

OPERATION INSTRUCTIONS

**for reverse osmosis membrane elements of SNRO series,
nanofiltration elements of SNNF series,
and ultrafiltration elements of SNUF series**

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1 GENERAL PROVISIONS

1.1. This Technical Description and Operation Instructions apply to reverse osmosis membrane elements of SNRO series, nanofiltration elements of SNNF series, ultrafiltration elements of SNUF series in sanitary design manufactured in accordance with TU (technical requirements) 22.29.29-011-67318131-2017.

This Technical Description and Operation Instructions establish the rules of storage, installation and operation, compliance with which ensures that the membrane elements are always ready for operation.

1.2. Sanitary membrane elements are available in the following versions:

- Reverse osmosis membranes of SNRO series:

types 3838-31, 3838-34, 3838-46, 7838-31, 7838-34, 7838-46, 8038-31, 8038-34, 8038-46, 3838-31 PP, 3838-34 PP, 3838-46 PP, 7838-31 PP, 7838-34 PP, 7838-46 PP, 8038-31 PP, 8038-34 PP, 8038-46 PP.

- Nanofiltration membranes of SNNF series:

types 3838-31, 3838-34, 3838-46, 7838-31, 7838-34, 7838-46, 8038-31, 8038-34, 8038-46.

- Ultrafiltration membranes of SNUF series:

types 3838-10-31, 3838-20-31, 3838-50-31, 3838-10-46, 3838-20-46, 3838-50-46, 3838-10-65, 3838-20-65, 3838-50-65, 3838-10-80, 3838-20-80, 3838-50-80, 3838-10-31 PP, 3838-10-46 PP, 3838-10-65 PP, 3838-10-80 PP,

4336-10-31, 4336-10-46, 4336-10-65, 4336-10-80, 4336-10-31 PP, 4336-10-46 PP, 4336-10-65 PP, 4336-10-80 PP,

4338-10-31, 4338-10-46, 4338-10-65, 4338-10-80, 4338-10-31 PP, 4338-10-46 PP, 4338-10-65 PP, 4338-10-80 PP,

6338-10-31, 6338-20-31, 6338-50-31, 6338-10-46, 6338-20-46, 6338-50-46, 6338-10-65, 6338-20-65, 6338-50-65, 6338-10-80, 6338-20-80, 6338-50-80, 6338-10-31 PP, 6338-10-46 PP, 6338-10-65 PP, 6338-10-80 PP,

6438-10-31, 6438-20-31, 6438-50-31, 6438-10-46, 6438-20-46, 6438-50-46, 6438-10-65, 6438-20-65, 6438-50-65, 6438-10-80, 6438-20-80, 6438-50-80, 6438-10-31 PP, 6438-10-46 PP, 6438-10-65 PP, 6438-10-80 PP,

7838-10-31, 7838-20-31, 7838-50-31, 7838-10-46, 7838-20-46, 7838-50-46, 7838-10-65, 7838-20-65, 7838-50-65, 7838-10-80, 7838-20-80, 7838-50-80, 7838-10-31 PP, 7838-10-46 PP, 7838-10-65 PP, 7838-10-80 PP,

8038-10-31, 8038-20-31, 8038-50-31, 8038-10-46, 8038-20-46, 8038-50-46, 8038-10-65, 8038-20-65, 8038-50-65, 8038-10-80, 8038-20-80, 8038-50-80, 8038-10-31 PP, 8038-10-46 PP, 8038-10-65 PP, 8038-10-80 PP,

8338-10-46, 8338-10-65, 8338-10-46 PP, 8338-10-65 PP.

Element designation scheme:

- reverse osmosis – SNRO AAB-B-CC PP / SNRO AAB-B-CC,
- nanofiltration – SNNF AAB-B-CC,
- ultrafiltration – SNUF AAB-B-DD-CC PP / SNUF AAB-B-DD-CC, where

SNRO, SNNF, SNUF – designation of a series of elements,

AA – element diameter, inch*10,

BB – element length, inch,

CC – thickness of the vortex generating mesh, milinch,

DD – molecular weight cutoff (MWCO), kDa,

PP – membrane sheet on a polypropylene backing.

1.3. Spiral membrane elements are cylinders obtained by spiral winding of membrane stacks on a perforated tube with the vortex generating mesh inside and drainage material enclosed between them. The membrane stack is sealed by gluing with adhesive composition at the three sides of the perimeter, the fourth side of the perimeter is open to the tube. The membrane acts as a semi-permeable filtering partition. The elements are wrapped in a vortex generating mesh on the outside.

1.4. The membrane elements are supplied dry.

1.5. The membrane elements are packed in bags made of barrier film that prevents oxygen penetration. The bags are sealed on both sides in the nitrogen atmosphere and vacuumed.

1.6. T-23, P-33 boxes made of corrugated multi-layer cardboard according to GOST R 52901-2007 are used as individual transportation containers.

2 PURPOSE

Sanitary membrane elements are intended for use in membrane separation units for the purpose of:

- concentration of whey proteins;
- production of milk protein concentrate;
- concentration and demineralization of milk, juices, extracts, animal and vegetable proteins, biologically active substances;
- production of lactose and its derivatives;
- processing of technical solutions in pharmaceutical, food and other industries.

3 TRANSPORTATION AND STORAGE

3.1. Transportation of dry elements packed in accordance with TU is carried out by any type of transport in covered vehicles in accordance with the current cargo transportation rules at a temperature of +5°C to +35°C.

3.2. Storage of new membrane elements.

3.2.1. New elements should be stored in their original packaging.

3.2.2. Elements packed in accordance with TU should be stored in closed dry rooms at a temperature of +5° to +35°C, humidity of up to 60%, avoiding exposure to direct sunlight.

3.2.3. Elements are to be stored in a horizontal position on pallets or racks located at a distance of at least 1 m from heating devices, in max. nine tiers, if there are additional reinforcers in the packaging box, and max. five tiers, if there are no additional reinforcers in the packaging box.

3.2.4. During storage, the elements should not be exposed to aggressive media, as well as thermal radiation and mechanical loads.

3.2.5. When storing elements, avoid freezing them.

3.3. Procedure of storing elements in the membrane unit.

3.3.1. Procedure of storing elements when the membrane unit is stopped for a short time.

If the membrane unit is idle for a short time (4 hours to 5 days), it is necessary to make short alkaline wash at least once a day. Complete wash should be done immediately before resuming the unit operation.

4 HOW TO INSTALL THE ELEMENTS IN THE HOUSING

4.1. To load the membrane elements into the pressure housing, the following is needed (example: three-seat housing, see Figure 1):

- membrane element (item 1) – 3 pcs;
- anti-telescoping device (ATD) (item 2) – 3 pcs.;
- end cap (item 3) – 1 pc;
- rubber seal for ATD and end cap (item 4) – 7 pcs.;
- protective gloves and glasses;
- glycerin;
- observation log or notepad.

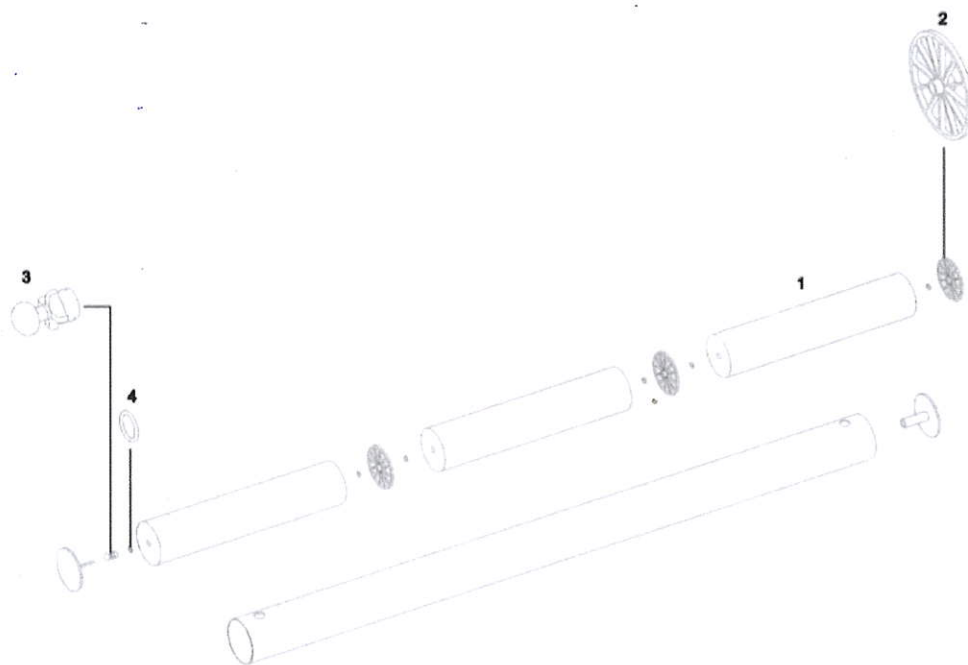


Figure 1. Diagram of installation of membrane elements into the pressure housing

- 4.2. Remove the end cap and remove the old membrane elements from the housing.
- 4.3. It is recommended to wash the housing with desalted water to make it easier to load the membrane elements.
- 4.4. Before loading, remove the membrane elements from the packaging, write down their serial numbers and the order in which they are located in the case into the notepad.
- 4.5. Load elements into the housing from the permeate cover side.
- 4.6. Install the rubber seals on the ATD and the end cap.
- 4.7. Thoroughly lubricate the rubber seals, as well as the permeate tubes of the elements 2-3 cm deep from the inside with glycerin.
- 4.8. Install the blind end cap and secure it.
- 4.9. Insert the end cap and ATD into the permeate tube of the first element, and one ATD into each of the other elements.
- 4.10. Push the first element into the housing so that its end with the installed ATD protrudes from the housing by 20-30 cm.
- 4.11. Take the next element and align its permeate tube with the ATD of the already installed element.
- 4.12. Load the remaining elements into the housing in the same way as in paragraphs 4.10-4.11.
- 4.13. Align the permeate cover with the last element's ATD, push it all the way into the housing, and lock it in place.

5 OPERATION PROCEDURE

5.1. Before starting the membrane plant, after replacing the membrane elements, they should be chemically washed for the first time. Washing is to be done as follows*.

5.1.1. Washing the plant with prepared water at a temperature of $+40\div 48^{\circ}\text{C}$ for 10 minutes, while draining permeate and retentate into the drain (the volume of water should be 3 times the total volume of the membrane unit).

5.1.2. A) Washing the plant using a chemical wash unit at standard pressure and flow (according to the operating instructions of the unit) with alkaline solution with the addition of enzymes with pH of $9.0\div 10.5$ at a temperature of $+47\div 48^{\circ}\text{C}$ for 40 minutes. (This step is only used for flushing NF and RO membranes).**

B) Washing the plant using a chemical wash unit at standard pressure and flow (according to the operating instructions of the unit) with alkaline solution with the addition of hypochlorite with pH of 10.5 at a temperature of $+47\div 48^{\circ}\text{C}$ for 30 minutes. Concentration of free chlorine should not exceed 200 mg/l. (This step is used only for washing UF membranes).**

5.1.3. Washing the plant with prepared water at a temperature of $+40\div 50^{\circ}\text{C}$ for 10 minutes, while draining permeate and retentate into the drain (the volume of water should be 3 times the total volume of the membrane plant).

5.1.4. Washing the plant using a chemical wash unit at standard pressure and flow (according to the operating instructions of the plant) with acid solution with pH of 1.8-2 at a temperature of $+47\div 48^{\circ}\text{C}$ for 20 minutes.

5.1.5. Washing the plant with prepared water at a temperature of $+40\div 48^{\circ}\text{C}$ for 10 minutes, while draining permeate and retentate into the drain (the volume of water should be 3 times the total volume of the membrane plant).

5.1.6. Washing the plant using a chemical wash unit at standard pressure and flow (according to the operating instructions of the plant) with alkaline solution with pH of 10.8-10.9 at a temperature of $+47\div 48^{\circ}\text{C}$ for 30 minutes.

5.1.7. Washing the plant with prepared water at a temperature of $+40\div 48^{\circ}\text{C}$ for 10 minutes, while draining permeate and retentate into the drain (the volume of water should be 3 times the total volume of the membrane plant).

5.1.8. When working with prepared water, need to record data on capacity, pressure, and differential pressure of the unit under the conditions specified by the manufacturer of the membrane unit (temperature, pressure, and inlet flow). This data should be recorded in the operation log and used as a reference for subsequent chemical washes.

5.2. Requirements for water quality for diafiltration, media displacement, and preparation of solutions for chemical washing are shown in Table 1.

5.3. Specialized detergents may be used for chemical washing of SNUF, SNNF and SNRO membrane elements, provided that the chemical washing conditions set out in par. 5.8 are met and approval is obtained from Membranium (JSC RM Nanotech).

**The washing program is indicative only. A more detailed washing program for each specific unit should be provided by the unit manufacturer or the detergent manufacturer.*

***When washing new membrane elements for the first time, this step may be skipped.*

Table 1. Requirements for water quality for diafiltration and preparation of solutions for chemical washing of membrane elements.

Parameter	Unit	Limit value		
		For SNUF elements	For SNNF elements	For SNRO elements
Turbidity	NTU units	1	1	1
Suspended solids	mg/l	5	1	1
Oxidability	mg O ₂ /l	5	5	5
Calcium	mg/l	10	5	5
Hardness	mg-Eq/L	1	0.5	0.5
Iron	mg/l	0.05	0.05	0.05
Zinc	mg/l	0.3	0.05	0.05
Copper	mg/l	0.1	0.05	0.05
Manganese	mg/l	0.05	0.02	0.02
Aluminium	mg/l	0.05	0.05	0.05
Silicon (as in SiO ₂)	mg/l	1	0.1	0.1
Silicone	mg/l	0	0	0
Total microbial number	number/ml	50	50	50
E. coli	number in 100 ml	0	0	0
Free chlorine	mg/l	1	0	0
Fat, oil, petroleum products	mg/l	0	0	0
pH	PH unit	6-8	6-8	6-8

5.4. When installing membrane elements, use only glycerine to lubricate rubber seals. The use of lubricants based on petroleum products is unacceptable and may lead to failure of the membrane elements.

5.5. During the start-up and operation of the membrane plant, need to provide the following:

5.5.1. Do not exceed the inlet pressure and inlet flow above the values specified in par. 5.8.

5.5.2. Take measures to protect the membrane elements from back pressure from permeate.

5.5.3. Avoid pressure shocks during startup, operation, and shutdown of the membrane plant.

5.5.4. When starting the plant, increase the inlet pressure to the operating value smoothly for 30-60 seconds at a speed of max. 0.07 MPa/sec.

5.5.5. When switching off the plant, reduce the pressure at the inlet of the elements from the operating value to zero smoothly for 30-60 seconds at a speed of max. 0.07 MPa/sec.

5.5.6. It is necessary to minimize the temperature difference between the washing and rinsing steps. The rate of temperature change should not exceed 5°C/min.

5.6. After commissioning, the membrane elements shall not be allowed to dry out; the elements shall always be wet.

5.7. Stable performance of the membrane elements is achieved within 5 (five) cycles of complete chemical washing.

5.8. Operating conditions of the membrane elements are shown in Table 2.

Table 2. Operating conditions for membrane elements of SNUF, SNNF, and SNRO series.

Parameter	Unit	Limit value				
		For SNUF elements	For SNUF PP elements	For SNNF elements	For SNRO elements	For SNRO PP elements
Working pressure	MPa	0.2-0.8		1.3-3.2	2.0-4.1	
Maximum pressure	MPa	1.0		5.5	5.5	
Maximum operating temperature	°C	50	60	50	50	60
Maximum temperature during chemical washing	°C	50	65	50	50	60
pH during operation	PH unit	2-10		4-10	4-10	
pH at chemical wash	PH unit	1.8-11	1.8-12	1.8-11	1.8-11	1.8-12
Maximum concentration of hydrogen peroxide during chemical washing (30 minutes, +25°C)	mg/l	1000		500	200	
Maximum concentration of free chlorine during chemical washing (30 minutes, +25°C, pH 10.5)	mg/l	200		0	0	
Maximum differential pressure at one element (vortex generating mesh thickness, mil)	MPa	0.1 (31 mil) 0.13 (46 mil) 0.15 (65 mil) 0.15 (80 mil)		0.1 (31 mil) 0.11 (34 mil) 0.11 (46 mil)	0.1 (31 mil) 0.11 (34 mil) 0.11 (46 mil)	
Maximum input flow for elements at the maximum differential pressure at the viscosity of separated media of 1 cPs at a temperature of +25°C						
For 3838 elements	m ³ /h	6 (31 mil) 6.5 (34 mil) 8 (46 mil) 10 (65 mil) 12 (80 mil)				

For 4336, 4338 elements	m^3/h	9 (31 mil) 13 (46 mil) 17 (65 mil) 21 (80 mil)
For 6338, 6438 elements	m^3/h	17 (31 mil) 21 (46 mil) 25 (65 mil) 29 (80 mil)
For 7838 elements	m^3/h	18.6 (31 mil) 21.9 (46 mil) 26.2 (65 mil) 29.6 (80 mil)
For 8038 elements	m^3/h	19 (31 mil) 23 (46 mil) 27 (65 mil) 32 (80 mil)
For 8338 elements	m^3/h	26 (46 mil) 31 (65 mil)

6 WARRANTY CONDITIONS FOR MEMBRANE ELEMENTS

6.1. JSC RM Nanotech provides warranty for the materials, manufacturing quality and operation of its roll-type membrane elements, if recommendations of JSC RM Nanotech are followed, and in accordance with the following provisions:

6.2. If these operation instructions are followed, JSC RM Nanotech guarantees operation of the membrane elements for 12 months from the start of operation, provided that the new elements were put into operation no later than 6 months after the date of shipment.

6.3. JSC RM Nanotech guarantees that neither the materials nor assembly quality of the new membrane elements have any defects, provided that such elements are operated and maintained in accordance with the operation instructions and specifications of JSC RM Nanotech. JSC RM Nanotech's obligations under this warranty are limited to repairing or, at the discretion of JSC RM Nanotech, replacing any element that, after inspection by JSC RM Nanotech, was found to be defective under this warranty.

6.4. The buyer is responsible for safety of roll-type membrane elements during transportation, storage and installation into pressure housings. Failure to comply with the conditions of transportation, storage, and installation into pressure housings may result in a refusal of warranty obligations.

6.5. The buyer is responsible for providing users with appropriate operation instructions for the system, training operators and maintenance personnel, and ensuring the possibility of proper cleaning and diagnostic procedures. If a consumer ignores recommendations for operation of membrane elements, this may be the reason for refusal of warranty obligations.

6.6. During the first start-up, the elements should be washed according to the procedure described in par. 5.1. According to the results of washing, an appropriate report should be drawn up. All initial parameters of the membrane unit operation should be sent to JSC RM Nanotech. Absence of the mentioned data at the first start of the membrane unit may be the reason for refusal of the manufacturer's warranty obligations.

6.7. For chemical washing, special cleaning solutions for the membrane elements may be used after coordination with JSC RM Nanotech. The buyer is responsible for the use of chemicals that are not recommended for use with membrane elements.

6.8. The buyer shall ensure that all parameters of the membrane unit operation are regularly recorded and systematically analyzed. The operation parameters (inlet pressure, retentate and permeate pressure, source product, retentate and permeate flow rates, process temperature, dry matter content in retentate and permeate, temperature and pH during chemical washing, name and quantity of cleaning reagents) should be recorded in the operation log of the membrane unit.

This information should be available to JSC RM Nanotech if it is sued for compensation in accordance with this warranty. Failure to provide JSC RM Nanotech with open access to the operation parameters of the membrane plant, in which JSC RM Nanotech's membrane elements are installed, will result in complete cancellation of the warranty obligations, except for those that apply to materials and components.

6.9. JSC RM Nanotech reserves the right to check suspected defective elements and the membrane unit at the User's facility, or to request the Buyer to carry out tests and send the results to JSC RM Nanotech.

ANNEXES

No.	Designation	Name
1	A	Geometric dimensions and specifications of reverse osmotic membrane elements of SNRO series
2	B	Geometric dimensions and specifications of nanofiltration membrane elements of SNNF series
3	C	Geometric dimensions and specifications of ultrafiltration membrane elements of SNUF series with a molecular weight cutoff of 10 kDa
4	D	Geometric dimensions and specifications of ultrafiltration membrane elements of SNUF series with a molecular weight cutoff of 20 kDa
5	E	Geometric dimensions and specifications of ultrafiltration membrane elements of SNUF series with a molecular weight cutoff of 50 kDa