BANDELIN
Ultraschall seit 1955

Operating Manual

SONOREX DIGITEC
SONOREX DIGITEC-RC

High-performance ultrasonic baths

Applies to:

DT 31, DT 31 H, DT 52, DT 52 H

DT 100, DT 100 H, DT 102 H, DT 102 H-RC, DT 103 H, DT 106

DT 156, DT 156 BH

DT 255, DT 255 H, DT 255 H-RC

DT 510, DT 510 H, DT 510 H-RC, DT 512 H

DT 514, DT 514 H, DT 514 BH, DT 514 BH-RC

DT 1028, DT 1028 H, DT 1028 CH

DT 1050 CH

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1 About this operating manual

This operating manual contains important and useful information for safe and efficient use of the ultrasonic bath.

- Please read this operating manual before using the ultrasonic bath.
- In particular, please observe chapter **2 Safety**.
- If you pass on this ultrasonic bath, include this operating manual.
- Contact your specialist dealer or BANDELIN if you have any questions that are not answered in this operating manual. You will find information on our service department in chapter **6.4 Repair**.

Illustrations are examples and not to scale.

2 Safety

2.1   Using the ultrasonic bath

The ultrasonic bath can used for the following applications:

- Ultrasonic cleaning of objects of all shapes, types and sizes
- Homogenisation, emulsification
- Rapid degassing of liquids
- Sonochemical applications, e.g. for radical generation or for improved material transport
- Preparation of samples for analysis

A solution made from water and a special agent for ultrasonic applications is used as the sonication fluid. You will find information on the sonication fluid in chapter **5.2 Sonication fluid**.

Goods to be treated may not be placed on the bottom of the ultrasonic oscillating tank. They must be placed in the sonication fluid in an insert basket or in another suitable container. You will find an overview of suitable accessories in chapter **10 Accessories**.

If there are stains, discolouration, signs of rust or similar, you can use special cleaning agents and indirect sonication to perform thorough cleaning.

2.2 Use in medical field

The intended medical purpose of the ultrasonic bath is the cleaning of instruments. Ultrasonic cleaning is performed in the context of further steps required when reprocessing medical devices. Please observe the hygiene requirements as per the applicable regulations during this procedure. The ultrasonic bath is a Class I medical device according to regulation (EU) 2017/745.

UMDNS nomenclature (ECRI/DIMDI): 14-263

Indications/application areas

Medical instruments can be cleaned in the ultrasonic bath as part of manual reprocessing as well as before or after machine reprocessing. The instrument manufacturer's specifications provide information on suitability for ultrasonic cleaning.

Contraindications/exclusions

- Optical equipment, camera systems, light cables, mirrors or objects made from or with elastic materials (e.g. catheters, ventilator system parts and flexible endoscopes) are unsuitable or only conditionally suitable for sonication. The respective manufacturer's specifications provide information on suitability for ultrasonic cleaning.
- The ultrasonic bath is not suitable for the cleaning and disinfection of contact lenses.
- The direct sonication of inflammable liquids is not permitted.

Possible side effects/restrictions

- Ultrasound does not disinfect. However, processes, e.g. chemical disinfection, can be accelerated in the ultrasonic bath.
- Surfaces can be mechanically attacked and coatings dissolved due to cavitation erosion.

User group

The ultrasonic bath may be used by persons who are qualified and trained for their work, e.g. in the reprocessing of instruments.

Pregnancy is not a contraindication for operating the ultrasonic bath.

2.3 Avoiding cross-contamination and infections

If you use the ultrasonic bath in the medical field, clean and disinfect the surfaces of the ultrasonic bath on a regular basis with at least a bactericidal, yeasticidal and, to a limited extent, virucidal surface disinfection agent to avoid cross-contamination. Reprocess accessories like holders, carriers or baskets in a washer-disinfector (WD).

At higher working temperatures, vapours and aerosols that are contaminated with impurities from the goods to be treated can rise from the ultrasonic bath. This can cause infections and illness. When cleaning medical instruments, avoid bath temperatures above 40°C. If necessary, use a lid, an extraction system or protective equipment.

2.4 Keep away from children

Children cannot see the dangers related to the ultrasonic bath. Therefore, keep children away from the ultrasonic bath.

2.5   Risk of electric shock

The ultrasonic bath is an electrical appliance. If safety rules are not observed, a life-threatening electric shock can result.

- Protect the ultrasonic bath against moisture and liquids. Keep the surface and the controls clean and dry.
- Only transport the ultrasonic bath when empty.
- Only drain the ultrasonic bath once it has been switched off. Disconnect an ultrasonic bath that does not have a drain from the mains before you empty it.
- Do not put the ultrasonic bath in the sink. Do not hose the ultrasonic bath down, do not immerse it in water and do not expose it to spray water.
- Disconnect the ultrasonic bath from the mains whenever you clean or maintain it.
- Connect the ultrasonic bath only to mains sockets with earthing contacts.
- If you discover a fault on the ultrasonic bath, disconnect the mains plug immediately. Do not connect a faulty ultrasonic bath to the mains.
- Have repairs performed only by the manufacturer. See chapter **6.4 Repair**.

2.6   Damage to health due to ultrasonic noise

Some people may find the typical ultrasonic noise produced during processing very unpleasant. Damage to health can result if you remain within a radius of 2 m for long periods.

- Wear suitable ear protection.
- Use a lid to reduce noise. The ultrasonic bath can also be used inside a soundproof box.

2.7 Risk due to high working temperatures

The ultrasonic bath, the sonication fluid and the goods to be treated can become hot during operation. Touching them can lead to burns. The working temperature can be set to up to 80°C.

Ultrasound heats the sonication fluid even without additional heating. Very high working temperatures can occur during lengthy ultrasonic operation. In ultrasonic baths with heating, the ultrasonic energy can cause the set working temperature to be exceeded considerably.

- Note the treatment times recommended by the ultrasound agent manufacturer. Do not leave the ultrasound switched on for longer than necessary.
- Do not reach into the sonication fluid with your hand. Remove the goods to be treated with the insert basket or with tongs.
- Allow the goods to be treated to cool down before you touch them.
- When you lift the basket out by the handles, your hands could touch the edge of the ultrasonic oscillating tank, which can be very hot. Allow the ultrasonic bath to cool after use before you lift it for emptying.

Non-aqueous liquids can heat up much faster than water. A possible flashpoint can be reached and exceeded after very short sonication. When using high-boiling liquids, the bath temperature can rise above 120°C due to the energy supplied by the ultrasound. This can lead to fires and to serious burns.

- Do not use any flammable, explosive, non-aqueous liquids (e.g. benzine or solvents) or mixtures with flammable liquids (e.g. alcohol solutions) directly in the stainless steel ultrasonic oscillating tank.
- Small quantities of flammable liquids can be sonicated indirectly in sample containers. Before sonicating flammable liquids, familiarise yourself with necessary safety measures and applicable regulations for handling these liquids.

2.8   Danger from ultrasound

High ultrasonic levels like those reached in the ultrasonic bath destroy cell structures. If part of the body is immersed in the soni-cation fluid during operation, this can cause damage to skin and also damage to internal tissue. The periosteum of finger bones can be damaged.

- Do not reach into the sonication fluid during operation.
- Never sonicate living creatures.

2.9   Danger from agents used

Agents used in the ultrasonic bath can be toxic or caustic. They can irritate eyes, skin and mucous membranes. The vapours and aero-sols can also be dangerous.

- Wear gloves and protective goggles when handling dangerous agents.
- Do not ingest the agents and do not allow them to come into contact with eyes or skin. Do not lean closely over the ultrasonic bath otherwise vapours could come into contact with your eyes and you could breathe in vapours.
- Place a lid on the ultrasonic bath during operation. Use an extraction system if there are dangerous vapours.
- Note the information on the label and on the safety data sheet for the agent.
- Keep the agents out of the reach of children and of persons who have not been instructed.

2.10   Disposing of sonication fluid

Dispose of the sonication fluid according to the information pro-vided by the manufacturer of the ultrasound agents used. The rec-ommended ultrasound agents from the TICKOPUR, TICKOMED and STAMMOPUR product ranges from DR. H. STAMM GmbH are bio-degradable according to the articles of Regulation (EC) no. 648/2004 (Detergents Regulation). If necessary, the sonication fluid needs to be neutralised before disposal.

During cleaning, water-polluting substances, e.g. oils or heavy-metal compounds, can contaminate the sonication fluid depending on the type of soiling. If the limit value for these substances is exceeded, the sonication fluid must be reprocessed or disposed of as special waste.

Observe the local waste water regulations.

2.11 Erosion of the ultrasonic oscillating tank

The surface of the ultrasonic oscillating tank is subject to erosion. How quickly this erosion takes place depends on the usage of the ultrasonic bath. The erosion leads to leaks in the ultrasonic oscillating tank. Sonication fluid can thus leak into the interior of the ultrasonic bath. Moisture on electrical components can lead to an electric shock or to a fire.

- Do not use the ultrasonic bath any more if you notice a leak. Disconnect the mains plug immediately. Empty the ultrasonic oscillating tank.

You can extend the service life of the ultrasonic oscillating tank by observing the following information:
- Change the sonication fluid when it is noticeably contaminated with particles.
- Use only demineralised water with an agent suitable for ultrasound.
- Do not use any chemicals in the ultrasonic oscillating tank that contain or release chloride ions. This is the case with some disinfection agents, household cleaning products and detergents. Chloride ions cause corrosion on stainless steel.
- Use the ultrasonic bath exclusively with accessories that are suitable for the ultrasonic bath and the goods to be treated, e.g. a basket. Do not place any goods to be treated directly on the bottom of the ultrasonic oscillating tank. You will find an overview of suitable accessories in chapter **10 Accessories**.

2.12   Avoiding damage to the ultrasonic bath

- Use aggressive agents exclusively in inset beakers or insert tubs. When working with aggressive agents, do not allow them to splash into the sonication fluid or onto the stainless steel surface. Replace contaminated sonication fluid immediately Clean surfaces and rub them dry.
- The ball in the ball valve can be attacked if highly acidic agents are used. The ball valve will leak. If use of a highly acidic cleaning agent is essential, use a stainless steel ball valve.
- Do not operate the ultrasonic bath without sonication fluid in the ultrasonic oscillating tank. In particular, make sure that the heating is switched off when the ultrasonic oscillating tank is empty. The filling level must be at or just over the filling level mark.

2.13   Interference with wireless communication

The ultrasonic bath can cause interference in nearby wireless communication devices, e.g.:
- Mobile phones
- WiFi devices
- Bluetooth devices

If interference with the functions of a wireless device occurs, increase its distance from the ultrasonic bath.

The ultrasonic bath meets the requirements for Class B devices according to EN 55011.

2.14   Safety stickers on the ultrasonic bath

- Observe all safety stickers on the ultrasonic bath.
- Keep the safety stickers in legible condition. Do not remove them. Replace them once they are no longer legible. Contact our customer service about this. See chapter **6.4 Repair**.

3 Design and function

3.1 Design
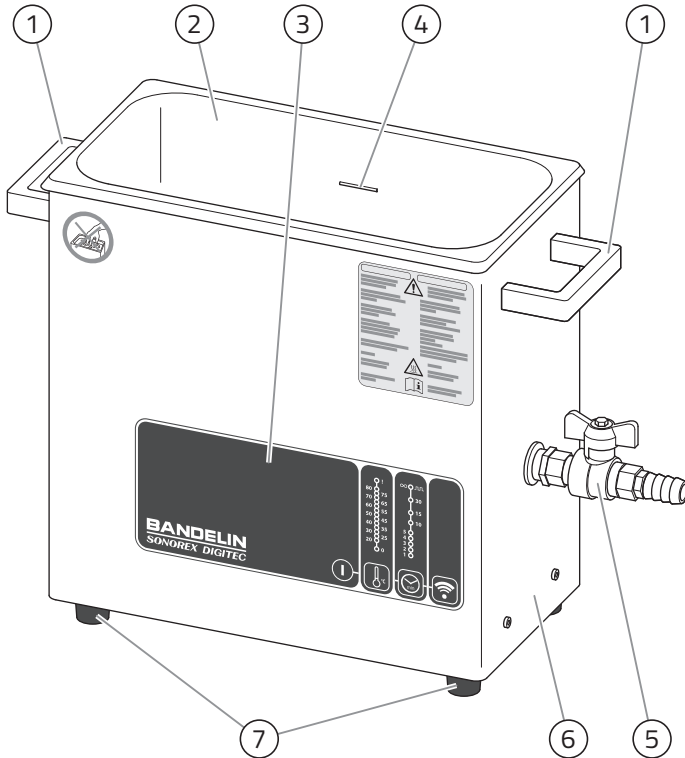
Fig. 1   Overview of ultrasonic bath

1   Handles (depending on model)
2   Ultrasonic oscillating tank
3   Control panel
4   Filling level mark
5   Drain with ball valve (depending on model)
6   Housing
7   Device feet

3.2   Control panel
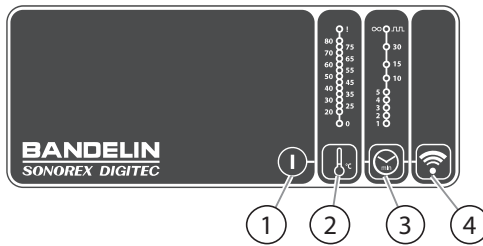
Fig. 2   Controls for ultrasonic baths with heating
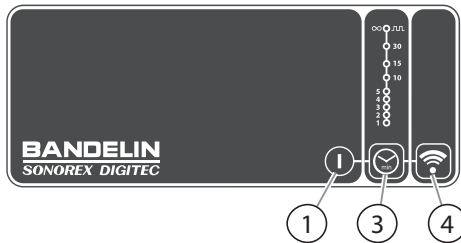
Fig. 3   Controls for ultrasonic baths without heating

1   On/off button for switching the ultrasonic bath on and off
2   Button for setting the heating temperature with temperature scale
3   Button for setting the sonication time with time scale
4   Start/stop button for ultrasound

3.3   Function

The ultrasonic bath uses cavitation triggered by low-frequency ultrasound. Piezoelectric oscillating systems are located on the underside of the ultrasonic oscillating tank. The ultrasound gener-ates large pressure fluctuations in the sonication fluid. Cavitation bubbles are formed at the pressure minima. At higher ambient pressures around the bubbles, the bubbles collapse very quickly. Strong, localised microstreaming then occurs on the surfaces of the treated objects. As a result soiling is removed from the surface of the objects. Particles of dirt are lifted off and fresh sonication fluid follows.

SONOREX ultrasonic baths use SweepTec®, a technology in which the ultrasonic frequency varies frequently around the working frequency. The optimum working frequency depends on the load, filling level, temperature and type of sonication fluid. The working frequency can differ greatly from the nominal frequency. SweepTec® creates a particularly homogenous ultrasonic field within the operating volume for continuously optimum results.

3.4 Remote control

The ultrasonic baths with the additional designation "RC" are equipped with an infrared interface for remote control from a PC. For communication, you require the WINSONIC-DT remote control, which consists of the infrared adapter IR 1 and software (order no. 3090).

Various additional functions allow easy operation using a PC to control processes and for quality control. The WINSONIC DT software required for this is not part of the standard scope of delivery of the ultrasonic baths. You can install the software on operating systems from Windows 2000. For further information, refer to the user manual for the WINSONIC DT software.

The command set for the infrared interface will be provided free of charge by the manufacturer on request. The user is responsible for the program-related implementation required for communication. This is not supported by the manufacturer. The manufacturer only guarantees the correct functioning of the infrared interface.

4 Preparation for operation

4.1 Requirements for setup location

The setup location for the ultrasonic bath must meet the following conditions:

- The setup surface must be horizontal, solid and dry.
- The load-bearing capacity must be sufficient for the ultrasonic bath with the sonication fluid. For weight and operating volume, see chapter **8 Technical data**.
- Sufficient ventilation must be guaranteed. The supply of air under the bottom of the ultrasonic bath may not be hindered by objects. If a soundproof box is used, it must also guarantee sufficient ventilation.
- A water connection for filling the ultrasonic bath should be located nearby. A basin must be available for draining or pouring out the sonication fluid.

4.2 Fitting ball valve

Concerns ultrasonic baths from DT 102 H / DT 102 H-RC.

Fit the supplied ball valve, the hose grommet and the hose as described in the assembly instructions included with the ball valve.

4.3   Performing a function test

Requirement
- The ultrasonic bath has adapted to the climatic conditions at the setup location for at least 2 hours.

Procedure
1. Insert the mains plug for the ultrasonic bath into an earthed mains socket.
2. Press the on/off button to switch the ultrasonic bath on.
3. Switch the ultrasound on briefly. Do this by pressing the start/ stop button. After 1 to 2 seconds, press the start/stop button again to switch off the ultrasound.

Result
» A noticeable noise can be heard when the ultrasound is switched on.

Contact our service department if you cannot hear any noise.

A foil test should be performed before the first use. This is used to document the effectiveness of the ultrasound. See chapter **6.3 Performing the foil test**.

4.4   Rinsing out the ultrasonic oscillating tank

Rinse the ultrasonic oscillating tank thoroughly with water before using it for the first time.

5 Operation

5.1 Direct and indirect sonication

Objects can be sonicated directly or indirectly in the ultrasonic bath.

Direct sonication is the standard process. The objects to be soni-cated are placed in the ultrasonic oscillating tank using suitable accessories, e.g. a basket. There, they are in direct contact with the sonication fluid in the tank.

Indirect sonication is used in the following cases:
- Sonication of sample fluids
- Use of chemically aggressive or flammable liquids
- Use of demineralised water without additives
- Removal of chemically aggressive soiling
- Removal of stains, discolouration and signs of rust with acidic agents.

The objects or liquids to be sonicated are placed in the sonication fluid in the ultrasonic oscillating tank using an inset beaker to transfer the ultrasound. The sonication fluid in the ultrasonic oscil-lating tank must contain an agent containing surfactant.

For accessories suitable for direct and indirect sonication, see chap-ter **10 Accessories**

5.2   Sonication fluid

A solution made from water and a special ultrasound agent is used as the sonication fluid. Drinking water or demineralised water can be used for the water.

Water without any additives is unsuitable for sonication. Use of demineralised water without an ultrasound agent leads to increased erosion of the ultrasonic oscillating tank.

The ultrasound agent used must foster cavitation and be biodegradable, easy to dispose of, material-compatible and long-lasting. BANDELIN recommends ultrasound agents from the TICKOPUR, TICKOMED and STAMMOPUR product ranges from DR. H. STAMM GmbH.

- Telephone advice: +49 30 76880-280
- Internet: www.dr-stamm.de

Observe the information on dosing provided by the ultrasound agent manufacturer. Please refer to the dosing table for the required quantities of ultrasound agent and water. See chapter **9 Dosing table**.

You can calculate the quantities yourself in the same way as the following example:

10 l ready to use solution, 2.5%:

$$\frac{10 \text{ l x } 2{,}5 \text{ \%}}{100 \text{ \%}} = 0{,}25 \text{ l agent}$$

10 l - 0,25 l = 9,75 l water

5.3   Sonication time

> **NOTICE**
>
> **Risk of damage to the goods to be treated**
> Excessively long sonication can damage the surface of the goods to be treated.
> – Select a short sonication time where possible.

The ideal sonication time depends on several factors:
- Type and concentration of agent
- Working temperature of sonication fluid
- Type of soiling
- Type of goods to be treated, in particular materials

Note the information on the recommended sonication time from the agent manufacturer. To begin with, select as short a sonication time as possible to protect the objects to be sonicated and the ultrasonic oscillating tank. Check the result. Lengthen the sonication time if the result is not sufficient.

5.4   Pour in sonication fluid

> ⚠ **CAUTION**
>
> **Risk of scalding**
> – Do not pour hot water into the ultrasonic oscillating tank.
> – Maximum filling temperature: 50°C.

> **NOTICE**
>
> **Damage due to condensation in the ultrasonic bath**
> At high humidity, condensation forms inside the device if you fill it with cold water.
> – Do not pour cold water into the ultrasonic oscillating tank when humidity is high.

> *NOTICE*

If you use an agent in powder form, do not pour it directly into the ultrasonic oscillating tank.

– Mix agents in powder form in another container before you pour them into the ultrasonic oscillating tank.
– Only pour the agent into the ultrasonic oscillating tank once it has dissolved completely.
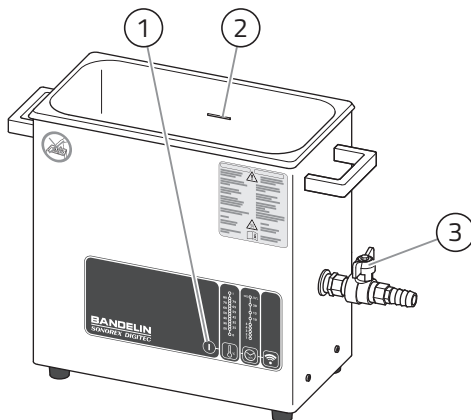
Fig. 4   Filling oscillating tank

1   On/off button for switching the ultrasonic bath on and off
2   Filling level mark
3   Drain with ball valve (depending on model)

Requirements
- The ball valve must be closed in ultrasonic baths with a drain.
- The ultrasonic bath must be switched off.

Procedure
1. Fill the ultrasonic oscillating tank with water up to $\frac{1}{3}$.
2. Pour the correct quantity of agent into the ultrasonic oscillating tank. See chapter **9 Dosing table**.
3. Fill the tank with water up to the filling level mark while avoiding foam formation. When using indirect sonication, take the displacement caused by inset vessels into consideration.

Result
» The ultrasonic bath is ready to switch on.

5.5 Switching sonication on and off

Requirements
- The ultrasonic oscillating tank has been filled.
- The mains plug has been connected to an earthed mains socket.

Procedure
1. If available, place the lid on the ultrasonic bath.
2. Press the on/off button to switch on the ultrasonic bath.
3. Press the button for setting the sonication time repeatedly until the required sonication time or the ∞ symbol for continuous operation is displayed.
4. Press the start/stop button.
   - » The ultrasound is switched on. You will hear the ultrasound noise.
   - » The LEDs indicate the remaining sonication time in seconds.
5. To switch off the sonication, press the start/stop button.

ⓘ   Information

– The ultrasound switches off automatically as soon as only the "0" LED is lit up. In continuous operation, the green LED next to the ∞ symbol lights up continuously. The ultrasound does not switch off automatically.
– You can extend, shorten or switch off the sonication at any time.
– If you do not press a button for more than 12 hours, the ultrasonic bath will be switched off automatically.

5.6 Switching the heating on and off

Concerns the following ultrasonic baths:
- DT 31 H, DT 52 H,
- DT 100 H, DT 102 H, DT 102 H-RC, DT 103 H,
- DT 156 BH,
- DT 255 H, DT 255 H-RC,
- DT 510 H, DT 510 H-RC, DT 512 H,
- DT 514 H, DT 514 BH, DT 514 BH-RC,
- DT 1028 H, DT 1028 CH,
- DT 1050 CH

Heated sonication fluid intensifies the effect of the ultrasound. Based on experience, the best results are achieved at working temperatures between 50 and 60°C. This allows the sonication time to be reduced. At higher working temperatures, the effect of the ultrasound decreases again.

Do not heat the sonication fluid used to reprocess medical instruments above 45°C.

Ultrasound also heats the sonication fluid. During continuous operation, the working temperature of the sonication fluid can rise above the set value – particularly if the ultrasonic oscillating tank is covered. Therefore, check the working temperature when processing temperature-sensitive objects.

- Note the information on the optimum working temperature from the agent manufacturer.
- Pre-heating during the degassing of the sonication fluid is ideal. See chapter **5.8 Degassing the sonication fluid – DEGAS**.
- Before pre-heating, remove the basket or other accessories from the ultrasonic oscillating tank. Cover the ultrasonic oscillating tank with the lid if available.

Requirements
- The ultrasonic oscillating tank has been filled.
- The mains plug has been connected to an earthed mains socket.
- The ultrasonic bath is switched on. The green "0" LED on the temperature scale lights up.

Procedure

1. Press the button for setting the temperature repeatedly until the required temperature between 20 and 80°C is displayed.
   » The target temperature is indicated by a continuously lit yellow LED.
2. To switch off the heating, hold down the button for setting the heating temperature for at least 2 seconds.
   » The "0" LED on the temperature scale lights up.

ⓘ   Information

– The current temperature is indicated by a flashing yellow LED. Below the set target temperature, the LED flashes quickly and the heating is on. Above the set target temperature, the LED flashes slowly and the heating is off.
– The yellow LED will light up steadily as soon as the target temperature and the actual temperature are the same.
– The red "!" LED will flash if the working temperature exceeds 85°C.

5.7 Avoiding retardation of boiling

At temperatures above 60°C, the ultrasound is activated automatically for 3 seconds every minute to mix the fluid to avoid retardation of boiling. This function cannot be switched off. You can configure the system so that this function is always active when the heating is switched on, even at temperatures below 60°C.

Requirement
▪ The ultrasonic bath is switched off.

Procedure
Hold down the button for setting the heating temperature and press the on/off button to switch on the ultrasonic bath.

» As soon as the heating is switched on, the ultrasound is activated once per minute regardless of the temperature.

ⓘ   Information

– The ultrasonic bath does not save the setting. The next time it is switched off and back on again, the function for preventing retardation of boiling will be active again from 60°C.

5.8 Degassing the sonication fluid – DEGAS

Sonication fluid that has been freshly filled or left in the ultrasonic oscillating tank for a long period must be degassed before use. Degassing the sonication fluid increases the effect of the ultrasound. You can use the DEGAS function to perform rapid degassing of the sonication fluid.

1. Press the start/stop button for at least 2 seconds.
    » The ultrasound is switched on.
    » The LEDs indicate the remaining degassing time.
2. To end degassing earlier, press the start/stop button.

ⓘ Information

The ultrasound noise becomes quieter during degassing. This means that the ultrasonic effect is increasing.

5.9 Adding goods to be treated

To achieve good results, observe the following information when inserting goods to be treated:

- Each time before sonication, check whether the sonication fluid is contaminated. If there is visible contamination, replace the sonication fluid.
- The sonication fluid must be degassed. See chapter **5.8 Degassing the sonication fluid – DEGAS**.
- The sonication fluid must be preheated to the required working temperature before you add objects.
- Use suitable accessories, e.g. a basket. Do not place any objects directly on the bottom of the ultrasonic oscillating tank. Use a studded silicone mat for sensitive objects. See chapter **10 Accessories**.
- Insert objects so they are distributed. Do not stack them. Sensitive objects may not touch other objects.
- The ultrasound must be switched off while objects are being inserted.
- Check the filling level. The goods to be treated must be completely submerged in the fluid. Inset beakers for indirect sonication need to be submerged at least 2 cm in the sonication fluid.

- Remove air bubbles from cavities. Rotate the objects accordingly. Remove air bubbles under inset beakers. The ultrasound only works where the fluid is in contact with the goods to be treated or the inset beaker.
- Position the side with greater soiling so it is facing downwards. Insert objects with joints (e.g. scissors or tongs) in open condition so that the whole surface is optimally reached by the sonication fluid.

5.10 Removing goods to be treated

> ⚠ **WARNING**
>
> **Risk of burns**
> The sonication fluid, goods to be treated, the surface of the ultrasonic bath as well as accessories can be very hot.
> – Do not touch the surface of the ultrasonic bath or accessories like the lid. Do not reach into the sonication fluid.
> – Allow the goods to be treated to cool down before you touch them.

Switch the ultrasound off before you remove the goods to be treated.

Do not remove the goods to be treated with your hands. For example, carefully lift out the insert basket with the goods to be treated and place it on a flat surface.

Rinse goods to be treated with clear water.

Do not leave the goods to be treated in the sonication fluid for too long. This can damage the goods.

5.11 Emptying the ultrasonic oscillating tank

> ⚠ **WARNING**
>
> **Risk of electric shock**
> – Disconnect the mains plug before lifting the ultrasonic bath.
> – Do not place the ultrasonic bath in a sink to empty it.
> – Make sure that fluid cannot get into the housing.

> ⚠ **CAUTION**
>
> **Hot sonication fluid and ultrasonic oscillating tank**
> There is a risk of burns when you lift the ultrasonic bath.
> – Allow the ultrasonic bath to cool before you lift it.

Soiling on the bottom of the ultrasonic oscillating tank reduces the ultrasonic nominal power. If there is visible contamination in the sonication fluid, drain and clean the ultrasonic oscillating tank.

Also note the agent manufacturer's information on the life of the sonication fluid.

Replace used sonication fluid completely. Do not freshen it up by adding fluid.

Procedure
1. Switch off the ultrasound. If applicable, switch off the heating. If you have to move the ultrasonic bath to empty it, disconnect the mains plug.
2. If the ultrasonic bath has a drain, open the ball valve. If the ultrasonic bath does not have a drain, carefully pour out the fluid via the corner of the ultrasonic oscillating tank.
3. Rinse the ultrasonic oscillating tank thoroughly.
4. Wipe the ultrasonic bath dry with a soft cloth.
5. If necessary, disinfect the ultrasonic bath with a suitable surface disinfectant.

5.12   Enabling and blocking continuous operation

The function can be blocked to prevent accidental activation of continuous operation.

Requirement
- The mains plug is disconnected.

Procedure
Press and hold down the button for setting the sonication time. At the same time, insert the mains plug into an earthed mains socket.

» The yellow "1 min" LED lights up.

ⓘ   Information

– You can enable continuous operation again in the same way. The green LED next to the ∞ symbol lights up to confirm this.

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5.13   Troubleshooting

Fault	Possible causes	Remedy
Ultrasonic effect too low, loud noises	• Sonication fluid contains gases. • There are too many goods to be treated in the ultrasonic oscillating tank.	• Degas the sonication fluid. See chapter **5.8 Degassing the sonication fluid – DEGAS**. • Reduce the number of goods to be treated.
Unsteady noises (throbbing)	• Incorrect filling level in the ultrasonic oscillating tank.	• Change the filling level of the sonication fluid in the ultrasonic oscillating tank slightly. Note the minimum filling level and correct dosing of agent while doing so. • Vary the position of the goods to be treated.
Heating not working	• The heating has switched off due to excessive temperature. • The heating is defective.	• Disconnect the ultrasonic bath from the mains and allow it to cool to below 50°C. Then restart operation. • Have the ultrasonic bath repaired.

6 Maintenance

6.1   Cleaning and care of the ultrasonic bath

Cleaning the housing

- Damp wipe the housing. Wipe it dry with a soft cloth.
- Do not use any abrasive cleaning products, only care products without scouring additives.
- If necessary, disinfect the housing with a suitable surface disinfectant.

Care of the ultrasonic oscillating tank

Impurities in the ultrasonic oscillating tank accelerate its wear, can lead to corrosion and reduce the ultrasonic effect. Therefore, observe the following instructions:

- Rinse the ultrasonic oscillating tank thoroughly with water after each use. Wipe it dry with a soft cloth.
- You can remove marks and residues with a stainless steel cleaning product without scouring additives.
- Do not use steel wool or scrapers to clean the ultrasonic oscillating tank.
- Metal parts and rust particles in the ultrasonic oscillating tank cause corrosion. Therefore, do not leave any metal parts in the ultrasonic oscillating tank. If rust marks are visible, remove them immediately with a soft cloth and a stainless steel cleaning product without scouring additive.

6.2   Checks

NOTICE

Damage to the ultrasonic bath
– Perform checks only on the filled ultrasonic bath.

If one of the checks does not lead to the desired result, contact our service department. See chapter **6.4 Repair**.

Checking indicator lamps

Requirement
- The ultrasonic bath is switched off.

Procedure
1. Hold down the start/stop button and press the on/off button.
   - » All LEDs light up briefly one after the other. Then all LEDs light up at the same time.
2. Press the start/stop button twice.
   - » The sonication time that was set last is then displayed again on the time scale. The "0" LED lights up on the temperature scale (if present).
   - » The ultrasonic bath is ready for operation again.

Check the output of the ultrasound and the heating.

The output can be checked with a wattmeter between the ultrasonic bath mains plug and the socket.

Procedure
1. Fill the ultrasonic oscillating tank with water.
2. Switch on the ultrasound and, if fitted, the heating one after the other. Read the output. Switch the heating and the ultrasound off again.
3. Compare the readings with the technical data. See chapter **8 Technical data**.

The measured values may deviate by a maximum of ± 20% from the values in the technical data.

Checking ultrasonic effect

Check the effect of the ultrasound upon commissioning and at regular intervals. We recommend a check every 3 months. See chapter **6.3 Performing the foil test**.

6.3   Performing the foil test

A foil test should be performed before the first use and at regular intervals, e.g. every 3 months. This is done to ensure the consistent effectiveness of the ultrasound. You are responsible for how often the test is performed.

The foil test is a simple method for determining the intensity and distribution of the cavitation in an ultrasonic bath. This done by inserting some aluminium foil stretched over a foil test frame. The foil is perforated or destroyed by cavitation up to a certain degree depending on the sonication time.

To be able to compare results, it is **important that the conditions of the foil test are always the same**:

- Ultrasonic oscillating tank is filled up to the filling level mark
- Working temperature of sonication fluid
- Degassing time
- Position of frame
- Foil type (brand, thickness)
- Sonication time
- Type and concentration of ultrasound agent

Fluid for the foil test

To achieve sufficiently strong cavitation, the interfacial tension of the water used needs to be reduced for the foil test with the aid of agents containing surfactant.

We recommend the following ultrasound agents:
- TICKOPUR R 33
- TICKOPUR R 30
- TICKOPUR TR 7
- TICKOMED 1
- STAMMOPUR R
- STAMMOPUR DR 8

If none of these agents are available, a neutral or mild alkaline agent that does not destroy aluminium should be used. The agent needs to be approved by the manufacturer for use in ultrasonic baths.

Test result and documentation

Using consistent test conditions, the test result should be assessed according to the perforated surface of the foils. The perforated surfaces of the foils should always have roughly the same spread and distribution – they are never congruent. A constant process check, e.g. when reprocessing medical devices, is only possible with regular foil tests.

You can download a documentation template for documenting the test results via this link:

https://bandelin.com/folientest/

You will also find a video showing the application.

Furthermore, the foil sheets can be archived in a suitable way (scan, photo, etc.). Then you will be able to compare the foil sheets whenever necessary.

Performance of the foil test

1. Fill the ultrasonic oscillating tank with water and a suitable ultrasound agent up to the filling level mark using the dosage specified by the manufacturer.

2. Degas the sonication fluid.
See chapter **5.8 Degassing the sonication fluid – DEGAS**.

3. Tension the aluminium foil (household foil 10 μm to 25 μm thick) on the foil test frame. Depending on the size of the bath, the frame may protrude. It is sufficient to cover the part of the foil test frame that is submerged in sonication fluid.
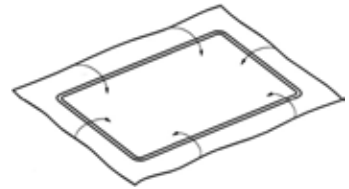
4. Place the covered foil test frame diagonally in the centre of the ultrasonic oscillating tank. Secure it if necessary.
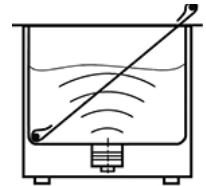
5. Switch the ultrasound on. Sonicate the foil for at least 1 minute until visible perforation or formation of holes occurs. The sonication time can be up to 3 minutes with stronger foils (thicker or coated).

6. Switch off the ultrasound. Remove the foil test frame. Take the aluminium foil off the foil test frame and allow it to dry.

7. The foil should be perforated, see illustration. Otherwise, we recommend having the device checked by the BANDELIN electronic GmbH & Co. KG service department: see chapter **6.4 Repair**.
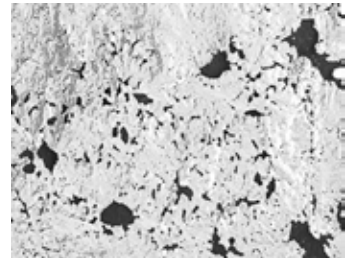
8. Archive the foil with the test date and the serial number of the ultrasonic bath. In addition, the documentation template for the foil test can be filled in and archived.

9. Rinse the ultrasonic oscillating tank thoroughly to remove loose foil particles.

You can order suitable foil test frames from BANDELIN electronic GmbH & Co. KG. The foil test frames are configured for a wide range of tank dimensions. Aluminium foil is additionally required to perform the test as it is not included in the delivery.

Type	Order no.	For
FT 1	3190	DT 31/H, DT 52/H
FT 4	3074	DT 100/H, DT 102 H/H-RC, DT 103 H, DT 106, DT 255/H/H-RC
FT 6	3222	DT 156/BH
FT 14	3084	DT 510/H/H-RC, DT 512 H, DT 514/H/BH/ BH-RC
FT 40	3094	DT 1028/H/CH
FT 45	3204	DT 1050/CH

6.4   Repair

> ⚠ **WARNING**
>
> **Risk to health due to contaminated ultrasonic bath**
> – Decontaminate the ultrasonic bath before shipping if it has come into contact with hazardous substances.

If the ultrasonic bath needs to be repaired, send it to the manufacturer.

Clean the ultrasonic bath before sending it.

Decontaminate the ultrasonic bath before shipping if it has come into contact with toxic, caustic, radioactive or biologically hazardous substances. Also clean and decontaminate accessories that you send in.

Download the decontamination certification form here:

https://www.bandelin.com/downloads

Fill in the form and attach it to the outside of the packaging so it is clearly visible. The package will not be accepted without the completed form.

Send the ultrasonic bath to the following address:

BANDELIN electronic GmbH & Co. KG

Heinrichstr. 3–4
12207 Berlin
Germany

7 Disposal

> ⚠ **WARNING**
>
> **Risk to health due to contaminated ultrasonic bath**
> – Decontaminate the ultrasonic bath before disposal if it has come into contact with hazardous substances.
> – Also decontaminate accessories before disposal.

Dispose of the ultrasonic bath properly as electronic scrap if it can no longer be used. Do not throw the ultrasonic bath in the household waste. Observe the locally applicable regulations for disposing of electronic scrap.

The oscillating elements contain sintered ceramics made from lead zirconium titanate.

- EC no. 235-727-4
- CAS no. 12626-81-2

This usage is permitted in accordance with RoHS Directive 2011/65/EU, Annex III, Exemption 7c. I.

Dispose of accessories as metal scrap or plastic waste depending on the materials used.

8 Technical data

Electrical data

Operating voltage	230 V~ (± 10 %) 50/60 Hz
Operating voltage (optional)	115 V~ (± 10 %) 50/60 Hz
Protection class	I
Degree of protection	DIGITEC: IP 33 DIGITEC-RC: IP 23
Ultrasonic frequency	35 kHz
Measuring accuracy of temperature sensor	± 2.5 °C

Type	Ultrasonic peak output/ultrasonic nominal output	Heating output	Power consumption (230 V)	Power consumption (115 V)
	[W]	[W]	[A]	[A]
DT 31	160/40	–	0.2	0.4
DT 31 H	160/40	70	0.5	1.0
DT 52	240/60	–	0.3	0.6
DT 52 H	240/60	140	0.9	–
DT 100	320/80	–	0.4	0.7
DT 100 H	320/80	140	1.0	2.0
DT 102 H	480/120	140	1.2	2.3
DT 102 H-RC	480/120	140	1.2	2.3
DT 103 H	560/140	200	1.5	–
DT 106	480/120	–	0.6	1.1
DT 156	640/160	–	0.7	1.4
DT 156 BH	860/215	600	3.6	7.1

Type	Ultrasonic peak output/ultra-sonic nominal output	Heating output	Power consumption (230 V)	Power consumption (115 V)
	[W]	[W]	[A]	[A]
DT 255	640/160	–	0.7	1.4
DT 255 H	640/160	280	2.0	3.9
DT 255 H-RC	640/160	280	2.0	3.9
DT 510	640/160	–	0.7	–
DT 510 H	640/160	400	2.5	–
DT 510 H-RC	640/160	400	2.5	–
DT 512 H	860/215	400	2.7	5.4
DT 514	860/215	–	1.0	1.9
DT 514 H	860/215	600	3.6	7.1
DT 514 BH	860/215	600	3.6	7.1
DT 514 BH-RC	860/215	600	3.6	7.1
DT 1028	1200/300	–	1.4	–
DT 1028 H	1200/300	1300	7.0	14.0
DT 1028 CH	1200/300	1450	7.7	15.3
DT 1050 CH	2400/600	1950	11.1	17.9

Dimensions and weights

Type	Internal dimensions of oscillating tank (L × W × H)	Operating volume	Connection for ball valve (drain)	Weight
	[mm]	[l]		[kg]
DT 31	190 × 85 × 60	0.6	–	2.0
DT 31 H	190 × 85 × 60	0.6	–	2.3
DT 52	150 × 140 100	1.2	–	2.4
DT 52 H	150 × 140 × 100	1.2	–	2.5
DT 100	240 × 140 × 100	2.0	–	3.2
DT 100 H	240 × 140 × 100	2.0	–	3.3
DT 102 H	240 × 140 × 100	2.0	G ¼	4.0
DT 102 H-RC	240 × 140 × 100	2.0	G ¼	4.0
DT 103 H	240 × 140 × 150	2.5	G ¼	4.2
DT 106	⌀ 240 × 130	4.0	G ¼	5.2
DT 156	500 × 140 × 100	4.0	G ¼	6.0
DT 156 BH	500 × 140 × 150	6.0	G ¼	7.2
DT 255	300 × 150 × 150	3.8	G ¼	4.8
DT 255 H	300 × 150 × 150	3.8	G ¼	4.8
DT 255 H-RC	300 × 150 × 150	3.8	G ¼	4.8
DT 510	300 × 240 × 150	6.6	G ½	7.3
DT 510 H	300 × 240 × 150	6.6	G ½	7.4
DT 510 H-RC	300 × 240 × 150	6.6	G ½	7.4
DT 512 H	300 × 240 × 200	8.7	G ½	8.2
DT 514	325 × 300 × 150	9.0	G ½	8.5

Type	Internal dimensions of oscillating tank (L × W × H)	Operating volume	Connection for ball valve (drain)	Weight
	[mm]	[l]		[kg]
DT 514 H	325 × 300 × 150	9.0	G ½	8.7
DT 514 BH	325 × 300 × 200	12.5	G ½	9.8
DT 514 BH-RC	325 × 300 × 200	12.5	G ½	9.8
DT 1028	500 × 300 × 200	19.0	G ½	13.9
DT 1028 H	500 × 300 × 200	19.0	G ½	14.6
DT 1028 CH	500 × 300 × 300	30.0	G ½	23.3
DT 1050 CH	600 × 500 × 300	60.0	G ½	37.0

Ambient conditions

Overvoltage category:	II
Degree of contamination:	2
Permitted ambient temperature:	5 to 40°C
Permitted relative humidity up to 31°C:	80% (non-condensing)
Permitted relative humidity up to 40°C:	50% (non-condensing)
Altitude:	< 2000 m above sea level

For indoor operation only

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9 Dosing table

Type	Operating volume	Dosage Water + agent				
	[l]	1 %	2 %	3 %	5 %	10 %
DT 31, DT 31 H	0.6	590 ml + 10 ml	585 ml + 15 ml	580 ml + 40 ml	570 ml + 30 ml	540 ml + 60 ml
DT 52, DT 52 H	1.2	1.1 l + 15 ml	1.1 l + 25 ml	1.1 l + 40 ml	1.1 l + 60 ml	1.0 l + 120 ml
DT 100, DT 100 H, DT 102 H, DT 102 H-RC	2.0	1.9 l + 20 ml	1.9 l + 40 ml	1.9 l + 60 ml	1.9 l + 100 ml	1.8 l + 200 ml
DT 103 H	2.7	2.6 l + 30 ml	2.6 l + 55 ml	2.6 l + 85 ml	2.5 l + 140 ml	2.4 l + 270 ml
DT 106, DT 156	4.0	3.9 l + 40 ml	3.9 l + 80 ml	3.8 l + 120 ml	3.8 l + 200 ml	3.6 l + 400 ml
DT 156 BH	6.0	5.9 l + 60 ml	5.8 l + 120 ml	5.8 l + 180 ml	5.7 l + 300 ml	5.4 l + 600 ml
DT 255, DT 255 H, DT 255 H-RC	3.8	3.7 l + 40 ml	3.7 l + 80 ml	3.6 l + 120 ml	3.6 l + 190 ml	3.4 l + 380 ml
DT 510, DT 510 H, DT 510 H-RC	6.6	6.5 l + 70 ml	6.4 l+ 140 ml	6.4 l + 200 ml	6.2 l + 330 ml	5.9 l + 660 ml
DT 512 H	8.7	8.6 l + 90 ml	8.5 l + 180 ml	8.4 l + 270 ml	8.2 l + 440 ml	7.8 l + 870 ml
DT 514, DT 514 H	9.0	8.9 l + 90 ml	8.8 l + 180 ml	8.7 l + 270 ml	8.5 l + 450 ml	8.1 l + 900 ml
DT 514 BH, DT 514 BH-RC	12.5	12.3 l + 130 ml	12.2 l + 250 ml	12.1 l + 380 ml	11.8 l + 630 ml	11.2 l + 1.3 l

Type	Operat-ing volume	Dosage Water **+ agent**				
	[l]	**1 %**	**2 %**	**3 %**	**5 %**	**10 %**
DT 1028, DT 1028 H	19.0	18.8 l + **190 ml**	18.6 l + **380 ml**	18.4 l + **570 ml**	18.0 l + **950 ml**	17.1 l + **1.9 l**
DT 1028 CH	30.0	29.7 l + **300 ml**	29.4 l + **600 ml**	29.1 l + **900 ml**	28.5 l + **1.5 l**	27.0 l + **3.0 l**
DT 1050 CH	60.0	59.4 l + **600 ml**	58.8 l + **1.2 l**	58.2 l + **1.8 l**	57.0 l + **3.0 l**	54.0 l + **6.0 l**

10 Accessories

Insert basket K ...,
made of stainless steel, screen mesh.
Protects goods to be treated and avoids damage to the tank bottom. Optimum transfer of the ultrasound.
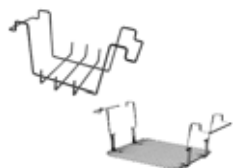
Utensil holder GH ...,
made of stainless steel, mesh size 12 x 12 mm.
For large individual parts.
GH 1 for glass flasks up to 105 mm diameter.

Lid D ...,
made of stainless steel.
For use with inserted basket.
Protects against contamination from outside. Condensation water is guided into the ultrasonic oscillating tank. Reduces noise.

Inset basket K ... EM,
made of stainless steel.
An alternative to DIN insert trays in the medical field. Basket holder KT required.

Basket holder KT ..., made of stainless steel.
For inset baskets K...EM or DIN insert trays in the medical field.

Lid D ... T,
made of stainless steel.
For use with inset baskets without handles (K ... EM).

Insert tub KW ...,
made of plastic, with lid.
For use of chemicals that attack the stainless steel tank. Note temperature and chemical resistance of PE (KW 3 ... KW 5) and PP (from KW 10-0).

Type	Insert basket	Utensil holder	Lid D …	Inset basket	Basket holder	Lid D … T	Insert tub
DT 31 /H	K 08	–	D 08	–	–	–	–
DT 52 /H	K 1 C	GH 1	D 52	–	–	D 1 T	–
DT 100 /H, DT 102 H /H-RC	K 3 C	GH 1	D 100	–	–	D 3 T	KW 3
DT 103 H	K 3 CL	–	D 100	–	–	D 3 T	KW 3
DT 106	K 6	–	D 6	–	–	–	–
DT 156	K 6 L	–	D 156	–	–	–	–
DT 156 BH	K 6 BL	–	D 156	–	–	–	–
DT 255 /H /H-RC	K 5 C	–	D 255	–	–	D 5 T	KW 5
DT 510 /H/ H-RC	K 10	GH 10	D 510	–	–	D 10 T	KW 10-0
DT 512 H	K 10 B	–	D 510	–	–	D 10 T	–
DT 514 /H	K 14	–	D 514	K 14 EM	KT 14	D 14 T	KW 14
DT 514 BH / BH-RC	K 14 B	–	D 514	–	–	D 14 T	KW 14 B
DT 1028 /H	K 28	GH 28	D 1028	K 29 EM	KT 30	D 28 T	KW 28-0
DT 1028 CH	K 28 C	–	D 1028 C	–	–	–	KW 28-0
DT 1050 CH	K 50 C	–	D 1050 C	–	–	–	KW 50 B-0

Inset baskets KD …, PD …,
screen mesh.
Suitable for inset beakers, for cleaning small parts.
KD 0: stainless steel, inner diameter 75 mm
PD 04: plastic, inner diameter 60 mm.

Inset beakers
SD … (glass), **EB** … (stainless steel), **KB** …, **PD** … (plastic).
For indirect cleaning of small parts, suitable for positioning lid
and beaker holder diameter 87 mm. With ring and lid.
KB 04, SD 04 and SD 05 diameter 76 mm, without lid.
SD 09 without lid.

Positioning lid DE …,
made of stainless steel.
For holding inset beakers. Positioning for optimum utilisation
of ultrasonic energy.

Beaker holder ES …,
made of stainless steel.
For holding 4 inset beakers in larger ultrasonic baths. Posi-
tioning for optimum utilisation of ultrasonic energy.

Impression tray holder LT 102,
made of stainless steel.
For cleaning impression trays.

Insert basket PK … C and K … P,
made of plastic, perforated.
For gentle cleaning of sensitive surfaces, e.g. on instruments
like probes, syringes and test plugs.

Injection nozzle holder ED …,
made of stainless steel.
For suspending in the ultrasonic oscillating tank. Holder for
different sizes of injection nozzle.

Type	Inset basket	Inset beaker	Positioning lid/ beaker holder	Impression tray holder	Insert basket	Injection nozzle holder
DT 31 /H	PD 04	KB 04, SD 05	DE 08	–	–	–
DT 52 /H	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 52	–	PK 1 C	ED 0
DT 100 /H, DT 102 H /H-RC	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 100	LT 102	PK 2 C	ED 9
DT 103 H	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 100	–	PK 3 C	–
DT 106	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 6	–	–	–
DT 156	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 156	–	–	–
DT 156 BH	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 156	–	–	–
DT 255 /H /H-RC	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 255	–	K 5 P	–
DT 510 /H /H-RC	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 510	–	–	ED 9
DT 512 H	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 510	–	–	–
DT 514 /H	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 514	–	–	–
DT 514 BH /BH-RC	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	DE 514	–	–	ED 14
DT 1028 /H	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	ES 4	–	–	–
DT 1028 CH	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	ES 4	–	–	–
DT 1050 CH	KD 0, PD 04	SD 06, SD 09, PD 06, EB 05	ES 4	–	–	–

Mounting brackets EK ...,
made of stainless steel, for laboratory flasks.
Prevents flasks floating to the surface. For screwing into
insert baskets and utensil holders.
EK 10 – 10 ml, max. diameter 31 mm
EK 25 – 25 ml, max. diameter 42 mm
EK 50 – 50 ml, max. diameter 52 mm
EK 100 – 100 ml, max. diameter 65 mm
EK 250 – 250 ml, max. diameter 85 mm

Handle adapter GV ...,
made of stainless steel.
For insert baskets and utensil holders.
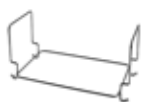
Test tube holder RG ...,
made of stainless steel.
For simultaneous sonication of 6 test tubes up to 25 mm
diameter and 8 test tubes up to 16 mm diameter. Can also be
used as a test tube stand. Content of test tubes remains visi-
ble.

Tableting punch holder TH ...,
made of stainless steel.
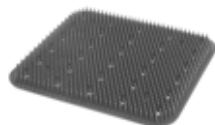For holding tableting punches with different diameters.

Sieve holder SH 7,
made of stainless steel.
For single sieve cleaning.
Sieve holder SH 28 C,
made of stainless steel.
For the simultaneous and gentle cleaning of up to 5 analysis
sieves with 200 mm diameter.

Studded silicone mat SM ...
For contact-free storage of highly sensitive instruments. Fas-
tening in basket prevents instruments from floating to the
surface and being damaged. Ultrasound permeable.

Fixation clamps FE 12
Set with 2 large and 5 small plastic clamps for safely securing
the flexible endoscope accessories in the basket. Prevents
damage to biopsy forceps and instruments.

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Type	Mounting brackets for laboratory flasks	Handle adapter	Test tube holder	Tableting punch holder	Sieve holder	Studded silicone mat	Fixation clamps
DT 31 /H	–	–	–	–	–	–	–
DT 52 /H	EK 10, EK 25, EK 50, EK 100, EK 250	GV 3	RG 2	–	–	–	–
DT 100 /H, DT 102 H /H-RC	EK 10, EK 25, EK 50, EK 100, EK 250	GV 3	RG 2	–	–	SM 3	–
DT 103 H	EK 10, EK 25, EK 50, EK 100, EK 250	GV 3	RG 2	–	–	–	–
DT 106	EK 10, EK 25, EK 50, EK 100, EK 250	–	–	–	SH 7	–	–
DT 156	EK 10, EK 25, EK 50, EK 100, EK 250	GV 3	–	–	–	SM 6	FE 12
DT 156 BH	EK 10, EK 25, EK 50, EK 100, EK 250	GV 3	–	–	–	SM 6	FE 12
DT 255 /H /H-RC	EK 10, EK 25, EK 50, EK 100, EK 250	GV 3	–	–	–	SM 5	FE 12
DT 510 /H /H-RC	EK 10, EK 25, EK 50, EK 100, EK 250	GV 10	–	–	–	–	–
DT 512 H	EK 10, EK 25, EK 50, EK 100, EK 250	GV 10	–	–	–	–	–
DT 514 /H	EK 10, EK 25, EK 50, EK 100, EK 250	GV 10	–	TH 14 B	–	SM 14	FE 12
DT 514 BH /BH-RC	EK 10, EK 25, EK 50, EK 100, EK 250	GV 10	–	TH 14 B-S 22 TH 14 B-S 28	–	–	–
DT 1028 /H	EK 10, EK 25, EK 50, EK 100, EK 250	GV 10	–	TH 28-S 22 TH 28-S 28	–	SM 29	FE 12
DT 1028 CH	EK 10, EK 25, EK 50, EK 100, EK 250	GV 10	–	TH 28 C TH 28 C-S 22 TH 28 C-S 28	SH 28 C	–	–
DT 1050 CH	–	–	–	–	–	–	–

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