

Fig. 1:
GENO-EDI-X 360

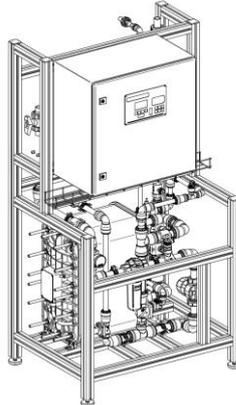


Fig. 2:
GENO-EDI-X 2700

Electrodeionisation systems

GENO-EDI-X
with GENO-EDI-tronic

100
180
360
720
1100
1450
2000
2700

Intended use

The electrodeionisation system GENO-EDI-X is designed to further enhance the quality of permeate generated by a reverse osmosis system.

The most common areas of application for the diluate produced (ultra-pure water) are:

- Steam sterilisation
- Semi-conductor industry
- Generation of pure steam
- Laboratories

Function

Electrodeionisation is a continuous, electro-chemical membrane process that combines membrane technology and ion exchanger technology.

In this process ion exchanger resin, ion-selective membranes and direct current are used to remove ions from the permeate of a reverse osmosis system.

The resulting diluate (ultra-pure water) has a residual conductivity of < 0.2 µS/cm. The residual conductivity depends on the quality of the feed water (permeate).

The advantage of this technology is the fact that the regeneration (by means of direct current) continuously takes place during operation and no chemicals (acids/bases) are required.

The core – the EDI module – consists of several chambers containing layers of anion and cation exchange resins. The chambers are separated from each other by anion and cation membranes.

The feed water (permeate) flows into the EDI module and is divided into a diluate, concentrate and electrolyte water flow. Due to the direct voltage applied, the ions move from the diluate chambers filled with ion exchanger resin to the concentrate chambers that are also filled with ion exchanger resin.

While the water in the diluate chambers is being fully demineralised, the direct current splits the water into hydrogen ions (H+) and hydroxide ions (OH-) by which in turn the ion exchange resins are regenerated again.

A part (10 %) of the feed water volume (permeate) rinses the concentrate and the electrode chambers. The volume designated as concentrate (unpressurised) is directed to the drain (or returned to the inlet of the reverse osmosis system to be fed again).

The electrodeionisation system GENO-EDI-X has a recovery of 90 – 95 %.

Application limits / Feed water specification

Conductivity equivalent FCE*: (CO ₂ included)	< 40 µS/cm
Range of pH value:	4 - 11
Cl ₂ concentration:	< 0.02 ppm
Fe concentration:	< 0.01 ppm
Mn concentration:	< 0.01 ppm
Sulphide concentration:	< 0.01 ppm
Concentration of residual hardness (CaCO ₃):	< 1.0 ppm (Δ 0.056 °dH)
TOC concentration	< 0.5 ppm
Silicate concentration (SiO ₂):	< 1.0 ppm
Water temperature:	10 – 25 °C

*FCE = permeate conductivity + (ppm CO₂ x 2.79) + (ppm SiO₂ x 1.94)

Technical requirements

Always install a fine filter, a system separator, a water softener and a reverse osmosis system upstream of the electrodeionisation system GENO-EDI-X.

In case the concentration of free CO₂ in the feed water (permeate) is too high, the stable operation of the system may be affected or the diluate quality may deteriorate. By installing a membrane degassing system upstream, the CO₂ concentration is reduced considerably. As an alternative, a dosing system to increase the pH value can be installed upstream of the reverse osmosis system, in order to reduce the CO₂.

As an option, it would make sense to continue to use the occurring concentrate (unpressurised) of the electrodeionisation system as its conductivity is approx. 10 to 20 times the feed water's conductivity.

This would considerably increase the economic efficiency.

If the concentrate is returned to the inlet of the reverse osmosis system, a pump and an intermediate storage tank are required. In addition, an activated carbon filter must be installed upstream of the reverse osmosis system.

Function

If the system is in standby mode and ready for operation, the inlet rejection valve and the inlet valve are closed. There is no voltage present at the EDI module. If available, the outlet rejection valve is open and the outlet valve closed. The electrodeionisation system receives its start signal from the level control of the diluate tank. Then, the EDI controller transmits the start signal to the RO controller. The RO system starts operation and produces permeate. By means of the inlet rejection valve, the timer-controlled discharge of the permeate to the drain takes place. In case the conductivity measuring cell for permeate is installed, the rejection can be terminated prematurely if the max. permeate conductivity set is undershot.

Upon termination of the inlet rejection, the inlet valve opens and the inlet rejection valve closes. When the inlet valve opens, the EDI cell is supplied with voltage. From the moment the inlet valve opens, the flows diluate and concentrate, the diluate conductivity, the pressure of permeate, diluate and concentrate as well as the temperature and the diluate are monitored and trigger a time-delayed (adjustable) warning or an alarm. The diluate is rejected via time by means of the outlet rejection - if available (option) -, with premature termination in case the max. diluate conductivity set is undershot. Following the opening of the outlet valve, the outlet rejection valve is closed. The diluate produced is now directed to the diluate tank.

As soon as the tank is full, a stop signal is transmitted to the EDI controller. Within the electrodeionisation system, the voltage supplied to the EDI cell is interrupted and the monitoring function of the EDI system is deactivated. After a set rinsing sequence, the RO system receives its stop signal, and the valves move to the following positions: Inlet rejection valve and inlet valve close and - if available - the outlet rejection valve is open and the outlet valve is closed. Now, the electrodeionisation system remains in standby mode until the next demand is made.

Scope of supply

Standard equipment

System ready for connection, fully mounted on a system rack, for continuous electro-chemical residual demineralisation of permeate originating from a reverse osmosis system.

Microprocessor controller with LCD graphic display (70 x 38 mm back-lit) Flow chart of the electrodeionisation system with supply tank including level control, pressure booster system for diluate as well as indication of the flow, pressure and conductivity values of the electrodeionisation system.

Version: Plastic foil keypad with 12 keys and serial interface RS 232, system piping within the electrodeionisation system equipped with pressure sensors, adjusting and solenoid valves as well as sampling fittings. Integrated flow sensors to monitor the volume flows diluate and concentrate. The switch cabinet features all power units as well as the control electronics. Quality control of diluate by means of temperature-compensated conductivity meter with digital indication at the display of the control electronics Piping within the system completely made of high-pressure resistant PE plastic pipes.

High-quality system rack made of anodised aluminium to house the system components.

Optional accessories

 **Note:** It is possible to retrofit existing systems with optional components. Please contact your local Grünbeck representative or Grünbeck's headquarters in Hoechst/taedt/Germany for more information.

GENO-EDI Profibus DP

Module to supply the system data
Order no. 770 860

GENO-EDI voltage-free single fault signals for DDC systems/central process control systems

Module for single fault signals (voltage-free) to control centre
Order no. 770 855

Quality-controlled rejection of permeate

Rejection of feed permeate in the inlet to the electrodeionisation system (conductivity-controlled)
Order no. 770 800

Analogue outputs (4-20 mA) for conductivity and temperature of diluate

Module to transmit the measured values to the control centre
Order no. 770 810

Quality-controlled rejection of diluate

Rejection of diluate prior to filling the pure water tank (conductivity-controlled)

for GENO-EDI-X 100 to 360

Order no. 770 815

for GENO-EDI-X 720 to 2700

Order no. 770 875

Measuring of conductivity and temperature of EDI concentrate

Module to measure the conductivity / temperature in the EDI concentrate (waste water) in the feed water

for GENO-EDI-X 100 to 360

Order no. 770 805

for GENO-EDI-X 720 to 2700

Order no. 770 870

GENO-membrane degassing system MEC 500-1 (1-stage)

To remove CO₂ from the feed water (permeate) of the electrodeionisation system
Flow volume of feed water:

0.1 – 0.7 m³/h

Amount of stripping gas* required:

0.2 – 1.8 Nm³/h

Order no. 770 200

GENO-membrane degassing system MEC 500-2 (2-stage)

To remove CO₂ from the feed water (permeate) of the electrodeionisation system
Flow volume of feed water:

0.1 – 0.7 m³/h

Amount of stripping gas* required:

0.4 – 3.6 Nm³/h

Order no. 770 205

GENO-membrane degassing system MEC 2200-1 (1-stage)

To remove CO₂ from the feed water (permeate) of the electrodeionisation system
Flow volume of feed water:

0.5 – 3.41 m³/h

Amount of stripping gas* required:

0.8 – 5.1 Nm³/h

Order no. 770 210

GENO-membrane degassing system MEC 2200-2 (2-stage)

To remove CO₂ from the feed water (permeate) of the electrodeionisation system
Flow volume of feed water:

0.5 – 3.41 m³/h

Amount of stripping gas* required:

1.6 – 10.2 Nm³/h

Order no. 770 215

*Stripping gas = oil-free, compressed air

Pure water tank for intermediate storage of diluate flowing unpressurised from GENO-EDI-X electrodeionisation systems

Tank version:

All tanks are pre-assembled, with PVC overflow pipe as well as connections for the inlet, diluate and the suction line of the pressure booster system. Grey PE. Hand hole with removable screw cap. Level sensor for installation in the tank, electrically connected to GENO-EDI-tronic controller.

Basic pure water tank GT-X 1000 with sterile air filter and level sensor

Useful capacity approx. 1000 litres
l 860 / w 960 / total height 2200 mm¹⁾

Order no. 712000040000

Additional tank GT 1000 with sterile air filter

Useful capacity approx. 1000 litres
l 860 / w 800 / total height 2200 mm¹⁾

Order no. 712000060000

¹⁾ **Tank height incl. connecting pieces.**
For larger tanks, please inquire

Additional tank without level control and overflow loop, incl. 2 connecting lines, id=36 mm.

 **Note:** A maximum of four supply tanks can be combined.

CO₂ trap for pure water tank

For the removal of free chlorine dioxide from the tank's ventilating air.

Order no. 712 800

For larger CO₂ traps, please inquire

Pressure booster system GENO-FU-X 2/40-1 NE

Compact, pressure-controlled pump aggregate consisting of a centrifugal pump completely made of stainless steel as well as an integrated pressure and flow meter for pump control and dry-run protection. Special version for the delivery of diluate.

Delivery rate: max. 1.2 - 4.4 m³/h

Delivery head: max. 26.7 - 59.4 m

Power supply: 230 V / 50 Hz

Power input: 1.07 kW

Connections: DN 25 / 1"

Protection: IP 55

Order no. 730 790

Pressure booster system GENO-FU-X 2/40-2 NE

Description as for single pressure booster system, however, with the possibility for time-load switchover.

Order no. 730 791

For larger systems, please inquire

General installation information

The installation site must provide adequate space. For installation and service work, sufficient space (> 50 cm, > 20 cm from the wall) must be provided around the system. A foundation of sufficient size and adequate load-bearing capacity must be provided. The required connections must be provided prior to the installation of the system. For dimensions and connection data, please refer to the table "Technical specifications".

The installation of an electrodeionisation system represents a major interference with the drinking water system. Therefore,

only authorised installation companies may install such systems.

Obey the local installation guidelines and general regulations.

Install a drinking water filter upstream (e.g. BOXER).

Install a system separator upstream

Install a water softener upstream

Install an activated carbon filter upstream

Install a reverse osmosis system upstream

If the CO₂ concentration is too high, a membrane degassing system must be provided in addition.

Provide a drain connection (at least DN 50) to discharge the concentrate.

For the electrical connection, a supply line to the system must be provided by the client according to the wiring diagram. This line must be dimensioned according to the system type.

The installation site must have a floor drain. If no floor drain is available, an adequate safety device needs to be installed. Floor drains that discharge to a lifting system do not work in case of a power failure.

Technical specifications	GENO-EDI-X								
	100	180	360	720	1100	1450	2000	2700	
Connection data									
Nominal connection diameter of feed water inlet pipe (screw connection)	DN 15			DN 25					
Nominal connection diameter of diluate outlet (screw connection)	DN 15			DN 25					
Nominal connection diameter of concentrate outlet (screw connection)	DN 15			DN 15					
Min. drain connection required	DN			50					
Connected load	kW/A/mm ²			2.0 / 16 / 1.5					
Power supply	V/Hz			1x 230 / 50 - 60					
Protection type/protection class				IP 54 / Ⓢ					
Performance data									
Feed water volume (nominal)	l/h	110	200	400	800	1200	1600	2200	3000
Diluate capacity at a feed water temperature of 15 °C and a recovery of approx. 90 % (nominal)	l/h	100	180	360	720	1100	1450	2000	2700
Concentrate volume flow at a recovery of approx. 90 % (nominal)	l/h	10	20	40	80	100	150	200	300
Diluate capacity max.****	l/h	150	300	600	1000	1350	2100	2600	3750
Min. diluate flow*** required	l/h	62.5	125	250	550	550	1100	1100	1400
Min. concentrate flow*** required	l/h	10	20	40	40	40	65	65	85
Operating voltage	V DC	< 106	< 213	< 426	≤ 67	≤ 67	≤ 120	≤ 120	≤ 160
Operating current	A	< 2.5	< 2.5	< 2.5	< 5	< 5	< 5	< 5	< 5
Max. volume flow of hydrogen gas	l/h	1.12			2.24				
Inlet flow pressure of permeate, min./max.	bar	2/5			3/7				
Outlet pressure of diluate, approx.	bar	0.5/1.5							
Max. operating pressure	barg	5			7				
Conductivity equivalent (FCE)**, max.	µS/cm	40							
Diluate conductivity*	µS/cm	< 0.2							
SiO ₂ reduction	%	90 – 99							
Recovery****	%	90 – 93			90 – 95				
Dimensions and weights									
Dimensions (w x h x d)	mm	900 x 1700 x 675							
Required room height/Installation height, min.	mm	2000							
Operating weight, approx.	kg	95	105	115	170	170	190	190	215
Ambient data									
Temperature of feed water, min./max.	°C	10/25							
Ambient temperature min./max.	°C	5/35							
Order no.		770 300	770 310	770 320	770 330	770 340	770 350	770 360	770 370

* Subject to the feed water quality

** For calculation, refer to the formula indicated in the paragraph "Application limits"

*** These volume flows must be considered as the absolute minimum for the flow rates of the EDI module!

**** In case of maximum recoveries of 93 or 95 %, the following shall also apply with regard to the feed water specification:
CaCO₃ < 0.02 ppm and SiO₂ < 0.5 ppm

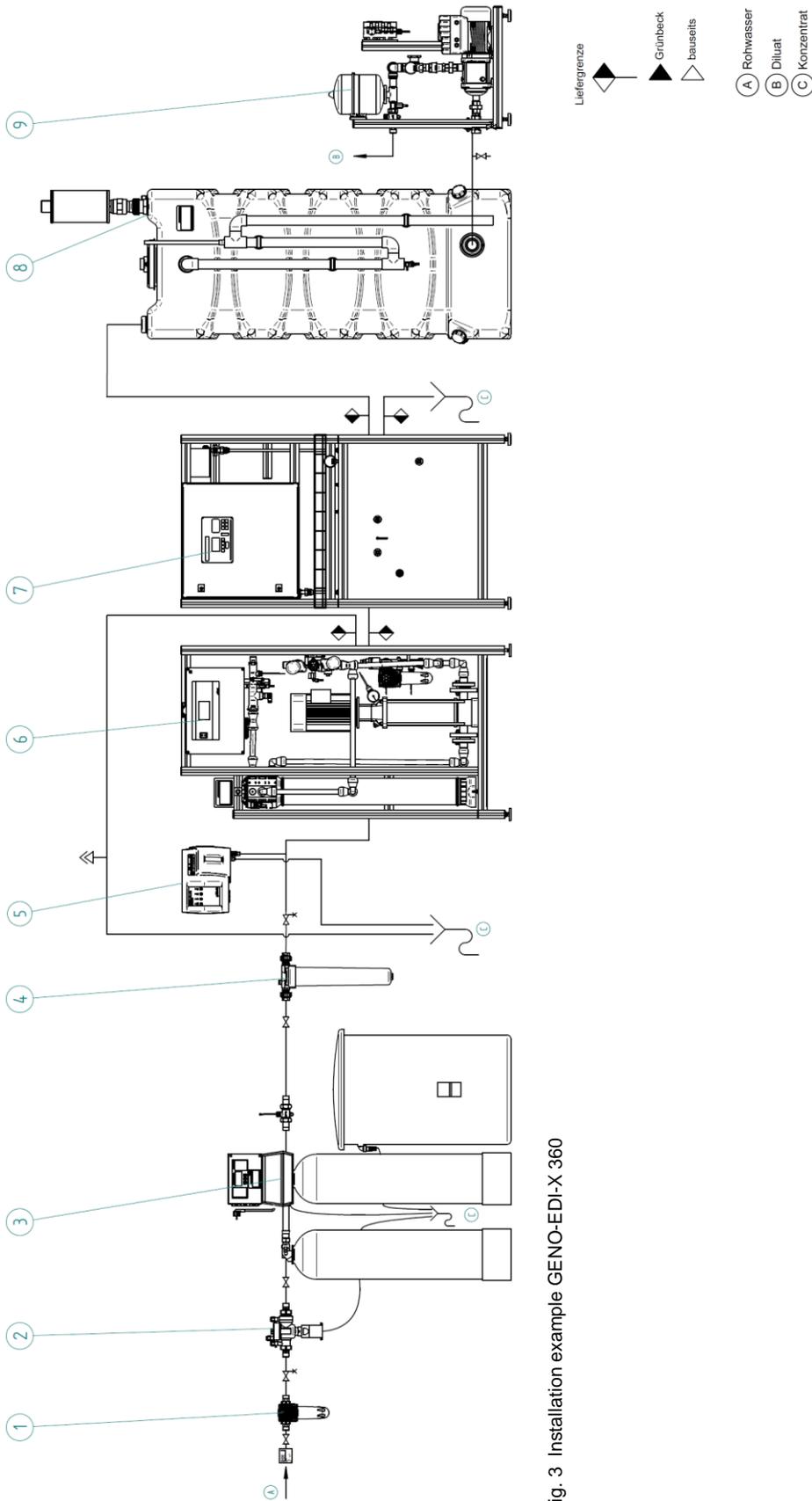


Fig. 3 Installation example GENO-EDI-X 360

- 1 Fine filter BOXER K 1"
- 2 Euro system separator DK 2
- 3 Water softener GENO-mat duo WE-X
- 4 Hardness control measuring device softwatch
- 5 Activated carbon filter AKF
- 6 Reverse osmosis system GENO-OSMO-X 400
- 7 Electrodeionisation system GENO-EDI-X 360 (with integrated GENO-membrane degassing system MEC 500 as an option)
- 8 Diluate tank with CO₂ trap
- 9 Pressure booster system GENO-FU-X 2/40-2 NE

Note: The concentrate and/or permeate pipe provided by the client on site (reverse osmosis system) must feature a provision to separate the pipes (e.g. a screw connection).

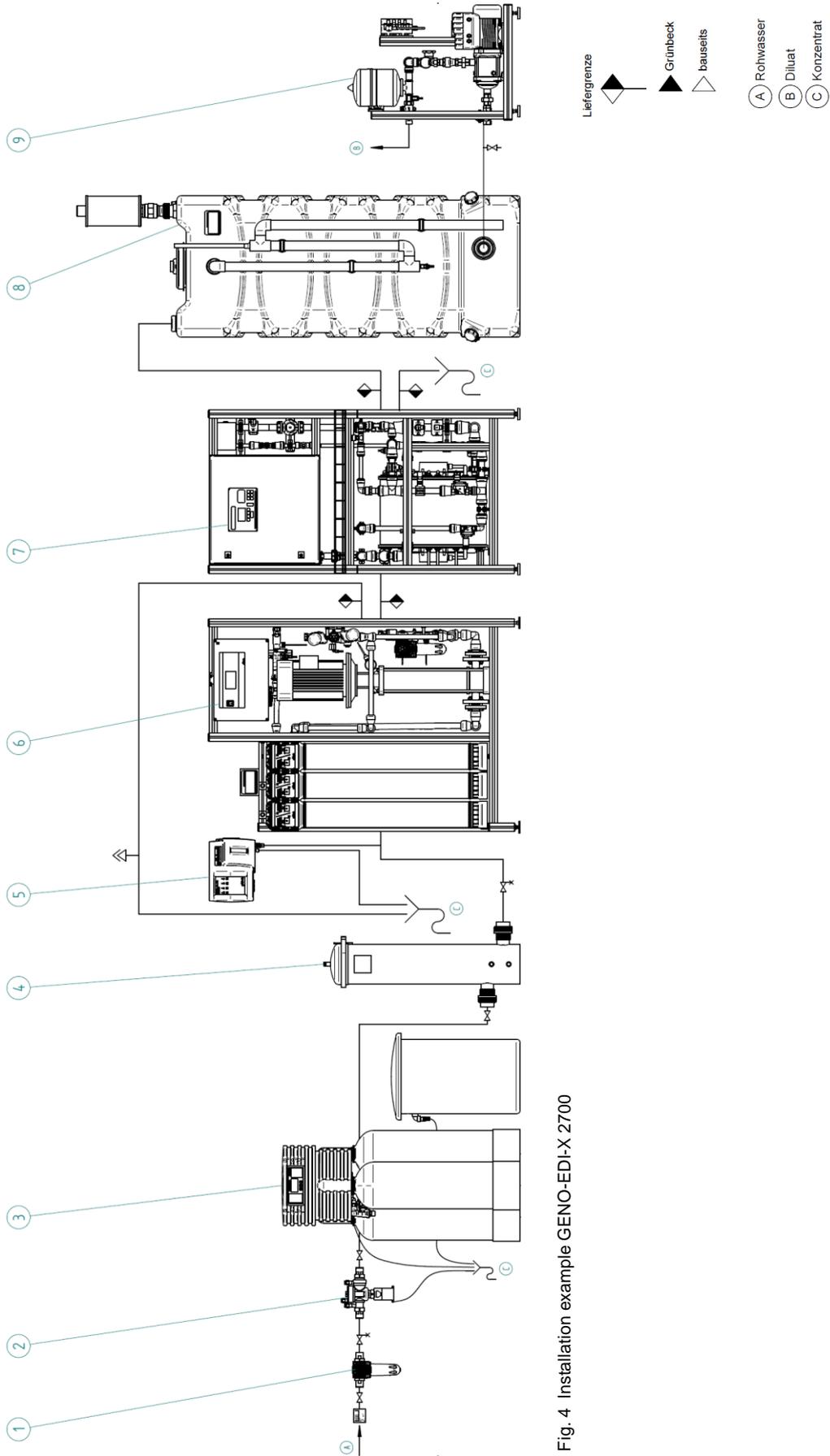


Fig. 4 Installation example GENO-EDI-X 2700

- | | |
|--|---|
| <ul style="list-style-type: none"> 1 Fine filter BOXER K 1 1/4" 2 Euro system separator DK 2 3 Water softener Delta p 1 1/4" 4 Hardness control measuring device softwatch 5 Activated carbon filter AKF 4500 6 Reverse osmosis system GENO-OSMO-X 3000 7 Electrodeionisation system GENO-EDI-X 2700 (with integrated GENO-membrane degassing system MEC 3000 as an option) 8 Diluate tank with CO₂ trap 9 Pressure booster system GENO-FU-X 2/40-2 NE | <ul style="list-style-type: none"> (A) Rohwasser (B) Diluat (C) Konzentrat |
|--|---|

Note: The concentrate and/or permeate pipe provided by the client on site (reverse osmosis system) must feature a provision to separate the pipes (e.g. a screw connection).