with an amplitude of 3.4 mm. When cooling errors occur, the cooling bath temperature must therefore be measured with a thermometer, then the cooling bath circulation is checked with an empty sample tube. Then, it is determined whether the stirring rod can move freely and that it does not strike or grind against anything. Finally, the stirring rod amplitude is tested. There is a special menu in the device for this purpose. The valid reference value is not simply some number on the display; this is only meant to be an indication. The tip of the oscillating stirring rob is observed and adjusted so that the points of regression are only about 3-4 mm apart. Then 2.5 ml of water is poured into a sample tube which is held under the thermistor so that the stirring rod stirs the water. It is determined whether the stirring rod oscillates well in the water.

When everything has been tested and adjusted, a sample measurement with water is carried out and the temperature value in display is observed. The time that the device takes to cool one sample from room temperature (20 °C to 25°C) to -2°C should be almost exactly one minute. If this is the case, it means that the cooling bath and the stirring rob are adjusted correctly. If cooling takes less than 45 seconds, then the cooling bath is too cold or the stirring rod setting is too high. If cooling takes longer than 75 seconds, the cooling bath is too warm or is circulating poorly or the stirring intensity is too low.

If an "error during cooling" occurs after the cooling bath and stirring rod have been tested and determined to be functioning correctly, then the thermistor and the calibration of the instrument must be tested. If the instrument has been incorrectly calibrated, it will not find its temperature scale and therefore cannot measure the temperature correctly.

Frozen too early

The state of the sample is instable when it is below its freezing point. It can therefore happen that the sample freezes due to an unintentional influence or on its own before the device triggers freezing. There are many possible reasons for this. If stirring is too strong or if the stirring rod is grinding against something, jolting can occur and trigger freezing. The longer cooling takes the more time the sample has to freeze on its own. Therefore the cooling should be carried out as quickly as possible. If the sample is contaminated, freezing may be triggered.

Not frozen:

If the temperature set for supercooling (the "trigger temperature") is reached, the device beats against the glass wall of the sample tube to trigger freezing. The temperature should then start to rise. A criterion for this is a rise in temperature of at least 0.1° C. This is always the case with water or calibration solutions if the stirring rod is set in such a way that it beats hard against the glass wall. This is not always the case with milk. Some milks freeze slowly. Should this error occur rarely with individual milk samples, the milk in question should be heated to approx. 40°C, cooled and measured again. However, if this error occurs often in a certain region, then it is better to lower the trigger temperature so that the samples are supercooled more aggressively, causing them to freeze easier. If this error occurs with calibration solutions, then the calibration of the device is incorrect or cooling bath liquid has leaked into the sample.

Plateau not found:

This error can only occur when the "Plateau Search Method" in accordance IDF is used to determine the freezing point. With this method, the temperature value must be within the defined range for a certain time during the plateau. It can so happen that a certain milk sample does not fulfil this criterion. Then a second sample of this milk must be measured. If this error occurs frequently even though the device is otherwise functioning correctly, the error is either with the thermistor or the result of external disturbances.

Uncalibrated or defective thermistor:

The instrument tests the current thermistor value when starting a measurement or calibration. Its electrical resistance is known to be a function of the temperature. This electrical resistance is translated with an ADC (analogue digital converter) into a number which is then used by the instrument. If the thermistor has a short circuit or a disruption, its resistance is zero or infinite, both of which conditions are impossible for a properly functioning thermistor. In this case, the thermistor will not start the measurement.

If the temperature which is given from the current thermistor value together with the calibration constant stored in the device is lower than +1°C (which is not possible with a thermistor which is located in a new, i.e. still warm sample), the device will also fail to start the measurement.

IDENTIFYING TECHNICAL DEFECTS

Switching on: the device must show the starting message *„CryoStar I (or. CryoStar automatic), Funke Gerber"* on the display when it is switched on.

Possible errors:

- Locking devices on the network connection block
- Locking device on the main conductor board
- Main rectifier. Verify that the voltage of the main condenser is at least 11 V.
- Power transformer
- Error with the main conductor board
- Display or a cable leading to the display is defective

Cooling phase: the device should reach a cooling bath temperature of at least -6°C in a reasonable amount of time. This time depends on the surrounding temperature, but should not be longer than 20 minutes.

Possible errors:

- Air supply is not functioning properly: ventilation slots on the sides of the device are clogged, the inside of the device is contaminated.
- A ventilator has failed.
- Ventilator control system is defective. Verify that the voltage is approx. 24-26 V.
- Cooling block has suffered heating damage and is now defective.
- Cooling block control system is defective. Verify that the Peltier connectors are approx. 6-10 V at full cooling capacity.
- No or poor circulation: when an empty sample tube is immersed (with lid removed) into the measuring site and taken back out, the cooling bath liquid should flow back in within approx. 1 to 2 seconds. **Possible errors:**
  - Cooling bath liquid has become too thick. Change the liquid.
  - Too little cooling liquid, therefore air in the lead: add liquid.
  - Pump is blocked. Switch off device, open lid, carefully turn the pump motor rotor by hand: it should spin without resistance. If this is not the case (contaminants in the pump): rinse pump and lead.
  - Pump control system is defective. Verify that the voltage on the pump motor connectors is approx. 24-26 V.
  - Pump motor is defective: replace motor.
    - Axle between pump motor and pump is defective: remove pump motor, check axle.
    - Device reports the signal "lift error" when starting a measurement. **Possible errors are:**
    - Final position switch on the lift is defective.
    - Cable from measuring head to main conductor board is defective.
    - Conductor board in measuring head is defective.
- Device indicates a much too cold value on the display immediately after staring a measurement, beats the sample tube and reports "not frozen". This only occurs with old firmware versions. **Causes:**
  - Thermisor is defective. Change thermistor, install newer firmware version.
  - Stirring rod cannot be properly adjusted. **Possible causes:**
    - Stirring rod has been bent during a thermistor change and is touching the thermistor shaft. Bend the stirring rod back into shape and adjust the thermistor so that the stirring rod can oscillate freely.
    - Upper part of the stirring rod has a fatigue fracture: replace stirring rod.
    - Stirring rod was assembled backwards. The magnet in the stirring rod must be orientated in such a way that it is pulled by the current-carrying reel and is not pushed away. Assemble the stirring rod in the correct position.
- Device measures and can be calibrated, but measurement values are scattered. **Possible causes:**
  - Thermistor is defective. Somewhere on the thermistor, microscopic cracks have formed which moisture can now seep through. This causes the electrical properties of the thermistor to become compromised, meaning that the thermistor must be replaced.
  - Impure specimen dishes.
  - Cooling bath liquid has reached the thermistor shaft. A measurement was started without a sample tube. This means that the thermistor was dipped into the cooling bath liquid and the remains of it stuck to the thermistor shaft and have slowly got into the sample.

IDENTIFYING OPERATIONAL ERRORS

Most errors that are made during operation of the device are incorrect calibrations. The calibration of a cryoscope is a precondition for each and every use. For measuring reasons it is necessary to use a thermistor to measure the temperature of a sample. Thermistors have a very strong temperature effect which is necessary for resolutions of more than 1 m°C. Unfortunately, the production-oriented fluctuation range of the resistance values of these components is so large that the temperature zero point (0°C) must usually be determined by a pre-calibration before the device can be calibrated with a new thermistor.

It has to be assumed that the A calibration cannot be successfully executed after a thermistor replacement. The reason for this is that the device first has to reach the set "trigger temperature" and then must recognize a rise in temperature after the glass wall has been hit (as a sign that the freezing has started). This does not happen because the values of the new thermistor result in false temperatures being given when calculated with the calibration constant of the old thermistor. Therefore a so-called pre-calibration is necessary, in which the device ignores the temperatures and follows a purely time-controlled measuring procedure. The calibration constants are subsequently adapted to the characteristics of the new thermistor so that both the A and the B calibration can be successfully carried out.

Unfortunately, it often happens that during the calibration sample tubes filled with calibration solution are taken for something else or that the incorrect menu item is selected.

MIX UP: A CALIBRATION INSTEAD OF B CALIBRATION

The entire temperature scale of the device is displaced. When re-measuring the calibration solutions, reversed values and a reversed sign are given.

Example:
A cal. with 0.000
A cal. with 0.000
B cal. with –0.557
A cal. with –0.557 (faulty operation)
Re-measuring solution B: results in 0.000
Re-measuring solution A: results in 0.557

MIX UP: TAKING THE A SOLUTION INSTEAD OF THE B SOLUTION

At first the A calibration goes as expected. However, when it comes to the B calibration, the devices reports the error "uncalibrated" or "thermistor defective" and remains uncalibrated.

Defective thermistor

This is a frequently occurring error. There are two possibilities:

1. The thermistor is (was) broken. This can be identified because display constantly shows a negative value that doesn't change.
2. The thermistor bonding is permeable. This is can be identified by extremely instable measurement behaviour. The reproducibility is very poor, e.g. there are variations of approx. ±0.1°C. In both cases the thermistor must be replaced.

Stirring rod errors

- **The stirring rod does not oscillate freely:** it must be able to move freely in the slot provided. It cannot be allowed to touch the thermistor at any place. This must be kept in mind when replacing the thermistor.
- **The stirring rod amplitude is not high enough:**
  The cooling of the sample is not carried out uniformly and takes much longer than 1 minute. With a correctly adjusted stirring rod, the cooling time is almost exactly 1 minute. The stirring rod amplitude must be approx. 3-4 mm. If necessary, the stirring rob must be adjusted accordingly.
- **The stirring rod amplitude is too high:**
  Premature freezing of the sample occurs frequently.

SPECIAL APPLICATIONS/MEASUREMENT OF CREAM

Since the liquid relevant for the freezing point only exhibits 60 % sample volume with a cream of approx. 40 %, it is recommended to increase the sample volume to 3 ml. In addition, the trigger temperature should be set to -3°C, or -3.2°C if the sample repeatedly fails to freeze. It is also possible to marginally increase the impact force of the stirring rod.

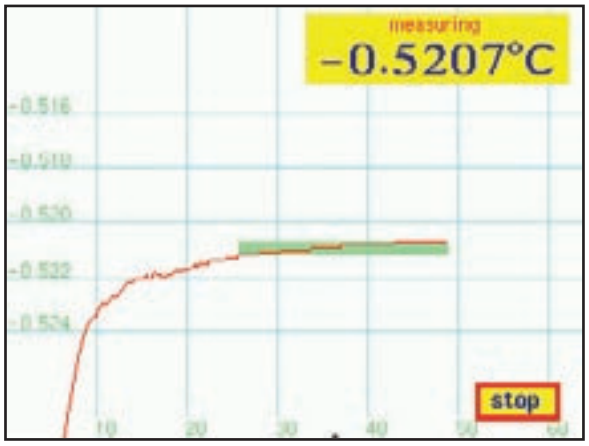
Suggested set points

Description	Set points
A calibration	0.000°C or -0.408°C
B calibration	-0.557°C or -0.600°C
Base value	-0.520°C (EU boundary value) Serves solely for calculation of the infiltration water content percentage.
Trigger temperature	-2.00°C (-3.00°C minimum)
Mode	Celsius
Plateau	Plateau search: 0.4 m°C / 22s
Fixed time:	50 s
Maximum:	0.2m°C
Language	free choice
Stirring rod / amplitude	3 - 4 mm
Stirring rod / frequency	**Note:** Do not change the set value! The values lie between 95 Hz and 104 Hz, depending on the device. Stirring rod/impact force. The impact force should be set to be so powerful that a relatively loud noise is heard when the trigger temperature (e.g. -2°C) is reached. However, it should be seen to that the impact force is not too strong, as this could lead to breakage of the sample tube. The set points lie between approx. 40 % and 50 %.

If the set points are changed, the device must be re-calibrated.

CryoStar automatic

CryoStar I



Important:
The freezing curve is illustrated on the graphic colour display during the measurement. This enables the plateau search in accordance with the prescribed standard (DIN/ISO/IDF/5764) to be ideally tested and reproduced (patent-registered).

Quick and reliable measurement of the freezing point in milk with the CryoStar
Reference measurement in accordance with DIN / ISO / IDF 5764

THE MOST IMPORTANT FEATURES AT A GLANCE:

- **Forward-looking and flexible:** fixed-time measurement, plateau search and maximum search features are available. All parameters relevant to these features can be programmed freely, and, of course, recorded as well. This means that the device can be adjusted to all national and international standards.

- **Easy-to-use:** operation is menu-assisted in the language of your choice. Currently, German, English, French, Greek, Italian, Polish, Portuguese, Spanish, Turkish and Hungarian are available.

- **Efficient:** a new cooling system provides for quick operational readiness even at high surrounding temperatures (up to approx. 32°C).

- **Fast:** up to 40 samples can be measured per hour, depending on the setting.

- **Multifunctional:** the device has a parallel connection (for standard printers) and can be hooked up to a PC with a serial interface. This makes it possible to map the freezing curve on the screen during a measurement and, when necessary, to save it. An efficient zoom function tops off the image. The software needed for this is included in the scope of delivery.

- **User-friendly:** the operation of this device is uncomplicated. The percentage of infiltration water is immediately indicated and printed out. The calibration is executed automatically. All settings and calibrations are permanently saved to non-volatile storage.

Technical specifications:

Connection:	230V/115 V AC (50...60 Hz), 180 VA
Measurement resolution:	0.0001°C (0.1 m°C)
Reproducibility:	± 0.002°C (± 2.0 m°C)
Measuring range:	0.0000°C to -1.5000°C
Sample volume:	2.0 ml to 2.5 ml *(recommended value: 2.2 ml)*
Sample turnover:	up to 40/h, typically 30/h
Interfaces:	1 x parallel, 1 x serial (RS232)
Cooling time:	approx. 15 min.
Display:	graphic colour display, freezing curve, measurement result [°C], [% infiltration water], date, time, measurement conditions
Protocol printing:	measurement result [°C], [% infiltration water], date, time, measurement conditions

CryoStar I (single sample device)
Automatic cryroscope

Reference method in accordance with ISO/IDF/DIN 5764
This device differs from the "CyroStar$_{automatic}$" only in the sample feed system.

Weight: 12.0 kg (net)
Dimensions: 290 x 380 x 190 mm (w x d x h)
7150 With measuring head: 240 mm (h)

CryoStar$_{automatic}$ (multi-sample device)

The measurement procedure of this device is identical to that of the single sample device "CyroStar 1".
It differs from the "CyroStar 1" only in the sample feed system. In addition, this device is equipped with a round magazine for 12 samples. This makes fully automatic measurement of 12 samples possible with the push of a button.

Weight: 14.6 kg (net)
Dimensions: 440 x 440 x 200 mm (w x d x h)
7160 With measurement head: 240 mm (h)

Accessories/Expendable items

Thermal printer protocol printer (6 V DC)
for direct connection to the devices CryoStar (art. no. 7150, 7160) and LactoStar (art.no. 3510, 3530). Please see art. no. 7157
7151 for compatible thermal paper rolls.

Replacement thermistor,
for CryoStar I and CryoStar$_{automatic}$ (art. no. 7150, 7160)
7152 in accordance with ISO/DIN 5764, PVC, white

Software
7156 for CryoStar (included in the scope of delivery)

Thermal paper roll
7157 for thermal printer art. no. 7151

Connecting cable (12 V DC)
7159 for CryoStar 12 Volt connection

7165 Calibration standard “A“
0.000°C, in 250 ml PE bottle

7166 Calibration standard “B“
-0.557°C, in 250 ml PE bottle

7167 Sample tube
mit Marke with marking at 2.0 ml, 50 pieces

7168 Sample stand
PPH, for 27 sample tubes (art. no. 7167)

7169 Cooling bath liquid
in 500 ml PE bottle

7174 Sampling pipette
adjustable from 1.0 to 5.0 ml

7175 Pipette tips
for art. no. 7174

7186 Calibration standard A
-0.408°C, in 250 ml PE bottle

7187 Calibration standard B
-0.600°C, in 250 ml PE bottle

7188 Confirmation standard C
-0.512°C, in 250 ml PE bottle

Lactometer

7500 easy-to-use hand refractometer for the in-house determination of SNF.

Solubility index mixer

for determining the solubility of milk, cream, whey powder, among others

in accordance with ADPI and DLG regulations, with special motor, glass mixing bowl, stainless steel stirrer, timer and continuous operation switch.
See also art. no. 3634

7610 Solubility index mixer

7620 Replacement glass mixing bowl

7621 Replacement stirrer

7622 Replacement drive belt

Reference table

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

Jolting volumeter

Type STAV II for determining the jolting volume of powdered milk.

White plastic casing, high gloss with single-phase AC motor 220 V/50 Hz, jolting mechanism with tension lock for measuring cylinder, five digit electrical pre-selection counter, on/off switch with control lamp, red semi matte control panel. The 250 ml measuring cylinders are standardised by weight and graduation in accordance with DIN 53194

7660

Replacement measuring cylinder

7661 for art. no. 7660

SHORT TIME HEATING DETECTION
determination of alkaline phosphatase

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

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

Testing strips Phosphatesmo MI,
7822 pack of 50 strips

Peroxtesmo MI
high temperature heating detection/UHT test
detemination of peroxidase

7825 pack of 100 strips

Mastitis detection
LactoStar is used to diagnose a mastitis infection (see art. no. 3510). In addition, determination by means of the California Mastitis Test can be done.

California Mastitis Test (CMT) (shalm test)
for quick determination of increased cell content in milk from which a possible mastitis infection can be diagnosed

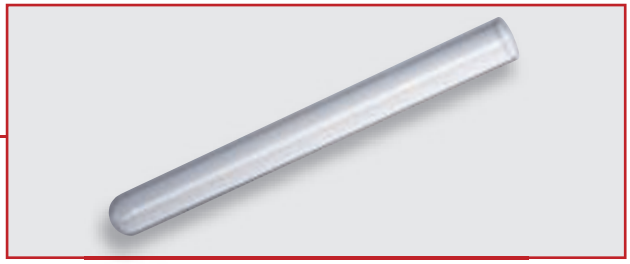
2 test trays with 4 dishes
7920 1 injection flask 250 ml

California Mastitis Test (CMT)
(test liquid)

7930 1 litre
7931 5 litres

Test tube
thick-walled, 100 pieces,

8100 160 x 15 x 16 mm



Coli tube

8120 20 x 10 mm, 100 pieces

Durham tube

8130 40 x 8 mm, 100 pieces

Coli tube stand
for 54 samples
stainless steel, sterilisable

8140 150 mm x 100 mm x 205 mm (w x h x d), 600 g

Sterilizing box for pipettes
stainless steel

8190 300 x 65 mm (length x thickness)

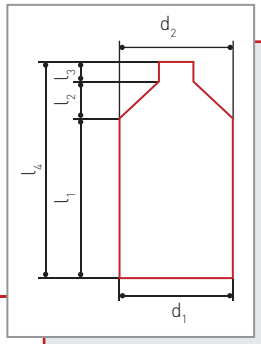
8191 420 x 65 mm (length x thickness)

8201 **Kapsenberg cap**
various colours

Dilution flask
borosilicate glass 3.3

8290 **250 ml,** with glass rod and silicon stopper, sterilisable

8291 without accessories
l_4 = 190 mm, l_3 = 20 mm, l_2 = 27 mm, l_1 = 143 mm, d_2 = 20.5 mm, d = 52 mm



Dilution pipettes

8300 **1.1: 0.1 ml**
l = 250 mm, Ø = 5.9 mm

8301 **1.0 + 1.1 ml,**
according to Demeter's method, with 2 markings
l = 225 mm, Ø = 6.9 mm

8302 **1.0 + 2.0 + 2.1 + 2.2 ml,**
according to Demeter's method, with 4 markings
l = 260 mm, Ø = 6.3 mm

8303 **1.0 + 1.1 + 1.2 ml,**
according to Demeter's method, with 3 markings
l = 225 mm, Ø = 7 mm

Petri dish
glass

8310 100 x 20 mm

Petri dishes

plastic (disposable),
sterile packaging

8312	1620 pieces, without vent cam, Ø 55 x 15 mm
8313	480 pieces, with vent cam, Ø 94 x 16 mm
8314	480 pieces, without vent cam, Ø 94 x 16 mm

Sterilizing box

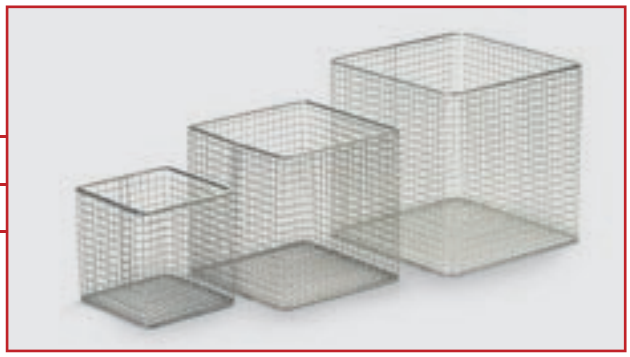
with insert,
stainless steel, for Petri dishes

8320	250 x Ø 120 mm

Wire cages

for sterilisation

8330	100 x 100 x 100 mm
8331	140 x 140 x 140 mm
8332	200 x 200 x 200 mm



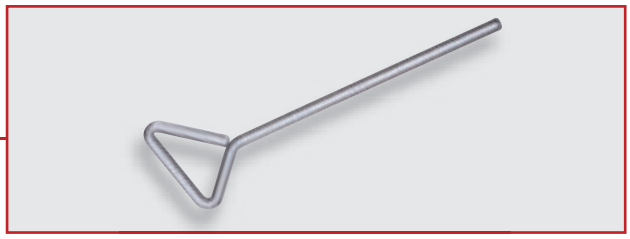
Smear needle

rectangular bend

8340	0.59 mm thick

Drigalski spatula
glass

8350 l = 150 mm, triangle height = 30 mm



Inoculation wire
stainless steel

8370 1 m, Ø = 0.46 mm

Burri loop
platinum, calibrated

8380 0.001 ml

8381 0.01 ml

Needle holder

8382 for inoculation wire loop

Slide
for microscope (art. no. 8761, 8762)
half white, cut edges,
50 pieces

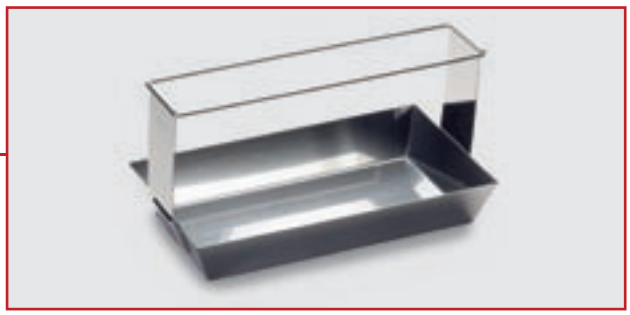
8400 76 x 26 mm

Cover glass
for microscope (art. no. 8761, 8762)

8401 18 x 18 mm

8410 Tweezers for slides

8420	**Staining stand** according to Bongert's method



8430	**Staining cuvette** rectangular

	Wire mesh
8440	with ceramic centre
8441	without ceramic centre

8450	**Tripod** for Bunsen burner

ColonyStar bacteria counter

easy-to-clean plastic casing, height adjustable illuminated area of 145 mm Ø with direct or indirect glare free lighting, frosted glass and clear glass plate with cm^2 und 1/9 cm^2 graduation, electrical contact pin with felt tip pen for marking Petri dishes of up to 145 mm Ø can be used. The supplied reducing insert can be used for dishes with smaller diameters.

220 V/50 Hz, 250 x 230 x 75 mm, 1.7 kg

	ColonyStar
8500	with accessories (art. no. 8501, 8503, 8504, 8505)
8501	**Magnifying lens** with sturdy base a. flexible arm
8502	**ColonyStar** without accessories
8502-001	Replacement **frosted glass plate**
8503	Automatic **contact pin**
8504	**Felt pen refill** replacement part for art. no. 8503
8505	**Clear glass plate** with dark field

Portable bench autoclaves

with screwed-on control thermometer for rapid and efficient vapour sterilisation 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 on request 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 in the shipment.

220 - 230 Volt, 50 - 60 Hz, 1.6 KW to 1.75 KW, aluminium, polished silk gloss exterior, thermostatic temperature controller, tested safety (GS)

8541 **CV-EL 12 L**
Volume 12 L, weight 6.1 kg, diameter 24 cm, interior height 24 cm, maximum usable diagonal 32 cm

8542 **CV-EL 18 L**
Volume 18 L, weight 7.7 kg, diameter 24 cm, internal height 38 cm, usable diagonal 43 cm

8543 **Wire basket**

Culture cultivating appliance

for cultivation of individual dairy cultures. Stainless steel culture vessels, 5 L with lid and stirrer, PP plastic casing, microprocessor controller, 8 different sizes from 1 x 5 L to 4 x 20 L

8610	1 x 5 L - vessel, 2 x 0.5 L starter culture flask
8611	2 x 5 L - vessel, 2 x 0.5 L starter culture flask
8612	4 x 5 L - vessel, 4 x 0.5 L starter culture flask
8613	1 x 10 L - vessel, 2 x 0.5 L starter culture flask
8614	2 x 10 L - vessel, 2 x 0.5 L starter culture flask
8615	4 x 10 L - vessel, 4 x 0.5 L starter culture flask
8616	2 x 20 L - vessel, 2 x 0.5 L starter culture flask
8617	4 x 20 L - vessel, 4 x 0.5 L starter culture flask

Test tube shaking device

The shaking function is started by pressing down on the test tube support plate.
Shaded pole motor, 45 Watt, 230V
rpm infinitely variable from 0-2800

8650 110 x 100 x 90 mm (w x d x h)

Magnetic stirrer L-71

without heater,
rpm range 50 - 1250
up to 5000 ml capacity
compact aluminium casing

8690 plate diameter: 155 mm

Magnetic stirrer L-81

with heater, heating plate temperature 50-325°C
rpm range 50 - 1250
up to 5000 ml capacity
compact aluminium casing

8691 plate diameter: 145 mm

Stirring rod

8696	25 x 7 mm
8697	30 x 7 mm
8698	80 x 9 mm

Photometer Spekol 1300

Single jet instrument for spectrum and kinetic measurements in the range of 190 - 1100 nm

with numerical display, equipped with printer interface. Easy handling with pre-programmed methods
230 V, 50-60 Hz, 11.5 kg, temperature range: 15 - 35°C

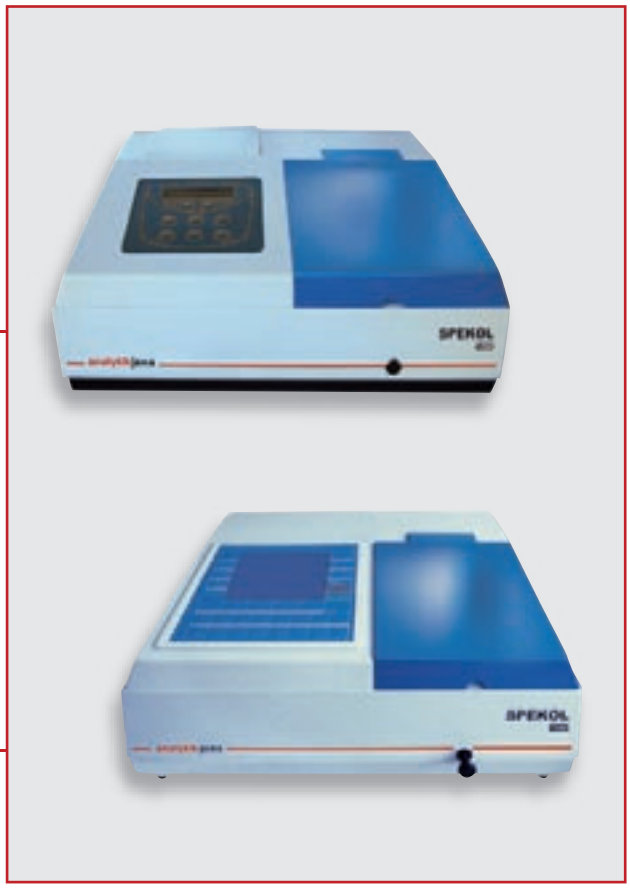
8700	465 x 365 x 175 mm (w x h x d)

Photometer Spekol 1500

Single jet instrument for spectrum and kinetic measurements in the range of 190 - 1100 nm

with high-resolution LDC-VGA screen,
equipped with printer interface.
Easy handling with pre-programmed methods
230 V, 50-60 Hz, 11.5 kg, temperature range: 15 - 35°C

8701	465 x 365 x 175 mm (w x h x d)



Manual 4x cuvette changer

8702	for 1 cm or for 5 cm, 10 cm cuvettes
8705	**Cuvettes**

Binocular microscope

with 45° slanted viewer

stable metal casing with coaxial fine and coarse focus with adjustable end stop. Built-in cross table movement L-R 74, V-H 30 mm.
Built-in illumination 6V/20W, power supply 230 V, 50 Hz.
Doppel lens Abbe condenser N.A 1.25 with iris diaghragm, pivotable filter holder, height adjustment,
glass filters: blue, green.
(Accessories: art. no: 8400, 8401, 8410)

Eyepiece: 0x planar eyepiece
Objectives: achromatic 4x/0.10; 10x/0.25; 40x0.65,
100 x 1.25 oil immersion

8761

Trinocular microscope

in addition to the binocular model with trinocular sliding tube
(accessories: art. no. 8400, 8401, 8410)

8762

Automatic water distillation apparatus

For generating distilled water with a conductivity of under 2.3 µS/cm at + 20°C.
Apparatus is fabricated completely from stainless steel 1.401. Wall holder and water supply and discharge hoses are included in the scope of the delivery.

Efficient energy consumption due to use of cooling water heated to 80°C.

Destillatmenge:	4 L / h
Storage tank:	4 L
Cooling water consumption:	50 L / h
Power supply:	220 V / 50 Hz; 3.2 kW
Dimensions:	510 x 460 x 230 mm
Weight:	13 kg

8771

Distillate amount:	7 L / h
Storage tank:	7 L
Cooling water consumption:	70 l / h
Power supply:	220 V / 380 V / 50 Hz; 4.8 kW
Dimensions:	670 x 500 x 340 mm
Weight:	19 kg

8772

Water bath

with digital clock up to 999 hours
and temperature rise safety

8786	7 L with gable cover approx. 11 kg, 240 x 20 x 140 mm
8788	22 l with gable cover approx. 16 kg, 350 x 290 x 220 mm

THE USE OF REFERENCE MATERIAL IN THE LABORATORY

Dr. Ulrich Leist, DRRR GmbH, reports

Dr. Ulrich Leist *studied chemistry and marine life science in Marburg, Stuttgart and Oldenburg, where he got his doctorate in the field of surface science. Afterwards, he was employed as a postdoctoral researcher for a year at Harvard University, Cambridge USA. He gathered additional experience in the field of interlaboratory tests/reference material during his four year employment at Muva Kempten. Since 2007 he has been the executive director of the Deutsches Referenzbüro für Lebensmittelringversuche und Referenzmaterialien GmbH (DRRR GmbH) (German Reference Office for Foodstuff Interlaboratory Tests and Reference Material, Ltd.).*

Fundamentals for evaluating laboratory results of the main parameters in dairy farming

The use of reference material in the laboratory serves to assure quality. On the one hand, laboratory personnel can be trained, methods can be developed, checked and optimized, and measuring devices can be tested for their operational capability, accuracy and precision. Of particular importance when doing this is the calibration of indirect measurement equipment, e.g. IR spectrometers, with which the measurement signal is first related to the reference parameter, for example to a measurement parameter such as fat.

To ensure the optimal use of reference material, the fundamental terms should be briefly defined:

- **Accuracy:** degree of the total error of an analysis and thereby an umbrella term for correctness and precision.
  A result is accurate when it is free of incidental and systematic mistakes.
- **Correctness:** degree of deviation from the measurement value (or, the mean of many measurement values) to the correct (actual) value due to a systematic mistake *(also: bias for the amplitude of a systematic mistake)*.
- **Precision:** precision indicates how widely the analysed values are scattered due to incidental mistakes. Precision is statistically described by the standard deviation or the confidence interval.
- **Reproducibility (repeatability limit) r:**
  The absolute difference between two single measurement values that can be expected from the same material, the same methods, the same person, the same instrument, the same laboratory and the same time frame with a probability of 95 %.
- **Comparability (comparability limit) R:**
  The absolute difference between two single measurement values that can be expected from the same material, the same methods, different people, different instruments, different laboratories and a larger time frame with a probability of 95 %.

Precision data for the methods is of particular importance as this makes it possible for laboratories to evaluate whether they are proficient in a method and whether measurement results of different laboratories are comparable. This is crucial in the case of reference methods because they are the accepted foundation on which products like foodstuffs can be judged. Precision data is documented in various standards and official regulations.

Precision data r and R from:

- DIN/EN/ISO
- IDF
- § 64 LFGB (previously: § 35 LMBG)
- VDLUFA

Precision data for milk

Parameter	Method	r	R	s_R	CRD	Range of application
Fat	Roese Gottlieb	0.02 % 0.02 % 0.01 %	0.04 % 0.03 % 0.025 %	0.014 % 0.011% 0.009 %	0.026 % 0.019 % 0.017 %	3.5 % fat 1.5 % fat (0.5 to 2 %) skim milk <0.5 % fat
Dry matter	102°C, sea sand	0.10 %	0.20 %	0.071 %	0.132 %	
Protein	Kjeldahl	0.04 %	0.10 %	0.035 %	0.068 %	
Lactose	enzymatic determination	Value x 0.05	Value x 0.06	$\frac{R}{2.83}$		
Freezing point	cryoscopy	0.004°C	0.006°C	0.002°C	0.004°C	

Precision data for powdered milk

Parameter	Method	r	R	s_R	CRD	Range of application
Fat	Roese Gottlieb	0.2 % 0.15 % 0.1 %	0.3 % 0.25 % 0.2 %	0.106 % 0.088 % 0.071 %	0.187 % 0.160 % 0.132 %	VMP, powdered cream Partially removed powder Skim milk powder
Dry matter	102°C, sea sand	0.2 %	0.4 %	0.141 %	0.265 %	
Protein	Kjeldahl	0.3 %	0.8 %	0.283 %	0.545 %	
Lactose	enzymatic determination	Value x 0.05	Value x 0.06	$\frac{R}{2.83}$		

Precision data for processed cheese

Parameter	Method	r	R	s_R	CRD	Range of application
Fat	SBR	0.1 % 0.2 %	0.4 % 0.6 %	0.141 % 0.212 %	0.278 % 0.412 %	10 % abs. fat 25 % abs. fat
Dry matter	102°C, sea sand	0.3 %	0.5 %	0.177 %	0.320 %	
Protein	Kjeldahl	0.19 %	0.38 %	0.134 %	0.251 %	
Lactose	enzymatic determination	Value x 0.05	Value x 0.06	$\frac{R}{2.83}$		

QUALITY FROM THE VERY BEGINNING

The use of modern analytical reference systems for the processing of milk is characterized by challenging analytical and statistical demands.

Milk processing is accompanied by a series of measures which assure quality. These measures of course include the analysis of milk beginning at the moment the milk is delivered to the milk processing company, namely dairies. For the analysis of chemical quality parameters of milk such as protein, fat, lactose, dry matter and freezing point, infrared spectroscopy methods as well as thermo-analytical methods (LactoStar) are used extensively in the processing of milk. When doing so, the use of modern IR spectrometers makes it possible to provide test results for the above-mentioned testing parameters within just a few seconds. The speed advantage over the reference testing methods such as Roese Gottlieb's method for determining fat content (test duration approx. 8 hours) or Kjeldahl's method for determining protein content (test duration approx. 8 hours) is enormous. This speed advantage enables rapid response to changes in the constitution of milk as well as with milk supply and the intermediate and end products and makes it possible to adjust the production accordingly. This means that e.g. the fat or protein content for the respective product can be held constant throughout the production time. The IR and thermal analysis not only lend themselves to the control of raw milk but also to all intermediate and end products.

The only disadvantage of the IR spectroscopic methods and thermo-analytical methods is the fact that these are indirect methods. That means that the analytical instruments have to be calibrated.

Calibration

For calibration, a concentration value must be related to the measurement signal of the analytical instrument.

This fundamental calibration is usually included in the scope of delivery of the instrument or is configured with the help of the instrument manufacturer.

The basic calibration is ultimately a relation of the physical measurement scope to a substance. The regular calibration related to a concrete product is usually carried out by the user himself. Here, the change in concentration of a substance is ultimately correlated to the change in the strength of the signal. Conventionally, to do this a sample is measured with the analytic instrument whose substance is determined at the same time through tests with rapid methods or reference methods. The test results obtained are then allocated to the analytical instrument during calibration. At the same time, this means that the uncertainty of measurement of the test results must be factored in to the instrument. The precision reached with the calibration can hence only lie within the boundaries of the method comparability. This means that the theoretically possible precision is entered into the analytical instrument. In addition, the measurement speed advantage is partially quantified by the increase in measurement certainty. In order to cancel out this disadvantage, the number of calibration sample tests with rapid or reference methods can be increased, which is however very costly. Since it is necessary to regularly calibrate the analytical instrument, each and every increase in the sample number for tests in the context of calibration value assignment leads to an increase in test complexity and expense.

However, consideration of measurement uncertainty can not be foregone. When fulfilling official regulations regarding foodstuffs, e.g. pasteurized milk, these uncertainties during calibration must be considered. If the target values for a product are not fulfilled, it can lead to penalties from the customer or to violation of food labelling regulations.

Modern analytical instruments boast precise measuring technology, but reliable and accurate calibration is essential to complement it.

The means of selecting accurate and precise calibration lies in the use of verified reference systems.

A reference system is ultimately dependent on the reference material which has been confirmed by interlaboratory tests. Particularly high demands are placed on quality assurance with a reference system like that of the DRRR corporation, which has earned the status of a leading proficiency level.

The reference values are determined by an interlaboratory test.

- Only reference methods are used to test reference methods
- The reference laboratories fulfil the demands of standards DIN EN ISO/IEC 17025
- The reference laboratories are under constant supervision, through with they regularly demonstrate their above-average competence by successful participation in respective interlaboratory tests
- The determination of reference values is carried out using extensive modern statistical methods in accordance with the current status of science and technology
- Materials are manufactured without preservatives, using actual shock frost procedures.

The use of reference materials yields the following advantages:

- The materials are related to the reference methods. Thus, the calibration also refers to reference methods. Being that the laboratories are supervised, the return to the reference method is largely assured.
- The material uncertainty corresponds to the comparability of the reference method.
- The use of reference materials makes the simultaneous testing of self-produced calibration samples superfluous. This means lower costs.
- The use of calibration materials assures high linearity, precision and accuracy.
- The materials can be used at any time. Thus, flexibility is increased. In connection with the rapid analysis time with an IR device, a considerable speed advantage is won over classic calibration procedures in dairy laboratories.

CALIBRATION PROCEDURE

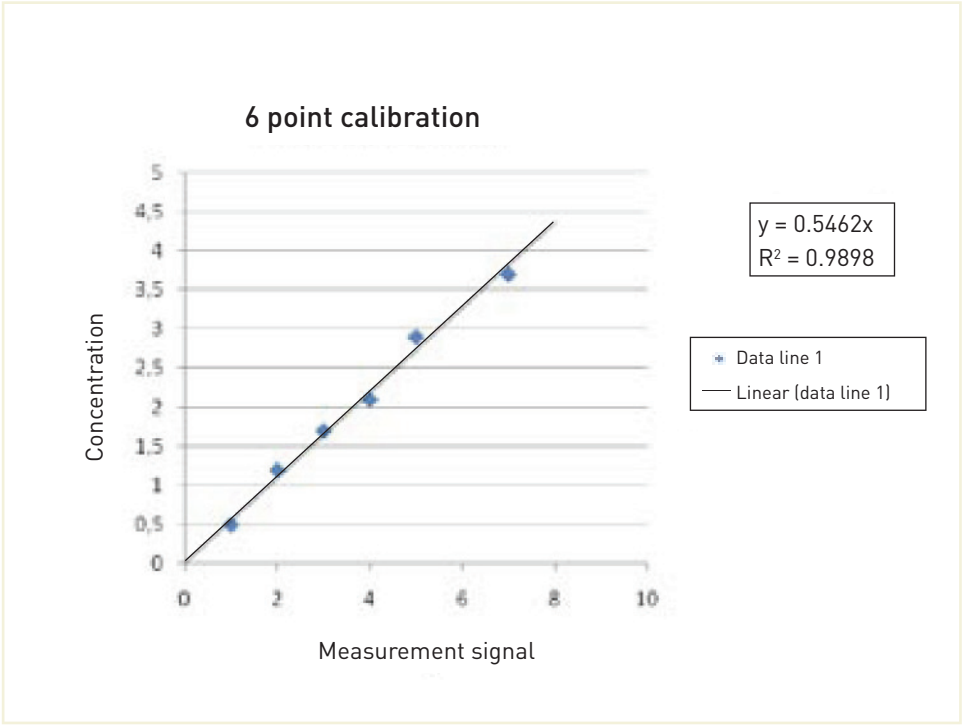
There are in essence two calibration procedures. First, the multiple point calibration procedure and second, the one point calibration procedure. A fundamental calibration is required for both procedures.

One point calibration

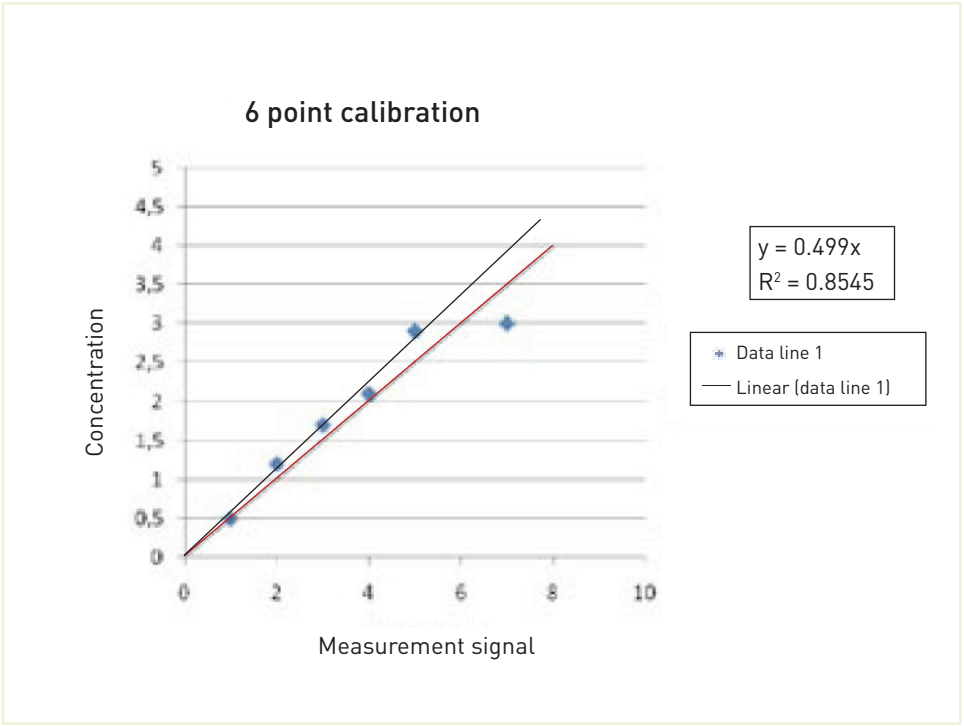
In this context, the calibration usually only has to do with a bias adjustment. This is by all means acceptable if the calibration itself can be assumed to be stable. If this is not the case, a deviation in the measurement value to the expected reference value can only indicate a general deviation. An adjustment to the instrument setting in the direction of the reference value can even in an extreme lead to a degradation of the calibration state.

Multiple point calibration

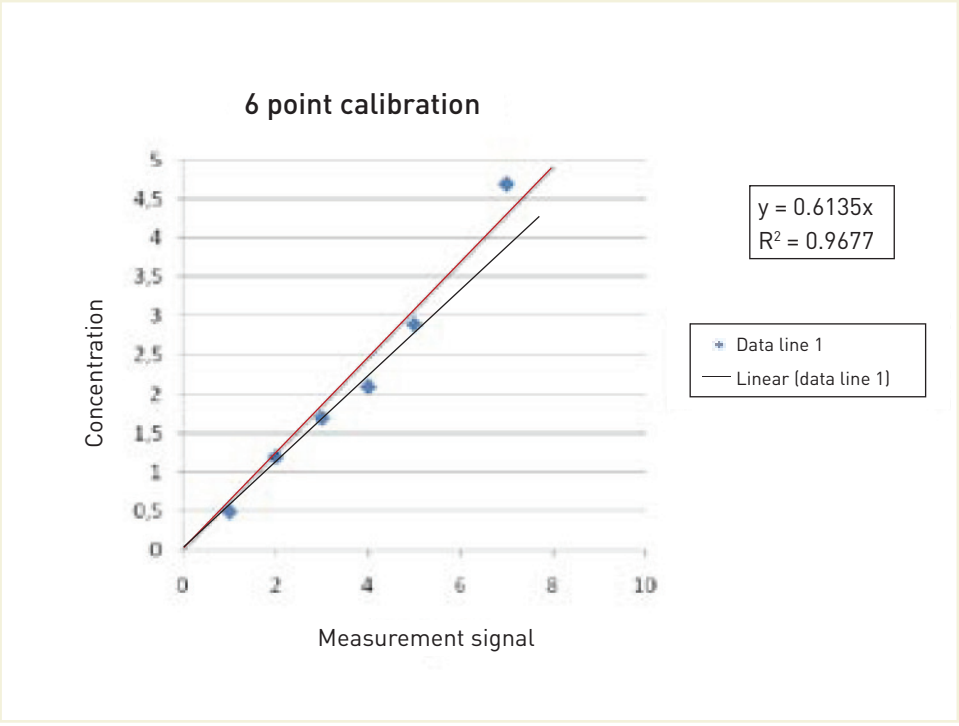
Various calibration samples with different concentrations of the target parameters are measured. The various concentrations of the respective substance (parameter) are set in relation to different measurement signal strengths. In doing so, for each calibration sample measured the reference value of the target parameter is related to the measurement signal. Within the area of concentration of the various calibration samples, a mathematical interrelation regarding the calibration slope between the sample concentration and measuring value is produced on the analytical instrument.
Of particular importance with the multiple point calibration is the "rear values", meaning the values with higher concentration. As can be seen in the following figure, the "rear" value has considerable influence on the calibration slope. If the calibration slope should be steepened, it is advisable to set additional calibration points in the high (rear) area of concentration. The goods of the calibration can be read off on the correlations coefficient, among other things. This should by all means be higher than 0.9. The correlation coefficient indicates how probable it is that the calibration points actually match the calibration slope. The maximum correlations coefficient that can be reached is 1 (=100 %).



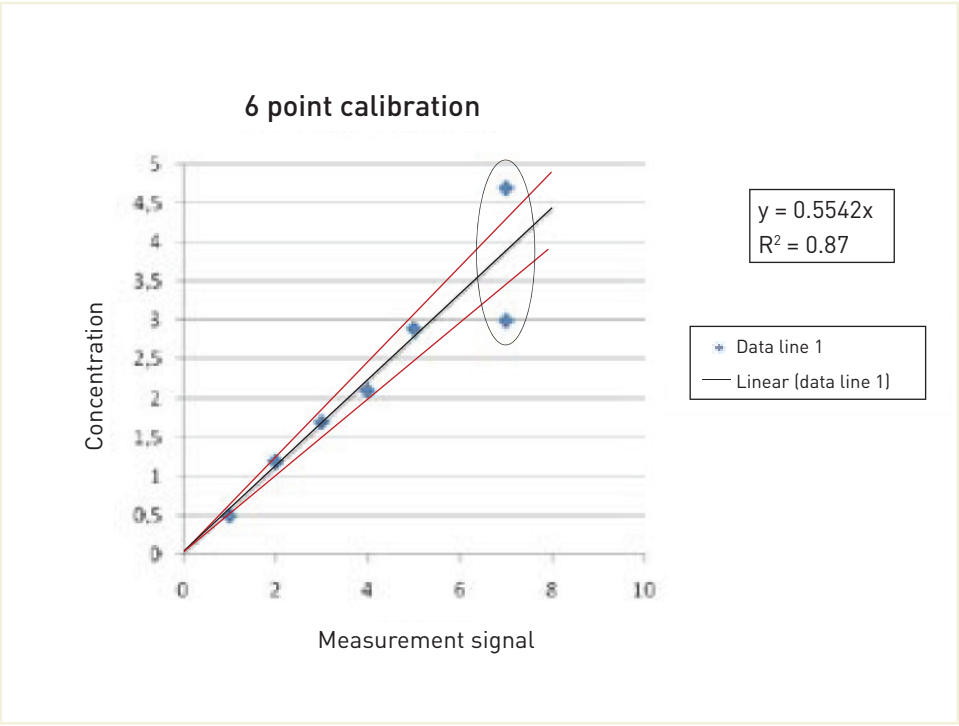
Normal 6 point calibration, with a correlation coefficient near 1.



The 6th measurement value (rear value) is low. The correlation coefficient is near 0.9.



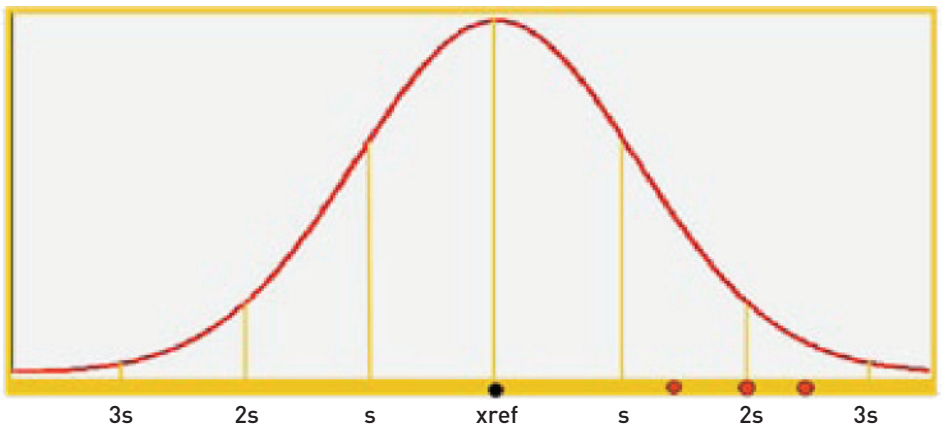
6 point calibration, the 6th measurement value is high, correlation coefficient near 1.



Range of calibration slope, with uncertainties in "rear" value area.

In addition to the use of reference material, interlaboratory tests are applied to assure quality. However, the focus of these is often set exclusively on the z-score. For this reason, it will be briefly explained in the following section.

THE Z-SCORE



With the midpoint and the standard deviation the z-score can be calculated for any laboratory using the following equation [2].

$$z - score = \frac{x_i - m}{s}$$

The respective laboratory measurement value (usually the midpoint of the repeat determination) $\mathbf{x}_i$ is set in the equation above. Then the midpoint **m** and the standard deviation **s** of the entire data set are entered into the equation. Thus, the distance of the laboratory value to the midpoint is calculated in units of standard deviation. A laboratory which has a z-score of exactly 2 has a distance to the midpoint of exactly 2 standard deviations. That means that the laboratory is just barely part of the 95.45 % of the values that are expected around the midpoint. In the area between 2 and 3 standard deviations lies the remaining 5 % of the values. A z-score of 3 or larger means that there is only a probability of 0.027 % of belonging to the data sat observed. The z-score is assessed accordingly:

z < 2	data credible
2 < z < 3	3 data questionable
z > 3	data not credible

In any case it can be wise for the interlaboratory test participant to select the data sets of a interlaboratory test with which he wants to use for comparison, for example because it uses the same methods, or features the competitor or his customer. He can calculate his own z-score according to his test question with equation 3, which has the necessary informative value according to the test question.

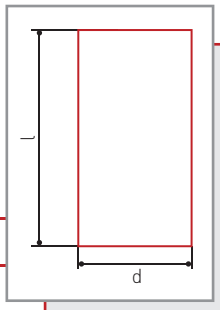
Reference material

You will find the most important reference material for chemical milk analysis eith article numbers 3517, 3518, 3519, 3521 (page 45)

LABORATORY GLASSWARE

Beaker

short design, borosilicate glass,
with graduation and spout



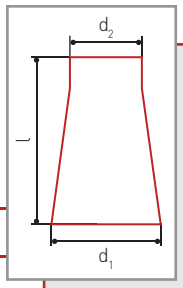
8800	**50 ml**	d = 38.7 mm,	l = 60 mm
8801	**100 ml**	d = 47 mm,	l = 70 mm
8802	**250 ml**	d = 67 mm,	l = 95 mm
8803	**400 ml**	d = 76.2 mm,	l = 110 mm
8804	**600 ml**	d = 86.6 mm,	l = 125 mm
8805	**800 ml**	d = 94 mm,	l = 135 mm
8806	**1000 ml**	d = 102 mm,	l = 145 mm

tall design, borosilicate glass,
with graduation and spout

8808	**50 ml**	d = 34.6 mm,	l = 71 mm
8809	**100 ml**	d = 44.5 mm,	l = 80 mm
8810	**250 ml**	d = 57 mm,	l = 122 mm
8811	**400 ml**	d = 67 mm,	l = 129 mm
8812	**600 ml**	d = 77.9 mm,	l = 148 mm
8813	**800 ml**	d = 84 mm,	l = 175 mm
8814	**1000 ml**	d = 92.8 mm,	l = 180 mm
8815	**2000 ml**	d = 114 mm,	l = 240 mm

Erlenmeyer flasks

narrow necked, borosilicate glass
with graduation, DIN 12380



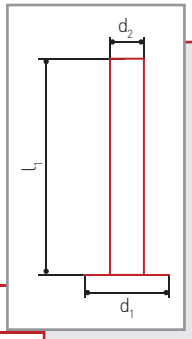
8817	**50 ml**	d_2 = 19.4 mm, l = 87 mm, d_1 = 51 mm
8818	**100 ml**	d_2 = 17.9 mm, l = 108 mm, d_1 = 63.5 mm
8819	**200 ml**	d_2 = 31.1 mm, l = 135 mm, d_1 = 78.7 mm
8820	**250 ml**	d_2 = 32 mm, l = 146 mm, d_1 = 83 mm
8821	**300 ml**	d_2 = 31.5 mm, l = 165 mm, d_1 = 86 mm
8822	**500 ml**	d_2 = 32.3 mm, l = 180 mm, d_1 = 104.5 mm
8823	**1000 ml**	d_2 = 38.9 mm, l = 225 mm, d_1 = 130.3 mm
8824	**2000 ml**	d_2 = 46.6 mm, l = 285 mm, d_1 = 165 mm

wide necked, borosilicate glass
with graduation, DIN 12385

8826	**50 ml**	d_2 = 31.1 mm, l = 86 mm, d_1 = 51.4 mm
8827	**100 ml**	d_2 = 31.7 mm, l = 107 mm, d_1 = 63.5 mm
8828	**200 ml**	d_2 = 45.7 mm, l = 140 mm, d_1 = 78 mm
8829	**250 ml**	d_2 = 47 mm, l = 140 mm, d_1 = 84.7 mm
8830	**300 ml**	d_2 = 47.6 mm, l = 154 mm, d_1 = 87 mm
8831	**500 ml**	d_2 = 46.8 mm, l = 175 mm, d_1 = 105 mm
8832	**1000 ml**	d_2 = 47.8 mm, l = 215 mm, d_1 = 132 mm
8833	**2000 ml**	d_2 = 64.8 mm, l = 280 mm, d_1 = 150 mm

Measuring cylinder

tall design, glass,
with spout



8850	**50 ml**	1/1 ml, d_2 = 22.4 mm, d_1 = 65 mm, l_1 = 195 mm
8851	**100 ml**	1/1 ml, d_2 = 27.5 mm, d_1 = 76 mm, l_1 = 245 mm
8852	**250 ml**	2/1 ml, d_2 = 36.5 mm, d_1 = 96 mm, l_1 = 320 mm
8853	**500 ml**	5/1 ml, d_2 = 47 mm, d_1 = 114 mm, l_1 = 380 mm
8854	**1000 ml**	10/1 ml, d_2 = 61 mm, d_1 = 145 mm, l_1 = 465 mm

Measuring cylinder

tall design, polypropylene,
blue graduation

8855	**50 ml**	1/1 ml, d_2 = 23 mm, d_1 = 68 mm, l_1 = 200 mm
8856	**100 ml**	1/1 ml, d_2 = 28 mm, d_1 = 88 mm, l_1 = 260 mm
8857	**250 ml**	2/1 ml, d_2 = 42 mm, d_1 = 101 mm, l_1 = 310 mm
8858	**500 ml**	5/1 ml, d_2 = 61 mm d_1 = 95 mm, l_1 = 350 mm
8859	**1000 ml**	10/1 ml, d_2 = 70.5 mm, d_1 = 135 mm, l_1 = 415 mm
8860	**2000 ml**	20/1 ml, d_2 = 81 mm, d_1 = 160 mm, l_1 = 490 mm

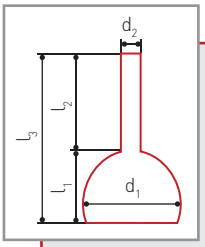
Mixing cylinder

AR glass, round base,
with NS PE stopper

8862	**100 ml 1/1**	d_2 = 22.4 mm, d_1 = 58 mm, l_1 = 280 mm
8863	**250 ml 2/1**	d_2 = 27.7 mm, d_1 = 85 mm, l_1 = 340 mm

Measuring flask

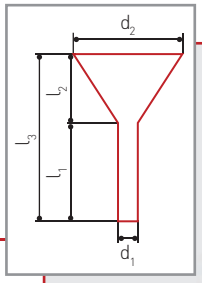
with stopper,
borosilicate glass, with ring markings
DIN 12664, adjusted to "In"



8870	**25 ml**	d_2 = 6.5 mm, d_1 = 37 mm, l_1 = 38 mm, l_2 = 73 mm, l_3 = 111 mm
8871	**50 ml**	d_2 = 12 mm, d_1 = 48 mm, l_1 = 45 mm, l_2 = 92 mm, l_3 = 137 mm
8872	**100 ml**	d_2 = 11.09 mm, d_1 = 60 mm, l_1 = 63 mm, l_2 = 111 mm, l_3 = 174 mm
8873	**250 ml**	d_2 = 12.9 mm, d_1 = 78 mm, l_1 = 85 mm, l_2 = 130 mm, l_3 = 215 mm
8874	**500 ml**	d_2 = 17.3 mm, d_1 = 100 mm, l_1 = 110 mm, l_2 = 150 mm, l_3 = 260 mm
8875	**1000 ml**	d_2 = 22 mm, d_1 = 126 mm, l_1 = 140 mm, l_2 = 165 mm, l_3 = 305 mm

Glass funnel

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

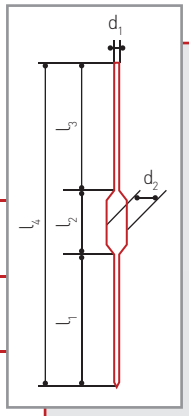


8876	d_2 = 55 mm, d_1 = 10 mm, l_3 = 90 mm, l_2 = 40 mm, l_1 = 50 mm
8877	d_2 = 100 mm, d_1 = 10.2 mm, l_3 = 180 mm, l_2 = 80 mm, l_1 = 100 mm
8878	d_2 = 150 mm, d_1 = 16 mm, l_3 = 275 mm, l_2 = 130 mm, l_1 = 145 mm
8879	d_2 = 200 mm, d_1 = 20.3 mm, l_3 = 330 mm, l_2 = 165 mm, l_1 = 165 mm

Measuring pipettes
colour code, AR glass

8882	**1 ml, 1/100**	l_4 = 360 mm, d_1 = 5 mm
8883	**2 ml, 1/50**	l_4 = 360 mm, d_1 = 5.9 mm
8884	**5 ml, 1/10**	l_4 = 360 mm, d_1 = 7.5 mm
8885	**10 ml, 1/10**	l_4 = 360 mm, d_1 = 9.9 mm
8886	**25 ml, 1/10**	l_4 = 400 mm, d_1 = 14 mm
8887	**50 ml, 1/5**	l_4 = 455 mm, d_1 = 16 mm

Volumetric pipette
color code, AR glass

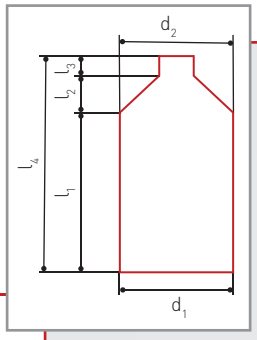


8888	**1 ml**	l_4 = 325 mm, l_3 = 135 mm, l_2 = 35 mm l_1 = 155 mm, d_1 = 4 mm, d_2 = 6 mm
8889	**2 ml**	l_4 = 340 mm, l_3 = 145 mm, l_2 = 40 mm l_1 = 155 mm, d_1 = 5 mm, d_2 = 7 mm
8890	**5 ml**	l_4 = 380 mm, l_3 = 155 mm, l_2 = 55 mm l_1 = 170 mm, d_1 = 6 mm, d_2 = 10 mm
8891	**10 ml**	l_4 = 450 mm, l_3 = 200 mm, l_2 = 70 mm l_1 = 180 mm, d_1 = 7 mm, d_2 = 12 mm
8892	**20 ml**	l_4 = 520 mm, l_3 = 250 mm, l_2 = 90 mm l_1 = 180 mm, d_1 = 8 mm, d_2 = 16 mm
8893	**25 ml**	l_4 = 530 mm, l_3 = 230 mm, l_2 = 105 mm l_1 = 195 mm, d_1 = 10 mm, d_2 = 17 mm
8894	**50 ml**	l_4 = 550 mm, l_3 = 245 mm, l_2 = 120 mm l_1 = 185 mm, d_1 = 7 mm, d_2 = 26 mm
8895	**100 ml**	l_4 = 575 mm, l_3 = 240 mm, l_2 = 135 mm l_1 = 200 mm, d_1 = 8 mm, d_2 = 36 mm

Pipette helper
8920 for pipettes up to 25 ml

Laboratory bottles

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



8970	**100 ml**	l_4 = 105	mm,	l_3 = 20	mm,	l_2 = 20	mm				
		l_1 = 65	mm,	d_1 = 55	mm,	d_2 = 31	mm				
8971	**250 ml**	l_4 = 140	mm,	l_3 = 25	mm,	l_2 = 25	mm				
		l_1 = 90	mm,	d_1 = 70	mm,	d_2 = 29.5	mm				
8972	**500 ml**	l_4 = 180	mm,	l_3 = 28	mm,	l_2 = 40	mm				
		l_1 = 112	mm,	d_1 = 84.7	mm,	d_2 = 29.5	mm				
8973	**1000 ml**	l_4 = 230	mm,	l_3 = 28	mm,	l_2 = 48	mm				
		l_1 = 154	mm,	d_1 = 100	mm,	d_2 = 29.5	mm				
8974	**2000 ml**	l_4 = 270	mm,	l_3 = 27	mm,	l_2 = 75	mm				
		l_1 = 168	mm,	d_1 = 136	mm,	d_2 = 29.5	mm				

Wide necked reagent bottles

AR glass, white with standard polish and stopper

8980	**50 ml**	NS 24/20	l_4 = 87	mm,	l_3 = 17	mm,	l_2 = 17	mm			
			l_1 = 53	mm,	d_2 = 14	mm,	d_1 = 45	mm			
8981	**100 ml**	NS 29/22	l_4 = 96	mm,	l_3 = 24.5	mm,	l_2 = 8.4	mm			
			l_1 = 63.1	mm,	d_2 = 28	mm,	d_1 = 53	mm			
8982	**250 ml**	NS 34/35	l_4 = 142	mm,	l_3 = 28	mm,	l_2 = 28	mm			
			l_1 = 86	mm,	d_2 = 34	mm,	d_1 = 142	mm			
8983	**500 ml**	NS 45/40	l_4 = 167	mm,	l_3 = 31	mm,	l_2 = 26	mm			
			l_1 = 110	mm,	d_2 = 43.8	mm,	d_1 = 87	mm			
8984	**1000 ml**	NS 60/46	l_4 = 200	mm,	l_3 = 45	mm,	l_2 = 30	mm			
			l_1 = 125	mm,	d_2 = 58	mm,	d_1 = 109	mm			
8985	**2000 ml**	NS 60/46	l_4 = 255	mm,	l_3 = 50	mm,	l_2 = 41	mm			
			l_1 = 164	mm,	d_2 = 58	mm,	d_1 = 134	mm			

Narrow necked reagent bottles

AR glass, white with standard polish and stopper

8990	**50 ml**	NS 14/15	l_4 = 77	mm,	l_3 = 15	mm,	l_2 = 12	mm			
			l_1 = 50	mm,	d_2 = 13	mm,	d_1 = 42	mm			
8991	**100 ml**	NS 14/15	l_4 = 105	mm,	l_3 = 25	mm,	l_2 = 7	mm			
			l_1 = 60	mm,	d_2 = 13	mm,	d_1 = 52	mm			
8992	**250 ml**	NS 19/26	l_4 = 135	mm,	l_3 = 25	mm,	l_2 = 30	mm			
			l_1 = 80	mm,	d_2 = 17.6	mm,	d_1 = 71	mm			
8993	**500 ml**	NS 24/20	l_4 = 165	mm,	l_3 = 47	mm,	l_2 = 35	mm			
			l_1 = 100	mm,	d_2 = 22	mm,	d_1 = 87	mm			
8994	**1000 ml**	NS 29/22	l_4 = 205	mm,	l_3 = 35	mm,	l_2 = 42	mm			
			l_1 = 128	mm,	d_2 = 28	mm,	d_1 = 108	mm			
8995	**2000 ml**	NS 29/32	l_4 = 265	mm,	l_3 = 35	mm,	l_2 = 70	mm			
			l_1 = 160	mm,	d_2 = 29	mm,	d_1 = 130	mm			

Culture tubes
DURAN glass, straight rim

9050	16 x 160 mm, 100 pieces

Culture tubes
with ISO thread and screw cap
AR glass, sterilisable

9054	16 x 100 mm, 100 pieces
9056	16 x 160 mm, 100 pieces

Test tubes
DURAN glass

9080	without rim, 16 x 160 mm, 100 pieces
9081	with rim, 16 x 160 mm, 100 pieces

Test tube brush
with wool head

9090	length: 230 mm

Weighing dishes
short design, with knob lid

9120	35 x 30 mm
9121	50 x 30 mm

Digital burette type µ 10
without bottle
certified conformity up to 100 ml,
smallest adjustment interval 10 µl.

9190 bottle: see art. no. 8973

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

9211 **Desiccator plate,** porcelain

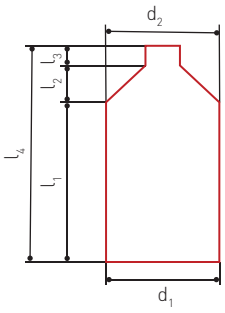
Wash bottles
polyethylene

9230 **100 ml** d_1 = 44.5 mm, d_2 = 12 mm, l_4 = 105 mm
l_3 = 15 mm, l_2 = 27 mm, l_1 = 63 mm

9231 **250 ml** d_1 = 59 mm, d_2 = 19.5 mm, l_4 = 139 mm
l_3 = 15 mm, l_2 = 39 mm, l_1 = 85 mm

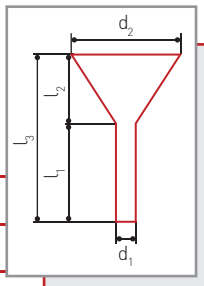
9232 **500 ml** d_1 = 74 mm, d_2 = 18 mm, l_4 = 175 mm
l_3 = 15 mm, l_2 = 45 mm, l_1 = 115 mm

9233 **1000 ml** d_1 = 94 mm, d_2 = 21.5 mm, l_4 = 220 mm
l_3 = 26 mm, l_2 = 49 mm, l_1 = 145 mm



Funnels

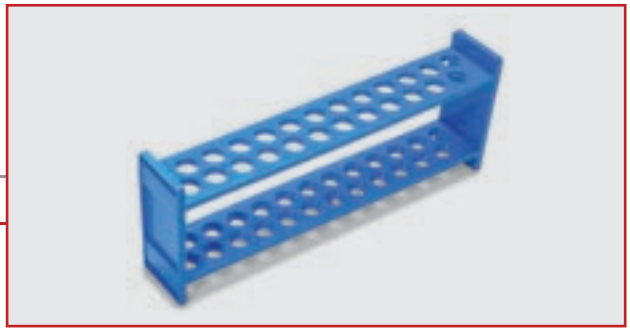
polyethylene



9235	d_2 = 40 mm, d_1 = 9.5 mm, l_3 = 63 mm, l_1 = 33 mm, l_2 = 30 mm
9236	d_2 = 70 mm, d_1 = 11.7 mm, l_3 = 109 mm, l_1 = 55 mm, l_2 = 54 mm
9237	d_2 = 100 mm, d_1 = 13.8 mm, l_3 = 155 mm, l_1 = 80 mm, l_2 = 75 mm
9238	d_2 = 120 mm, d_1 = 15.3 mm, l_3 = 175 mm, l_1 = 85 mm, l_2 = 90 mm
9239	d_2 = 140 mm, d_1 = 16.7 mm, l_3 = 170 mm, l_1 = 65 mm, l_2 = 105 mm

Test tube racks

PP plastic, for glass 160 x 16 mm,
sterilisable up to 121°C



9255	12 samples
9256	24 samples

Test tube rack

9257	36 samples, wire, plastic coated

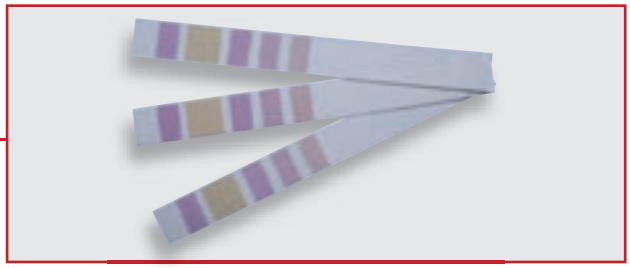
9300 **Laboratory lift**

Lyphan strips
in plastic screw jar

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

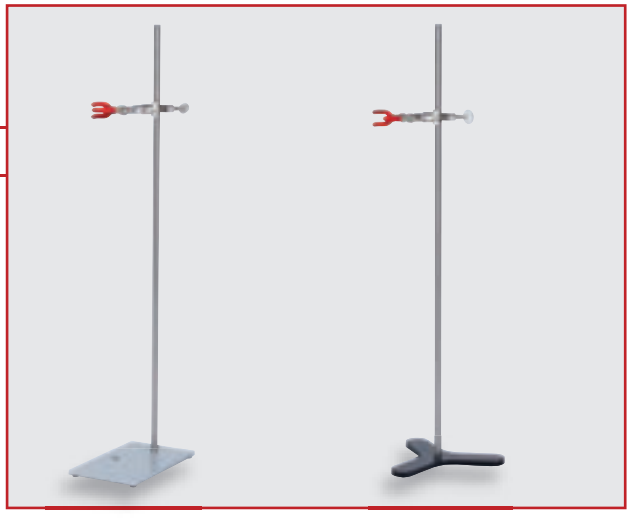
Indicator paper
for degree of freshness of milk, Duplex

9365	pH 7.9 – 11, 100 pieces



Burette stand

9400	Plate stand, 210 x 130 x 750 mm
9401	Tripod stand, 210 x 130 x 750 mm



9405 **Double socket**

9406 **Double socket**
rotatable

Stand clamp
without socket

9407 25 mm

9408 60 mm

9409 **Stand ring**
with socket, 160 mm

Burette clamp
with socket

9410 single

9411 double

9440 **Laboratory clock**
0 - 60 min.

9470 **Laboratory vacuum pump/compressor**
electrical, can be used as a vacuum or pressure pump
max. output 16 L/min.,
max. operating pressure 3.5 bar

Proportioning devices (digital)

for aggressive acids and bases,
without bottle

9484	1 – 10 ml: 0.05 ml, with thread adapter: A25, A28, A32, A38, A40
9485	2.5 – 25 ml: 0.1 ml, with thread adapter: A32, A38, A40

Variable proportioning devices

for aggressive acids and bases,
without bottle

9487	1 – 10 ml: 0.2 ml, with thread adapter: A25, A28, A32, A38, A40
9488	2.5 – 25 ml: 0.5 ml, with thread adapter: A32, A38, A40

Replacement parts for proportioning devices

Adapter external thread

9489	32 mm for bottle thread A 25 mm 32 mm for bottle thread A 28 mm 45 mm for bottle thread A 32 mm 45 mm for bottle thread A 38 mm 32 mm for bottle thread S 40 mm 45 mm for bottle thread S 40 mm

Microlitre pipettes

variable volume adjustment, with disposable tips

9495	10 – 100 µl
9498	100 – 1000 µl

Pipette tips

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

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