

# Operating Manual

APU 28 Series  
AOX Sample Preparation Systems  
with control unit connect



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For a proper and safe use of this product follow the instructions. Keep the operating manual for future reference.

General Information           <http://www.analytik-jena.com>

Documentation Number       11-0607-004-23

Edition                        B (08/2023)

Technical Documentation      Analytik Jena GmbH+Co. KG

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# Table of contents

<b>1 Basic information .....</b>	<b>5</b>
1.1 About this manual .....	5
1.2 Intended use .....	6
<b>2 Security .....</b>	<b>7</b>
2.1 Safety labeling on the device .....	7
2.2 Requirements for the operating personnel.....	8
2.3 Safety instructions for transport and commissioning.....	8
2.4 Safety instructions: during operation .....	9
2.4.1 Summary of safety instructions .....	9
2.4.2 Safety instructions: protection against explosion and fire .....	9
2.4.3 Safety instructions – electrical equipment .....	9
2.4.4 Handling of auxiliary and operating materials .....	10
2.5 Safety instructions – maintenance and repair .....	10
2.6 Behavior during emergencies .....	11
<b>3 Function and design .....</b>	<b>12</b>
3.1 Functionality .....	12
3.2 Design.....	15
3.3 Connections and interfaces .....	19
3.4 Tube system .....	21
<b>4 Installation and commissioning .....</b>	<b>23</b>
4.1 Ambient conditions and space requirements .....	23
4.2 Power supply.....	23
4.3 Unpacking and setting up the device.....	24
<b>5 Operation.....</b>	<b>28</b>
5.1 Operating the control module control unit connect .....	28
5.1.1 Creating a rack setup and managing setups .....	31
5.1.2 Calibrating racks and managing rack configurations.....	35
5.1.3 Changing software settings.....	38
5.1.4 Retrieving system information.....	39
5.2 Performing a sample enrichment .....	40
5.2.1 AOX sample preparation .....	40
5.2.2 SPE-AOX sample preparation process.....	42
5.2.3 Display during sample enrichment .....	44
5.2.4 Stopping sample processing and editing a section during operation.....	45
<b>6 Maintenance and care .....</b>	<b>47</b>
6.1 Maintenance overview .....	47
6.2 Replacing tubes.....	47
6.3 Venting and rinsing the tube system.....	48
6.4 Change aspiration needle.....	50
6.5 Changing the seals on the dosing head .....	51
6.6 Check dosage .....	51

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<b>7</b>	<b>Transport and storage</b> .....	<b>52</b>
7.1	Transport.....	52
7.2	Preparing the device for transport.....	52
7.3	Moving the device in the laboratory.....	53
7.4	Storage .....	54
<b>8</b>	<b>Disposal</b> .....	<b>55</b>
<b>9</b>	<b>Specifications</b> .....	<b>56</b>
9.1	Technical data.....	56
9.2	Standards and directives .....	57

# 1 Basic information

## 1.1 About this manual

These operating instructions describe the sample preparation systems of the APU 28 with the APU 28/1 S and the APU 28/1 SPE as well as their operation with the control unit connect. The devices and the control module are configured together and provided in a set as APU 28 connect S and APU 28 connect SPE. Both configurations will be referred to collectively in the following as APU 28 connect. Differences will be explained in the corresponding sections.

The control unit connect control module is also offered separately for retrofitting devices of the APU 28. In this case, these instructions for operation and maintenance of the converted devices are also valid.

The device is intended to be operated by qualified specialist personnel who must observe all instructions given in the operating manual.

The operating manual provides information about the design and operation of the device and provides operating personnel with the necessary know-how for safe handling of the device and its components. Furthermore, the operating manual includes information on the maintenance and servicing of the device as well as information on potential causes of malfunctions and their correction.

### Conventions

Instructions for actions occurring in chronological order are numbered and combined into action units.

Warnings are indicated by a warning triangle and a signal word. The type, source and consequences of the hazard are stated together with notes on preventing the hazard.

Elements of the control and analysis program are indicated as follows:

- Program terms are in bold (e.g., the **System** menu).
- Menu items are separated by vertical lines (e.g., **System | Device**).

### Symbols and signal words used in this manual

The user manual uses the following symbols and signal words to indicate hazards or instructions. These warnings are always placed before an action.



### WARNING

Indicates a potentially hazardous situation which can cause death or very serious (possibly permanent) injury.



### CAUTION

Indicates a potentially hazardous situation which can cause slight or minor injuries.



### NOTICE

Provides information on potential material or environmental damage.

## 1.2 Intended use

The sample preparation systems of the APU 28 are used for the automated enrichment of adsorbable organically bound halogens (AOX) in aqueous solutions on activated carbon. The sample preparation systems work according to the column method according to DIN EN ISO 9562, EPA1650C, EPA9020B and others. It is possible to set individual parameters that deviate from the norm.

The devices are supplied with the removable control unit connect for APU 28 with touch display.

The double channel system APU 28 connect S enriches two AOX samples on activated carbon in parallel.

The single channel system APU 28 connect SPE enriches AOX and SPE-AOX samples on activated carbon. In the case of SPE-AOX samples, automated solid phase extraction (SPE) precedes the AOX adsorption.

Both systems can also be used to enrich samples for AOF determination.

The devices are equipped with racks for working with Analytik Jena columns (18 x 6 mm). Optionally, the devices can be configured with racks for the use of alternative AOX columns with the dimensions 40 x 9 mm and 47 x 6 mm. If required, you can expand the systems with additional racks.

The device and its components may only be used for the analyses listed in the user manual. Only this specified use is regarded as the intended use, ensuring the safety of the user and the device.

## 2 Security

For your own safety and to ensure error-free and safe operation of the device, please read this chapter carefully before commissioning.




Observe all safety instructions listed in this user manual and all messages and information displayed on the monitor by the control and analysis software.

### 2.1 Safety labeling on the device





Warning and mandatory action labels have been attached to the device and must always be observed.




Damaged or missing warning and mandatory action labels can cause incorrect actions leading to personal injury or material damage. The labels must not be removed. Damaged warning and mandatory action labels must be replaced immediately!

The following warning and mandatory action labels have been attached to the device:

Warning symbol	Meaning	Comment
	Warning of crushing	At the sampler arm There is a risk of crushing hands in the movement area of the sampler arm.
	Warning of cuts	At the sampler arm There is a risk of injury at the aspiration needle during operation.
	Warning of hand injuries in gear drive	At the sampler arm There is a risk of hand injuries at the Z-drive.

The following GHS pictographs are affixed to the storage bottles for safety labeling of the chemicals:

GHS pictograph	Meaning	Comment
	Corrosiveness warning	On the storage bottle for acidic sodium nitrate rinsing solution (pH ≈ 1.7) The acidic rinsing solution causes skin burns and severe eye damage.
	Warning against flammable substances	On the storage bottle for methanol (only for SPE-AOX) Methanol is flammable and can cause burn injuries if ignited.
	Warning of acute toxicity	Methanol can lead to poisoning and organ damage.
	Health hazard	

Mandatory signs/ information symbols	Meaning	Comment
	Disconnect the power supply before opening the device cover	At power supply: Before opening the device cover, switch off the device and disconnect the mains plug from the mains socket.
	Observe the operating manual	On the mains switch: Before starting work, read the operating manual.
	For People's Republic of China only	The device contains controlled substances. Analytik Jena GmbH+Co. KG warrants that these substances will not be released from the device within the next 25 years provided the device is employed as intended.

## 2.2 Requirements for the operating personnel

The device must only be operated by qualified specialist personnel instructed in the use of the device. This instruction also include teaching the contents of this user manual and of the user manuals of the connected system components. We recommend training by qualified employees of Analytik Jena or its representatives.

In addition to the safety instructions in this user manual, the general applicable safety and accident prevention regulations of the respective country the device is operated in must be observed and adhered to. The operator must ensure the latest version of these regulations.

The user manual must be accessible to the operating and service personnel.

## 2.3 Safety instructions for transport and commissioning

Incorrect installation can create serious hazards. This may cause an electric shock.

- Only the Analytik Jena customer service or specialist personnel trained and authorized by them is allowed to install and commission the device and its system components.
- Unauthorized assembly and installation is not permitted.
- Insufficiently secured components pose a risk of injury. During transport, secure the device components as specified in this operating manual.
- Only transport the device in its original packaging. Ensure that all transport protections have been fitted and the device is completely empty.
- Loose parts must be removed from the system components and packed separately.

To prevent health damage, the following must be observed when moving the device in the laboratory (lifting and carrying):

- For safety reasons, two persons are required to transport the device who must hold the device by either side of the equipment.
- The device has no carrying handles. To transport the device, grip the device firmly at the bottom with both hands and lift it at the same time.



- Risk of damage to health due to improper decontamination! Perform a professional and documented decontamination of the device before returning it to Analytik Jena. The decontamination report is available from Service when registering the return. Without a completed decontamination report, the acceptance of the device will be refused. The sender may be liable for damage caused by inadequate decontamination of the device.

## 2.4 Safety instructions: during operation

### 2.4.1 Summary of safety instructions

The operator must make sure that the device and its safety equipment is in sound condition each time before starting up the device. This applies in particular after each modification or extension of the device or its repair.

Observe the following:

- The device may only be operated if all items of protective equipment (e.g. covers in front of electronic components) are in place, properly installed and fully operational.
- The sound condition of the protection and safety equipment must be checked regularly. Any defects must be corrected as soon as they occur.
- Protective and safety equipment must never be removed, modified or switched off during operation.
- Risk of crushing in the movement range of the sampler arm, especially to hands. Hands and fingers can be crushed in the drives. There is a risk of puncture and cut injuries at the needle. Maintain a safety distance from the sampler arm during operation.
- Caution when handling glass components. Risk of broken glass and therefore risk of injury!
- Modifications, conversions and extensions to the device are only permitted after consultation with Analytik Jena. Unauthorized modifications can jeopardize the device's operational safety and may lead to limitations regarding the warranty and access to customer service.

### 2.4.2 Safety instructions: protection against explosion and fire

The device may not be operated in an explosive environment.

### 2.4.3 Safety instructions – electrical equipment

Lethal voltages may occur in the device! Contact with live components may cause death, serious injury or painful electrical shock.

- Work on the electronics may only be carried out by the customer service of Analytik Jena and specially authorized technicians.
- The power plug must be connected to a proper power outlet to ensure that the device meets protection class I (ground connector). The device may only be connected to power sources whose nominal voltage is the same as that on the rating plate of the equipment. Do not replace the removable power cable of the device with a power cable that does not meet the specifications (with no protective ground conductor). Extensions of the supply cable are not permitted!
- The basic module and the system components may only be connected to the mains when they are switched off.

- Electrical connection cables between the basic module and the system components may only be connected or disconnected when the device is switched off.
- Ensure that no liquid enters the interior of the device, for example at cable connections. There is a danger of electric shock.
- Before opening the device's housing, the device must be switched off using the mains switch and the mains plug must be disconnected from the power outlet.
- The device automatically moves the sampler arm for initialization each time it is switched on. The device also performs initialization when power is restored after a power failure. There is a risk of accident in the operating range of the arm.

#### 2.4.4 Handling of auxiliary and operating materials

The operator is responsible for the selection of substances used in the process as well as for their safe handling. This is particularly important for radioactive, infectious, poisonous, corrosive, combustible, explosive and otherwise dangerous substances.

When handling hazardous substances, the locally applicable safety instructions and instructions in the safety data sheets from the manufacturers of the auxiliary and operating materials must be complied with.

- For the operation of the sample preparation system, nitric acid nitrate solution (pH  $\approx$  1.7) is used as rinsing solution. For the SPE-AOX process, methanol is also required as an eluent. Observe the regulations and instructions in the safety data sheets for the handling of the corrosive rinsing solution and methanol. Always wear goggles and protective gloves when handling these hazardous materials. Observe the notes on the labels.
- Ensure good room ventilation in working rooms.

Observe the following:

- The operator is responsible for carrying out suitable decontamination should the device become contaminated externally or internally with dangerous substances.
- Splashes, drops or larger liquid spillages should be removed using an absorbent material such as absorbent cotton, laboratory wipes or cellulose.
- In case of biological contamination, wipe the affected area with a suitable disinfectant. Then wipe the cleaned areas so that they are dry.
- The only suitable cleaning method for the housing is wipe disinfection. If the disinfectant has a spray nozzle, apply disinfectant to a suitable cloth before using it on the device.  
Proceed with particular care and ensure utmost cleanliness when working with infectious material because the device cannot be decontaminated as a whole.
- Before using a cleaning or decontamination procedure other than the one prescribed by the manufacturer, the user is required to check with the manufacturer that the intended procedure will not damage the device. Safety labels attached to the device must not be moistened or wiped with methanol.

## 2.5 Safety instructions – maintenance and repair

The device is generally maintained by the customer service department of Analytik Jena or specialist personnel trained and authorized by them.

Unauthorized maintenance can damage the device. For this reason, only the activities described in the user manual in the "Maintenance and care" chapter may be performed by the operator.

- Only clean the exterior of the device with a slightly moistened, non-dripping cloth. Use only water and, if required, customary surfactants.

- All maintenance and repair work on the device must only be carried out when the device is switched off (unless specified otherwise).
- Use only original spare parts, wear parts and consumables. They have been tested and ensure safe operation. Glass part are wear parts and are not subject to the warranty.
- All protective equipment must be reinstalled and checked for proper function when the maintenance or repair work is complete.

## 2.6 Behavior during emergencies

If there is no immediate risk of injury, switch off the device and the connected system components immediately in hazardous situations or in the event of an accident and/or disconnect the power plugs from the power outlets.

Always ensure free access to the main switch as well as to the mains connection on the rear of the device.

### 3 Function and design

#### 3.1 Functionality

The sample preparation systems of the APU 28 enrich adsorbable organically bound halogens (AOX) on activated carbon. The devices operate according to the column method (in accordance with DIN EN ISO 9562, EPA1650C, EPA9020B) and prepare up to 28 aqueous samples fully automatically for AOX determination. The processing time for a sample is about 45 min. The environmental parameter AOX includes organic chlorine, bromine and iodine compounds. All device models can also be used to enrich samples for AOF determination.

In addition, the APU 28/1 SPE model allows the fully automatic SPE-AOX enrichment. With the preceding solid phase extraction, the average processing time for one sample is 110 to 120 min.

AOX enrichment process

As the placement diagram shows, one sample is arranged on the sample tray in each case and one duplex column to its left.

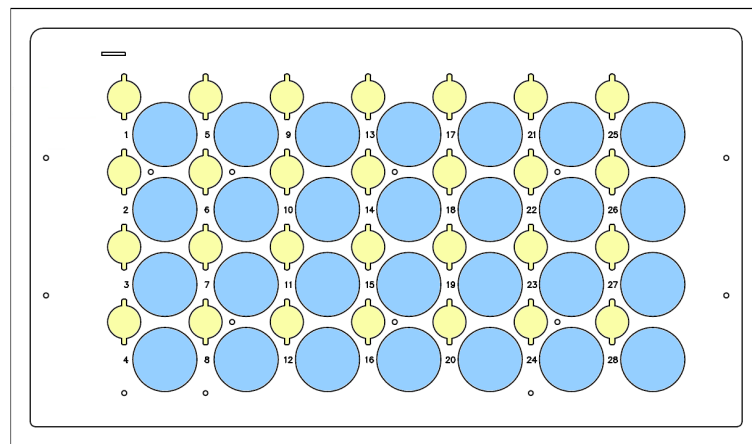


Fig. 1 Placement diagram for AOX samples

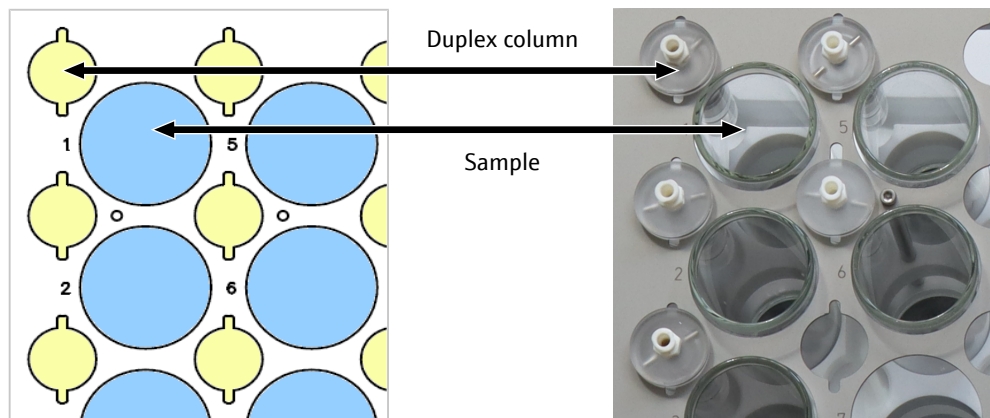
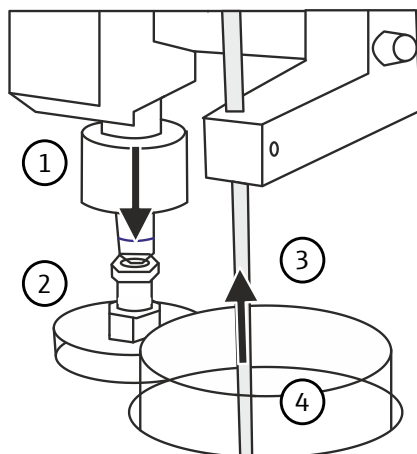


Fig. 2 Arrangement of sample vessels and duplex columns

In a first step, the sample preparation system stirs the current sample to mix it homogeneously. Then the device picks up the sample with the aspiration needle and pumps the sample slowly over the duplex column at the same time.



**Fig. 3 AOX adsorption diagram**

- |                     |                           |
|---------------------|---------------------------|
| 1 Dosing head       | 2 Duplex column           |
| 3 Aspiration needle | 4 Sample in sample vessel |

The device then rinses the loaded activated carbon in the duplex column with an acidic nitrate rinsing solution (pH  $\approx$  1.7) in order to remove inorganic chlorine compounds (matrix). The residual sample and the rinsing solution run via the drainage channel on the sample tray into the waste canister.

At the end of each sample preparation, the device backwashes the tube system and needle with rinsing solution and is then ready for the next sample.

According to the DIN EN ISO 9562 standard, the device operates with the following settings:

- Sample volume 100 ml
- Rinsing volume 25 ml
- Dosing rate 3 ml/min

You can adjust the settings individually.

Equip each duplex column with two quartz containers. The quartz containers are supplied as ready-filled disposable columns, but can also be refilled. The quartz containers contain 50 mg activated carbon between two plugs made of a temperature-stable fiber material.

The activated carbon binds organically bound halogen compounds on its large surface. When adsorption is complete, the activated carbon in the first tube binds the bulk of AOX. Only a small amount is expected on the second tube. Always analyze both quartz containers after sample preparation.

If water samples have a high percentage of organic compounds, the bulk of AOX may not adsorb on the first tube. A similarly high or even higher AOX content is then measured on the second tube. This phenomenon is called breakthrough. In this case, it is recommended to dilute the samples before sample preparation.

#### SPE-AOX enrichment process

The SPE-AOX method is used for the enrichment of organically bound halogens in aqueous solutions with a high content of inorganic chlorides (>1 g/l) according to ISO 9562, if prior dilution of the sample cannot be performed. Highly saline waters can be, for example, industrial wastewater. Wastewater in municipal wastewater treatment plants can also be heavily contaminated with chlorides, for example due to road salt in winter.

The SPE-AOX method separates organic compounds from the highly saline matrix in a first step by solid phase extraction. After elution with methanol, AOX enrichment takes place on activated carbon.

Insoluble inorganic and organic halogen compounds and halogens adsorbed on solids are not detected by this method. Samples containing particles must be filtered before adsorption.

As the placement diagram shows, one SPE-AOX sample preparation occupies two sample locations on the tray at a time. You can place a maximum of 12 SPE-AOX samples on the tray. Wiper and waste container for the spent SPE columns are to be placed on position 28.

You can load a rack with SPE and AOX samples.

If you are only preparing SPE samples, the last row of trays must remain free. The dosing head does not reach this last row. However, you can fill up the free spaces with AOX samples.

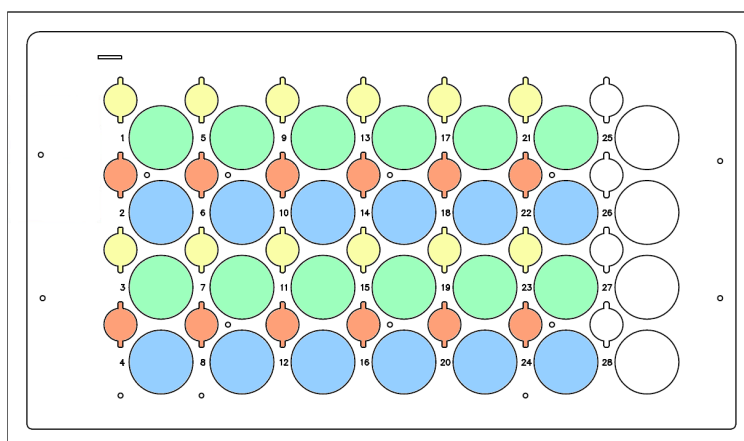


Fig. 4 Placement diagram for SPE-AOX samples

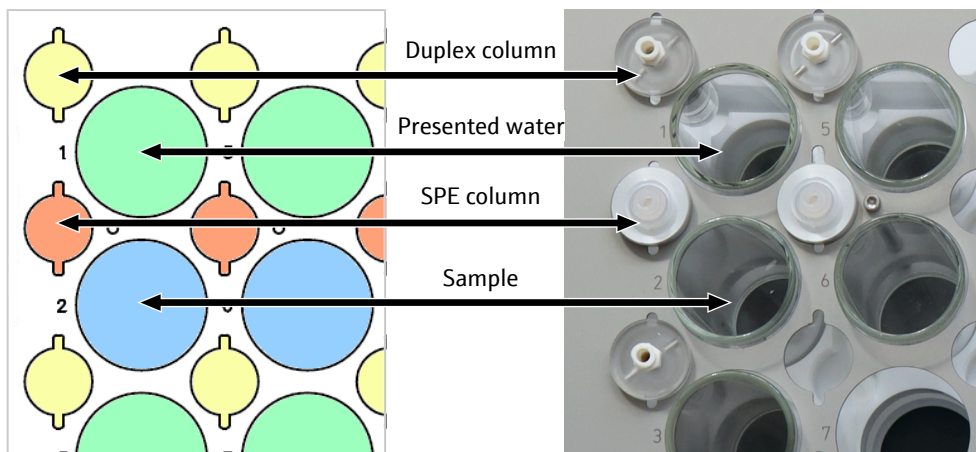
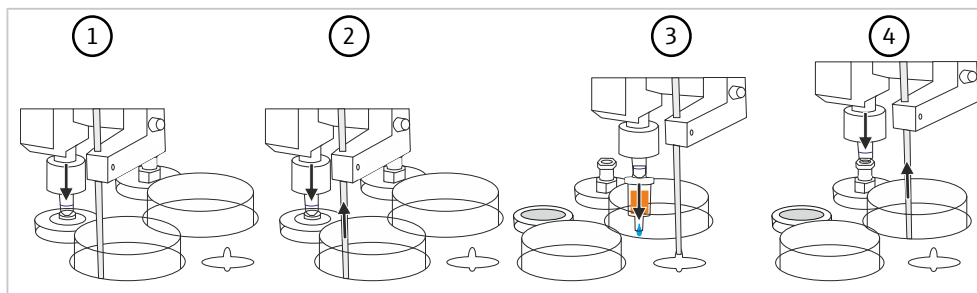


Fig. 5 Arrangement of sample vessels and columns

For the SPE-AOX method, place the sample, the supply of ultrapure water, and the two columns on the tray as follows:

	Rack placement
Sample	In sample vessel on an even position number $n$
SPE column	Left of the sample
Supply of ultrapure water	In sample vessel on an uneven position number $(n - 1)$
Duplex column	Left of the supply of ultrapure water

Automated SPE-AOX enrichment proceeds as follows:



**Fig. 6 Diagram of the SPE-AOX method**

- |                                  |                                    |
|----------------------------------|------------------------------------|
| 1 SPE column conditioning        | 2 Sample application on SPE column |
| 3 AOX desorption from SPE column | 4 AOX application on duplex column |

**Step 1** serves the preparation. The device conditions the SPE column with methanol. In the further course, the SPE column does not run dry.

In **step 2** the device meters the sample on the SPE column. AOX is adsorbed on the SPE column. The rest of the sample drains into the waste canister via the drainage channel. The device rinses the SPE column with rinsing solution before and after sampling.

In **step 3** the dosing head lifts the SPE column. The dosing head moves over the sample vessel with ultrapure water and desorbs the bound AOX with methanol from the column. In the sample vessel, the eluate is diluted with the ultrapure water in the vessel and mixed homogeneously by stirring. The device rinses the SPE column with nitrate rinsing solution.

In control software default mode, the device uses 5 ml methanol and 5 ml nitrate rinsing solution to desorb the sample from an SPE column. In expert mode, the volumes can be freely chosen. The total volume in the sample vessel is calculated as follows:

$$V_{\text{water}} + V_{\text{methanol}} + V_{\text{rinsing solution}} = V_{\text{tot}}$$

Then the device scrapes off the SPE column into the waste container on position 28.

In **step 4** the aspiration needle picks up the diluted eluate. At the same time, the device pumps the solution over the duplex column on which the actual AOX enrichment on activated carbon takes place. The device rinses the duplex column with nitrate rinsing solution.

## 3.2 Design

The sample preparation system consists of the following components:

- Basic device APU 28 including power supply
- Storage bottle holder
- Removable control module control unit connect with touch display on a magnetic holder

The control module controls all operations from the movement of the sampler arm, to the pump unit, to the magnetic stirrer.

### Basic device

The sampler arm of the basic device moves the aspiration needle and the dosing head to the respective sample position on the rack. The aspiration needle picks up a sample from the sample vessel. The dosing head simultaneously meters the sample onto the column.

The stirrer bracket on the back of the device allows the device to mix the current sample.

The nitrate rinsing solution and a storage bottle with methanol (SPE-AOX only) are attached to the basic device in a removable holder. The pump unit also meters these solutions according to the preset operating sequences.

The rack has a drainage channel through which residues of the sample and the rinsing solution drain into the waste canister. Before starting a sample preparation process, it is necessary to adjust movements of the sampler arm to the rack or to check the adjustment. The control software stores the offset values (calibrations) of up to .6 racks. Check the calibration every time you change the rack. Always secure duplex columns to the rack with a .30° twist. Otherwise, the dosing head could lift the duplex columns. The four device feet are height-adjustable.



**Fig. 7 Single-channel system APU 28 connect SPE comprising basic device APU 28/1 SPE and control module**

- |                                                           |                                            |
|-----------------------------------------------------------|--------------------------------------------|
| 1 Autosampler arm                                         | 2 Pump unit                                |
| 3 Dosing head                                             | 4 Control module control unit connect      |
| 5 Rack with duplex columns and sample vessels             | 6 Basic device with height-adjustable feet |
| 7 LED for status display                                  | 8 Aspiration needle                        |
| 9 Position 28 (for wiper and waste container SPE columns) | 10 Canister for nitrate rinsing solution   |
| 11 Storage bottle with methanol (SPE-AOX only)            |                                            |

Devices of the APU 28 series are equipped with a sample rack, further accessories and a consumables starter set:

- Magnetic stirring rod
- Duplex columns for quartz container
- Canister for nitrate rinsing solution
- Sample vessels (maximum volume 120 ml)
- Waste canister
- Pack of disposable columns with activated carbon

Double-channel system APU 28/1 S

The double channel system can enrich two AOX samples in parallel. The model has two dosing heads and two aspiration needles. It processes two adjacent samples with the same settings. The processing time for a maximum of 28 samples of approx. 10 h 30 min is half the time required by the single channel system.





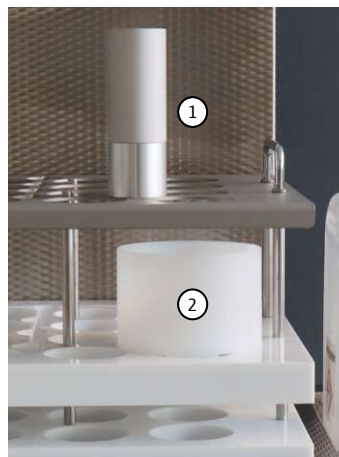
**Fig. 8 Double channel system APU 28/1 S with 2 dosing heads and needles**

Single channel system APU 28/1 SPE

With the single channel system you can enrich SPE-AOX samples as well as AOX samples. The more complex SPE-AOX process is suitable for solutions with high salinity. The process performs a solid phase extraction before the actual AOX adsorption on activated carbon. Solid phase extraction first accumulates AOX on an organic resin, separating the saline matrix.

You can place AOX and SPE-AOX samples together on one rack. This will give you a lot of flexibility. Note, however, that you always need two sample locations on the rack for one SPE-AOX sample. Here, the specimen must be placed on a straight specimen position. The last row of the rack must be left empty for SPE-AOX-only samples. Positions 25 and 26 are only available for AOX-only sample preparation.

Wiper and waste container for spent SPE columns are placed on position 28. After AOX desorption, the dosing head moves to this position and wipes off the spent SPE column. The column falls into the waste container.



**Fig. 9 Discarding SPE columns**

- 1 Wiper for SPE columns
- 2 Waste container

In addition, the single channel system is equipped with the following components:

- Methanol storage bottle
- Pack SPE columns
- Fixture for SPE columns
- Wiper and waste container for SPE columns (for position 28)

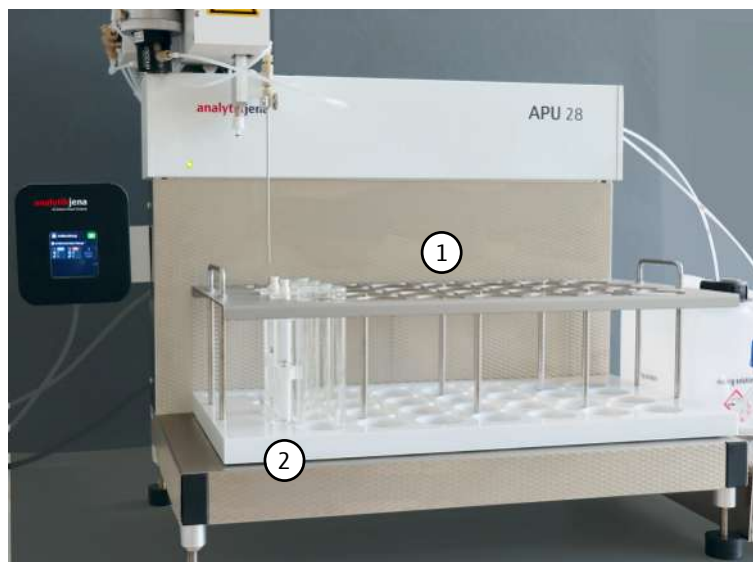
Configurations of the APU 28 series

The APU 28 connect S device configuration contains the APU 28/1 S and the control module.

The APU 28 connect SPE device configuration contains the APU 28/1 SPE and the control module.

Optional configuration with column flexibility rack

By default the devices of the APU 28 series are equipped with racks for the preparation of Analytik Jena columns (18 x 6 mm). However, they can be optionally configured with the column flexibility rack for alternative columns (40 x 9 mm, 47 x 6 mm).

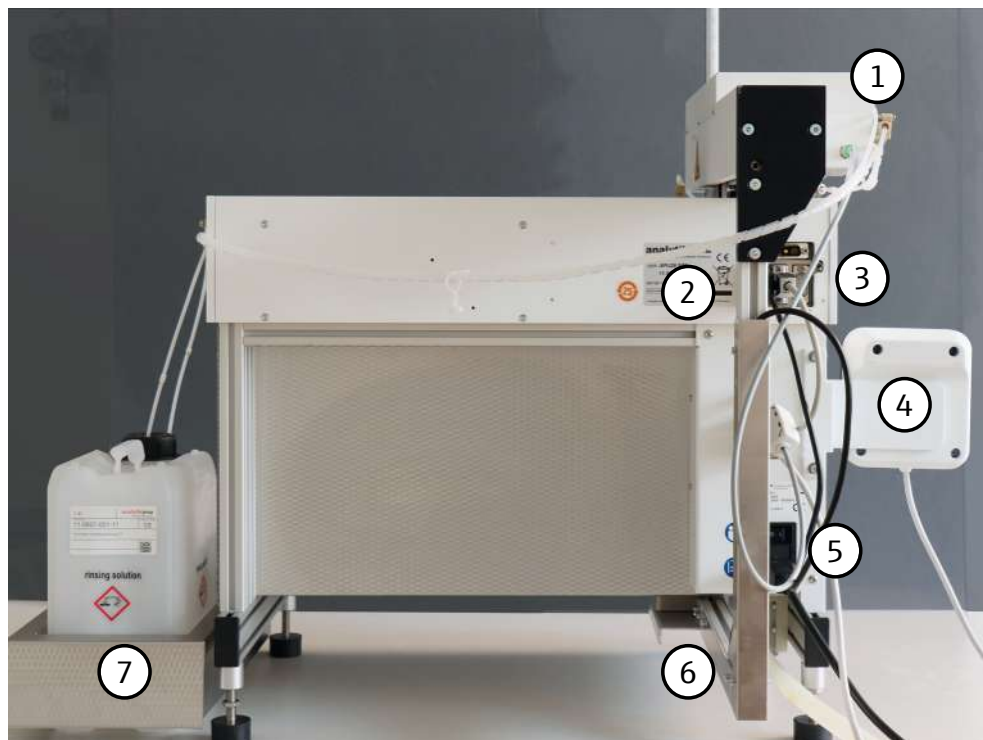


**Fig. 10** Column flexibility rack for alternative columns

1 Flexible rack for third-party tubes

2 Duplex columns for third-party tubes

### 3.3 Connections and interfaces



**Fig. 11 Rear of the device**

- |                                                           |                                       |
|-----------------------------------------------------------|---------------------------------------|
| 1 Autosampler arm with pump unit                          | 2 Type plate                          |
| 3 Electrical connections, interfaces                      | 4 Magnetic holder with control module |
| 5 Main switch, device fuses, mains connection             | 6 Stirrer arm                         |
| 7 Holder with storage bottle for nitrate rinsing solution |                                       |

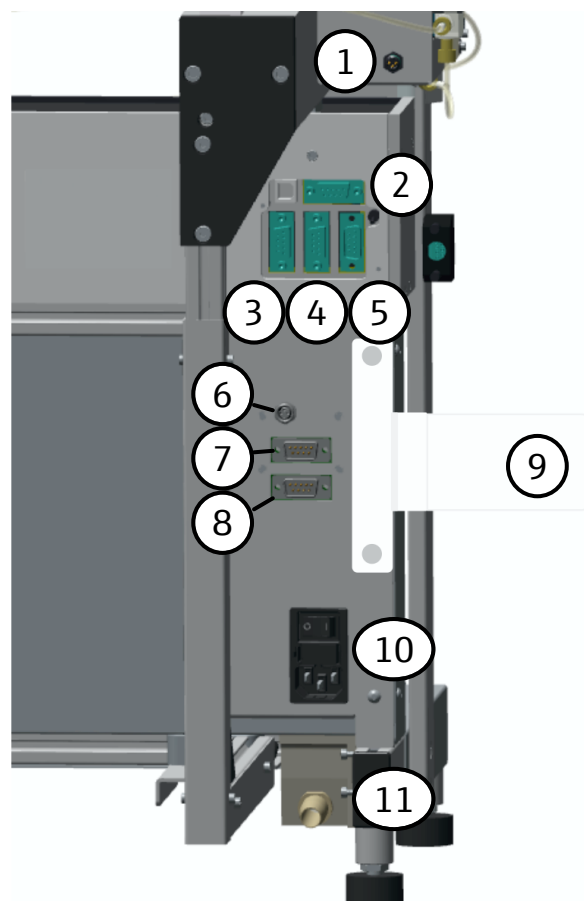
The main switch, the power connection for the detachable power cord and the interfaces are located on the rear of the device.

The nozzle for the waste hose is located on the rear at the bottom right of the basic device. Make sure that the waste hose is connected and runs with a steady slope down to the waste canister.

The magnetic holder for the control unit connect module is mounted on the right side with two hexagon socket screws. The interface cable is long enough for you to detach the control module and place it on the table or hold it in your hand during setup.

#### Interfaces

The interfaces connect the basic device with the control module, the stirrer, the sampler arm as well as the solenoid valves and the pump unit.



**Fig. 12 Connections and interfaces**

- |                                                  |                                                                     |
|--------------------------------------------------|---------------------------------------------------------------------|
| 1 Power supply for solenoid valves and pump unit | 2 Connection socket (not used)                                      |
| 3 "Stirrer" interface (to magnetic stirrer)      | 4 "Aux" interface for controlling the xyz drives of the sampler arm |
| 5 RS 232 interface (not used)                    | 6 Power supply for solenoid valves and pump unit                    |
| 7 "Aux" interface for controlling the xyz drives | 8 Control module interface                                          |
| 9 Magnetic holder for control module             | 10 Main switch, device fuse, mains connection                       |
| 11 Waste hose connection                         |                                                                     |

Type plate

The type plate contains the following information:

- Manufacturer identification
- Model name
- Model number
- Serial number
- Year of manufacture
- Conformity marks

### 3.4 Tube system

The various device components are connected via marked tubes. The circled numbers in the tube diagrams correspond to the markings on the tubes.

To prevent carryover, the device automatically backflushes the tubes and tube connections with rinsing solution at the end of each sample preparation process. The cleaning effect is only guaranteed if original tubes are used.

You can reorder a tube set with all tubes and tube connections and replace the tubes.

Please note that the function of the sample preparation system depends on the tightness of the tube connections. If air enters the pump unit, air bubbles will lead to inaccurate dosing volumes. Vent the tube system:

- after each tube change
- in case of large air bubbles in the tubes
- in case of dosing errors

Tube diagram APU 28/1 S

The double channel system APU 28/1 S has two pump units and valves at its disposal which pump liquid samples and rinsing solution through the system.

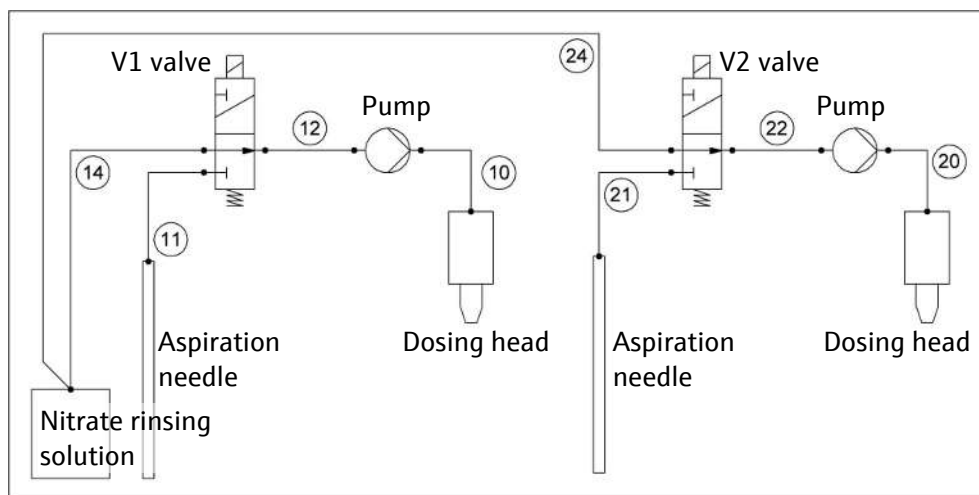


Fig. 13 Tube diagram APU 28/1 S

Tube diagram APU 28/1 SPE

The single channel system APU 28/1 SPE has one pump unit and two valves at its disposal. The pump unit pumps sample, rinsing solution and methanol through the system via the two valves for the more complex SPE-AOX process.

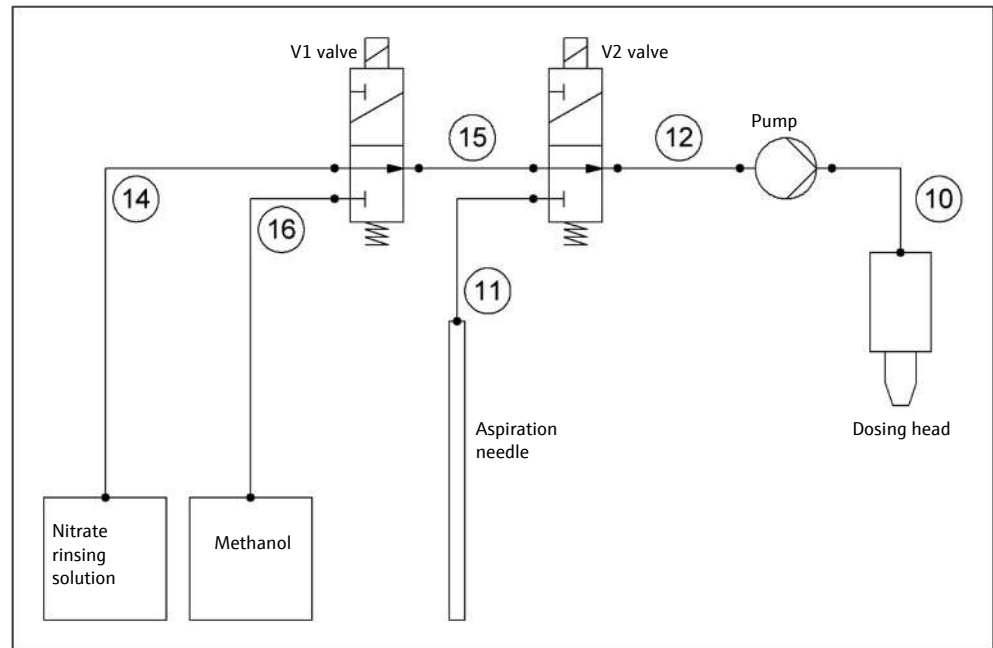


Fig. 14 Tube diagram APU 28/1 SPE

## 4 Installation and commissioning

### 4.1 Ambient conditions and space requirements

#### Climatic conditions

The requirements for the climatic conditions at the installation location are set out in the specifications.

#### Installation location requirements

- This laboratory device is designed for inside use.
- The installation site must be free of drafts, dust and caustic fumes.
- The laboratory atmosphere must be as halogen-free as possible.
- Avoid direct sunlight and radiation from heaters onto the device. If necessary, provide air conditioning.
- Do not locate the device near sources of electromagnetic interference.
- Avoid mechanical shocks and vibrations.
- The device must be positioned in such a way that allows easy access from all sides.

#### Spatial requirements



#### NOTICE

##### Risk of device damage

The sampler arm and stirrer arm move along the XY axis during operation. If objects obstruct the movement, the XY drive may be damaged.

- Keep the entire floor area of the device of 490 x 550 mm free. In particular, ensure that the potential movement range behind the device is unobstructed.

The required space depends on all components that make up the measuring station: sample preparation system, control unit connect module and holder for storage bottles. The spatial requirement amounts to 800 x 650 x 550 mm. Maintain a safe distance to other equipment and walls.

### 4.2 Power supply



#### WARNING

##### Danger due to electrical voltage

- Only connect the device to a properly grounded socket which complies with the voltage indicated on the device's rating plate.
- Do not use an adapter in the feeder.

The device operates on single-phase alternating current.

The installation of the electrical equipment in the laboratory must comply with the DIN VDE 0100 standard. At the connection point, an electrical current in accordance with the standard IEC 60038 must be available.

For more information, see the technical data (→ "Technical data" 56).

## 4.3 Unpacking and setting up the device

The device may only be set up, installed and repaired by the customer service department of Analytik Jena or by persons authorized by Analytik Jena.

When installing and commissioning your device, observe the information in the "Safety instructions" section. Compliance with these safety instructions is a requirement for the error-free installation and the proper functioning of your measuring station. Observe all warnings and instructions that are attached to the device itself or displayed by the control and analysis program.

To ensure trouble-free operation, please make sure that the installation conditions are observed.



---

### NOTICE

#### Risk of pump damage

The pump unit may overheat if it runs dry. The frictional heat can damage the sealing system of the pump.

- Never operate the device without sample and nitrate rinsing solution (and methanol for SPE-AOX).



---

### NOTICE

#### Risk of damage to the sensitive electronics

- Only connect the device and the other components to the power grid when they are switched off.
- Only connect and disconnect electrical connection cables between the system components when the system is switched off.



---

### NOTICE

#### Keep the original packaging

Transport damage can only be avoided if the device is transported in its original packaging.

- Keep the original packaging for transport, e.g., in case the device must be returned to the manufacturer for repair.

---

The sample preparation system is unpacked and assembled by the Analytik Jena customer service or authorized and trained specialist personnel.

Check when unpacking the device for completeness and soundness of the delivery in accordance with the packing list included.

After assembly the customer service tests the sample preparation unit and documents the test.

You can move the device yourself in the laboratory or set it up again after transport and storage. To clean, proceed as follows:

- ▶ Allow the sample preparation system to acclimatize for at least one hour after storage and transport.

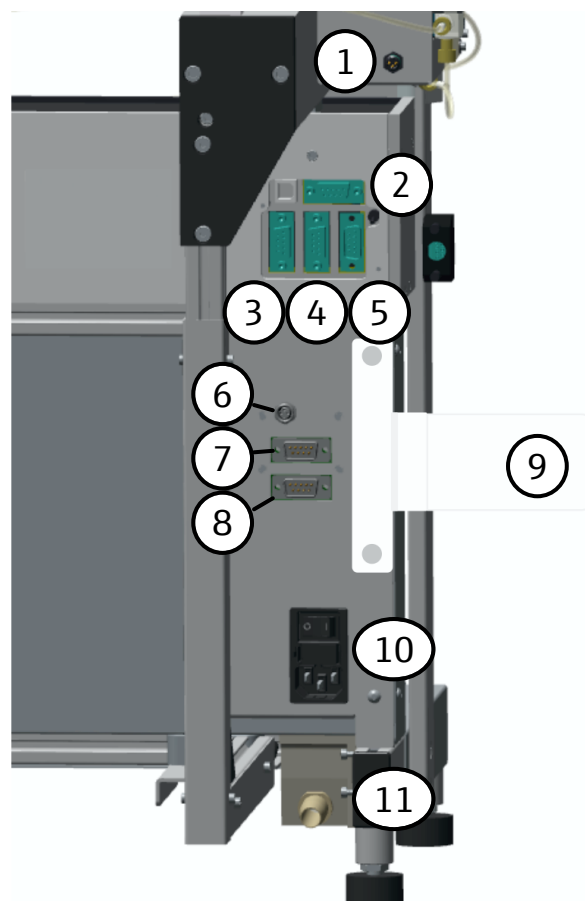


- ▶ Carefully remove the basic device, control module and other accessories from the transport packaging. Retain the transport packaging.
- ▶ Place the sample preparation system in the designated location.
- ▶ Remove the transport lock for the sampler arm. To do so, undo the two hexagon socket screws.



**Fig. 15** Removing the transport lock

- ▶ Mount the holder of the control module control unit connect on the basic device.
- ▶ Level the device using the height-adjustable feet. To do this, use the bubble level (spirit level) provided. This is the only way to ensure that sample residues and rinsing solution can drain safely into the waste canister via the drainage channel in the rack.
- ▶ Place the rack on the base of the device.
- ▶ Connect the control module via the interface cable on the rear of the device.
- ▶ Check whether the other interfaces are connected according to the illustration.
- ▶ Connect the waste hose to the rear of the device.
- ▶ Guide the waste hose into the waste canister with a continuous downward slope. The waste hose must not dip into the liquid in the canister. Shorten waste hose if necessary.
- ▶ Plug the power cable into the connector on the back of the device and connect it to the electrical mains.



**Fig. 16 Connections and interfaces on the rear of the device**

- |                                                  |                                                                     |
|--------------------------------------------------|---------------------------------------------------------------------|
| 1 Power supply for solenoid valves and pump unit | 2 Connection socket (not used)                                      |
| 3 "Stirrer" interface (to magnetic stirrer)      | 4 "Aux" interface for controlling the xyz drives of the sampler arm |
| 5 RS 232 interface (not used)                    | 6 Power supply for solenoid valves and pump unit                    |
| 7 "Aux" interface for controlling the xyz drives | 8 Control module interface                                          |
| 9 Magnetic holder for control module             | 10 Main switch, device fuse, mains connection                       |
| 11 Waste hose connection                         |                                                                     |

- ▶ Hang the holder for the storage bottles on the right side of the device.
- ▶ Fill the storage canister for nitrate rinsing solution and place it in the holder.
- ▶ Immerse tube 14 in the nitrate rinsing solution.
- ▶ Fix the aspiration needle to the holder. Connect tube 11 to the needle via the fingertight connection.

For APU 28 connect SPE :

- ▶ Fill the storage canister for methanol and place it in the holder.
- ▶ Immerse tube 16 in the methanol bottle.

For the APU 28 connect S:

- ▶ Also immerse tube 24 in the nitrate rinsing solution.
- ▶ Fix the second aspiration needle to the holder.
- ▶ Connect tube 11 to the rear needle via the fingertight connection.

- ▶ Connect tube 21 to the front needle via the fingertight connection.
- ▶ Turn on the device.
- ▶ Adjust the sampler arm to the rack.



---

## NOTICE

### Risk of device damage

If the sampler arm is not adjusted or is incorrectly adjusted, the needle may hit the surface of the rack during operation. This may destroy the needle and the drive.

- Calibrate the racks before first use, after each modification, and after transport and storage of the device.
- When using multiple racks, check that you have loaded the correct rack configuration.

- 
- ▶ Flush the tube system so that all tubes are filled free of air bubbles.
  - ▶ If necessary, vent the tube system.
    - ✓ The device is ready for operation.

### See also

- 📖 Venting and rinsing the tube system [▶ 48]
- 📖 Calibrating racks and managing rack configurations [▶ 35]

## 5 Operation

### 5.1 Operating the control module control unit connect


#### Instrument activation

When you switch on the device at the main switch, the control module control unit connect starts automatically.

The sample preparation system initializes, recognizable by the movement of the sampler arm in the X, Y and Z directions. During initialization, the control module displays the start screen with the Analytik Jena logo.



Fig. 17 Start screen

After initialization, the **Setup** page appears on the control module with the last setup used (sample assignment of a rack for a sample preparation) and the menu icon . You can edit and extend the setup. At the first start an empty main menu appears, because no setup has been created yet.

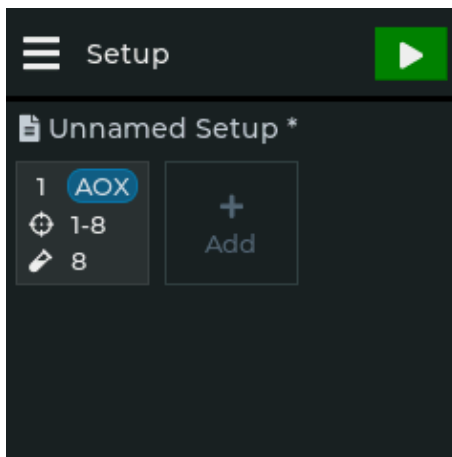
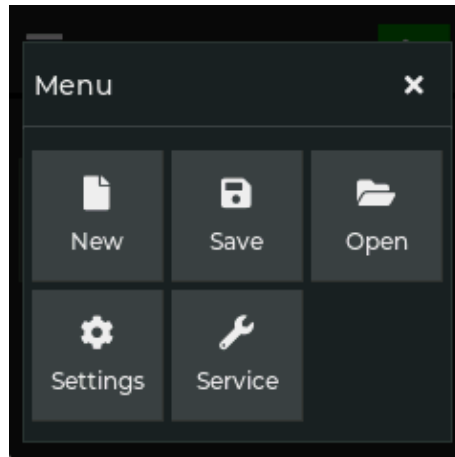


Fig. 18 Setup page with current setup

#### The menu

Tap the menu icon  to open the menu.



**Fig. 19** Menu page

You can access the following functions via the menu:

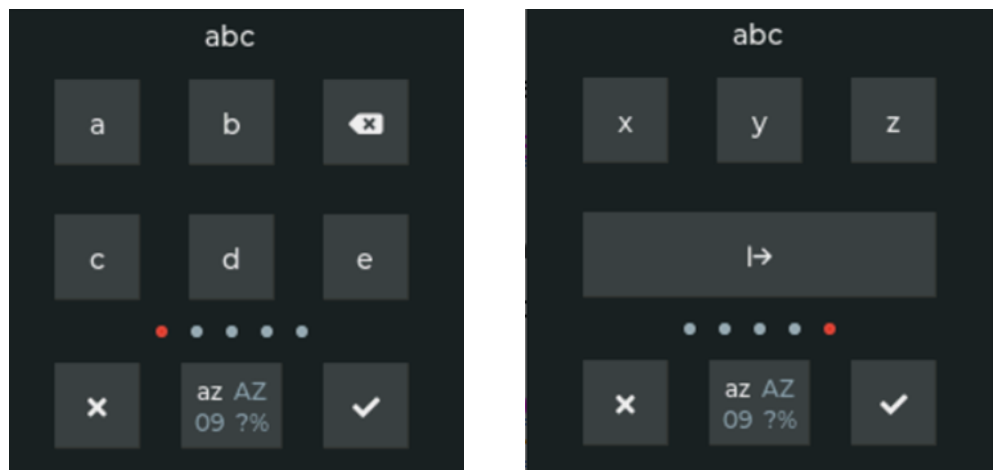
Function	Description
New	Create a new setup for sample preparation
Save	Save a new or revised setup
Open	Load or delete a saved setup
Settings	Change software settings and configure racks
Service	Retrieve system information

Activating a function

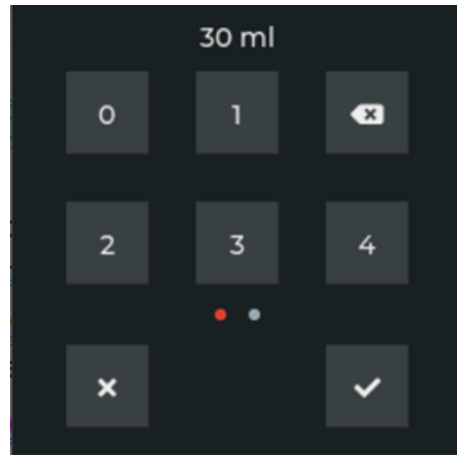
On the touch display, you activate a function by tapping on it. A keyboard is displayed for input fields.

The keyboards

Use the keyboard to enter process parameters for sample preparation and the name of a setup when saving. Alphanumeric and numeric keyboards are available, distributed over several pages.



**Fig. 20** Alphanumeric keyboard with pages (a ... c) and (x ... z)



**Fig. 21** Numeric keyboard with page (0 ... 4)

On the keyboards you will find the following buttons:

Button	Description
	Delete characters to the left of the cursor
	End input without saving, close keyboard
	Save input, close keyboard
	Toggle between the following inputs: <ul style="list-style-type: none"> <li>▪ Lowercase letters (<b>az</b>)</li> <li>▪ Capital letters (<b>AZ</b>)</li> <li>▪ Digits (<b>09</b>)</li> <li>▪ Special characters (<b>?%</b>)</li> </ul> Only available on the alphanumeric keyboard

Scrolling through pages

Some settings and displays, e.g. extensive setups or the selection on the keyboards, are spread over several pages. You can scroll through the pages by swiping from one edge to the other.

- ▶ Swipe left on the display to go to the next page.
- ▶ Swipe right to go to the previous page.

Scrolling through lists and selecting an option

In the software you can select options in lists. Long lists are provided with a scroll bar.

- ▶ Tap the arrow keys on the scroll bar to scroll up and down through the list.
- ▶ To select an option, move it to the center of the list so that it is marked with the gray bar and a red arrow on the right. Tap the option.
  - ✓ The option will be activated.

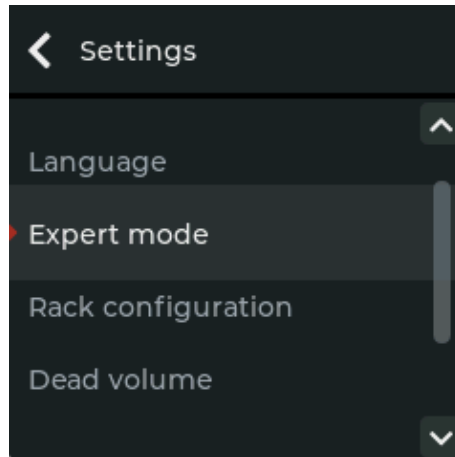






Fig. 22 Selection list with scroll bar

Exiting pages, canceling processes


- ▶ Tapping the icon  on the left of the title bar of a page will return you to a previous page view or the **Setup** page.
- ▶ If you tap on the  icon during a process, e.g. during rack calibration, you can interrupt the running process after a query.

### 5.1.1 Creating a rack setup and managing setups

A setup contains the entire assignment of a sample rack. You can divide the setup into sections. A section contains a group of consecutive sample locations whose samples are prepared with the same operating mode, AOX or SPE, and with the same process parameters. With the APU 28 connect SPE you can, separately in sections, place AOX and SPE samples simultaneously on one rack.

After starting the device during initial commissioning, an empty main menu appears because no setup has been created yet. The last setup used is displayed on the control module at each subsequent start. You can use this setup, edit it for your purposes, or create a new setup. The definition of the process parameters of a section is done in a wizard that guides you through the settings. By default, some parameters are preset, e.g. the pump speed during adsorption. These parameters are not displayed in the default mode. If you want to control all parameters, activate the expert mode in the menu via the command  | **Settings** | **Expert mode** | **enabled**. The additional selectable parameters are marked with the  icon in the wizard.

Creating a new setup via the menu

- ▶ Tap  | **New**.
  - ✓ An empty setup appears.

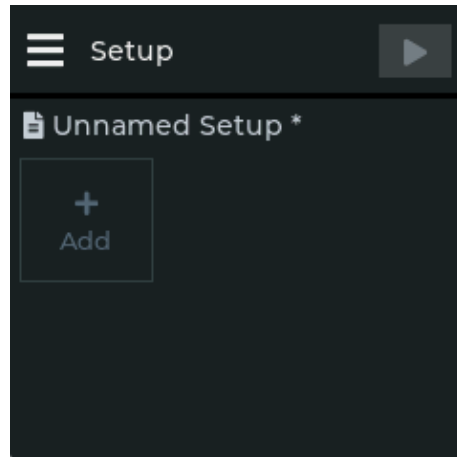


Fig. 23 Empty setup

- ▶ Tap **Add** to setup a new section.
  - ✓ The software opens the wizard **Create Section**. Define the operating mode and process parameters for this section. Create additional sections as needed. When the setup is complete, you can start the sample preparation by tapping on the green arrow .

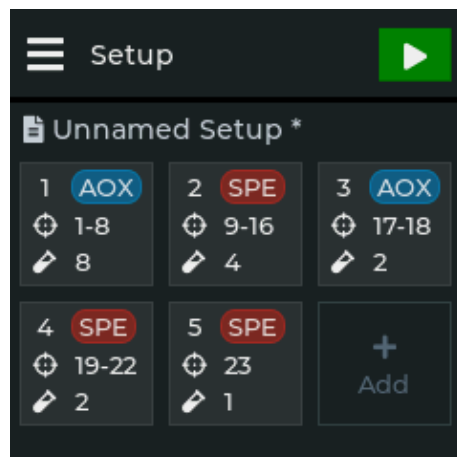


Fig. 24 Setup with multiple sections of AOX and SPE for the APU 28 connect SPE

Creating a section for AOX samples

A setup can contain a maximum of 28 AOX samples. The wizard guides you step by step through the creation of the section. When you have defined a parameter, tap on **Next**. You define the following parameters consecutively for the sample preparation:

- ▶ Tap **Add** in the setup.  
The wizard starts.
- ▶ For the APU 28 connect SPE:
  - Operation mode** select: Tap the option **AOX**.  
The operating mode **AOX** is marked in red.
  - ▶ Define **Start position** with the buttons **+** and **-**.  
If a setup has already been created, only the next free slots are available as start positions. The APU 28 connect S has two aspiration needles and prepares two AOX samples in parallel. The number of the start position in a section is therefore always odd for this device. The APU 28 connect SPE has only one aspiration needle. The number of the start position is not limited here.
  - ▶ Define **Sample count** with the buttons **+** and **-**. The wizard checks how many sample slots are still available and limits the selection.



- ▶ Enter **AOX Sample volume**. Tap the input field and enter the number using the numeric keypad. Tap  to confirm.
- ▶ Enter **AOX Rinse volume** for rinsing the enriched duplex column with nitrate rinsing solution.
- ▶ Tap **Finish**.
  - ✓ The occupied section is displayed in the setup. In the section field you can see the sample type, start and end position on the rack and the number of samples.

Creating a section for SPE-AOX samples

A setup can contain a maximum of 12 SPE-AOX samples. The procedure is similar to entering a section for AOX samples.

- ▶ Tap **Add** in the setup. The wizard starts.
- ▶ Select **Operation mode**: Tap the option **SPE**. The operating mode **SPE** is marked in red.
- ▶ Define **Start position** with the buttons **+** and **-**. 2 sample positions are required for SPE-AOX processing. The number of the start position in a section is therefore always odd.
- ▶ Define **Sample count**. The software checks how many sample slots are still available and limits the selection.
- ▶ Enter **SPE Sample volume** for the enrichment on the SPE column.
- ▶ Enter **Rinse volume** for rinsing the SPE column after sample enrichment with nitrate rinsing solution.
- ▶ Enter **AOX Sample volume** for the enrichment on the duplex column.
- ▶ Enter **AOX Rinse volume** for rinsing the enriched duplex column with rinsing solution.
- ▶ Tap **Finish**.
  - ✓ The occupied section is displayed in the setup. In the section field you can see the sample type, start and end position on the rack and the number of samples displayed.

Process parameter overview



In the expert mode, you can vary further process parameters for which a preset value is used in the standard mode. You can define the following process parameters in the different modes:

Process parameters	Adjustable in mode	Preset value	Adjustable set of values
(AOX) sample volume	Standard	100 ml	For standard mode: 5 ... 120 ml For expert mode: max. 3.0 l
(AOX) rinsing volume	Standard	25 ml	5 to 500 ml
Methanol volume for conditioning the SPE column	Expert	10 ml	0 to 15 ml
SPE rinsing volume after conditioning	Expert	0 ml	0 to 25 ml
Sample volume for enrichment on the SPE column	Standard	100 ml	For standard mode: 5 ... 105 ml For expert mode: max. 3.0 l
SPE rinsing volume after sample enrichment	Standard	25 ml	5 to 500 ml


Process parameters	Adjustable in mode	Preset value	Adjustable set of values
SPE methanol volume for elution	Expert	5 ml	0 to 10ml
SPE rinsing volume after elution	Expert	5 ml	0 to 10ml
Homogenization time	Expert	10 s	0 ... 60 s (10 s steps)
Stirring speed (stage)	Expert	7	1 ... 10
Pump delivery rate	Expert	3 ml/min	1 ... 6 ml/min
Number of backflush cycles	Expert	1	1 ... 10
Backflush volume	No	1 ml	

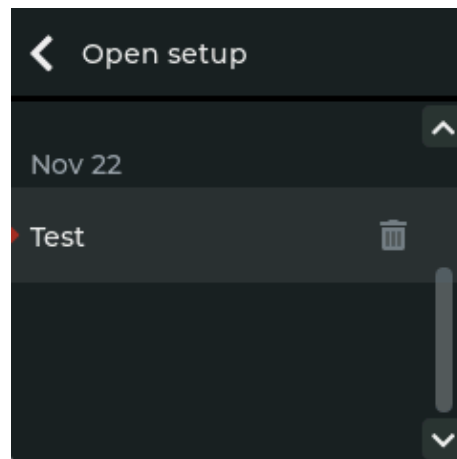
Saving a setup

Save the prepared setup if you want to use it more than once.

- ▶ Select the menu option  | **Save**.
- ▶ Enter **Setup Name:** with the displayed keyboard. The name can contain upper and lower case letters, digits and special characters. The maximum number of characters is 19 characters.
- ▶ Tap on the  icon and save the setup.

Loading or deleting a saved setup



- ▶ Select the menu option  | **Open**.
- ▶ Select the desired setup from the list. The software shows a red arrow next to the selected setup.



**Fig. 25** Open setup page

- ▶ Tap setup again to load it.
  - ✓ The software loads the setup and closes the page.

Delete a setup as follows:

- ▶ Select setup and tap on the  icon.
- ▶ Acknowledge the prompt for deleting the setup with **OK**.
- ▶ Tap on the  arrow in the page title to leave the page.

Editing a setup

You can edit individual sections in a setup and use them as the basis for a new setup.

- ▶ Load the desired setup.
- ▶ Tap a created section and open the parameter display.

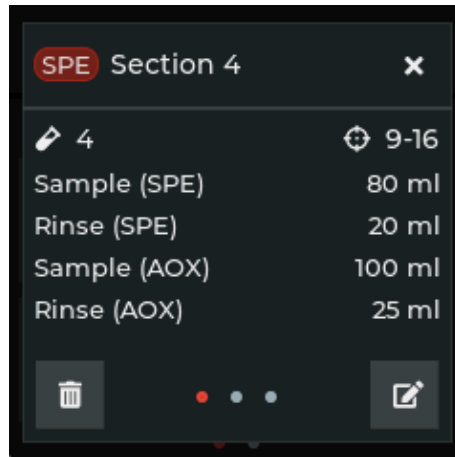







Fig. 26 Section with saved parameters

- ▶ Tap on the  icon and edit the process parameters of the section. You can edit all parameters except the sample type and the start position of the section.
- ▶ To delete the section, tap on the  icon and acknowledge the delete prompt with OK.

If you have deleted a section, you can create a new section on the freed sample slots.




#### See also

-  AOX sample preparation [▶ 40]
-  SPE-AOX sample preparation process [▶ 42]
-  Stopping sample processing and editing a section during operation [▶ 45]

## 5.1.2 Calibrating racks and managing rack configurations

You can work with multiple racks on the device. Each rack must be calibrated before first use, i.e. the movements of the sampler arm must be adjusted to the rack geometry. The offset data determined during calibration is stored as a rack configuration on the control module. You can save the configurations of up to 6 different racks on the control module and load them as needed. If you are working with multiple racks, mark the racks so you don't mix them up. For example, write the number of the rack on the edge with a water-proof pen. You must select a rack for sample processing.

Opening the Rack configuration page

- ▶ Select the menu item  | **Settings**.
- ▶ On the **Settings** page select the option **Rack configuration**.
- ▶ On the **Rack configuration** page the loaded rack has a red background:
  - For a rack with the  icon offset values are already stored. This rack configuration can be selected immediately. The currently selected rack is highlighted in red.
  - For a rack with the  icon no offset values have been stored.

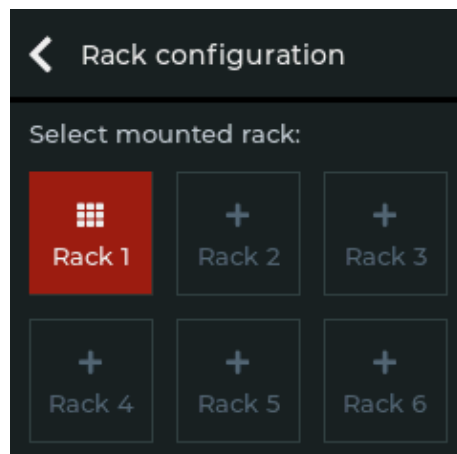



Fig. 27 Rack configuration page

Loading a saved rack configuration

- ▶ On the **Rack configuration** page tap on a configuration with a  icon.
- ▶ Select the **Use** function in the following menu.
  - ✓ On the **Rack configuration** page the activated rack is highlighted in red.

Calibrating a rack

During rack calibration, the movement of the sampler arm is adjusted to the duplex column. The adjustment is made at positions 15 and 16 for the APU 28 connect S two-channel system and at position 15 for the APU 28 connect SPE single-channel system. In addition, the needle of the APU 28 connect SPE is adjusted to the oblong hole of position 20. The needle dips into the oblong holes later during elution. During adjustment, the needle remains above the oblong hole.

When you recalibrate a saved rack, the software overwrites the already saved rack configuration when you start the calibration. The calibration is done in a wizard. When you have adjusted a position correctly, tap on **Next**.





## NOTICE

### Risk of device damage

If the sampler arm is not adjusted or is incorrectly adjusted, the needle may hit the surface of the rack during operation. This may destroy the needle and the drive.

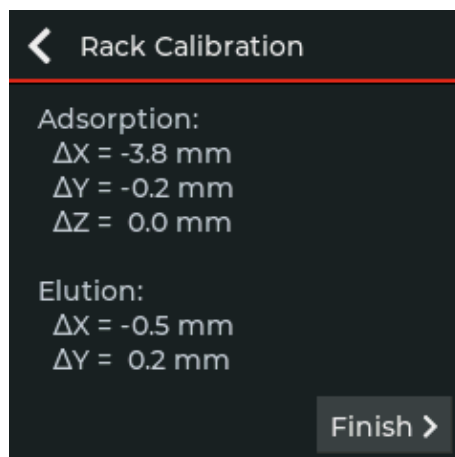
- Calibrate the racks before first use, after each modification, and after transport and storage of the device.
- When using multiple racks, check that you have loaded the correct rack configuration.

- ▶ Place the rack on the device.
- ▶ APU 28 connect S: Place a duplex column on each of positions 15 and 16.
- ▶ APU 28 connect SPE: Place a duplex column on position 15.
- ▶ Open the **Rack configuration** page.
- ▶ Select an already created rack on the **Rack configuration** page and recalibrate it ( icon) or create a new rack ( icon).
- ▶ Tap **Calibrate**. Acknowledge the prompt **OK** to start calibrating.
  - ✓ The sampler arm goes to position 15 and lowers the dosing head over the duplex column.



**Fig. 28 Rack Calibration page**

- ▶ Adjust the dosing head at the **Adsorption X/Y Offset** position using the arrow keys so that it is centered over the duplex column.
  - ✓ The software displays the  $\Delta X$  and  $\Delta Y$  offset values at the bottom of the page.
- ▶ Adjust the immersion depth of the dosing head on the **Adsorption Z Offset** position. Lower the dosing head using the arrow keys until the colored rubber seal is almost completely immersed in the Luer coupling of the duplex column. The  $\Delta Z$  offset value is displayed at the bottom of the page.
- ▶ APU 28 connect SPE: The sampler arm moves the aspiration needle over the oblong hole at position 20. Adjust the position of the needle using the arrow keys in the X and Y directions so that the needle is centered over the oblong hole. The Z direction, i.e. the lowering into the oblong hole, is not adjusted.
  - ✓ The software shows an overview of the calibrated offset values.




**Fig. 29 Offset values overview**

- ▶ Tap **Finish** to complete the calibration.
  - ✓ The sampler arm returns to position 1. The determined offset values are stored in the rack configuration. The rack is selected and gets a red marking.

Deleting a rack configuration

You can delete an unneeded rack configuration on the **Rack configuration** page.

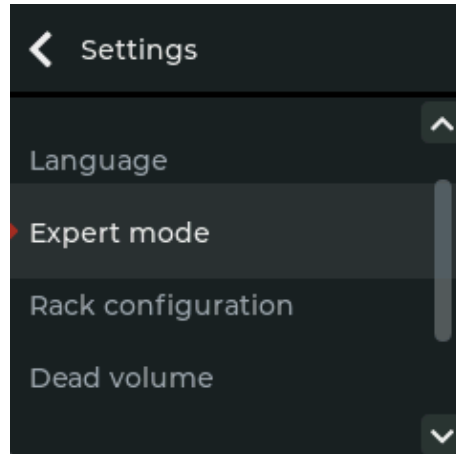
- ▶ Tap on the rack configuration.
- ▶ On the next page, tap the **Delete** function and confirm the prompt to delete the calibration data with **OK**.
  - ✓ On the **Rack configuration** page, the memory location is marked with the  icon and can be occupied with new calibration data.

**See also**

📄 Changing software settings [▶ 38]

**5.1.3 Changing software settings**


▶ Tap the menu icon  and select **Settings** to open the **Settings** page.



**Fig. 30 Settings page**

▶ Use the arrow keys on the scroll bar to navigate in the list and activate the function by tapping on it.


The following functions are available:

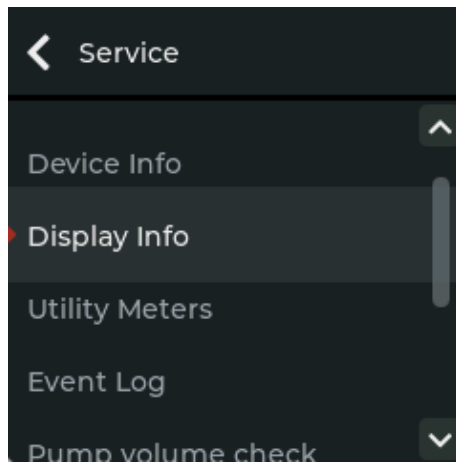
Function	Description
Language	Change language settings You can choose between German and English software interface.
Rack configuration	<ul style="list-style-type: none"> <li>▪ Select saved rack configuration for use</li> <li>▪ Calibrate rack</li> <li>▪ Delete rack configuration</li> </ul> The properties/calibrations of up to 6 racks can be stored on the control unit connect module.
Expert mode	Enable or disable expert mode  <b>disabled</b> In the default setting <b>disabled</b> some sample processing parameters are preset. These settings are suitable for most applications.  <b>enabled</b> In expert mode, you can freely define all sample processing parameters. Additionally selectable parameters are marked with the  icon in the wizard.
Dead volume	Pump tubing volume  The dead volume of the Analytik Jena tube set is 1300 µl. This value is preset upon delivery by Analytik Jena. Change the value only if a newly used tube set contains a different specification.

**See also**

📄 Calibrating racks and managing rack configurations [▶ 35]

### 5.1.4 Retrieving system information

Tap on the menu icon  and call up the service menu with **Service**.



**Fig. 31 Service page**

In the service menu you can view the following system information:

System information	Description
<b>Device Info</b>	View device data: <ul style="list-style-type: none"> <li>▪ Device type</li> <li>▪ Firmware Version</li> </ul>
<b>Display Info</b>	View control unit data: <ul style="list-style-type: none"> <li>▪ Application Version</li> <li>▪ Bootloader Version</li> <li>▪ Display Version</li> <li>▪ Display Serial No.</li> </ul>
<b>Utility Meters</b>	View operating time data: <ul style="list-style-type: none"> <li>▪ Operating hours</li> <li>▪ Number of SPE reprocessing processes</li> <li>▪ Number of AOX reprocessing processes</li> <li>▪ Pump volume (in milliliters)</li> <li>▪ Number of valve operations</li> </ul> After maintenance, the customer service can reset the meter reading.
<b>Event Log</b>	Documentation of events that occurred during the reprocessing process
<b>Pump volume check</b>	Check the correctness of the pump calibration by pumping a defined sample volume
<b>Technical Support</b>	Customer service and application phone number and email address

Have the system information available for communication with customer service in the event of a service call.

## 5.2 Performing a sample enrichment

### 5.2.1 AOX sample preparation



#### CAUTION

##### Risk of injury from moving parts

There is a risk of injury in the movement range of the sampler arm. For example, hands or fingers might be crushed.

- Maintain a safety distance from the sampler during operation.



#### NOTICE

##### Risk of pump damage

The pump unit may overheat if it runs dry. The frictional heat can damage the sealing system of the pump.

- Never operate the device without sample and nitrate rinsing solution (and methanol for SPE-AOX).



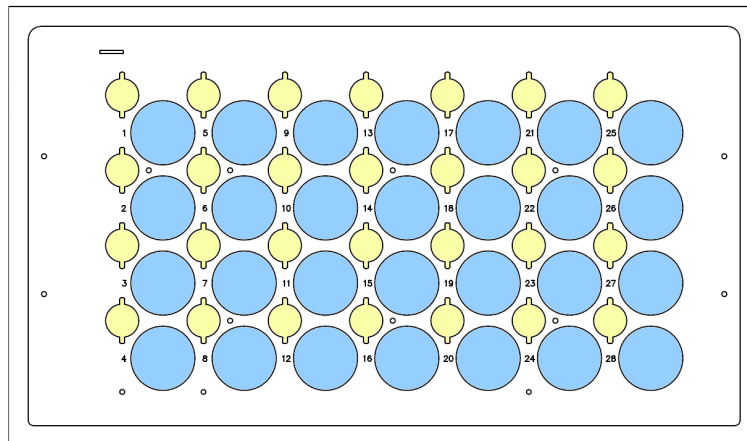
#### NOTICE

##### Risk of waste solution backwater



The waste solution must be able to drain freely into the waste container. The waste hose must not be immersed in the solution, otherwise the liquid may rise back up the hose.

- Connect the waste hose and arrange it with a steady slope down to the waste container. Prevent kinks in the hose.
  - Check the fill level of the waste container each time before starting the device. Empty the waste in time.
- 
- ▶ Before starting the device, check if the waste hose is properly connected and if the capacity of the waste canister is sufficient.
  - ▶ Check whether the storage vessel is filled with nitrate rinsing solution. Refill rinsing solution, if necessary.
  - ▶ Switch on the device via the mains switch on the rear of the device.
  - ▶ Fill the acidified samples into the sample vessels.  
Volume: Sample volume + 20 ml
  - ▶ If you want to stir the samples: Place magnetic stir bars in the sample vessels.
  - ▶ Seal the sample vessels, e.g. using the aluminum foil rounds provided.
  - ▶ Place the sample vessels on the rack. Refer to the placement diagram.








**Fig. 32 Placement diagram for AOX samples**

- ▶ When working with the double channel system APU 28 connect S: For an odd number of samples, place an additional sample vessel with nitrate rinsing solution or with ultrapure water on the rack.  
Example: With 9 samples in position 10 Rinsing solution/Ultrapure water
- i** NOTICE! Always fill the rack to an even number of samples. The pump could otherwise run dry.
- ▶ Load the duplex columns with two quartz containers each. Ensure that the seals are seated correctly.
- ▶ Insert the duplex columns into the rack. Always place columns to the left of the sample vessels.
- ▶ Secure the duplex columns in the rack by rotating them (30°).  
**i** NOTICE! The dosing head could lift an unsecured duplex column out of position.
- ▶ Check via menu item  | **Settings** | **Rack configuration** if the correct rack configuration is loaded. The loaded rack is highlighted in red. If necessary: Load the correct rack configuration.  
**i** NOTICE! If the rack is not calibrated or if the wrong rack configuration is loaded, the drives and needle may be damaged during operation.
- ▶ Load a setup or set it up again.
- ▶ Before the start: Check whether the created setup corresponds to the rack assignment.
- ▶ Start the sample preparation process with .
  - ✓ The device prepares the samples automatically.

#### See also

-  Functionality [▶ 12]
-  Creating a rack setup and managing setups [▶ 31]
-  Calibrating racks and managing rack configurations [▶ 35]

## 5.2.2 SPE-AOX sample preparation process



---

### CAUTION

#### Risk of injury from moving parts

There is a risk of injury in the movement range of the sampler arm. For example, hands or fingers might be crushed.

- Maintain a safety distance from the sampler during operation.
- 



---

### NOTICE

#### Risk of pump damage

The pump unit may overheat if it runs dry. The frictional heat can damage the sealing system of the pump.

- Never operate the device without sample and nitrate rinsing solution (and methanol for SPE-AOX).
- 



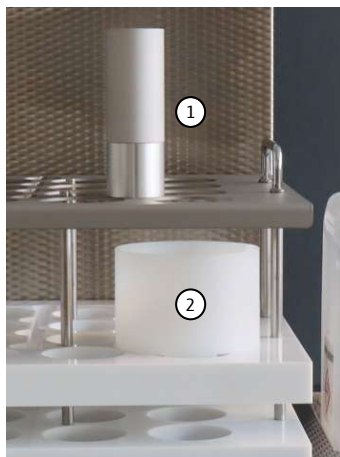
---

### NOTICE

#### Risk of waste solution backwater

The waste solution must be able to drain freely into the waste container. The waste hose must not be immersed in the solution, otherwise the liquid may rise back up the hose.

- Connect the waste hose and arrange it with a steady slope down to the waste container. Prevent kinks in the hose.
  - Check the fill level of the waste container each time before starting the device. Empty the waste in time.
- 
- ▶ Before starting the device, check if the waste hose is properly connected and if the capacity of the waste canister is sufficient.
  - ▶ Check whether the storage vessels are filled with nitrate rinsing solution and methanol. Refill solutions, if necessary.
  - ▶ Switch on the device via the mains switch on the rear of the device.
  - ▶ Place waste container and wiper for SPE columns at position 28.

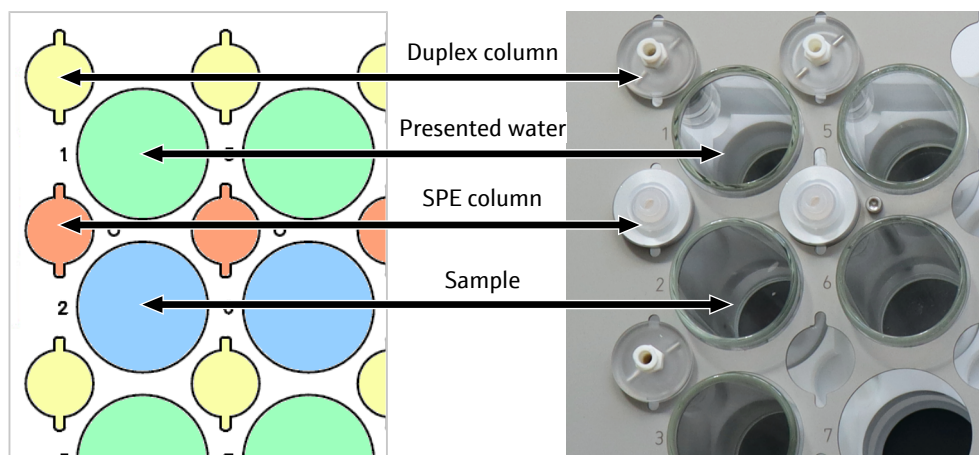


**Fig. 33 Waste container and wiper**

1 Wiper for SPE columns




2 Waste container

- ▶ Fill the acidified samples into the sample vessels.  
Volume: Sample volume 20
- ▶ If you want to stir the samples: Place magnetic stir bars in the sample vessels.
- ▶ Seal the sample vessels, e.g. using the aluminum foil rounds provided.
- ▶ Place the sample vessels on the tray. Refer to the placement diagram. SPE-AOX processing always occupies two sample positions. Place samples on even position numbers.






**Fig. 34 Placement of the tray for the SPE-AOX process**

- ▶ Leave the last row of the tray empty or fill positions 25 and 26 with AOX samples.
- ▶ Place sample vessels with a defined volume of ultrapure water (= presented water) on the odd position numbers.
- ▶ Load the duplex columns with two quartz containers each. Ensure that the seals are seated correctly.
- ▶ Insert the duplex columns into the tray. Always place duplex columns to the left of the vessels containing ultrapure water.
- ▶ Secure the duplex columns in the tray by rotating them (30°).  
**i** NOTICE! The dosing head could lift an unsecured duplex column out of position.
- ▶ Insert the holders for SPE columns into the tray. Place the holders to the left of the samples. Insert the SPE columns into the holders.

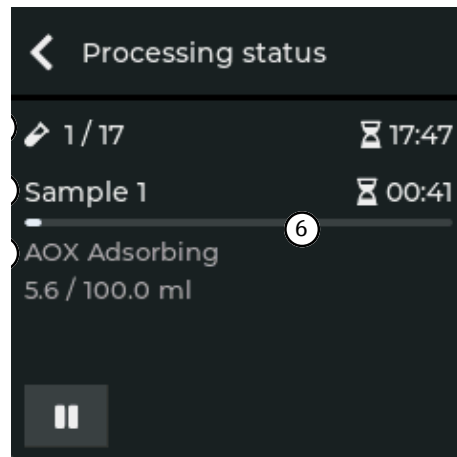
- ▶ Check via menu item  | **Settings | Rack configuration** if the correct rack configuration is loaded. The loaded rack is highlighted in red. If necessary: Load the correct rack configuration.
  -  **NOTICE!** If the rack is not calibrated or if the wrong rack configuration is loaded, the drives and needle may be damaged during operation.
- ▶ Load a setup or set it up again.
- ▶ Before the start: Check whether the created setup corresponds to the rack assignment.
- ▶ Start the sample preparation process with .
  - ✓ The device prepares the samples automatically.

**See also**

-  [Functionality \[▶ 12\]](#)
-  [Creating a rack setup and managing setups \[▶ 31\]](#)
-  [Calibrating racks and managing rack configurations \[▶ 35\]](#)

### 5.2.3 Display during sample enrichment

The **Processing status** page shows the current progress during sample enrichment.



**Fig. 35 Processing status page with display of current sample enrichment**

The **Processing status** page documents all processing steps:

AOX status display	Description
Move to sample	The device moves the sampler arm to the sample.
Stirring	The device stirs the sample.
AOX Adsorbing	The device picks up the sample and simultaneously applies it to the duplex column.
AOX Rinsing	The device rinses the duplex column with rinsing solution.
Reverse rinsing	The device backflushes the tube system and the needle after each sample.
SPE-AOX status display	Description
Move to sample	The device moves the sampler arm to the sample.
SPE Conditioning	The device conditions the SPE column with methanol.


SPE-AOX status display	Description
SPE Rinsing	The device rinses the SPE column with rinsing solution before and after sampling.
SPE Adsorbing	The device applies the sample to the SPE column.
SPE Eluting	The device elutes the adsorbed AOX with methanol from the SPE column.
SPE Rinsing	After elution, the device rinses the SPE column with rinsing solution.
Eject SPE cartridge	The device discards the used SPE column into the discard vessel.
Reverse rinsing	The device backflushes the tube system and the needle after discarding the SPE column.
Move to auxiliary	The device moves the sampler arm to the sample vessel with presented ultrapure water.
Stirring	The device stirs the mixture of ultrapure water, AOX, methanol and rinsing solution.
AOX Adsorbing	The device picks up the mixture and simultaneously applies it to the duplex column.
AOX Rinsing	The device rinses the duplex column with rinsing solution.
Reverse rinsing	The device backflushes the tube system and the needle.

Once a setup has been processed completely, the control unit displays the message that the sample processing was successful.

Acknowledge the message with **OK** and return to the **Setup** page. The device is ready for the next sample preparation process.

## 5.2.4 Stopping sample processing and editing a section during operation

You can stop a running sample process and edit the process parameters or stop the process completely.

- ▶ On the **Processing status** page tap on the  icon to pause a running sample enrichment.
  - ✓ The sampler arm returns to its initial position. The message **Processing paused** appears with the following options:

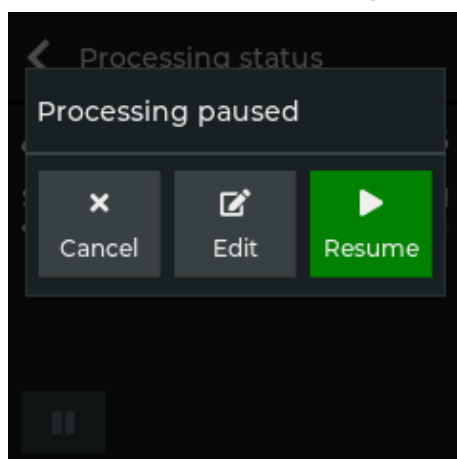



Fig. 36 Message Processing paused

Option	Description
<b>Cancel</b>	Terminate sample preparation
<b>Edit</b>	Change parameter settings You can edit the parameters of the samples/sections that have not yet been processed in the setup.
<b>Resume</b>	Continue the interrupted sample processing. The device continues enrichment of the last processed sample.

Editing a section during operation

During the sample processing pause, you can edit a section or add more sections in the setup.

- ▶ On the **Processing status** page tap on the  icon to pause a running sample enrichment.
  - ✓ The sampler arm returns to its initial position. You can now place more samples on the rack or regroup the samples.
- ▶ Tap **Edit**.
  - ✓ The setup is displayed in which sections or samples that have not yet been processed can be edited. The currently edited section is outlined in yellow. When you edit this section, a yellow hourglass is also displayed.

#### See also

-  [Creating a rack setup and managing setups \[▶ 31\]](#)

## 6 Maintenance and care

### 6.1 Maintenance overview

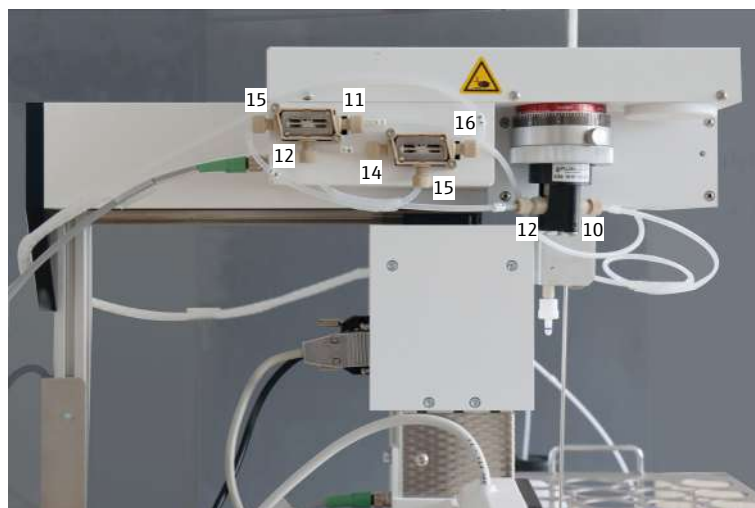
Carry out the following cleaning and maintenance work regularly and each time the device is taken out of service.

Maintenance interval	Maintenance task
Weekly	<ul style="list-style-type: none"> <li>▪ Cleaning the device</li> <li>▪ Rinse sample tray with water</li> </ul>
Monthly	<ul style="list-style-type: none"> <li>▪ Check the tube connections for proper fit and tightness. If necessary, replace tubes</li> </ul>
If necessary	<ul style="list-style-type: none"> <li>▪ Calibrate the racks during initial commissioning, after transport or repair of the device</li> <li>▪ Clean storage vessels for nitrate rinsing solution (and methanol) before each refill</li> <li>▪ Vent the sample preparation system after changing the tubing, in the event of large air bubbles or dosing errors</li> <li>▪ Change damaged aspiration needle</li> <li>▪ Changing the seals on the dosing head</li> <li>▪ Rinse the tube system with ultrapure water</li> </ul>

### 6.2 Replacing tubes

You can order a tube set with all marked tubes and tube connections. Replace tubes when connections leak or when tubes are clogged or worn.

When changing, pay attention to the numbering of the tubes. Observe the tube diagrams for this purpose.



**Fig. 37** Numbered tubes on pump and valves of APU 28 connect S

The tubes with fingertight connectors are attached hand-tight to the pump, valves and the aspiration needle.



**CAUTION**

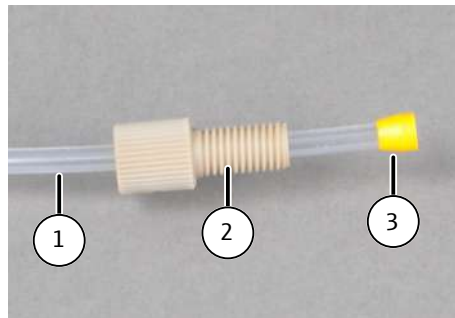
**Acid in tubes**

Residues of the acidic rinsing solution may be found in the tubes.

- Rinse the system with ultrapure water before replacing the tubes.

Fingertight connections

- ▶ When replacing Fingertight connections, only use straight cut, round, uncrimped hose ends.
- ▶ Slide the conical nipple onto the hose with the conical side towards the banjo bolt. The conical nipple and hose end must be flush.
- ▶ Do not jam the banjo bolt during insertion and only tighten it hand-tight.



**Fig. 38 Replacing the Fingertight connection**

- |                  |              |
|------------------|--------------|
| 1 Hose           | 2 Banjo bolt |
| 3 Conical nipple |              |

**See also**

📄 Tube system [▶ 21]

**6.3 Venting and rinsing the tube system**

Vent the tube system:

- after each tube change
- in case of large air bubbles in the tubes
- in case of dosing errors

First vent the tube system by flushing it with ultrapure water. In most cases, air bubbles can be eliminated in this way. Only use the kit for elimination of air if this is not successful.

Venting by flushing with ultrapure water

- ▶ For the single channel system APU 28 connect SPE place four sample vessels with ultrapure water on positions 1 to 4.
- ▶ For the double channel system APU 28 connect S place eight sample vessels with ultrapure water on positions 1 to 8.
- ▶ Provide a vessel, e.g. a large beaker, with ultrapure water as a substitute for the rinsing solution in an elevated position, above the level of the pump. The elevated position reduces the suction pressure.
- ▶ Pull tube 14 out of the storage vessel for the nitrate rinsing solution. Carefully wipe off residues of the acidic solution with a cloth. Immerse the tube in the vessel containing ultrapure water.



- ▶ Proceed in the same way with the two-channel system with tube 24.
- ▶ Switch on the device and control module and create an AOX sequence with sample volumes of 5 ml and rinsing volumes of 100 ml.
- ▶ Make sure that there is sufficient ultrapure water in the vessel: 500 to 1000 ml for single and double channel systems respectively.
- ▶ Start processing the sequence.
- ▶ If necessary, move air bubbles in the tubes in the direction of the dosing head and aspiration needle by tapping lightly.

Venting with the kit for elimination of air

The scope of delivery includes a kit for elimination of air with adapter, silicone tube (approx. 10 cm) and plastic syringe.



## NOTICE

### Risk of pump damage

Excessive negative pressure can destroy the sealing system of the pump unit.

- Only use the Analytik Jena kit for elimination of air and work according to the regulation.



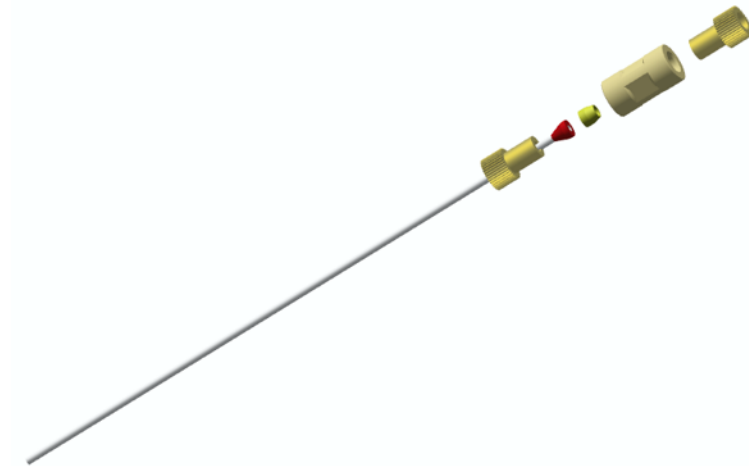
**Fig. 39** Kit for elimination of air on position 1

- ▶ Place a sample vessel with ultrapure water on position 1.
- ▶ For the double channel system APU 28 connect S place two sample vessels with ultrapure water on positions 1 and 2.

- ▶ Screw on the venting adapter. Attach the adapter to the left of position 1 instead of a duplex column on the tray. Attach the silicone tube to the bottom of the adapter.
- ▶ Provide a vessel, e.g. a large beaker, with ultrapure water as a substitute for the rinsing solution in an elevated position.
- ▶ Pull tube 14 out of the storage vessel for the nitrate rinsing solution. Carefully wipe off residues of the acidic solution with a cloth. Immerse the tube in the vessel containing ultrapure water.
- ▶ Proceed in the same way with the two-channel system with tube 24.
- ▶ Switch on the device and control module and create an AOX sample with a sample volume of 5 ml and rinsing volume of 100 ml.
- ▶ Make sure that there is sufficient ultrapure water in the vessel.
- ▶ Start processing the sequence.
- ▶ Once the device has moved to position 1, connect the plastic syringe to the silicone tube.
- ▶ During the entire dosing process for the 5 ml sample create a light subpressure with the syringe to remove air bubbles from the tubing.
- ▶ End the process when the valve switches to the rinsing solution. Remove syringe. Guide the silicone tube downwards so that the rinsing solution can run off via the drainage channel in the tray.
- ▶ Wait for the tube to be rinsed.
- ▶ For the double channel system, repeat the whole procedure on position 2.

## 6.4 Change aspiration needle

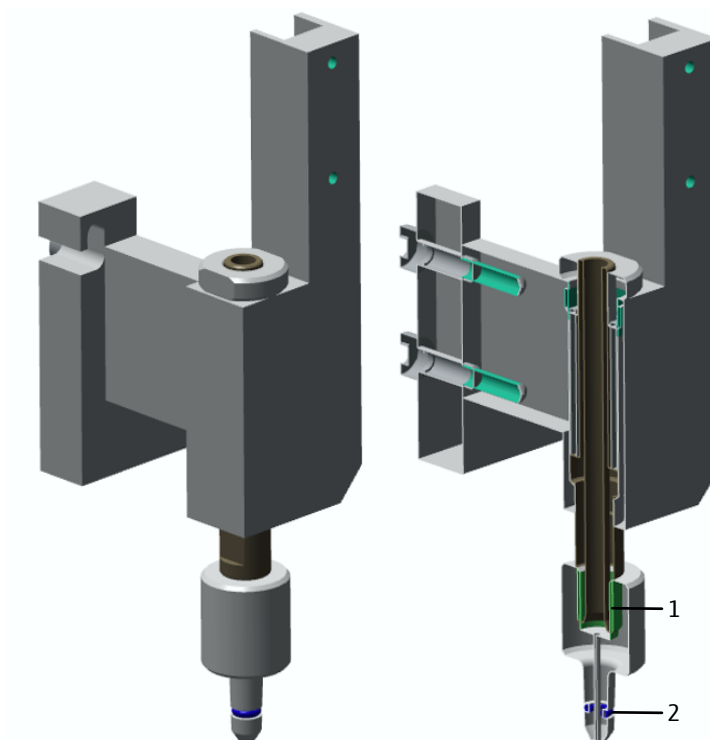
Change the aspiration needle if the needle is corroded, severely bent or leaking.



**Fig. 40** Aspiration needle, disassembled

- ▶ Insert the conical sealing cones as shown in the illustration.
- ▶ Screw the fingertight connectors on handtight.

## 6.5 Changing the seals on the dosing head



**Fig. 41 Dosing head (with cross-section)**

1 Sealing cone


2 Sealing ring

Change the sealing ring on the dosing head if the dosing head no longer seals tightly with the column during dosing.

Change the sealing cone in the dosing head if the dosing head drips.

## 6.6 Check dosage

Check the dosage once a month by weighing a sample amount.

- ▶ Fill a sample vessel with ultrapure water and determine the weight.
- ▶ Place the sample vessel on position 1 of the rack.  
APU 28 connect S: Place filled sample vessels in positions 1 and 2.
- ▶ Select the menu item  | **Service** | **Pump volume check**.
- ▶ Enter the dosage, 100 ml for example in the **Test volume** field and tap **Next** .
- ▶ After the end of the test, determine the weight of the sample vessel again and check the correctness of the sample quantity.

If the dosage is incorrect, check the tubes for air bubbles and bleed the tube system.

## 7 Transport and storage

### 7.1 Transport

When transporting the device, observe the safety instructions in the "Safety instructions" section.

Avoid the following during transport:

- Impact and vibration  
Risk of damage due to shock, impact or vibration!
- Large temperature fluctuations  
Risk of condensation!

### 7.2 Preparing the device for transport




---

#### WARNING

##### Risk of damage to health due to improper decontamination

- Decontaminate the device professionally and document the cleaning measures before returning the device to Analytik Jena.
  - The customer service department will send you the decontamination report when you register the return.
- 




---

#### NOTICE

##### Risk of device damage due to unsuitable packaging material

- Only transport the device and its components in the original packaging.
  - Empty the device completely and attach all transport locks before transporting the device.
  - Add a suitable desiccant to the packaging to prevent damage from moisture.
- 
- ▶ Backwash the tube system with ultrapure water.
  - ▶ Switch off the power of the device using the mains switch on the back. Disconnect the mains plug from the mains socket and from the connection on the device.
  - ▶ Disconnect the interface cable to the control unit.
  - ▶ Remove the glass sample vessels from the rack. Empty the vessels and pack them in a shatterproof manner.
  - ▶ If available: Remove duplex column holders and SPE columns with inserts from the rack.
  - ▶ For APU 28/1 SPE: Remove the waste container and wiper from the rack. Discard the used SPE columns.
  - ▶ Tilt the rack slightly so that solution residues can drain off via the drainage channel.
  - ▶ Pull the tubes out of the storage bottles. Wipe off the tubes with a clean paper towel.
    - ⚠ CAUTION! The tubes contain acidic rinsing solution and methanol residues.

- ▶ Disconnect the aspiration needle(s) from the tubes. Remove the needles from the holders. Put the needles in their packaging.
  - i** NOTICE! The needles can bend easily.
- ▶ Pack open tube ends in protective bags and attach them to the device, e.g., with adhesive tape.
- ▶ Remove the storage bottles from the holder and empty them.
- ▶ Remove the bottle holder from the device.
- ▶ Disconnect the waste hose from the back of the device. Empty the waste canister.
- ▶ Attach the transport lock for the sampler arm to the basic device using the two hexagon socket screws.
- ▶ Pack the device and accessories in their original packaging.
  - ✓ The device is ready for transport.



Fig. 42 Attaching the transport lock

See also

- ▣ Venting and rinsing the tube system [▶ 48]

## 7.3 Moving the device in the laboratory



### CAUTION

#### Risk of injury during transport

Dropping the device poses a risk of injury and damage to the device.

- Proceed carefully when moving and transporting the device. Two persons are required to lift and carry the device.
- Grip the device firmly at the bottom with both hands and lift it simultaneously.

Observe the following when moving the device within the laboratory:

- Insufficiently secured components pose a risk of injury!  
Before moving the device, remove all loose parts and disconnect all connections from the device.
- For safety reasons, two persons are required to transport the device, one person on each side of the device.
- As the device does not have carrying handles, grip the device firmly with both hands at the lower end. Lift the device simultaneously.

- Observe the guide values and adhere to the legally mandated limits for lifting and carrying loads without auxiliary means.
- Observe the installation conditions at the new location.

## 7.4 Storage



---

### NOTICE

#### **Risk of device damage due to environmental conditions**

Environmental influences and condensation can destroy individual components of the device.

- Only store the device in air-conditioned rooms.
- Ensure that the atmosphere is free of dust and corrosive vapors.

---

If the device is not installed immediately after delivery or not required for longer periods, it should be stored in its original packaging. A suitable desiccant should be added to the equipment to prevent damage from moisture.

The requirements for the climatic conditions of the storage location can be found in the specifications.

## 8 Disposal

Waste water is produced during operation. Depending on the measuring mode, the waste water contains methanol (SPE-AOX only), sodium nitrate, nitric acid and sample. Dispose of the neutralized waste in accordance with the legal requirements.

At the end of its service life, the device and its electronic components must be disposed of as electronic waste in accordance with the applicable regulations.

## 9 Specifications

### 9.1 Technical data

General characteristics	Model name/type	<ul style="list-style-type: none"> <li>▪ APU 28/1 S Double channel system for AOX sample preparation</li> <li>▪ APU 28/1 SPE Single channel system for AOX + SPE-AOX sample preparation</li> </ul>
	Dimensions (W x H x D)	
	<ul style="list-style-type: none"> <li>▪ Device</li> </ul>	490 x 650 x 550 mm
	<ul style="list-style-type: none"> <li>▪ Device with control module and bottle holder</li> </ul>	800 x 650 x 550 mm
	<ul style="list-style-type: none"> <li>▪ Control module</li> </ul>	Control unit connect 105 x 115 x 55 mm
	<ul style="list-style-type: none"> <li>▪ Display (W x H)</li> </ul>	45 x 45 mm
	Mass	ca. 17 kg
Methods data	Number of samples AOX	28
	Number of samples SPE-AOX	12
	Sample volume	1 to 105 ml
	Rinsing volume	1 to 100 ml
	Particle handling capacity	<100 µm
	Quartz container dimensions	
	<ul style="list-style-type: none"> <li>▪ Rack for AJ AOX columns for APU 28 series</li> </ul>	<ul style="list-style-type: none"> <li>▪ 18 x 6 mm</li> </ul>
	<ul style="list-style-type: none"> <li>▪ Rack column flexibility for APU 28 series</li> </ul>	<ul style="list-style-type: none"> <li>▪ 40 x 9 mm + 47 x 6 mm</li> </ul>
	Stirring function	For current sample
	Max. sample vessel volume	120 ml
Electrical variables	Operating voltage	100 to 240 V AC ± 10 %
	Frequency	50/60 Hz
	Fuses	T 3.15 A H Use only original fuses from Analytik Jena!
	Typical average power consumption	50 VA
	Control module interface	RS 232
	Ambient conditions	Temperature during operation
Humidity during operation		≤ 90 % (+30 °C)
Altitude during operation		≤ 2000 m
Air pressure		0.7 to 1.06 bar
Temperature and humidity during storage		+5 to +55 °C, 10 to 30 %, use desiccant



## 9.2 Standards and directives

Protection class and protection type	The device is protection class I. The housing is protection type IP 20.
Device safety	<p>The device complies with the following safety standards</p> <ul style="list-style-type: none"> <li>▪ EN 61010-1</li> <li>▪ EN 61010-2-081</li> </ul>
EMC compatibility	<p>The device has been checked for transient emissions and noise immunity.</p> <p>It meets the requirements for transient emissions according to</p> <ul style="list-style-type: none"> <li>▪ EN 61326-1 (EN 55011 group 1, class B)</li> </ul> <p>The device meets the requirements for noise immunity according to</p> <ul style="list-style-type: none"> <li>▪ EN 61326-1 (requirements for use in a basic environment)</li> </ul>
Environmental and ambient influences	<p>This device has been tested in environmental simulations under operation and transport conditions and is in accordance with the requirements in:</p> <ul style="list-style-type: none"> <li>▪ EN 60068</li> </ul>
EU directives	<p>The device meets the requirements of the directive 2011/65/EU.</p> <p>The device is designed and tested in accordance with standards meeting the requirements of EU directives 2014/35/EU and 2014/30/EU. The device leaves the factory in a sound condition with regard to technical safety. To maintain this condition and to ensure safe operation, the user must strictly observe the safety and operating instructions contained in this operating manual. For accessories delivered with the device and system components from other manufacturers, the information provided in their respective operating manuals has priority.</p>
Guidelines for China	<p>The device contains substances subject to regulation (according to the directive GB/T 26572-2011). Analytik Jena guarantees that, if the device is used as intended, these substances will not leak within the next 25 years and therefore will not pose a threat to the environment or health within this time period.</p>

## List of figures

Fig. 1	Placement diagram for AOX samples .....	12
Fig. 2	Arrangement of sample vessels and duplex columns.....	12
Fig. 3	AOX adsorption diagram .....	13
Fig. 4	Placement diagram for SPE-AOX samples .....	14
Fig. 5	Arrangement of sample vessels and columns.....	14
Fig. 6	Diagram of the SPE-AOX method.....	15
Fig. 7	Single-channel system APU 28 connect SPE comprising basic device APU 28/1 SPE and control module...	16
Fig. 8	Double channel system APU 28/1 S with 2 dosing heads and needles .....	17
Fig. 9	Discarding SPE columns.....	17
Fig. 10	Column flexibility rack for alternative columns.....	18
Fig. 11	Rear of the device .....	19
Fig. 12	Connections and interfaces .....	20
Fig. 13	Tube diagram APU 28/1 S.....	21
Fig. 14	Tube diagram APU 28/1 SPE.....	22
Fig. 15	Removing the transport lock .....	25
Fig. 16	Connections and interfaces on the rear of the device.....	26
Fig. 17	Start screen.....	28
Fig. 18	Setup page with current setup .....	28
Fig. 19	Menu page .....	29
Fig. 20	Alphanumeric keyboard with pages (a ... c) and (x ... z) .....	29
Fig. 21	Numeric keyboard with page (0 ... 4) .....	30
Fig. 22	Selection list with scroll bar.....	31
Fig. 23	Empty setup.....	32
Fig. 24	Setup with multiple sections of AOX and SPE for the APU 28 connect SPE.....	32
Fig. 25	Open setup page .....	34
Fig. 26	Section with saved parameters .....	35
Fig. 27	Rack configuration page .....	36
Fig. 28	Rack Calibration page .....	37
Fig. 29	Offset values overview .....	37
Fig. 30	Settings page .....	38
Fig. 31	Service page.....	39
Fig. 32	Placement diagram for AOX samples .....	41
Fig. 33	Waste container and wiper .....	43
Fig. 34	Placement of the tray for the SPE-AOX process.....	43
Fig. 35	Processing status page with display of current sample enrichment .....	44
Fig. 36	Message Processing paused .....	45
Fig. 37	Numbered tubes on pump and valves of APU 28 connect S .....	47
Fig. 38	Replacing the Fingertight connection.....	48
Fig. 39	Kit for elimination of air on position 1 .....	49

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Fig. 40	Aspiration needle, disassembled.....	50
Fig. 41	Dosing head (with cross-section).....	51
Fig. 42	Attaching the transport lock.....	53