Vibro™-I Manual

Please be sure to read this entire user manual prior to use of the equipment.

Please read all safety instructions carefully.

This user manual is part of the product. Keep it in a safe place for future reference.

Replacement manuals can be downloaded from our Webpage at: www.sanimembranes.com

Version: 20201214

SANI Membranes

1. Description

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a. Introduction

The Vibro™-I is an industrial filtration solution for applications where low energy consumption, high flux, sanitary function, low capital investment and gentle filtration are key words. The Vibro™-I delivers continuous low fouling filtration where the filter is kept clean by vibration shear.

The membrane module vibrates vertically while the patented Vibro™ technology makes the media inside the module stationary. The relative vibration of media and membrane creates turbulence on the membrane surface and thereby keeps the fouling layer at a minimum. The turbulence is only created at vertical surfaces. Thus, the energy required to create the turbulence at the membrane surfaces is minimized. Because the Vibro-I only creates turbulence at the membrane surfaces, the need to cool the retentate is reduced and most often eliminated, which again adds to the energy savings.

The Vibro™-I handles the feed solution very gently as no large circulation pump is needed. A conventional circulation pump can damage cells, molecules etc. during operation. By eliminating the circulation pump Vibro™-I has become the most product gentle industrial scale MF and UF system on the marked.

The elimination of the circulation pump also gives you virtually uniform trans membrane pressures throughout the unit. The uniform TMP gives you the sharpest membrane cut-offs of any industrial system.

Due to the open design of the Free Flow Plate™ Module (HP1), the Vibro™-I can handle very difficult products with high viscosity, high mass loadings and even high particulates. When extremely difficult feeds are processed, it is possible to homogenize the retentate in the Vibro™ systems by attaching a “slow” circulation pump.

The Vibro™-I is fully drainable of both retentate and permeate. Thus, no product loss and faster CIP cycles.

The Vibro™-I utilizes the 2.5 m^2 Free Flow Plate™ module (HP1) and comes with 7.5; 10; 15 or 20 m^2 membrane as 1-tower units. The units can be connected in series or parallel depending on your needs.

The tower configuration and the elimination of circulation pumps, cooling aggregates, booster pumps and intricate piping layout gives the Vibro™-I systems a small footprint. All media contacting parts are in durable polymeric materials or stainless steel.

The Vibro™-I can conform to GMP/FDA/EC regulations for materials in contact with food and other sanitary standards on request.

b. Validity

This manual applies to the Vibro-I in all versions including: Vibro-I 7.5 m^2; Vibro-I 10 m^2; Vibro-I 15 m^2 and Vibro-I 20 m^2.

This manual applies to the Vibro-I in combination with a suitable feed, permeate and CIP systems. The design and the degree of automation of said systems can vary a lot depending on the application and other needs of the end-user. A dedicated feed; permeate and CIP system should be designed and constructed in collaboration with the end-user.

c. Symbols

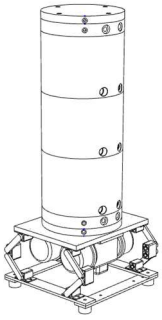
As warning of danger, all text statements in these instructions to be noted will be marked as follows:

⚠ **WARNING**
This symbol denotes a possible danger with medium risk that death or (severe) injury may result if it is not avoided.

⚠ **CAUTION**
This symbol denotes a possible danger with a low risk that moderate or minor injury may result if it is not avoided.

ATTENTION
This symbol denotes a danger with low risk of damage to property if not avoided.

2. System

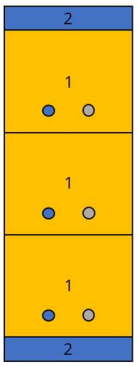


a. Parts list Vibro-I

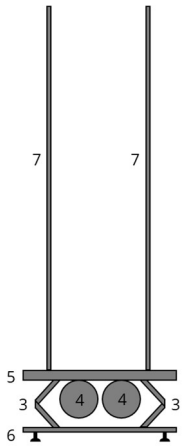
- HP1 2.5 m^2 membrane modules
- Vibro-I Cushion Assemblies (top and bottom)
- Vibro-I Motor Assembly

b. System Description

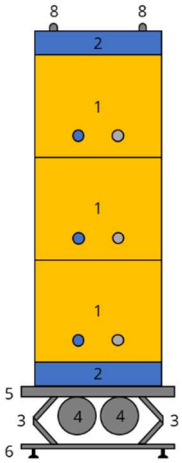
1. HP1 2.5 m^2 Membrane Module
2. Vibro-I Cushion Assembly
3. Industrial Springs
4. Vibro-I Motor
5. Base Plate
6. Vibro-I Stand
7. Rods
8. Nuts



Vibro-I Membrane Assembly



Vibro-I Motor Assembly



Vibro-I

The Vibro-I Membrane Assembly consist of a number of stacked HP1 2.5 m^2 membrane modules (1) connected with 2 Vibro-I Cushion Assemblies (2) on the top and bottom of the HP1 stack. The Vibro-I Membrane Assembly is the only part of the Vibro-I with product contact.

The Vibro-I Motor Assembly consist of a Vibro-I Stand with 4 feet (6), 4 Industrial Springs (3) are mounted on the Vibro-I Stand (6) and the Base Plate (5) is mounted on top of the Industrial Springs (3). The 2 Vibro-I Motors are mounted under The Base Plate (5) and 4 Rods (7) are mounted on top of the Base Plate (5).

The Vibro-I Membrane Assembly is assembled on top of the Vibro-I Motor Assembly (see assembly instructions) and secured with 4 Nuts (8) on top, forming the Vibro-I ready for production.

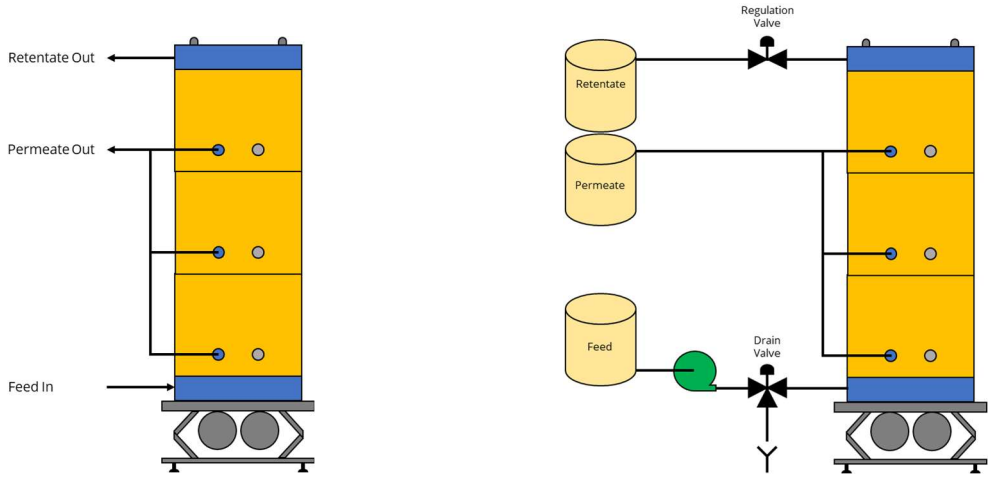
The Vibro-I Motor Assembly is connected to 400V, its function is to make the Vibro-I Membrane Assembly vibrated vertically at the right frequency and amplitude during operation.

9. Vibro-I Cushion
10. Media Inlet/Outlet Part
11. Top/bottom Part
12. Media Inlet/Outlet

Vibro-I Cushion Assembly

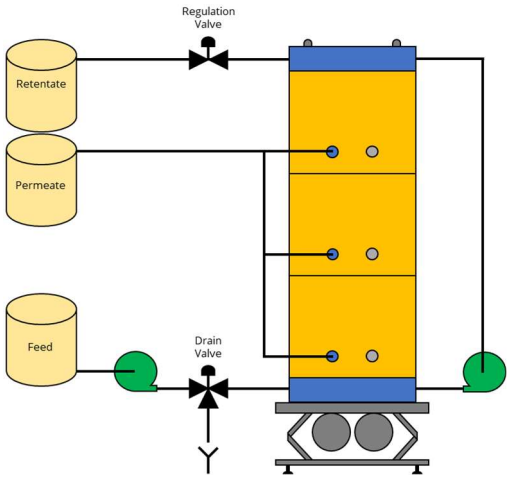
The Vibro-I Cushion Assembly consist of a Vibro-I Cushion (9) secured between a Media Inlet/Outlet Part (10) and a Top/Bottom Part (11). The Media Inlet/Outlet Part (10) has minimum two Media Inlet/Outlets for feed and retentate.

The Media Inlet/Outlet Part (10) comes in different versions with a different number and sizes of Media Inlet/Outlets and connections for instruments as pressure transducers, thermometer etc.



The standard way to run the Vibro-I is to feed media in through one of the feed inlets in the bottom of the Vibro-I Membrane Assembly and plug the other one. The permeate is taken out through the individual permeate outlets of each HP1 membrane module and the retentate is bleeded out at the desired concentration through one of the Media Inlets/Outlets in the top Vibro-I Cushion, while the other one is plugged. The Vibro-I is aerated during filling and drained through the retentate outlet and drained through the feed inlet.

The Vibro-I Motors must be turned on when the Vibro-I Membrane Assembly is filled with media (pressure above 0.1 bar) and turned off during drainage and filling (pressure below 0.1 bar). It is crucial to start the Vibro-I Motors as soon as the filling is done as the fouling starts immediately. Starting the Vibro-I Motors too late can result in sever fouling of the membranes. **ATTENTION** Automating the starting and stopping of the Vibro-I Motors is very easy and highly recommendable in any application.



If the retentate has a high viscosity, high solid loads or a tendency to make fouling cakes on the membrane a slow mix / homogenization flow can be beneficial. A mix pump is then mounted between the 2nd Media Inlets/Outlets in the top Vibro-I Cushion and the 2nd Media Inlet/Outlet in the bottom Vibro-I Cushion. The mix flow has a relatively slow speed (approx. 0.1m/s over the membrane surface) to mix the retentate in the Membrane Assembly and avoid severe fouling of the membrane.

See more examples of use in the Operation section.

3. Safety

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a. Intended use

The Vibro-I is a filtration system for MF and UF filtration that can be operated in numerous ways both 100% manual, 100% automated and every option in-between. The user should read and understand this manual before use. The Vibro-I is intended for use in an industrial or research facility.

The Vibro-I is intended to filter media and can only be used with HP1 membrane modules from SANI Membranes.

The Vibro-I can only be used together with a feed system with a CE approved safety valve set to maximum 4 bars.

The Vibro-I is a vibrating machine product that must be placed on a foundation that can absorb the reactions from the vibrations. Preferable vibration absorption is through suitable heavy flooring or foundations. Be aware that eigenfrequency or natural frequency response in buildings can lead to structural damage. ⚠ **WARNING**

The Vibro-I is NOT suited for use in explosive environments. ⚠ **WARNING**

This instruction manual is part of the Vibro-I. The Vibro-I is intended exclusively for use in accordance with this instruction manual.

The Vibro-I must only be used for intended use, the following are examples of improper use ⚠ **WARNING**:

- Unauthorized modifications and technical changes to the Vibro-I are improper use.
- Operation outside the permissible physical conditions given in this document (e.g. temperature, pressure, chemical vapors etc.) and given in the specification sheet for the HP1 membrane module used.
- Installation of unauthorized items on the Vibro-I.
- Connection of unsuited devices to the Vibro-I (e.g. unsuited feed systems).
- Use of media with biological materials in Safety Classes 2 and 3.
- Use of flammable or potentially explosive substances.
- Filtration of unstable media.
- Use of media which are incompatible with PP, Stainless Steel, Silicone, EPDM or other materials in the Vibro-I, HP1 membrane module or feed system used.

b. Personnel Qualification

All personnel operating the Vibro-I must have read this instruction manual thoroughly and be skilled in the art of pressurized filtration. All personnel operating the Vibro-I should be used to conduct themselves in a laboratory or industrial process environment and have passed mandatory safety courses etc. Students operating the Vibro-I must be instructed thoroughly by skilled teachers or other skilled personnel in proper use of the Vibro-I.

c. Media

The media used in the system can be dangerous to handle and cause personnel injuries or equipment damage when not handled correctly.
The operator should always seek the applicable safety information for the media to be filtered (e.g. handling and storage and conduct in emergency situations). ⚠ **WARNING**

Personal safety equipment should always be worn when applicable (e.g. safety googles, safety gloves etc.). ⚠ **WARNING**

Do Not use media with biological materials in Safety Classes 2 and 3. ⚠ **WARNING**

Do Not use flammable or potentially explosive substances. ⚠ **WARNING**

Do Not use unstable media where concentration changes might start chemical reactions within the media. ⚠ **WARNING**

The operator should always make sure that the media to be filtered is compatible with the materials in fluid connection in the Vibro-I (PP, Stainless Steel and PDMS) and the feed system used. **ATTENTION**

d. Pressurized Components

The pressure and media flow needed to drive the filtration in the Vibro-L is generated by an external feed system (not included). The external feed system and the tubing and fittings between the external feed system and the Membrane Assembly including the Membrane Assembly are a separate pressurized system. The system must be **operated at maximum 4 bar** at room temperature and the external feed system must have a CE approved safety valve set at **maximum 4 bar**. Parts of the system can burst if they are subjected to pressures over 4 bar. ⚠ **WARNING** Operating Pressure: 0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C. ⚠ **WARNING**

e. Leaking fluids

If the fluid system is leaking, liquid spill can cause a serious health danger depending on media. The operator should always seek the applicable safety information for the media to be filtered (e.g. handling and storage and conduct in emergency situations).

Personal safety equipment should always be worn when applicable (e.g. safety googles, safety gloves etc.). ⚠ **WARNING**

If the fluid system is leaking, liquid spill to the floor can cause a slipping hazard. ⚠ **CAUTION**

f. Moving parts

Body parts can be crushed when they come into contact with moving parts, e.g. the Membrane Assembly, the Industrial Springs. This can lead to injuries. ⚠ **WARNING**

Lose hair or lose clothing parts can be caught in moving parts and cause injuries. ⚠ **CAUTION**
The Vibro-I must be placed on a horizontal non-slippery surface as the vibrating movement can otherwise make the Vibro-I move doing operation and cause injuries. ⚠ **CAUTION**

g. Personal protective equipment

Mandatory personal protective equipment to protect against risks arising from the equipment or the material being processed:

- Tight-fitting work clothing - Protects against being caught by moving parts. ⚠ **CAUTION**
- Head covering - Protects hair from being pulled into moving parts. ⚠ **CAUTION**
- Safety glasses - Protects against substances leaking under high pressure, splashing liquids etc. ⚠ **WARNING**
- Safety shoes - Protects against injuries to the feet caused by mechanical effects. ⚠ **CAUTION**

h. Accessories and spare parts

The Vibro-I can only be used together with a feed system with a CE approved safety valve set to maximum 4 bars or a 4 bar software hard stop. ⚠ **WARNING**
The use of unsuitable accessories, consumables and spare parts can be hazardous and have the following consequences:

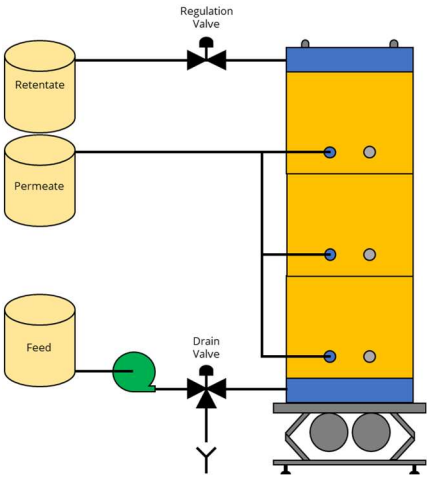
- Severe personnel injury ⚠ **WARNING**
- Damage to the device ⚠ **WARNING**
- Malfunctions of the device **ATTENTION**
- Device failure **ATTENTION**

Only use accessories, consumables and spare parts that are in technically perfect condition.
The use of accessories, consumables and spare parts **not** approved by SANI Membranes is the sole responsibility of the operator.

4. Operation

a. Introduction

The Vibro-I is simple to operate and gives you a perfect continuous filtration.



The Membrane Assembly is filled by feeding media carefully through the Feed Inlet with the Regulation Valve closed and the Air vent and Permeate Outlets open. Close the Air vent when the media has covered the membrane completely (pressure is above 0.1 bar). Start the Vibration Motors just after filling the Membrane Assembly with media and turn it off just before draining the Membrane Assembly for media. Severe fouling will occur if you stop the Vibration Motors with pressurized media in the chamber.

The pressure is regulated up to the operating pressure and retentate is bleeded out through the Regulation Valve. The amount of retentate to bleed out is calculated from your desired up-concentration degree and the amount of permeate produced (e.g. to up-concentrate your feed to double concentration you need to bleed out the same amount of retentate as the amount of permeate produced).

When the filtration process is finished, take of the feed pressure and drain the system for retentate and permeate. Clean the system with the appropriate CIP protocol for your membrane and application and finish the CIP by filling the system with an appropriate storing solution for your membrane and application.

Attention: Organic membranes must never be allowed to dry out after initial wetting. See storage after CIP. **ATTENTION**

Attention: Always maintain a positive trans membrane pressure when operating Your Vibro-I. The Permeate Outlets must be kept open when the unit is in operation. **ATTENTION**

Pressure guidelines during operation:

a) Avoid operating the unit at excessive flux leading to fast and high fouling of the membranes
b) Recommended trans membrane pressure for microfiltration is 0.05 - 1 bar
c) Recommended trans membrane pressure for ultrafiltration is 1 - 3 bar

b. General Guidelines – Process

1. Maintain a positive trans membrane pressure (min 0.02 bar) when vibration mode is on and keep the permeate drain open at all times
2. Maintain a retentate flow to avoid dead-end type filtration. A suitable retentate flow is normally +300 L/h but it is highly application dependent
3. Operating Pressure: 0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C ⚠ **WARNING**

4. When filtering media with high viscosity or high solids load a mix flow of 300-6000 l/h should be established
5. When MF filtering media with high solids load, the mix flow and vibration must be initiated as soon as the unit is filled to avoid severe fouling

Microfiltration (0 – 1 bar)

1. Keeping a very low trans membrane pressure: 0.05 to 0.4 bar often gives the best long-time results
2. The flux can be very high and easily result in severely fouled areas in the Vibro-I unit. Reduce the flux by lowering the trans membrane pressure and let more retentate out to avoid severe fouling

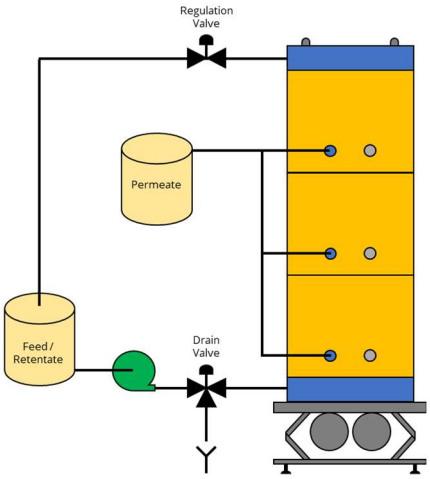
Ultrafiltration (1 – 4 bar)

1. Make sure that the system pressure does not exceed 4 bar – with a 4 bar safety valve or a 4 bar software hard stop.
   ⚠ **WARNING** Operating Pressure: 0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C. ⚠ **WARNING**

Examples of Microfiltration and Ultrafiltration Process Configurations:

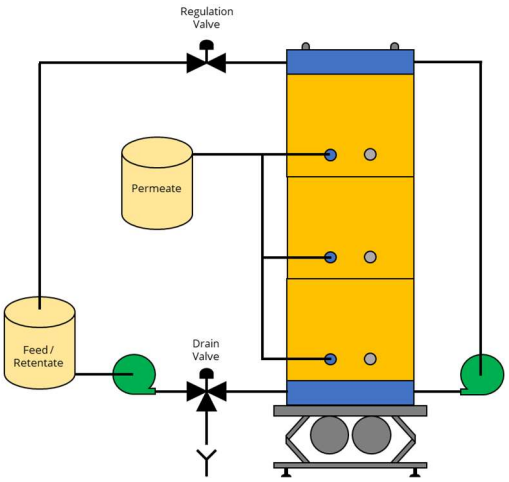
MF/UF batch mode with Batch Feed System and concentration in tank

- Simple configuration for viscosities up to "cream level"
- The trans membrane pressure is regulated with the Regulation Valve
- The retentate flow is regulated with the speed of the feed pump in combination with the Regulation Valve
- The concentration factor in the retentate is calculated from the amount of permeate collected and the initial feed volume
- This setup can also be used for diafiltration applications



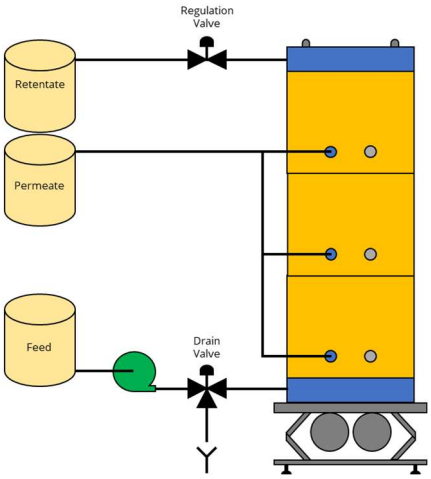
MF/UF batch mode with Batch Feed System and concentration in tank – high solids or high viscosity

- Configuration for high viscosity or high solids load; retentate must be kept fluid
- A mix flow is established to keep the retentate mixed and diminish fouling
- The trans membrane pressure is regulated with the Regulation Valve
- The retentate flow over the feed/retentate tank is regulated with the speed of the feed pump in combination with the Regulation Valve
- The concentration factor in the retentate is calculated from the amount of permeate collected and the initial feed volume
- This setup can also be used for diafiltration applications



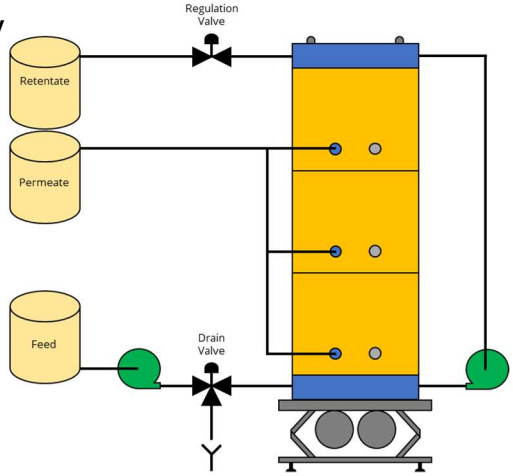
Continuous MF/UF mode– plug flow

- Configuration for viscosities up to "cream level"
- The trans membrane pressure is regulated with the feed pump
- The concentration factor is regulated with the Retentate Valve (flow of permeate measured against flow of retentate).
- The retentate can be bleeded out continuously or in portion depending on your setup and application



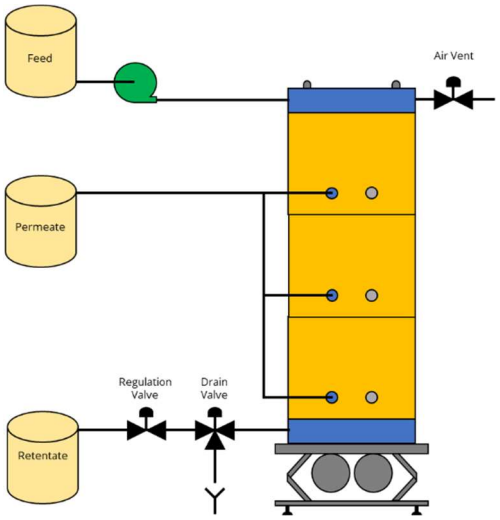
Continuous MF/UF mode with mix pump – high solids or high viscosity

- Configuration for high viscosity or high solids load; retentate must be kept fluid.
- The trans membrane pressure is regulated with the Regulation Valve
- The concentration factor is regulated with the Retentate Valve (flow of permeate measured against flow of retentate).
- The retentate can be bleeded out continuously or in portion depending on your setup and application



Continuous MF/UF mode with precipitate in the feed– plug flow

- Configuration for viscosities up to "cream level"
- If precipitate is present it can be an advantage to feed in at the top and take retentate out at the bottom
- A dedicated Air Vent is necessary in this configuration
- The trans membrane pressure is regulated with the Regulation Valve
- The concentration factor is regulated with the Retentate Valve (flow of permeate measured against flow of retentate).
- The retentate can be bleeded out continuously or in portion depending on your setup and application



The process configurations above are only examples of simple configurations. The optimal process configuration is highly application dependent and an application specific process configuration must be thought trough to each industrial application including CIP system, degree of automation, temperature control system etc.
The Vibro-I units can also be coupled in parallel, series and into cascade filtration systems.

c. Normal CIP for all Process Configurations (MF and UF):

Water flushes, buffer flushes or CIP cleaning must be performed after each run with media in the Vibro™-I. The appropriate cleaning method must be found for each membrane and membrane application by the user. Typical CIP routines for operation with organic material could consist of:

Standard Dairy CIP:

- Drain for product
- Flush through with warm water and drain
- Lye, 55°C at pH 11.5 for 20-25 min. and drain
- Flush with water for 5 min. and drain
- Lye, 55°C at pH 11.5 with enzymes for 20-25 min. and drain
- Flush with water for 5 min. and drain
- Acid at pH 1.5 for 15-20 min. and drain
- Flush with water for 5 min. and drain
- Ready for new production or leave filled with water or water + preservation or 20% alcohol until next production

Simple CIP

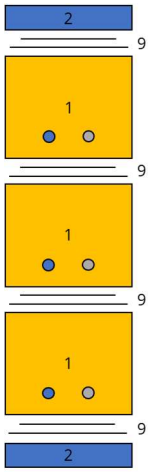
- Drain for product
- Flush through with warm water and drain
- Lye, 55°C at pH 11.5 for 20-25 min. and drain
- Flush with water for 5 min and drain
- Ready for new production or leave filled with water or water + preservation or 20% alcohol until next production

Ensure around 50/50 flow through the permeate and the retentate outlet at as low trans membrane pressure as possible. To adjust timing adjust flow, adjust trans membrane pressure and retentate flow.

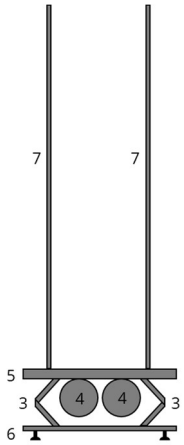
5. Assembly and Disassembly of the Vibro-I

a. Assembly and re-assembly of the Vibro-I

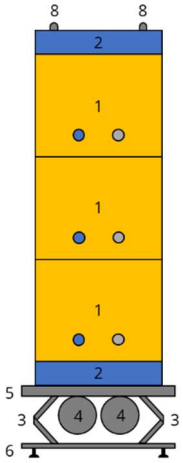
1. HP1 2.5 m^2 Membrane Module
2. Vibro-I Cushion Assembly
3. Industrial Springs
4. Vibro-I Motor
5. Base Plate
6. Vibro-I Stand
7. Rods
8. Nuts
9. Inner and Outer Gaskets



Vibro-I Membrane Assembly Parts

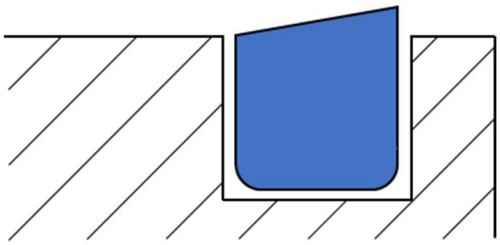


Vibro-I Motor Assembly



Vibro-I

1. Unpack all the parts of the Vibro-I in the area where it should be situated
2. Make sure that all parts are intact and clean
3. Assemble the Vibro-I Motor Assembly by mounting the 4 Rods (7) on the Base Plate (5)
4. Place the bottom Vibro-I Cushion Assembly (2) with the gasket groves up in the desired orientation by sliding it over the 4 Rods (7)
5. Place the Inner and Outer Gaskets (9) carefully in the gasket groves of the Vibro-I Cushion Assembly (2). The Outer Gasket is only needed if regular outside spray wash.
6. Make sure that the lip of the Inner Gasket is facing up

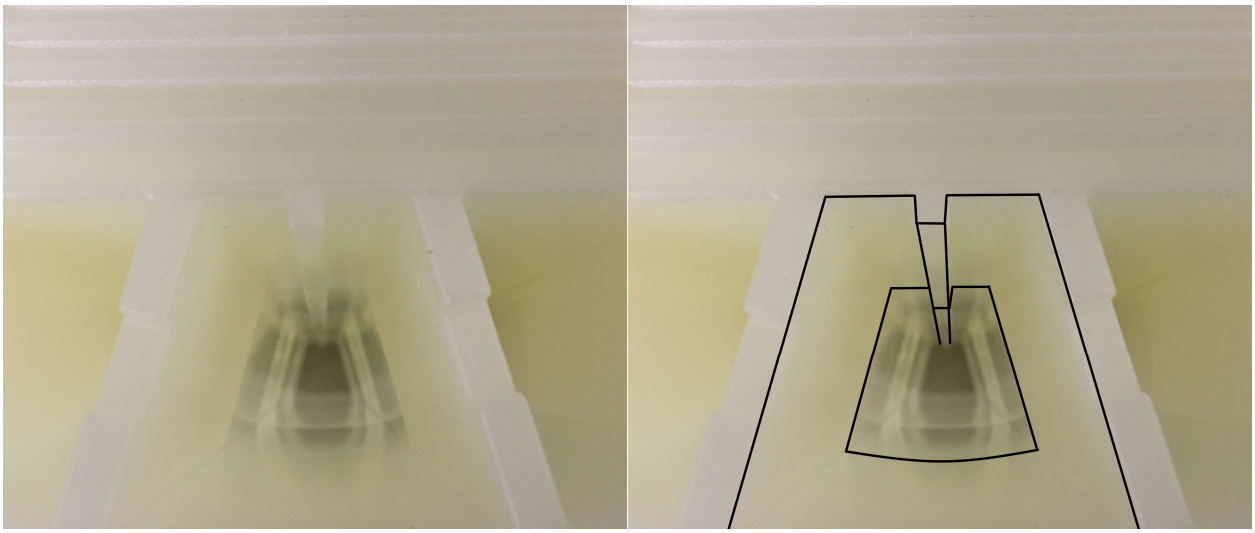


A cross-section of the Inner Gasket placed correctly with the 'lip' on the top right

7. The Permeate Outlets on the HP1 2.5 m^2 Membrane Modules (1) is secured with lock-nuts and should not be disassembled or tightened without expert knowledge.

8. Fittings for the permeate outlets are mounted on the permeate outlets. It is important to secure the permeate outlets from turning inside the module with an Allen wrench on the opposite side of the module.

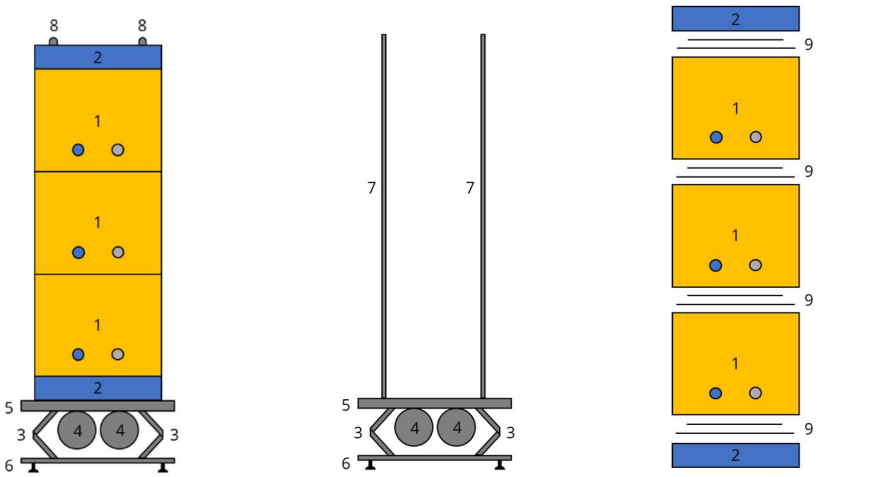
9. Place the bottom HP1 2.5 m^2 Membrane Module (1) in the desired orientation by sliding it over the Rods (7) and ensure it is perfectly aligned with the Vibro-I Cushion Assembly
10. Place the Inner and Outer Gaskets (9) carefully in the gasket groves of the HP1 2.5 m^2 Membrane Module (1).
11. Make sure that the lip of the Inner Gasket is facing up
12. Place all the HP1 2.5 m^2 Membrane Modules (1) in the same way and make sure it is perfectly aligned with the previous HP1
13. Place the top Vibro-I Cushion Assembly (2) on top of the top HP1 2.5 m^2 Membrane Module (1) in the desired orientation – and make sure that the two inner squares also are perfectly aligned.
14. Place washers on each Rod (7) and secure the Nuts (8) by cross tightening them slowly with a torque wrench adjusted to 35 Nm for the 7.5 m^2; 40 Nm for the 15 m^2 and ; 42 Nm for the 20 m^2 (The nuts must be re-tightened after 8 hours in operation of the Vibro-I).
15. Connect the Vibro-I to power, feed system etc.



When looking down in the central cavity of aligned HP1 elements the central rod and module sides needs to be perfectly aligned as on the left photo. The aligned rod and sides are marked in black on the right photo.

b. Disassembly of the Vibro-I

1. HP1 2.5 m^2 Membrane Module
2. Vibro-I Cushion Assembly
3. Industrial Springs
4. Vibro-I Motor
5. Base Plate
6. Vibro-I Stand
7. Rods
8. Nuts
9. Inner and Outer Gaskets



Vibro-I | Vibro-I Motor Assembly | Vibro-I Membrane Assembly

1. Disconnect the drained Vibro-I from all other equipment and power
2. Take off the 4 Nuts (8) and the washers at the top of the Membrane Assembly
3. Lift the top Vibro-I Cushion Assembly (2) free off the Rods (7)
4. Take the Inner and Outer Gaskets (9) off the top HP1 2.5 m^2 Membrane Module (1)
5. Lift the top HP1 2.5 m^2 Membrane Modules (1) free off the Rods (7)
6. Lift all the HP1 2.5 m^2 Membrane Module (1) off the Rods (7) in the same way.
7. Take the Inner and Outer Gaskets (9) off the bottom Vibro-I Cushion Assembly (2)
8. Lift the bottom Vibro-I Cushion Assembly (2) free off the Rods (7)
9. Make sure that all parts are intact and clean them with 50% Ethanol if necessary
10. Store the HP1 2.5 m^2 Membrane Module (1) in preservation fluid (e.g. 20% EtOH) if they are to be reused

6. Service and Maintenance

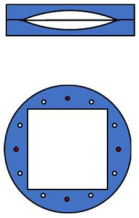
a. Tightening and re-tightening the Vibro-I top bolts

The 4 Nuts (8) on top of each module tower must be tightened with a torque wrench adjusted to 35 Nm for the 7.5 m^2; 38 Nm for the 10m^2; 40 Nm for the 15 m^2 and 42 Nm for the 20 m^2 (The nuts must be re-tightened after 8 hours in operation of the Vibro-I after each re-assembly).

b. Servicing the Vibro-I Cushion Assemblies

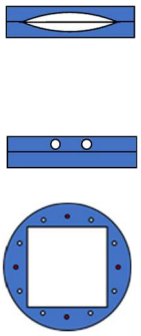
Every 6 - 8 weeks the Vibro-I Cushion Assemblies must be inspected and maintained as described below.

1. Disassemble the Vibro-I Membrane Assembly. (see separate instruction above)
2. Inspect that the Vibro-I Cushions in the Vibro-I Cushion Assemblies is intact and still inflated.
3. Exchange the Vibro-I Cushion in the Vibro-I Cushion Assembly if the Vibro-I Cushion is not intact or inflate the cavity below the cushion. (see separate instruction below)
4. Re-tighten the 8 M8 Allen bolts in the Vibro-I Cushion Assembly with a torque wrench adjusted to 4 Nm
5. Re-assemble the Vibro-I (see separate instruction above)



c. Exchanging the Vibro-I Cushion in the Vibro-I Membrane Assembly

1. Disassemble the Vibro-I Cushion Assembly by un-screwing the 8 M8 Allen bolts
2. Clean the top/bottom part and the inlet part of the Vibro-I Cushion Assembly with 50% Ethanol
3. Place the top/bottom part of the Vibro-I Cushion Assembly on a flat surface
4. Place a new Vibro-I Cushion in the cushion pocket in the top/bottom part of the Vibro-I Cushion Assembly and align it with the sides of the pocket
5. Place 8 M8 Allen bolts in the inlet part of the Vibro-I Cushion Assembly in the holes corresponding to the threads in the top/bottom part
6. Place the inlet part on top of the top/bottom part while aligning the 4 holes.
7. Cross tighten the 8 M8 Allen bolts carefully and tighten them with a torque wrench adjusted to 4 Nm



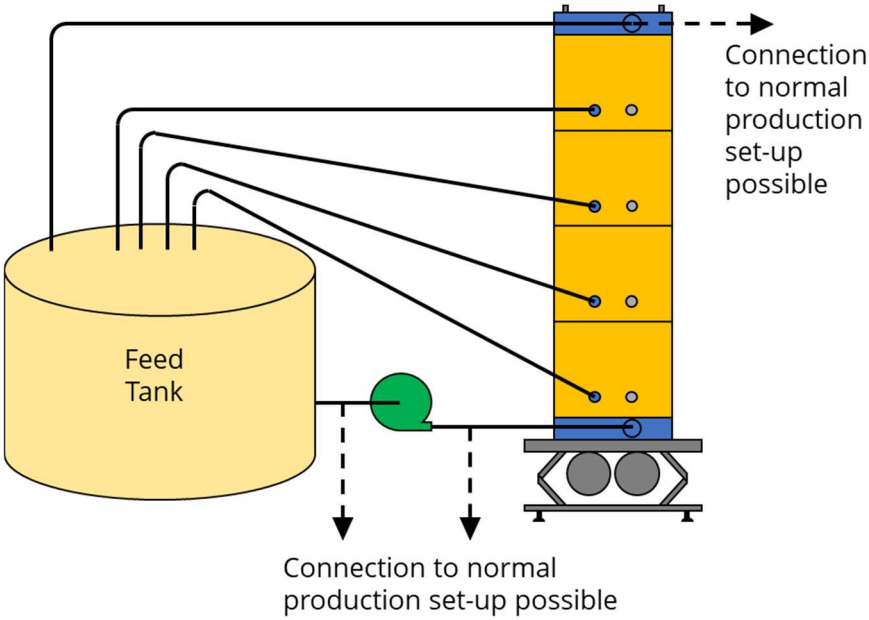
d. If the permeate quality drops

If permeate quality is not acceptable, one of the filter modules might be defect. Identify the defect module observing permeate from each individual module and exchange or isolate the faulty module.

1. Isolate the Vibro-I in question from the others if more Vibro-I units operate in parallel
2. Drain the Vibro-I for permeate and retentate, disassemble the tubing in the permeate system
3. If permeate is mounted in Tube–Tee–Tube manifold, push in a plug in one side of the Tee and mount a tube in each Tee-fitting leading back to the feed tank or to the permeate tank
4. Run a test production on the unit or a normal production on the whole filtration system
5. Test the quality of the permeate from each module and mark the modules with low permeate quality

A: Stop the production and drain the Vibro-I for permeate and retentate. CIP clean the Vibro-I and drain it. Disassemble the unit and exchange the faulty membrane module with a new HP1 membrane module with the correct membrane cut-off. Reassemble the unit and permeate system, CIP clean the Vibro-I and restart production.

B (temporary solution): With a tube-squeeze seal off permeate from faulty module and continue production, alternatively lead permeate from defect module back to feed tank. During CIP open tube-squeeze and include faulty unit in all of CIP cycles, and seal off again during production. The sealing off can lead to back-pressure in the defect module, and this can lead to further membrane defects.



Test Set-up

e. Maintenance and exchange of the Wheels

If the Vibro-I is on wheels, the wheels must be exchanges after 1000 hours in operation.

f. Maintenance and exchange of the Industrial Springs

The Industrial Springs supporting the Base plate must be changed after 20.000 hours of operation.

g. Maintenance and exchange of the Vibration Motors

The Vibration Motors must be exchanged after 30.000 hours of operation.

7. Installation, Design of External Systems and Control of the Vibro-I

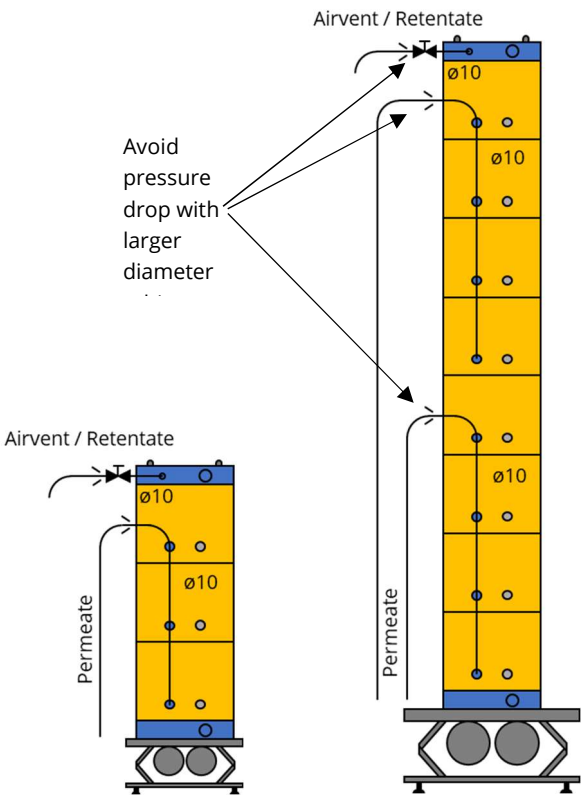
Installation of the Vibro-I can be done in numerous ways depending on application and choice of functions. A tailormade system for your exact needs can always be discussed with SANI Membranes Product Specialists. The following is a short description of some of the possibilities.

In all installations of the Vibro-I the following points are necessary:

- The Vibro-I is placed on a stable horizontal surface or the Vibro-I stand is mounted to a stable horizontal skid
- The Vibro-I is a vibrating machine product that must be placed on a stable foundation that can absorb the reactions from the vibrations. Preferable vibration absorption is through suitable heavy flooring or foundations. Be aware that eigenfrequency or natural frequency response in buildings can lead to structural damage ⚠ **WARNING**
- If the Vibro-I is on wheels it is crucial to exchange these regularly ⚠ **WARNING** (see Service and Maintenance) or mount the Vibro-I on a stable foundation or skid
- The Vibration Motors needs 400V and must only be on when the Vibro-I is filed with media
- A suitable permeate system is connected to the Vibro-I which ensures the permeate can leave the membrane without restrictions that can cause pressure increases
- A suitable feed system is connected to the Vibro-I
- A 4 bar safety valve or a 4 bar safety software hard stop needs to be present in the feed system (max. 4 bar up to 35°C, 3bar up to 55°C and 1bar up to 80°C) if the feed pressure can exceed 4bar
- A control system for the feed system, the vibration motors and additional instrumentation is connected to the Vibro-I

a. Permeate System

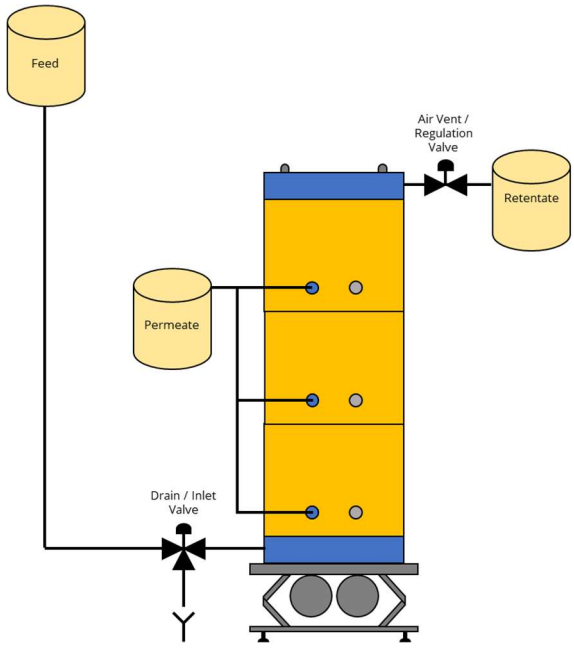
All Vibro-I systems needs to have a permeate system attached as each HP1 membrane module has individual permeate outlets. The permeate outlets are usually connected to a collection tube that runs to a permeate collection tank. The HP1 membrane modules can be delivered with different permeate fittings chosen by the customer. The fittings could be ½" Triclamp DN08 (mini Triclamp), hosepipe (ID 8mm or 10mm), straight pipe (ID 8mm or 10mm) for push-in connectors or with female ¼" threads for customers to design the permeate system freely.
The permeate system can be designed in numerous ways depending on application and process parameters. The most important parameter when designing a permeate system is that no negative trans membrane pressure should be build-up in the system while running the Vibro-I. A pressure build-up in the permeate system can result in negative TMP when reducing the feed pressure dramatically or stopping the feed system quickly. Negative TMP should be avoided at all times when using the Vibro-I as it can result in damaging the membrane modules and thereby compromising your future filtrations. The maximum negative TMP acceptable for the HP1 module is 0.050bar.
It is important to design your permeate system thoroughly as the pressure in the permeate system will have an effect on your effective TMP.
By leading the permeate up along the sides and out at the top of the Vibro-I the pressure loss created by the water column inside the Vibro-I is compensated and running at extremely low TMPs is made possible.



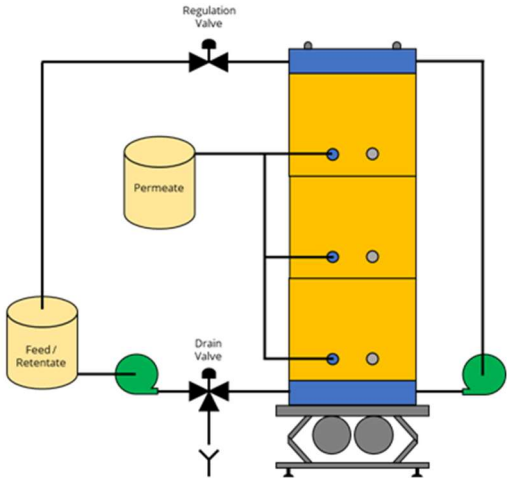
In MF applications the permeate will drain through the membranes, due to the relatively large pore size of the MF membranes. An alternative is to use individual tubes from each permeate outlet.
In UF applications a valve in the bottom of the permeate system is necessary for complete drainage. The permeate system in UF can be designed leading down along the Vibro-I as 100% uniform TMP is typically not crucial for the application.
Reduce the pressure drop in the permeate system by using a larger diameter tubing between the Vibro-I and the collection tank
If the Airvent is used for retentate out, reduce the pressure drop in the system by using a larger diameter tubing after the valve
If your application delivers a valuable feed it is an advantage to design the permeate system so it can be drained completely by gravity. The permeate should always flow freely downward. In big systems an air vent at the highest point of the system could be an advantage for 100% drainage if the membrane does not let air through its pores.

b. Feed System

All Vibro-I system needs to have a feed system attached capable of delivering the feed to the system in the right quantities at the desired pressure. There are endless ways of designing a feed system for a Vibro-I depending on application and degree of automation required. When designing your feed system, you should always take the maximum allowed feed pressure into consideration.
The Vibro-I is designed to work at: 0-4 bar at 5-35°C, 0-3 bar at 35-55°C and 0-1 bar at up to 80°C. It should not be possible to go beyond these limits! A 4bar safety valve in the system is necessary, and if automated steering is chosen the alarms and emergency stops applied must be chosen with respect for these limits.
First you should decide if you want to feed-in in the bottom or the top of the Vibro-I. Feeding-in in the bottom has the advantage that emptying the system for air while filling it is quite easy. Choosing to feed in through the top is normally only chosen when the feed contains particles that are heavier than water and will settle at the bottom.
Second you should decide if a mix flow pump is necessary for your application. The mix flow pump is used for difficult high fouling feeds with high viscosity, or mass loads e.g. bottom beer, pectin or skier and applications where the flux is relatively small compared to the amount of retentate taken out.
Third you should decide upon the necessary degree of instrumentation needed for your application of the Vibro-I. Typically instrumentation are flow meters on inlet, permeate and retentate, manometers before and after the membrane, and temperature sensor to control temperature during CIP
Fourth you should decide on your degree of automation during operation and CIP. A manual system is very flexible and preferred for simple applications, while a 100% automated system with automatic valves, up concentration degree, heat exchanger, CIP programs, dosing pumps etc. are preferred for routine production of valuable products.
The simplest feed system is to let gravity create the needed feed pressure. A feed tank is suspended above the Vibro-I system and the needed pressure in the feed compartment is created by the height difference of the feed tank and the Vibro-I system.

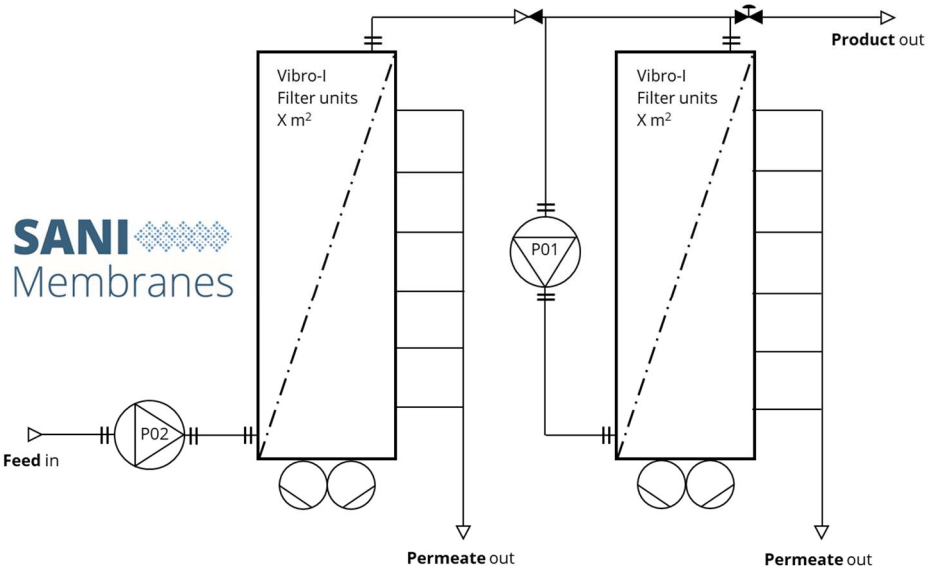


Example of a gravity driven feed system



Example of a simple feed system over a tank with a mix flow pump

The simplest feed system with a feed pump is a continuous system over tank. The speed of the feed pump does not need to be controlled as the pressure can be regulate on the regulation valve. The regulation valve also functions as the air vent, and the degree of up concentration can be determined from the tank level. The application could be protein concentration or other concentrations of biomass. When a high concentration is reached for a given application it could be beneficial to add a mix flow pump to the system to mix up the retentate in the unit and avoid fouling cakes from forming.
Vibro-I can also be coupled into bigger multistage filtration systems in endless different configurations depending on needs and application. Vibro-I's special features should be thought into multistage systems and the design should be done very carefully to utilize all the benefits of the Vibro-I.



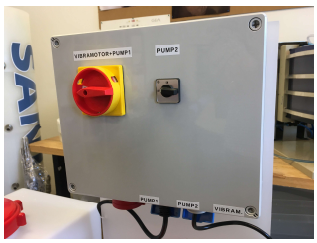
Example of a 2-stage Vibro-I system. 1st stage with no mix flow and 2nd stage with mix flow, for Dairy or protein concentration

c. Vibration Motors

The Vibration Motors have 1 speed used for all filtration modes. They should in principle be turned on exactly when the Vibro-I is filled with feed and turned off again when the pressure is taken completely off the unit. Practically the Vibro is turned on when the pressure exceeds 0.1bar and turned off again when the pressure falls below 0.1bar. This is easy to do with PID steering and can also easily be achieved with manual steering and a pressostate set to 0.1bar. The Vibration motors should not be on when the system is drained as it can harm the membrane.

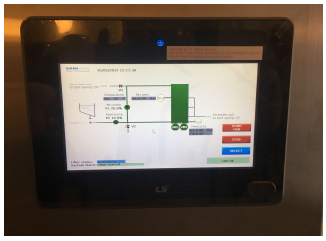
d. Control

There are endless possibilities of controlling a Vibro-I system. For smaller systems manual control are often sufficient while bigger systems are controlled with automated PC/PLC steering.
The simplest manual steering system could have on/off contact on the feed pump and a pressostate set to 0.1bar that starts and stops the vibrations motors. The feed pressure is controlled with a manual regulation valve on the retentate out connection from the Vibro-I. If a mix flow pump is needed an additional on/off switch is needed for it or it is connected to run in parallel with the vibro motors.
For many applications it is necessary to control the pump speed via a frequency converter that is controlling feed pressure. The rest of the system can be kept manual or different degrees of automation can be added.
PLC-steering of the Vibro-I is the normal choice for industrial systems where automation and logging of parameters is crucial. The complexity of the PLC-steering depends on the degree of instrumentation needed for your application and functions of the Vibro-I. How many manometers are

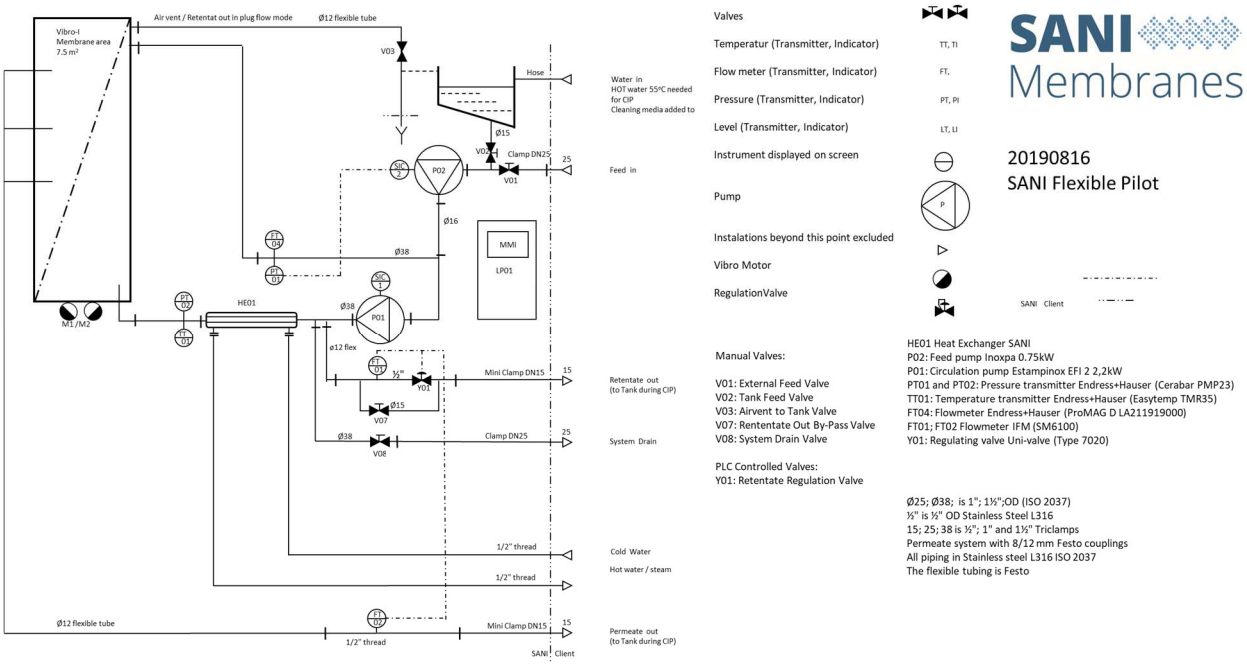


Example of a simple steering for a Vibro-I with filtration over a tank and a mix flow pump

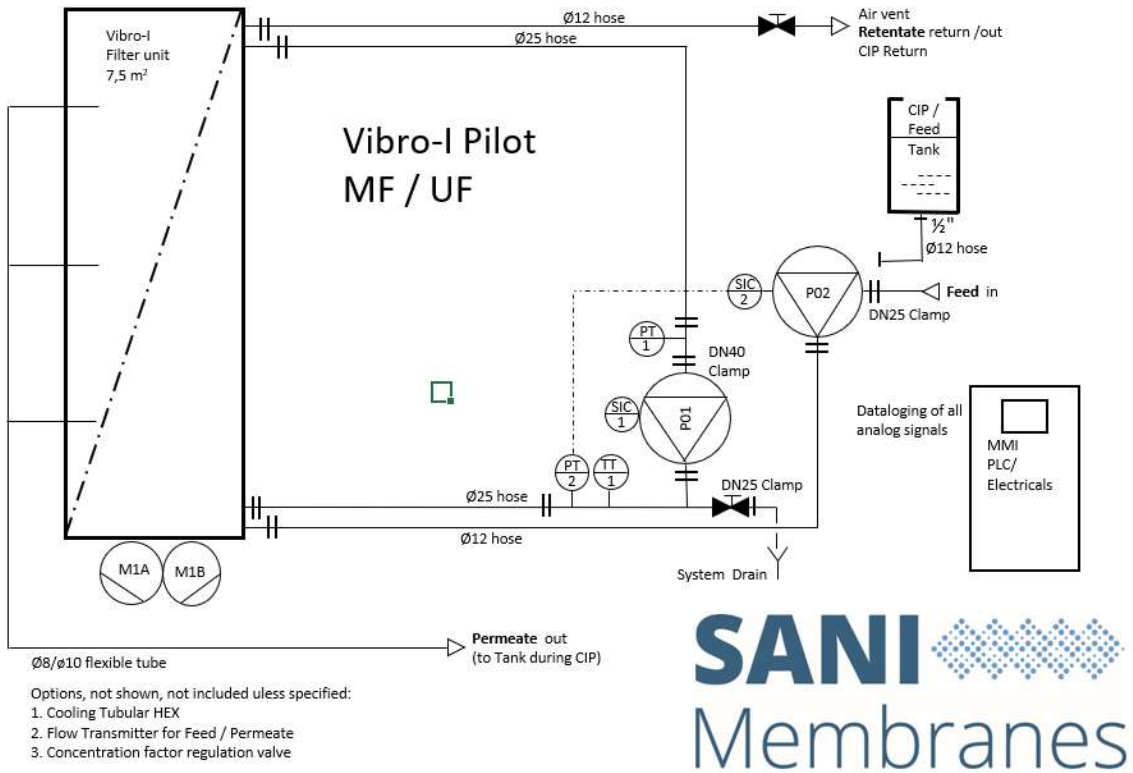
needed, are flow meters necessary, are temperature measurements necessary, are a heat exchangers necessary for cooling and/or heating during CIP, are CIP cleaning performed manually or automatically with dosing pumps for CIP chemicals, are automatic regulation valves for the retentate needed to control of the concentration degree etc. etc.



Example of a simple PID-steering for a Vibro-I with frequency converter steered pumps and manual valves



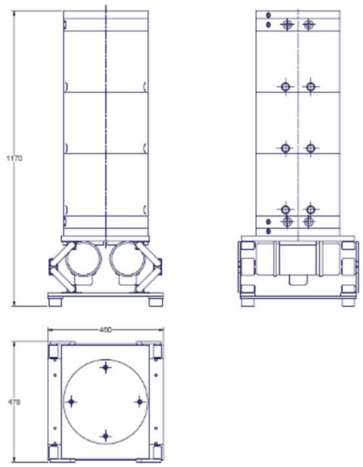
Example of a PI diagram for a PID controlled feed system with mix flow pump, heat exchanger, flow meters, controlled concentration degree. CIP tank etc.



Example of a PI diagram for a PID controlled feed system with mix flow pump, CIP tank etc.

8. Technical Data

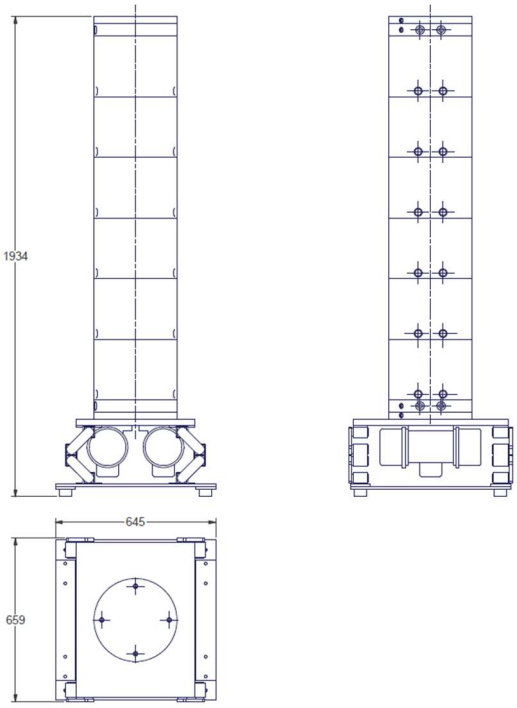
Vibro™-I 7.5 m² Data	
Weight	120 kg
Dimensions (L x W x H)	478 mm x 400 mm x 1170 mm
Membrane	3 x 2.5 m² Free Flow Plate Modules (HP1)
Internal Retentate volume	15.0 L, Fully Drainable
Internal Permeate volume	2.1 L, Fully Drainable
Operating Pressure	0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C
Vibration Motor	Electric, 480 W



Vibro™-I 10 m² Data	
Weight	130 kg
Dimensions (L x W x H)	478 mm x 400 mm x 1430 mm
Membrane	4 x 2.5 m² Free Flow Plate Modules (HP1)
Internal Retentate volume	18.9 L, Fully Drainable
Internal Permeate volume	2.8 L, Fully Drainable
Operating Pressure	0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C
Vibration Motor	Electric, 480 W

Vibro™-I 15 m² Data	
Weight	190 kg
Dimensions (L x W x H)	659 mm x 645 mm x 1934 mm
Membrane	6 x 2.5 m² Free Flow Plate Modules (HP1)
Internal Retentate volume	26.5 L, Fully Drainable
Internal Permeate volume	4.2 L, Fully Drainable
Operating Pressure	0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C
Vibration Motor	Electric, 900 W

Vibro™-I 20 m² Data	
Weight	210 kg
Dimensions (L x W x H)	659 mm x 645 mm x 2420 mm
Membrane	8 x 2.5 m² Free Flow Plate Modules (HP1)
Internal Retentate volume	34.2 L, Fully Drainable
Internal Permeate volume	5.6 L, Fully Drainable
Operating Pressure	0-4 bar at 5-35°C, 0-3 bar at 5-55°C and 0-1 bar at up to 80°C
Vibration Motor	Electric, 900 W



Vibro™-I Cushion Assemblies	
Option 1	2 X 1"and 1 X ¼" threaded inlets/outlets
Option 2	2 X 1/2"and 1 X ¼" threaded inlets/outlets
Pharma and Food Option	GMP and FDA with 2 X (1" / ½" / blank) clamp inlets/outlets

More options are available upon request

Free Flow Plate™ Membrane Module (HP1) Standard Membranes

Membrane type	Cut-off	Membrane Material
UF	5 kDa	PES
UF	5 kDa	PESH
UF	30 kDa	PESH
UF	100 kDa	PVDF
UF	300 kDa	PES
UF	400 kDa	PAN
MF	800 kDa / 0,08 µm	PVDF
MF	0,2 µm	PVDF
MF/Filter	1 µm	PET (Woven)
MF/Filter	5 µm	PET (Woven)
MF/Filter	10 µm	PET (Woven)

The HP1 can be equipped with your membrane of choice. SANI Membranes have a line of standard MF and UF membranes from Synder, Microdyn-Nadir and others on stock. Most commercially available membranes can however also be used with the HP1. Please, do not hesitate to contact us with your membrane wishes.

9. Conformity

The Vibro-I system is CE marked to demonstrate compliance with relevant regulations including the European Machine, Electrical and Pressure Directives.

The Vibro™-I can conform to GMP/FDA/EC regulations for materials in contact with food and other sanitary standards on request.