Product Overview



Sophisticated Life Science Research Instrumentation



TSE Isolated Organ Systems

Automated system for research on isolated organs

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Specifications subject to change without notice



Contents

1.	General	5
2.	System components	6
2.1.	Organ bath – basic unit	6
2.2.	Bath vessels	8
2.3.	Organ holders	9
2.4.	Transducers	9
2.4.1.	ISOMET isometric transducer (force transducer)	
2.4.2.	ISOTON isotonic transducer (position transducer)	
2.5.	Thermostat / Warm water circulation	
2.6.	Control unit / Computer / Interface	14
2.7.	Software	14
3.	Switchboard for isolated organs	16
3.1.	Using the switchboard	
3.2.	Test mode	17
4.	Automatic post-tensioning	19





TSE Isolated Organ System

1. General

The new TSE system for studies on isolated organs, is a flexible automated system which, thanks to its modular construction, can be configured for a wide range of applications and different specimens from all the usual species from rat to pig. The control of the whole system is carried out from a single personal computer.

The standard version of the space-saving basic unit is designed for 4 bath vessels; however, systems for up to 8 bath vessels can also be supplied. Vessels with different capacities can quickly be exchanged with one another.

In this new system we have, for the first time, been able to minimize the **dead volume** for nutrient media in the bath vessel and vessel inlet tubing! As the tendency to use low-volume bath vessels is increasing, this fact is of fundamental importance. The smaller volume of nutrient medium which is therefore required means that test substance consumption is also reduced!



2. System components

The 4-place system consists of the following components:

- Basic unit
- 4 jacketed thermostattable bath vessels, with gassing device
- Organ holders
- 4 transducers, isotonic or isometric, with customer-specific measuring range
- Electronically controlled thermostat with built-in pump for maintaining a constant temperature in the system
- Jacketed thermostattable storage vessel for nutrient solution, with gassing device
- Optional: stimulation device (stimulator, electrodes)
- Optional: software-controlled pre- and post-tensioning device
- 1-2 special interfaces
- Electronic process control ("control unit")
- IBM-compatible PC
- Software

2.1. Organ bath – basic unit

The space-saving stable **basic unit** accommodates the bath vessels and transducers and includes:

- 1. **Base frame**: dimensions 500 x 300 x 500 mm (WxHxD). Stable PVC/metal construction including all solenoid valves, metering valves for carbogenization, bath vessel holder with screw thread, transducer holder with manual tension control unit
- 2. **Heat exchanger** with large-capacity warm water jacket for keeping the nutrient medium and inlet/outlet tubing at a constant temperature
- 3. Software-controlled **miniature pump** for metered nutrient medium transport
- 4. Optional: **motors** for automatic post-tensioning
- 5. Power supply with plugs for control unit



TSE isolated organ system diagram (configuration with 4 bath vessels + built-in organ hooks)

The altered bath vessel design allows the following system components to be accommodated in a base equipped with a screw thread; this is screwed onto the bath vessel:

- Nutrient medium inlet and outlet,
- Carbogenization frit (intensity controlled by rotary knob),
- Organ holder, which also serves as the 1st electrode for organ stimulation and means that the use of an additional organ arm is no longer necessary,
- Base for 2nd stimulation electrode (shape according to user's specification).

A further innovation: all parts coming into contact with the nutrient medium, e.g. tubing connections, fittings, valves, etc. are made from high-quality plastics such as Teflon and silicone (no metal – not even stainless steel!).

All electrical assemblies in the basic unit are controlled by 24V DC for safety reasons.

2.2. Bath vessels

The standard apparatus is designed for **4 bath vessels**; systems for up to 8 bath vessels can also be supplied. In the standard version the following sizes of bath vessel can be used:

- 2.5 ml
- 5 ml
- 10 ml
- 20 ml
- 25 ml
- 50 ml
- 100 ml
- 500 ml;

larger volumes are available on request.

The jacketed thermostattable bath vessels are characterized by their having a minimal **dead volume** for the nutrient solution and therefore for the test substance!

We have taken a completely new path in developing the new bath vessels. The conventional L-shape has been dropped and a space-saving vertical shape has been

selected. In this way it has been possible to increase the volume of the water jacket, which is a great advantage when it comes to maintaining a constant temperature in the vessels.

The bath vessel is screwed onto the base of the basic unit. As a result of the built-in inlet and outlet in the base, changing the solution in the bath vessels now takes place as a complete exchange. This method considerably reduces nutrient medium consumption!

In addition, as in the L-shaped vessels, an overflow outlet is situated at the nominal volume level so that the rinsing method "by displacement via the overflow principle" is also available; this is used in various applications.









2.3. Organ holders

The exact configuration of the specimen-holding device in the bath vessel depends on the type of specimen and the specific problem to be investigated; it is designed **according to the customer's requirements**. For example, specimens can be:

- directly placed round 2 organ hooks (e.g. vessel rings),
- tensioned between 2 organ hooks with holding threads (e.g. intestinal strips), or
- held by organ clamps.

In this case the upper organ hook or holding thread makes the contact with the transducer located above the bath vessel.

Various organ hooks and organ clamps are available for the lower attachment point. Some of these are shown in the illustration on the right.

In the standard version the lower part of the organ holder consists of an organ hook; this is built into the bath vessel base. During organ stimulation this hook also serves as the 1st electrode.

Alternatively the specimen can also be attached to an **organ arm** that projects into the vessel from above. This organ arm can be equipped with a **micrometer screw** in order to achieve precise manual height adjustment with an accuracy of 0.01mm.



In the basic version the pre- and post-tensioning of the specimen is carried out manually. An automatic pre- and post-tensioning device is available on request.

2.4. Transducers

The system can be operated with both **isometric** and **isotonic** transducers; this offers the largest possible degree of flexibility. The transducers are placed in a holder that can be manually adjusted both vertically and horizontally; they are easily exchanged.



With the help of built-in motors and an **automatic post-tensioning device** the height adjustment of the transducers can be *software-controlled* in order to maintain the constant tension of the specimen during the study period. These motors can also be operated manually via switches on the basic unit.

The transducers are calibrated using the **BioSys** software.

2.4.1. ISOMET isometric transducer (force transducer)



This transducer measures the **force** of the muscle contraction at a practically constant specimen length.

It is preferably used with those muscles that are characterized by rapid contractions, i.e. high shortening speeds; depending on the problem they can also be used for smooth muscles:

- Isolated cardiac muscle specimens (papillary muscles, auricular strips, skinned heart muscle fibers)
- Skeletal muscles
- Ring specimens, e.g. blood vessel rings (arteries/veins), tracheal rings / tracheal strips
- Vessel strips
- Uterus
- Urethra
- Diaphragm





The special construction of the transducer ensures that the load to be measured is always applied to the same point; this is a requirement for obtaining reproducible results.

The transducer is available for the following measuring ranges as standard:

- ISOMET-05 from 0...5g
- ISOMET-10 from 0...10g
- ISOMET-20 from 0...20g
- ISOMET-50 from 0...50g
- ISOMET-100 from 0...100g

Other ranges are available on request!

Technical data (ISOMET-05 as an example)			
Measuring principle:	magnetoresistive effect		
Measuring range:	0.1 to 5 gram		
Resolution:	0.01 gram		
Max. load:	300%		
Length with clamping rod:	150 mm		
Housing:	15mm x 15mm x 54mm		
Attachment:	with clamping rod 6 mm dia.		
Force transfer:	via 1 mm bore in 3 mm pin		
Linearity:	better than 0.5%		
Temperature dependency (typical):	minus 0.01 gram / °C		
Weight:	approx. 45 gram		



2.4.2. ISOTON isotonic transducer (position transducer)



Isotonic transducers are used for measuring the muscle contraction **distance**, i.e. they measure the change in length of the specimen under a constant load.

Isotonic transducers are preferably used for **smooth muscular organs** that are characterized by relatively slow contractions, e.g.

- Lung specimens,
- Intestinal sections,
- Esophagus.





Technical data (ISOTON-10 as an example)				
Measuring principle:	solid state magnetically controlled potentiometer, wear-free			
Measuring range:	up to 10 mm			
Resolution:	0.01 mm			
Torque:	low, 0.49x10 ⁻⁶ Nm/0.5gcm			
Long working life:	>500m. cycles			
Bearings:	ball bearings			
Mechanical angle:	360°			
Magnetic influence:	±0.001%/Oersted			
Linearity:	0.02% at ±10°			
	0.1% at ±30°			
	0.3% at ±45°			
Recommended working range:	±45°			
Temperature coefficient:	±0.02%/°C			
Working temperature range:	-40°C+125°C			
Length with clamping rod:	215mm			
Housing:	50mm x 50mm x 55mm			
Weight:	approx. 75 gram			
Attachment:	with clamping rod 7mm dia.			

ISOTON is available for a wide range of measuring ranges.

2.5. Thermostat / Warm water circulation

The complete system is thermostatted with warm water. The thermostat with built-in circulation pump is designed for continuous operation. The electronic temperature control adapts the amount of heat supplied to the requirements of the system. This results in short heating-up times and high temperature stability. The required temperature is reached throughout the whole system in approx. 15 minutes.

The system is filled during the installation by our service technicians. It is only necessary to change the water at a later date if, for example, the system has been transported or repaired. Once the system is completely full it requires no topping up with water.



2.6. Control unit / Computer / Interface

The **control unit** contains all the necessary interfaces for controlling the solenoid valves, metering pumps, motors and other assemblies; it is responsible for the communication between the basic unit and the computer.

We recommend the use of a **computer** with at least a Pentium processor.

The following **interface** cards must be built into the computer:

- TSE special Online-V interface
- TSE PIO interface

As it is equipped with **built-in amplifiers** the special Online-V interface is ideally suitable for the direct connection of transducers in the millivolt range!

2.7. Software

The **BioSys** program is used for both online recording and evaluation of the organ contractions in the isolated organ system. The program-controlled operation of all automatic components (valves, pumps, etc.) is carried out by the subprogram

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Switchboard for isolated organs,
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which can be called up at any time from the online recording program of BioSys.

The optional

Automatic post-tensioning device

is also controlled by BioSys. If the system is equipped with an organ stimulation device then this is also controlled via a special software module.

When a trial is running BioSys shows the organ contractions as trend curves similar to those seen on an analog recorder. At the same time numerical values (e.g. force in grams) are outputted. Up to 16 channels can be shown on the screen at once.



While a measurement is taking place the operator can:

- displace the curves in the X- (time axis) and Y-directions,
- magnify or reduce the curves,
- set event markers with accompanying texts (e.g. test substance addition),
- switch individual measuring stations (bath vessels) on and off.

All data is stored on the hard disk. After the end of the measurement this data can be read in again by the evaluation program, displayed and evaluated. Lists are produced in which the contraction distances or contraction forces are calculated at any times selected by the operator as well as their differences from operator-defined reference values. The analysis files generated are present in ASCII format and can be imported into standard software packages such as EXCEL for further statistical and graphical evaluation.

More information about the **BioSys** software can be found in the detailed operating instructions which is available separately. In this manual only the subprogram **Switchboard for isolated organs** and the **automatic post-tensioning device** are described in detail.



3. Switchboard for isolated organs

The **BioSys** program is used for control and data acquisition. The **Switchboard for** isolated organs is called up from the **BioSys** recording program.

A window appears on the screen that shows a strip containing buttons. Each button represents a bath vessel. Each bath vessel can be controlled *individually*.

IO-Panel					
ON	Bath-1	Bath-2	Bath-3	Bath-4	OFF
Rinsing Mode Rinsing-1(Overflow) Empty (sec) 10 Fill (sec) 10					
Rinse		Stop	Test		<u>I C</u> lose

3.1. Using the switchboard

The control of the isolated organ system *while a trial is taking place* is carried out from the main screen of the switchboard with the help of 3 different automatic modes.

1. Mode selection

Two different options are available for changing the solution in the bath vessels: **Rinsing-1** and **Rinsing-2**.

Rinsing Mode			
Rinsing-1(Overflow)	•		
Rinsing-1(Overflow) Rinsing-2(Empty/Fill)			
Emptying			



Rinsing-1 Overflow The selected bath vessels are filled from below according to the *overflow principle*; the filling time is controlled (timer).

- **Rinsing-2** Empty/Fill The bath vessel is first emptied completely by draining downward and then filled again; the filling time is controlled (timer).
- **Emptying** The bath vessel is only emptied. **Rinsing-1** or **Rinsing-2** can later be used for filling.

2. Bath vessel selection

After the required mode has been selected the operator must then select the bath vessels.

The operator can switch the required mode for each individual bath vessel on and off by using the buttons 1 to 4 (or 1 to 8 if 8 bath vessels are used). Each time a button is activated it switches on or off in sequence. Activated buttons appear bright. The **ON** and **OFF** buttons switch *all* baths on or off.

3. Time fields

The time for automatically emptying and filling the bath vessels is entered here in seconds.

The RINSE button is used to activate the set automatic mode.

The timers count downward towards zero; the function then ends automatically. The function can also be terminated manually by using the **STOP** button.

3.2. Test mode

IO-Panel					
ON	Bath-1	Bath-2	Bath-3	Bath-4	OFF
E Pump			Bath valves		
Solvent valve		□ Inflow/drain			
Thermostat valve					<u>I C</u> lose



The test mode is used for

- filling the bath with nutrient medium for the first time at the start of a trial (all baths),
- rinsing at the end of a trial,
- or for emptying.

In addition this mode can be used for operating the various system components (pumps, valves) for testing or cleaning purposes, either individually or all at once.

Pump Solvent valve	switches the pump on/off opens the valve for draining off the nutrient solution				
Thermostat valve	opens the valve for emptying the thermostat				
Buttons	select the bath vessel				
Bath valves Inflow/drain	opens or closes the inlet/outlet valve switches between the inlet/outlet valve				

The current status of each function is shown.

Gui	Guide values for the filling and emptying times				
These values apply for empty suction tubing.					
a)	Completely filling the system (storage vessel, organ baths): approx. 30 s				
b)	Filling organ baths:				
	1 to 2 organ baths:	approx. 10 s			
	3 to 4 organ baths:	approx. 12 s			
C)	Emptying 1 to 4 organ	baths: at least 20 s			



4. Automatic post-tensioning

The **automatic post-tensioning device** allows the position of the transducer above the organ bath to be *controlled by the software* so that a particular tension can be maintained in the specimen during the trial.

- \Rightarrow The **Status** line shows ON or OFF for each measuring place (bath vessels 1-4).
- \Rightarrow The **Value** display corresponds to the numerical value in the normal graphics display of **BioSys** and shows the momentary measured value in calibrated units.

Key commands

- **Arrow I/r** Selects a measuring place for setting (white script).
- **Arrow up/down** Moves the post-tension mechanism manually one step upward or downward each time the button is pressed.
- **Page up/down** Moves the post-tension mechanism continuously up/down; the motor continues running until the next time that the same key is pressed.
- **Enter key** Switches the automatic for the selected measuring place on or off.
- **Esc** Exits the menu.

Setting the pre-tension

All the measuring places used must be calibrated!

- 1. Suspend the organ and set it manually using the buttons on the measuring place.
- 2. Call up the automatic post-tension menu
- 3. Use the left/right arrow keys to select the measuring place (white script).
- 4. Use the up/down arrow keys or the page up/down keys to alter the pre-tension until the required value (e.g. 5000 mg) is shown.
- 5. Use the Status key to set to ON.

During this setting – i.e. when the menu is shown – the automatic post-tension is switched off. Control only starts when the menu is exited.





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Inhalation

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As your partner TSE Systems offers you solutions that are fully intergrated with state-ofthe-art technology and powerful software, customized to your specific needs, dependably consistent and easier to use for meeting even the most challenging research work.

Our committed team is ready to assist you in formulating solutions for your research. Let us become part of your team. Do not hesitate to contact us.



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