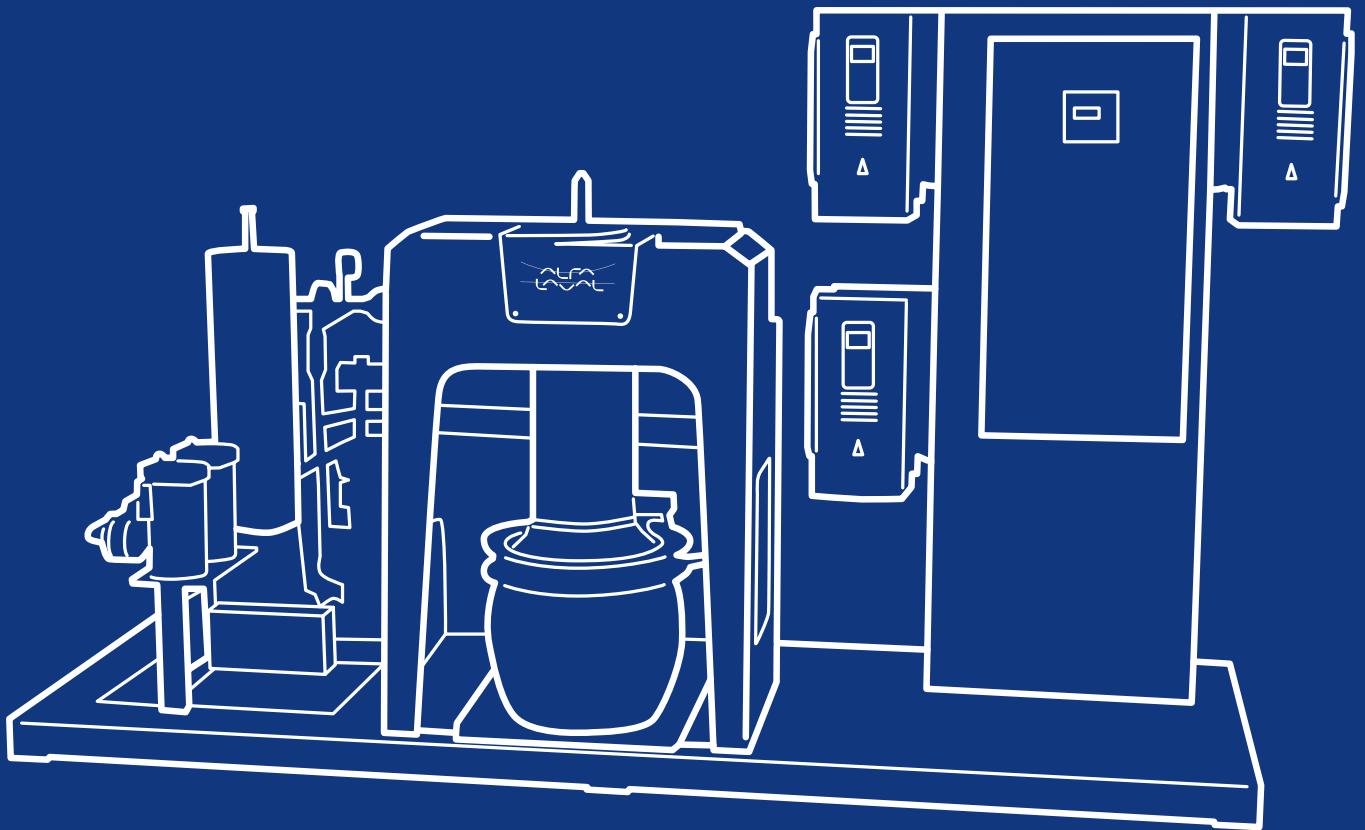




PureDry

Technical information for waste fuel recovery and sludge minimization





Inside view

The Alfa Laval PureDry separation system recovers reusable fuel from waste fuel oil and minimizes sludge generation. Used with the Alfa Laval PureBilge system, it forms a complete solution for handling waste oil and oily water.

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Summary

The Alfa Laval PureDry reduces fuel consumption costs by up to 2% and minimizes sludge generation on board ships and at diesel power plants.

The Alfa Laval PureDry is a waste fuel recovery and sludge minimization system. This automated modular system continuously recovers fuel oil from the waste fuel oil collected from the machinery spaces of diesel engine installations on board ships and at power plants. The system typically separates the waste fuel oil into three phases:

- Fuel oil containing less than 5% water
- Water containing less than or equal to 1000 ppm oil
- Super-dry solids for disposal

The system operates at flow rates of up to 500 litres per hour. Flexible and effective, it comprises five units: a demulsifier dosing unit, a pumping unit, a heating unit, a separation unit, and a control unit.

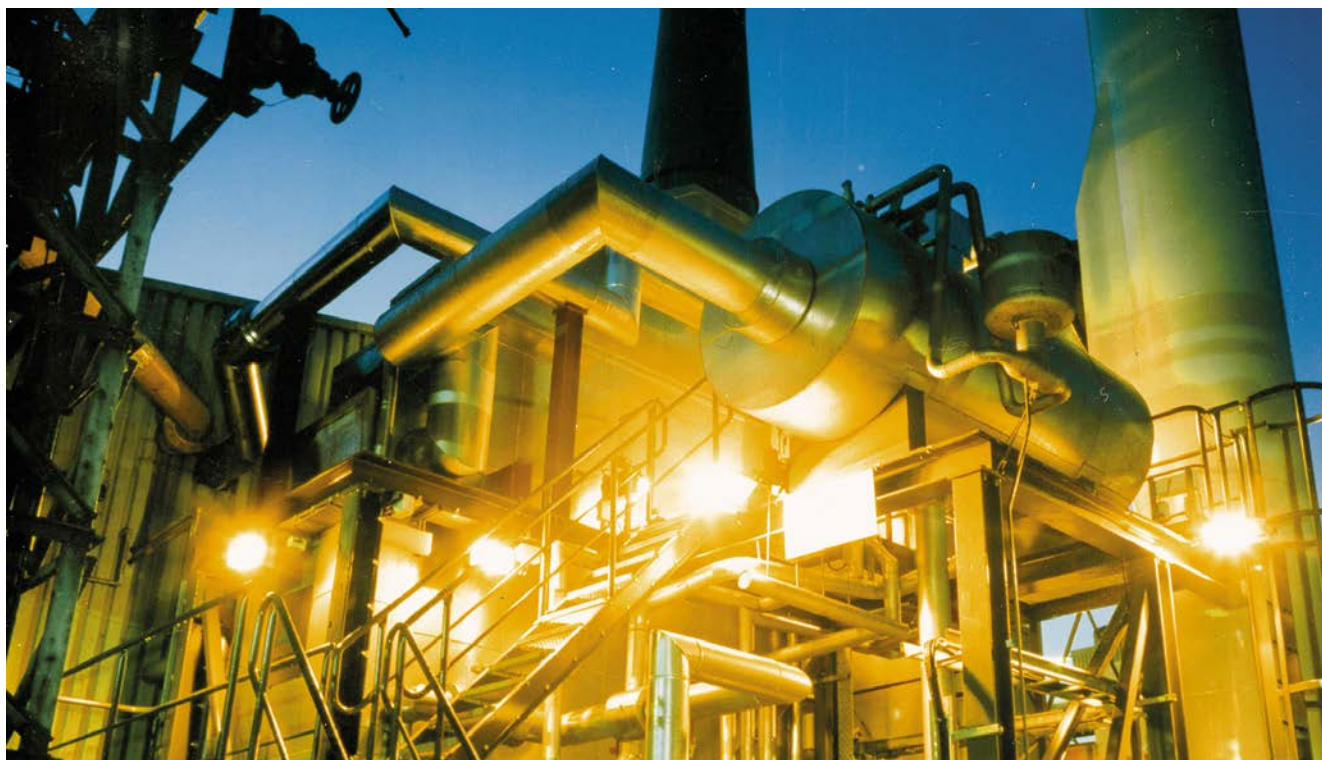
This document provides technical information about the Alfa Laval PureDry system. It includes information about fuel recovery, sludge minimization, the waste oil treatment process, system design, system benefits and a description of the equipment.

Benefits for shipyards and power plants

- Compact, modular, easy-to-install system
- Increased payload capacity due to smaller holding tank volumes for waste oil and waste water
- Easy to integrate with existing onboard systems
- Smaller sludge incinerator

Benefits for owners and operators

- Substantial savings from recovery of fuel oil
- Minimal land-based sludge disposal
- Reduction in carbon dioxide footprint
- Effective pretreatment of water prior to discharge to the bilge tank



The Alfa Laval PureDry system

A fully integrated, automated modular system, the Alfa Laval PureDry efficiently recovers fuel oil from waste oil and oily water while minimizing the sludge volume on board ships and at power plants.



Alfa Laval PureDry system.

Waste fuel recovery and sludge minimization systems must meet the individual requirements of diesel engine installations as well as the demands of ship owners and power plant operators for safety, reliability, compactness and automation.

The systems must also be capable of handling different operating conditions and the varying composition and characteristics of the waste oil to be treated.

Overview

The Alfa Laval PureDry system enables ship owners and power plant operators to realize significant savings by recovering fuel oil from various sources, such as waste oil and oily waste from diesel engines and boilers. It also significantly minimizes sludge handling and disposal costs.

The PureDry system has proven to be a reliable, effective method for the continuous recovery of fuel in diesel engine installations. It also provides effective pre-treatment of oily waste before it is pumped to the bilge system.

The PureDry system operates at flow rates of up to 500 litres per hour and typically separates waste oils into:

- Fuel oil containing less than 5% water
- Water containing less than or equal to 1000 ppm oil
- Super-dry solids to be landed ashore as dry waste, typically 10–20 kg/24 h

System benefits

Up to a 2% reduction in fuel costs

Recovered fuel oil can be transferred to the fuel tank.

Reduction in carbon dioxide footprint

Waste fuel recovery represents a valuable contribution to reducing CO₂ emissions for shipping and power plant companies with environmental targets.

Up to 99% reduction in oily waste volumes

The system removes the maximum amount of water from waste oil, and forwards it to the bilge system, thus eliminating oily waste.

Savings on waste oil handling costs

The system contributes to substantial savings in the total cost of handling waste oil and sludge.

Increased payload capacity

Reduced holding tank volumes for waste oil and waste water corresponds to a similar increase in payload or plant capacity.

Compact, modular design

Easy-to-install, modular system provides flexibility for installation in any convenient location.

Reliable operation

The simple separator design ensures easy and reliable operation. Smart automation adapts the process control to varying feed conditions. No water consumption is required and no additional waste generated.

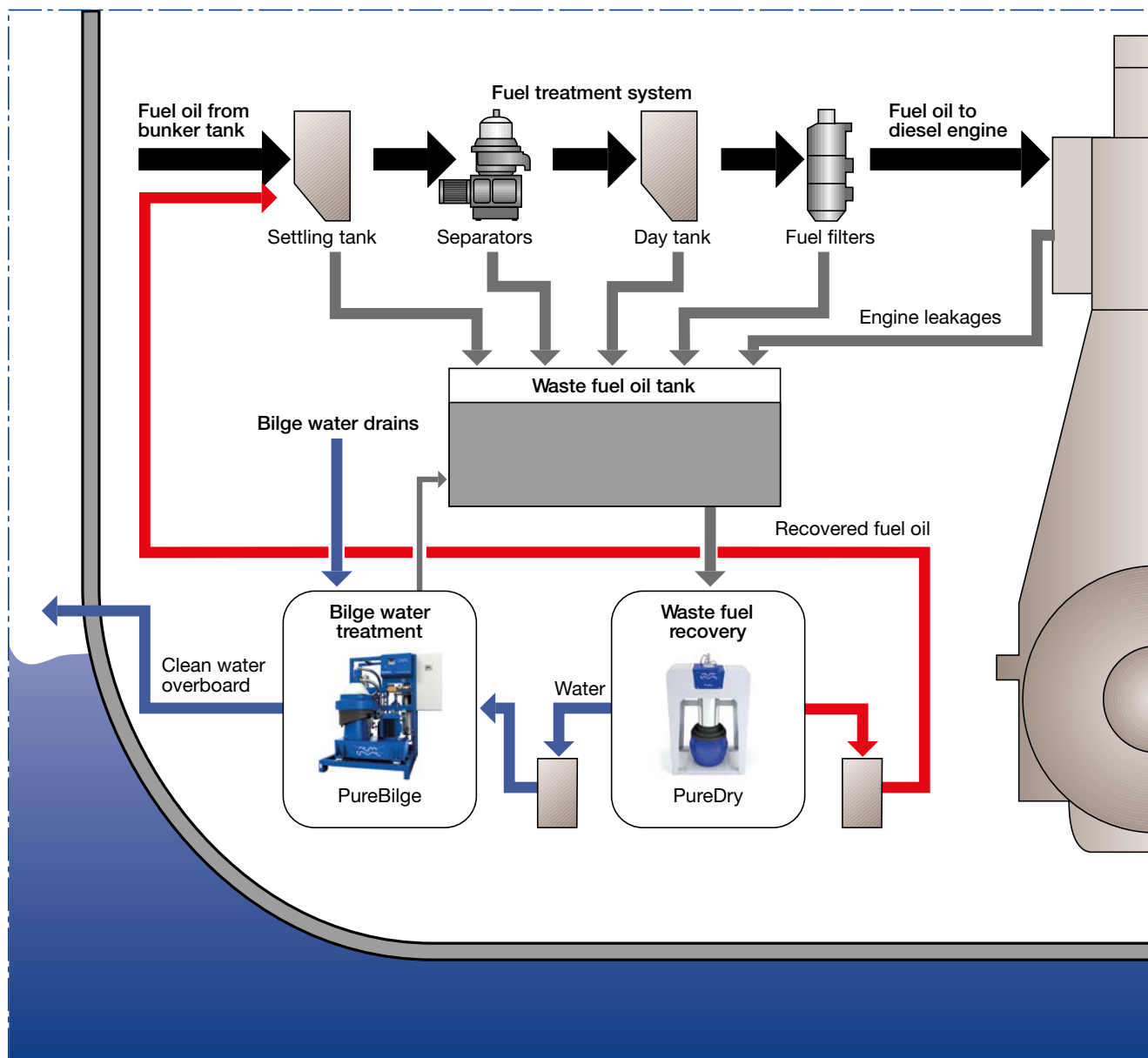
Robust and stable

Heater and software specifically designed for waste fuel oil enable robust and stable operations. A heat tracing element at the valve block prevents clogging of sludge inside the system.

Maintenance and Service by Exchange Kit

The Maintenance and Service by Exchange (MSE) Kit makes replacing the Alfa Laval Xcavator, separator insert, bearing housing and consumables as easy as replacing the insert in a filter. Upon replacement, used parts should be returned to the nearest Alfa Laval service centre and a new MSE Kit will be sent from Alfa Laval for future use in order to maintain the equipment in good operating condition.

Alternatively, maintenance can be implemented on board or on site by your crew or operator.



The Alfa Laval PureDry waste fuel treatment system with integrated bilge water treatment system.

Waste fuel recovery

During the course of fuel handling and fuel treatment, some fuel is lost. Based on experience, this loss is estimated at up to 2% of the total fuel consumption. Alfa Laval PureDry can recover this lost fuel for reuse.

Sources of recoverable fuel

- Automatic backflushing fuel oil filters
- Fuel settling and service tank drains, tank coamings and cofferdams
- Fuel injection pumps
- Boiler burner leakages
- Drip trays under fuel transfer pumps, etc.
- Pipe leakages
- Fuel spill incidents
- Fuel oil purifiers

A condition for recovery of fuel oil is that the waste fuel oil collected from the sources listed above is collected in a separate tank from that used for other drains and leakages, such as lube oil, hydraulic oils, etc. PureDry treats the waste fuel oil in this tank, separating out the water and solids and recovering reusable fuel.

Why it is important to segregate the collection of waste fuel oil from other waste oils

Waste oil comes from tank sediments, leakages, filters and purifiers and, in many cases, is collected in a common waste oil tank and subsequently landed or incinerated. A condition for efficient recovery of reusable fuel from waste oil is that the waste fuel oil must be kept separate from other types of oily waste. This applies particularly to oily waste from lube oil separators in order to avoid contamination of the recovered fuel oil.

Recovering re-usable fuel from waste fuel oil with PureDry

Segregating the waste fuel from other oily waste enables the successful recovery of re-usable fuel oil. Typically, the recovered fuel is discharged from PureDry into a recovered fuel oil holding tank. From there, it is transferred to the fuel tanks for reuse after normal treatment.

The separated water is discharged to the bilge system and separated solids in the form of super-dry, non-pumpable sludge are collected in a container at the base of the separator.

Disposal of the super-dry solids

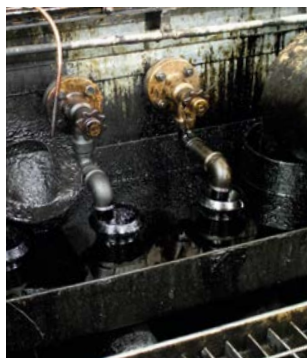
Super-dry solids are generally disposed of on land. A ship with a 20 MW engine using heavy fuel oil and Alfa Laval PureDry, for instance, typically generates less than 10 kg of super-dry solids during a 24-hour period. These solids can be landed and disposed of as dry waste in the same manner as oily rags and used filter cartridges.

Fuel loss: Slow steaming vs. MCR

Should there be a reduction in engine power, there is no reduction in fuel losses. Fuel losses are proportional to engine operation; that is, they are about the same when operating at reduced power outputs as when operating at maximum continuous rating (MCR). See the table below.

Fuel loss source	Fuel losses at reduced engine power vs. at 100% MCR
Fuel separators	Less fuel losses only if the number of fuel separators in operation is reduced
Fuel transfer and booster pumps	No change
Service tanks	No change (same drainage intervals – same tank volumes)
Fuel injection pumps	Virtually no change
Automatic fuel oil filter	Virtually no change

Images showing main sources of recoverable fuel



Service tank drains.



Fuel separators.



Automatic fuel oil filters.

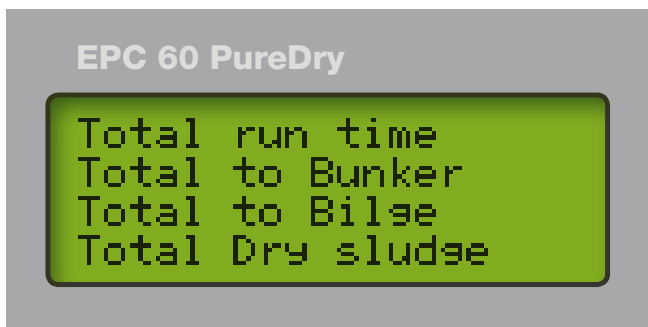


Fuel injection pumps.

Regulatory aspects of waste fuel recovery

Operations on board ships, for instance, must comply with the International Maritime Organization (IMO) guideline MEPC.1/Circ.642, “re-generation of fuel oil from oil residue (sludge) should be an approved means of disposal of oil residue (sludge).”

The guideline IMO MEPC.1/Circ.642 further stipulates that “oily drains should be recorded in the oil record book as any other oil residue (sludge) collection.” With PureDry, the amount of oil that is recovered and forwarded to the recovery tank is recorded in the tamper-proof Alfa Laval EPC 60 PureDry control system. The amount of water forwarded to the bilge system and the amount of super-dry solids produced are also recorded by the EPC 60 PureDry control system.



Total counters for run time, recovered fuel to bunker or fuel tank, water to bilge system and super-dry solids shown on the display of the Alfa Laval EPC 60 PureDry control system.

MEPC.1/Circ.642 – Re-generation of fuel oil from oil residue

- 4.6.1 Oil residue (sludge) may be used on board as re-generated fuel. Oil residue (sludge) is collected in an oil residue (sludge) tank prior to processing (disposal) back into the fuel oil system as re-generated fuel oil.
- 4.6.2 Oily drains should be recorded in the oil record book as any other oil residue (sludge) collection.
- 4.6.3 Re-generation of fuel oil from oil residue (sludge) should be an approved means of disposal of oil residue (sludge) according to the Supplement to the IOPP Certificate.
- 4.6.4 The re-generating process may include filtration, decanting or purification to remove unwanted heavy parts from the oil residue (sludge).

5 Definitions for the purpose of the Guidelines

- 5.1 Oily waste means oil residues (sludge) and oily bilge water.
- 5.2 Oil residue (sludge) means the residual waste oil products such as those resulting from the purification of fuel or lubricating oil from main or auxiliary machinery or separated waste oil from bilge water separators, oil filtering equipment or oil collected in drip trays, and waste hydraulic and lubricating oils.

Extract from IMO MEPC.1/Circ.642.

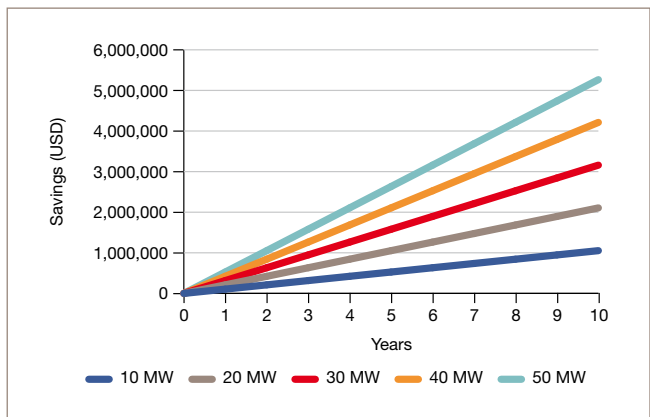
Reducing fuel costs by investing in PureDry

The Alfa Laval PureDry has been tested and proven to recover on average up to 2% of the total fuel consumption on board a ship.

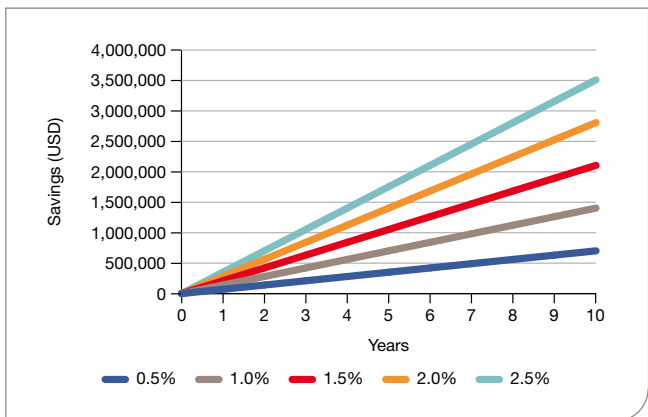
Factors determining the profitability of a PureDry installation include the fuel consumption of the engines, the vessel’s sailing time per year, the percentage of fuel that can be recovered and the price of bunker fuel.

The graph below (left) indicates the savings that can be achieved in relation to different engine sizes. The diagram is based on a waste fuel recovery of 1.5%.

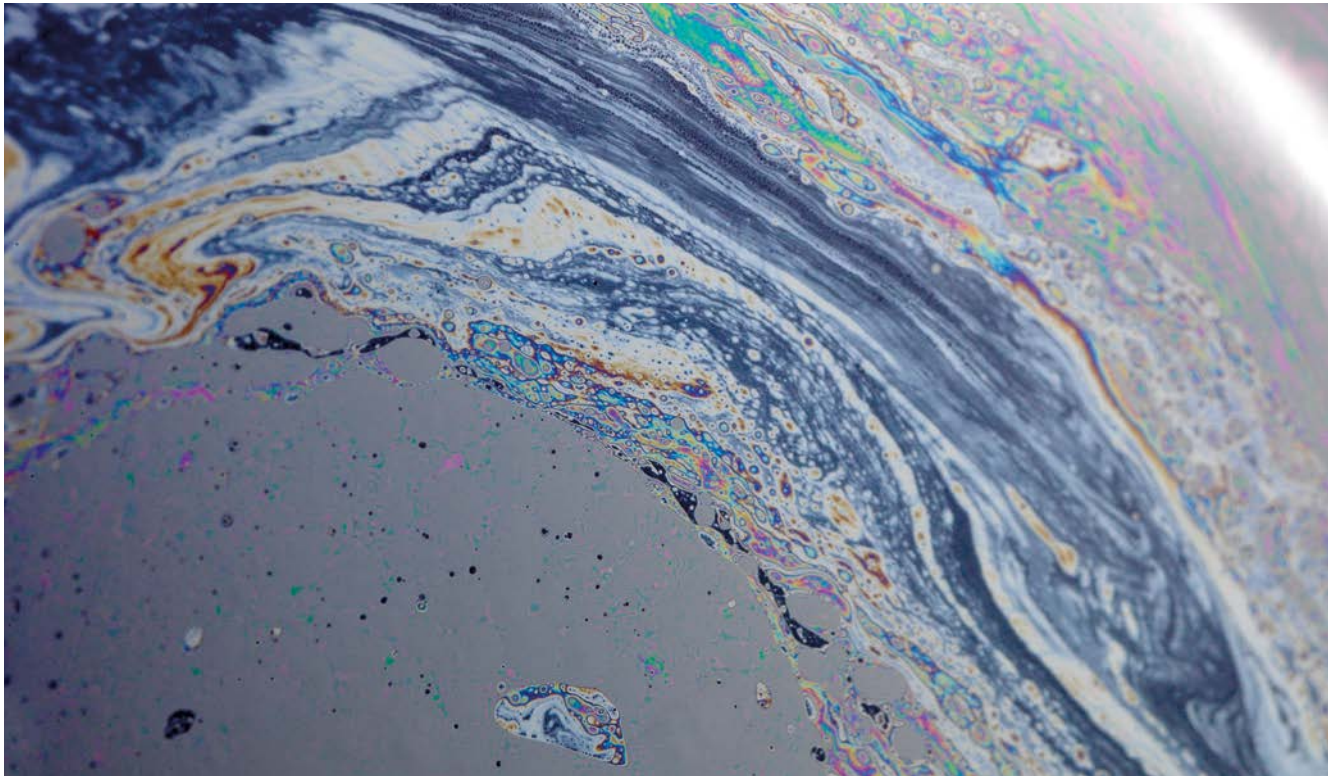
The graph below (right) shows the savings relating to different fuel recovery factors for a typical ship. Fuel savings at diesel power plants will vary, depending upon similar factors such as fuel prices, fuel consumption and engine run time.



Direct savings from installing PureDry for waste fuel recovery.



Direct savings from a PureDry investment for a typical ship.



Defining waste oil and oily water

Waste oil

Waste oil generally refers to any used products primarily derived from petroleum, which include, but are not limited to, fuel oils, motor oils, gear oils, cutting oils, transmission fluids and hydraulic fluids. Used oil from many different engine areas along with considerable amounts of water are collected and stored in common waste oil tanks.

Waste oil is a mixture of water, oil and solids that comes from the fuel treatment system and operation of diesel engines.

The PureDry system processes waste oil and produces recovered fuel oil, water clean enough to put into the bilge system and super-dry solids for land-based disposal.

Oily water

Oily water (bilge water) is water from the bilge wells and other sources, lightly contaminated by oil, that can be cleaned in a bilge water separator before being discharged.

Note: For the purposes of this document, waste oil and oily water are referred to jointly as oily waste.

Emulsions and suspensions

By definition, an emulsion is a mixture of two immiscible liquids. An oil-in-water emulsion consists of small oil droplets dispersed in a continuous water phase. A water-in-oil emulsion is an inverse emulsion, where droplets of water are dispersed in a continuous phase of oil. A suspension is a mixture in which solid particles are dispersed in the continuous water or oil phase.

Emulsions can form under agitation, such as during pumping or throttling in the valves. The emulsion droplets generally coalesce, or combine, into larger droplets because of their insolubility.

Increasing the droplet size helps facilitate separation. However, the presence of surfactants, such as detergents, soaps and other surface-active compounds, may contribute to stabilization of small droplets. Stable emulsions are difficult to break down, but the high g-force in a centrifugal separator efficiently handles even the most stable emulsions. There are different mechanisms for emulsion and suspension destabilization and breakdown, including coalescence and flocculation.

Coalescence is a process in which two or more droplets collide, resulting in the formation of a larger droplet.

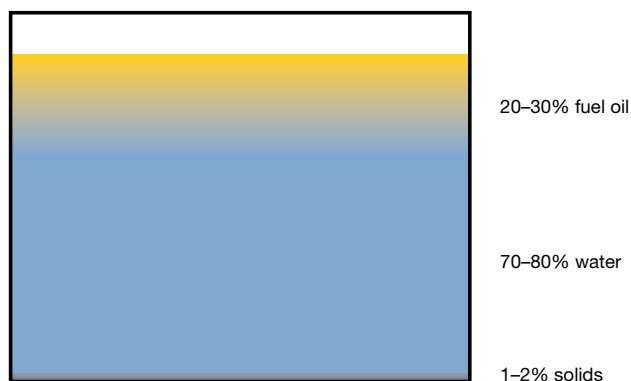
- The high centrifugal force generated in a high-speed centrifugal separator greatly contributes to the coalescence of small droplets.
- Elevated temperature accelerates the rate of coalescence by increasing the probability of the droplets colliding and by decreasing the viscosity of the continuous phase.

Flocculation is a process by which two or more particles unite without losing their individual identities, forming larger aggregates or clusters.

Tanks for waste fuel oil

Waste fuel oil is collected in a dedicated tank for waste fuel (waste lube oil in a separate tank). Besides water, it typically contains oil and inorganic and organic solids, including precipitated heavy oil compounds. Oil that ends up in the waste fuel oil tanks can include fuel oil from purifiers and filters, and oil from all types of fuel leakages. Solvents and detergents from cleaning may also collect in waste fuel oil tanks.

The contents of waste fuel oil tanks that collect the residues from fuel purifiers typically consist of 70–80% water, 20–30% oil and 1–2% solids.



Stratification in the waste fuel oil tank.

To ensure proper handling, the use of high, narrow tanks rather than wide, shallow tanks is recommended to create good conditions for gravitational settling, which is a primary means of separation. Oil rises to the top and particles settle on the tank bottom, generally dividing the tank contents into three distinct layers:

- *Top layer* – Mainly oil contaminated by water and solids.
- *Middle layer* – An aqueous phase consisting of water polluted by oil, chemicals and particles in emulsified form.
- *Bottom layer* – Solids and heavy sludge.

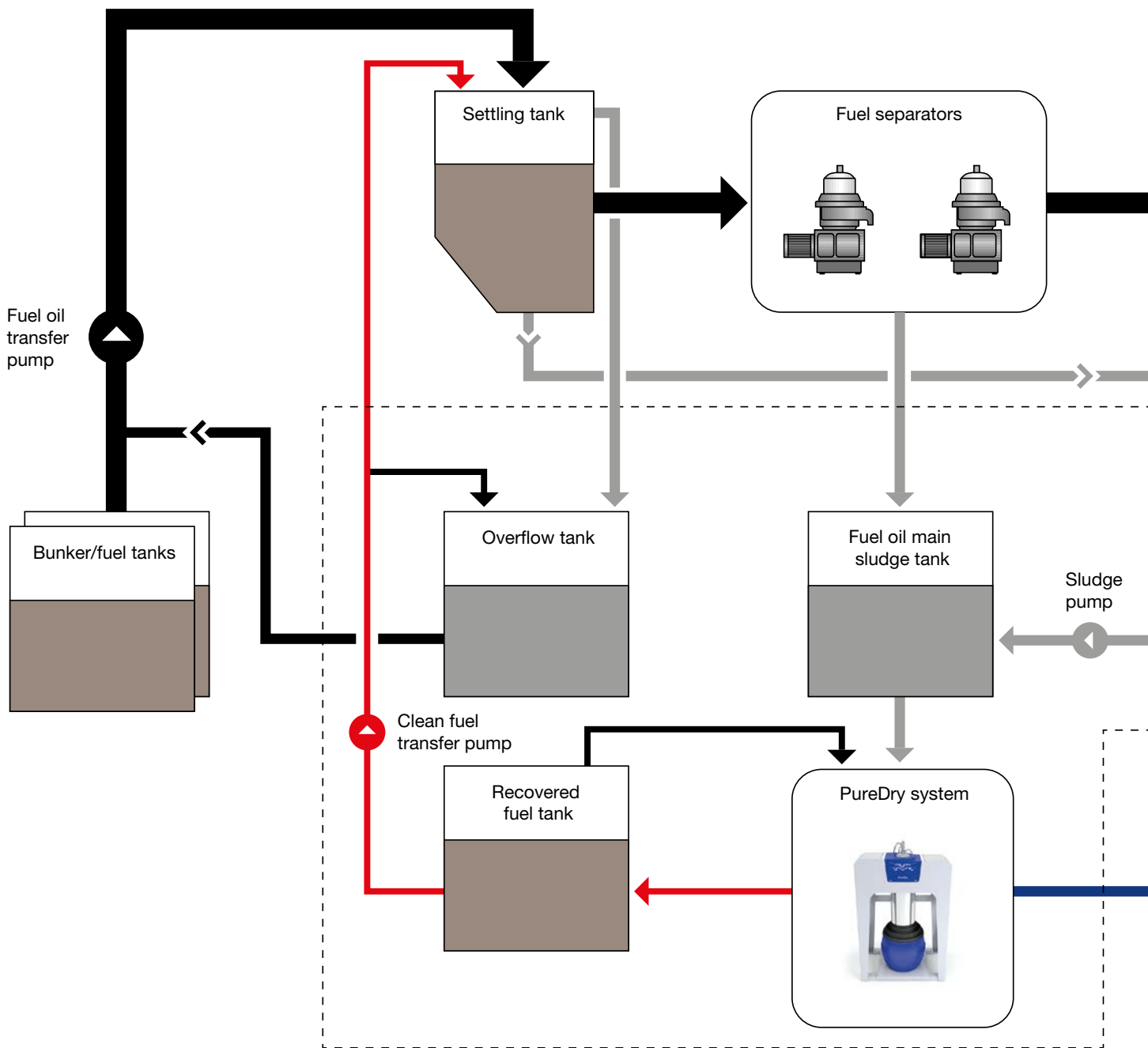


MV KSL Singapore (Frontline) leaving the Shanghai Waigaoqiao Shipbuilding Company with the first PureDry on board, which was installed at an Asian shipyard.

Drying up the oily waste streams

PureDry in combination with the Alfa Laval PureBilge system forms an optimal integrated waste oil/bilge water treatment solution.

Alfa Laval's fully integrated waste oil/bilge water treatment system with waste fuel recovery.



The Alfa Laval PureDry recovers reusable fuel oil, concentrates the solids to super-dry sludge and sends the water to the bilge system. PureBilge then takes care of the fine polishing of the oily water prior to discharge.

PureDry for waste fuel recovery

Segregated waste systems that keep fuel oil waste separate from other oily waste streams are a good platform for efficient waste oil management. This arrangement enables fuel oil to be recovered using a PureDry system.

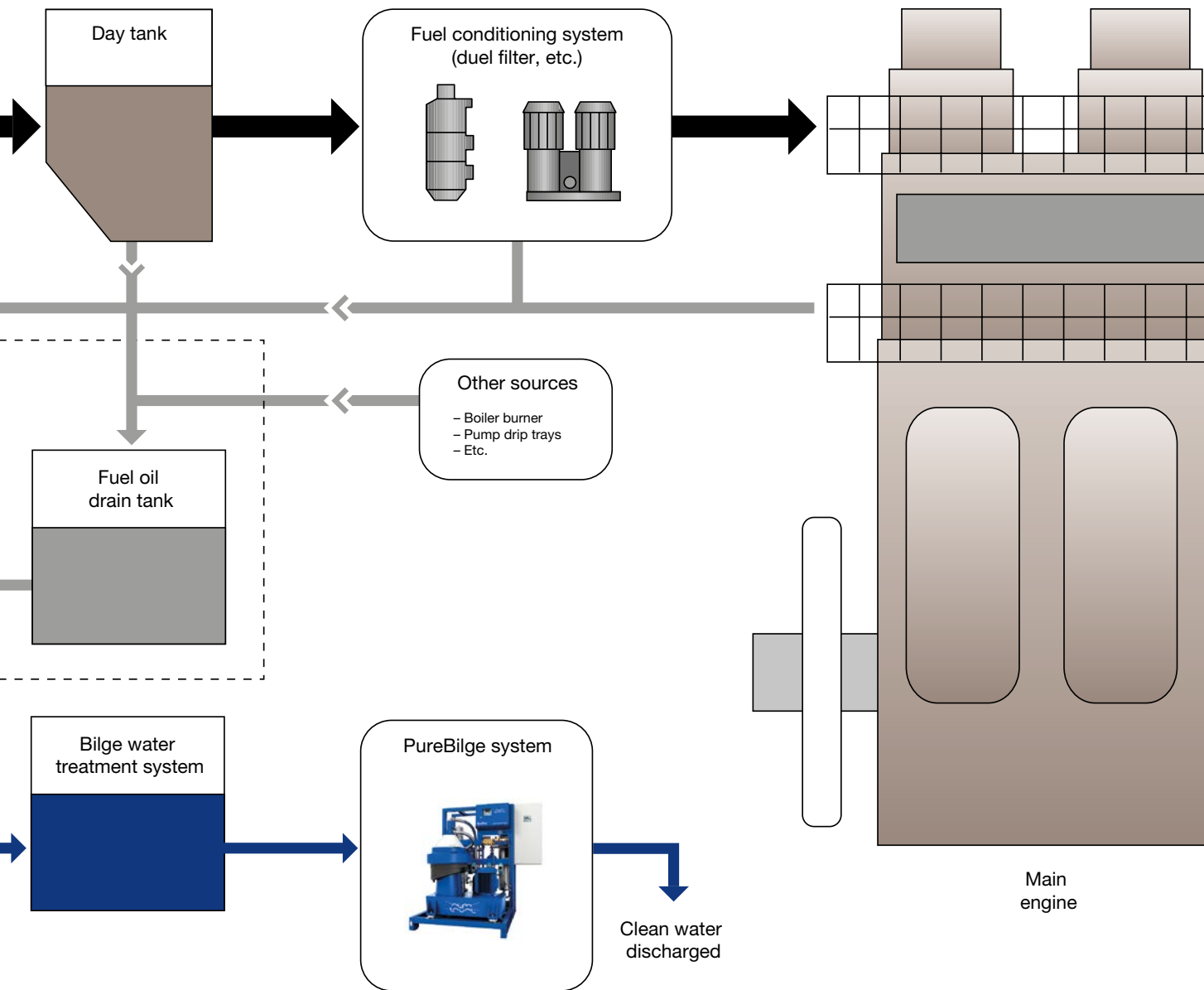
The illustration shows in principle a layout for a complete waste oil/bilge water treatment system with waste fuel recovery. For installation of a PureDry solution on existing vessels or in

existing power plants, the layout may differ thereby providing various process solutions. The core requirement for a successful implementation is, however, the segregation of waste fuel oil systems and other waste oil systems.

Installing PureDry makes it possible to reduce the volumes of waste oil tanks by at least 50%.

PureBilge for bilge water treatment

Water separated during the treatment process is pumped to the bilge water system for further processing by the Alfa Laval PureBilge system. To comply with IMO regulations, PureBilge further reduces the oil content in the water to below 5 ppm and it can then be safely discharged overboard.



PureDry operating principle

The revolutionary design of the Alfa Laval PureDry BX 50 separator ensures efficient processing of waste oil.

Separator function

The BX 50 high-speed centrifugal separator continuously processes waste oil, which it separates into oil, water and solids.

The separator bowl containing a disc stack rotates at high speed, and solids from the waste oil accumulate at the bowl's periphery. From the periphery, the solids are continuously discharged by a patented spiral-shaped device called the XCavator into a container under the separator. The amount of solids accumulated is continuously monitored by means of a load cell.

An oil paring disc, which forms part of the separator bowl, continuously discharges recovered oil from the separator through the oil outlet under pressure. The oil is directed to the oil recovery holding tank. A built-in water paring disc continuously discharges separated water through the water outlet.

Although sealing water is added to the bowl during start-up, no additional water is required, so no additional waste is created by the process itself.

Process operating principle

A positive displacement feed pump operating at a constant flow directs the waste oil to the system.

The process liquid then passes through a duplex strainer, which traps large particles, into a preheater. For optimum separation efficiency, the heater raises the temperature of the unprocessed liquid to the desired feed temperature of 95°C.

A three-way changeover valve directs the oily waste to the separation stage if all process conditions, such as feed temperature and feed pressure, are met. During an alarm situation, loss of operating pressure, power failure or when any preset condition is not met, the valve recirculates the fluid back to the waste oil tank(s).

The water is then transferred either to the bilge water treatment system for further processing to ensure that it meets IMO or other standards for discharge, or back to the waste oil tank, according to the process conditions.

To enhance performance in the presence of stable emulsions, a demulsifier dosing unit is included. The unit is connected before the pumping stage in order to mix the Alfa Laval demulsifier directly into the feed.

The process is continuously monitored and controlled by the EPC 60 control system for fully automatic operation.

Capacity and sizing

The throughput capacity of the PureDry BX 50 system is up to 500 litres per hour, depending on the amount of emulsions and whether the demulsifier dosing unit is used.

In most cases, a single PureDry system has sufficient capacity to handle the waste oil produced from a diesel engine installation on board a ship. In some cases, for the largest marine engines or in multi-engine power plants, the installation of more than one PureDry system may be required for optimum fuel recovery.

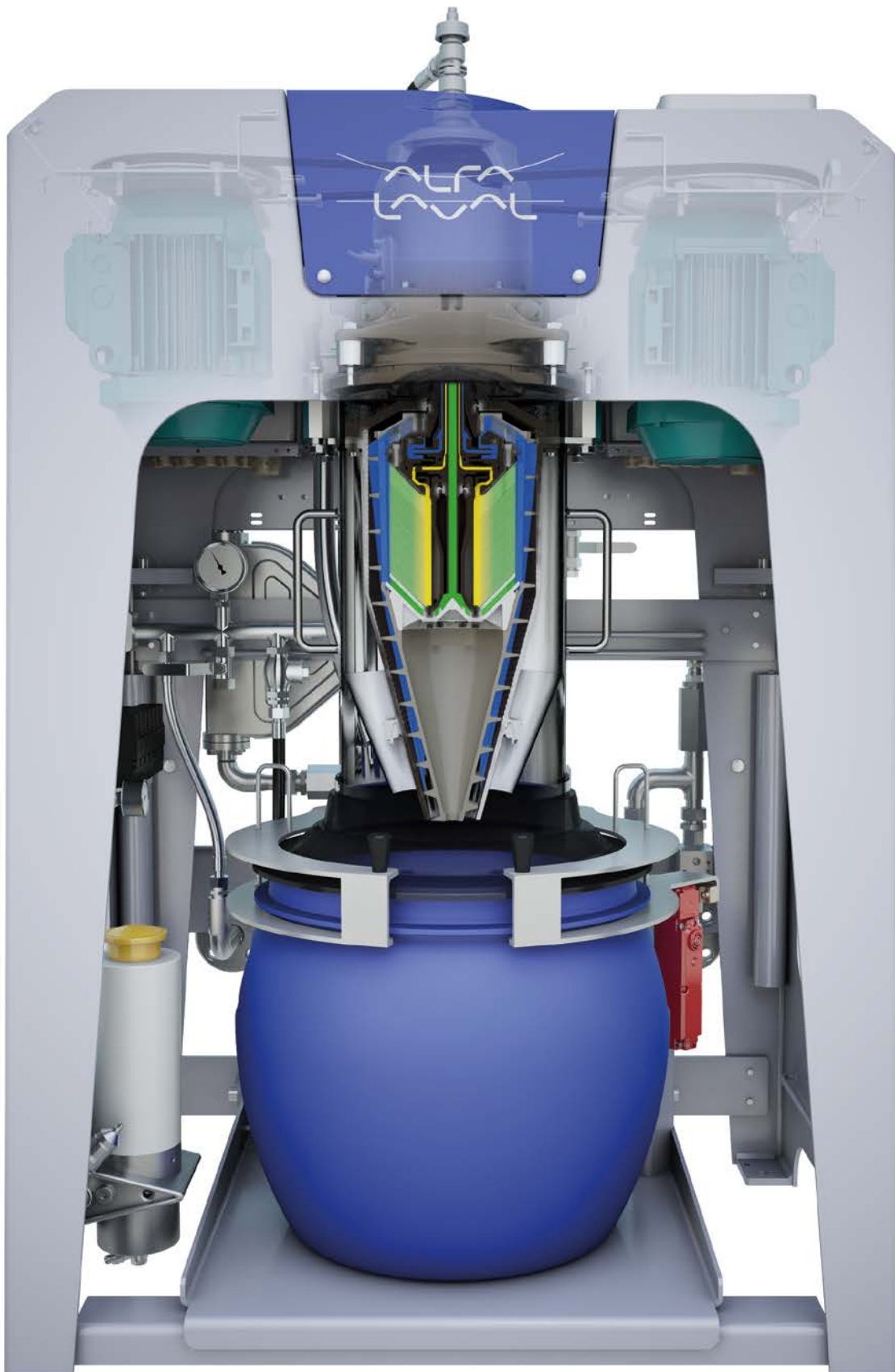
Calculations based on the estimated waste oil production for a particular installation will determine the number of PureDry systems required to provide adequate coverage.

Solids production

The typical amount of super-dry solids produced when processing fuel from a diesel engine running on HFO is around 25–50 g/MWh. This corresponds, for example, to approximately 10–20 kg of solids produced during a 24-hour period.



Super-dry solids.



Cross-section of an Alfa Laval PureDry BX 50 separator.

PureDry equipment

The compact, modular design of the Alfa Laval PureDry makes it easy to install and reliable to operate.

Overview

The PureDry system makes efficient use of available space and provides flexibility and easy access for operation and maintenance.

The system consists of five units:

- Demulsifier dosing unit
- Pump unit
- The BX 50 separator with valves and flow meters
- Heater unit with strainer, pressure transmitters and valves
- Control unit

System components

Feed pump

A positive displacement feed pump with a variable frequency drive electric motor directs unprocessed waste oil from the tanks to the system. The pump unit consists of a compact stand-alone pump module, which is designed for ease of installation and ease of accessibility for maintenance.

To protect the pump from dry running, the unit is equipped with a water-priming device that is automatically activated upon start-up. This water-priming device may also be manually activated whenever necessary. The pump has a pressure relief valve, pressure gauges and a non-return valve on the discharge side.

Duplex strainer

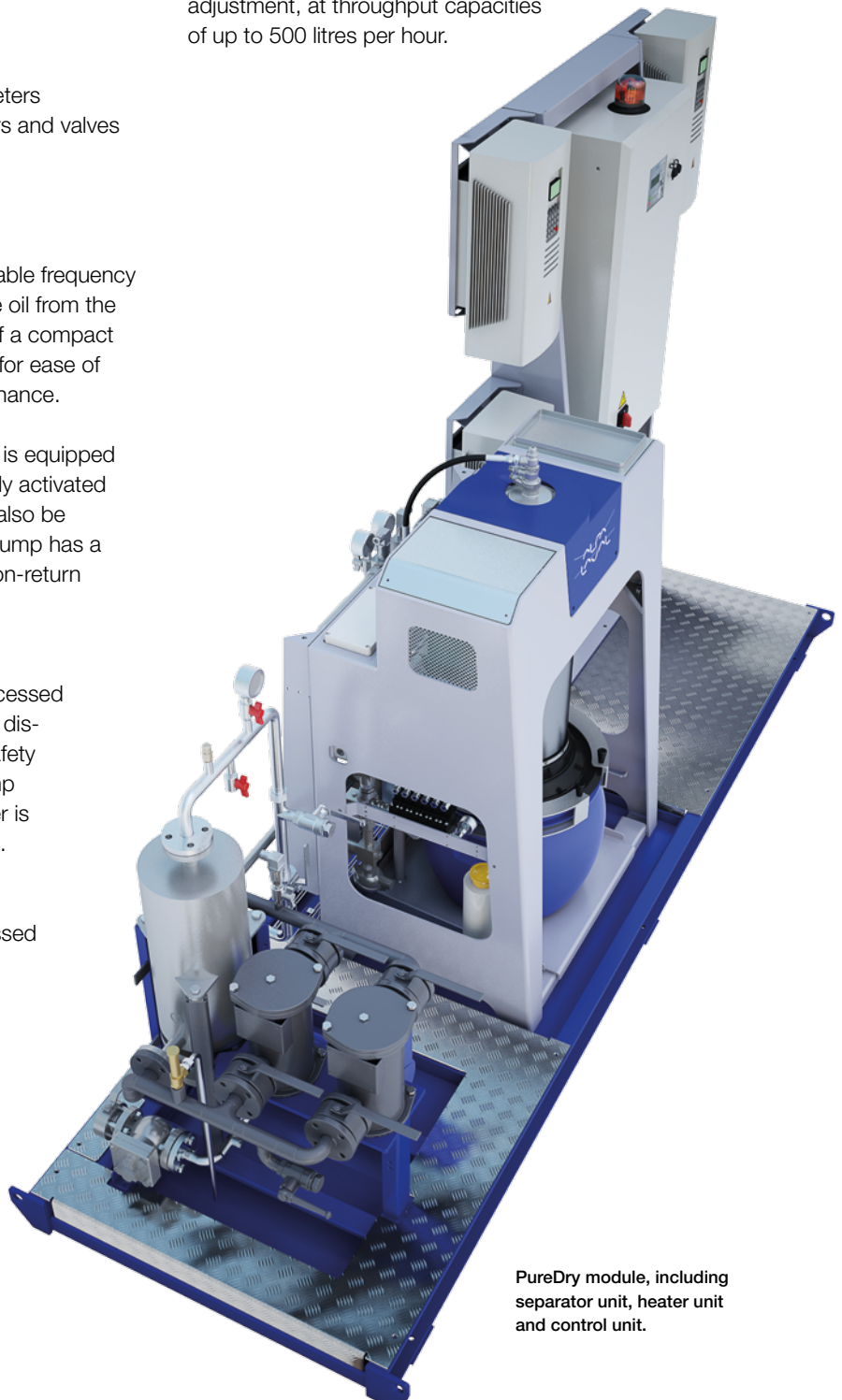
To trap large particles suspended in the unprocessed liquid that may cause unnecessary operational disturbances, a duplex strainer is installed as a safety measure. The strainer is installed after the pump to protect the pump from dry running if the filter is clogged. The pump is not sensitive to particles.

Heat exchanger

A shell-and-tube heater preheats the unprocessed liquid to 95°C using steam or hot water as the heating medium.

Centrifugal separator

The BX 50 separator is designed for continuous, high-efficiency separation of large volumes of waste oil. It simultaneously separates oil, water and solids from waste oil/water of varying composition and density, without requiring adjustment, at throughput capacities of up to 500 litres per hour.



PureDry module, including separator unit, heater unit and control unit.

The BX 50 separator is optimized to treat waste oil. It has integral paring disc pumps for continuous discharge of separated oil and water. In the disc stack, the three phases are separated into outlets for oil, water and super-dry solids.

At the bottom of the separator is a container that collects the super-dry solids. The amount of solids accumulated in the container is continuously monitored by means of a load cell.

Flow meters

High-accuracy flow meters are used to measure the water and oil output capacities from the PureDry separator.

Three-way changeover valves

Three pneumatically activated three-way changeover valves direct the treated media based on the installed control conditions.

Constant pressure valve

Installed before the separator, this fast-acting, high-precision valve ensures a constant flow of oily waste to the separation system regardless of fluctuations in the feed viscosity.

Control cabinet

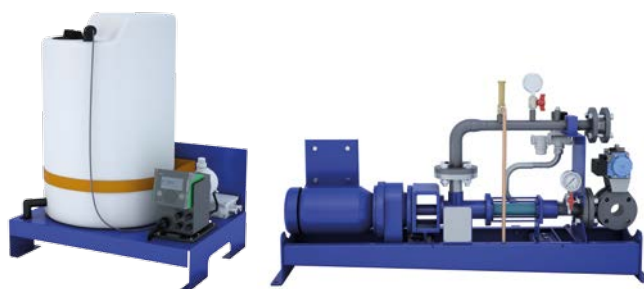
Centrally located to monitor all PureDry functions, the control cabinet contains all electric power functions, all frequency drives, the power supply for the optional chemical dosing unit and the Alfa Laval EPC 60 process controller and operator panels.

Process controller

The EPC 60 process controller provides fully automated advanced monitoring and control functions. The controller also contains logging functions that record the amounts of oil, water and solids that have been processed. A proportional integral (PI) temperature controller accurately maintains the temperature set point for separation, even under variable feed conditions.

Demulsifier dosing unit

PureDry is equipped as standard with a demulsifier dosing unit. Under extreme conditions, centrifugal force alone is not sufficient to deliver high separation efficiency for satisfactory treatment and a de-emulgator is then added. The dosing unit efficiently handles oily waste with stable emulsions by reducing the binding forces within the emulsion. When injecting small quantities of Alfa Laval demulsifier into feed that contains stable emulsions, it significantly improves the quality of the recovered oil as well as of the quality of the water separated.



Demulsifier dosing unit.

Pump unit.

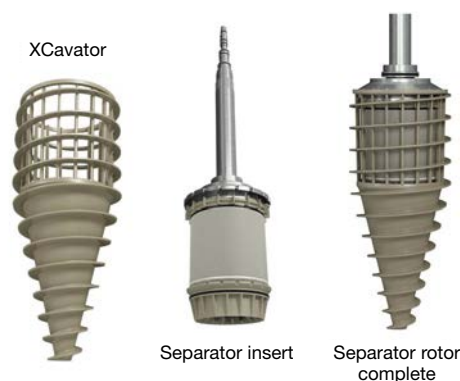
Maintenance and Service by Exchange

PureDry is built with pre-assembled blocks, which are easily exchanged and specially designed to ease service; for example, replacing the separator insert is as easy as replacing the insert in a filter. The exchange parts are replaced at nine-month intervals and used parts can be returned to the nearest Alfa Laval service centre. Replacement of exchange parts typically requires between one and two hours. The PureDry EPC 60 process controller alerts the operator well in advance that service will soon be required.

PureDry is supplied with a Maintenance and Service by Exchange (MSE) Kit, which includes an Alfa Laval XCavator, a separator insert (rotor and disc stack), a bearing housing and a consumables kit. Replacement of the separator insert is recommended every nine months.

The MSE Kit enables service to be conducted with minimal downtime. Upon replacement, used parts should be returned to the nearest Alfa Laval service centre. To maintain the equipment in good operating condition, a new MSE Kit will be sent from Alfa Laval for future use.

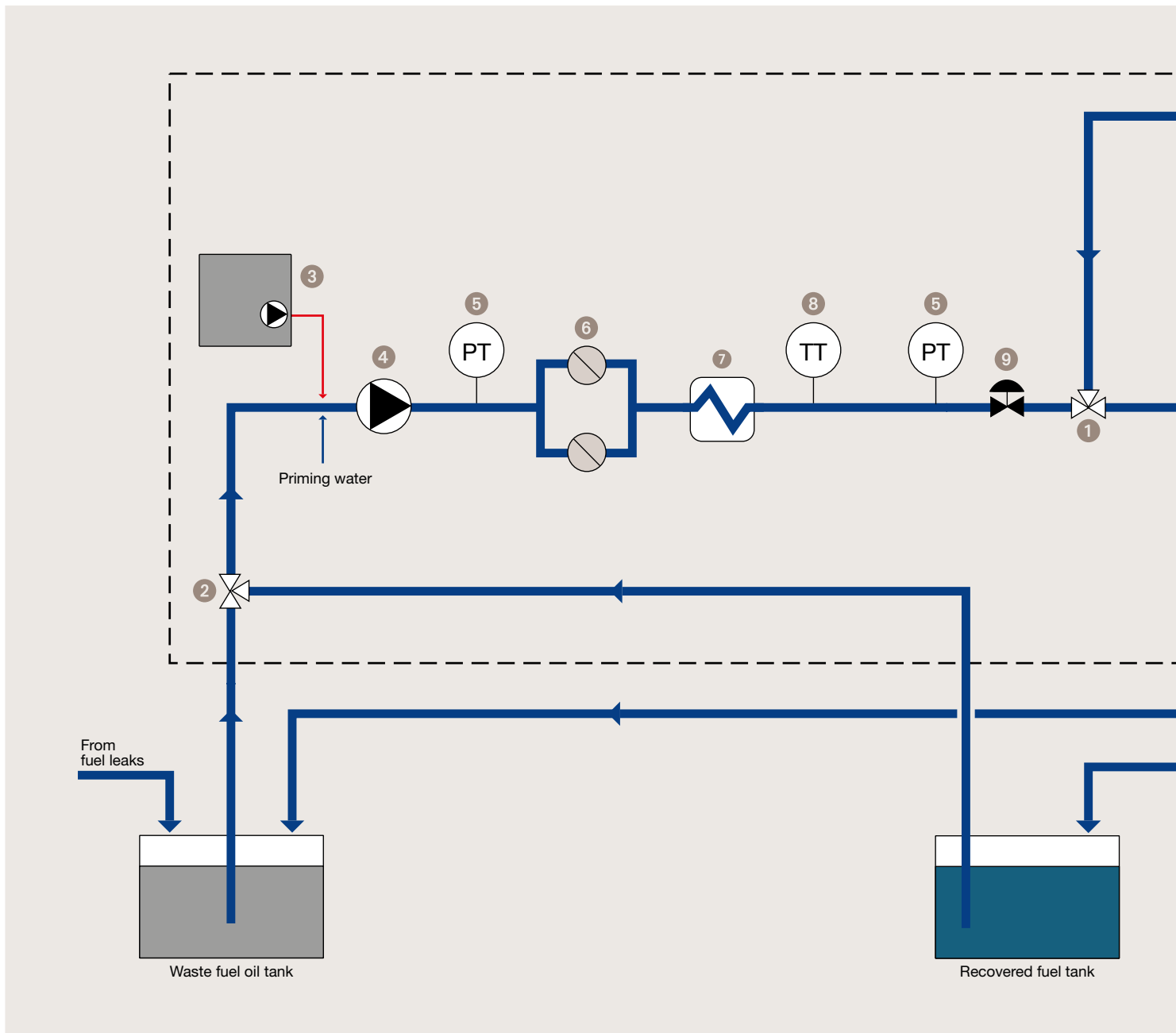
Alternatively, the separator insert and bearing housing can easily be overhauled at the facilities of your local maintenance service provider.



Exchange parts: XCavator, separator insert and separator rotor.

PureDry system flow chart

- 1 *Three-way valve*
Directs the feed from the heater to the separation stage.
- 2 *Three-way changeover valves*
Directs the treated media to different tanks depending on process status.
- 3 *Demulsifier dosing unit*
Enhances separation efficiency by adding Alfa Laval demulsifier to the feed.
- 4 *Feed pump with electric motor*
Transfers oily waste to the heater.
- 5 *Pressure transmitters*
Measures the pressure in the inlet and outlet and signals the process controller.
- 6 *Duplex strainer*
Traps large particles in the feed before it enters the heater.
- 7 *Shell-and-tube heater*
Raises temperature of the feed to the required treatment temperature of 95°C.
- 8 *Temperature transmitters*
Measures the temperature of the liquid from the heater and signals the process controller.
- 9 *Temperature transmitters*
Measures the temperature of the liquid from the heater and signals the process controller.



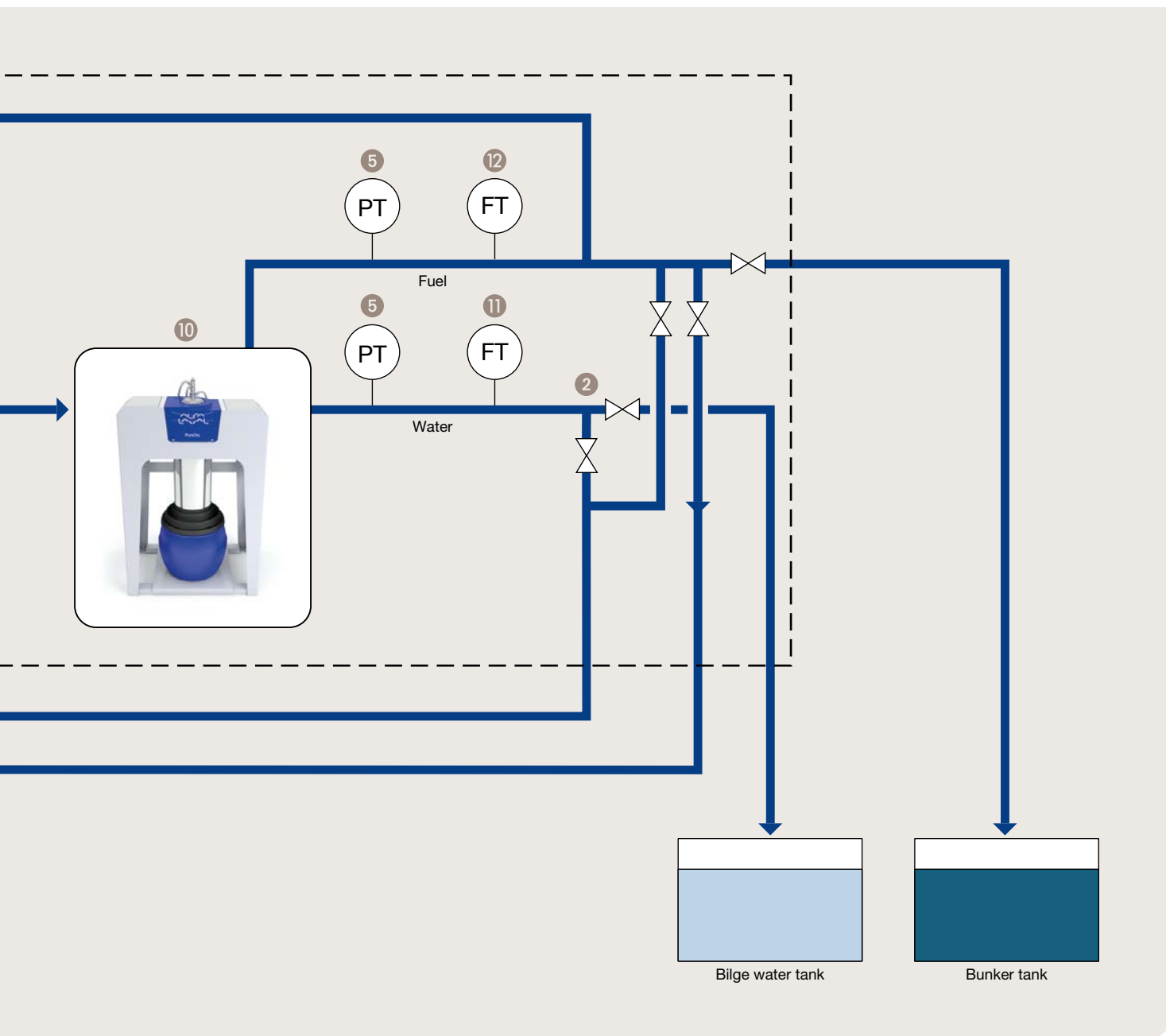
9 *Constant pressure valve*
Ensures stable feed conditions despite viscosity variations.

10 *BX 50 high-speed centrifugal separator*
Continuously separates oily waste into oil, water and solids.

11 *Flow transmitter (water)*
Measures the water flow rate out of the separator with high accuracy.

12 *Flow transmitter (fuel)*
Measures the oil flow rate out of the separator with high accuracy using a full-flow meter.

13 *EPC 60 control unit (not pictured below)*
Automatically regulates the operation of the BX 50 separator.





PureDry on board Norwegian Breakaway

Waste fuel recovery using PureDry

MV Norwegian Breakaway is a cruise ship owned by Norwegian Cruise Line and delivered in 2013. The ship is equipped with four main engines with a total rating of 43 MW.

A PureDry system was installed on board at the shipyard and went into full operation in April 2013.

Media treated: Waste fuel oil streams from service tanks, automatic filters, fuel separators, and other sources, collected in a dedicated waste fuel oil tank.

Recovered fuel oil: Approximately 10 m³ per week. Sent to a recovered fuel tank and then returned to the ship's bunker tanks.

Separated water: Sent to bilge holding tank.

Separated solids: The ship produces approximately 14–19 kg of super-dry solids per 24 hours, which are landed as dry waste in the same way as oily rags, filter inserts, etc.



**Christer Karlsson, Senior Vice President, Newbuilding,
Norwegian Cruise Line.**

"It's been very easy to implement it – no problem at all in fact. We see good results on the Breakaway."

"For us, waste fuel recovery is going to be standard on all newly built vessels."

"Under normal conditions, we dispose the waste fuel onshore. With PureDry, we can recover at least 80–90% of the waste fuel and put it back into the system. If we recover 10 cubic meters per week, with a price of 600 dollars per ton, we actually recover 6,000 dollars per week.

And it's very user-friendly. The only thing that we do on a regular basis is to watch and replace the sludge bag, normally twice a day."



Alex Rojas, Second Engineer, MV Norwegian Breakaway.

Retrofitting

The PureDry BX 50 system is also a suitable replacement for older treatment systems. Due to its compact design, it fits into almost any available space. To facilitate transport on board, the system can be divided into these parts:

- Demulsifier dosing unit
- Pumping unit
- Heating unit
- Separation unit
- Control unit

Documentation

Alfa Laval supplies each PureDry system with full documentation as paper copies and/or as PDF (Portable Document Format) files on a CD-ROM. The instruction manual, which can also be made available in most major languages, includes system description, system reference/installation instructions, separator manual, spare parts catalogue, component descriptions, etc.



Classification

Alfa Laval ensures that several key components for the PureDry system are type approved by the leading classification societies.

Spare parts, service and support

PureDry is supplied with a Maintenance and Service by Exchange Kit, a new XCavator, and a consumables kit. After one year, the crew replaces the separator insert and the XCavator. The used parts are returned to the nearest Alfa Laval Service Center, and the ship orders new kits. The PureDry separator remains under continuous warranty. Global technical service, training and support are available throughout the lifetime of all Alfa Laval systems and equipment. Alternatively, maintenance can be implemented on board or on site by your crew or operator.

Reference information

System data

Connections and consumptions

Power supply voltage	Three-phase, 380–500V (for other voltage, transformer is supplied)
Power supply frequency	50 or 60 Hz
Power consumption	Max. 6 kW (complete system)
Instrument air	
Separator	ISO G 1/4"
Heating module	ISO G 1/2"
Water	
Separator	ISO G 1/2"
Feed pump unit	ISO G 3/4"
Steam inlet	DN 15
Demulsifier consumption	Approx. 5 litres/24h

Operational limits

Nominal feed capacity	500 l/h (actual capacity varies with composition of feed)
Feed temperature	50°C to 95°C
Ambient temperature	5°C to 55°C
Acidity of feed	> pH 5
Maximum allowed density of sealing liquid	1000 kg/m ³
Operating water	Min. 2 bar, max. 8 bar
Operating air	Min. 4 bar, max. 8 bar

Net weights

Module complete	950 kg
Separator unit	310 kg
Heating unit	170 kg
Control unit	190 kg
Pump unit	86 kg
Demulsifier dosing unit	30 kg

Service intervals

In addition to the maintenance on board or on site, a kit-based maintenance concept called Maintenance and Service by Exchange (MSE) can be used for the separator. The kit includes separator insert (rotor and disc stack), Xcavator, and consumables kit.

MSE Kit	Every 9 months
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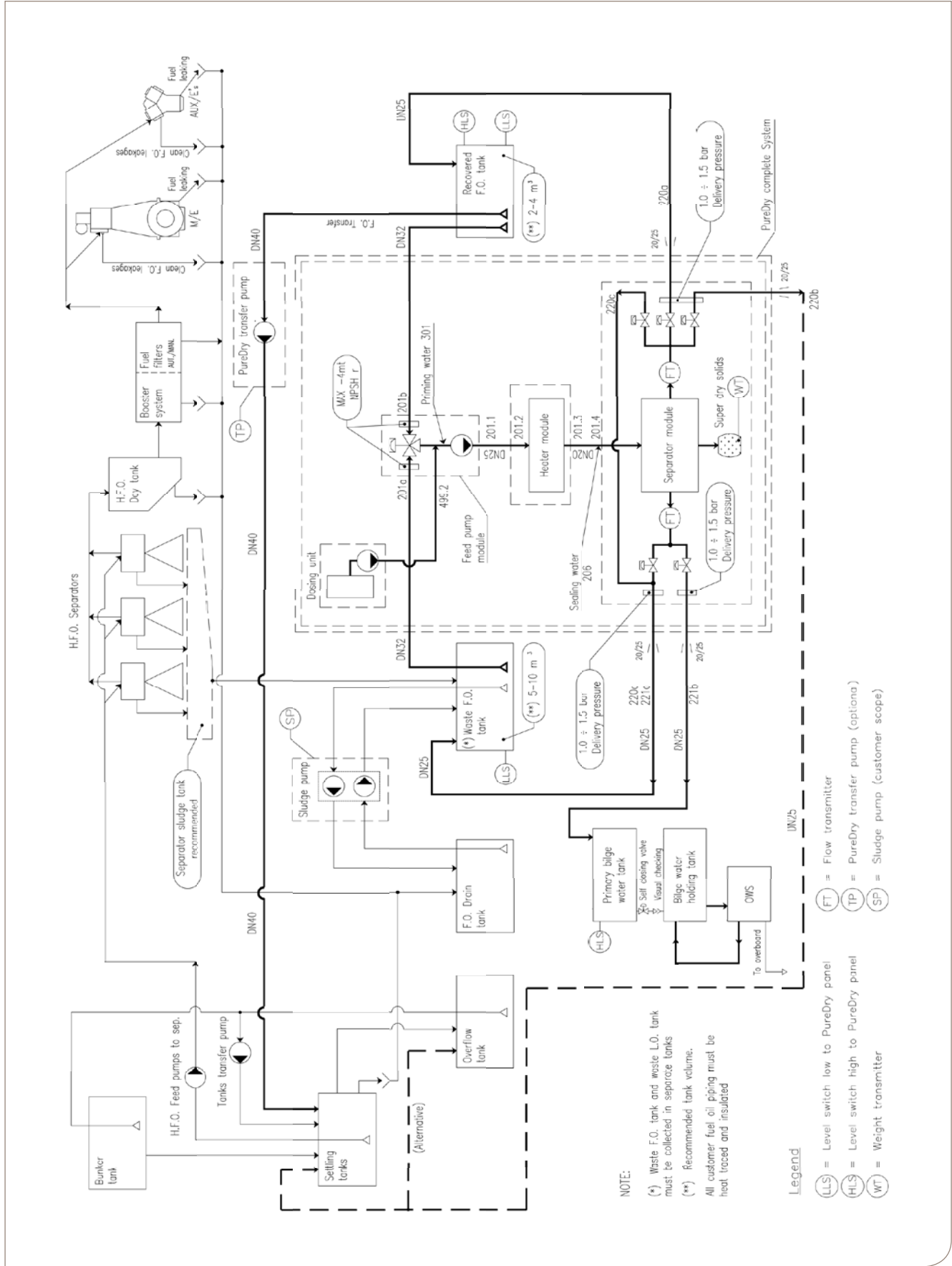
Directives and standards

The product is designed in accordance with the following directives and standards:

- 2006/42/EC Machinery Directive
- EN 12547 Centrifuges – Common safety requirements
- EN 60204-1 Safety of machinery – Electrical equipment of machines. Part 1: General requirements
- EN ISO 12100 Safety of machinery – General principles for design – Risk assessment and risk reduction
- EN ISO 13849-1 Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design
- EN ISO 13849-2 Safety of machinery – Safety-related parts of control systems – Part 2: Validation
- ISO 3744 Acoustics – Determination
- 2004/108/EC Electromagnetic Compatibility Directive
- EN 61000-6-2 Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments
- EN 61000-6-4 Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments

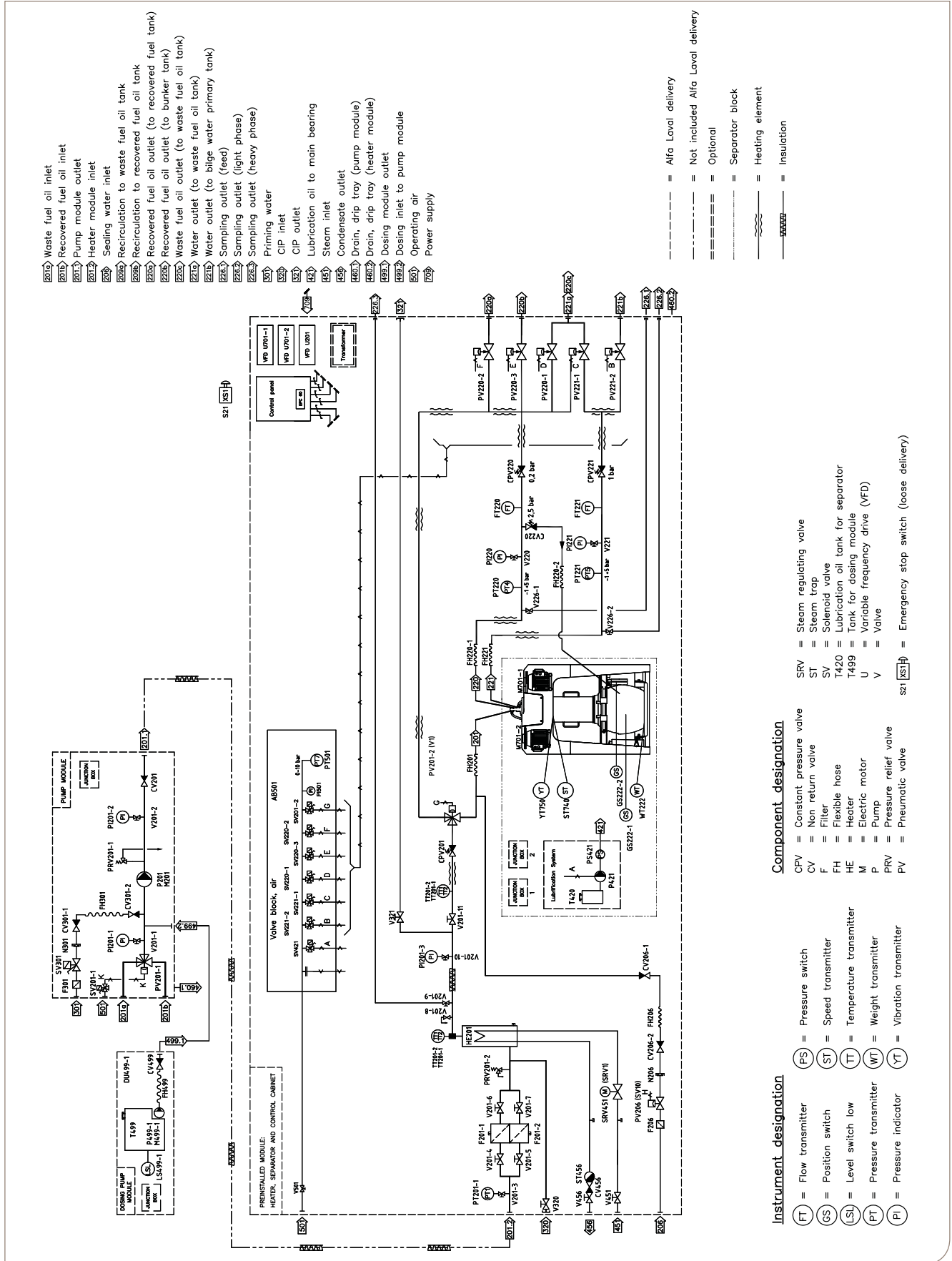
Integration diagram

Alfa Laval ref. 9004773, rev. 9



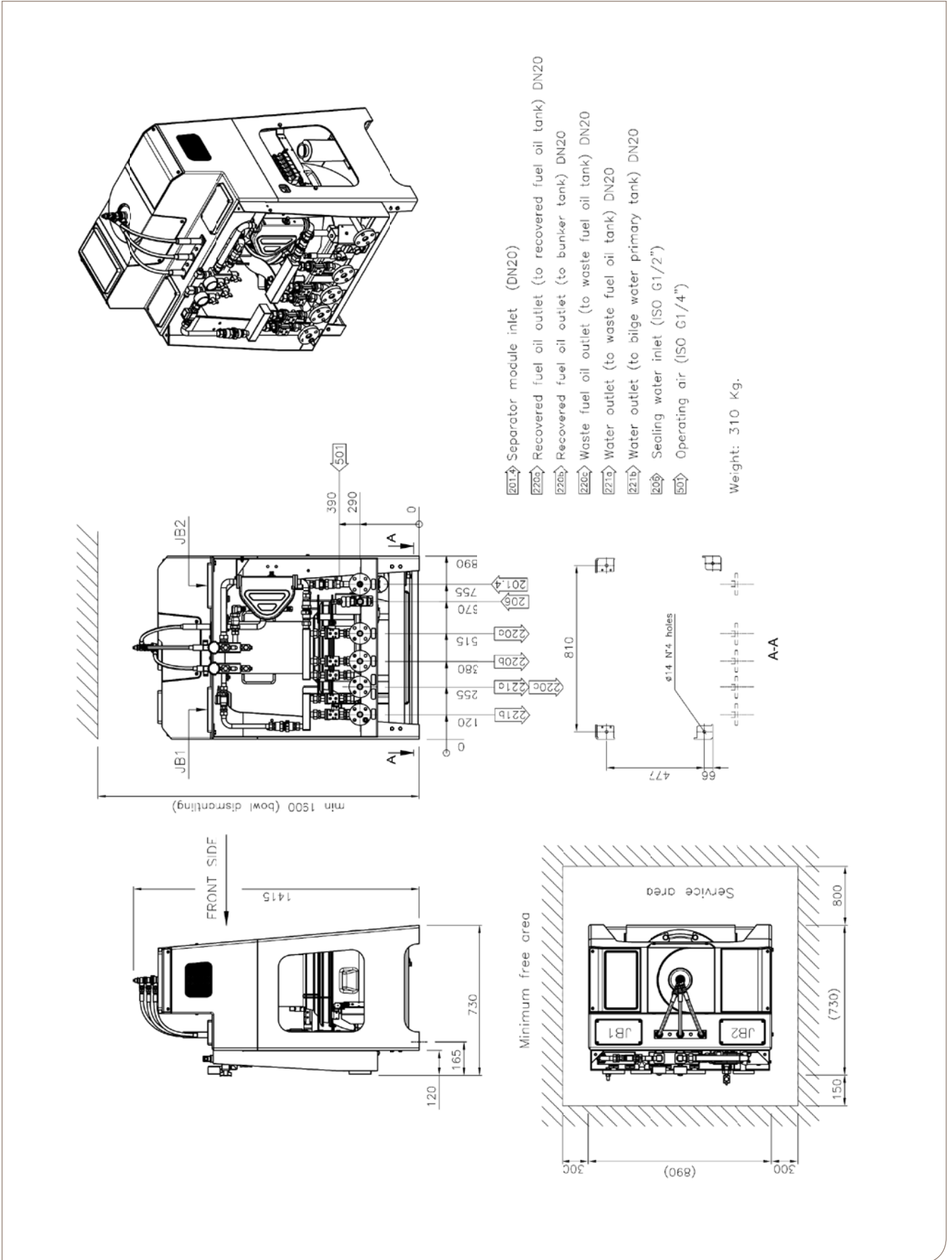
Flow chart

Alfa Laval ref. 9881311, rev. 0



Dimension drawing – separator unit

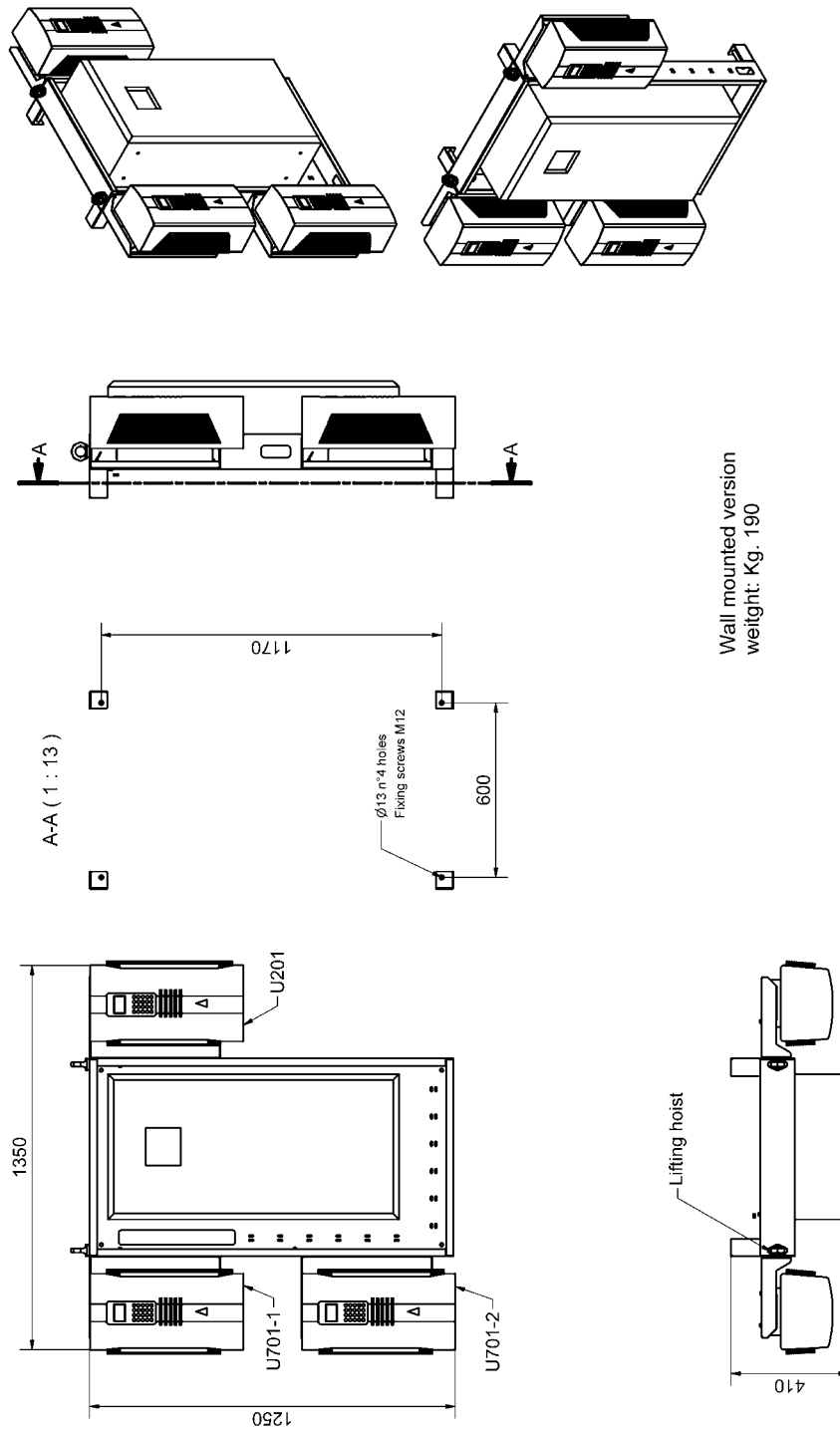
Alfa Laval ref. 9022103, rev. 0



Please note: With the optional drip tray the separator height will be 70 mm higher.

Dimension drawing – control unit

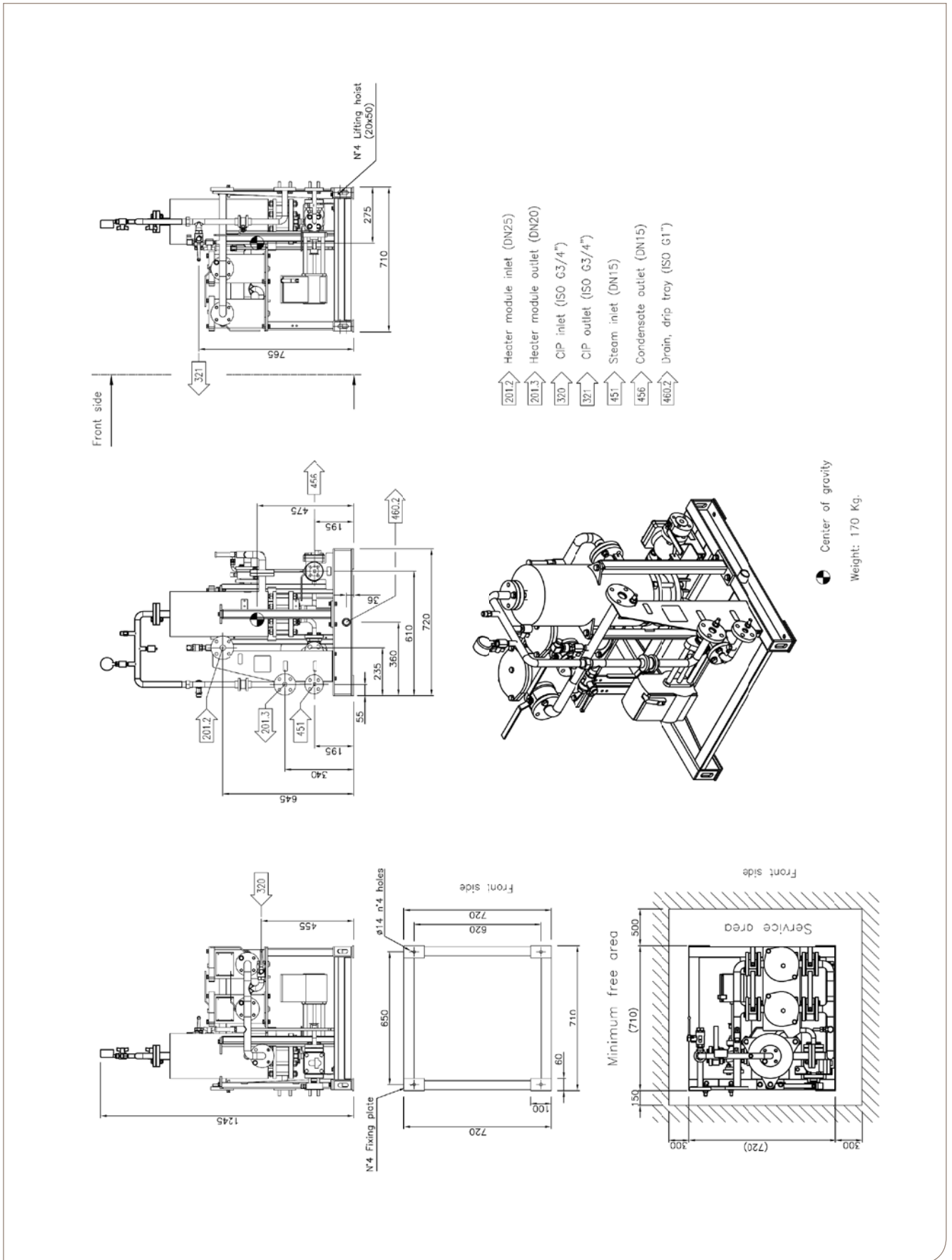
Alfa Laval ref. 9003781, rev. 1



Wall mounted version
weight: Kg. 190

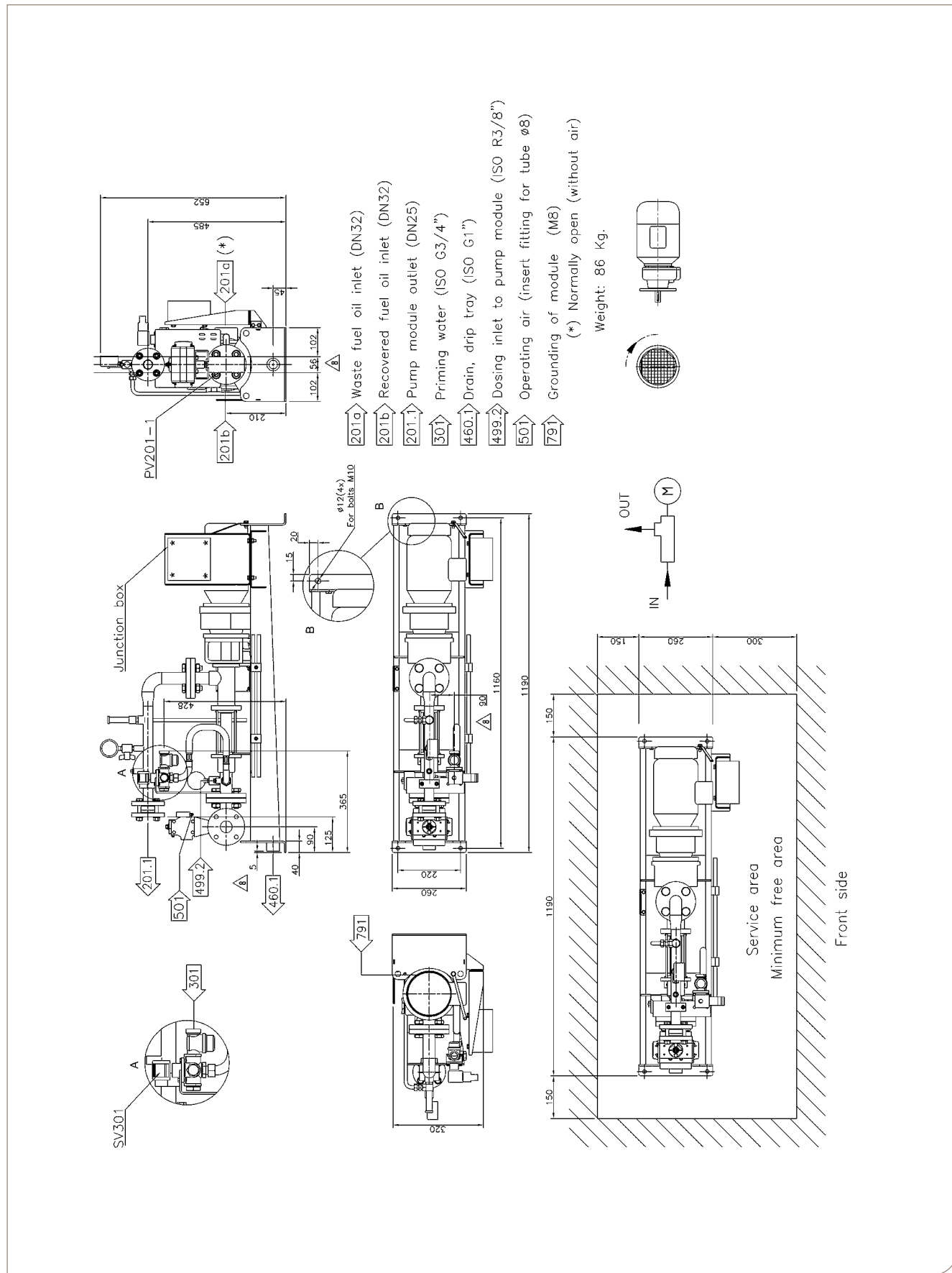
Dimension drawing – heater unit

Alfa Laval ref. 9020731, rev. 0



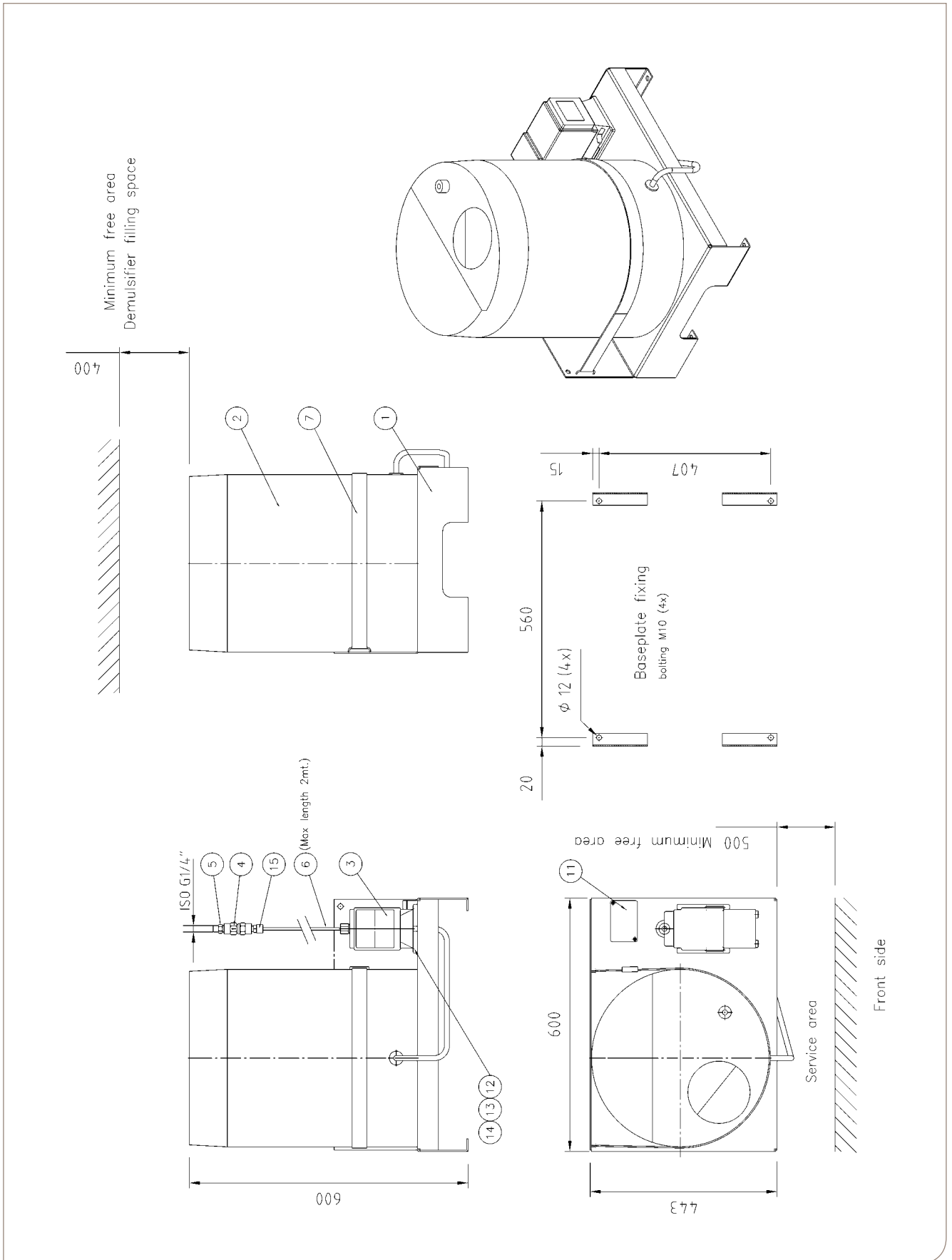
Dimension drawing – pump unit

Alfa Laval ref. 9001500, rev. 8



Dimension drawing – demulsifier dosing unit

Alfa Laval ref. 570058, rev. 6



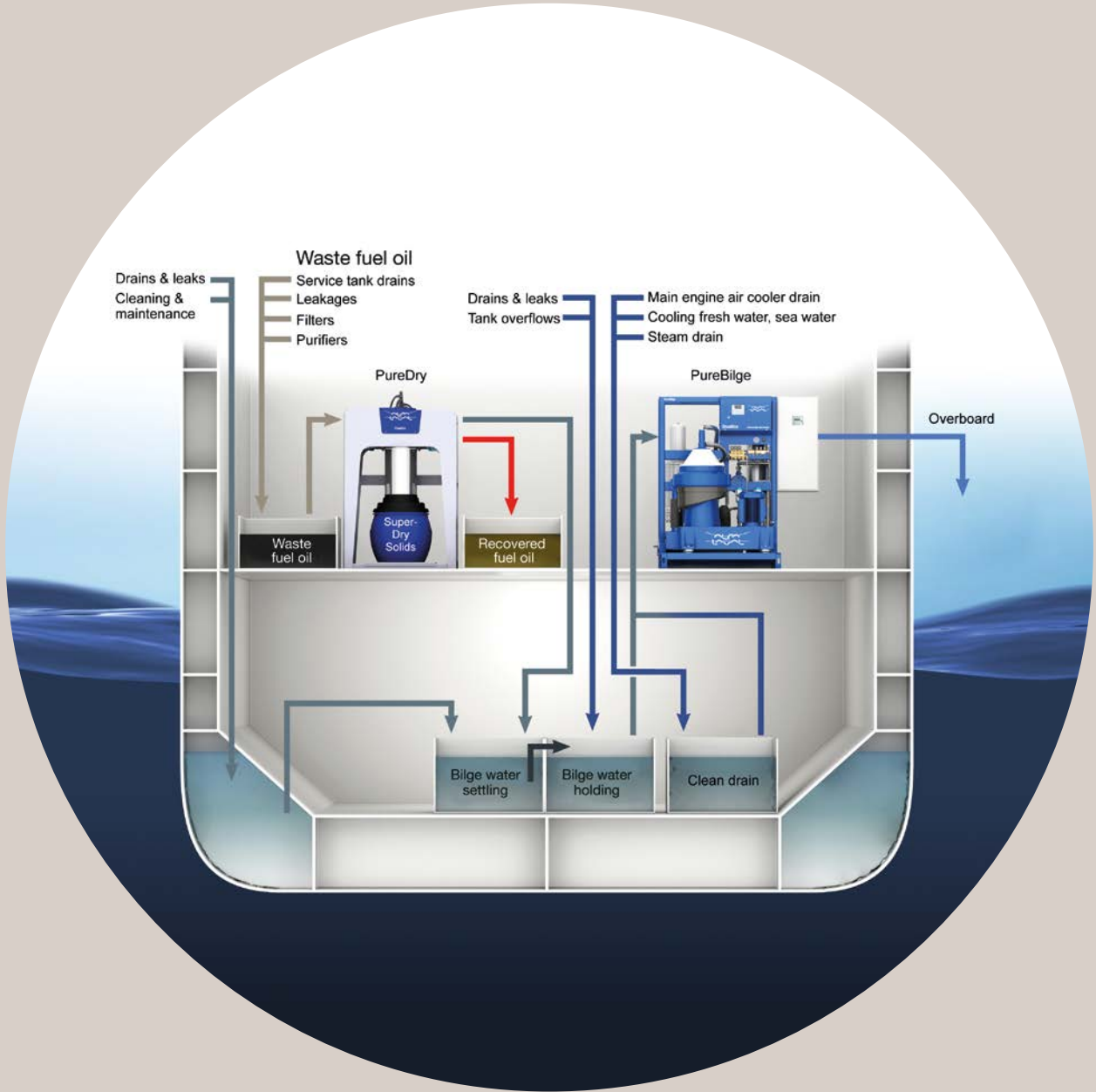
Connection list

Alfa Laval ref. 9881317, rev. 0

Connection number	Description	Requirements/limits
201a	Waste fuel oil inlet	<p>General</p> <ul style="list-style-type: none"> Fuel oil density: 850–991 kg/m³ @ 15°C Fuel oil viscosity: 1.5–700 cSt @ 50°C Water density: 1000–1035 kg/m³ @ 15°C Waste fuel oil tank temp. range: 50–80°C Max. density of sediments: 1600 kg/m³ <p>Feed data</p> <ul style="list-style-type: none"> Flow range: 100–500 l/h (mixed fuel oil and water) Max. inlet pressure: 200 kPa NPSH r (net positive suction head required): 4 m
201b	Recovered fuel oil inlet	<p>General</p> <ul style="list-style-type: none"> Flash point: Above 100°C Fuel oil density: 900–991 kg/m³ @ 15°C Fuel oil viscosity: 1.5–700 cSt @ 50°C Water density: 1000–1035 kg/m³ @ 15°C Recovered fuel oil tank: Temp. range: 50–80°C <p>Feed data</p> <ul style="list-style-type: none"> Flow range: 100–250 l/h (with 100% HFO) Max. inlet pressure: 200 kPa NPSH r (net positive suction head required): 4 m
201.1	Pump module outlet	<ul style="list-style-type: none"> Max. outlet pressure: 600 kPa Recommended pipe length between connection points 201.1 and 201.2: 1–10 m
201.2	Heater module inlet	<ul style="list-style-type: none"> Inlet temp. range: 50–80°C Min. inlet pressure: 400 kPa See system tech. data: doc. 9009280
201.3	Heater module outlet	<ul style="list-style-type: none"> Outlet operating temp. range: 93°C ±5°C Flow range: 100–500 l/h (mixed fuel oil and water) Recommended pipe length between connection points 201.3 and 201.4: 0.5–5 m See system tech. data: doc. 9881316
201.4	Separator module inlet	<ul style="list-style-type: none"> Inlet temp. range: 93°C ±5°C Min. inlet pressure: 100 kPa
206	Sealing water inlet	<ul style="list-style-type: none"> Temp. range: 10–40°C Pressure range: 200–800 kPa Water max.: 5 l/discharge and start-up Flow valve capacity: 2.8 l/min Max. allowed density: 1000 kg/m³ Quality requirements: see AL doc. 553406
209a	Recirculation to waste fuel oil tank	<ul style="list-style-type: none"> Outlet operating temp. range: 93°C ±5°C Outlet pressure range: 200–300 kPa Flow range: 100–500 l/h (mixed fuel oil and water)

Connection number	Description	Requirements/limits
209b	Recirculation to recovered fuel oil tank	<ul style="list-style-type: none"> • Outlet operating temp. range: 93°C ±5°C • Outlet pressure range: 200–300 kPa • Flow range: 100–250 l/h (with 100% HFO)
220a	Recovered fuel oil outlet (to recovered fuel oil tank)	<ul style="list-style-type: none"> • Fuel oil flow average: 100–250 l/h • Temp. range: 93°C ±5°C (separation working temp.) • Max. delivery pressure with 700 cSt, density 991 kg/m³ at: 100 l/h: 150 kPa 250 l/h: 100 kPa
220b	Recovered fuel oil outlet (to bunker tank)	<ul style="list-style-type: none"> • Fuel oil flow average: 100–250 l/h • Temp. range: 93°C ±5°C (separation working temp.) • Max. delivery pressure with 700 cSt, density 991 kg/m³ at: 100 l/h: 150 kPa 250 l/h: 100 kPa
220c	Waste fuel oil (to waste fuel oil tank)	<ul style="list-style-type: none"> • Fuel oil with water content • Temp. range: 93°C ±5°C (separation working temp.) • Max. delivery pressure with 700 cSt, density 991 kg/m³ at: 100 l/h: 150 kPa 250 l/h: 100 kPa
221a	Water outlet (to waste fuel oil tank)	<ul style="list-style-type: none"> • Mixed water with fuel content • Temp. range: 93°C ±5°C (separation working temp.) • Max. delivery pressure 100% water: 150 kPa • Max. flow: 500 l/h
221b	Water outlet (to bilge water primary tank)	<ul style="list-style-type: none"> • Delivery max. pressure: 150 kPa • Temp. range: 93°C ±5°C (separation working temp.)
301	Priming water (for feed pump)	<ul style="list-style-type: none"> • Flow only during start-up and stop sequence • Flow valve capacity: 8 l/min • At start-up and stop: max. 8 litres total volume • Temp. range: 10–40°C • Pressure range: 200–800 kPa • Max. allowed density: 1000 kg/m³ • Quality requirements: see AL doc. 553406
320	CIP-inlet	<ul style="list-style-type: none"> • Flow only during cleaning in place sequence • Cleaning liquid temp. range: 70–90°C • Pressure range: 100–500 kPa
321	CIP-outlet	<ul style="list-style-type: none"> • Flow only during cleaning-in-place sequence • Cleaning liquid temp. range: 70–90°C • Pressure range: 100–500 kPa

Connection number	Description	Requirements/limits
451	Steam inlet	<p>Saturated steam</p> <ul style="list-style-type: none"> • Steam max. consumption: 60 kg/h • Pressure range: 700–800 kPa at module inlet connection <p>Note: Steam consumption flow based on a working process condition with Δt of 50°C</p>
456	Condensate outlet	<ul style="list-style-type: none"> • Condensate (see 451 data)
460 .1	Drain, drip tray (from feed pump module)	<ul style="list-style-type: none"> • Normally no flow • No back pressure allowed
460.2	Drain, drip tray (from heater module)	<ul style="list-style-type: none"> • Normally no flow • No back pressure allowed
499.1	Dosing module outlet	<ul style="list-style-type: none"> • Flow range: 0.2–7.0 l/h • Delivery pressure: 400 kPa <p>Note: Max. hose length 3.0 m available between dosing module and feed pump module (connecting points 499.1–499.2)</p>
499.2	Dosing inlet to pump module	<ul style="list-style-type: none"> • Flow: 0.2–7.0 l/h • Inlet pressure: 300 kPa
501	Operating air	<ul style="list-style-type: none"> • Required pressure range: 400–800 kPa • Max. momentary consumption: < 0.1 Nm³/h • Quality requirements: See AL doc. 553407
709	Power supply (to control panel)	<ul style="list-style-type: none"> • See system tech. data: doc. 9009280



Alfa Laval in brief

Alfa Laval is a leading global provider of specialized products and engineering solutions.

Our equipment, systems and services are dedicated to helping customers to optimize the performance of their processes. Time and time again.

We help our customers to heat, cool, separate and transport products such as oil, water, chemicals, beverages, foodstuffs, starch and pharmaceuticals.

Our worldwide organization works closely with customers in almost 100 countries to help them stay ahead.

How to contact Alfa Laval

Contact details for all countries are continually updated on our web site. Please visit www.alfalaval.com to access the information.

