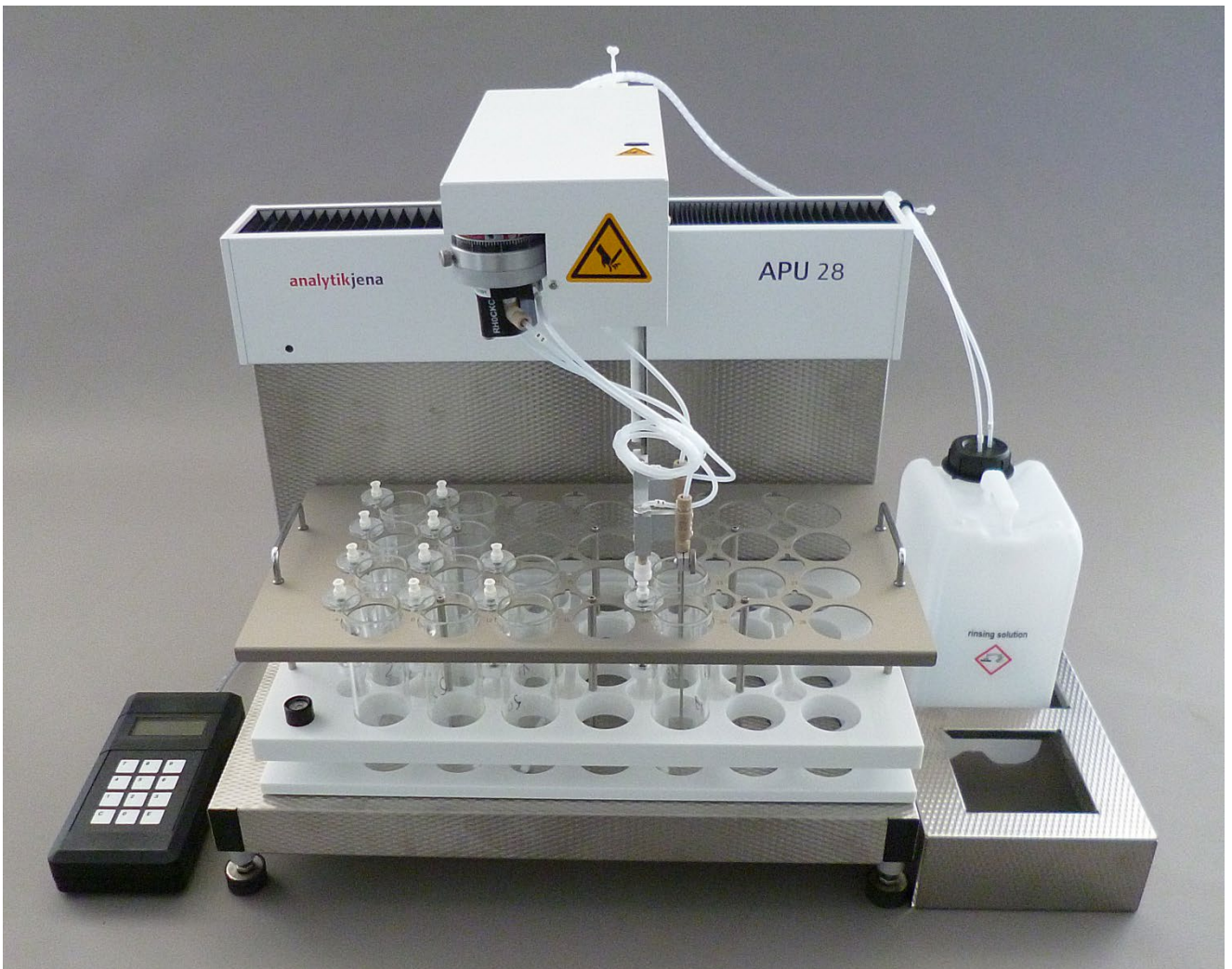


# Operating instructions

## Sample Preparation Systems of the APU 28 Series



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# 1 Basic information

## 1.1 User manual notes

User manual	The user manual provides the required know-how for the safe handling of the sample preparation system and its components. The user manual further includes instructions for maintaining and servicing the sample preparation system and potential causes and remedies of any faults.
Requirements to be met by the user	The sample preparation system must only be operated by <b>qualified</b> specialist personnel instructed in preparing samples. The instruction must also include conveying the content of this user manual and the user manuals of other system components or add-on equipment.
Conventions	<p><b>Instructions for actions</b> which occur in chronological order are numbered and combined in action units.</p> <p><b>Warnings</b> are indicated by warning triangles and a signal word. The type, source and consequences of the danger are stated together with notes on preventing the danger.</p> <p>The elements of the control and analysis program are indicated as follows:</p> <ul style="list-style-type: none"> <li>▪ Program terms are indicated by small caps (e.g., FILE menu).</li> <li>▪ Buttons are depicted as follows (e.g. &lt;1&gt;)</li> </ul>
Symbols and signal words used	The user manual uses the following symbols and signal words to indicate hazards or instructions. The warnings are always placed before an action.




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### WARNING

Indicates a potentially hazardous situation which might cause death or very serious injuries (deformities).

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### CAUTION

Indicates a potentially hazardous situation which might cause light or minor injuries.

---




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### ATTENTION

Provides information on potential material or environmental damage.

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## 1.2 Intended use

The sample preparation systems APU 28, APU 28 S and APU 28 SPE must only be used for the sample preparation methods described in this user manual.

Any other use is not as intended!

Only the operator is liable for any damages that result from this.

Operational safety can only be guaranteed if the device is used in accordance with the information in this user manual.

The intended use also includes the adherence to the installation conditions prescribed by Analytik Jena AG which are available from the customer service address stated above.

### 1.2.1 Purpose

The APU 28 series consists of 6 sample preparation systems – 3 standard systems conceived for working with AOX columns produced by Analytik Jena AG (APU 28, APU 28 S and APU 28 SPE) and 3 flexible systems (APU 28 flexi, APU 28 S flexi and APU 28 SPE flexi) which are conceived for the use of alternative AOX columns (40 x 9 mm or 47 x 6 mm).

Operation, maintenance and servicing of the flexi systems do not differ from the corresponding standard systems. Therefore, the following document does not contain separate information for these systems.

Standard systems are not suitable to be used with alternative AOX tubes while flexi systems are not suitable to be used with Analytik Jena columns. If required, the systems can be upgraded with a suitable auxiliary tray.

#### APU 28

The sample preparation system APU 28 is a fully automated **single** channel system for preparing samples for the AOX determination according to the column method defined in ISO 9562.

The individual samples are processed in sequential order.

#### APU 28 S

The sample preparation system APU 28 S is a fully automated **double** channel system for preparing samples for the AOX determination according to the column method defined in ISO 9562.

Two samples are processed simultaneously in one step.

Compared to the APU 28 system, this translates into twice the sample throughput.

#### APU 28 SPE

The sample preparation system APU 28 SPE is a fully automated **single** channel system for preparing samples for the **SPE-AOX** determination and the AOX determination in accordance with ISO 9562.

The individual samples are processed in sequential order.



## 1.3 Warranty and liability

The warranty duration and liability comply with the legal requirements and the provisions in the general terms and conditions of Analytik Jena AG.

Deviations from the intended use described in this user manual result in limitations of warranty and liability in the event of a damage. Damage to wearing parts is not included in the warranty.

Warranty and liability claims are excluded for personal injury and property damage due to one or several of the following causes:

- use of sample preparation systems other than intended
- improper commissioning, operation and servicing
- modifications without prior consultation with Analytik Jena AG
- unauthorized intervention
- operation of the sample preparation system with faulty safety equipment or improperly fitted safety and protection equipment
- inadequate monitoring of the equipment components subject to wear
- use of other than original spare parts, wearing parts or consumables
- improper repairs
- faults due to the non-observance of this user manual

## 1.4 Product identification

Type plate

The type plate contains the following information on the sample preparation system:

- Manufacturer identification
- Model name
- Model number
- Serial number
- Year of manufacture
- Information on conformity

## 2 Safety instructions

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

Comply with all safety instructions contained in this user manual and pay careful attention to all messages and notes which are displayed on the display of the control unit.

### 2.1 Safety markings

Safety symbols have been attached to the sample preparation system and accessories whose content must always be observed.

Damaged or missing safety symbols can cause incorrect actions leading to personal injury or material damage! The safety symbols must not be removed! Damaged safety symbols must be replaced without delay!

The following safety symbols are attached to the sample preparation system and its accessories:

Warning symbol



Warning of electric voltage



Warning of hand injuries



Warning against corrosive substances



Warning of cuts



Warning of hand injuries in gear drive

Mandatory sign



Unplug power cord



Follow instructions

The reservoir for sodium nitrate rinse solution with nitric acidity (pH ≈ 2) and the waste container are marked with the hazard pictogram for corrosive substances:

GHS pictogram



Warning against corrosive substances

GHS pictogram

The storage bottle for methanol is marked with the following warning symbols:



Highly flammable



Toxic



Health hazard

The device contains regulated substances (according to the directive "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products"). Analytik Jena AG guarantees that the substances will not leak within the next 25 years and, therefore, will not cause any environmental danger or health risk within this period of time if the device is used as intended.

EFUP pictogram



China RoHS label

## 2.2 Technical condition

Design and construction of the sample preparation unit correspond to the current generally accepted rules of technology. Unauthorized modifications or changes, especially such that affect the safety of the staff and the environment, are generally not allowed.

The following has to be observed:

- Any manipulation of the safety equipment is prohibited! In case of an accident manipulations of the safety equipment will be interpreted as deliberate!
- The sample preparation unit must only be operated in sound and operationally safe condition. The technical condition must always comply with the legal requirements and regulations.
- Prior to every use, the sample preparation unit must be checked for damage and sound condition.
- Any changes to the sample preparation system affecting its safety must be reported by the operating personnel to the operator without delay.
- The equipment components must only be connected to supply cables intended and designed for this purpose.
- All safety equipment and interlocks must be well accessible and regularly checked for proper operation.

## 2.3 Requirements for the operating personnel

The APU 28 must only be operated by qualified specialist personnel instructed in preparing samples. The instruction must also include conveying the content of this user manual and the user manuals of other system components or add-on equipment.

When used by untrained personnel or in an improper manner or for improper use, the sample preparation unit can pose a risk.

Therefore, every person tasked with the operation of the sample preparation unit must have read and understood this user manual and the user manuals of any additional equipment before carrying out the respective tasks. This also applies if the respective person has already worked with or been trained on this kind of sample preparation unit.

It is recommended that the operator have the operating personnel confirm the knowledge of the content of the user manual in writing. The ultimate responsibility for the accident-free operation of the sample preparation unit rests with the operator or the specialist personnel authorized by him.

In addition to the safety at work instructions in this user manual the generally applicable safety and accident prevention regulations of the respective country of operation must be observed and adhered to. The operator must ascertain the latest version of these regulations.

The user manual must be accessible to the operating and service personnel at any time!

The following has to be observed:

- The sample preparation unit must only be commissioned, operated and serviced by trained personnel instructed in technical safety.
- The operation or servicing of the sample preparation unit by minors or individuals under the influence of alcohol, drugs or medication is not permitted.
- It must be ensured that only authorized personnel works with the sample preparation unit.
- The operating personnel must be familiar with the dangers arising from measuring liquids. The appropriate protective equipment must be used.
- Prior to pauses or at the end of the work appropriate skin cleaning and protection measures must be carried out.
- Eating, drinking, smoking or handling open flames is prohibited in the operating room of the sample preparation unit!

## 2.4 Safety instructions, transport and installation

The APU 28 is always installed by the customer service department of Analytik Jena AG or its authorized and trained specialist personnel.

Unauthorized assembly and installation are not permitted. Incorrect installation can create serious hazards.

The following has to be observed:

- When placing the device on the laboratory desk consider the movement range of the arm during operation. Ensure that the whole potential movement range behind the device is unobstructed.
- Insufficiently secured components pose a risk of injury!
- During transport the components of the equipment must be secured in accordance with the instructions in the user manual.
- Only transport the sample preparation unit in its original packaging!  
Ensure that all transport locks and safety devices have been fitted and that the sample preparation unit is completely empty.
- To prevent health damage the following must be observed when moving the sample preparation unit in the laboratory (lifting and carrying):

For safety reasons, two persons are required to transport the sample preparation unit who must hold the unit by either side of the equipment.

Because the sample preparation unit does not have carrying handles, hold the device firmly with both hands by its lower end.

The guide values and statutory limits for lifting and carrying loads without auxiliary equipment must be observed and adhered to.

## 2.5 Safety instructions - operation

### 2.5.1 General

Before starting the sample preparation unit, the operator must verify the proper condition of the sample preparation unit including its safety equipment. This is particularly important each time the sample preparation system was amended, upgraded or repaired.

The following has to be observed:

- The sample preparation unit must only be operated if all protective equipment (e.g. covers, drip pans for chemicals) 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.
- Caution near the movement range of the arm guiding the cannula! Accident risk during operation!
- Free access to the power switch on the back of the enclosure and to the mains power cord has to be ensured during operation.

### 2.5.2 Safety instructions - Protection against explosion and fire

The sample preparation unit must not be operated in an explosive environment. Smoking or handling open flames is prohibited in the room in which the sample preparation unit is operated!

The operating personnel must be familiar with the location of the fire-fighting equipment in the operating room of the sample preparation unit.

### 2.5.3 Safety instructions - electrical equipment

Work on electrical components of the sample preparation unit may only be carried out by a qualified electrician in accordance with the applicable electrical engineering rules.

The following has to be observed:

- The sample preparation unit must always be switched off before extension modules are electrically connected or disconnected.
- Before opening the sample preparation unit, it must be switched off using its main switch and the mains connector must be disconnected from the power outlet!
- The electrical components must be checked regularly by a qualified electrician. Any defects, such as loose connections, faulty or damaged cables, must be repaired without delay.
- Ensure that no liquid reaches the cable connections or the interior of the electrical device! Danger of electric shock!
- Immediately switch off the sample preparation unit using the main switch (on the rear of the housing) and pull the mains connector from the power outlet if there is any interference with the electric components.

- Behavior after restoration of power supply (after a power failure):  
The device will perform a number of automatic movements (initialization) after the power supply was restored. Therefore, the operator must take particular care within the operating radius of the arm guiding the cannula! Risk of accidents!

#### 2.5.4 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 dangerous substances local safety codes and guidelines must be observed.

The following general notes do not replace the specific local regulations or the regulations in the EC safety data sheets of the manufacturers for the auxiliary and operating materials.

The following has to be observed:

- The relevant regulations and the notes in the EC safety data sheets of the manufacturers have to be observed and complied with regards to storage, handling, use and disposal for all auxiliary and operation materials used during the operation or maintenance of the sample preparation unit.
- Auxiliary and operation materials may never be placed in containers or vessels for food. The approved containers for the relevant material are to be used and these have to be labeled accordingly. The notes on the labels have to be observed!
- Wearing protective goggles and rubber gloves is mandatory when handling reagents. The notes on the labels have to be observed.
- The regulations and notes on the safety data sheets for the handling of sodium nitrate solution and methanol must be observed!
- Biological samples must be handled according to local guidelines regarding the handling of infectious material.
- Caution when handling glass components. Risk of broken glass and therefore risk of injury!
- Auxiliary and operating materials as well as their containers may not be disposed in domestic waste or enter the sewage system or the soil. The applicable regulations for disposal of these materials must be meticulously observed.
- Ensure good room ventilation in working rooms.

#### 2.5.5 Safety instructions: service and repair

Maintenance of the sample preparation unit is generally performed by the customer service department of Analytik Jena AG or its authorized and trained specialist personnel.

Unauthorized servicing can lead to maladjustment or damage to the sample preparation unit. Therefore, the tasks that the operator is allowed to carry out are strictly limited to the tasks listed in chapter → "Maintenance and care" on page 40.

The following has to be observed:

- The exterior of the sample preparation unit may only be cleaned with a damp, not dripping, cloth after the unit has been switched off.

- The sample preparation unit must always be switched-off before carrying out any service and repair work (unless stated otherwise).
- Only use original accessories and original replacement parts from Analytik Jena AG. The notes in the chapter "Service and care" must be observed.
- All protective equipment must be reinstalled correctly immediately after completion of the service and repair work and be checked for operation!

## 2.6 Behavior during emergencies

The sample preparation unit must be switched off using the main switch (on the equipment backplate) and disconnected from the mains supply in case of dangerous situations or accidents.

Because a rapid response can save lives during an emergency, the following has to be ensured:

- The operating staff has to be aware where safety equipment, accident and danger alarms as well as first aid and rescue equipment are located and be familiar with their handling.
- The operator is responsible for the respective training of the operating staff.
- All equipment for first aid (first-aid kit, eyewash bottles, stretcher, etc.) as well as equipment for firefighting (fire extinguishers) must be within reach and easy to access. All equipment has to be in a sound condition and should be checked regularly.



### 3 Function and setup

#### 3.1 Description

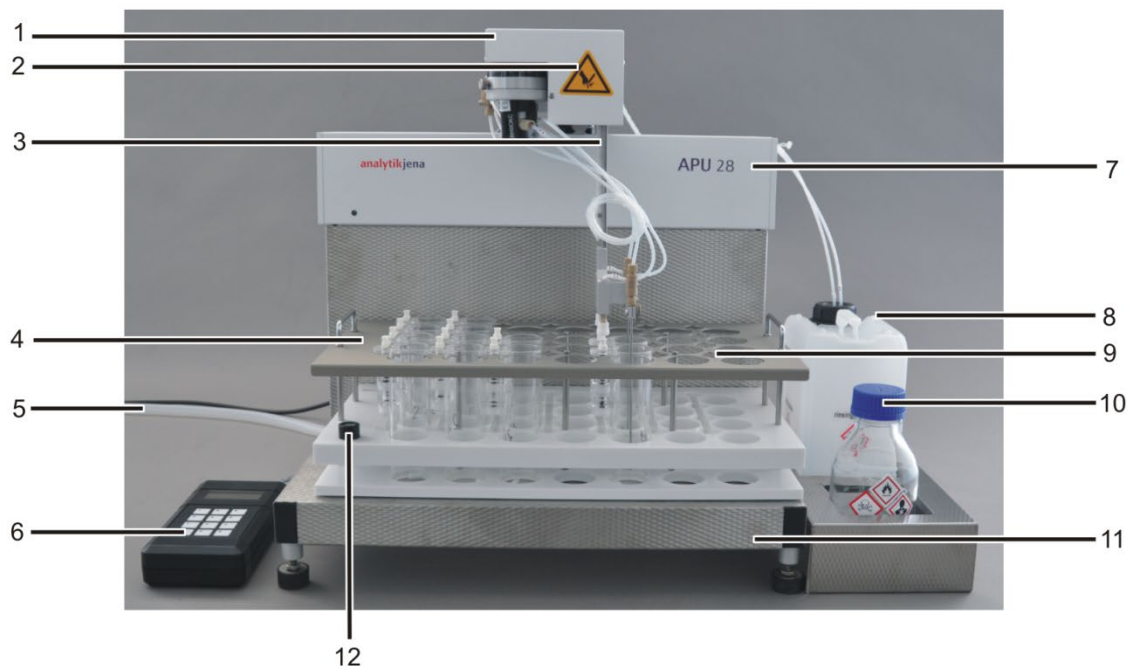


Figure 1 Sample preparation system – front view

- 1 Pump unit
- 2 Warning label, other versions → "Safety markings" page 10
- 3 Cannula guide
- 4 Sample tray
- 5 Waste hose  
(to the waste container/canister) positioning instructions relevant to the unit's functioning  
→ "ATTENTION" pages 27 and 29
- 6 Control unit with display and keypad → "Programming" page 31
- 7 Basic device
- 8 Storage container for nitrate solution
- 9 Position 28 (scraper SPE columns)
- 10 Storage bottle for methanol (only APU 28 SPE)
- 11 Rack with 4 feet
- 12 Circular spirit level → "Unpacking and setting up the sample preparation system" page 26

Basic device  
Control unit

The standard version of the sample preparation system APU 28 consists of the following components:

- Basic device including power supply
- Control unit – used for programming sequences, controls the running gear and the pump unit

Each of the three sample preparation systems APU 28, APU 28 S and APU 28 SPE is delivered with one tray and its accessories.

Before the initial start-up of the unit, the operator must align the running gear with the tray or verify the alignment. The offline coordinates are stored in the control unit which means that the control units and the trays of two different systems must not be mixed up.

Sample cup

The maximum sample container volume is 120 ml.

AOX columns and sample containers must always be positioned in accordance with the loading plan supplied with the unit. Columns must be fastened by rotating them by 30 degrees (locking device).

### 3.1.1 Device-specific features

APU 28 S

The sample preparation system APU 28 S is a **double** channel system which allows processing two samples at the same time.

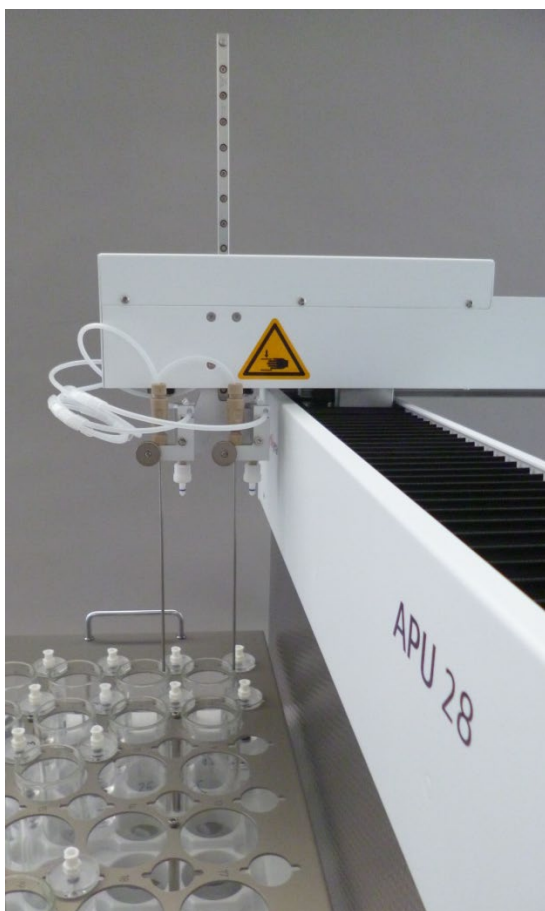


Figure 2 Double channel system APU 28 S

APU 28 SPE

Additional accessories to the sample preparation system APU 28 SPE are a scraper, a receptacle and 12 inserts for the SPE columns.

The scraper for the SPE columns is placed in position 28 and the receptacle is placed underneath this position; for further information → page 30.

### 3.2 Hose system

#### 3.2.1 Hose connections/hose diagrams

**Hose diagram** The connection between the individual components is made with labeled hoses. The encircled numbers and letters in the hose diagram correspond to the labels on the hoses in the sample preparation system.

To prevent carry-over, hoses and hose connections are flushed automatically → "Backwash the entire sample range" page 36.

The effectiveness of this function can only be guaranteed when using hoses supplied by Analytik Jena AG.

Please use the following hose numbers for replenishment orders.

#### 3.2.2 Hose diagram APU 28

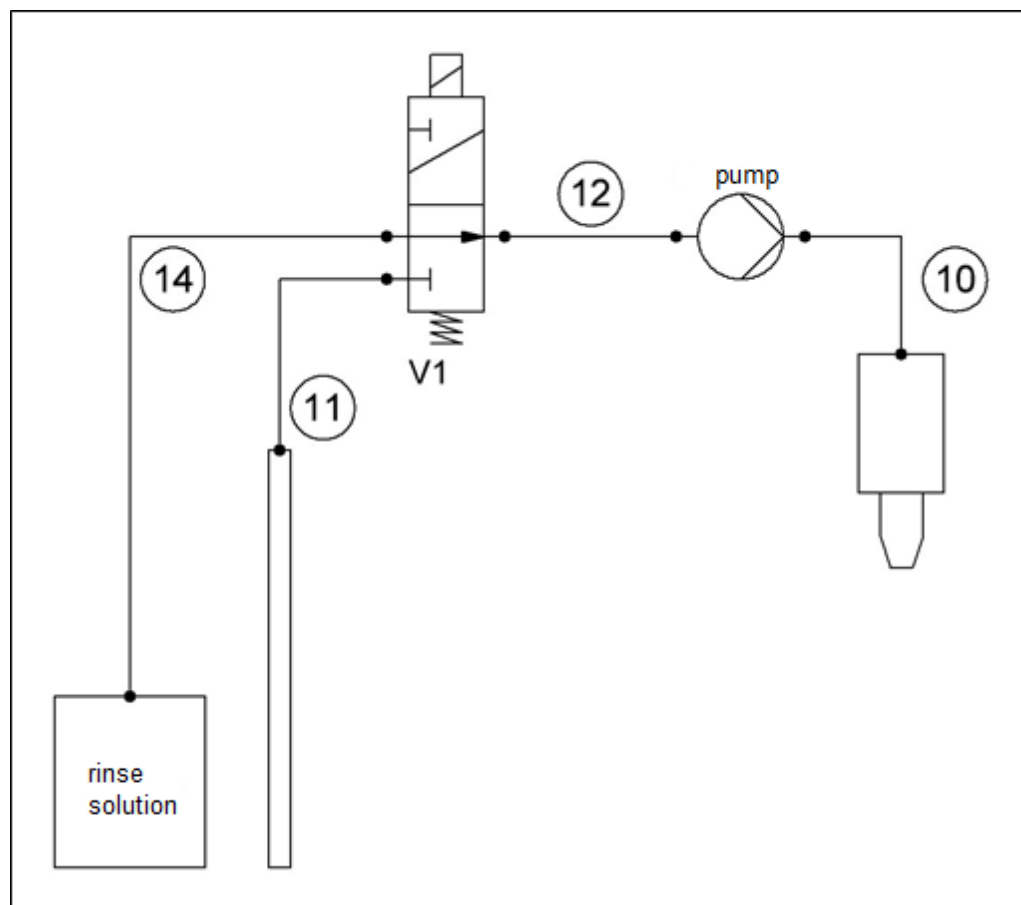


Figure 3 Hose diagram APU 28

### 3.2.3 Hose diagram APU 28 S

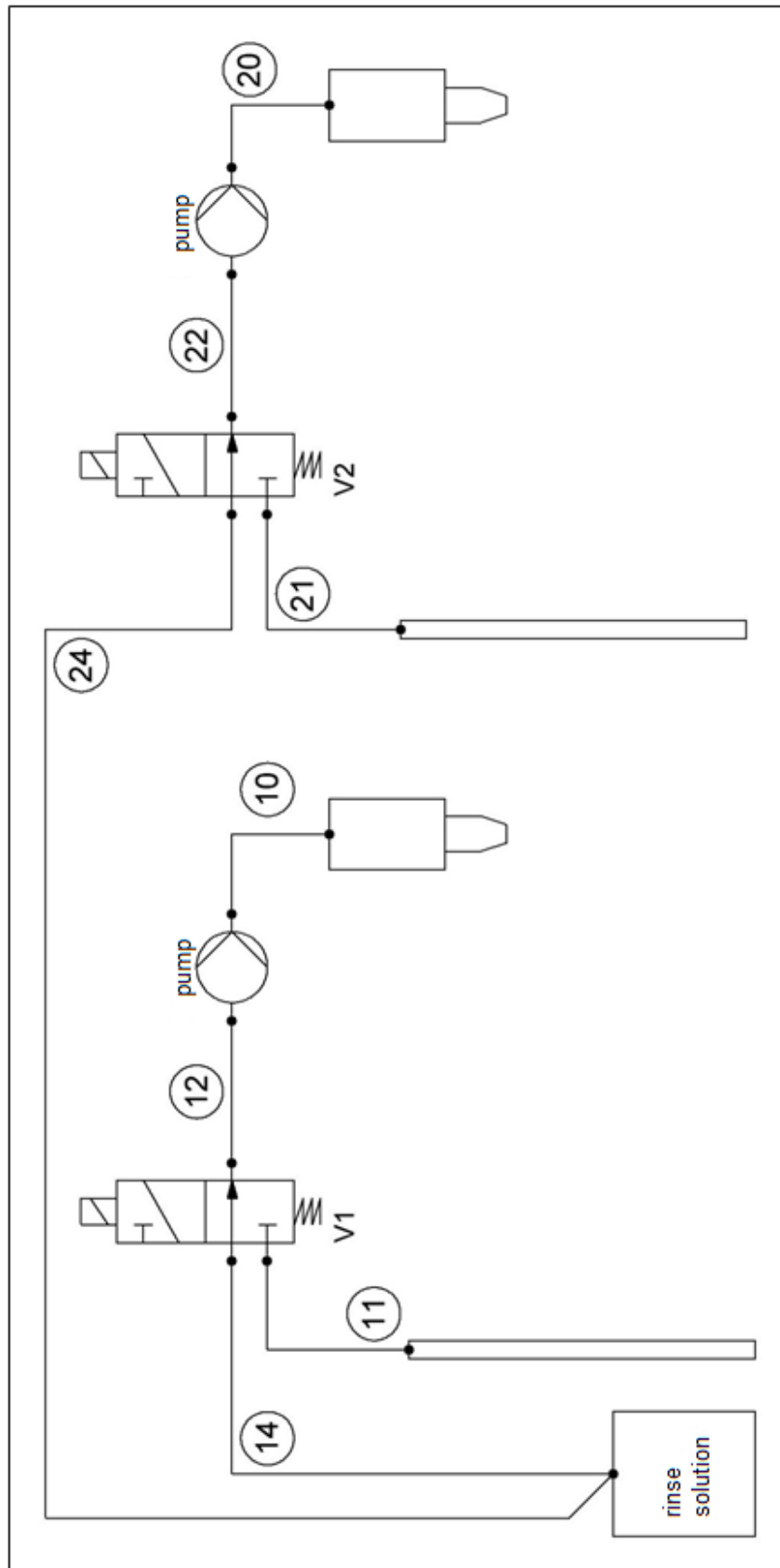


Figure 4 Hose diagram APU 28 S

### 3.2.4 Hose diagram APU 28 SPE

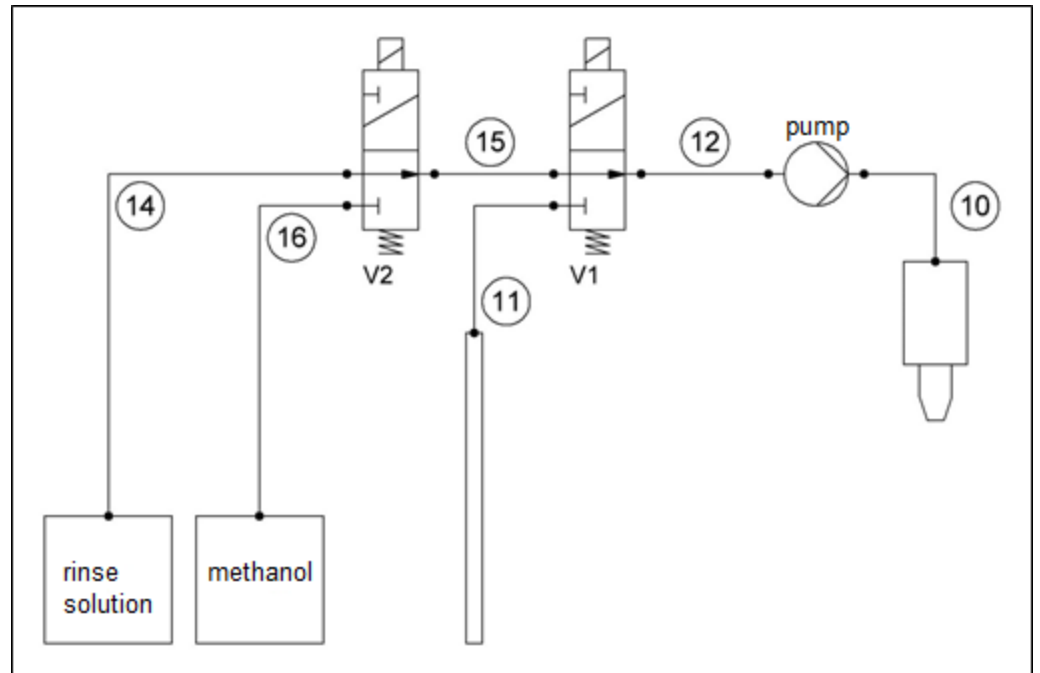


Figure 5 Hose diagram APU 28 SPE

### 3.2.5 Seals and connections

The proper functioning of the sample preparation system strongly depends on the tightness of the connections. Please make sure to strictly follow the instructions when replacing hoses and connections and ensure that the system is vented after replacing these components (→ "Venting the sample preparation system" page 23).

Ingress of air into the system will impair the precision of the dosage.

Fingertight screw connection

The screw connections used on the system are Fingertight connections. These flangeless fittings consist of a conical nipple and a banjo bolt. These hose connections seal purely by tightening the plastic banjo bolt finger-tight.

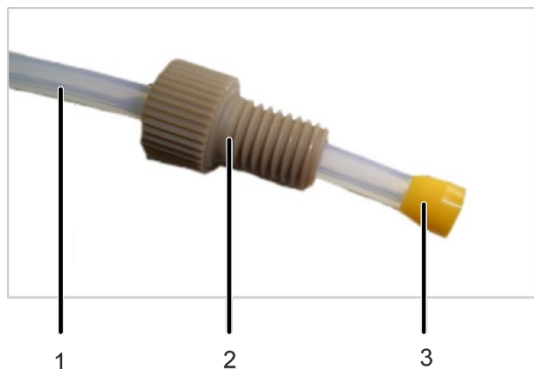


Figure 6 Fingertight screw connection

- 1 Hose
- 2 Banjo bolt
- 3 Conical nipple

Follow the respective instructions → "Replacing the hose connections" page 40 when replacing a Fingertight connection.

### 3.3 Metering head

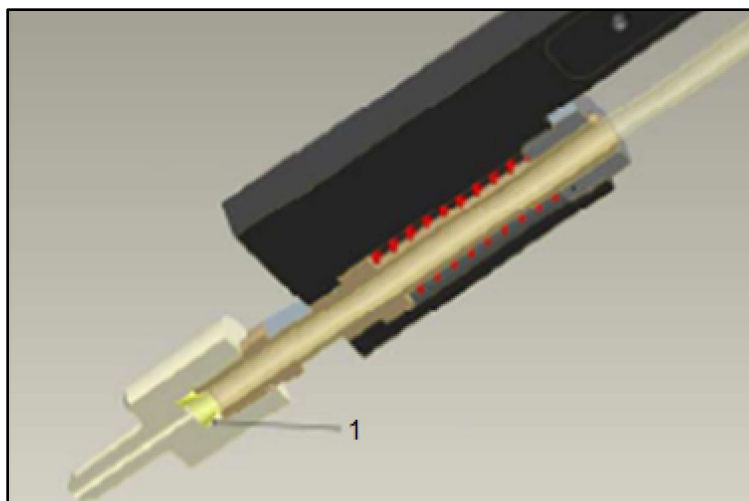


Figure 7 Metering head (cross section)

- 1 Conical nipple

## 3.4 Cannula

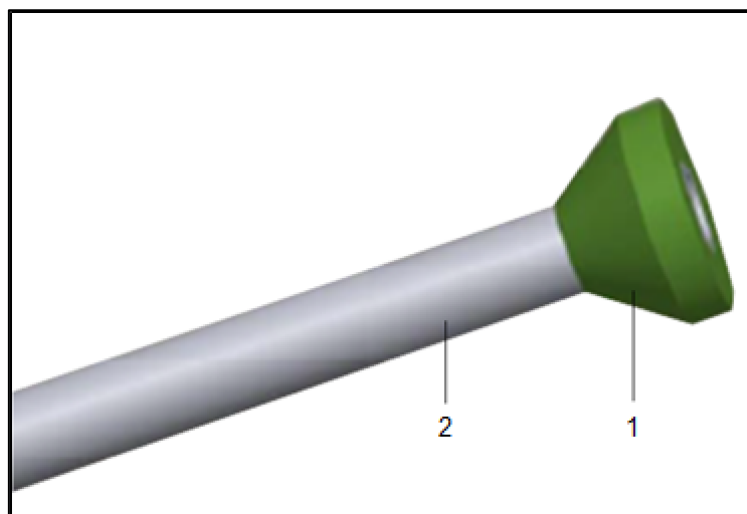


Figure 8 Cannula

- 1 Conical nipple
- 2 Cannula (detail)

### 3.4.1 Venting the sample preparation system



#### ATTENTION

Fully vented metering pumps are essential to ensure the correctness and stability of the dosing volume.

Observe the following sequence to fully vent the pump(s) and the hose system:

The sample preparation system is vented by reducing the intake pressure and by using a venting adapter to create a temporary vacuum at the metering head. For this purpose, use a syringe with a silicon tube of approx. 10 cm length and attach it to the venting adapter. Provide a vessel with a stock of rinse solution at an elevated point above the pump level to reduce the intake pressure.



Figure 9 Venting the system

Proceed as follows:

1. Insert the venting adapter in position 1 of the sample tray (the silicone hose is attached to the venting adapter).
2. Place a sample container with ultrapure water in position 1 (for APU 28 S also in position 2) and another container with ultrapure water at an elevated point as a backup for the rinse solution. Insert hose 14 (for APU 28 S hoses 2 and 24) from the rinse solution container to the ultrapure water container.
3. Switch on the device.
4. Use the control unit to enter a sample volume of 5 ml and a rinse volume of 100 ml.
5. Start the cycle for sample 1 (number of samples = 1 or 2 for APU 28 S).
6. Once the device has moved to position 1, connect the syringe to the silicone tube.
7. Create a **gentle negative pressure** from the start of the rinsing process throughout the sample metering process (5-ml sample) until the system switches to using the rinse solution.
8. After the system has changed over to metering the rinse solution, remove the syringe and allow delivery of the rinse solution to the outlet of the sample tray.

APU 28 S

For APU 28 S, repeat the entire process for position 2.



### ATTENTION

Applying a very strong negative pressure may destroy the sealing system in the pump.

### Note

There is the option to repeat the process with additional samples without applying a negative pressure. To do this, place the required number of sample containers with ultrapure water to the programmed positions in the sample tray and provide a sufficient amount of ultrapure water in the elevated rinse solution container. (Processing a sequence of 4 samples per channel is usually enough to fully vent the system.)



## 4 Installation and commissioning

### 4.1 Site requirements

#### 4.1.1 Installation conditions

The following requirements are placed on the climatic conditions in the operating room of the analyzer:

- Temperature range: +10 °C to +35 °C
- Max. humidity: 90% at 30 °C
- Air pressure: 0.7 bar to 1.06 bar

As far as possible, the atmosphere in the laboratory should be free of halogen and dust and free from draft, corrosive vapors and vibration. Smoking is prohibited in the operating room of the sample preparation unit!

The location of the sample preparation must fulfill the following requirements:

- Do not place the sample preparation unit directly near a door or window.
- Do not place the sample preparation unit near sources of electromagnetic interference.
- Avoid direct sunlight and radiation from heaters onto the sample preparation unit. If necessary ensure air conditioning.

Keep a safety distance of at least 5 cm to other equipment or walls!

#### 4.1.2 Space requirement



---

#### ATTENTION

When placing the device on the laboratory desk consider the movement range of the arm during operation!

Ensure that the whole potential movement range behind the device is unobstructed.

---

The required space depends on the number of components needed for measurement (control module, sample preparation, reagent bottles).

#### 4.1.3 Energy supply



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#### ATTENTION

The sample preparation unit may only be connected to a properly grounded power outlet in accordance with the voltage specifications on the type plate.

---

APU 28

The APU 28 is operated on single-phase alternating current.

The installation of the electrical equipment of the laboratory must comply with the standard DIN VDE 0100. After the connection point an electrical current in accordance with the standard IEC 38 must be available.

#### 4.1.4 Unpacking and setting up the sample preparation system



---

##### ATTENTION

The APU 28 must only be positioned, assembled and installed by the customer service department of Analytik Jena AG or by specialist personnel authorized and trained by Analytik Jena AG!

Any unauthorized intervention on the sample preparation unit can endanger the user and the operational safety of the equipment and limits or completely invalidates any warranty claims.

**The APU 28 must never be operated without a sample or a rinse solution!**

---



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##### ATTENTION

Retain the transport packaging! Return transport for service must be in the original packaging. This alone prevents transport damage.

---

The sample preparation unit APU 28 is unpacked and assembled by the customer service department of Analytik Jena AG or its authorized and trained specialist personnel.

Please 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.

##### Horizontal alignment

The sample preparation system must be horizontally aligned by changing the level of the 4 adjustable feet to ensure that the sample liquid can freely flow off the rack.

A circular spirit level is provided for aligning the unit and for verifying the alignment – for the position of the circular spirit level see page 17.

## 5 Operation

### 5.1 Sample enrichment AOX

#### 5.1.1 Preparation

1. Verify that the waste hose is connected to a suitable waste container or drain, that liquids can flow off freely and that the capacity of the waste container is adequate.



#### ATTENTION

When connecting the waste hose, make sure that

- the hose does not sag,
- the hose has a continuous slope and
- the hose is not immersed in the liquid in the waste container.

It may be necessary to cut the waste hose to a suitable length.

2. Verify that the amount of nitrate solution in the storage canister or storage bottle is sufficient.
3. Switch on the device.



Figure 10 Main switch on the rear of the device

4. Fill the samples into the sample containers (sample volume + 15 ml).
5. If required, add magnetic stirring rods into the sample containers.
6. If required, close the sample containers (e.g. aluminium foil).
7. Put the sample containers into the tray.
8. Fill the duplex columns with adsorption containers.
9. Put the prepared duplex columns into the tray and lock them in place using the locking device.
10. Program the analysis sequence → "Programming" page 31.
11. Start the sequence.



### CAUTION

Never reach into the movement range of the sampler arm while the sequence is processed.



### ATTENTION

Never run the sample preparation pump(s) dry (operation without liquid)! Otherwise, this may cause damage to the pump which may result in incorrect metering.

Make sure to provide a sample container with a sufficient sample volume for each programmed sample in the sequence for processing the tray!

APU 28 S

To process an odd number of samples with the APU 28 S, the sample tray must be filled with an even number of samples. The extra sample container can be filled with rinse solution or ultrapure water, for example.

Example: 9 samples → position 1 – 9 sample solution → position 10 rinse solution/ultrapure water

## 5.1.2 Loading the rack for AOX

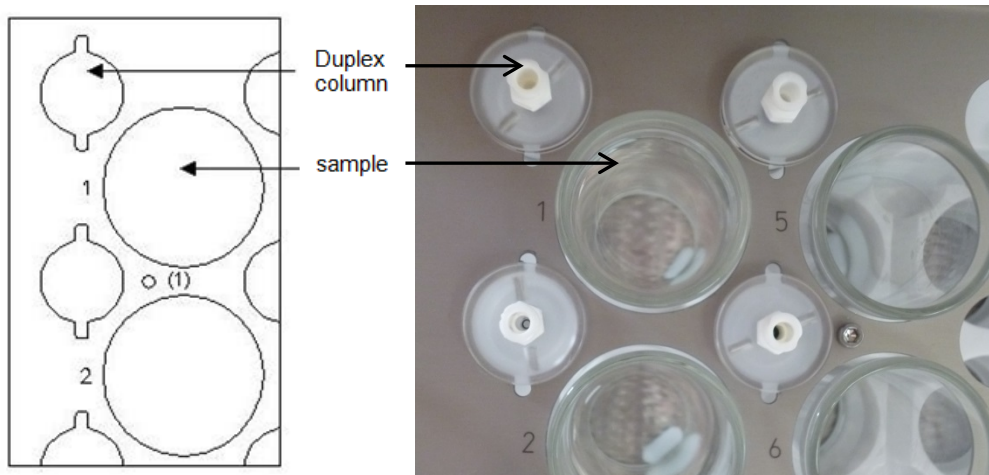


Figure 11 Loading pattern and example (rack AOX)

## 5.2 Sample enrichment SPE AOX

### 5.2.1 Preparation

1. Verify that the waste hose is connected to a suitable waste container or drain, that liquids can flow off freely and that the capacity of the waste container is adequate.



#### ATTENTION

When connecting the waste hose, make sure that

- the hose does not sag,
- the hose has a continuous slope and
- the hose is not immersed in the liquid in the waste container.

It may be necessary to cut the waste hose to a suitable length.

2. Verify that the amount of nitrate solution or methanol in the storage canister or storage bottle is sufficient.
3. Switch on the device → "Preparation" page 27.
4. Fill the samples into the sample containers (sample volume + 15 ml).
5. If required, add magnetic stirring rods into the sample containers.
6. If required, close the sample containers (e.g. aluminium foil).
7. Place the sample containers in the corresponding positions on the tray → "Loading the rack for SPE-AOX" page 30.
8. Fill a defined volume of ultrapure water into the containers for desorbing samples from the SPE columns.



#### ATTENTION

Always use 5 ml of methanol and 5 ml of nitrate solution to desorb the sample from an SPE column. Therefore, the volume in the container is calculated as follows:

$$V_{\text{H}_2\text{O}} + V_{\text{MeOH}} + V_{\text{NO}_3^-} = V_{\text{H}_2\text{O}} + 10 \text{ ml} = V_{\text{total}}$$

$V_{\text{H}_2\text{O}}$  – prepared volume of ultrapure water

$V_{\text{MeOH}}$  – rinse volume of methanol

$V_{\text{NO}_3^-}$  – rinse volume of nitrate solution

9. Fill the duplex columns with activated carbon tubes.
10. Put the prepared duplex columns into the tray and lock them in place using the locking device.
11. Insert the retainers for the SPE columns to the corresponding positions in the tray.
12. Put the SPE columns into the retainers on the tray.

13. Insert the waste container and the scraper for the SPE columns on the tray (see figure 12).
14. Program the analysis sequence → "Programming" page 31.
15. Start the sequence.



**CAUTION**

Never reach into the movement range of the sampler arm while the sequence is processed.

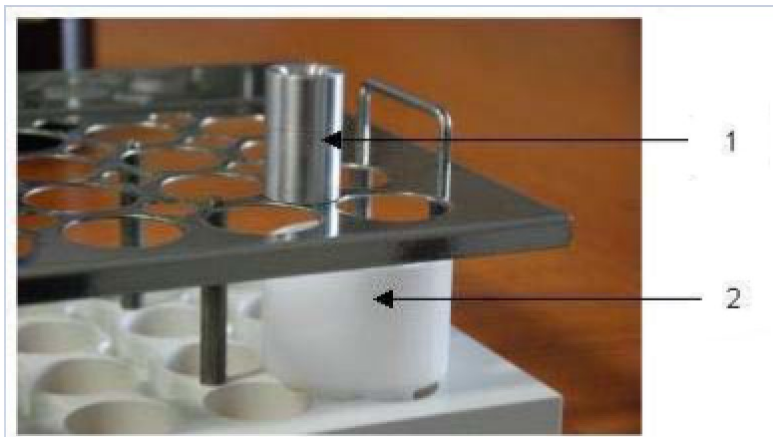


Figure 12 Ejection SPE columns

- 1 Scraper
- 2 Waste container

**5.2.2 Loading the rack for SPE-AOX**

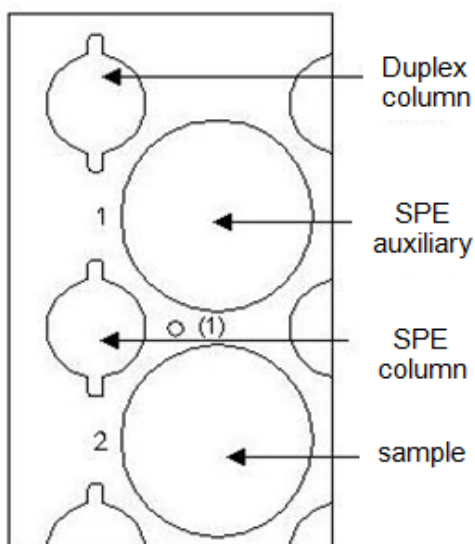


Figure 13 Loading pattern for SPE-AOX

## 5.3 Programming

### 5.3.1 Keypad description

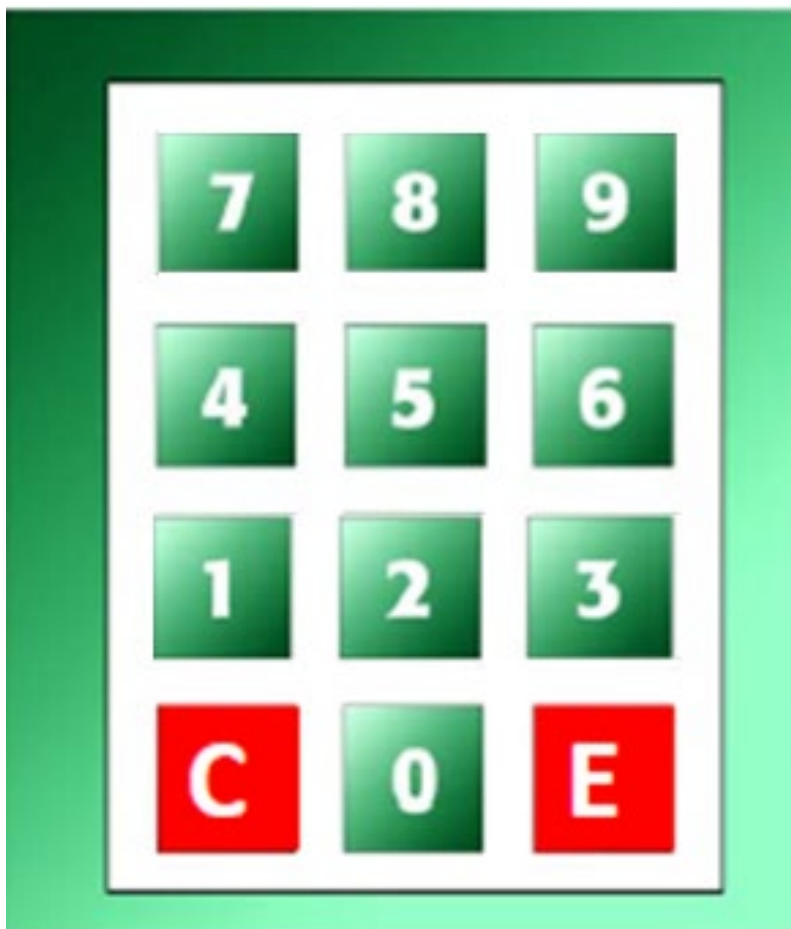


Figure 14 Keypad

Functions of the lower keypad row

<b>E</b>	<ul style="list-style-type: none"> <li>▪ START (starts the sequence)</li> <li>ENTER (confirms a selection and continues with the next step)</li> <li>HOLD (cancels the sequence after completing the processing of the current sample)</li> <li>BACK (returns to the previous step)</li> </ul>
<b>C</b>	<ul style="list-style-type: none"> <li>▪ CLEAR</li> <li>STOP (immediately aborts the sequence)</li> <li>MENU</li> <li>NEXT</li> <li>VOLUME (selects between the same volume for all samples or individual sample volumes)</li> </ul>
<b>0</b>	<ul style="list-style-type: none"> <li>▪ PUMP ADJUST (keep pressed during power up)</li> <li>For more information see section "Pump adjustment" p. 39.</li> </ul>

Function –  
after pressing E (START)

0

- Matrix  
During operation, the sample sequence can be extended here; the current sequence can be extended up to the maximum number of 28 positions/samples - see Figure 15  
(For programming the sequence see section "5.3.3 p. 36 and 5.3.4 p. 37)

Functions of the digits –  
after pressing C (Menu)

1

- Switches between AOX mode and SPE mode (APU 28 SPE only)

2

- Matrix (setting the sample volume/number of samples etc.)

3

- Software version

4

- Setting the offset coordinates/sampler adjustment  
→ "Setting the offset coordinates" page 37

5

- Setting the number of backwash cycles  
→ "Backwash the entire sample range" page 36

6

- Setting the volumes for conditioning the SPE columns  
→ "Conditioning an SPE column with methanol" page 35

7

- Setting the stirring speed (level 1 to 10)

8

- Setting the metering speed, optional (1 to 6 ml/min)

9

- Setting the language (German or English)

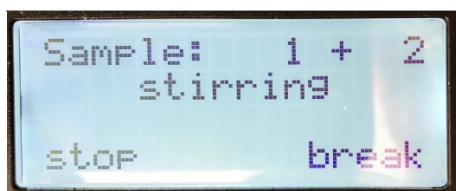
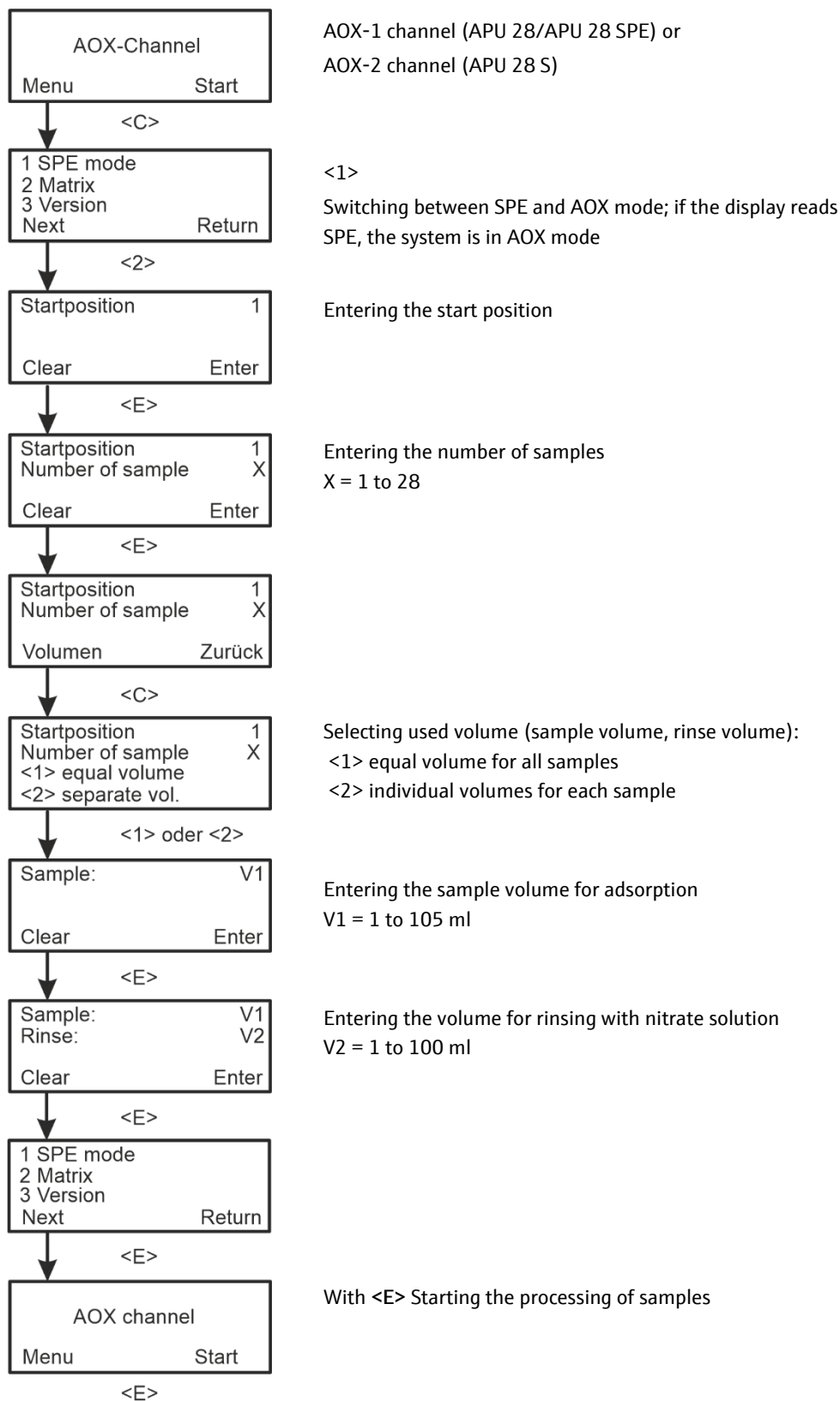


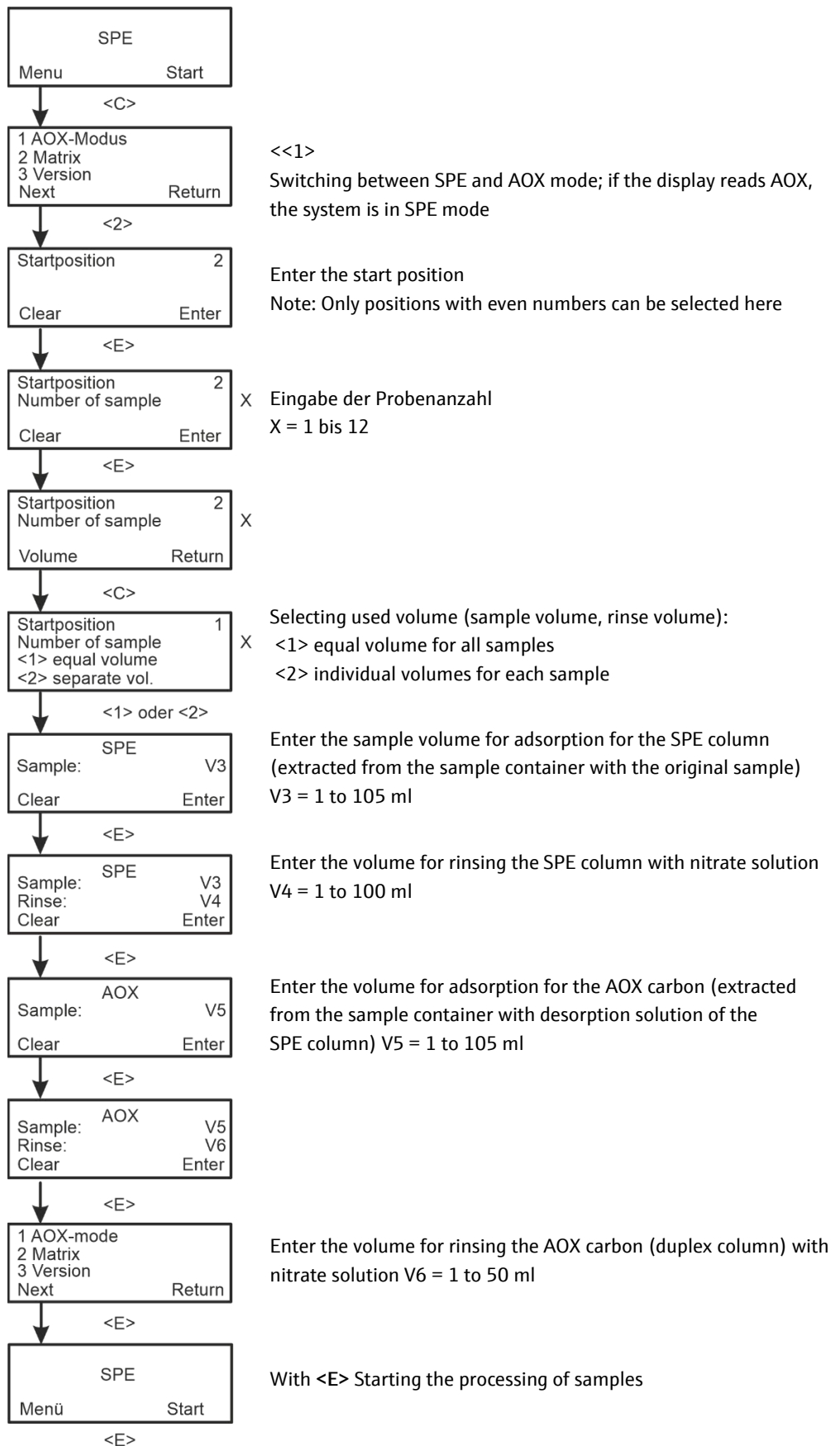
Figure 15 Display on the control panel



### 5.3.2 Programming an AOX sequence



### 5.3.3 Programming a SPE sequence (APU 28 SPE)

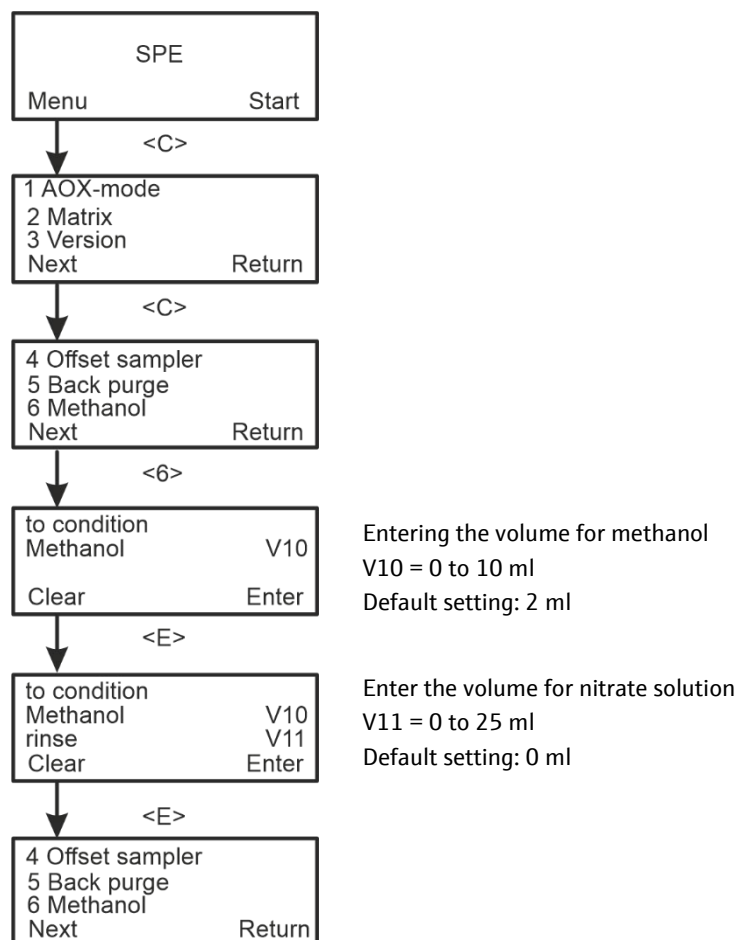


### 5.3.4 Conditioning an SPE column with methanol



#### ATTENTION

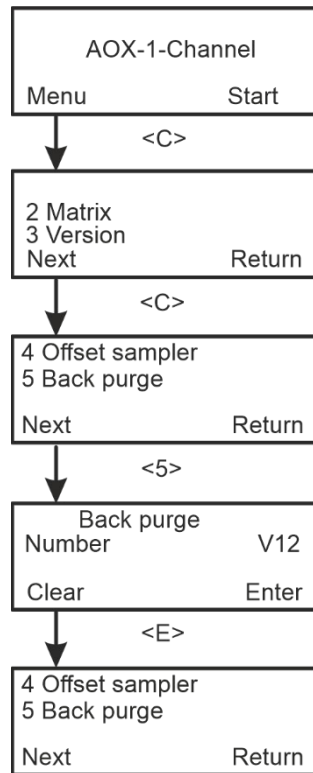
Within the specified range, the volumes are variable. However, they are identical for all samples. Within the sequence, conditioning is executed immediately before the adsorption step.



### 5.3.5 Backwash the entire sample range

Increasing the volume will increase the number of rinse cycles.

→ Vol = number of rinse cycles

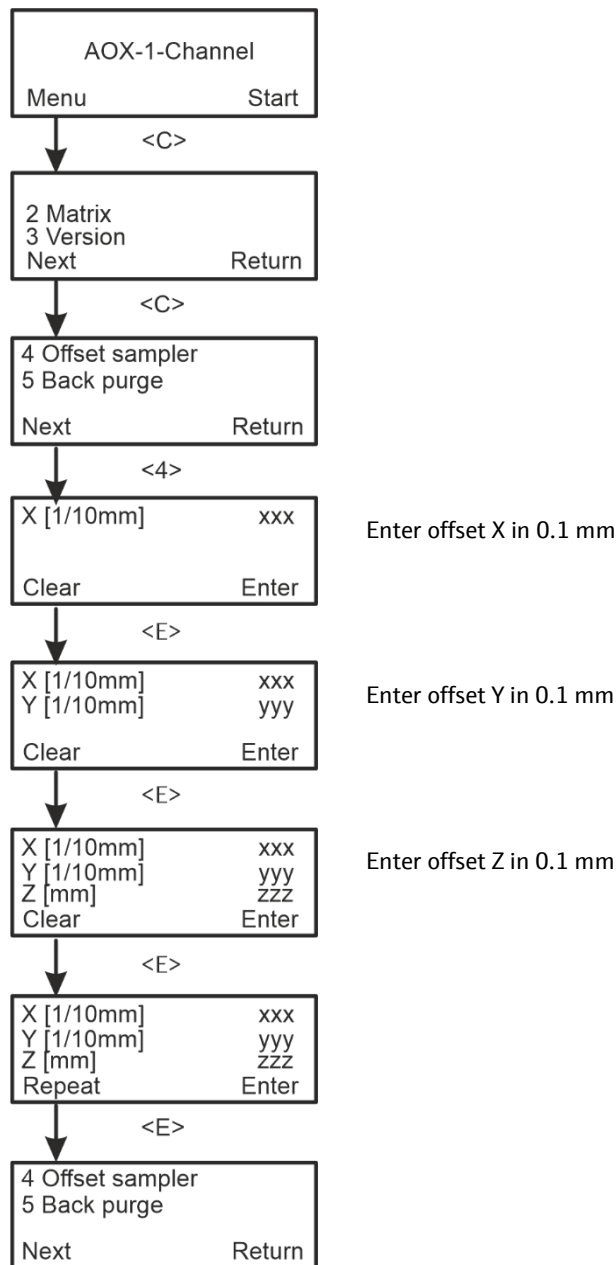


Enter the number of rinse cycles  
 V12 = 1 to 10  
 Default setting: Once

### 5.3.6 Setting the offset coordinates/sampler adjustment

Before the initial start-up of the unit and after replacing the tray, the operator must align the running gear with the tray or verify the alignment.

The following procedure is applicable for software version 5.1 (and higher).



Offset coordinates  
X, Y and Z

The running gear places the metering head above column 14. Check the position. Complete the calibration function using the <ENTER> key and repeat this step, if necessary.

The XY calibration is complete when the metering head is positioned precisely above column 14.

Then, enter **offset Z = 130 mm** (default value).

Complete the calibration function using the <ENTER> key.

If the sealing between the metering head and the column is insufficient, increase the offset Z by 1 mm.

The offline coordinates are stored in the control unit which means that the control units and the trays of two different units must not be mixed up.

APU 28 SPE

Adjustment

**NOTICE**

During adjustment, the system does not initially move to the final depth after approaching pos. 1!

## Explanation

First - according to section "Setting the offset coordinates/sampler adjustment" p. 37 - the AOX coordinates for the duplex column are approached (position 14).

Then, the system moves to position 1 (for SPE adjustment, Figure 16) - initially not to the final depth - see Figure 17.

```
X [1/10mm] 38
Y [1/10mm] 15
Z [mm] 85
Clear Enter
```

Figure 16 Display indications



Figure 17 Dosing head not at the final depth

Each coordinate x, y and z must be entered (Figure 18) and confirmed with "Enter" - only then the sampler moves to the final position - see Figure 19.

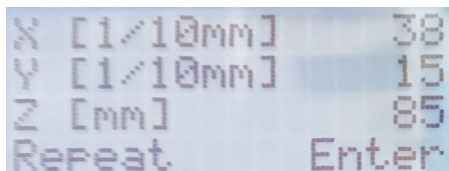


Figure 18 Display indications



Figure 19 Dosierkopf – finale Position

### 5.3.7 Pump adjustment

The "Pump adjust" function allows you to check the pump volume. Perform the following:

1. While switching on the APU28 press the button .

The display "Pump adjust" appears; this allows the pump volume to be checked.

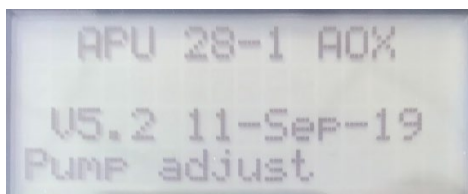


Figure 20 Display „Pump adjust“



#### NOTICE

Only the set volume is dosed. No flushing volume can be entered and therefore no sample processing is possible.

2. The APU28 must be switched off to exit the "Pump adjust" function.

After switching on again regularly, a flushing volume can be set under Matrix in addition to the sample volume.

## 6 Maintenance and care

### 6.1 Maintenance intervals

Sample preparation system APU 28, APU 28 S, APU 28 SPE APU 28 flexi, APU 28 S flexi, APU 28 SPE flexi	
Maintenance task	Maintenance interval
Clean and maintain the device	once per week and each time the device is taken out of operation
Clean the drip pan/rack	once per week and each time the device is taken out of operation
Clean the reagent vessels (nitrate solution, methanol)	once per month and before filling, if necessary
Rinse device with ultrapure water	once per month and each time the device is taken out of operation
Check screw connections for tight fit and replace, if required	once per month → "Replacing the hose connections" page 40
Inspect the fastening screws for tight fit	Monthly
Vent the sample preparation system	as required → "Venting the sample preparation system" page 23

### 6.2 Instructions

#### 6.2.1 Replacing the hose connections

Fingertight screw connection

When replacing damaged Fingertight screw connections only use **straight cut, round and unpinched** hose ends for the connection.

Push the conical nipple with the **conical** side towards the banjo bolt onto the hose. The conical nipple and hose end must be flush.

For further information → "Seals and connections" page 22



#### ATTENTION

Ensure that none of the connections leaks after servicing:

- Do not insert the Fingertight screw connections twisted!
- Tighten all screw connections finger-tight!



## 7 Troubleshooting

If the suggested solutions are not successful, contact the service department.

Service

Analytik Jena AG  
 Konrad-Zuse-Str. 1  
 07745 Jena · Germany  
 Phone + 49 3641 77 7407  
 Fax + 49 3641 77 7449  
 Email info@analytik-jena.de

### 7.1 Malfunction of the control module

Malfunction of the sampler – no connection	
Cause	Remedy
No communication with the sampler	<ul style="list-style-type: none"> <li>▪ Check connection</li> <li>▪ Power cycle the system</li> <li>▪ Call Service</li> </ul>
Malfunction of the sampler – runtime	
Cause	Remedy
Completion message of the sampler movement takes too long	<ul style="list-style-type: none"> <li>▪ Call Service</li> </ul>

### 7.2 Equipment faults and analytical problems

Malfunction of the sampler – no/too little sample extracted from the sample container	
Cause	Remedy
Clogging due to particles being too big	<ul style="list-style-type: none"> <li>▪ Fill ultrapure water into the sample container and run a sequence to rinse the system → "Backwash the entire sample range" page 36</li> <li>▪ Call Service</li> </ul>
Air inside the system	<ul style="list-style-type: none"> <li>▪ Vent the sample preparation system → "Venting the sample preparation system" page 23</li> <li>▪ Call Service</li> </ul>

## 8 Transport and storage

### 8.1 Transport

#### 8.1.1 Preparing the sample preparation unit for transport



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#### WARNING

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 the customer service department when registering the return.

**Analytik Jena must refuse acceptance of contaminated devices. The sender may be liable for any damage caused by inadequate decontamination of the device.**

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#### ATTENTION

Unsuitable packaging material and residue of measuring solution and chemicals can damage individual components of the sample preparation unit!

Only transport the sample preparation unit in its original packaging! Make sure that the sample preparation unit is fully drained and all transport locks have been fitted!

---



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#### ATTENTION

The cannulas can bend!

Attach the cannulas or put them into their original packaging!

---

Proceed as follows for preparing the sample preparation unit for transport:

1. Rinse the hose system with ultrapure water.
2. Drain the hose system.
3. Use the device's main switch to turn off the sample preparation unit and unplug the mains plug from the power outlet.
4. Detach the connecting cable for the control module and the power cable on the rear of the sample preparation unit.
5. Attach the cannulas to the bracket.
6. Carefully package the accessories, in particular protect glass components against breakage.

## 8.1.2 Transport notes

Pay attention to the safety instructions in the chapter → "Safety instructions, transport and installation" on page 13.

Take particular care when transporting the sample preparation unit to prevent damage from impact or vibration. The sample preparation unit should be transported in such a way that major temperature fluctuations are avoided to prevent the formation of condensate.

## 8.1.3 Moving the sample preparation system inside the laboratory



### CAUTION

There is a risk of injury and damage to the sample preparation unit if the sample preparation unit is dropped unintentionally!

Proceed with great care when moving the sample preparation unit!

Moving the sample preparation system

Keep in mind the following information:

- Insufficiently secured components pose a risk of injury! Before moving the sample preparation unit, remove all loose components, in particular all reagent containers.
- Detach the control module and the power cable from the sample preparation unit.
- For safety reasons, two persons are required to transport the sample preparation unit who must hold the unit by either side of the equipment.
- Because the sample preparation unit does not have carrying handles, hold the device firmly with both hands by its lower end.
- Observe the guide values and adhere to the legally mandated limits for lifting and carrying without auxiliary means!
- Consider the information in chapter → "Site requirements" page 25 when placing the unit at a new location.

## 8.2 Storage



### ATTENTION

Environmental influences and condensate formation can destroy individual components of the sample preparation unit!

The sample preparation unit must be stored in an air-conditioned room. The atmosphere must be low in dust and free from aggressive vapors.

If the sample preparation unit is not installed immediately after delivery or not needed for prolonged periods, it should be stored in its original packaging. A suitable desiccant should be added to the packaging to prevent damage from moisture.

The following requirements are placed on the climatic conditions in the storage room of the sample preparation unit:

- Temperature range: +5 °C to +55 °C
- Max. humidity: 10 % to 30 %
- Air pressure: 0.7 bar to 1.06 bar

## 8.3 Recommissioning after transport or storage

### 8.3.1 Assembling and connecting the sample preparation unit after transport or storage

Components of the sample preparation system

Consider the information in chapter → "Site requirements" page 25 when placing the sample preparation unit.

Proceed as follows for assembling the components of the sample preparation unit:

1. Carefully remove the basic device, accessories and any add-on devices from the transport packaging. Do not damage the transport packaging!
2. Place the sample preparation unit at its intended location.
3. Remove all adhesive tape.
4. Place the reagent containers into the bracket at the right-hand side of the sample preparation unit.
5. Place the control unit on the left-hand side of the sample preparation unit.
6. Insert hose 14 into the nitrate solution (for APU 28 S: hoses 14 and 24).
7. Insert hose 16 into the methanol bottle (APU 28 SPE only).

**CAUTION**

Always switch off the APU 28 before connecting any system components!

Before connecting the mains cable verify that the main switch on the back of the equipment is set to "0"!

---

**ATTENTION**

Settled condensation and temperature differences can damage individual components of the sample preparation unit during recommissioning.

Allow the sample preparation unit to acclimatize for at least one hour before recommissioning after moving it into its operating room.

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1. Connect the mains cable and the control unit to the rear of the sample preparation system.
  2. Insert the mains plug into a grounded power outlet.
- 

**ATTENTION**

All hoses must be filled with nitrate solution or ultrapure water and without any trapped air bubbles before recommissioning the unit after transport or storage and before each initial start-up of the equipment.

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## 9 Disposal

### Waste water

Waste water is produced in analysis operation. Depending on the measurement mode this water contains methanol, sodium nitrate and parts of the sample.

The neutralized (if necessary) waste must be brought to the appropriate waste disposal center for correct disposal according to the appropriate legal guidelines.

### Sample preparation system APU 28

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

# 10 Specification

## 10.1 Technical data

Characteristics

<b>General characteristics</b>	
Name	Sample preparation system
Type/model name	APU 28, APU 28 S, APU 28 SPE
Dimensions of the basic device (W x H x D)	approx. (700 x 650 x 550) mm
<b>Procedural data</b>	
Number of samples AOX	28
Number of samples SPE/AOX	12
Sample volume	(1 – 105) ml
Rinse volume	(1 – 100) ml
Particle handling capacity	< 100 µm
Operation	Control module with numeric keypad
Stirring function	current sample
Sample container volume	max. 120 ml
<b>Electrical variables</b>	
Operating voltage	100 – 240 V AC (±10 %), 50/60 Hz
Fuse	T 3.15 AH (Only use original fuses by Analytik Jena AG!)
Typical average power consumption	50 VA
Interface to the device control	RS 232 (between control unit and sample preparation unit)
<b>Environmental conditions</b>	
Temperature during storage	(5 – 55) °C
Temperature during operation	(10 – 35) °C
Humidity during operation	90 % max at +30 °C
Humidity during storage	(10 – 30) % (use desiccant)
Air pressure	(0.7 – 1.06) bar

## 10.2 Standards and directives

Safety class and safety type	The device is classified as protection class I. The casing has the protection level IP 20.
Device safety	The device complies with the following safety standards <ul style="list-style-type: none"> <li>▪ EN 61010-1</li> <li>▪ EN 61010-2-081</li> <li>▪ EN 61010-2-051</li> </ul>
EMC compatibility	The device has been checked for transient emissions and noise immunity. It meets the requirements for transient emission according to <ul style="list-style-type: none"> <li>▪ EN 61326-1 (EN 55011 group 1, class B)</li> </ul> It meets the requirements for noise immunity according to <ul style="list-style-type: none"> <li>▪ EN 61326-1 (requirements for use in a basic EMC environment)</li> </ul>
Environmental compatibility	The device has been tested for environmental compatibility and meets the requirements stipulated in <ul style="list-style-type: none"> <li>▪ ISO 9022-3</li> <li>▪ ISO 9022-2</li> </ul>
EU directives	The device meets the requirements of Directive 2011/65/EU (RoHS II). The device has been 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 as far as technical safety is concerned. To maintain this condition and to ensure safe operation, the operator must strictly observe the safety and operating instructions contained in this operating manual. For accessories which have also been supplied, and system components from other manufacturers, their operating instructions should be referred to.
Guidelines for China	The device contains regulated substances (according to the directive "Management Methods for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products"). Analytik Jena guarantees that the substances will not leak within the next 25 years and, therefore, will not cause any environmental danger or health risk within this period of time if the device is used as intended.