Free Flow Plate™ Cross Flow Filtration

The Free Flow Plate™ technology is the perfect MF and UF filtration solution for process development and industrial filtration applications where low energy consumption, sanitary function, high flux and low capital investment are key words. Free Flow Plate™ technology systems deliver low fouling continuous filtration where the filter is kept clean by cross flow shear.

Pilot Scale
Free Flow Plate™
Cross Flow Filtration

Industrial Scale
Free Flow Plate™
Cross Flow Filtration

Truly sanitary cross flow filtration with uniform Trans Membrane Pressure

Free Flow Plate™ technology is conceived with excellent sanitary function as the main focus. The result is a very open design with no flow dead areas and an extremely low pressure loss in cross flow settings. The design is fully drainable of both retentate and permeate and very easy and fast to clean.

The patented Free Flow Plate™ technology is built around a semi hollow polymer plate where the membrane is welded onto. The Free Flow Plates™ are then welded together to form a rigid membrane element. Filtration takes place from the outside of the plate through the membrane to the inner part of the plate.

SANI Membranes

MORE FILTRATION, LESS ENERGY

The Free Flow Plate™ Technology

The open design with parallel membranes fused onto the Free Flow Plates™ gives a membrane to membrane distance of 1,7 mm, creating rectangular flow channels for the feed between the Free Flow Plates™. As no spacers is necessary the feed experience true free flow, and turbulence at the membrane surface is created by fast re-circulation of the feed in a loop. The flow speed needed to create the necessary turbulence is however lower in the Free Flow Plate™ configuration than in for example tubular and spiral wound systems.

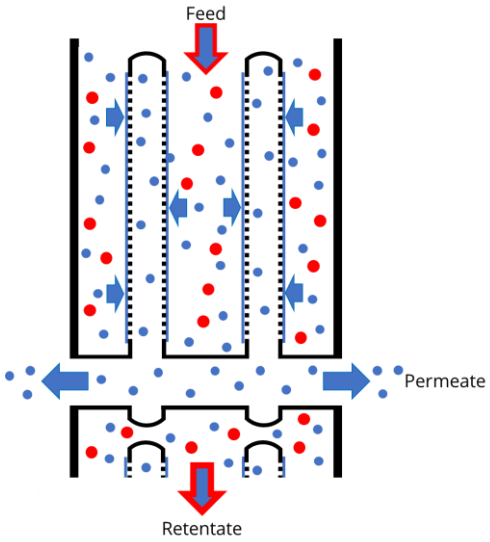
The open design of the modules results in a very low pressure loss over the modules. The low pressure loss makes the Free Flow Plate™ configuration very energy efficient as the energy needed to drive the circulation pump is dramatically reduced compared to other cross flow systems.

The open design with no flow dead areas also makes the Free Flow Plate™ modules very sanitary in operation. As no spacers are needed, no flow dead areas are present. As a result, severe fouling has no natural initiation points to build up from. The lack of flow dead areas also makes the fouling much easier to remove in cleaning cycles, where the fouled flow dead areas often is the main challenge. Thus, Free Flow Plate™ modules are very easy and quick to wash with normal CIP chemicals.

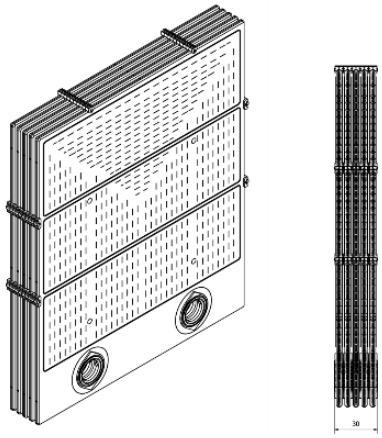
The modules are fully drainable of both retentate and permeate, which gives you shorter cleaning cycles and no loss of valuable products as everything can be drained prior cleaning.

Because of the low pressure loss over the modules, the Free Flow Plate™ systems can operate with unpreceded uniform trans membrane pressures (TMP). The uniform TMP's results in sharper membrane cut-offs, which again leads to better filtration.

The open design also makes it possible to work with very demanding feeds with high viscosity, high solid loads and even high particulates. Often pre-filtration is no longer needed when switching to the Free Flow Plate™ technology.



The open design Free Flow Plate™ Cross Flow



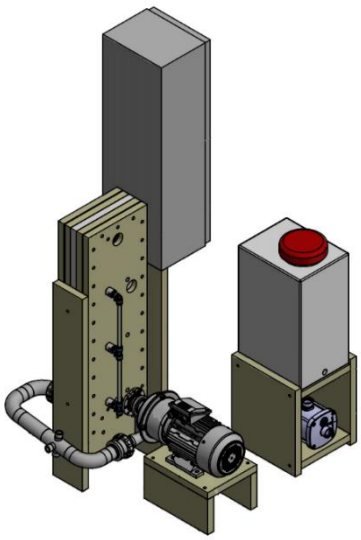
0,35 m^2 Free Flow Plate™ Pilot Element (HPP)

2,5 m^2 Free Flow Plate Module (HP1)

Typical applications

Sanitary:	Biotech, pharma, cell harvesting, broth filtration, enzyme concentration, biomass fractionation etc.
Food & Beverages:	Dairy, milk fractionation, whey concentration, wine filtration, beer filtration, juice filtration, juice concentration etc.
Water:	Sterile water, drinking water, pre-filtration, industrial waste water, municipal waste water etc.
Industrial:	Fuel oil, lubrication media, gear box oils, hydraulic oils, waste streams etc.

Free Flow Plate™ Cross Flow Pilot Plants

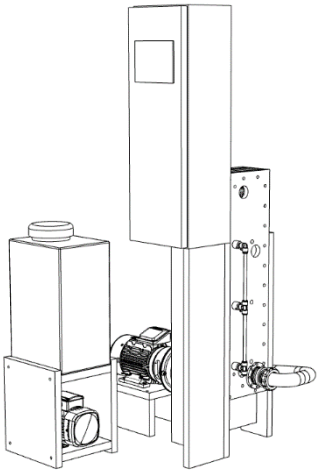


The perfect MF and UF cross flow filtration pilot plant solution. Low fouling continuous filtration where the filter is kept clean by cross flow shear.

The Free Flow Plate™ pilot plants are exceptional for gaining insight into filtration processes, for selecting the right membranes and for filtering or separating almost any media in a development or even a small production set-up. The ability to work with small samples makes it the perfect tool for process development in biotech, pharma, food etc.

The pilot plants have a 2 or 4 m^2 membrane module utilizing 6 or 12 Free Flow Plate™ Pilot elements (HPP) respectively. Due to the open design of the 0,35 m^2 filter element, the pilot plants can handle very demanding feeds with high viscosity, high solids loadings and even high particulates.

Individual permeate outlets from each HPP element makes it possible to use several different membranes in the same experiment series. Thus, membrane selection for a given application is made straight forward.



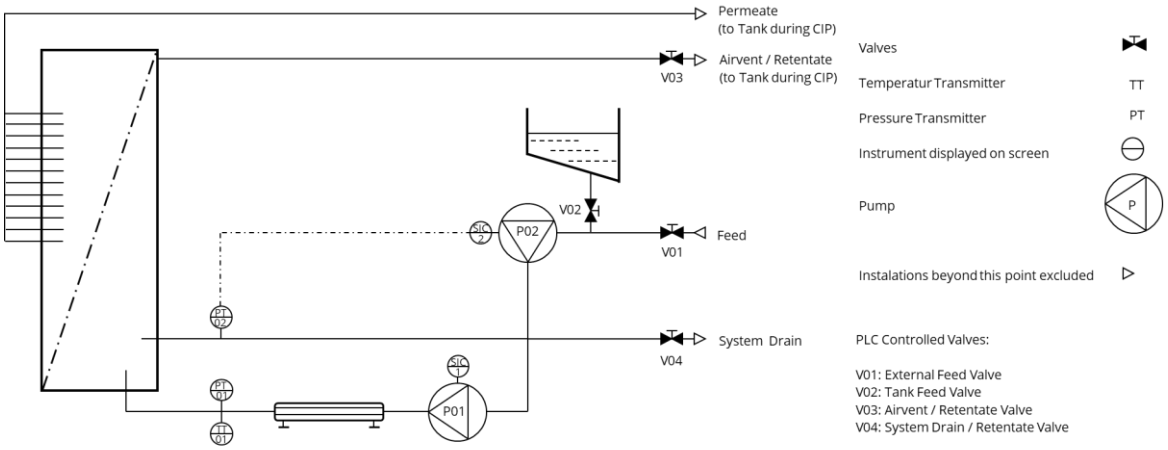
The pilot plants have clear polymer windows giving excellent visibility of the membrane during operation and cleaning. A groundbreaking feature that makes it possible to visually follow fouling build-up and membrane cleaning processes.

The standard pilot plants are easy to use with manual valves, PLC controlled centrifugal pumps, limited instrumentation and an optional heat exchanger. The standard pilot plants can however be customized with additional instrumentation and automation if required.

All temperatures, pressures and pump speeds are logged automatically for later analysis.

All media contacting parts are in durable polymeric materials or stainless steel. The Free Flow Plate™ pilot plants can conform to FDA materials and sanitary standards if required.

SANI Membranes can also design and produce a custom pilot plant from scratch - tailored for your specific application and special needs. Pilots utilizing the industrial 2,5 m^2 HP1 module are also available.



PI diagram of a standard Free Flow Plate™ pilot plant with heat exchanger

Industrial Scale Free Flow Plate™ Cross Flow Filtration

Free Flow Plate™ cross flow filtration is an industrial MF and UF solution for applications where low energy consumption, sanitary function, high flux and low capital investment are key words.

Free Flow Plates™ plants utilizes the 2,5 m^2 Free Flow Plate™ module (HP1) and delivers continuous low fouling filtration where the filter is kept clean by cross flow shear.

The HP1 module is supplied in a pressure housing forming a complete "Lego" block product, stackable to any plant size.

The open design of the modules results in a very low pressure loss over the modules. The low pressure loss makes the Free Flow Plate™ cross flow plants very energy efficient, as the energy needed to drive the circulation pump is dramatically reduced compared to other cross flow systems e.g. plate and frame and spiral wound systems.

The low pressure loss over the modules effectively reduces or eliminates the energy needed to cool the circulating retentate in many applications.

The open module design with no flow dead areas makes the Free Flow Plate™ cross flow plants very sanitary in operation. As no spacers are needed, no flow dead areas are present. Thus, severe fouling and cake build-up has no natural initiation points.

The elimination of flow dead areas also makes the fouling easier to remove in cleaning cycles, where the fouled flow dead areas often is the main challenge. Thus, Free Flow Plate™ modules are very easy and quick to wash with normal CIP chemicals.

The Free Flow Plate™ cross flow plants are fully drainable of both retentate and permeate, which gives shorter cleaning cycles and no loss of valuable products as the plant can be drained completely prior to cleaning.

Due to the open sanitary design, the plants can handle very difficult samples with high viscosity, high mass loadings and even high particulates. Often pre-filtration is no longer needed when switching to Free Flow Plate™ technology.

Because of the low pressure loss over the modules the Free Flow Plate™ plants can operate with unpreceded uniform TMP. The uniform TMP's results in sharper membrane cut-offs which again leads to better filtration.

New and improved products with e.g. higher viscosity and sharper cut-offs are made possible by the Free Flow Plate™ technology.

Benchmarking a Free Flow Plate™ cross flow plant with a conventional spiral wound plant typically results in a 40-50% reduction in energy consumption at the same flux. Benchmarking a with a conventional plate-and-frame plant typically results in an 50-80% reduction in energy consumption at the same flux.

The footprint of a Free Flow Plate™ cross flow plant is smaller than a plate and frame system and comparable to a spiral wound system with the same membrane area.

All media contacting parts are in durable polymeric materials or stainless steel. Free Flow Plate™ plants can conform to FDA materials and sanitary standards if required.

Part of a MF/UF cascade Free Flow Plate™ cross flow plant

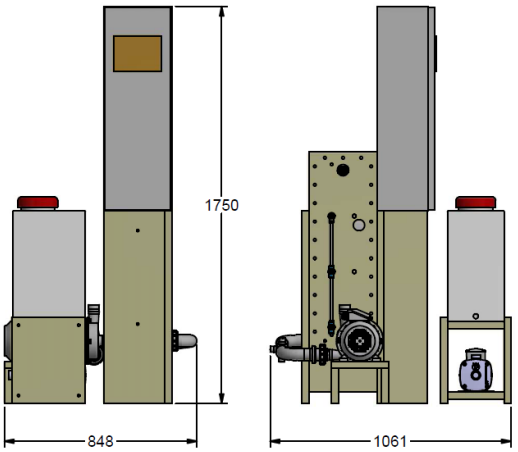
A 160 m^2 Free Flow Plate cross flow plant.

Technical Data Free Flow Plate™ Systems and Modules

Free Flow Plate™ Pilot Plant Data

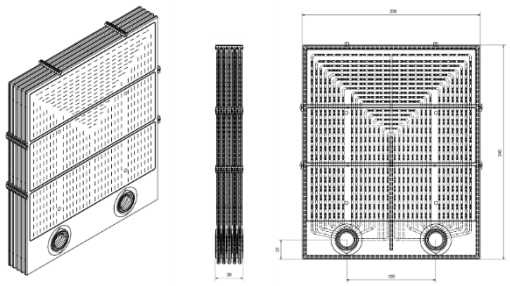
Membrane Type	Free Flow Plate Pilot Elements - HPP
Membrane Area	2,1 m^2 (6 x 0,35 m^2) or 4,2 m^2 (12 x 0,35 m^2)
Dimensions (L x W x H)	1061 mm x 848 cm x 1750 cm
Pressure Pump	0,43 kW 400 V AC 2900 RPM Centrifugal Pump
Circulation Pump	2,2 kW 400V AC 2900 RPM Centrifugal Pump
Feed/CIP Tank	40 L
Dead Volume	Drainable; 6 L for 2,1 m^2 version and 9 L for 4,2 m^2 version
Instruments*	2 PLC Controlled Frequency Converters
	2 Electronic Pressure Transducers (0-6 bar)
	1 Temperature Transducer (0-100°C)
Viscosity Range, Apparent	1-1000 cP (e.g. Cream Cheese+)
Temperature Range	5-85°C
Flow	Feed inlet 0-4 m^3/h, circulation flow 0-15 m^3/h
Operating Pressure	0-4 bar

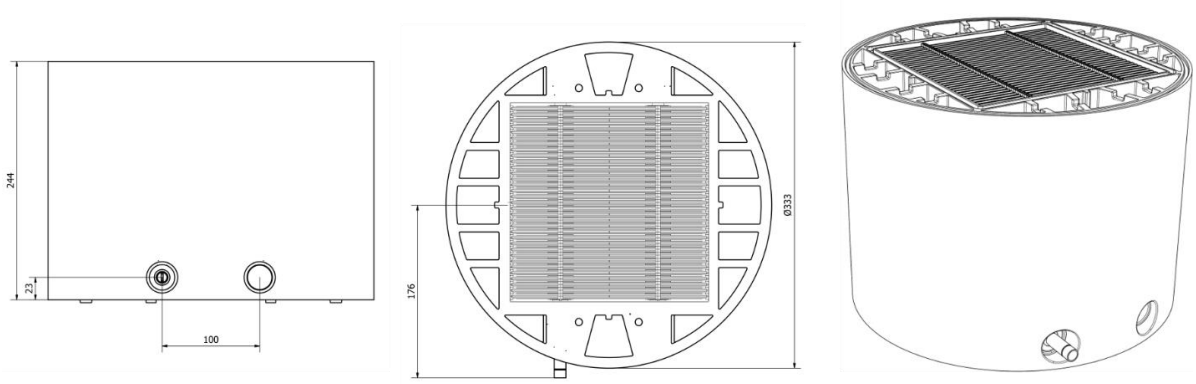
*Standard Pilot Plant, additional instruments and heat exchanger can be fitted



Free Flow Plate™ Pilot Element (HPP) Data

Generic Design	Free Flow Plate™. Fused Polypropylenes
Membrane Type	Most organic membranes (MF, UF, and other filter types)
Membrane Area	0,35 m^2
Dimensions (L x W x H)	242 mm x 30 mm x 202 mm
Viscosity Range, Apparent	1-1000 cP (e.g. Cream Cheese+)
Temperature Range	5-85°C
pH Range	1-14
Operating Pressure	0-10 bar
Free Chlorine	Membrane dependent





Free Flow Plate™ Module (HP1) Data

Generic Design	Free Flow Plate™. Fused Polypropylenes
Membrane Type	Most organic membranes (MF, UF, and other filter types)
Membrane Area	2,5 m^2
Dimensions (D x H)	333 mm x 245 mm
Viscosity Range, Apparent	1-1000 cP (e.g. Cream Cheese+)
Temperature Range	5-85°C
pH Range	1-14
Operating Pressure	0-4 bar
Free Chlorine	Membrane dependent

The HPP and 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 commercial available membranes can however also be used with the HP1. Please, do not hesitate to contact us with your membrane wishes.

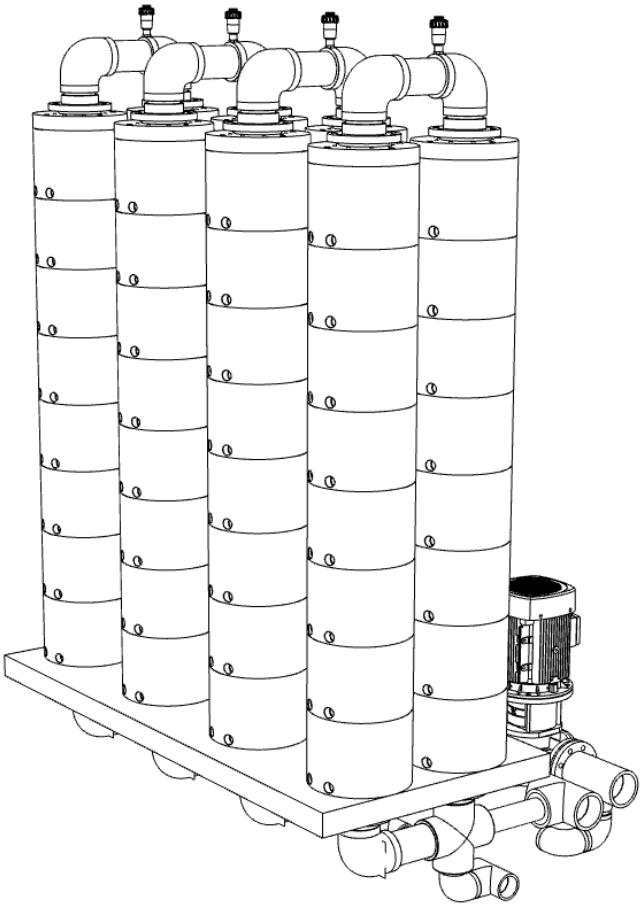
Free Flow Plate™ Cross Flow Filtration

Sanitary - The simple and open design makes the module very sanitary – fully drainable, easy to wash and with no flow dead areas

Energy Efficient - The open design makes the pressure loss in cross flow operation very minute. This means highly energy efficient.

New processes - Low pressure loss means very uniform TMP which leads to very sharp cut-offs. New and improved products are possible

2,1 m^2 Free Flow Plate™ Pilot Plant



160 m^2 Industrial Free Flow Plate™ Plant

For more information see www.sanimembranes.com

SANI Membranes

MORE FILTRATION, LESS ENERGY

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