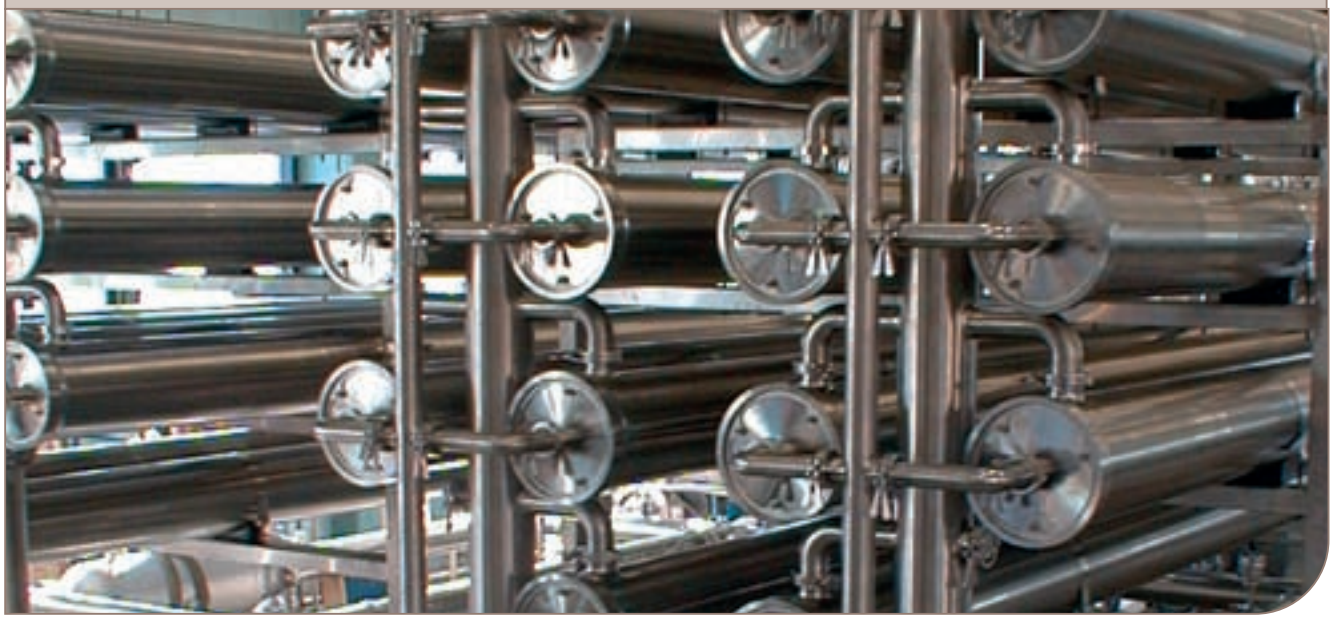
Alfa Laval Membrane RO/NF system

Reverse osmosis and nanofiltration system for concentration and recovery



The Alfa Laval Membrane RO/NF system is a cross-flow reverse osmosis (RO) and nanofiltration (NF) membrane system designed for automatically controlled continuous product concentration and water recovery.
This system provides cost-effective standardized solutions to a wide range of specific concentration and by-product recovery requirements. It is designed to provide minimal hold-up volume and with a stringent focus on hygiene throughout.

Applications

The Alfa Laval Membrane RO/NF system is normally used as a concentration and recovery stage within other processes, reducing the volume of a feed solution by removing water. The system can be used for the cost-effective removal of water from products such as fruit juice, yeast extract, vinasse, coffee, tea, sugars, proteins and UF permeate solutions prior to evaporation.

Energy consumption normally amounts to 4–8 kW per m^3 water removed and for concentration up to 20–40% TS depending on the characteristics of the feed solution and the operating pressure. Units of this type are in considerable demand for installations that process apple juice, blood plasma, gelatine and egg as well as for the recovery of valuable by-products from waste permeate streams in ultrafiltration systems. The process temperature is related to the particular feed product being treated. Typical temperatures are in the range 15–60°C (58–140ºF) as best suits the individual product. This results in both high product quality and low energy consumption.

Design

Alfa Laval Membrane RO/NF systems are supplied as a frame-mounted unit featuring pre-assembled component items and prefabricated piping. The unit is ready for operation as soon as it is installed and connected to the supply systems for upstream and downstream product, utilities and power.

The piping, pumps, strainers, valves and fittings, as well as the control panel, are all manufactured by Alfa Laval. This provides users with a significant advantage in terms of effective service and reduced spare parts inventory.

This pre-assembled, frame-mounted set-up also results in easy, reliable operation, along with straightforward maintenance that helps keep downtime to a minimum.

All piping and equipment in contact with the product or with CIP (Cleaning In Place) liquids are of sanitary-level design, and steel parts are made of AISI 316L stainless steel. The spiral membranes also comply with sanitary-level requirements and with all relevant food and dairy standards.

The system is controlled and monitored via a PLC operator panel that includes a motor control centre equipped with frequency drivers on the pumps to reduce energy consumption. The system uses 3 x 400 VAC/50 Hz power with enclosures for motors and a combined control/motor control centre with IP54-standard protection.

The control and operation of the Alfa Laval Membrane RO/NF system are intended to provide automatically controlled continuous product concentration. Cleaning is based on CIP procedures, controlled and monitored by the operator via the local PLC operator panel.

Operating principle

Alfa Laval RO/NF membrane filtration units feature completely automated operation via the easy-to-use MemProC® control system. This includes separate modes for selecting production, cleaning, sanitation and water recirculation operations, complete with all the necessary sub-sequences. This ensures safe, reliable operation of the entire system.

The feed product is introduced into the feed tank system by the level control feed valve. The feed pump then pumps the product to a number of membrane filtration stages connected in series – the so-called loops. Each loop consists of a number of spiral housing modules, containing the unique Alfa Laval spiral reverse osmosis or nanofiltration membranes. These membranes permit water to pass into the permeate stream, while the juice, proteins, sugars, etc. are rejected and thus become increasingly concentrated as they pass through one loop after another.

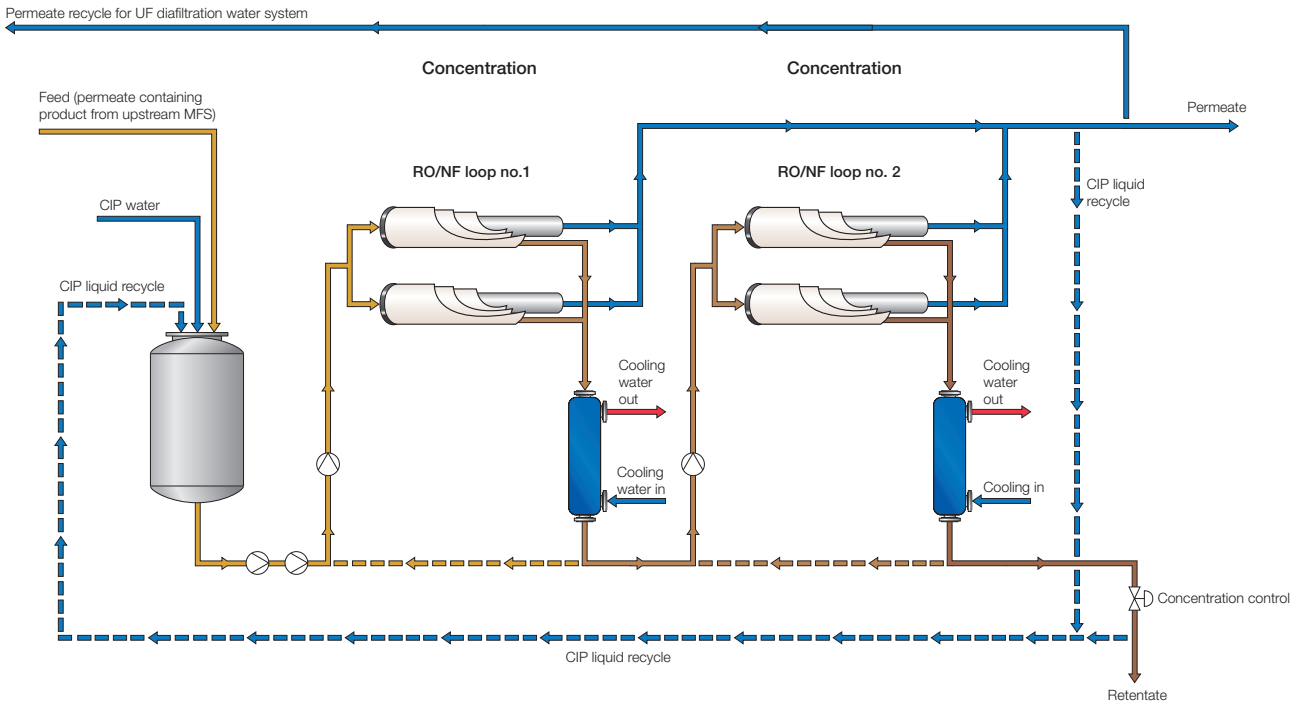
In each loop, the recirculation pump system provides the membranes with the cross-flow rate that is appropriate for keeping fouling to the minimum, balanced against the overall capacity of the system. The unit also contains a cooling system for removing any heat generated by the pumps.

The permeate collected from the loops enters the permeate tank system, where the level control permeate pump discharges it upstream or downstream for either recycling or disposal via a drain system.

The retentate flow rate output is normally controlled by a flow ratio system – the Volumetric Concentration Factor (VCF) value – or by an optional density in-line instrument to obtain constant product concentration.

When a production cycle has been completed, the product is displaced out of the system by use of water to ensure maximum product recovery. This displacement sequence is followed by a water flushing step to remove any product left behind on the surface of the membrane.

The next step is a CIP sequence, the details of which depend on the specifications of the individual feed product.



Additional systems and equipment

The following systems and equipment are available as optional extras.

1. In-line density instrument to ensure constant product concentration in the final loop.

2. Loop plug-flow system for reducing the quantities of flushing water needed in the CIP sequence, by having a valve system in each loop. This makes it possible to include a clearly defined flushing-out sequence when using cleaning agents.

3. Heating section for CIP solution. This section uses low-pressure steam as the source of heat and is equipped with a heat exchanger, a temperature transmitter and a control valve system.

4. External CIP valve system with three diverting valves. This is used for cleaning external feed, retentate and permeate lines.

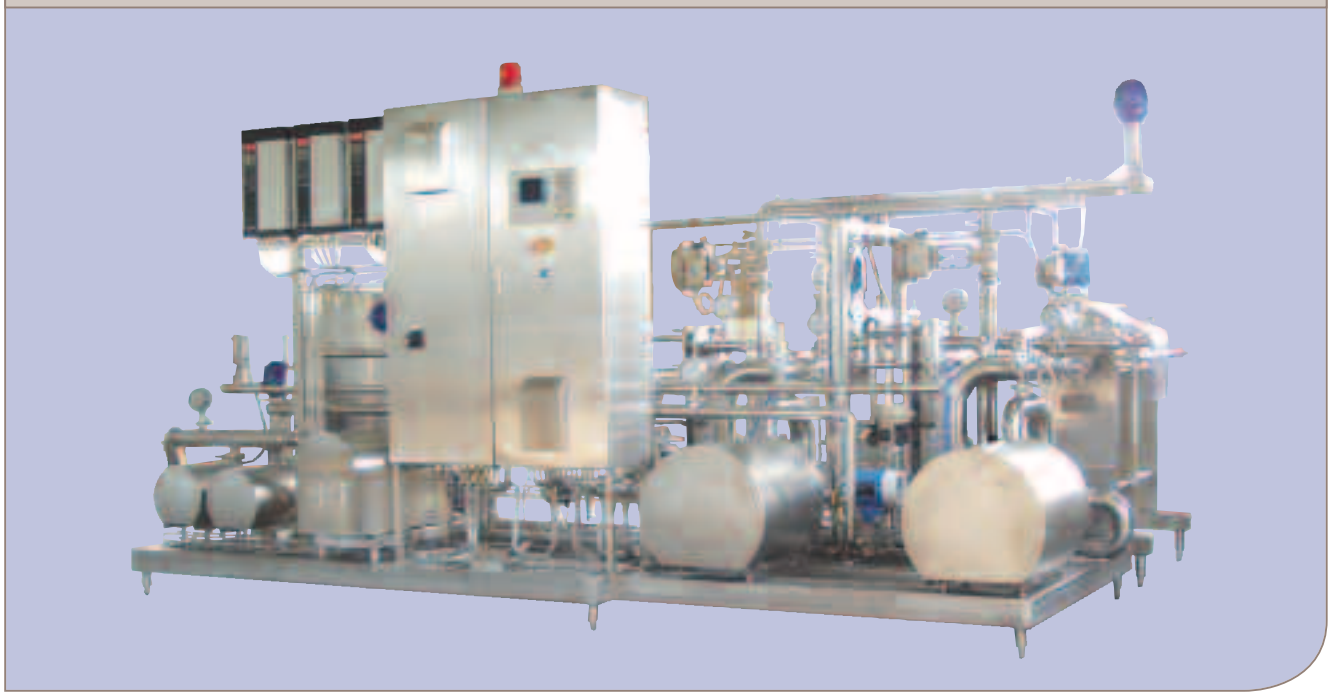
Specifications

	Alfa Laval Membrane RO/NF 10	Alfa Laval Membrane RO/NF 15	Alfa Laval Membrane RO/NF 25	Alfa Laval Membrane RO/NF 40
Operating time, hours/day	12–20	12–20	12–20	12–20
CIP, hours/day	3–4	3–4	3–4	3–4
Number of loops	1	2	2	3
Number of modules (housings)	6	6	12	18
Type of modules (housings)	M8.0-4-PN40	M8.0-4-PN40	M8.0-4-PN40	M8.0-4-PN40
Type of spiral	8038	8038	8038	8038
Number of spirals	24	24	48	72
Installed power, kW	70	81	140	195
Water consumption, m^3 (US gal) / CIP sequence	8 (2,114)	12 (3,171)	12 (3,171)	16 (4,228)
Pump seals, m^3/day (GPD)	0.15 (39.63)	0.2 (52.83)	0.2 (52.83)	0.3 (79.25)
CIP chemicals, kg (lb) / sequence	5–10 (11–22)	10–15 (22–33)	10–15 (22–33)	15–20 (33–44)
Plant dimension, L x B x H, m	5 x 3 x 2.5	5 x 4 x 2.5	5 x 4 x 2.5	5 x 5 x 2.5
Plant dimension, L x B x H, ft	16.41 x 9.84 x 8.20	16.41 x 13.12 x 8.20	16.41 x 13.12 x 8.20	16.41 x 16.41 x 8.20
Space required, L x B x H, m	7 x 4.5 x 3	7 x 5.5 x 3	7 x 5.5 x 3	7 x 6.5 x 3
Space required, L x B x H, ft	22.97 x 14.76 x 9.84	22.97 x 18.04 x 9.84	22.97 x 18.04 x 9.84	22.97 x 21.33 x 9.84
Weight, kg (lb)	3,500 (7,718)	5,000 (11,025)	6,750 (14,884)	9,500 (20,948)
Noise level, dB (A)	< 80	< 80	< 80	< 80
Feed operation pressure, bar (psi)	35–40 (508–580)	35–40 (508–580)	35–40 (508–580)	35–40 (508–580)

Note: the Alfa Laval Membrane RO/NF 10 system can also be used for operation in batch mode.

Alfa Laval beer recovery system

Standardized microfiltration membrane filtration system for beer recovery



Introduction

Alfa Laval membrane filtration systems provide a straightforward solution that enables breweries to both recover beer and concentrate the surplus yeast at the same time. This is done via a highly efficient, continuous process.

50–60% of the surplus yeast, the equivalent of 1–2% of the total beer production, can be filtered out and recovered as high-quality near-sterile beer with no oxygen pick-up. During this process, the yeast cells are concentrated up to a level of 20% dry matter.

Design

The special Alfa Laval cross-flow system for beer recovery features purpose-designed Alfa Laval microfiltration membranes, mounted in the well-proven Alfa Laval M39H plate-and-frame module with open channels.

The special FSM0.45 membranes are made of polyvinylidene fluoride (PVDF), with a pore size of 0.45µm. These inert, beverage-grade fluoropolymer membranes comply with all FDA regulations.
The membrane surface in one unit can vary from 30 m^2 up to 168 m^2. Depending on the capacity required, the system will consist of one to five loops.

Optimized flow dynamics

The Alfa Laval M39H plate-and-frame module has been developed specifically for the microfiltration of medium-to-high viscosity products that contain suspended solids. The open-channel design results in good flow dynamics under low-pressure conditions. This also keeps energy consumption to a minimum.

The Alfa Laval surplus yeast filtration system provides the following features and benefits: :

Features

- 0.45µm microfiltration membranes ensure good retention of both yeast and other micro-organisms
- Plate-and-frame system with open channels that ensure good flow dynamics and high efficiency
- Modular design makes the system easy to extend to meet growing requirements
- Low membrane replacement cost compared to ceramic systems
- Fully automated system that can operate continuously for 20 hours/day, with no batch recirculation required
- Gentle handling of yeast
- Compatible with commercially available cleaning agents
- Beer recovery from fermentation and maturation surplus yeast

Benefits

- Low operating costs (labour, energy, chemicals, etc.)
- Continuous processing ensures maximum utilization and accurate yield control
- No oxygen pick-up ensures that the recovered beer is of high quality
- Well-proven, robust design results in very reliable operation
- Low operating temperature
- Minimum autolysis by tank to tank operation

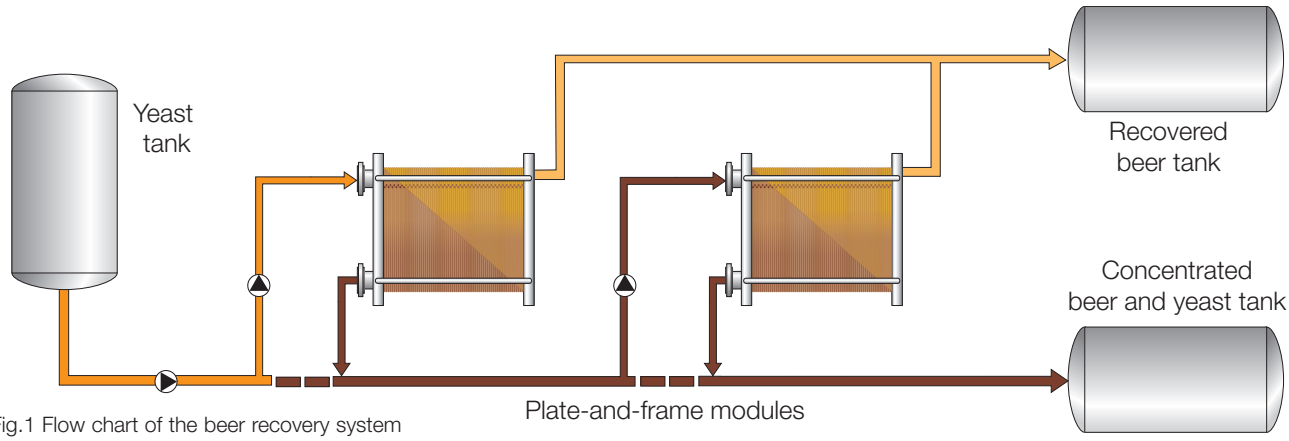


Fig.1 Flow chart of the beer recovery system

Technical specifications

Plant type	Beer RecoverAL 30	Beer RecoverAL 48	Beer RecoverAL 78	Beer RecoverAL 128	Beer RecoverAL 168
Feed concentration ➔ output concentration	5 ➔ 20% dry matter / 12 ➔ 20% dry matter				
Operation temperature (ºC (F))	20 (68) or lower				
Operation mode	Continuous				
Number of loops	1	2	3	4	5
Number of modules	1	2	3	4	5
Membrane area (m^2 (ft^2))	30 (322.9)	48 (516.7)	78 (839.6)	128 (1,378)	168 (1,808)
Power consumption (kW)	25	50	75	130	175
Space required, L x B x H (m)	3.5 x 4 x 2.5	4 x 4.5 x 2.5	5 x 4.5 x 2.5	6 x 5 x 2.5	7 x 5 x 2.5
Weight (kg)	2,800	3,500	4,400	5,900	7,000
Capacity (hl/day (GPD))					
0% FY + 100% MY	25 / 45 (660.4 / 1,189)	95 / 105 (2,510 / 2,774)	170 / 180 (4,491 / 4,755)	295 / 305 (7,793 / 8,057)	405 / 390 (10,700 / 10,300)
100% FY+ 0% MY	55 / 100 (1,453 / 2,642)	205 / 230 (5,416 / 6,076)	380 / 395 (10,040 / 10,430)	650 / 680 (17,170 / 17,960)	900 / 870 (23,780 / 22,980)
Recovered beer (hl/day)					
0% FY + 100% MY	22 / 22 (581.2 / 581.2)	80 / 50 (2,113 / 1,321)	145 / 85 (3,830 / 2,245)	250 / 145 (86,604 / 3,830)	345 / 175 (9,114 / 4,623)
100% FY+ 0% MY	45 / 45 (1,189 / 1,189)	175 / 110 (4,623 / 2,906)	325 / 185 (8,586 / 4,887)	560 / 320 (14,790 / 8,454)	770 / 390 (20,340 / 10,300)
Operation time (h/day)					
0% FY + 100% MY	18				
100% FY+ 0% MY	20				

FY = Fermentation Yeast
MY = Maturation Yeast

Auxiliary Membrane Filtration Equipment

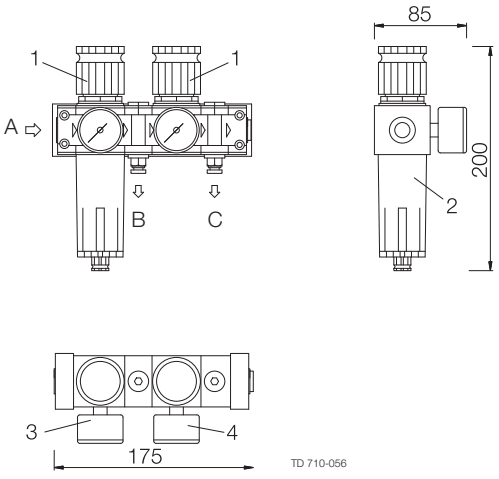
Alfa Laval Filter/Regulator for Compressed Air

The filter/regulator is used for regulating the pressure of and filtering compressed air. It includes a filter (5 micron), two regulators and two dual scale pressure gauges at 0-12 bar and 0-6 bar, respectively.

The air pressure can be set to 0-12 bar by the first regulator, and to 0-4 bar by the second regulator, thus providing both pilot and signal air.

TECHNICAL DATA

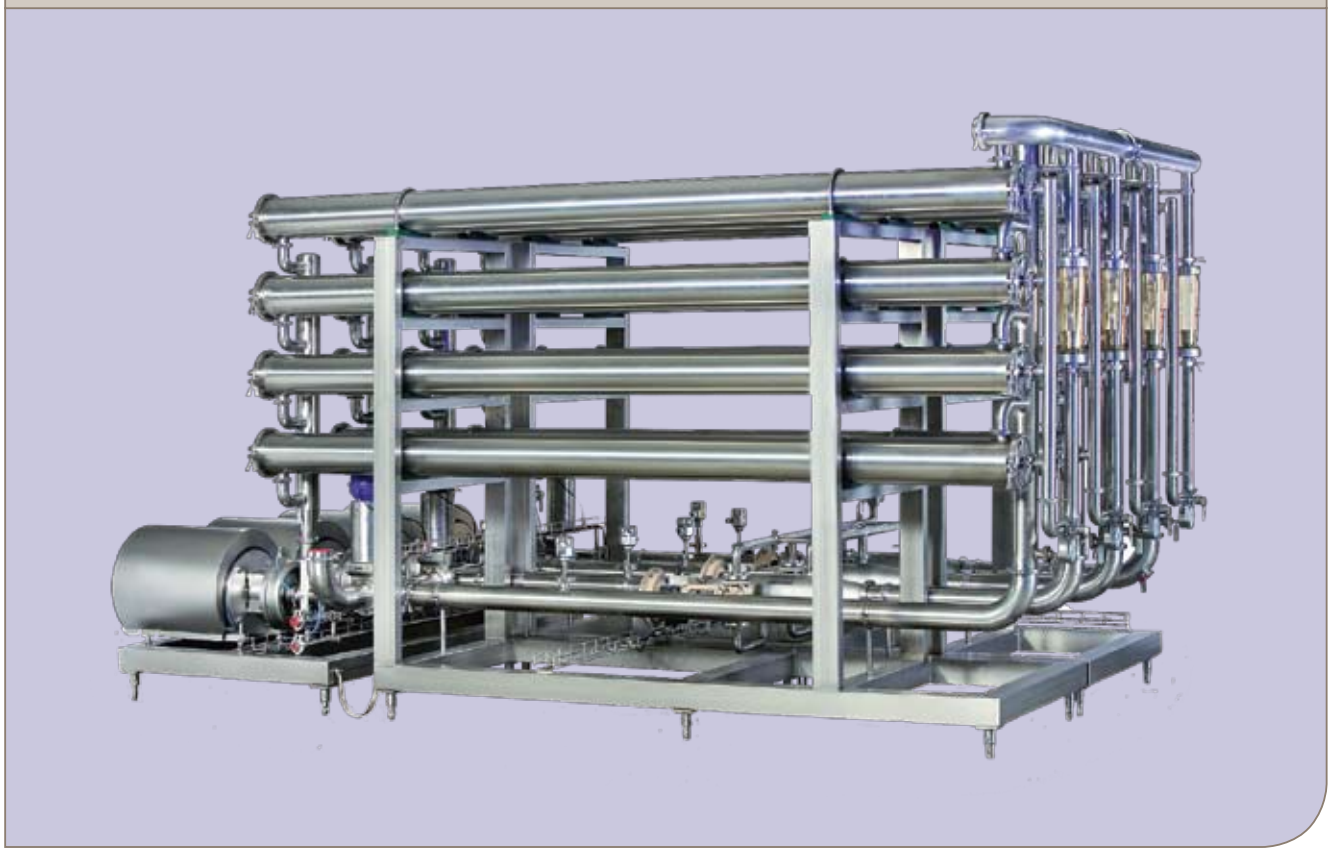
Code no.: 106249
Max. inlet air pressure: . . . . . 12 bar
Rated capacity: . . . . . 1100 Nl/min.
Weight: . . . . . 1 kg



A	Air inlet (Max.12 bar)
B	Hose OD 6 mm 0-12 bar
C	Hose OD 6 mm 0-4 bar
1.	Regulator
2.	Filter ¼" BSP
3.	Pressure gauge (0-12 bar)
4.	Pressure gauge (0-6 bar)

Alfa Laval Membrane-UF system

Ultrafiltration system for continuous concentration and purification



Section of Alfa Laval Membrane-UF 10 system

The Alfa Laval Membrane-UF system is a cross-flow ultrafiltration system designed for automatically controlled continuous product concentration. These systems provide cost-effective standardized solutions for specific concentration requirements and are designed with minimal hold-up volume and with a stringent focus on hygiene throughout.

Applications

The Alfa Laval Membrane-UF system is normally used as a concentration and purification stage within other processes, reducing the volume of a liquid by removing water and other low-molecular substances.

The system can be used for the cost-effective concentration of proteins, gums and other feeds prior to further evaporation. Units of this type are in considerable demand for installations that process blood plasma, gelatine, egg, pectin extract, carrageenan and chitosane, as well as in the production of natural colours and the recovery of protein from waste streams.

The actual process temperature is related to the particular feed product being treated. Typical temperatures lie in the range 5–90°C (41–194°F).

Design

Alfa Laval Membrane-UF systems are supplied as a frame-mounted unit featuring pre-assembled component items and prefabricated piping. The unit is ready for operation as soon as it is installed and connected to the supply systems for upstream and downstream product, utilities and power.

The piping, pumps, strainers, valves and fittings, as well as the control panel, are all manufactured by Alfa Laval, providing users with a significant advantage in terms of effective service and reduced spare parts inventory.

This pre-assembled, frame-mounted set-up also results in easy, reliable operation along with straightforward maintenance that helps keep downtime to a minimum.

All piping and equipment in contact with the product or with CIP (Cleaning In Place) liquids are of sanitary-level design, and steel parts are made of AISI 316L stainless steel. The spiral membranes also comply with sanitary-level requirements and with all relevant food and dairy standards.

The system is controlled and monitored via a PLC operator panel that includes a motor control centre equipped with frequency drivers on pumps to keep energy consumption down. The system uses 3 x 400 VAC/50 Hz power, with enclosures for motors and a combined control/motor control centre with IP54-standard protection.

Heating/cooling section

The control and operation of the Alfa Laval Membrane-UF system are intended to provide automatically controlled continuous product concentration and purification. Cleaning is based on CIP procedures, controlled and monitored by the operator via the local PLC operator panel.

Operating principle

Alfa Laval Membrane-UF units feature completely automated operation via the easy-to-use MemProC® control system. This includes separate modes for selecting production, cleaning, disinfection and water recirculation operations, complete with all the necessary sub-sequences. This ensures safe, reliable operation of the entire system.

The feed product is introduced into the feed tank system by the level control feed valve. The feed pump then pumps the product to a number of membrane filtration stages connected in series – the so-called loops. Each loop consists of a number of spiral housing modules, containing the unique Alfa Laval spiral ultrafiltration membranes. These membranes permit salts and water to pass into the permeate stream, while the proteins, gums, etc. are rejected and thus become increasingly concentrated as they pass through one loop after another.

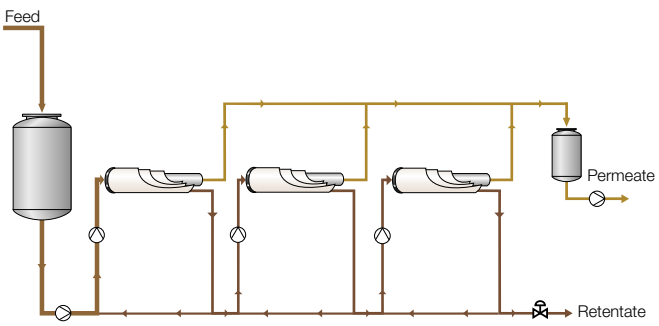
In each loop, the recirculation pump system provides these membranes with the cross-flow rate that is appropriate for keeping fouling to the minimum, balanced against the overall capacity of the system. The unit also contains a cooling system for removing any heat generated by the pumps.

The permeate collected from the loops enters the permeate tank system, where the level control permeate pump discharges it upstream or downstream for either recycling or disposal via a drain system.

The retentate flow rate output is normally controlled by a flow ratio system – the so-called Volumetric Concentration Factor (VCF) value – or by an optional refractometer/density in-line instrument to obtain the desired product concentration or volume reduction.

When a production cycle has been completed, the product is displaced out of the system using water, to ensure maximum product recovery. This displacement sequence is followed by a water flushing step to remove any product left behind on the membrane surface.

The next step is a CIP sequence, the details of which depend on the specifications of the individual feed product concentration process.



Overview of system layout

Additional systems and equipment
The following systems and equipment are available as optional extras.

1. A special heating/cooling section for the feed solution and to recover the heat from the outgoing streams. These sections are equipped with a retentate pump. The heat exchanger incorporates three sections – one for heating incoming product, one as a heat exchanger for the permeate/incoming product, and one as a heat exchanger for the retentate/incoming product.

2. In-line refractometer instrument of the K-Patent type to control product concentration in the final loop.

3. Loop plug-flow system for reducing the quantities of flushing water needed in the CIP sequence, by having a valve system in each loop. This makes it possible to include a clearly defined flushing-out sequence when using cleaning agents.

4. Heating section for CIP solution. This section uses low-pressure steam as the source of heat and is equipped with a heat exchanger, a temperature transmitter and a control valve system.

5. External CIP valve system with three diverting valves. This is used for cleaning external feed, retentate and permeate lines.

Specifications

	Alfa Laval Membrane-UF 2	Alfa Laval Membrane-UF 4	Alfa Laval Membrane-UF 7	Alfa Laval Membrane-UF 10
Operating time (hours/day)	12–20	12–20	12–20	12–20
CIP (hours/day)	3–4	3–4	3–4	3–4
Number of loops	2	2	3	4
Number of modules (housings)	6	12	18	24
Type of modules (housings)	M6.3-3-PN16	M6.3-3-PN16	M6.3-3-PN16	M6.3-3-PN16
Type of spiral	6338	6338	6338	6338
Number of spirals	18	36	54	72
Installed power (kW)	52	81	113	146
Water consumption m^3/ CIP sequence (US gal)	15 (3,963)	20 (5,283)	25 (6,604)	30 (7,925)
Pump seals m^3/day (GPD)	0.2 (52.83)	0.3 (79.25)	0.4 (105.7)	0.5 (132.1)
CIP chemicals kg/sequence (lb)	7–12 (15 - 26)	10–15 (22 - 33)	15–20 (33 - 44)	20–25 (44 - 55)
Plant dimension required, L x B x H (m)	4.5 x 4.5 x 2.5	4.5 x 4.5 x 2.5	5.5 x 4.5 x 2.5	6.5 x 4.5 x 2.5
Plant dimension required, L x B x H (ft)	14.76x14.76x8.20	14.76x14.76x8.20	18.04x14.76x8.20	21.33x14.76x8.20
Space required, L x B x H (m)	5 x 6 x 2.5	6 x 6 x 2.5	7 x 6 x 2.5	8 x 6 x 2.5
Space required, L x B x H (ft)	16.4x19.69x8.20	19.69x19.69x8.20	22.97x19.69x8.20	26.25x19.69x8.20
Weight kg (lb)	3200 (7,055)	4400 (9,700)	6300 (13,890)	7900 (17,420)
Noise level	< 80 dB (A)	< 80 dB (A)	< 80 dB (A)	< 80 dB (A)
Feed operation pressure bar (psi)	2–4 (29-58)	2–4 (29-58)	2–4 (29-58)	2–4 (29-58)

Alfa Laval De-alcoholisation module

Cost-efficient solution for chilled non-alcohol beer below 0.05%

Introduction

The Alfa Laval De-alcoholization module enables breweries to produce non-alcohol or very low alcohol beer without facing the heavy capital investments typically required for such applications. The cost- and energy-efficient de-alcoholization concept provides chilled low-alcohol beer below 0.05% alcohol by volume. This is achieved by a combination of diverse technologies, from beer degassing and culinary steam generation to vacuum stripping and alcohol condensing, which work in tandem as an integrated system.

The system also produces a condensate stream composed of water, stripped alcohol and other volatiles that can be reused for ethanol production and concentration of aroma volatiles.

Application

The De-alcoholization module is ideal for removal of alcohol from full-strength beer for the production of low-alcohol (LAB) and non-alcohol (NAB) beer.

Benefits

- Single-pass removal of alcohol (to <0.05% ABV) with degassing step
- Minimal thermal impact (stripping at low temperature)
- Low energy consumption
- Sanitary design prepared for CIP and SIP
- Exceptional reliability and low maintenance.

Design

The De-alcoholization module combines processes for effective single-pass removal of alcohol from beer at low temperature and pressure. The de-alcoholization principle uses stripping without the need for recirculation. The process is especially designed with focus on a high degree of energy recovery, minimizing thermal energy and the risk of freezing the de-alcoholized beer.

Options

- Pre-treatment with separator
- Final product carbonation and blending
- Seal water recirculation.

Working principle

Alcohol removal and condensate cooling: The alcohol present in the feed beer is removed in a special vertical stripping column. This column makes it possible to achieve high desorption by flowing a stripping gas (culinary steam) up a tower of densely packed material under conditions that are close to a vacuum.

The production capacity is set by regulating the incoming beer flow prior to routing to the liquid distributor at the top of the column. This distributor then disperses beer into the column, where it trickles downwards against the flow of the stripping gas injected at the base of the column and rising up through it.

The vapour stripped out of the beer consists of steam, alcohol and other volatiles. This vapour vents from the top of the column and a plate heat exchanger is then used to cool the vapour into an alcohol condensate stream. A final vacuum phase removes any remaining non-condensable volatiles. A glycol-side recirculation pump minimizes any risk of the stripped vapour stream freezing during condensing. One key benefit of this stripping principle is its exceptionally effective

alcohol removal at low temperature and pressure. This does away with any need for recirculation to achieve the required specifications for the final de-alcoholized beer.

If any additional stripping is required, for whatever reason, the system includes a recirculation loop for sending stripped beer back to the column. Stripping efficiency can also be boosted by regulating the temperature of the beer before it is passed into the column, or by altering the pressure in the system.

The process sections of Alfa Laval De-alcoholization Module – degassing and aroma recovery (right), alcohol removal & culinary steam generation (middle) and condensate cooling (left).

Gentle heating with high recovery: Final heating to the temperature required during alcohol stripping takes place in a dedicated heating section. To minimize product degradation from exposure to high temperature, the heating section re-circulates water through a brazed plate heat exchanger that is fed with steam.

To ensure a high degree of energy recovery and keep the need for costly thermal inputs to a minimum, the warm outgoing flow of de-alcoholized beer is used to heat the feed beer, using an energy-efficient Alfa Laval plate heat exchanger.

Beer degassing and aroma recovery: The carbonation level of the feed beer is reduced by degassing in a low-pressure chamber installed upstream of the stripping column. The degassing prevents formation of foam when distributing the beer at the top of the column.

A chilled separator vessel returns condensable aroma vapours removed during degassing to the feed beer stream.

Culinary steam generation: The module includes a culinary-quality steam generator based on the heating of soft water in a shell-and-tube or plate heat exchanger supplied with steam.

The steam that is produced serves as the stripping gas that enters the base of the column during the stripping process.

Chilling: The de-alcoholized beer is cooled to the required outlet temperature in a glycol-fed cooling section integrated into the module's plate heat exchanger that is part of the De-alcoholization module.

The cooling system is designed to minimize any risk of the de-alcoholized beer freezing during the chilling phase.

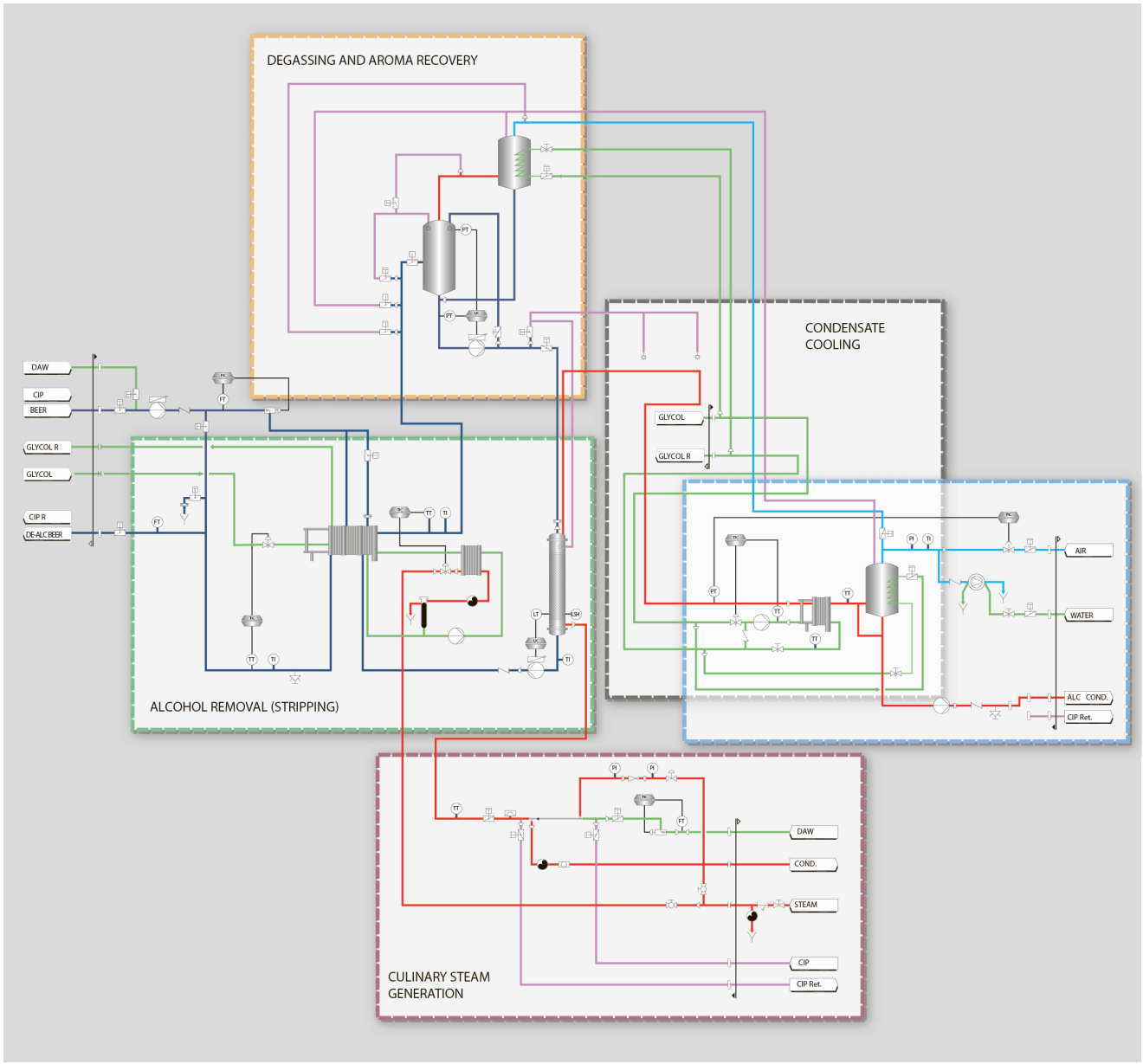
Control and automation: The module is fully automated, with all operations controlled via a local PLC Siemens system (with remote connection to SCADA).

Specific functions and operating procedures can be selected via an easy-to-use colour touch panel, which displays a comprehensive array of process data (including current status, actual and set point temperatures, alarm conditions and controller settings).

Cleaning-in-place: The De-alcoholization module is equipped with a built-in cleaning-in-place (CIP) programme and also features steam-based sterilization-in-place (SIP) of both the stripping column and the vapour lines leading to the vapour condenser. The cleaning frequency required depends on a combination of beer quality and specifications, and the type of impurities to be removed. However, a typical recommended routine would involve CIP with caustic acid twice per week and SIP once per week, followed by acid cleaning twice a month. If exceptional fouling is encountered, flooding the entire stripping column with lye overnight is recommended.

Hygiene: To ensure full compliance with international food industry regulations and hygiene requirements, all components that come into contact with process liquids are made of stainless steel, with heat resistant seals.

The De-alcoholization module's condensate cooling section.



Flowchart for the De-alcoholization module, featuring the major process sections: alcohol removal, degassing and aroma recovery, culinary steam generation and condensate cooling.

Technical data

Energy consumption depends on the particular specifications of the de-alcoholization process. The following figures apply to a fixed feed beer flow with an inlet/outlet temperature of 2 to 4 °C, which has the following specifications:

Feed beer (alcohol by volume)	4.5 to 8.0% ABV[1]
Exit beer	<0.05% ABV
Capacity range	5 to 100 hl/h[1] (6 to 117 bbl/h)
Soft water	2 to 16 hl/h (1 to 8 gpm)
Heating[2]	100 to 1950 kg/h (300 lb/h 5850 lb/h)
Cooling (of product & condensing)[2]	70 to 1170 kW (240 to 4000 mBTU/h)
Seal water for vacuum system	~ 10 to 20 hl/h (4.4 to 9 gpm)[3]
Electricity installed/operating	13/8 to 48/30 kW (17/11 to 64/40 HP)
Instrument air	~ 1 m³/h (2,120 cfm)

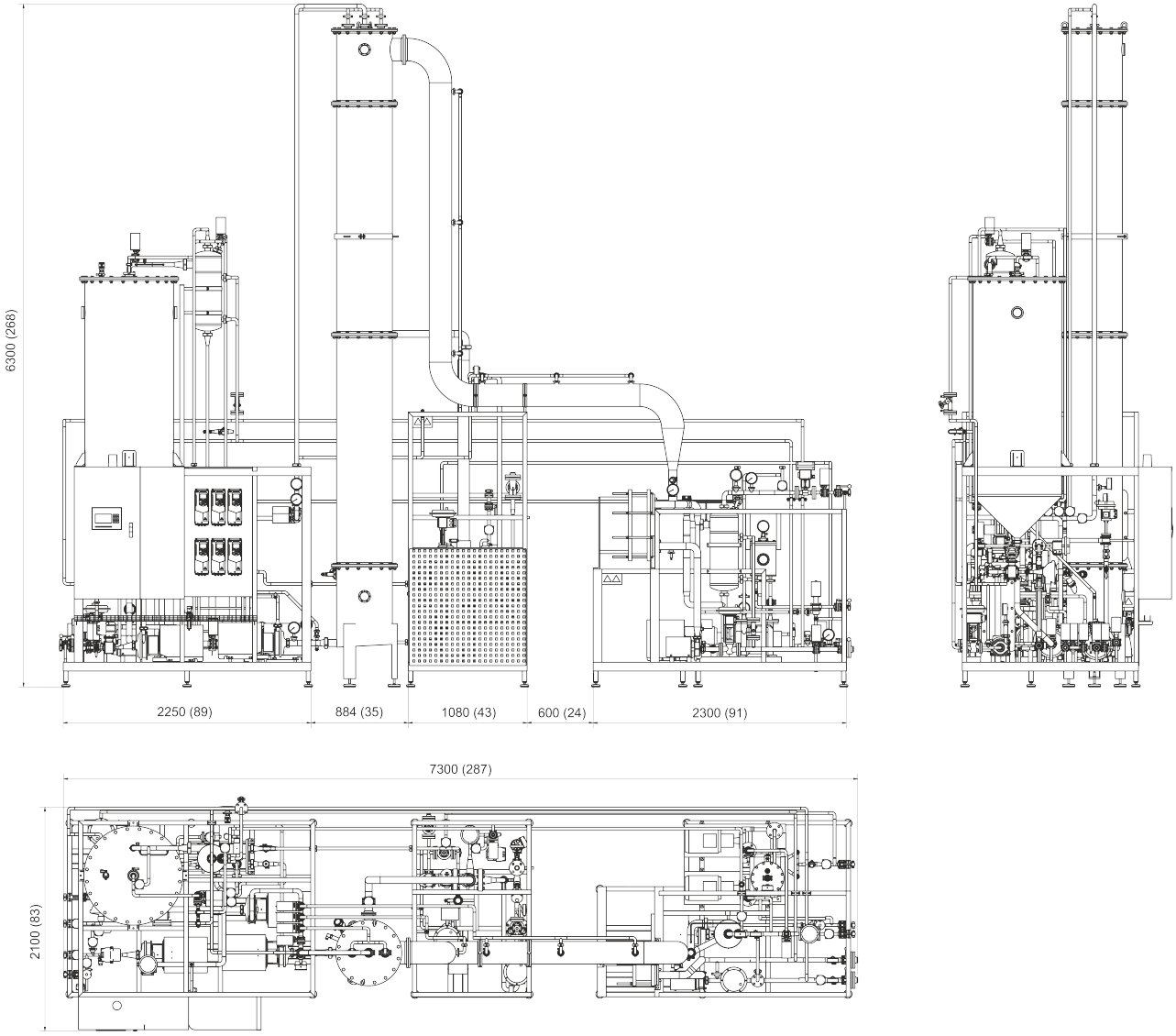
[1] Final alcohol by volume (ABV) and NAB/LAB capacity will depend on feed beer alcohol and CO_2 content.

[2] Steady state operation.

[3] Can be decreased if re-circulated.

Nominal capacity: The standard capacities can range from 5 to 100 hl/h and will depend on the target alcohol by volume in the feed beer and the final beer, as well as the stripping pressure and operating temperature. The throughput can be increased by lowering the stripping pressure, increasing the operating temperature and/or tuning the final alcohol reduction target.

Nominal stripping pressure	10 to 11 kPa (1.5 to 1.6 psi)
Operating temperature	~ 40 °C (104°F)



The Alfa Laval De-alcoholization module is fully assembled and dimensioned as shown above, as example, for the 10 hl/h case. Dimensions are indicative in mm (inches).