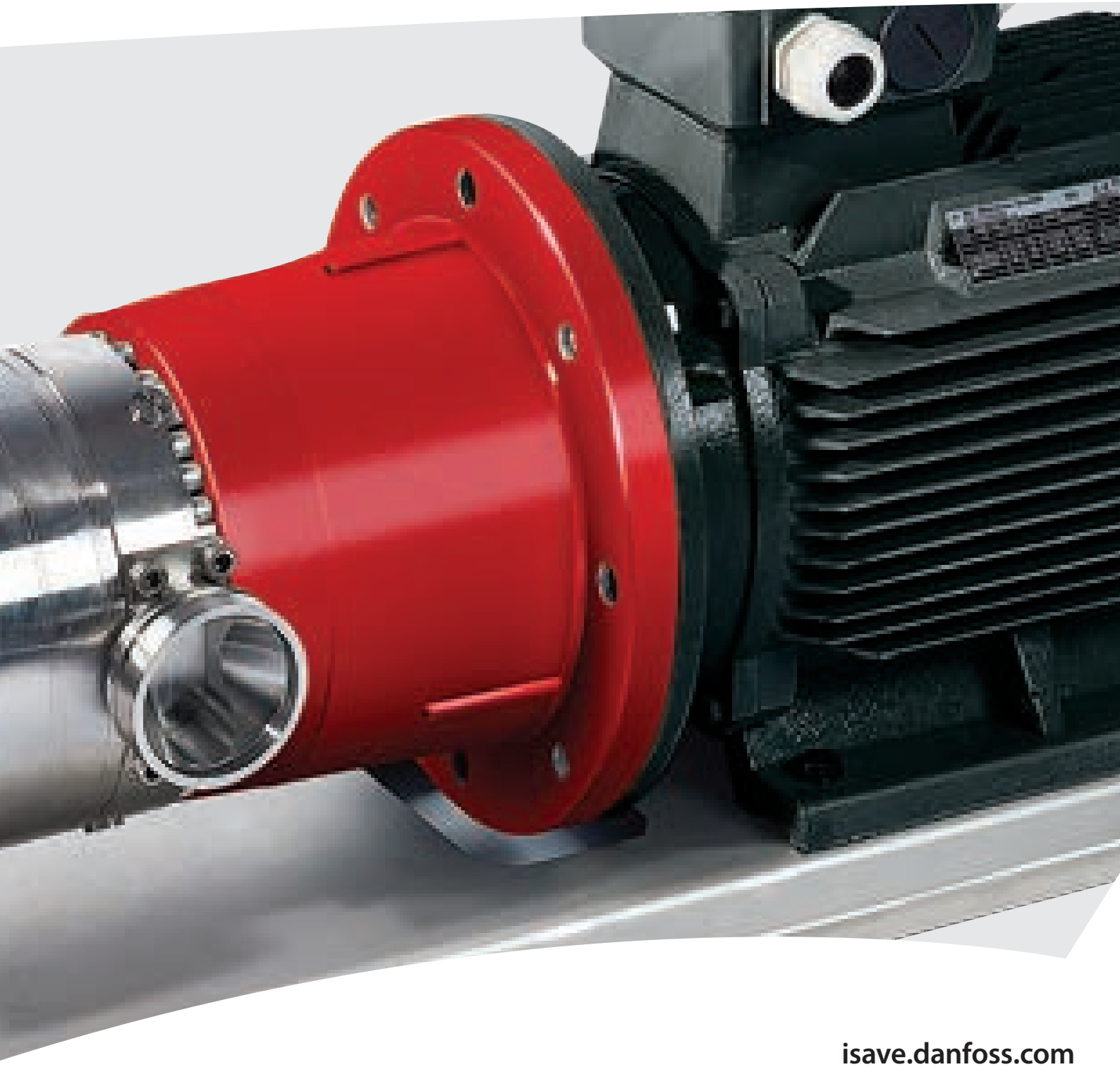
MAKING MODERN LIVING POSSIBLE

User manual

Installation, Operation and Maintenance Manual

iSave 40



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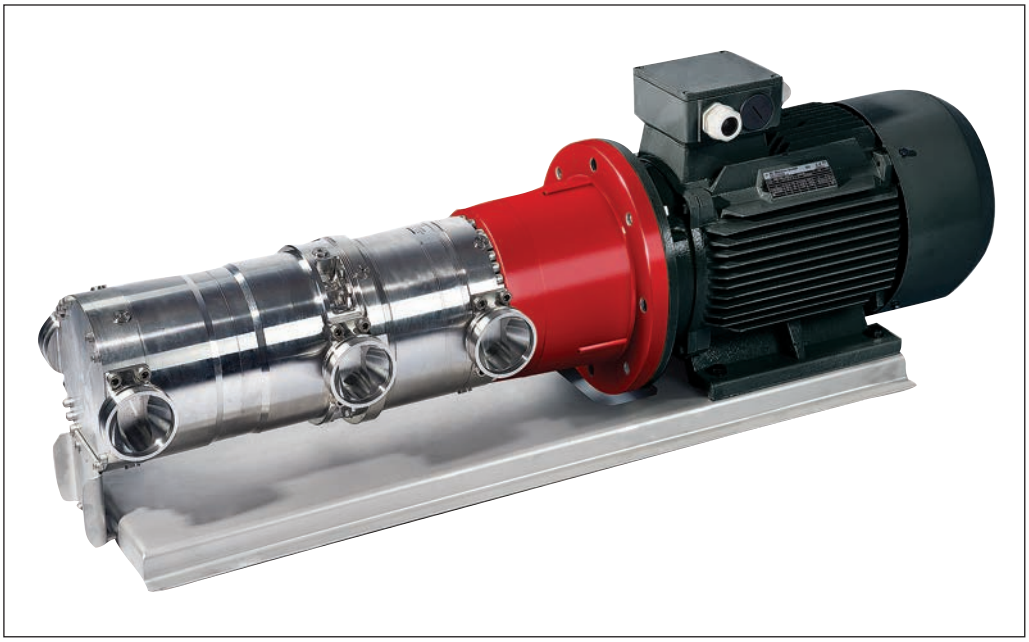

Document information and copyright

Installation, Operation and Maintenance Manual. Original operating manual document.

Danfoss can accept no responsibility for possible errors in the manual and instructions.

Danfoss reserves the right to alter its products without notice. This also applies to products already on order provided that such alterations can be made without subsequential changes being necessary in specifications already agreed.

Validity

This manual is valid for iSaves with:

1. Code no.: 180F7001
   Serial no.: 02

2. Code no.: 180F7003
   Serial no.: 02

3. Code no.: 180F7011
   Serial no.: 03

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Danfoss A/S
Danfoss High Pressure Pumps
Nordborgvej 81
6430 Nordborg
Denmark

EG-Konformitätserklärung gemäß EG-Richtlinie 2006/42/EG	**EC Declaration of Conformity according to Directive 2006/42/EC**	**Déclaration de conformité CE conformément à la Directive 2006/42/CE**
Hiermit erklären wir, dass die Maschine gemäß 2006/42/EG entwickelt ist.	We hereby declare that the machine is designedaccording to the directive 2006/42/EC.	Par la présente, nous déclarons que la machine est concue conformément á la Directive 2006/42/CE.
Beschreibung der Maschine Hochdruck-Pumpe	**Machine description** High pressure pump	**Description de la machine** Pompe haute pression
Maschinentyp iSave 21 / iSave 40	**Machine designation** iSave 21 / iSave 40	**Type de machine** iSave 21 / iSave 40
Seriennummer N/A	**Serial number** N/A	**Numéro de série** N/A
Technisches Dossier, Kontaktperson Leiter Qualitätsabteilung	**Technical dossier, Contact person** Manager Quality Department	**Personne de contact pour le dossier technique** Manager département qualité
Angewandte harmonisierte Normen DS/EN ISO 12100: 2011	**Used harmonised standards** DS/EN ISO 12100: 2011	**Normes harmonisées appliquées** DS/EN ISO 12100: 2011

Hersteller-Unterschrift / Titel:	Manufacturer's signature / Title:	Signature du fabricant / Titre:
2012 - 08 - 30 Datum	2012 - 08 - 30 Date	2012 - 08 - 30 Date
Welm Friedrichsen Leiter F&E	Welm Friedrichsen Director R&D	Welm Friedrichsen Directeur R&D

2. Introduction

2.1 General

iSave is manufactured by Danfoss A/S, and is sold and marketed by a net of authorised distributors worldwide.

This manual contains the necessary instructions for the installation, operation and service of the iSave.

All personnel who are responsible for the operation and maintenance of the iSave unit must read and fully understand these instructions, especially the section "Safety" before:

- Transportation of the iSave unit.
- Lifting the unit.
- Installing the iSave unit on a frame.
- Connecting the iSave unit to the fluid system.
- Connecting the electric motor and instrumentation.
- Commissioning the unit.
- Servicing the iSave unit, mechanic and electrics-parts.
- Decommissioning the iSave unit.

Ensure that these instructions are always readily available to all personnel concerned.

2.2 Target group

This manual is intended for use by personnel with qualified training and experience in the operation and maintenance of a Sea Water Reverse Osmosis (SWRO) or Brackish Water Reverse Osmosis (BWRO) system.

2.3 Symbols

NB!	Indicates something to be noted by the reader
	Indicates a situation which will or could result in damage to the iSave and its function
	Indicates a situation which will or could result in personal injury and/or damage to the iSave
	Electrical hazard - Indicates a high-voltage warning
	Safety glasses required
	Hearing protection required
	Safety shoes required
	Safety helmet required

2.4 Manufacturer and customer service

Danfoss A/S
High Pressure Pumps
DK-6430 Nordborg, Denmark
Telephone: +45 7488 2222
Email: ro-solutions@danfoss.com
Homepage: www.ro-solutions.com/
www.isave.danfoss.com

2.5 Additional technical documents

Document name	Content
Instruction: Start and stop of the SWRO with iSave unit	Description of how to start and stop the iSave in the preferred RO system set-up
Instruction: Membrane cleaning of RO system with iSave unit	Description of how to clean the membranes in the preferred RO system set-up
Dimensional drawings	Description of the dimensions of the iSave
iSave parts list	Sectional drawings, parts list and spare part numbers
Instruction: iSave overload protection	Electrical wiring diagram on how to protect the iSave against overload / mechanical overload protection of the iSave
Instruction: Hose assembly and installation	Guideline for hose assembly and installation
Service instructions: Disassembling and assembling	Description of how to assemble and disassemble the iSave
Operating and maintenance instructions: Electric motor	Operating and maintenance instructions for the standard electric motor, delivered from Danfoss

3. Safety instruction

3.1 General

The iSave must not be used for other purposes than those described in 3.2 "Intended use" without first consulting your local iSave distributor.

This manual must be read and completely understood by the responsible specialist personnel prior to installation and commissioning.

Use of this manual does not relieve operation and maintenance personnel of the responsibility of applying normal good judgement in the operation and care of this product and its components.

The manual must be available to all personnel concerned at the site at all time.

An iSave must always be installed and used in accordance with existing national and local sanitary and safety regulations and laws. It is the responsibility of the safety officer or the chief operator to assure compliance with all local regulations that are not taken into account in this manual.

The iSave is a rotating machine that typically operates at high pressure.

Always wear suitable safety and lifting equipment when handling the iSave.

- Bolt the iSave properly to the base before start-up to avoid personal injury and/or damage to the iSave.
- The pipe connections to the iSave must be stress-free mounted, securely fastened to the iSave and well supported. Improper installation will or could result in personal injury and/or damage to the iSave.
- Proper installation and care of shutdown devices and over-pressure protection equipment is essential.

- All electrical installation work must be carried out by authorised personnel in accordance with EN60204-1 and/or local regulations.
- Install a lockable circuit breaker to avoid inadvertent starting. Protect the motor and other electrical equipment from overloads with suitable equipment.
- The electric motors must be supplied with adequate cooling ventilation.

- Improper installation can cause fatal injuries.
- The iSave must not operate outside the application range.
- During the initial start-up, slowly raise the pressure of the system and adjust the overpressure protection equipment for proper limit settings.
- Make sure that the pressure is released from the iSave before the iSave is disconnected from any pipe or hose connections in the iSave.
- Make sure that the iSave can be drained without injuring anyone and without contaminating nearby equipment or the environment.
- Before intervening in the iSave/system, the power must be shut off and the starting device must be locked. When intervening in the iSave unit, follow the instructions for Service/Maintenance, chapter 8.
- A failure to follow the instructions can result in personal injury and/or damage to the iSave. It will also invalidate the warranty.

The iSave must never run dry. Dry running produces heat and will cause damage to internal parts.
If the iSave does not function satisfactorily, contact your local iSave distributor.

NB! Use of this manual does not relieve operation and maintenance personnel of the responsibility of applying normal good judgment in the operation and care of this product.

3.2 Intended use

The iSave is designed for use as energy recovery device in Sea Water Reverse Osmosis (SWRO) or Brackish Water Reverse Osmosis (BWRO) system.

The iSave must not be used for other purposes than recommended and quoted for without consulting your local iSave distributor.

3.3 Application range

The iSave should only be used within the following limits:

iSave		iSave 40
Code number		180F7011
Geometric displacement	cm^3/rev in^3/rev	626 41.4
Pressure		
Differential pressure HP in - HP out max. [1]	barg psig	5 72.5
HP inlet min./max. pressure continuous	barg psig	15-83 217-1,200
HP inlet min. pressure, intermittent [2] [3]	barg psig	3 43.5
LP inlet max. pressure continuous	barg psig	5 72.5
LP inlet max. pressure intermittent [3]	barg psig	10 145
LP oulet min. pressure continuous	barg psig	1 14.5
LP differential LP in - out max.	barg psig	1.2 at 40 m^3/h 17.5 at 176.1 gpm
Speed		
Min. speed continuous	rpm	600
Max. speed continuous	rpm	1,200
Typical flow		
HP outlet flow [4] at max. differential pressure	m^3/h gpm	21-41 92.4-180.5
Lubrication flow at 60 barg (871 psig) max.	m^3/h gpm	0.8 3.5
LP inlet max. flow continuous	m^3/h gpm	67 295
Torque		
Torque at 3 barg differential operation	Nm (lbf-ft)	80 59
Torque at max. differential [1] operation	Nm (lbf-ft)	102 75
Starting torque (stick/slip)	Nm (lbf-ft)	150 110
Media temperature [5]	°C °F	2-40 36-122
Ambient temperature	°C °F	0-50 32-122
Filtration requirements (nominal) [6]		3 micron melt-blow

[1] Continuous torque above max. differential pressure will harm the iSave
[2] Pressure can reach this pressure level at start-up and permeate flush.
[3] Intermittent pressure is acceptable for less than 10 minutes within a period of 6 hours.
[4] Typical average flow at 60 barg
[5] Dependent on NaCl concentation
[6] Please see section 5. filtration

Asynchronous motor according to DIN-IEC and VDE 0530 standards.

Voltage and frequency according to IEC 38.

The motors are fitted with a rating plate in multi-tension:
380-420 V / 660-720 V, 50 Hz or 440-480 V, 60 Hz
Tolerance ± 5% according to VDE 0530

NB! The iSave 40 with code no 180F7001 and 180F7003 are delivered with a 11 kW (15HP), 6 pole motor. If supply voltage is maximum 400 V and the iSave shall operate above 1,100 rpm and boost at a pressure of up to 5 bar, the motor shall be sized up to a 15 kW (20 HP) to ensure no overload of motor.

Insulation according to DIN-IEC 34	Class F
Ambient temperature 40°C, 1000 m above sea level	Class B
Degrees of protection, minimum	IP55

⚠ Applications not suitable for the iSave can cause damages to the iSave unit, with risk of personal injury.

⚠
- It is always the system builders' responsibility that the system design does not cause any form of hazard and are adapted to local regulations.
- Proper installation and care of shutdown devices and over-pressure protection equipment is essential.

3.4 Preferred system design

Danfoss recommends building systems with a high degree of safety. The P&ID in chapter 5.16 shows the Danfoss preferred system design.

4. Arrival inspection, handling and storage

4.1 Arrival inspection

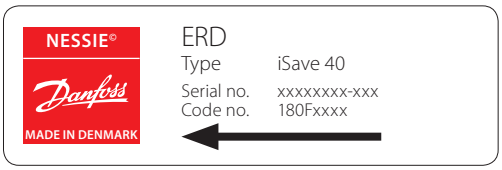
The iSave is packed in a wood container with plugs in the port connections to protect the unit from damage during transport.

Remove all packing materials immediately after delivery. Immediately check the shipment for damage on arrival and make sure that the name plate/type designation is in accordance with the packing slip and your order.

In case of damage and/or missing parts, a report should be drawn up and presented to the carrier at once.

The identification label on the iSave states the specific type, the serial number and the code number of the iSave; see label below.

The last three digits of the Serial No. indicate the week and year of production.



4.2 Return to the supplier

Flush the iSave with clean filtered water. Drain the iSave and plug the port connections with a cap/cover. Pack the iSave into a suitable container and make sure that it is suitably fastened to the container.

Please contact your local authorised distributor or:

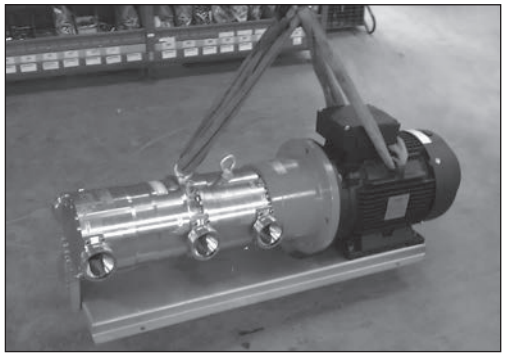
Danfoss A/S
High Pressure Pumps
DK-6430 Nordborg, Denmark
Telephone: +45 7488 2222
Fax: +45 7445 3831
Email: ro-solutions@danfoss.com
Homepage: www.ro-solutions.com

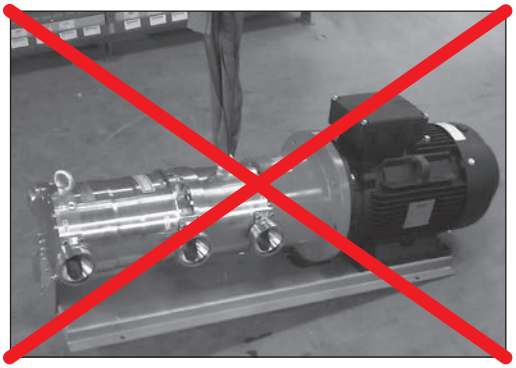
4.3 Handling

- Personnel involved in lifting and transporting the equipment must be trained in proper handling and safety procedures.
- Observe the local regulations regarding lifting.
- Use suitable, permitted lifting equipment.
- The iSave (set) could slip the lifting arrangement.
- Be aware of individuals located in the operation area while lifting the component.

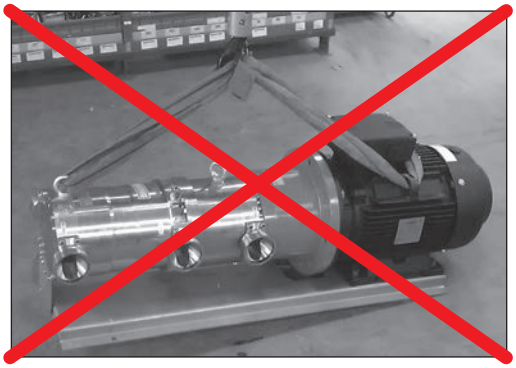
The weight of the iSave, including electric motor, is about 260 kg (573 lb). The weight of the electric motor is about 110 kg (242 lb). All parts weighing more than 20 kg (44 lb) must be lifted using lifting slings and suitable lifting devices, e.g. an overhead crane or fork lift.

Secure lifting slings around the part of the iSave and the back of the electric motor.
Make sure that the load is balanced before attempting the lift.





Never lift the iSave unit with only one fastening point.
Incorrect lifting can result in personally injury and/or damage to the unit.

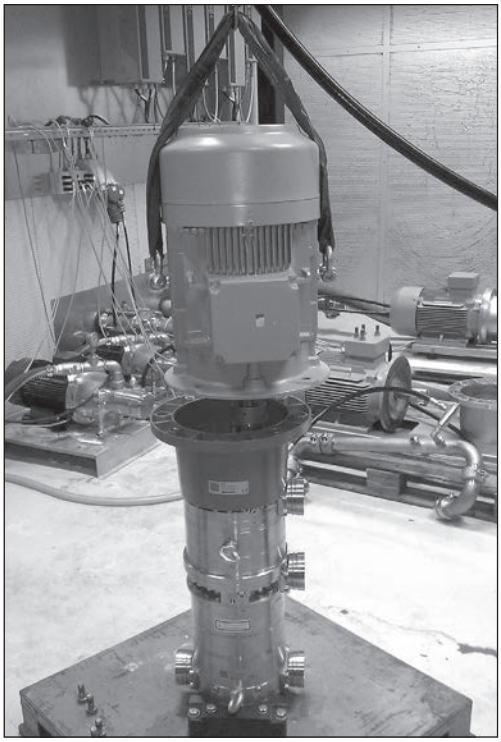


Never lift the iSave in the bell housing.
Incorrect lifting can result in personally injury and/or damage to the unit.

4.3.1 How to assemble the iSave and electric motor

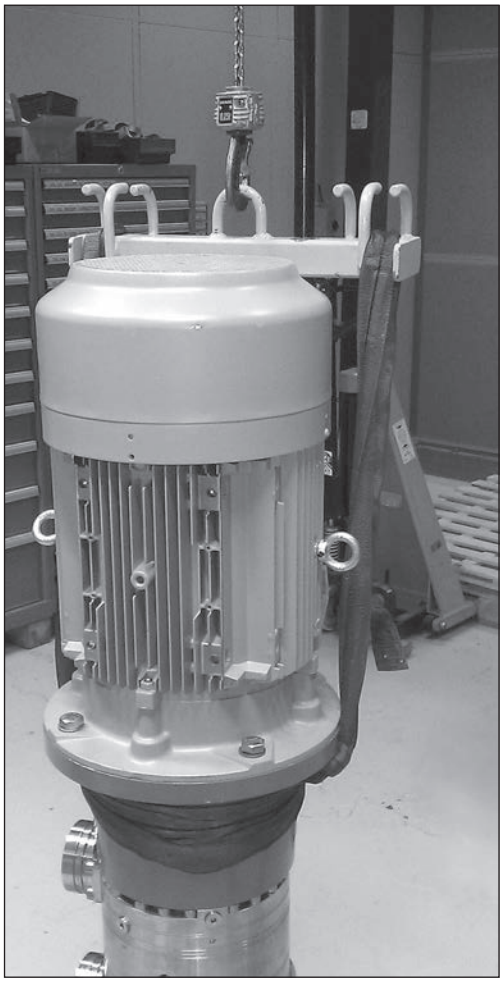
1) The driver coupling is pre-mounted from factory. Do not move the coupling.
2) Insert the coupling element into the coupling in the bell housing.
3) Position the electric motor on the bell housing. Make sure that the two coupling parts are connected properly.
4) Tighten the 4 bolts.

⚠ Lift the electric motor ONLY in the lifting eyes provided. The lifting eyes on the motor must only be used for lifting the motor – and **not the whole unit**.

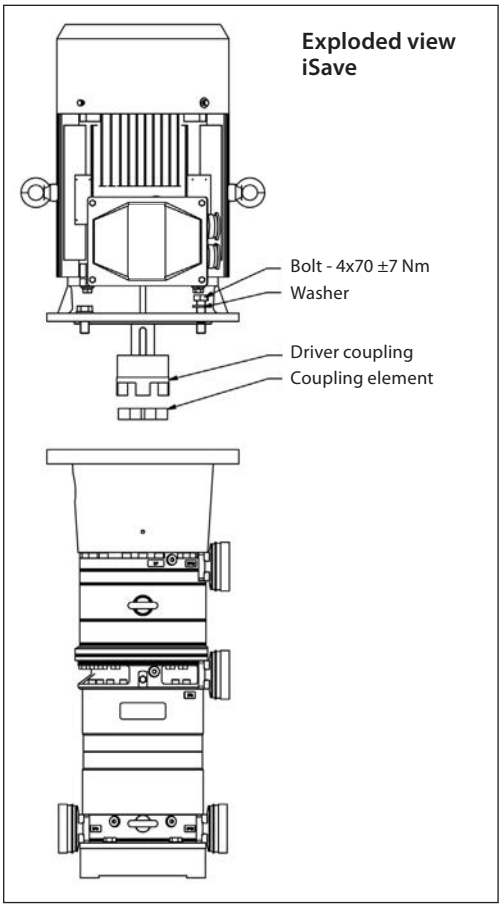


4.3.2 Lifting the whole iSave

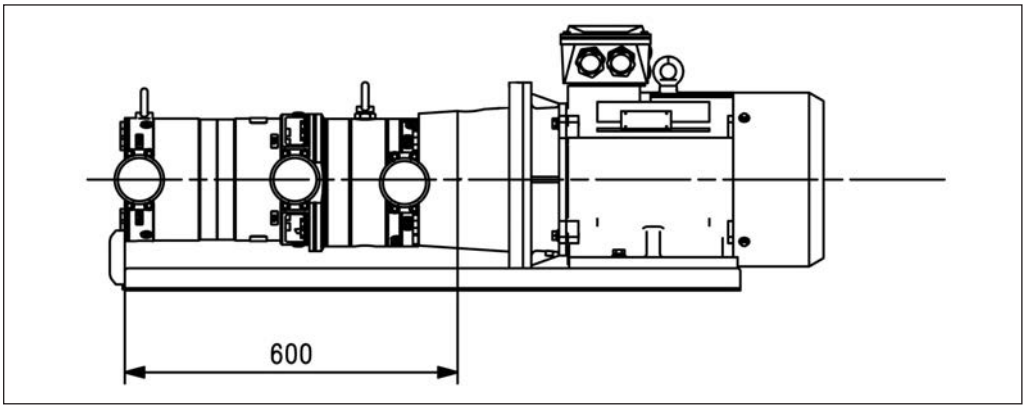
Tie two lifting belts around the bell housing before lifting the whole iSave.



Do not lift the whole iSave in the lifting eyes on the electric motor.



4.3.3 Centre of mass



4.4 Storage

Each iSave is tested before shipment and therefore holds water.

Storage temperature:
-40 °C to +70 °C (-40 °F to 158 °F) – provided that the iSave is drained of fluid and stored "plugged".

Frost protection is required if the iSave is not completely drained of fluid and at temperatures below 1°C. Danfoss recommends using DOWFROST from DOW Chemical Company or Chillsafe mono propylene glycol from Arco Chemical Company.

If the iSave is protected against frost, the storage temperature can be:
-40°C to +70°C (-40°F to 158°F)

- The iSave is NOT delivered frostprotected from the factory.
- Only remove caps from the openings of the iSave at the time of installation.

4.5 Outdoor Storage

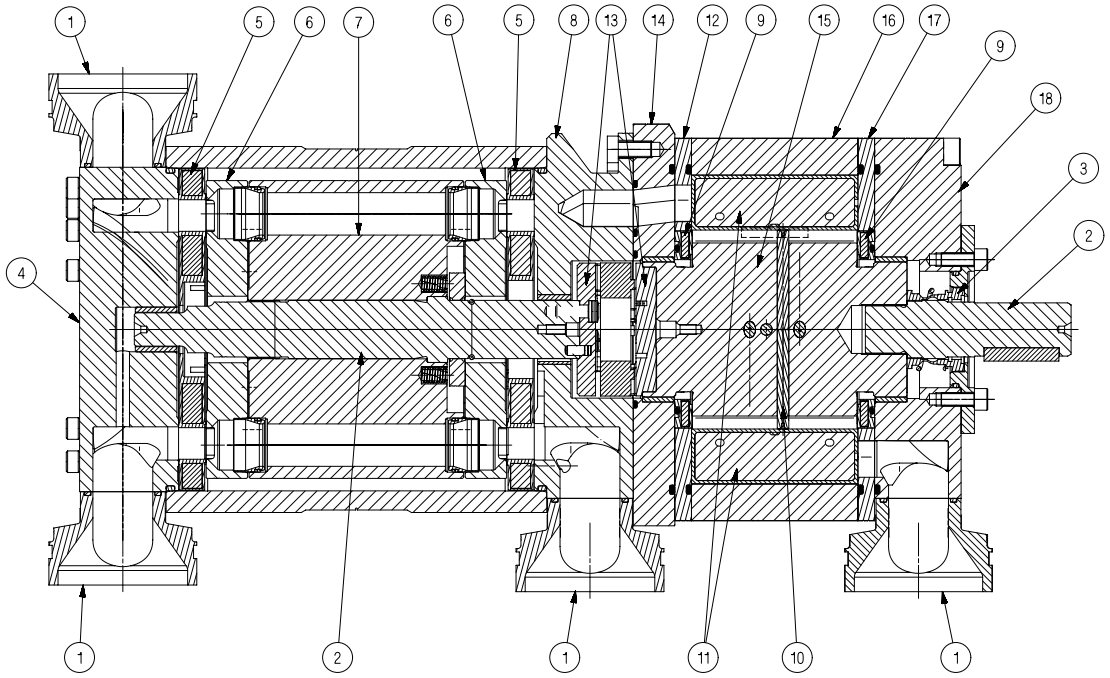
- For outdoor storage cover the iSave (set) with waterproof material.

5. Technical data and design review

5.1 Design details

1: 3" Victaulic connections
2: Shaft
3: Low pressure shaft seal
4: Port flange
5: Port plate
6: Valve plate
7: Cylinder barrel
8: Port flange
9: Sealing plate
10: Pins

11: Vanes
12: Port plate
13: Coupling
14: Adapter flange
15: Rotor
16: Stator
17: Port plate
18: Outlet flange



5.2 Sound level of the iSave

The A-weighted sound pressure level @ 1m, $L_{PA, 1M}$ is 89 dB (A) for the iSave including the iSave motor. Measurements are according to EN ISO 3744: 2010. The test is made under following conditions:

1. iSave and electric motor mounted on Danfoss base plate.
2. Base plate is isolated from concrete ground by rubber vibration dampeners.
3. Flexible hoses are used on high pressure and low pressure sides of the iSave.
4. Rotation speed 1,200 rpm.
5. System pressure 80 bar and a booster pressure of 1.5 - 3 barg.

Influences:
Since the iSave is mounted on a base plate and connected to the electric motor by a bell housing, the noise level can only be determined for the complete unit (system).

It is therefore important that the iSave unit is mounted correctly on a frame with dampeners to minimise vibrations and noise.

It is also strongly recommended to use high-pressure flexible hoses between the hard piping in the RO plant and the iSave. See "hose assembly and installation" in appendix 10.7.

Alternative use multiple flexible Victaulic® couplings on the hard piping.

The noise level is influenced by:
- The speed of the iSave. High speed creates more noise than low speed.
- Rigid mounting of the iSave base plate generates more noise than flexible mounting.
- Pipe mounting directly to the iSave increases the noise level compared to flexible hoses.
- Pressure: Higher pressure provide higher sound level.

5.3 Materials

All critical parts of the iSave are made of Super Duplex 1.4410/UN S32750 or the like.

Non-critical parts that are not in contact with sea water are made of AISI316.

The shaft to the electric motor is sealed by a standardised mechanical seal.

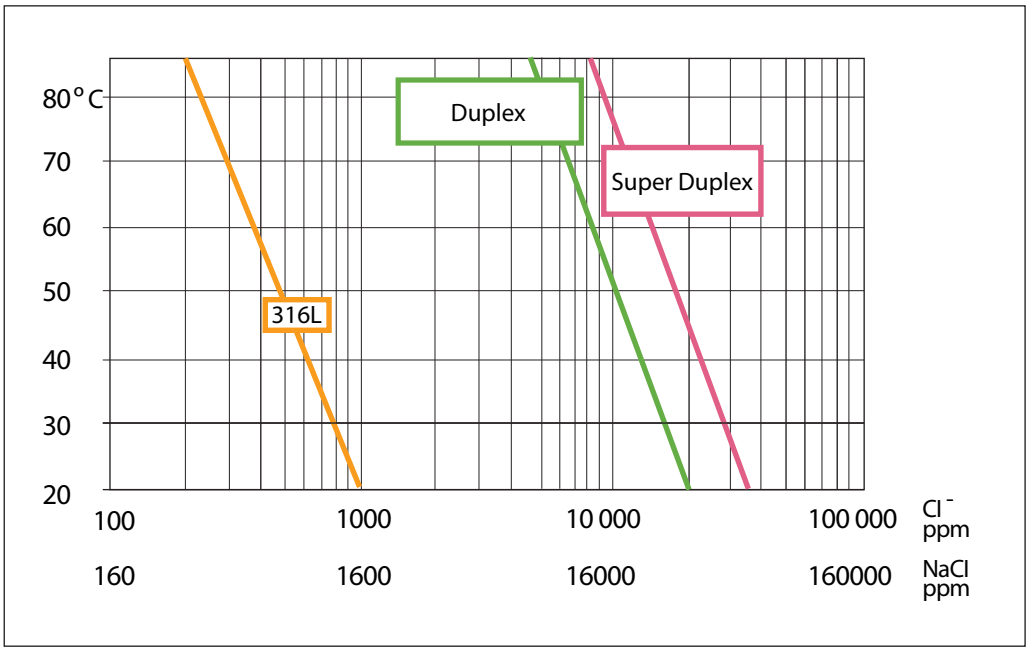
For a detailed material/part overview see appendix 10.5.

5.4 Temperature and corrosion

The chart below illustrates the corrosive resistance of different types of stainless steel related to NaCl concentration and temperature.

Depending on the NaCl concentration, the fluid temperature must be between:

+2°C to +50°C (+35.6°F to 122°F).



In order to minimise the risk of crevice corrosion, always flush the iSave according to the specified start/stop procedure.

5.5 Dimensions and weights

For dimensions and weights please refer to "Dimensional drawings", appendix 10.4.

5.6 Electric motor data

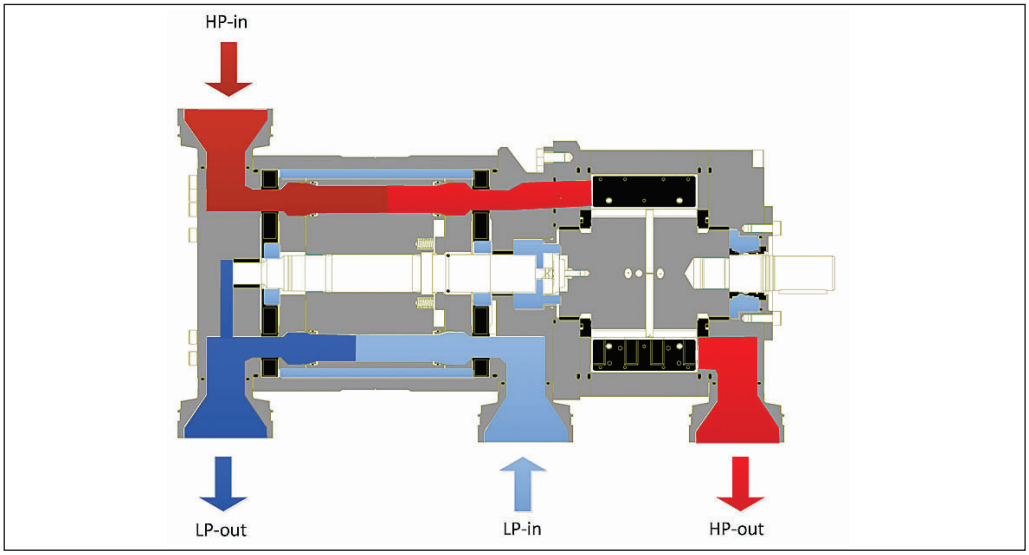
See " Application range" and "Operating and Maintenance instructions, electric motor" in appendix 10.9.
Special motor design can be used.

5.7 How does the iSave work?

The figure below shows a section view of the iSave.

The iSave consists of a rotating isobaric pressure exchanger and a positive displacement pump, also called booster pump. The rotation speed of the pressure exchanger and the pump is exactly the same, as they are driven by the same electric motor.

See also the iSave animation at:
www.isave.danfoss.com



5.7.1 Pressure exchanger function

NB! The pressure exchanger consists of two port plates, one at the concentrate side and one at the seawater side. In between there is a rotor with several ducts that connect the concentrate side with the seawater side.

The pressure exchanger transfers pressure from the high-pressure (HP) concentrate (HP in) to the low-pressure (LP) seawater coming from low-pressure feed pump (LP in).

To separate the HP side from the LP side there is a sealing zone on both port plates. A single duct in the rotor is either on the HP side, or on the LP side or in the sealing zone. A single duct is never in contact with more than one zone at the time. When the rotor rotates a duct will go from the LP zone over the first sealing zone into the HP zone, and hereafter from the HP zone over the second sealing zone and back to the LP zone.

The flow through the HP side of the iSave is forced and controlled by the booster pump.

When the high-pressure concentrate is flowing into the iSave it pressurizes the seawater in the duct coming from “LP in”. The pressurized seawater is then pumped out of “HP out”. Just before the HP concentrate in the duct comes to the seawater port plate, the duct goes into the sealing zone and the flow in the duct stops. When the duct goes into the LP zone the concentrate water is de-pressurized. The (LP) seawater coming from the LP feed pump (LP in) forces the LP concentrate out of “LP out”.

This pressure exchange process is repeated for each duct with every rotation of the rotor, and the ducts are thus continuously filling and discharging. The flow on the HP side and LP side of the iSave is nearly constant over time.

There is no physical barrier in the ducts between the concentrate and seawater. This means that there will be a small amount of mixing between the two liquids.

When the iSave is rotating the water always flows respectively from LP-in to HP-out, AND from HP-in to LP-out. However, if the feed flow into LP-in is higher than the flow into HP-in, some of the LP feed flow will flow directly to LP-out.

When the iSave is not rotating the seawater can only run directly from LP-in to LP-out.

5.7.2 Booster pump

The booster pump is a positive displacement pump, which means that the flow is controlled by the speed of the electric motor; e.g. if the rotation speed of the electric motor is raised by 10%, the flow will be 10% higher and vice versa. The required rpm can be calculated based on the “rated flow” of the particular iSave. See Data sheet 521B1116. At low speeds you may hear some minor clicking sounds from the pump. This is normal and is caused by the pins in the vane pump.

5.7.3 Lubrication flow

To lubricate the moving parts in the pressure exchanger there is a well defined leak between port plate/valve plate.

In the booster pump there is a well-defined leak between rotor/sealing plates.

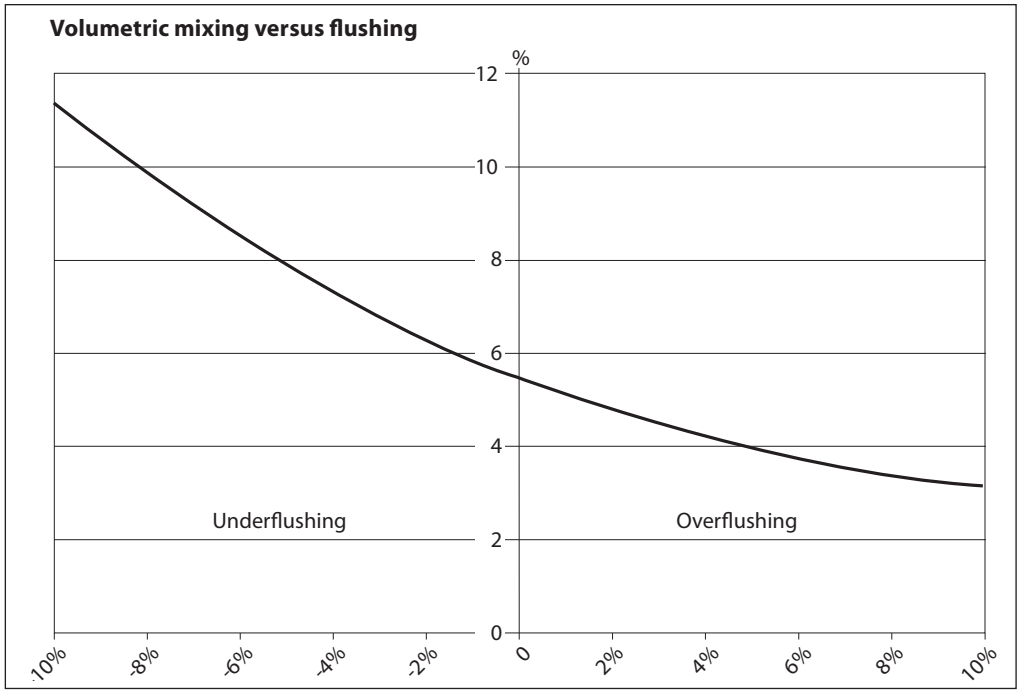
The lubrication flow inside the iSave always goes from the HP side to the LP side.

5.7.4 Volumetric mixing

There is no physical barrier in the ducts between the concentrate and the seawater. This means that there will be a small amount of mixing between the two liquids. Because the two liquids are in contact for a short amount of time, the mixing is relatively low.

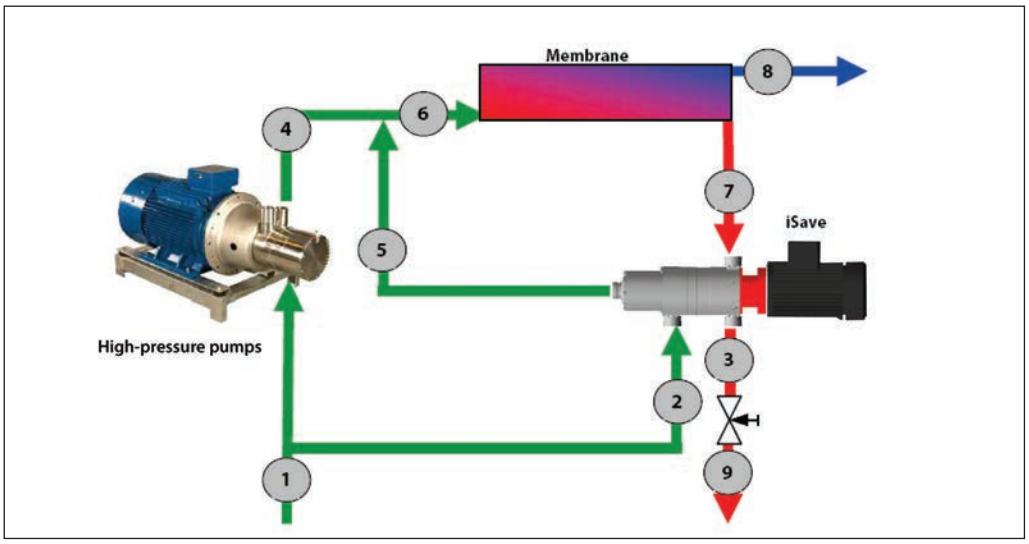
On the RO market the mixing rate is defined at “balanced flow” when HP-in is equal to LP-in.

The customer can reduce mixing by over-flushing the LP feed with excess feed water. See figure on next page. Optimal over-flushing is obtained when the energy loss on LP feed is equal to or less than the energy loss caused by the excess pressure at the membrane.



5.7.5 How does the iSave work in an RO system?

The figure below illustrates a typical flowpath of an SWRO or BWRO with an iSave.



The high-pressure (HP) concentrate (7) flows to the low-pressure (LP) concentrate outlet (3). The LP seawater (2) flows to the HP seawater outlet (5).

The rotor, moving between the high-pressure and low-pressure streams, removes the high-pressure concentrate (7) and replaces it with feed water (2).

The flow rate on the HP seawater outlet (5) is controlled by the iSave alone.

The flow rate on the LP concentrate outlet (3) is controlled by the seawater feed pump (1) and the back pressure valve.

This means that changing the LP feed flow (2) will not affect HP outlet flow (5) and, vice versa, that changing the HP outlet flow (5) will not affect the LP outlet flow (3).

As LP seawater (2) is flushing the LP concentrate to LP outlet (3), it is essential that the flow on the LP inlet (2) is equal to or slightly higher than the HP inlet (7). Otherwise there will be an “under-flush” and higher mixing will occur in the HP outlet (5). This higher mixing will result in a slightly higher pressure at the membrane.

The booster pump integrated in the iSave must only overcome the pressure drop from HP in (7) to HP out (5).

During the RO process operation, water is pumped into the HP membrane feed (6) by the HP pump (4) and the iSave (5). Almost all water coming from the HP pump (4) penetrates the membranes (8). Only a slight amount of the water is used as lubrication flow in the iSave. The lubrication flow is measured as the difference between the HP pump flow rate (4) and the permeate flow rate (8). The resistance to permeate in the membrane pressurises the HP loop.

The isobaric pressure exchanger technology in a SWRO or BWRO changes the HP concentrate into HP seawater that is fed into the HP membranes. The iSave energy recovery technology thus significantly reduces flow needed from the main HP pump (4). Overall energy consumption of a SWRO or BWRO plant using the iSave depends on the recovery rate.

The operator can change the recovery rate to optimise the RO system performance. Changing the recovery rate in an RO system equipped with iSave is easy. Using a VFD, change the speed of the iSave and thereby the flow in the HP flow rate.

Increased speed = Lowered recovery rate
Decreased speed = Raised recovery rate

Then change the LP feed flow (2) flow to the iSave to minimise mixing and optimise energy consumption. Make sure that flow and pressure are within the rated parameter of the iSave in question.

5.8 Seawater quality

5.8.1 Pre-filtration

It is important that the incoming water is filtered properly to assure optimum service life of the iSave. A true graded density melt-blown depth filter cartridge rated at 3 µm is therefore recommended. Poor pre-filtration of the feed water will result in reduced service life of the iSave.

The iSave may request a different pre-filter of the seawater than the HP pump and other components in the RO system.

As the various filters on the market differ greatly, Danfoss RO Solutions recommends using cartridges with consistent, reliable performance and high efficiency, in which fibres are blown continuously onto a central support core.

Danfoss RO Solutions does not recommend cartridges requiring any type of binders or resins.

NB! Filters can be purchased from Danfoss High Pressure Pumps.

For more information on the importance of proper filtration, please consult our publication "Filtration", 521B1009, which also will provide you with an explanation of filtration definitions and guidance on how to select the right filter. See section 5.8.1 for filter installation instructions.

5.8.2 Air bubbles

Large bubbles in a pressurised RO system can result in damage to piping and equipment. All air must be bled from both the LP and HP before the RO system is pressurised. Special consideration should also be given to air bubbles in feed flow, continuously fed into the HP pump and iSave.

5.8.3 Chemicals

The iSave should not be exposed to chemicals that will damage the RO membranes.

5.9 Initial start up and flushing

Prior to the initial start-up, all piping associated with the iSave unit should be thoroughly flushed to assure that no impurities enter the iSave. Inadequate pre-flushing will strongly affect the life of the iSave and may lead to its eventual breakdown.

It is recommended to disconnect all connections to the iSave and to thoroughly flush the piping before the iSave is connected to the inlet and outlet connections.

It is recommended to install temporary basket strainers at both inlets to the iSave during the initial start-up and commissioning.

It is essential that the water used for the final pre-flush is pre-filtered to a level described in chapter 5.8

Also see "Instruction for start and stop of the SWRO with iSave unit" in appendix 10.1.

5.10 Initial start-up and settings of safety equipment

The high-pressure pump that feeds water into the high pressure line may be able to generate a pressure higher than the maximum allowable pressure in the system. There is thus a risk of personal injury and/or damage to the iSave.

Depending of the type and size of the feed pump of the RO system, this pump may be able to generate a pressure higher than the maximum allowable pressure in the LP system. There is thus a risk that the iSave or the LP equipment could be damaged by over-pressurisation.

To prevent such over-pressurisation, appropriate relief valves should be used and procedures should be implemented to safeguard the HP and LP sides of the iSave and/or the RO system.

5.11 Flushing

RO membranes require periodic flushing to limit biological fouling.

There are two types of flushing: feed water (seawater) flush and freshwater (permeate) flush.

Regardless of the flush water used, the water must be pre-filtered to the level described in chapter 5.8. All parts of the iSave must be flushed, i.e. LP- and HP flow channels.

Feed water flushing is part of a normal shutdown sequence. After the HP pump has been stopped, the permeate and concentrate production will continue until the high-pressure drops below the osmotic pressure. Both the iSave and the LP seawater feed pump must run until the conductivity measured at point (7) and (3) are satisfactory. See also P&ID in chapter 5.16.

Fresh water flushing is performed before every extended shutdown of the RO plant. Permeate is simultaneously fed into the iSave at LP in (2), and either to the HP pump inlet (1) or through some other injection point such as the CIP connections or full flow cleaning connection. See also P&ID in chapter 5.16. Permeate may be produced during this flushing process.

Special attention should be given to the pressure in the HP line (7) as the iSave may start to cavitate when it runs at high speed and the pressure in the HP line (7) drops below 3 bars. This can be avoided by reducing the speed of the iSave to about 750 rpm and keeping the pressure in the HP line at the minimum of 1 bar. At this low pressure the iSave may only run for a maximum of 10 minutes.

Failing to flush the iSave with fresh water before extended shutdowns may result in extensive biological growth and cause corrosion in the iSave and other equipment in the RO system.

5.12 CIP or membrane cleaning

The purpose of membrane cleaning is to reduce scaling and fouling in the membranes. For optimal performance specific chemicals are required, depending on the cause of the pollution. After chemical treatment the system must be flushed with fresh water.

The flush water coming out of the membranes may consist of a large amount of suspended inorganic particles. It is important to assure that these particles are not lead into the iSave.
It is essential that the water used for the final pre-flush is pre-filtered to a level described in chapter 5.8.
The iSave should not be exposed to chemicals that will damage the RO membranes.

Also see instruction “Membrane cleaning of RO system with iSave unit” in appendix 10.3.

5.13 High pressure remains after shutdown

The HP line of the RO system equipped with an iSave can remain pressurised for a long time after shutdown. Pressure decreases as water slowly leaks through the iSave. If more rapid system depressurisation is required, the system should be bled through a suitable valve on the HP concentrate line.

Always check the pressure in the high-pressure lines before doing service on the HP lines or pressurised equipment.

5.14 Over-pressurisation caused by low pressure isolation

If the low-pressure side of the iSave is blocked and the iSave is exposed to high-pressure, there is a risk that the iSave or the LP piping could be damaged by over-pressurisation.

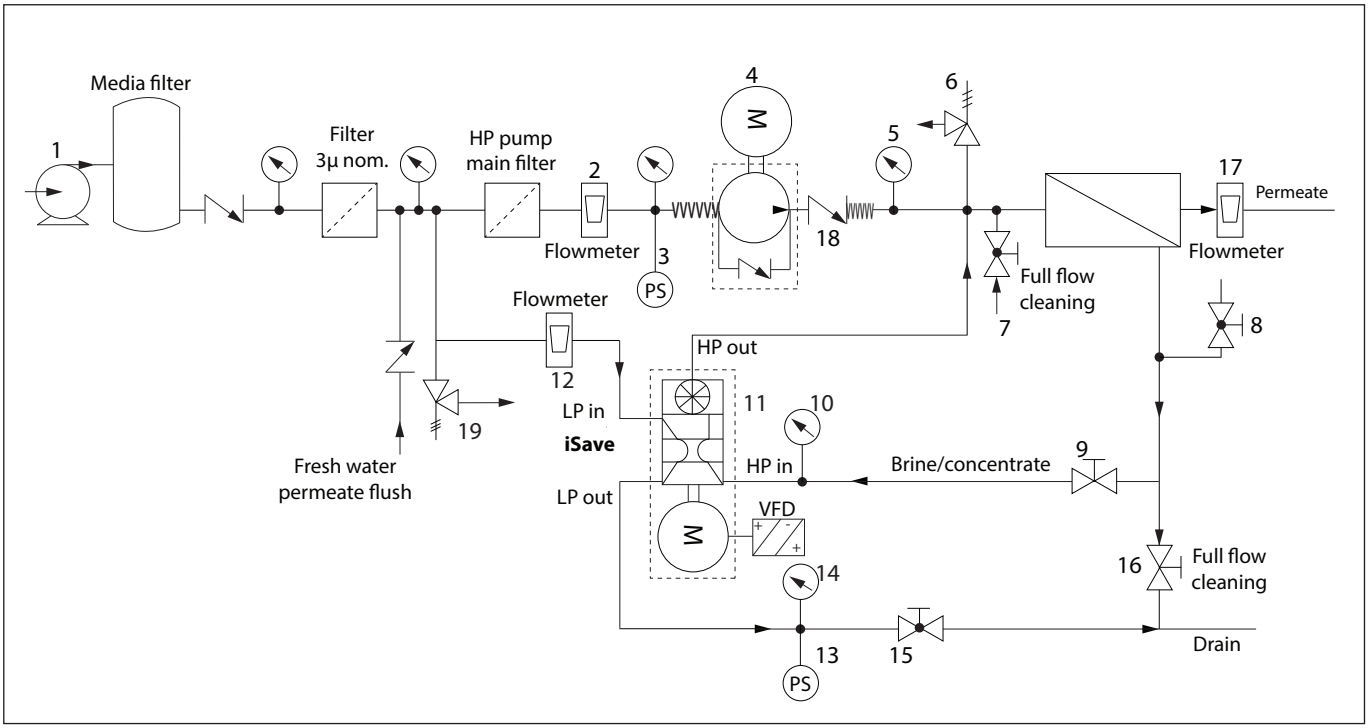
To prevent such over-pressurisation, appropriate relief valves should be used and procedures should be implemented to assure that the HP of the iSave is depressurised prior to the isolation of the LP side.

5.15 Over-pressurisation caused by the high pressure pump

The HP pump may be able to generate a pressure higher than the maximum allowable pressure for the iSave or the system – particularly if the HP pump is a positive displacement pump, the pump will be able to generate extremely high levels of pressure.

To prevent such over-pressurisation, appropriate relief valves should be used and procedures should be implemented to assure that the HP of the iSave is protected against excess pressure.

5.16 Preferred system design and P&ID



5.17 Explanation of P&ID setup

- The pressure switch (3) must stop the iSave (11) and the high-pressure pump (4) at pressures lower than the minimum inlet pressure or higher than the allowable maximum pressure.
- The non-return valve (18) prevents the high-pressure flow from the membrane to flow back through the HP pump and into the low pressure piping. This may occur when the high-pressure pump stops.
- The pressure relief valve (6) protects the entire system against pressure overload and relieves the water if the pressure exceeds the maximum set pressure. If the high pressure pump is a positive displacement pump, the pump can build up a very high pressure that will exceed the mechanical strength of the membrane housing, pipes and other accessories.
- The valve (8) bleeds the air out of the system. The valve must be placed at the highest point in the system.
- The pressure relief valve (19) protects the low pressure pipes against pressure overload and relieves the water if the pressure exceeds the maximum allowable pressure.

- Inlet filters assure proper water quality. High quality water extends the service life of the whole system.
- The pressure switch (13) must stop the iSave when the pressure is lower than the minimum inlet pressure or higher than the maximum pressure.

See “Start and stop” procedure, “Membrane cleaning” procedure and “iSave overload protection” instructions in appendices 10.2, 10.3. and 10.6.

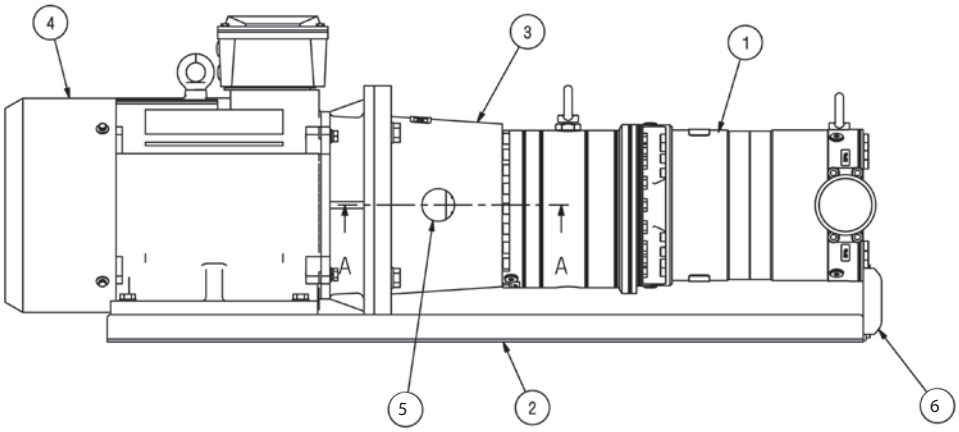
6. On-site installation

6.1 General

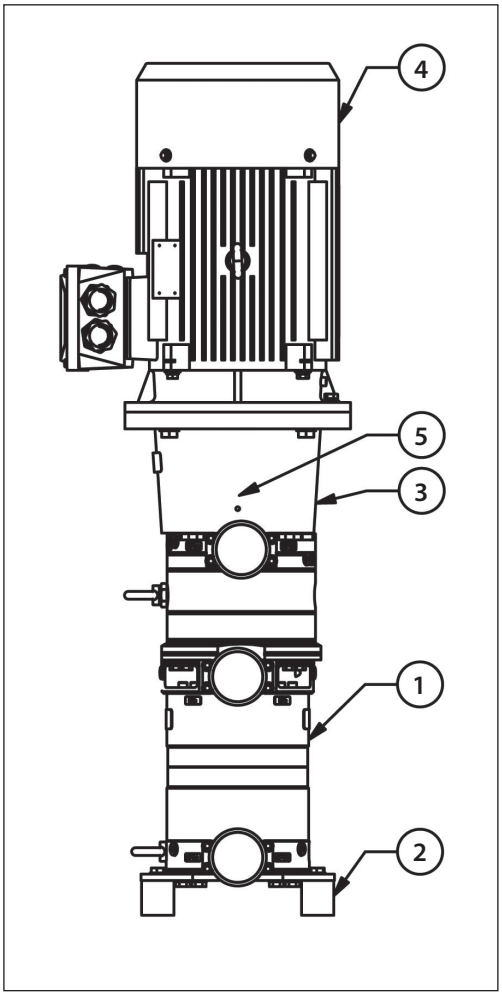
For safety instructions see chapter 3.1

6.2 Installation and alignment

The figure below illustrates the major iSave components.



1: iSave
2: Base plate (AISI 316)
3: Bell housing
4: Motor
5: Flexible coupling
6: Support bracket (AISI 316)



The iSave is connected to the electric motor by the bell housing and a flexible coupling. The bell housing is not suitable for bearing the weight of either the iSave or the motor. Both the iSave and motor must be supported without applying stress/load to the bell housing.

Danfoss provides the iSave with a base plate and support brackets. Although the base plate is of a sturdy design, it can flex or bend when it is bolted to the foundation. The base plate thus requires a solid foundation such as concrete or rigid steel frame. The base plate itself must be aligned to avoid bending caused by bolting to an uneven foundation.

A rigid foundation for the iSave assembly is important, and the iSave assembly must be bolted to the foundation. The bolts used must be of proper design and must be installed in accordance with the bolt manufacturer's recommendations.

To reduce noise it is recommended to use resilient mounts between the base plate and the foundation. Make sure that the bolts are properly locked and will stay locked over time.

An unlocked bolt can result in personal injury and/or damage to the iSave.

Misalignment of the base plate may cause stress and/or damage to the bell housing.

6.3 Orientation

The iSave 40 can be mounted horizontally and vertically.

When mounted vertically, the electric motor must be placed above the iSave.

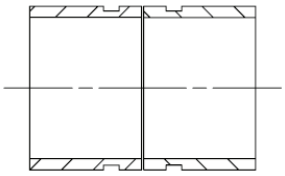
6.4 Piping and joints

Piping material and schedule is of high importance. The strength of the Victaulic® connections is influenced by the material used for both the Victaulic® clamps and the hard piping.

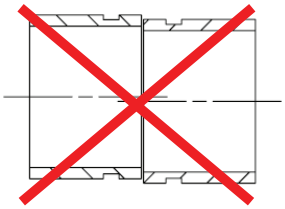
The hard piping and connections used must be of proper design and must be installed in accordance with the manufacturer's recommendations.

Hard piping to the iSave must be properly aligned to avoid stress on the iSave port connections. Pipe connections must be aligned as shown in the figures below.

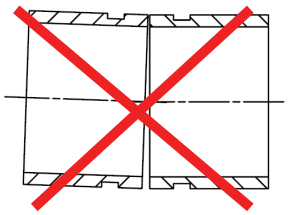
Don't use the iSave as a strain for hard piping.



Correct piping alignment



Incorrect piping alignment



Incorrect piping alignment

The hard piping and connections used must be of proper design and must be installed in accordance with the manufacturer's recommendations.

A failure to comply with this will or may result in personal injury and/or damage to the iSave.

Misalignment of the hard pipes may place stress on the iSave port connection and may damage the iSave.

6.5 Flexible couplings and flexible hoses.

The strength of the Victaulic® connections is influenced by the material used for both the Victaulic® clamps and hose couplings.

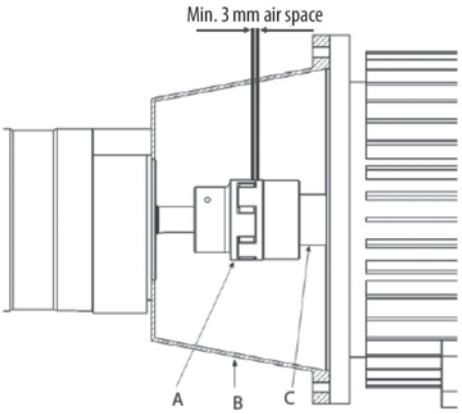
See also "Hose assembly and installation" in appendix 10.7.

The flexible hose and connections used must be of proper design and must be installed in accordance with the manufacturer's recommendations.

A failure to comply with this will or may result in personal injury and/or damage to the iSave.

6.6 Mounting of coupling

The figure below illustrates how to mount the flexible coupling between the iSave and to connect it to the electric motor.



A: Flexible coupling
B: Bell housing
C: Motor shaft

Any axial and radial load on the shaft must be avoided.

6.7 Accessibility

With respect to the service and replacement of the complete iSave unit, it is recommended to maintain sufficient space around the unit.

The space must be sufficient enough to allow safe lifting of the equipment, with no risk of personal injury and/or damage to the iSave.

6.8 Drives

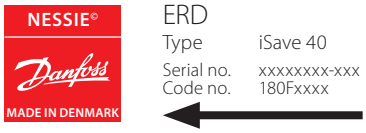
6.8.1 Electric motor

The iSave must only be driven by an electric motor.

Using anything other than an electric motor can lead to an irreparable fracture of the iSave's internal parts.

6.8.2 Speed control

The rotation speed on the electric motor can be controlled by a VFD. **The VFD must be able to operate at constant torque over the whole range of speed.** The direction of rotation can be seen on the identification label.



When connecting to the power supply, check the direction of rotation. This can be made by:

1. **Looking at the fan in the end of the electric motor.**
2. **Removing the plug in the bell housing and watch the rotation of coupling.**
3. **Before assembling the iSave on the electric motor, check the rotation of the shaft on the electric motor.**

Special attention has to be on NON PROTECTED – FREE ROTATING shaft on the electric motor. Ignorance will or could result in personal injury.

- Running the iSave in the wrong direction for more than a few minutes can cause unintended wear on the iSave.
- If the electric motor is running at a lower speed, extra care must be taken to ensure that the electric motor is NOT overheated. External cooling may be necessary.

6.8.3 Starting torque on the iSave/ramping the electric motor.

Because of the inertia and stick-slip friction of the iSave internal parts, the torque will exceed the maximum allowable operation torque for the iSave when the speed is ramped up from zero to maximum.

It is required to use a VFD or a soft starter.

When ramping up the speed the ramping up time should be between 3-15 seconds from zero to maximum. The starting torque on the iSave can be up to 150 Nm, (110 lbf ft).

Since the nominal torque of the motor (11 KW [15 HP] 6 pole) is 108 Nm (80 lbf ft), the VFD must be able to deliver 140% start torque.

The Danfoss VFD type FC301 and FC302 can be used.

6.8.4 Torque overload protection on the iSave.

The electric motor and iSave must always be protected against overload.

At continuously operation the maximum torque on the iSave must be monitored.

The electric motor must be shut of if the maximum torque of the iSave exceeds the defined limit.

If more electric motors are powered by the same soft starter or VFD, each electric motor must be equipped with "torque limit equipment" to protect the iSave against overload.

Below are examples of equipment which can measure the load on the electric motor or limit the torque on the iSave.

1. VFD with integrated current monitoring relays.
2. External current monitoring relays.

See also examples of "iSave overload protection" equipment in appendix 10.6

The electric motor and iSave must always be protected against overload.

If the torque exceeds the maximum operation torque, it may lead to an irreparable fracture of the iSave´s internal parts.

7. Commissioning, start-up and shutdown

7.1 Safety regulations

The operator ensures that all inspection and installation work is performed by authorised, qualified specialized personnel who are thoroughly familiar with the manual.

Before starting up the iSave and the high-pressure pump, make sure that the following requirements are met:
- The iSave has been properly connected to the electric power supply and is equipped with all protection devices in accordance with EN60204-1.
- Check that all motor protections are properly set.
- All safety equipment, auxiliary equipment and connections required are proper connected and operational.
- Check all bolts in all connections and in the foundation of the iSave and the pumps.

- All pipes are flushed, free from debris and full of water.
- The iSave has been bled and is full of water.
- At pressure lower than 10 bars, check the system for leakage.

Slowly raise the pressure in the system and set all pressure switches to the correct limit and continually check all connections for leakage.

- Set pressure relief valve on both low and high-pressure at the maximum system pressure.
- Check high-pressure hoses for proper assembly and inspect for external leakage for all connections.

- At low pressure, start the iSave and check direction of rotation.
- “Startand stop procedure” instructions in appendix. 10.1

7.2 Support

Danfoss A/S offers commissioning and service at system manufacturer’s location. Rated quotes are offered upon request.

7.3 Commissioning

Before starting up the iSave and the high-pressure pump, make sure that the following requirements are met:

8. Service/Maintenance

8.1 Safety regulations

The operator ensures that all maintenance, inspection and installation work is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

Before intervening in the iSave/system;
- The power must be shut off and the starting device must be locked.
- The pressure in the high-pressure lines must be drained to the low-pressure side.
- The water in all connected pipes must be drained.

Always use suitable safety and lifting equipment when handling the iSave, and follow the instructions in chapter 4.3

- When safety equipment has been adjusted make sure that proper re-adjustment has been made before start-up.
- When the system is re-started after service and maintenance follow the instructions in chapter 7 and in "Start and stop procedures" in appendix. 10.2

8.2 Support

Danfoss A/S offers commissioning and service at the system manufacturer's location. Rated quotes are offered upon request.

8.3 Maintenance schedule

The schedule of preventive maintenance below will help ensure that the iSave provides years of trouble-free performance.

One day after commissioning:

1. Re-check bolts in the foundation and the base plate of the iSave and tighten the bolts to specified torque if necessary.
2. Visually inspect all pipe connections/ couplings for external leakage.
3. Re-check bolts in all pipe connections/ couplings and tighten the bolts to specified torque if necessary.

4. Replace filters if necessary.
5. Clean the filter housing and reinstall filters. Make sure no debris enters the system.

Three months after commissioning:

1. Re-check bolts in the foundation and the base plate of the iSave and tighten the bolts to specified torque if necessary.
2. Re-check alignment of the iSave base plate and iSave.
3. Visually inspect all pipe connections / couplings for external leakage.
4. Re-check bolts in all pipe connections / couplings and tighten the bolts to specified torque if necessary.

5. Replace filters if necessary.
6. Clean the filter housing and install the new filter. Make sure no debris enters the system.
7. Audibly inspect the iSave assembly. If there is irregular sounds or vibrations inspect the internals parts of the iSave and replace if necessary.

8,000 hours of operation after commissioning:

1. Re-check bolts in the foundation and the baseplate of the iSave and tighten the bolts to specified torque if necessary.
2. Re-check alignment of iSave base plate and iSave.
3. Visually inspect all pipe connections / couplings for external leakage.
4. Re-check bolts in all pipe connections / couplings and tighten the bolts to specified torque if necessary.

5. Replace filters if necessary
6. Clean the filter housing and install the new filter. Make sure no debris enters the system.
7. Visually inspect pump coupling and replace if necessary.
8. Audibly inspect the iSave assembly. If there is irregular sounds or vibrations inspect the internals parts of the iSave and replace if necessary.
9. Check power consumption. If there are irregular performances, inspect the internals parts of the iSave and replace if necessary.

Annually:
1. See above section: **"8,000 hour of operation after commissioning"**.
2. See **"Operating- and maintenance instruction, electric motor"** in appendix 10.9

Follow manufacturer's recommendations for electric motor service and maintenance.

9. Trouble-shooting

9.1 Safety regulations

The operator ensures that all inspection and installation work is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

Before intervening in the iSave/system;
- The power must be shut off and the starting device be locked.
- The pressure in the high-pressure lines must be drained to low-pressure side.
- The water in all connected pipes must be drained.

The numbers in () correspond to the preferred system design and P&ID.

Problem	Possible cause	Action
VFD cannot start the iSave at initial start-up.	VFD is not designed for constant torque.	Choose a VFD that is designed for constant torque.
	VFD cannot deliver 140% start torque.	Choose a VFD that is designed for minimum 140% start torque.
	Ramp-up settings in the VFD are not correct. VFD is tilting.	Set ramp-up parameters correct.
	Valve (9) is closed.	Open valve (9).
	Pressure in the HP line (5) is too high.	Start the iSave only when the pressure in the HP line is low.
Torque on iSave is too high during operation.	Pressure difference from HP-out (5) to HP-in (10) is too high.	Clean or change membranes.
	Debris in the booster pump or iSave.	Clean the system.
	Wear in the booster pump or iSave.	Repair or change the parts.
	Design of the basic plant does not fit the performance of the iSave.	Change design to fit the iSave performance.
Permeate production is too low (17).	Valves (6), (7), (8) or (16) are leaking.	Repair or change valve(s).
	Internal leakage in iSave.	Repair iSave.
	HP pump flow (2) is too small.	Correct speed on the HP pump.
		Check the HP pump and repair if necessary.
Pressure on the membranes (5) is too high.	Fouling on the membranes.	Clean the membranes.
	Mixing in the iSave is too high.	Check flow on LP-in (12) and adjust flow.
	Flow out of the iSave is too low and causes a recovery rate that is too high.	Check speed on iSave and change if necessary.
		Booster pump in the iSave is worn out. Perform service on the VP.
Pressure on the membranes (5) is too low.	Valves (6), (7), (8) or (16) are leaking.	Repair or change valve (s).
	Internal leakage in iSave.	Repair iSave.
	HP pump flow (2) is too small.	Incorrect speed on the HP pump.
		Check the HP pump and repair, if necessary.

10. Appendix

10.1 General SWRO system understanding with iSave

- Basically the permeate flow is the same as the flow from the high-pressure pump.
- The HP concentrate flow into iSave HP-in and HP seawater-out is determined by the rpm of the iSave (See flow curve page 27).
- The iSave HP flow determines the recovery rate (higher rpm on the iSave gives lower recovery rate and vice versa).
- Flow on the low-pressure side of the iSave is determined by feed pump and the pressure control valve LP-out (not by the rpm of the iSave).
- The flow on the low-pressure side must be at least the same as on the high-pressure side of the iSave (LP in flow = HP in flow; this is called balanced flow).
- To minimize mixing, the flow on the low-pressure side can be adjusted up to 10% higher than the high-pressure flow.

10.2 Instruction for start and stop of the SWRO with iSave unit (180R9213)

Below procedures are general guidelines for the start-up and shut-down functions of SWRO-systems with the Danfoss iSave energy recovery device.

Procedure details may differ depending on the system design.

The numbers marked in () refer to the diagram on the next page.

10.2.1 Prior to start-up

Prior to initial start-up all piping connected with the iSave unit must be thoroughly flushed to ensure that no impurities enter the iSave. Inadequate pre-flushing will strongly influence the life of the iSave and might lead to breakdown of the iSave.

1. Install all filter cartridges in the system.
2. With the iSave disconnected from the piping, the system must be flushed in order to remove possible impurities from the system (pipes, hoses, membranes etc.).
   Flushing must run until the system can be ensured clean.
3. Connect the iSave to the pipework. The iSave is now ready for start-up.

10.2.2 Starting up the system

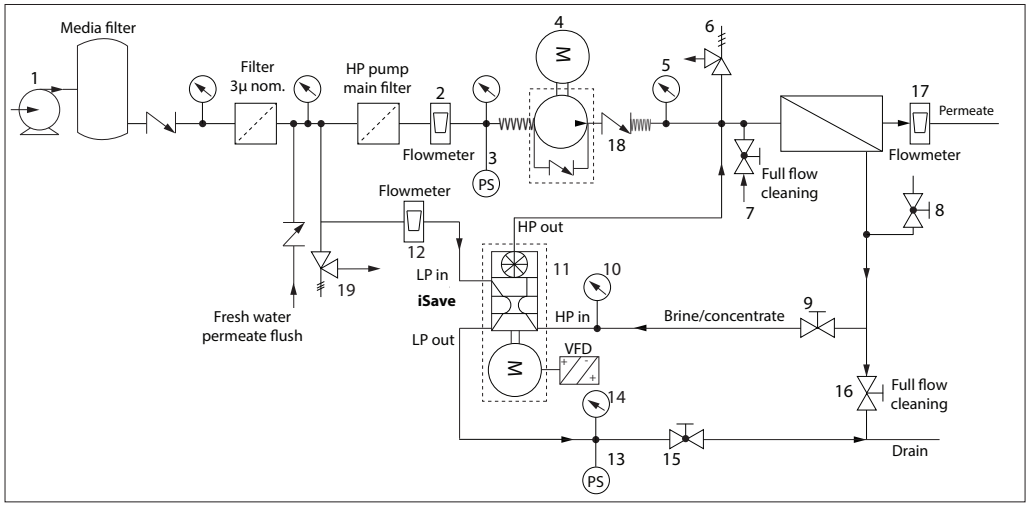
1. Make sure that all valves are set in normal operating positions.
2. Start the seawater supply pump (1).
3. Make sure all pipework is flushed with water. Vent all air from the system through air valve (8) and iSave unit (11). The iSave has ¼" plugs to vent both the HP and LP side.
4. Start the iSave unit when the pipework is full of water and the system and iSave unit has been bled.

NB!

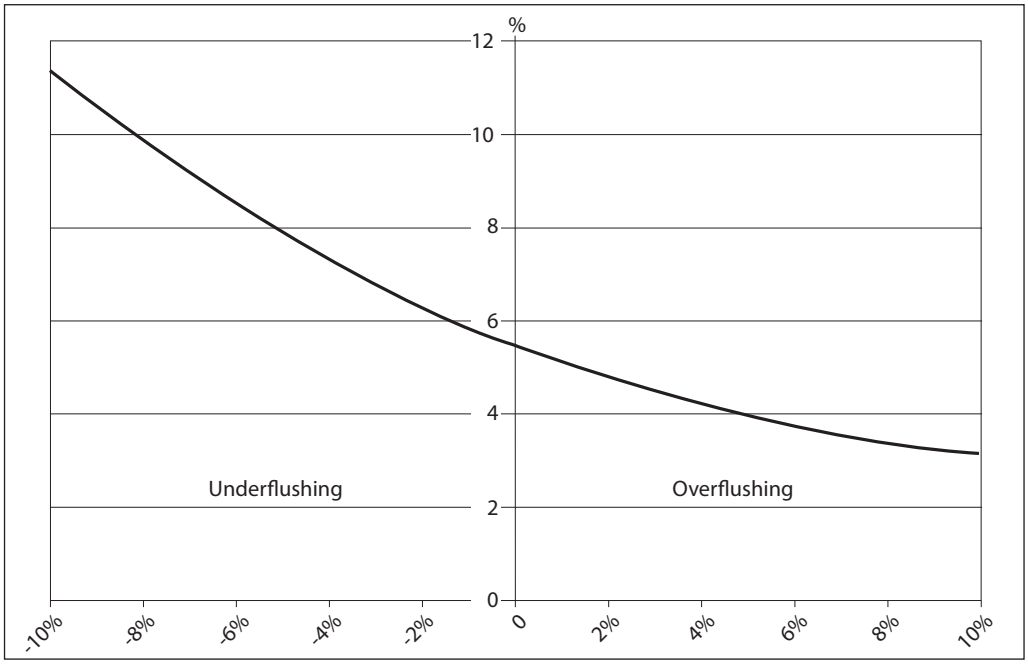
- **Always start the iSave unit before the high-pressure pump is started.**
- **The speed of the iSave unit must be ramped up over a period of 3–15 seconds.**
- **If possible, run the iSave at maximum 750 rpm.**
- **When HP in is below 15 bars/217psig, the maximum operation period is 10 minutes.**
- **Ensure the VFD/SoftStarter can deliver 140% start torque since the iSave starting torque can be higher than nominal torque of the motor.**

5. With a pressure control valve (15), adjust the back pressure of the "LP-out" to a minimum of 1 bar/14.5 psig (14).
6. An "over flush" of the iSave can be done to bleed any remaining air from the system. Flush minimum 10% higher flow rate (12) at "LP- in" compared to the flow rate on "HP-out". Flush over a period of minimum 5 minutes.
7. Adjust the speed of the iSave unit to desired flow (recovery rate). The speed is normally controlled by a VFD.
8. Start the high-pressure pump (4), and the system pressure (5) will rise until the permeate flow (17) almost equals the flow (2) from the high-pressure pump.
9. Adjust LP-in flushing flow:
   There are two ways to check the optimal LP-in flushing flow.
   1. Check the low-pressure flow rates (12), adjust flow with valve (15) or feed pump to achieve balanced flow. It might be a benefit to "over flush" the iSave with up to 10% to lower mixing and HP pressure at membrane.
   2. Adjust low-pressure flow with valve (15) or feed pump upwards slowly. Check HP pressure at membrane, (the pressure will fall with increased LP flow because of decreasing mixing. Adjust upwards until the HP pressure at the membrane does not fall any more. (See mixing curve page 27).
10. Check that the pressure (14) of "LP-out" is at least 1 bar/14.5 psig.
11. How to adjust system if LP-in flow or pressure is too high/low:
    1. If the "LP -in" flow (12) is too low and the "LP-out" pressure (14) is higher than 1 bar/14.5 psig, increase flow and pressure on the pressure control valve (15).
    2. If the "LP-in" flow (12) is too low and the "LP-out" pressure (14) is below 1 bar/14.5 psig, adjust the flow by raising the flow from the seawater supply pump (1).
    3. If the "LP-in" flow (12) is too high, reduce flow by the pressure control valve (15) or the flow from the seawater supply pump (1).

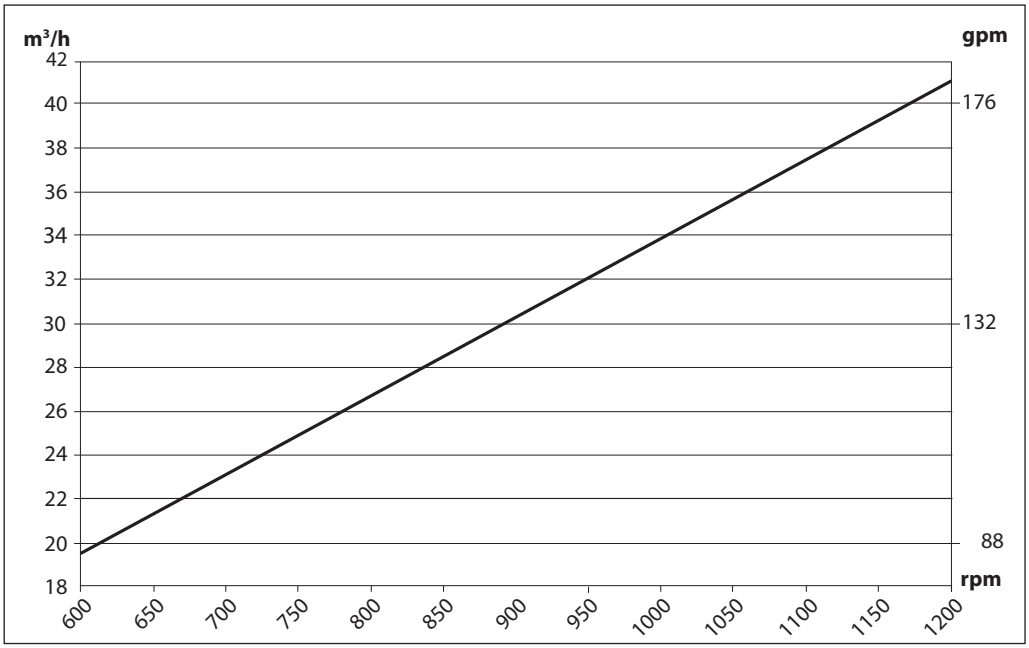
P&ID



Mixing curve



Flow curve iSave 40



10.2.3 Daily system shutdown

1. The system is running in normal operation and producing permeate flow.
2. Stop the high-pressure pump (4).
3. Keep the iSave unit (11) running until the wanted pressure (5) at the membranes is reached and the TDS in the high-pressure line is equal to the TDS in the low-pressure line.

NB! **When "HP in" is below 15 bars/217 psig, the maximum operation period is 10 minutes. If the pressure (10) at "HP in" drops below 3 bars/43.5 psig, the sound will change of the iSave. This is due to cavitation. Also see Data sheet for iSave. If possible run the iSave at maximum 750 rpm.**

4. Stop the iSave unit (11).
5. Stop the seawater supply pump (1).

10.2.4 2-14 days system shutdown

1. Run the "daily system shutdown" procedure.
2. Supply fresh water to the iSave unit (11) and the SWRO system. Make sure that the iSave unit and the SWRO system are filled at the same time to ensure optimal flushing.
3. Run the system while the iSave unit is running, until all seawater is discharged.

NB! **When "HP-in" is below 15 bars/217 psig, the maximum operation period is 10 minutes. If the pressure (10) in "HP-in" drops below 3 bars/43.5 psig, the sound will change of the iSave. This is due to cavitation. Also see Data sheet for iSave. If possible, run the iSave at maximum 750 rpm.**

4. Stop the iSave unit (11).
5. After the iSave has stopped rotating, stop fresh water supply.

10.2.5 Long-term system shutdown

For a long-term shutdown period, the SWRO system including the iSave unit must be thoroughly flushed with fresh water to remove any salt. Run the "daily and 2-14 days system shutdown" procedure.

Further, any biological growth should be prevented.

Make a final flush of the iSave unit with the same solution used to preserve the SWRO membranes. Flush both the high-pressure and low-pressure sides of the iSave (11). The high-pressure flush is performed by circulating the solution through the iSave unit and the membranes by rotating the iSave unit.

NB! **If possible, run the iSave at maximum 750 rpm.**

10.3 Membrane cleaning of the RO system with iSave unit

Below procedures are general guidelines for the membrane cleaning of SWRO-systems with the Danfoss iSave. Procedure details may differ depending on the system design.

The purpose of membrane cleaning is to reduce scaling and fouling in the membranes. For optimal performance specific chemicals are required, depending on the cause of the contamination.

After chemical treatment the system must be flushed with fresh water. The flushing water, coming out of the membranes, may consist of a large amount of suspended inorganic particles. It is important to assure that these particles are not fed into the iSave.

NB! **It is recommended to disconnect the piping from the "HP-in" of the iSave and flush the contaminated water from the membranes directly to drain. By disconnecting the pipes there will be no accumulation of contaminations in the HP-piping and HP-valves. See P&ID no 2.**

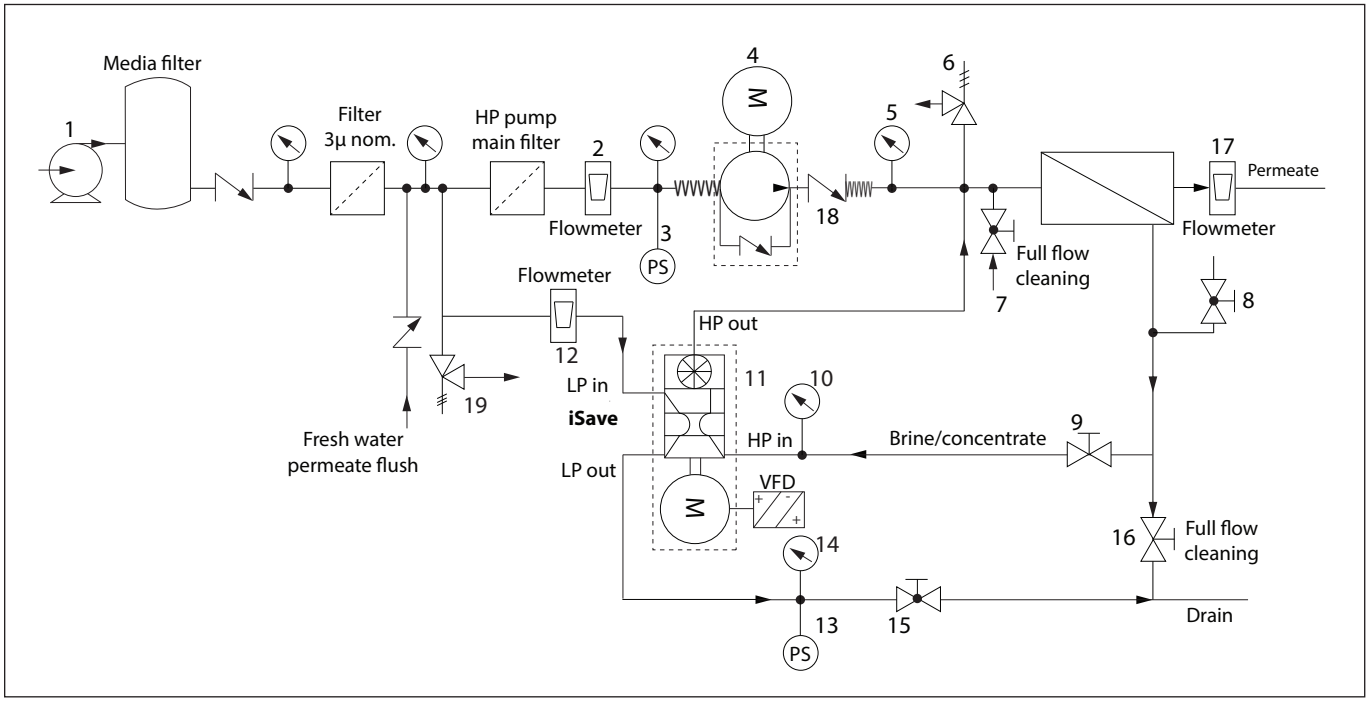
10.3.1 Membrane cleaning

The procedures below are based on Dow's Cleaning and Sanitization: Cleaning steps described in Dow's Form No. 609-02090-1005. Other procedure may be used depending on the membranes used.

Below procedure is according P&ID no 1.

1. Stop the high-pressure pump (4), and stop the iSave (11).
2. Stop the seawater supply pump (1).
3. Close valve (9) and open valve (16).
4. Pump mixed cleaning solutions to the vessel at conditions of low flow rate and low pressure to displace the process water. Use only enough pressure to compensate for the pressure drop from feed to concentrate. The pressure should be low enough that essentially no or little permeate is produced. A low pressure minimizes re-deposition of dirt on the membrane. Dump the brine/ concentrate to prevent dilution of the cleaning solution.
5. Recycle: After the process water is displaced, cleaning solution will be present in the concentrate/brine stream. Recycle the cleaning solution from the piping to the cleaning solution tank.
6. Turn of the pump and allow the elements to soak.
7. Feed the cleaning solution at high flow into the “full flow cleaning” adapter (7). The high flow rate flushes out the foulants removed from the membrane surface by the cleaning.
8. Flush RO permeate or deionised water into the “full flow cleaning” adapter (7). Flush out the cleaning solution. It is essential that the water used for the final pre-flush is pre-filtered to a level described in the Data sheet.
9. Open valve (9) and flush through the iSave. The iSave may start to rotate backwards – this is OK.
10. When flushing is finalised – assure that no foulants remain in the piping or valve (9).
11. Close the high pressure “full flow cleaning” valve (7) and close valve (16).

10.3.2 P&ID no. 1

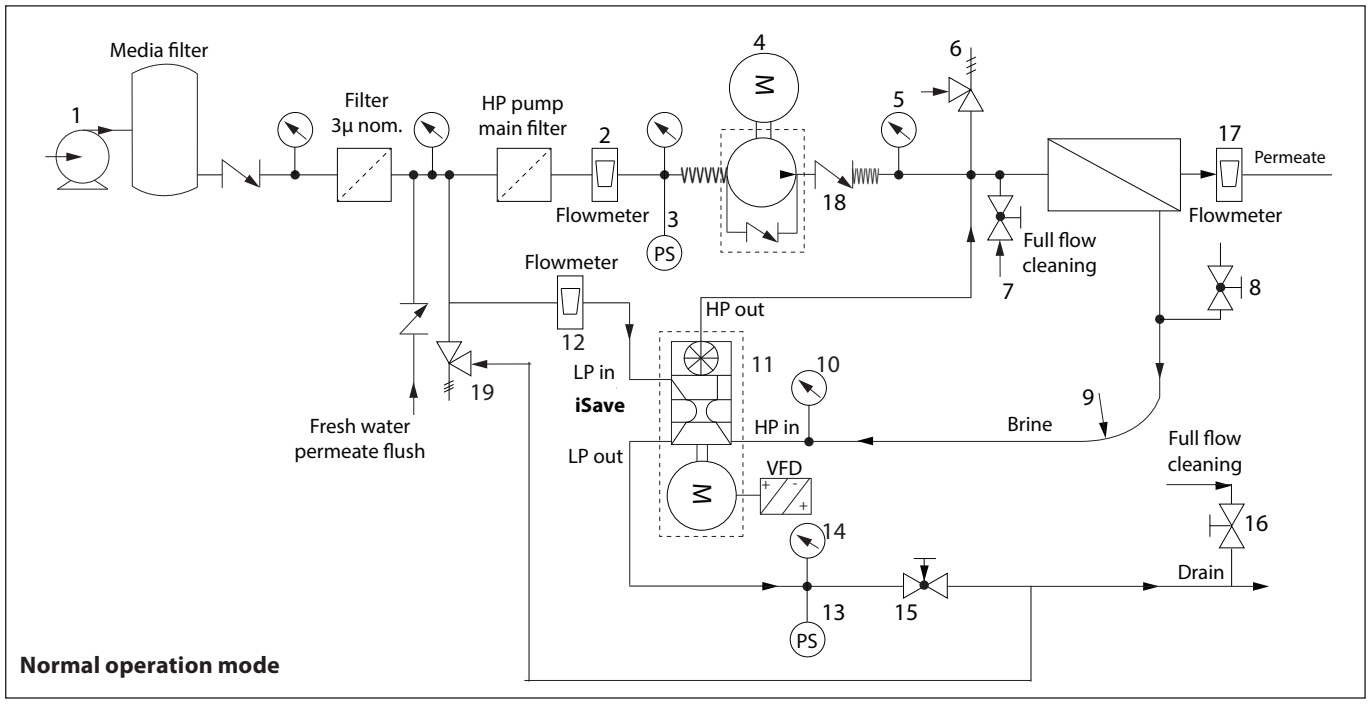


Below procedure is according P&ID no 2.

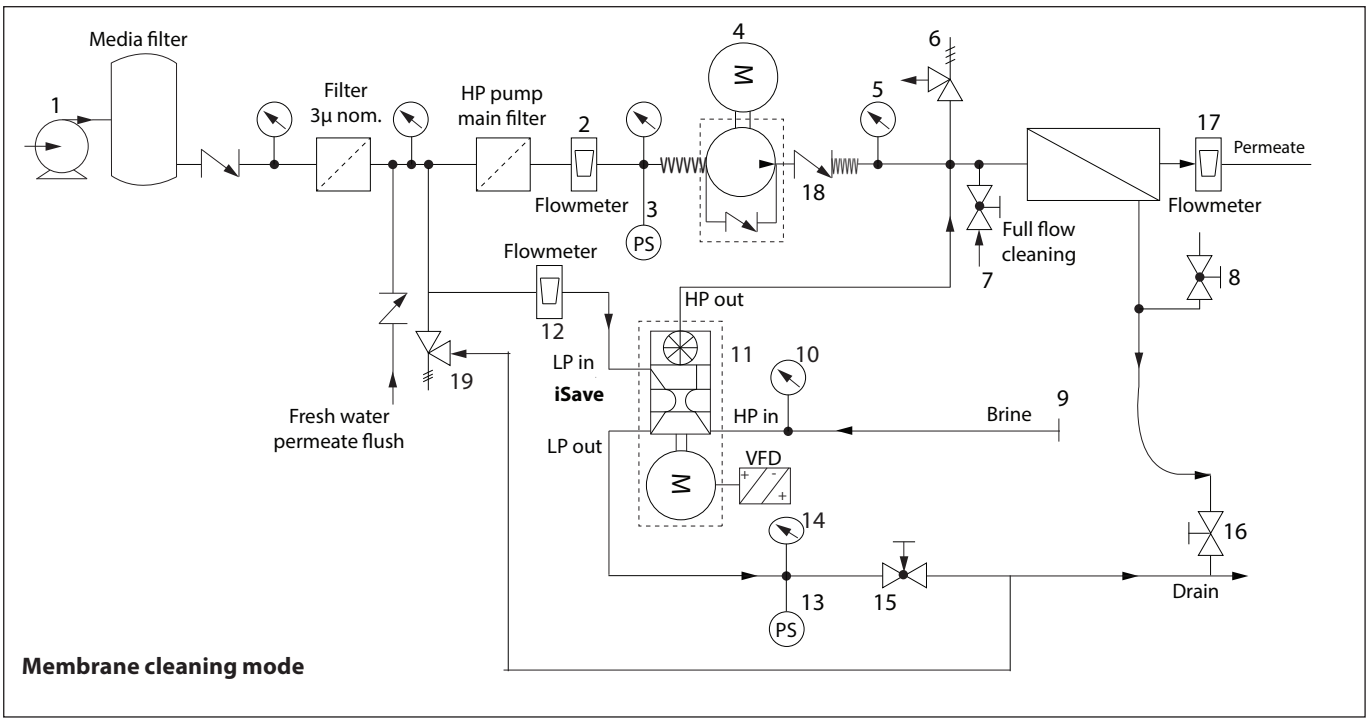
1. Stop the high-pressure pump (4), and stop the iSave (11).
2. Stop the seawater supply pump (1).
3. Disconnect pipe in joint (9) and connect the pipe to low-pressure “Full flow cleaning” joint (16).
4. Plug pipe in joint (9).
5. Open valve (16).
6. Pump mixed cleaning solutions to the vessel at conditions of low flow rate and low pressure to displace the process water. Use only enough pressure to compensate for the pressure drop from feed to concentrate. The pressure should be low enough that essentially no or little permeate is produced. A low pressure minimizes re-deposition of dirt on the membrane. Dump the brine/ concentrate to prevent dilution of the cleaning solution.
7. Recycle: After the process water is displaced, cleaning solution will be present in the concentrate stream. Recycle the cleaning solution from the piping to the cleaning solution tank.
8. Turn of the pump and allow the elements to soak.

9. Feed the cleaning solution at high flow into the “full flow cleaning” adapter (7) on the feed side of the membrane. The high flow rate flushes out the foulants removed from the membrane surface by the cleaning.
10. Flush RO permeate or deionised water into the “full flow cleaning” adapter (7) on the feed side of the membrane. Flush out the cleaning solution. It is essential that the water used for the final pre-flush is pre-filtered to a level described in the Data sheet.
11. Remove plug (9). Water will flow out of the iSave and the iSave may start to rotate backward – this is OK.
12. Continue to flush the iSave until no chemicals are coming out of the iSave.
13. When flushing is finalised – Close the high- pressure “full flow cleaning” valve (7) and close valve (16).
14. Connect the high pressure pipe to joint (9) again.

10.3.3 P&ID no. 2

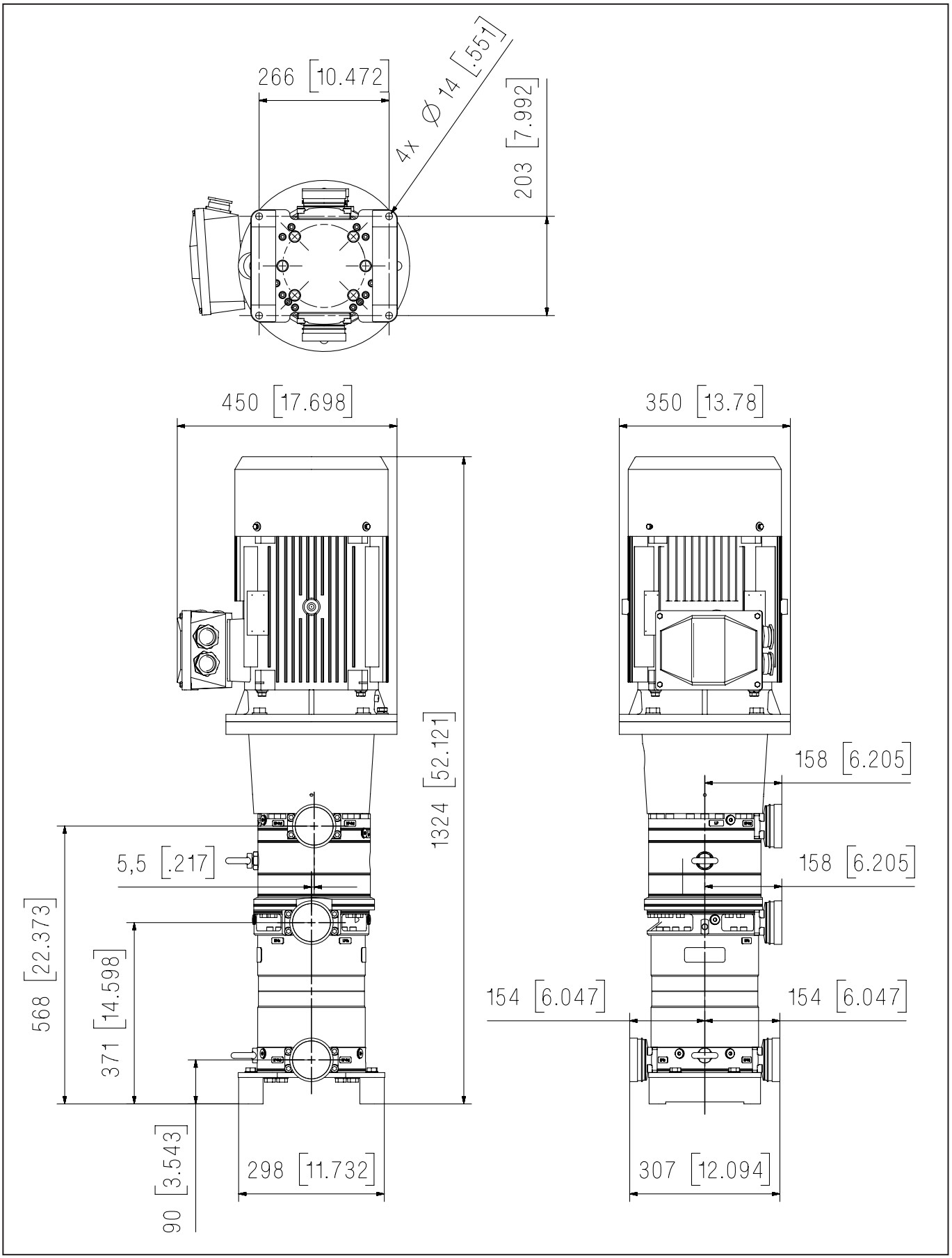


Normal operation mode

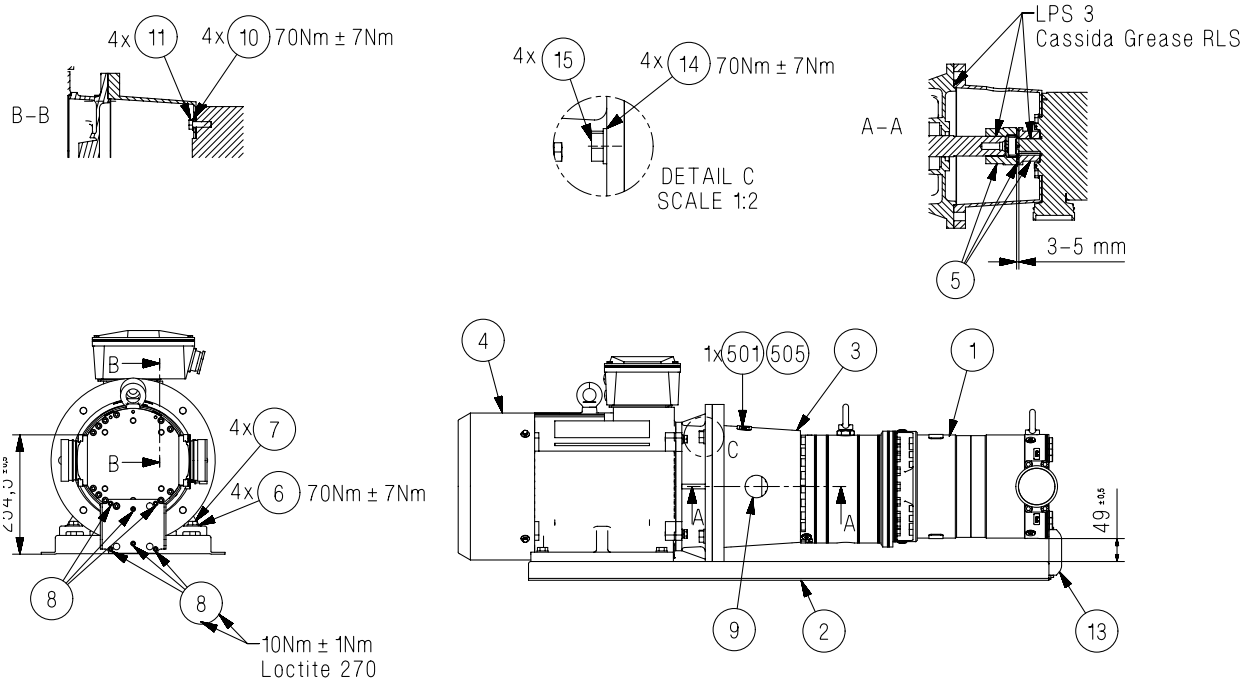


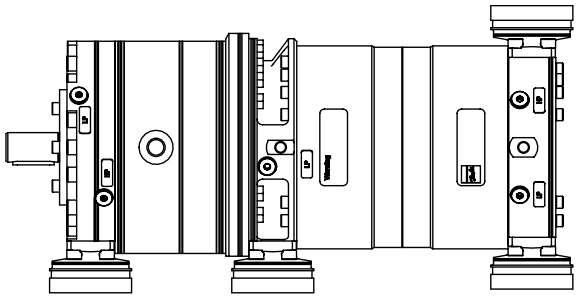
Membrane cleaning mode

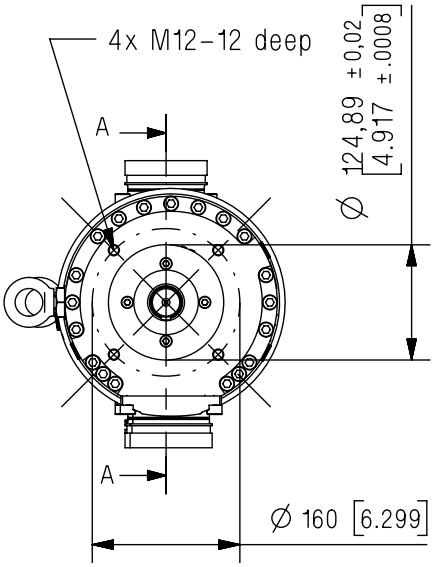
10.4 Dimensional drawings

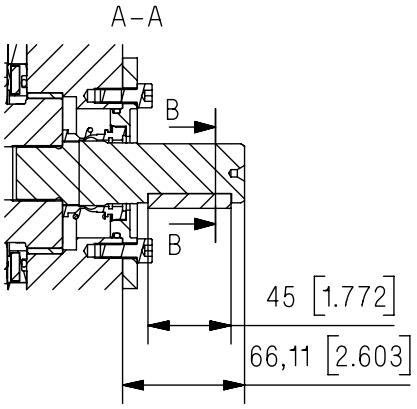


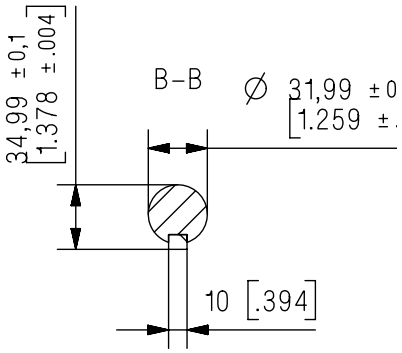
imensions without tolerances acc. To ISO 2768-1 designation C.











Dimensions without tolerances acc. to ISO 2768–1 designation C.

10.5 iSave parts list

This parts list provides an overview of the content of various service sets for the iSave 40 as well as exploded views of the iSave, pressure exchanger and booster pump.

10.5.1 Pressure exchanger

Note: The parts listed are not sold seperately, only in various kits

Exploded view, see 10.5.8 page 39.

Pos.	Qnt.	Designation	Material	180F4114 Valve plate	180F4115 Port plate, brine	180F4116 Port plate, seawater	180F4117 Sealing kit
1	1	Adapter ring	Polymer				
2	1	Adapter flange	Super Duplex				
3	3	3" Victaulic connection	Super Duplex				
4	6	Bleed plug	Super Duplex				
5	1	Bearing	PEEK				
6	1	Port plate, seawater	Super Duplex / PEEK			x	
7	2	Valve plate	Super Duplex	x			
8	1	Retainer	Super Duplex				
9	1	Cylinder barrel	Super Duplex				
10	1	Casing	Duplex				
11	1	Port plate, brine	Super Duplex / PEEK		x		
12	1	Bearing	PEEK				
13	1	Outlet flange	Super Duplex				
20	1	Lifting eye	Steel				
21	4	Pin, Ø10.5x20	Super Duplex				x
22	2	Pin, Ø6x10	AISI 303				x
23	12	Springs	Hastelloy C276				
30	6	O-ring, Ø11x2	NBR				x
31	3	O-ring, Ø65x3	NBR				x
32	2	O-ring, Ø182x4	NBR				x
33	24	Back-up ring	PEEK				x
34	24	O-ring, Ø28x2	NBR				x
35	1	O-ring, Ø9.19x2.62	NBR				x
36	1	O-ring, Ø30.2x3	NBR				x
40	12	Bolt, M10x20 / CS A4-80	AISI 316				x
41	12	Bolt, M8x60 / CS A4-80	AISI 316				x
42	12	Bolt, M8x20 / CS A4-80	AISI 316				x

10.5.2 Booster pump (vane pump), parts list

Note: The parts listed are not sold seperately, only in various kits.

Exploded view, see 10.5.7 page 38.

Pos.	Qnt.	Designation	Material	180F4118 Port plate, out	180F4119 Port plate, in	180F4120 Sealing plate, out	180F4121 Sealing plate, in	180F4122 Vane kit	180F4123 Sealing kit
101	1	Adapter flange	Super Duplex						
102	2	Bearing	PEEK						
103	1	Port plate - in	Super Duplex		x				
104	1	Sealing plate - in	PEEK				x		
105	1	Adapter for eye bolt	Steel						
106	1	Stator	Super Duplex						
107	1	Rotor	Super Duplex						
108	8	Pin	PEEK						
109	8	Vane	Super Duplex / PEEK					x	
110	1	Sealing plate - out	PEEK			x			
111	1	Port plate - out	Super Duplex	x					
112	1	Outlet flange	Super Duplex						
113	1	3" Victaulic connection	Super Duplex						
114	1	Flange for shaft seal	Super Duplex						
115	3	Bleed plug	Super Duplex						
120	1	Eye bolt	Steel						
121	4	Pin, Ø10x30	AISI 303						
122	1	Shaft seal	Hastelloy C276 NBR						x
123	2	Pin, Ø4x9	PEEK			x	x		x
130	2	O-ring, Ø126x3	NBR						x
131	2	O-ring, Ø89x3	NBR						x
132	4	O-ring, Ø192x4	NBR						x
133	1	O-ring, Ø93x3	NBR			x	x		
133	2	O-ring, Ø93x3	NBR						x
134	1	O-ring, Ø9,2x2,6	NBR						x
135	2	O-ring, Ø65x3	NBR						x
136	3	O-ring, Ø11x2	NBR						x
140	18	Bolt, M10x35 / CS A4-80	AISI 316						x
141	4	Bolt, M10x20 / CS A4-80	AISI 316						x
142	4	Bolt, M8x20 / CS A4-80	AISI 316						x
143	19	Bolt, M10x65 / CS A4-80	AISI 316						x

10.5.3 iSave, 180F7011

Exploded view, see 10.5.9 page 40.

Pos.	Qnt.	Designation	Material	180F4125 Couplings kit
130	2	O-ring, Ø126 x 3	NBR	x
131	2	O-ring, Ø89 x 3	NBR	x
201	1	Pressure exchanger		
202	1	Booster pump		
203	1	Coupling VP	Super Duplex	x
204	1	Spider	Hytrel 6356	x
205	7	Bolt, M8 x 20	Super Duplex	x
206	13	Bolt, M10 x 20 A4-80	AISI 316	x
208	1	Coupling PE	Super Duplex	x
209	5	Pin, Ø6 x 15	Super Duplex	x

10.5.4 iSave on base plate, horizontal, 180F7001

Exploded view, see 10.5.10 page 41

Pos.	Qnt.	Designation	Material	180Z0246 Coupling kit
1	1	iSave 180F7011	Super Duplex	
2	1	Base plate	AISI 316	
3	1	Bell housing	Aluminium	
4	1	Electric motor	Aluminium or cast iron	
5	1	Coupling	Aluminium/polymer	x
6	4	Bolt, M12 x 40	AISI 316	
7	4	Washer	AISI 316	
8	1	Bolt, M6 x 12	AISI 316	
9	1	Plug	Polymer	
10	4	Bolt, M12x30	AISI 316	
11	4	Washer	AISI 316	

10.5.5 iSave on foot, vertical, 180F7003

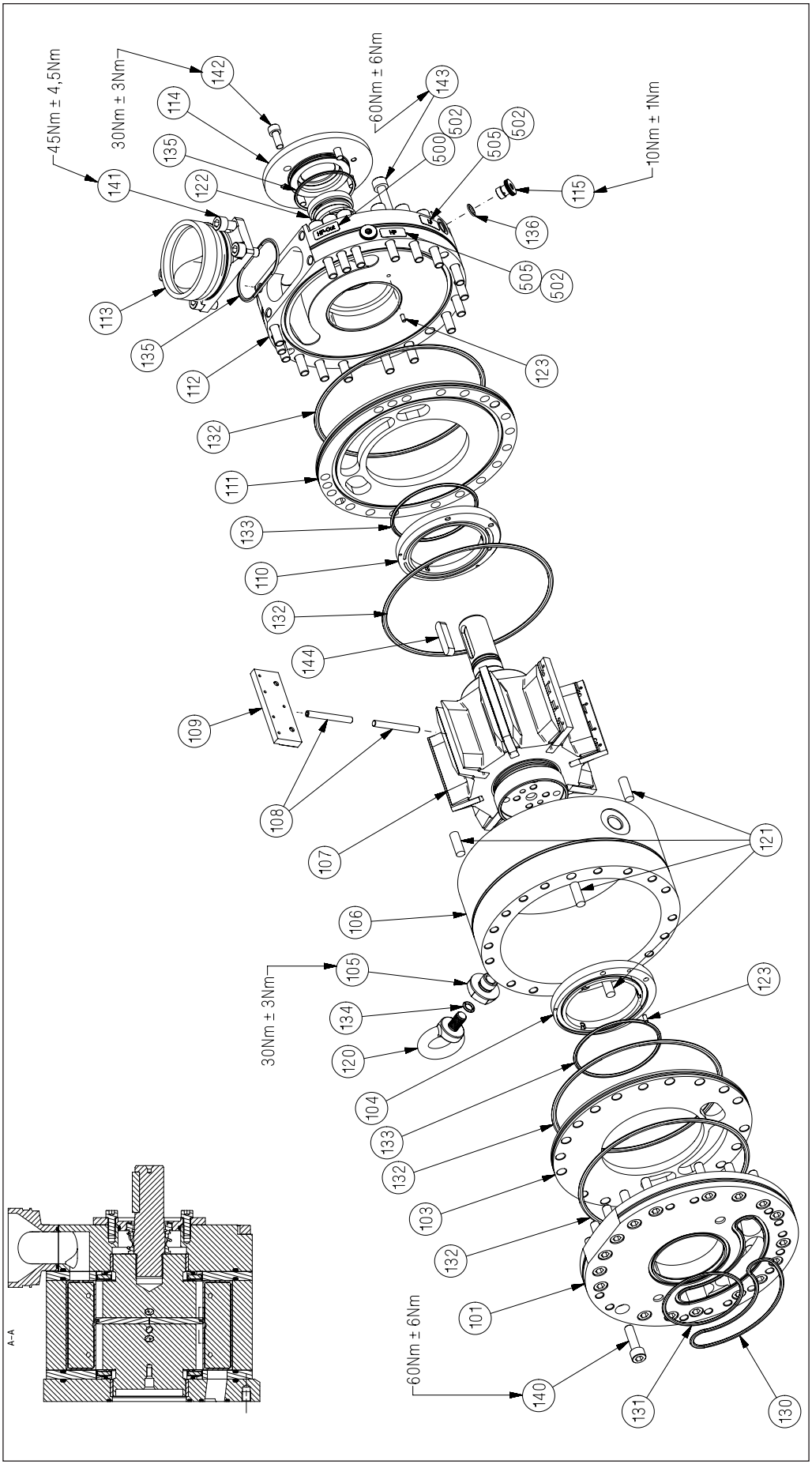
Exploded view, see 10.5.11 page 42.

Pos.	Qnt.	Designation	Material	180Z0246 Coupling kit
1	1	iSave 180F7011	Super Duplex	
2	1	Bell housing	Aluminium	
3	1	Electric motor	Aluminium or cast iron	
4	2	Foot for base plate	AISI 316	
5	1	Base plate		
6	1	Coupling	Aluminium/polymer	x
7	4	Bolt, M12 x 25	AISI 316	
8	4	Washer	AISI 316	
9	1	Bolt, M12 x 30	AISI 316	
10	4	Washer	AISI 316	
10	4	Bolt, M16 x 40	AISI 316	
11	4	Washer	AISI 316	
13	1	Plug	Polymer	

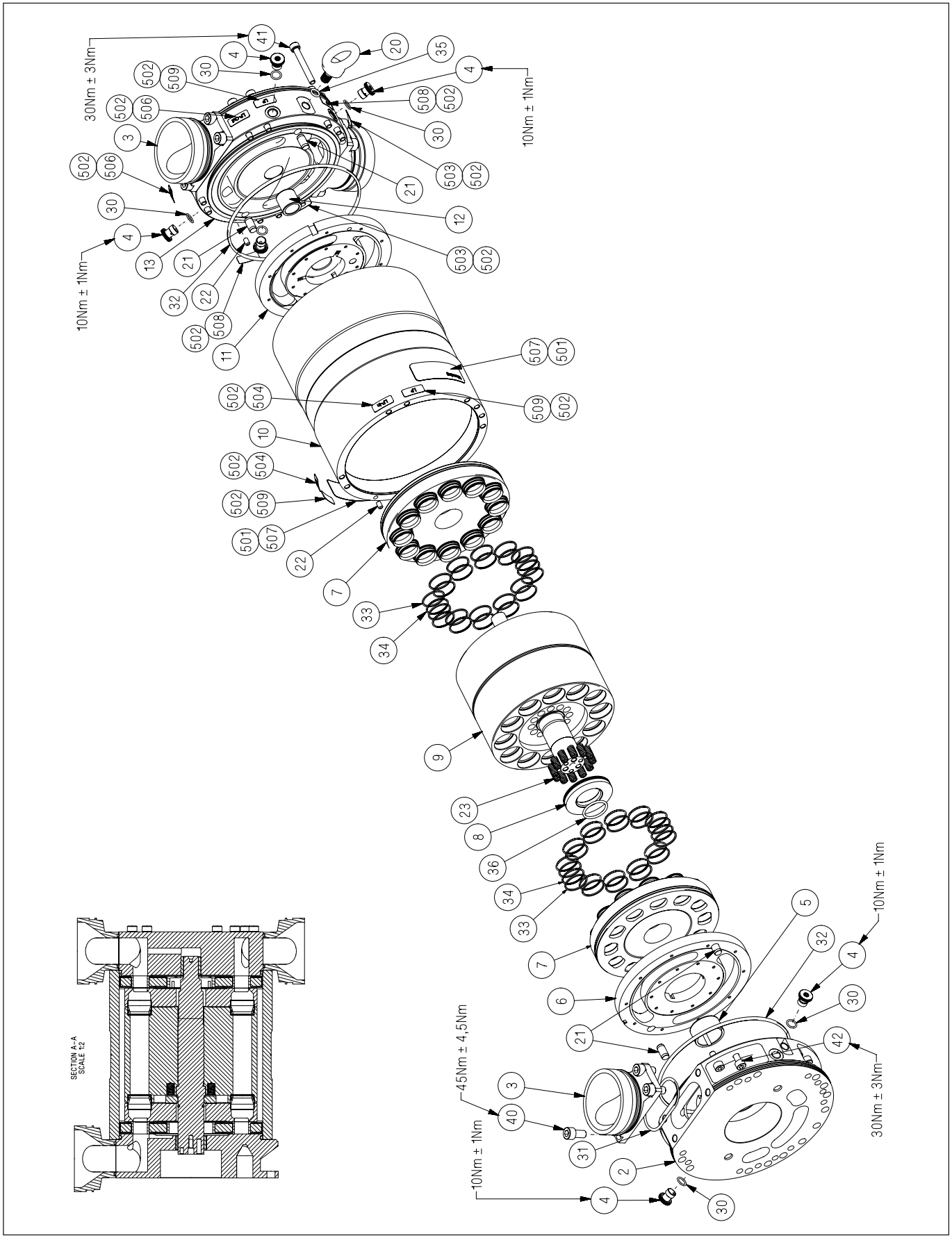
10.5.6 Tool kit

Qnt.	Designation	180F4112 Tool kit
1	Press bush shaft seal	X
1	Bolt, M6 x 45	X
1	Nut, M6	X
1	Handle	X
3	Press bushes for valve plate	X
1	Allen key, 6 mm	X
1	Allen key, 8 mm	X
1	Fork wrench, 24 mm	X

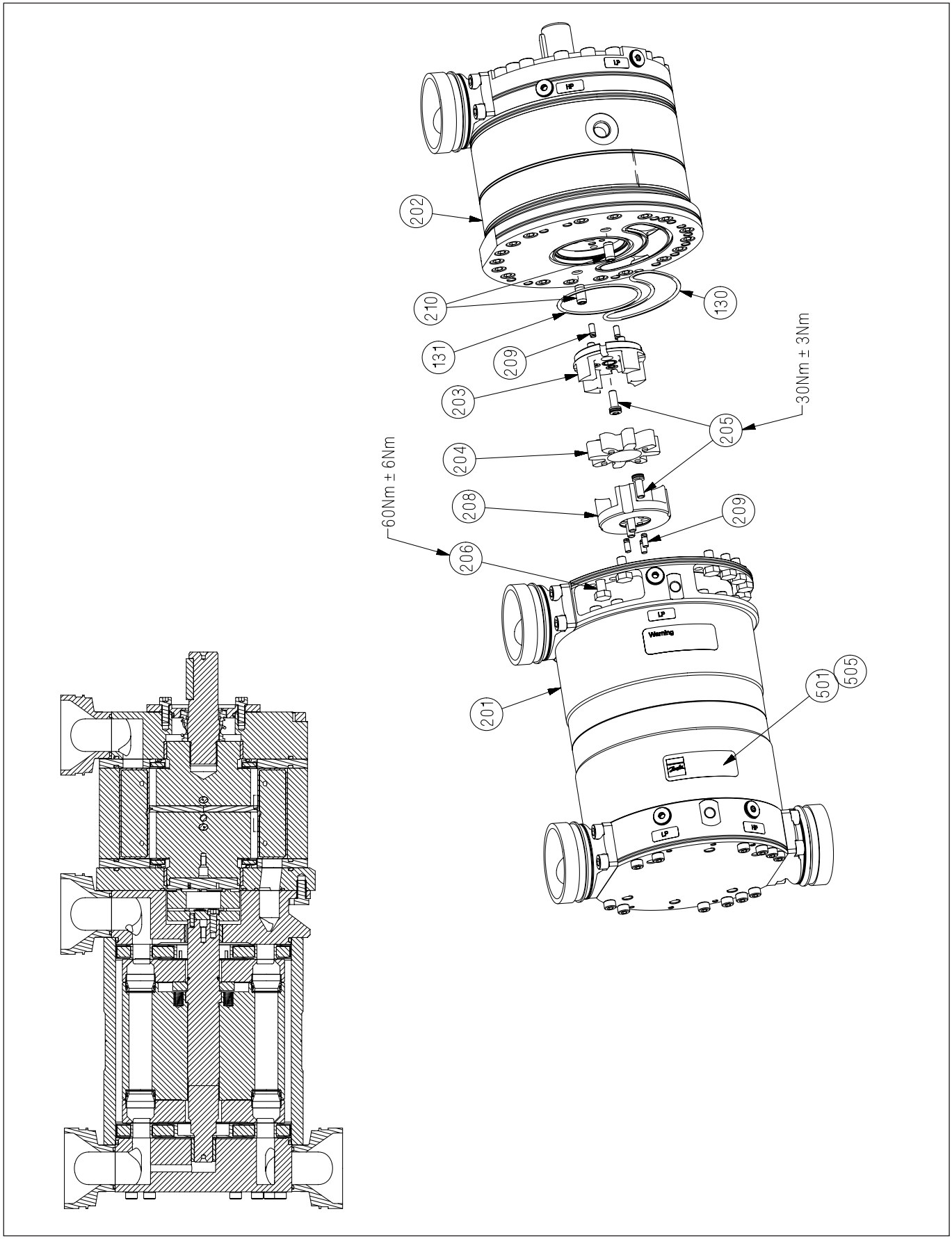
10.5.7 Exploded view vane pump



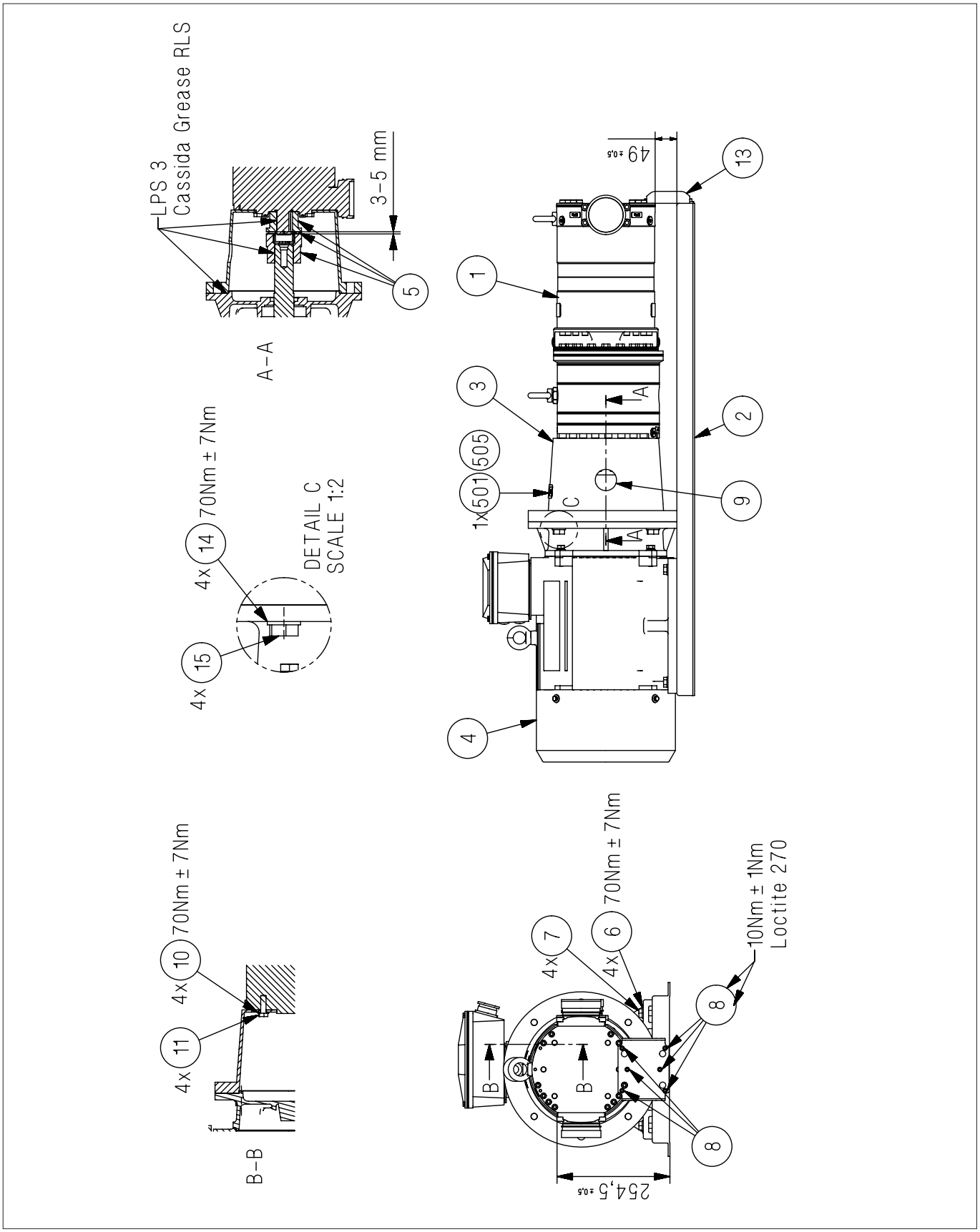
10.5.8 Exploded view pressure exchanger



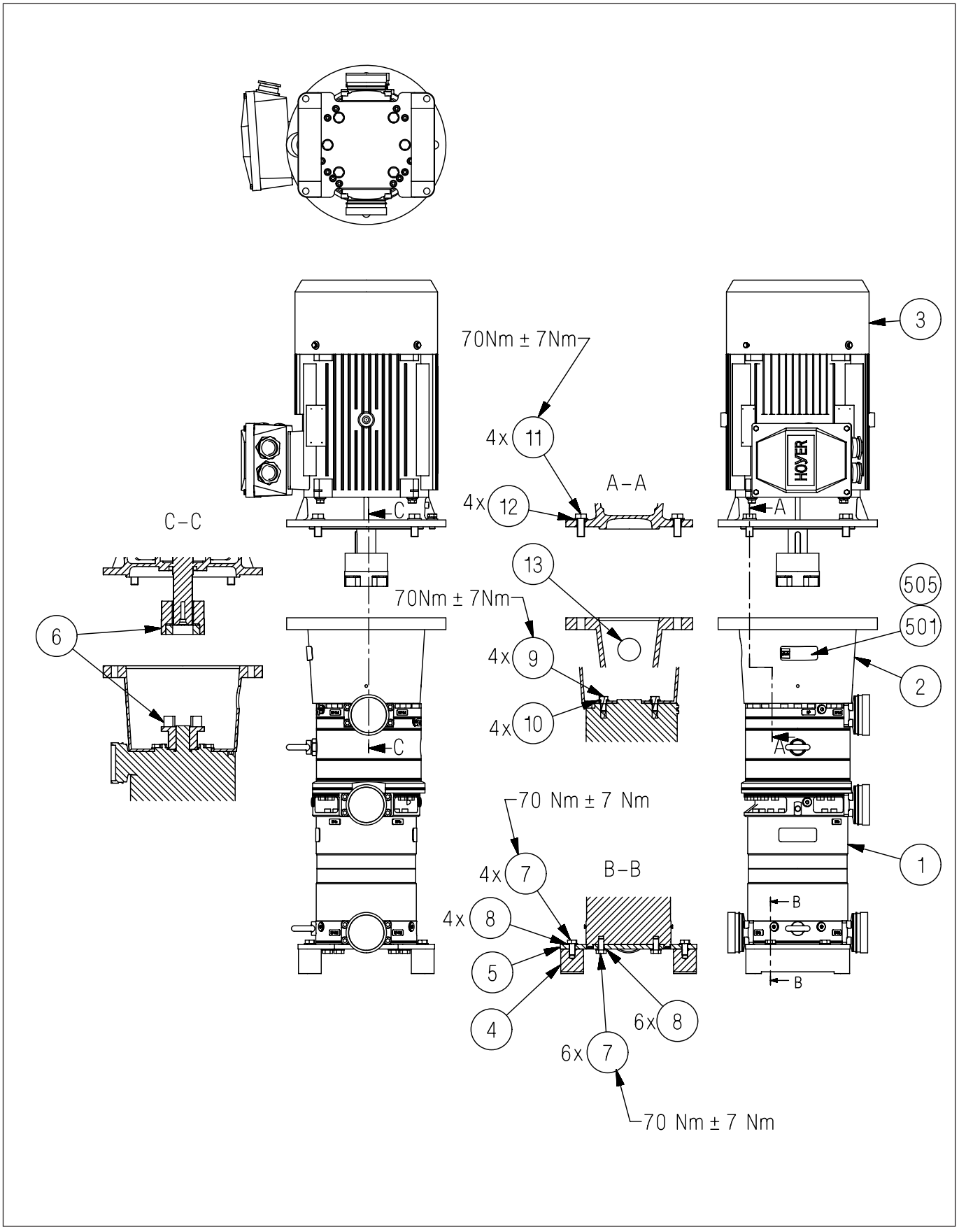
10.5.9 Exploded view iSave



10.5.10 Exploded view iSave on base plate, horizontal



10.5.11 Exploded view iSave on foot, vertical



10.6 iSave overload protection and VFD settings

Protection by VFD
For full protection on both the iSave and the electric motor, one VFD can be used for each iSave. See electrical schematic diagram on next page.

The Danfoss FC 300 Series can provide the speed control and overall protection of both the electric motor and the mechanical parts in the iSave.

Alternative one VFD can control the speed of several iSaves. But the overload protection of the electric motors and torque limitations on the iSaves must be provided by additional equipment. This can be done by "current monitoring relays", see page 46.

Danfoss FC 300 parameter setup
For detailed information of the VFD see the operation instruction supplied together with the VFD.

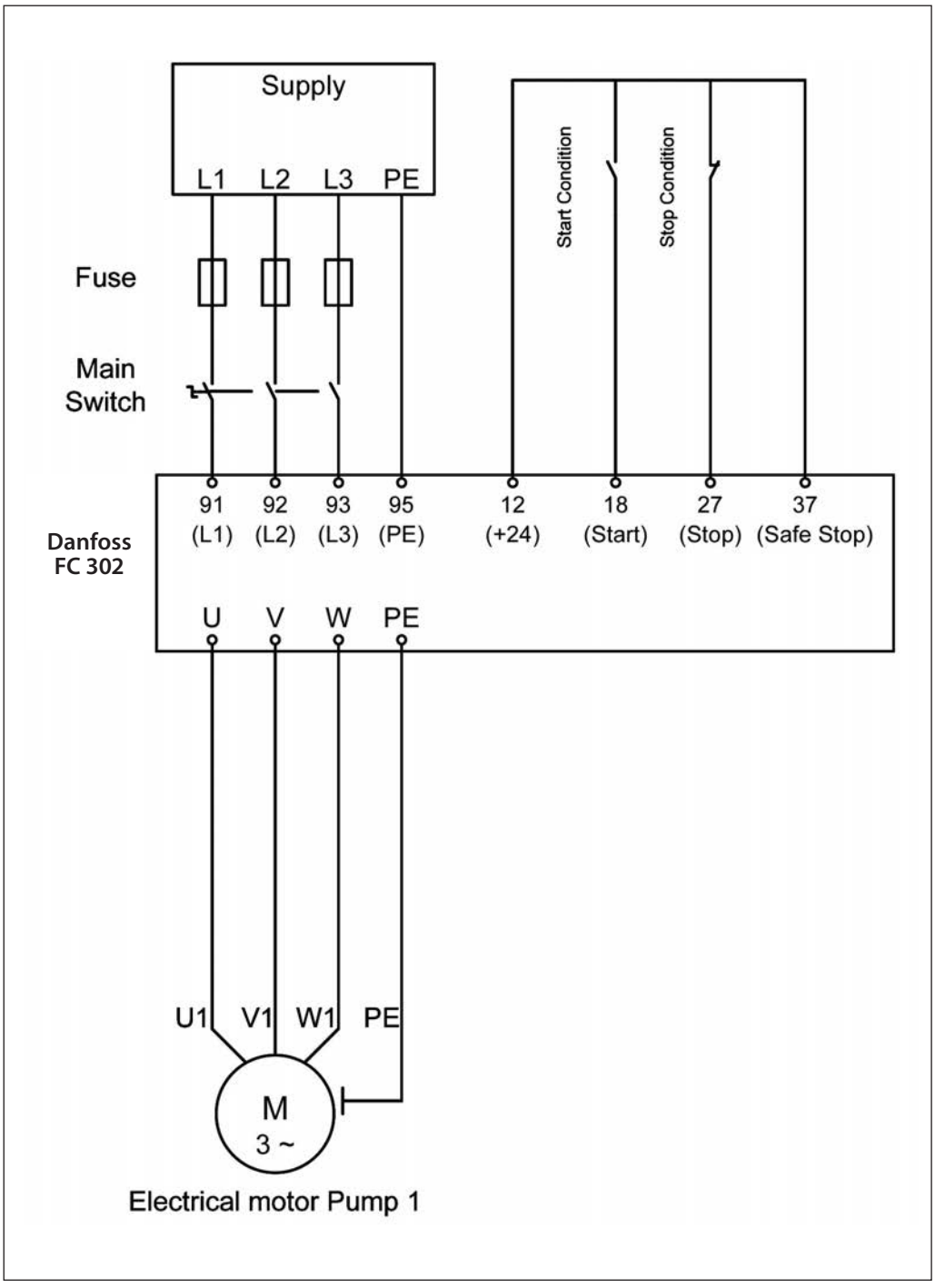
At initial start up of the VFD run the "Initialisation" parameter settings and the following parameters:

Par. no.	Parameter description	Set value
341	Ramp up	3-15 seconds
342	Ramp down	3-15 seconds
413	Motor speed, high limit	1,200 rpm
416	Torque limit motor	140% [1]
419	Max output	65 Hz

[1] Torque limit must be calculated according to maximum torque of the iSave.
See section 3.3.

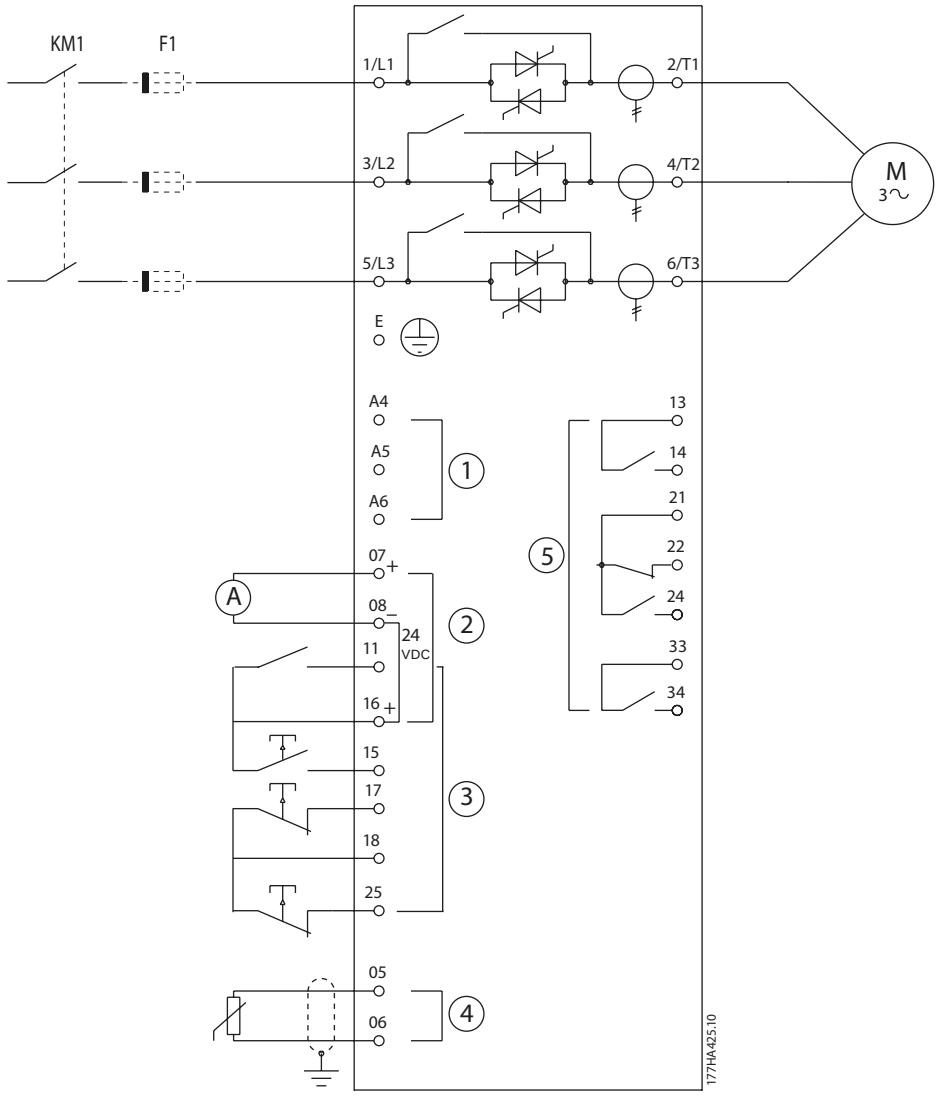
10.6.1 Danfoss FC 300 Series with one iSave

Electrical schematic diagrams according to EN60204-1.



10.6.2 Danfoss Soft Starter MCD 500

Electrical schematic diagram



1	Control supply (model dependent)
2	Outputs
07, 08	Programmable analog output
16, 08	24 VDC output
3	Remote control inputs
11, 16	Programmable input
15, 16	Start
17, 18	Stop
25, 18	Reset
4	Motor thermistor input (PTC only)
5	Relay outputs
13, 14	Relay output A
21, 22, 24	Relay output B
33, 34	Relay output C

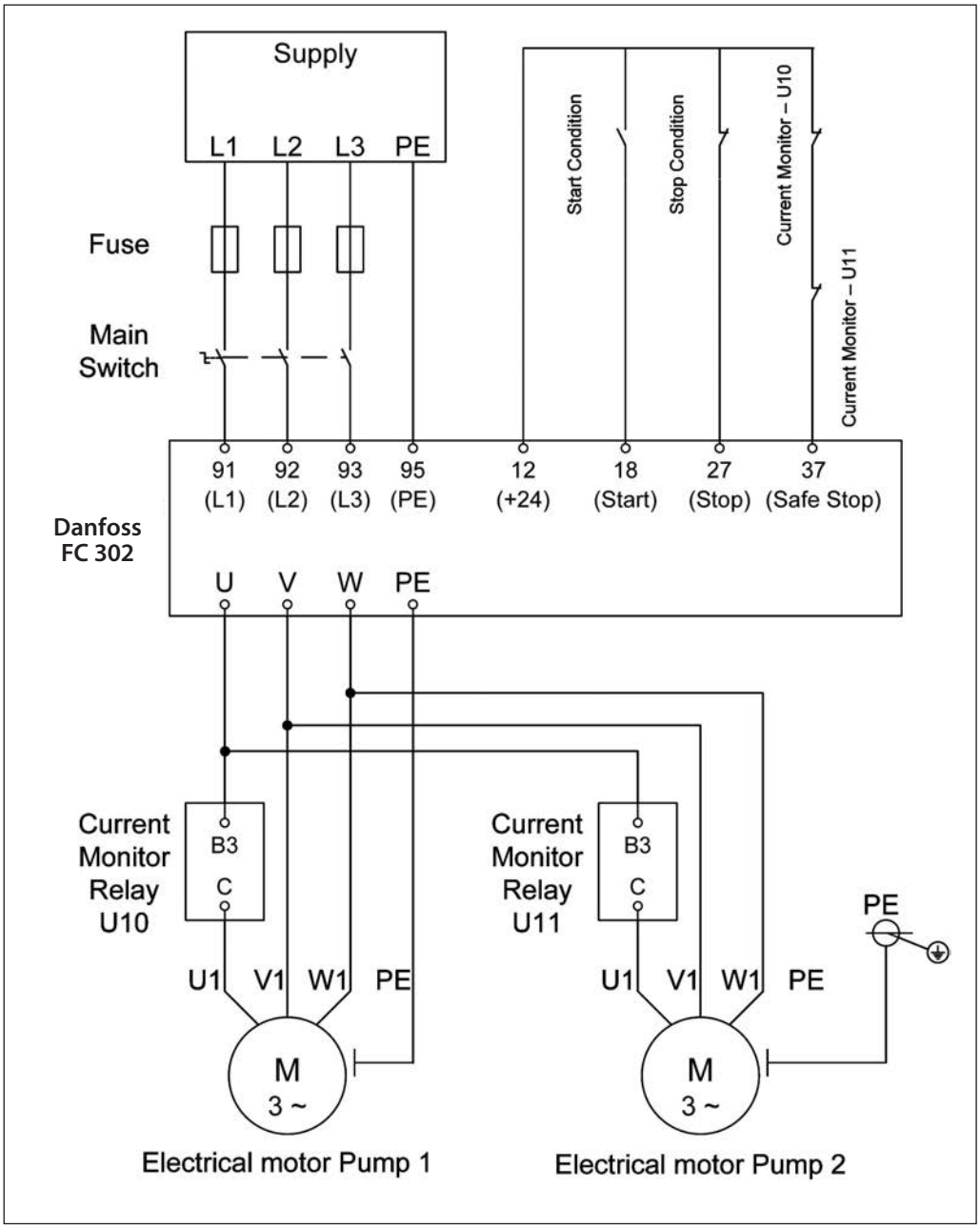
10.6.3 Protection by current monitoring relays

The current monitoring relay constantly measures the current in an electrical wire. The current is indirectly reflecting the torque on the electric motor. If the measured value exceeds the adjusted threshold value the relay sends a signal to a main switch that cuts of the power to the electric motor.

When using a current monitoring relays together with a VFD attention must be on choosing a VFD compatible relay.

10.6.4 Danfoss FC 302 with two iSaves

Electrical schematic diagrams according to EN60204-1.



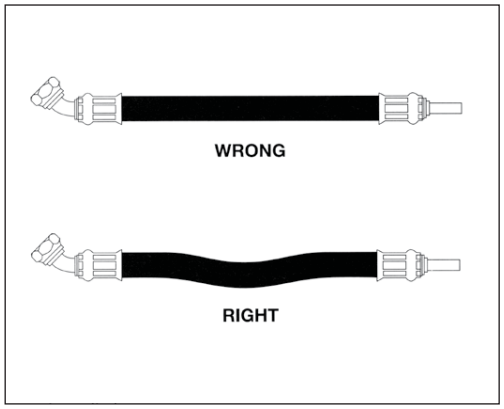
10.7 Hose assembly and installation

Correct hose installation is essential for satisfactory performance. A too long hose will involve extra costs, and the installation will appear disorganized. Too short hose connections will not allow adequate flexing and length variations required for expansion or contraction, and the hose service life will thus be reduced.

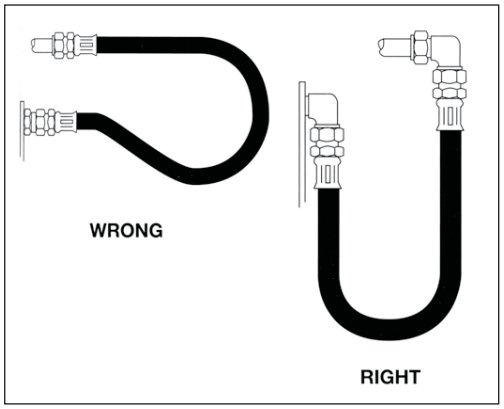
The following diagrams show correct hose installations providing maximum performance and cost savings.

Check with these examples when fixing the length of a specific assembly.

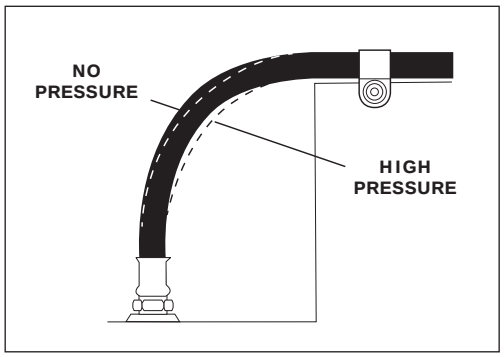
Allow the hose to slacken at straight hose installations to provide for length variations when applying pressure.



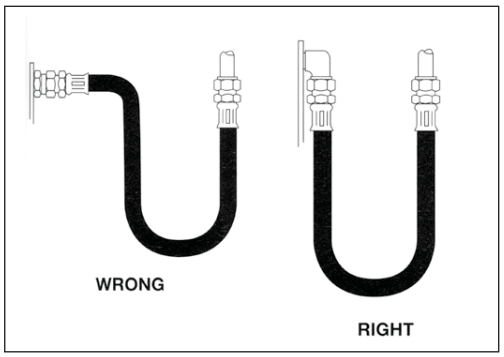
At radius below required minimum, angle adaptor must be used to prevent sharp bends.



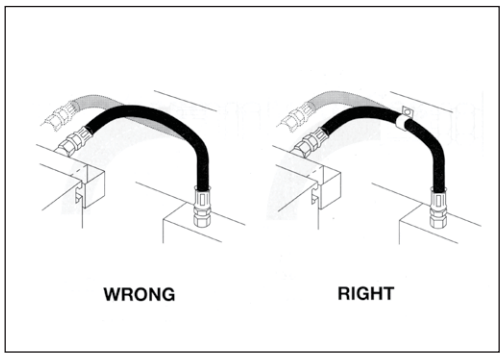
To allow hose to expand when pressurized, clamps should not be used at bends. Do not clamp high and low pressure lines together.



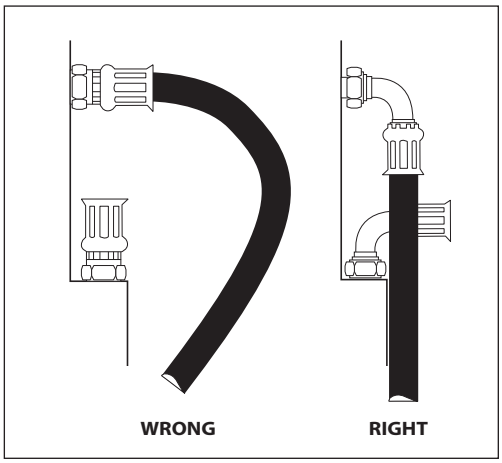
Use proper angle adaptors to avoid sharp twist or bend of hose.



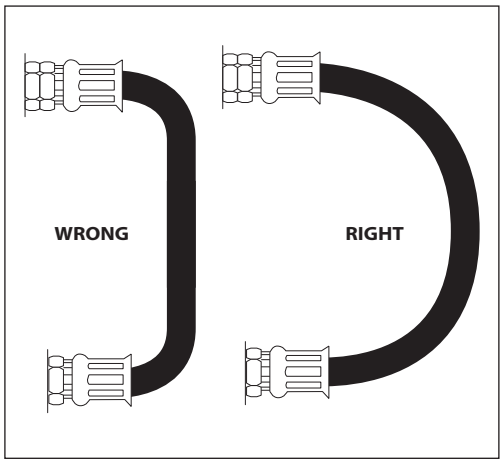
Hoses required bent over two planes must be clamped at change of plane to prevent twisting.



Elbows and adaptors should be used to relieve strain on the assembly and to provide well-organized installations to facilitate access for inspection and maintenance.

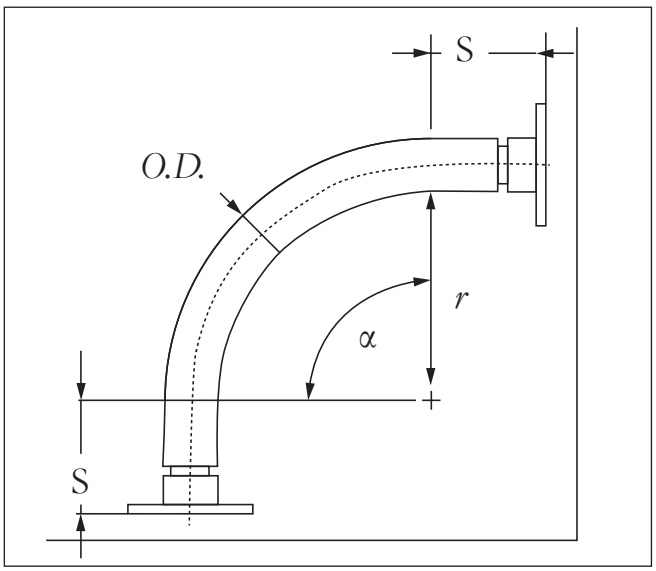


To prevent hose collapse and flow restriction, hose bend radii should be kept as large as possible. Refer to hose specification tables for minimum bend radii.



Hose specification tables:

O.D.	S		r		Max. pressure	
inch	mm	inch	mm	inch	bar	psi
1	79	3.11	152	6.08	82	1,189
1.5	85	3.35	250	9.84	82	1,189
2	115	4.53	630	24.80	80	1,160
3	150	5.90	300	11.80	80	1,160
2	89	3.50	170	6.70	6	87
3	116	4.57	170	6.70	6	87
3	116	4.57	180	7.09	20	290



10.8 Service instructions - Disassembling and assembling

10.8.1 General information

This document illustrates instructions for disassembling and assembling the iSave 40.

To understand the design of the iSave, see exploded views starting on page 21.

Always use suitable lifting equipment.

Important!
It is essential that the iSave is serviced in conditions of absolute cleanliness.

- The weight of the iSave, including electric motor, is about 260 kg (573 lb).
- The weight of the pressure exchanger alone is about 75 kg (165 lb).
- The weight of the booster pump alone is about 50 kg (110 lb).

Tools needed to disassemble the iSave:

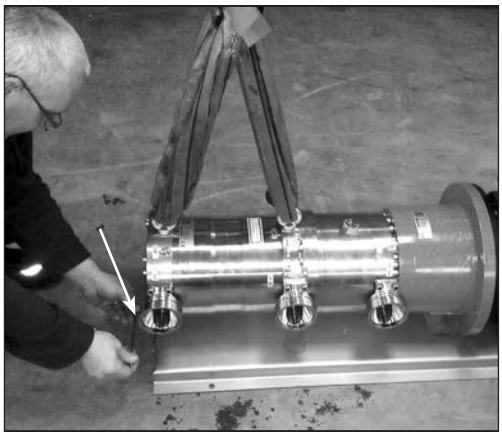
Parts included in tool set (180F4112):
- 6 mm and 8 mm allen key
- C-wrench 24 mm
- 1 M6 bolt and nut
- Handel for rotor assembly
- Tool for shaft seal assembly
- Tool for retainer assembly
- 3 press bolt-set for valve plate assembly

Parts not included in tool set:
- 2 screwdrivers
- Torque wrench 10-60 Nm

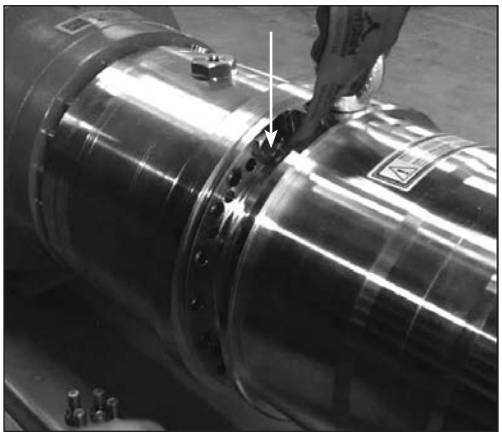
To prevent cold welding, lubricate threads of the screws with PTFE lubrication type and screw them into the component and tighten by hand.

10.8.2 Disconnect the iSave from electric motor

1. Apply a light lifting force on the pressure exchanger and disconnect the support bracket between the pressure exchanger and base plate.

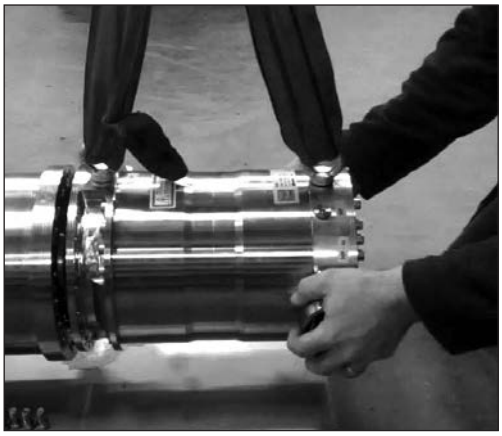


2. Unscrew 10 bolts in the adapter flange between booster pump and pressure exchanger. Leave the 2 upper bolts tighten.

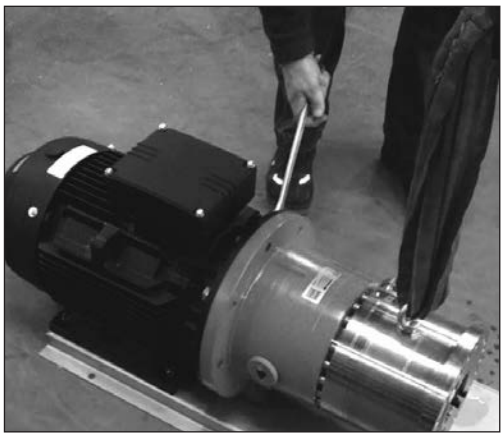


3. Unscrew the 2 upper bolts.

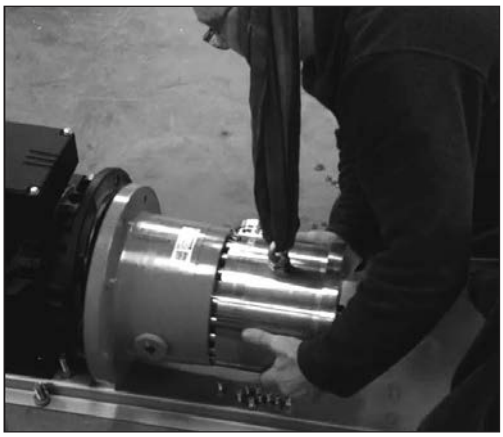
4. Carefully pull and lift the pressure exchanger from the booster pump.



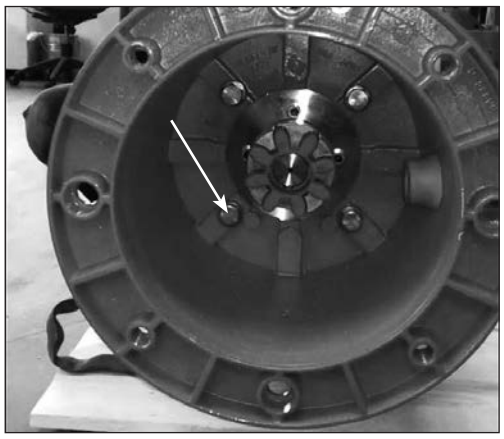
5. To disconnect the bell housing, unscrew the 4 bolts on the electric motor.



6. Carefully pull and lift the booster pump from the electric motor.

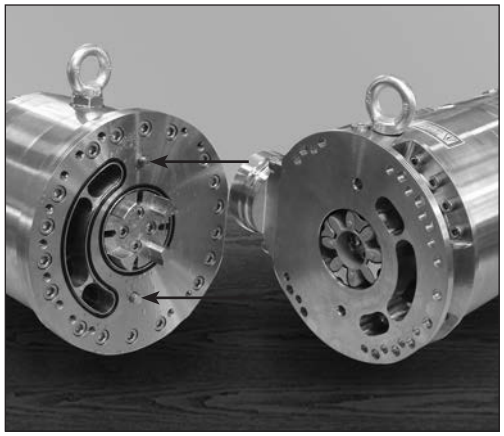


7. Disassemble the bell housing from the booster pump by unscrewing the 4 bolts in the bell housing.



8. It is also possible to disconnect the complete unit from the motor first. In this case, please follow step 1, 5, 6 and 7 afterwards.

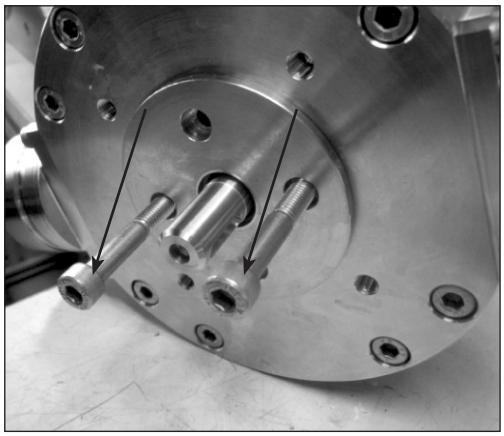
9. After the pressure exchanger is released from the booster pump, remove the two guide pins.



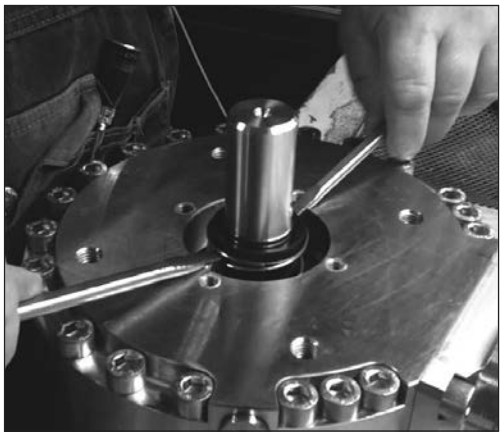
10.8.3 Disassembling the booster pump

1. Disassemble the flange for shaft seal.

If flange cannot be removed easily, use two M8 bolts.

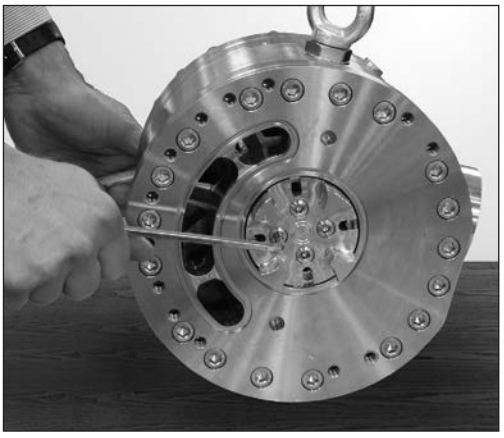


2. Wet the shaft seal first with clean filtered water. Carefully lift the shaft seal by using 2 screwdrivers.

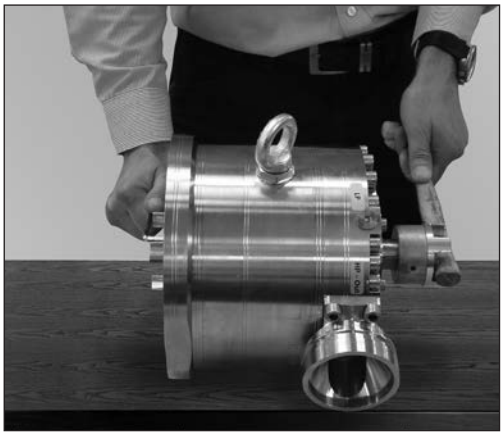


3. If coupling has to be changed, follow the next two steps.

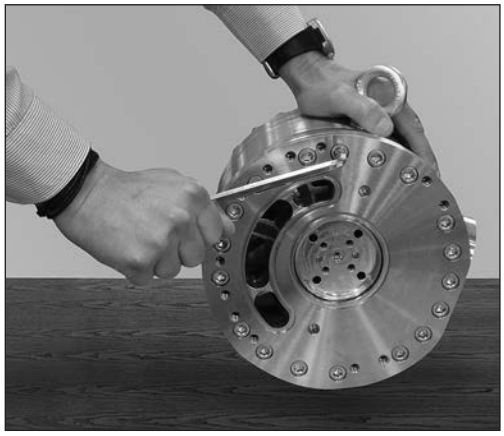
4. Unscrew the 4 coupling bolts. Use a hammer handle at the opposite end to prevent the shaft from turning.



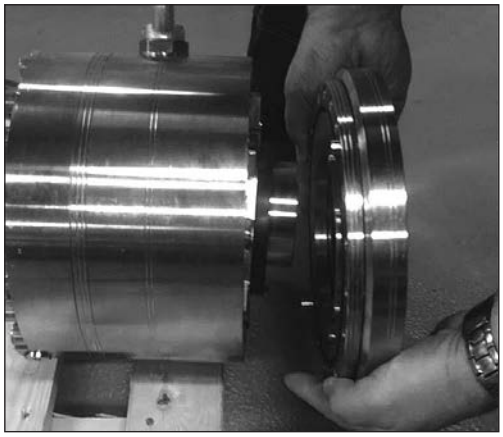
5. Remove coupling and the two pins.



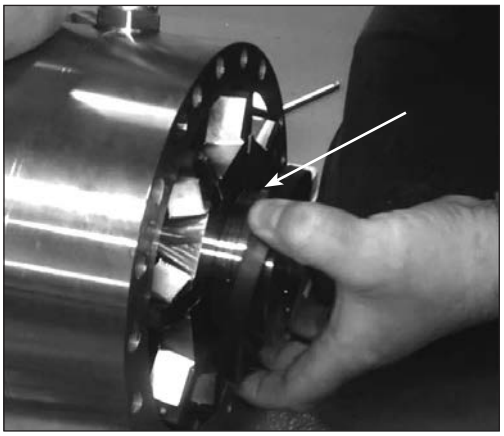
6. Loosen all the bolts in the adapter flange.



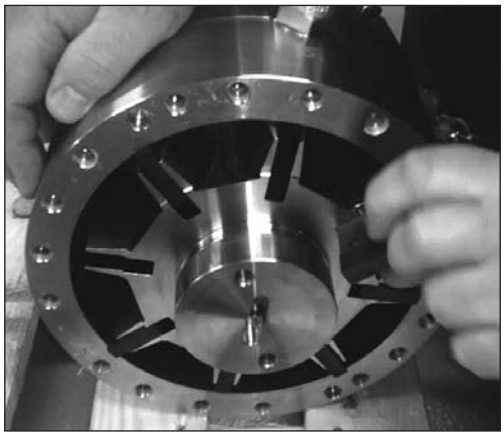
7. Carefully disassemble adapter flange and port plate from the stator ring.



8. Remove the sealing plate.



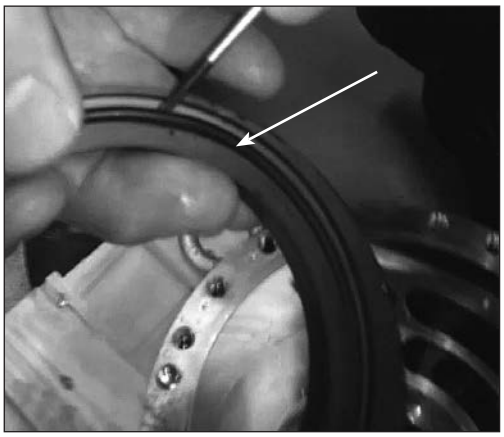
9. Remove the 8 vanes.



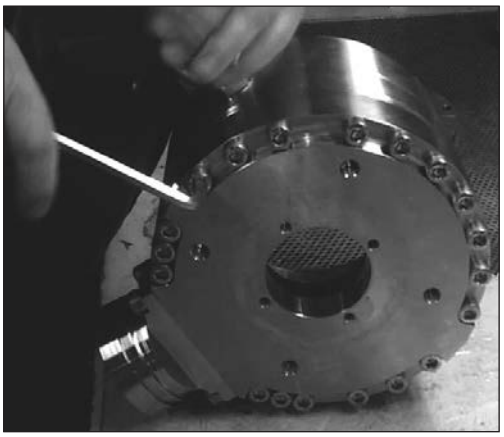
10. Carefully guide the rotor out of the stator.

11. Remove the sealing plate and pin.

12. Remove the O-ring from the sealing plate.



13. Unscrew the bolts in the outlet flange.



14. Remove the HP outlet flange.

15. Remove the port flange.

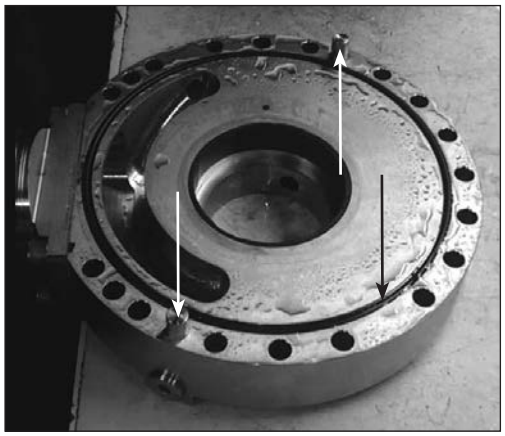
10.8.4 Assembling the booster pump

WARNING:
Do not use silicone when assembling the iSave. Do not reuse disassembled O-rings; they might be damaged. Always use new O-rings.

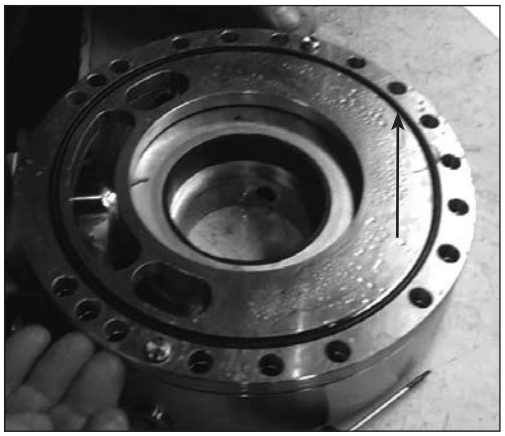
Important:
It is essential that the pump is serviced in conditions of absolute cleanliness. All parts must be absolutely clean before mounting.

Lubrication:
- To prevent seizing-up, lubricate all threads with PTFE lubrication type.
- It is important to lubricate ALL parts to be assembled with clean filtered water (Especially all PEEK parts).

1. Place the HP outlet flange on the desk and mount the O-ring and 2 pins.

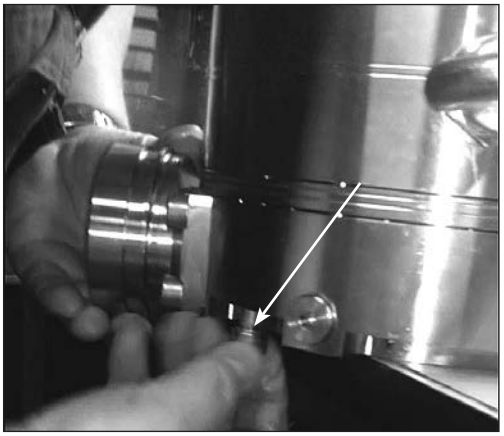


2. Align the port plate-out on the two pins and mount the O-ring on the port plate.



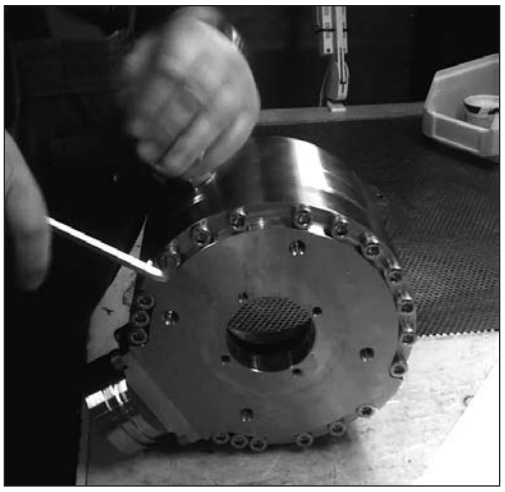
3. Turn the stator with the two identification rings closest to the port plate and position the stator on the 2 pins.

4. From down side up and by hand, screw in two bolts in the stator.



5. Tighten the bolts by using an allen key.

6. Tilt the flange and stator; assemble and screw in the rest of the bolts in the flange. Tighten bolts to a torque of 60 ±6 Nm.



7. Assemble and position the two pins in the pin holes.

9. Mount the O-ring in the sealing plate and guide pin in flange.

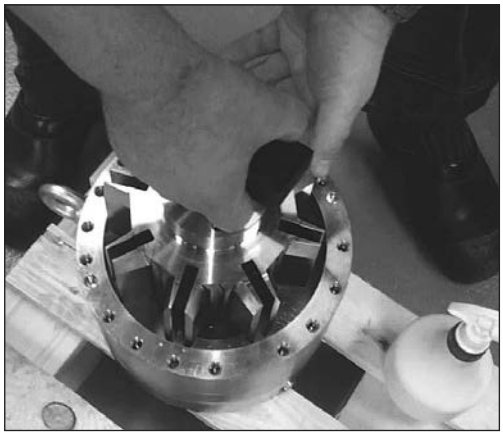
It is important to lubricate to ensure the O-ring does not drop out.

10. Position the sealing plate on the guide pin.

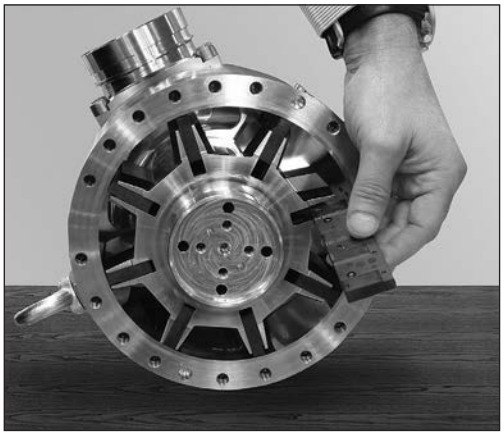
    Ensure correct choice of sealing plate.
    Only one sealing plate fits the guide pin.

11. Position the 8 pins in the rotor. 2 pins in each hole.

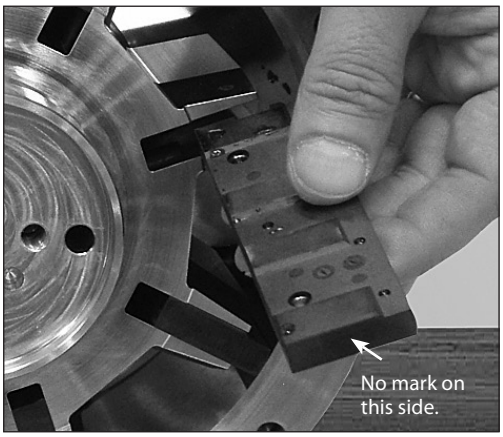
12. By using the handle tool provided, carefully lever the rotor into the stator.



13. Fit the 8 vanes into each slot. Notice vane position. Place the straight site of the vane onto the pin with the mark downward.

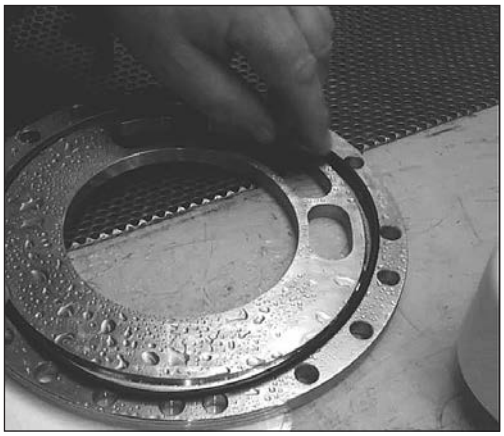


14. Orient the vanes with correct end into rotor. See the arrow below.



15. Assemble the new O-ring on the adapter flange.

16. Assemble the new O-ring on the port plate-in.

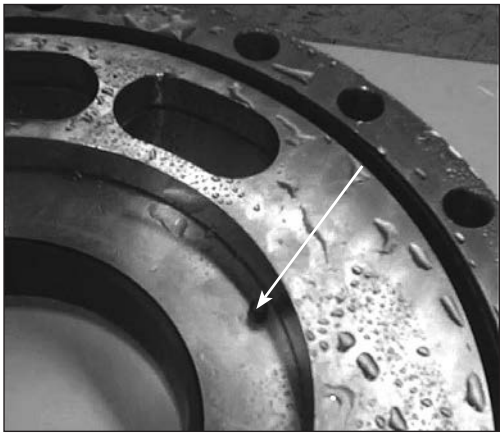


17. Position the port flange in on the adapter flange and position the two guide pins.

18. Assemble the new O-ring on the correct sealing plate.

It is important to lubricate to ensure the O-ring does not drop out.

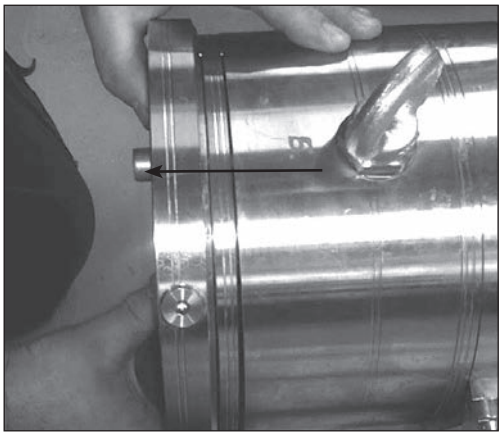
19. Position the guide pin in the adapter flange.



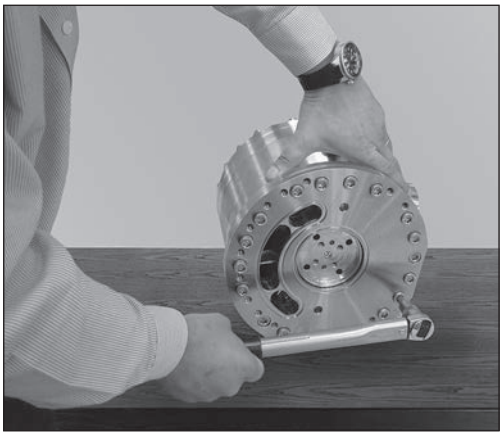
20. Position the sealing plate over the guide pin.

21. Carefully position the adapter flange assembly into the two guide pin holes.

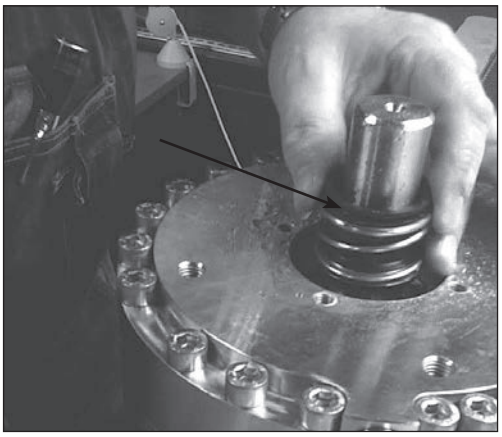
22. Mount two bolts in the adapter flange.



23. Mount all bolts in the adapter flange. Tighten the bolts to a torque of 30 ±3 Nm.



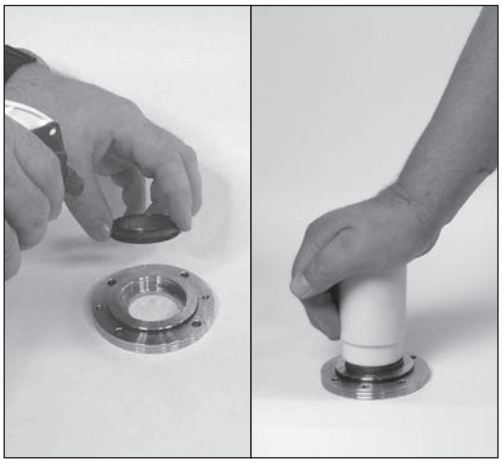
24. Turn the pump with shaft upwards. Lubricate the shaft and shaft seal with clean filtered water. Mount the shaft seal with the carbon ring upwards.



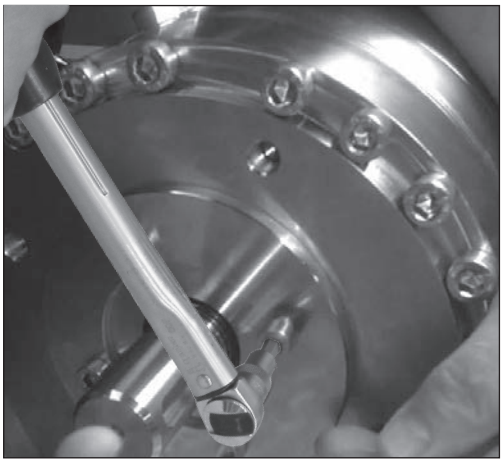
25. Using the shaft tool provided, carefully press down the shaft seal to the shoulder of the shaft.

26. Lubricate and press new ceramic ring into the shaft seal cover by using the press bush tool.

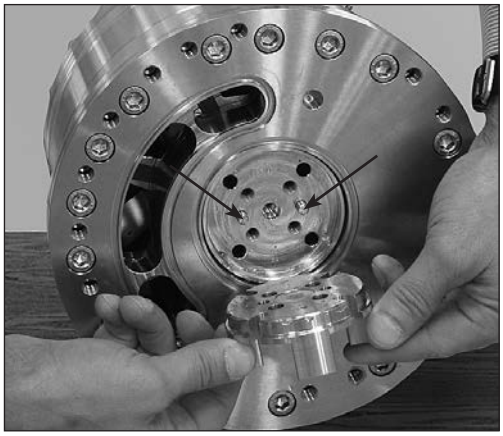
WARNING:
Ensure that the face with rubber seal is positioned against shoulder in shaft seal flange.



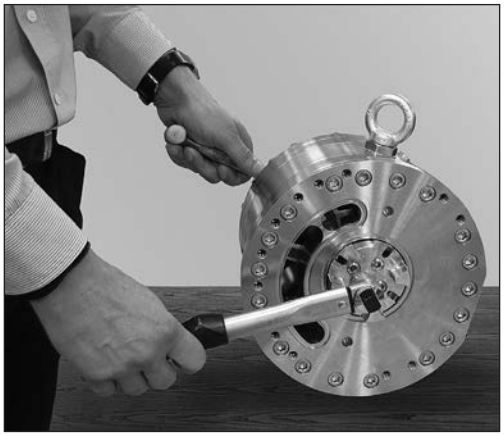
27. Mount a new O-ring on the flange for shaft seal and assemble the minor flange on top of the flange. Tighten bolts to a torque of 30 ±3 Nm.



28. Mount the two pins and the coupling part.

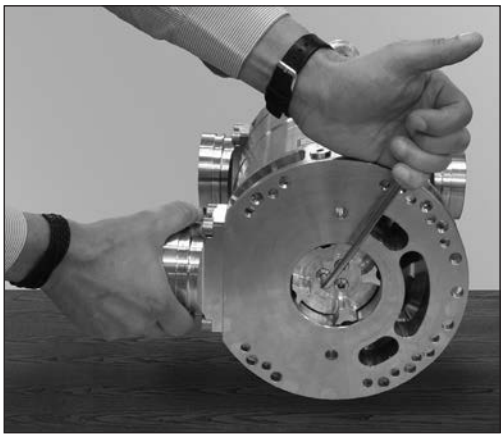


29. Mount the four bolts and tighten them to a torque of 30 ±3 Nm.

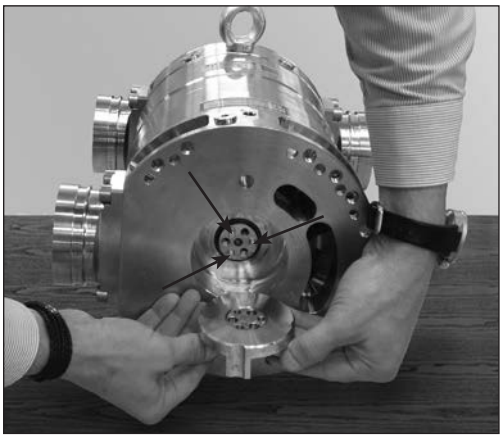


10.8.5 Disassembling the pressure exchanger

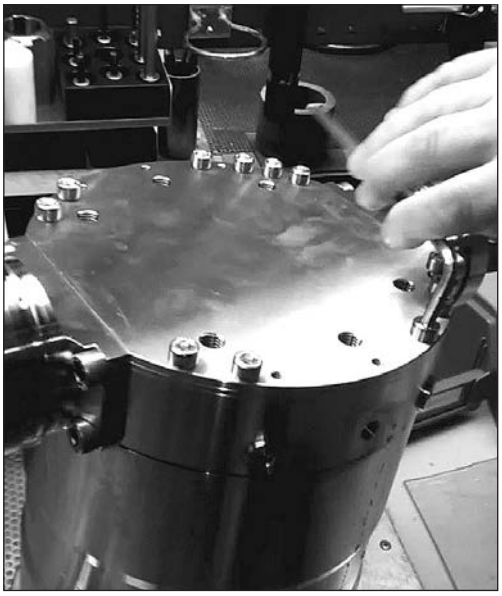
1. Unscrew the 3 coupling bolts.



2. Remove coupling and the 3 pins.



3. Unscrew all the bolts.

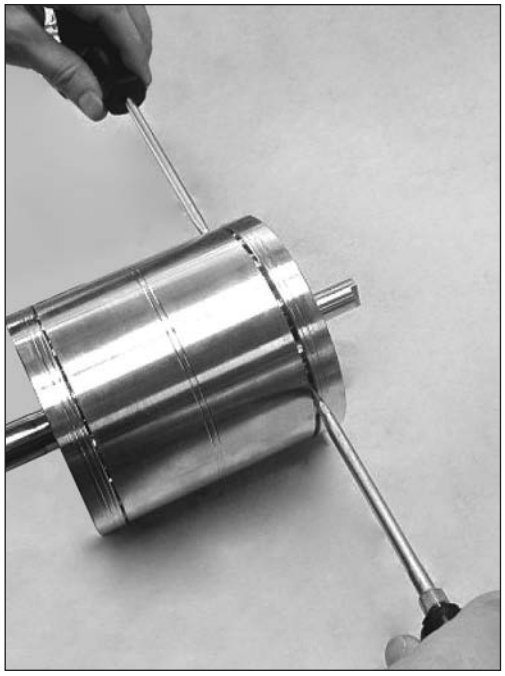


4. Carefully lever the flange and port plate from the casing.

5. Carefully take the cylinder barrel assembly out of the casing.

6. Remove port plate and the two pins.

7. Carefully lever the 2 valve plate assembly free with help from 2 screwdrivers.



10.8.6 Assembling the pressure exchanger

WARNING:
Do not use silicone when assembling the iSave. Do not reuse disassembled O-rings; they might be damaged. Always use new O-rings.

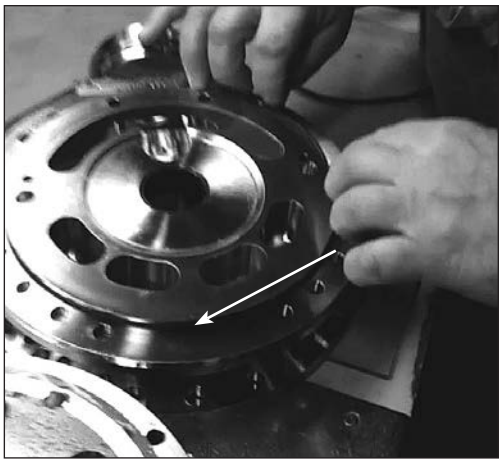
Important:
It is essential that the pump is serviced in conditions of absolute cleanliness. All parts must be absolutely clean before mounting.

Lubrication:
- To prevent seizing-up, lubricate all threads with PTFE lubrication type.
- It is important to lubricate ALL parts to be assembled with clean filtered water (Especially all PEEK parts).

Assembling cylinder barrel in pressure exchanger, see page 19.

Follow step 1-3 if LP in flange has been disassembled from casing.

1. Assemble the O-ring on the LP in port flange.

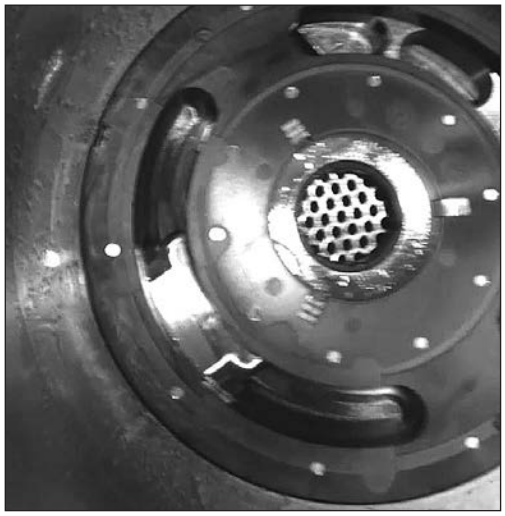


2. Position the guide pin into the casing.

3. Position the LP in flange on the guide pin and assemble all the bolts into the casing. Tighten the bolts to a torque of 30 ±3 Nm.

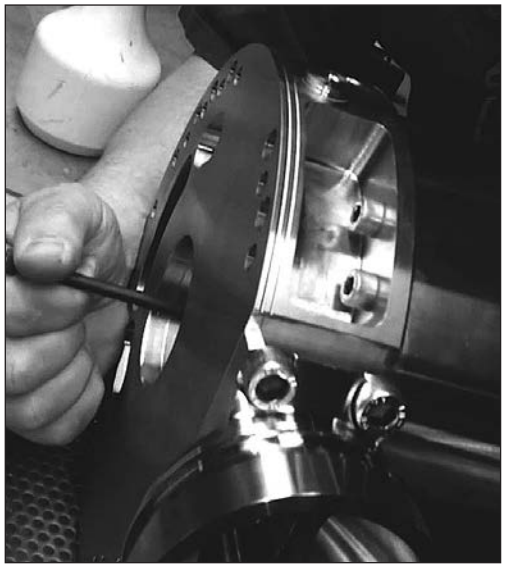
4. Turn the assembly and position the two guide pins in the flange inside the casing.

5. Position the port plate on the flange using the two guide pins as guide. Only one port plate fits.



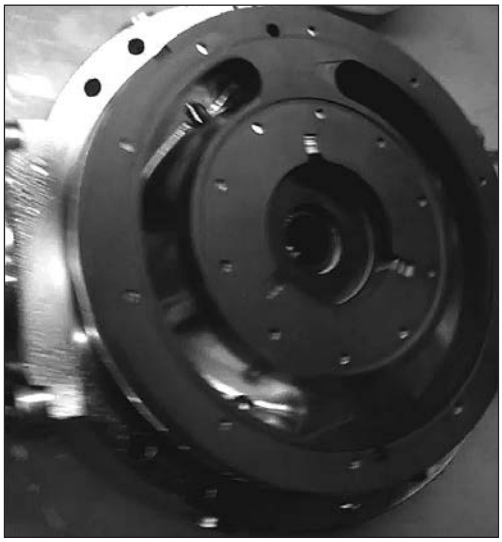
6. Mount the provided M6 threaded rod into the shaft of the cylinder barrel.

7. Carefully guide the cylinder barrel into the flange bearing.



8. Assemble the O-ring on the HP/LP flange and position the two guide pins into the flange.

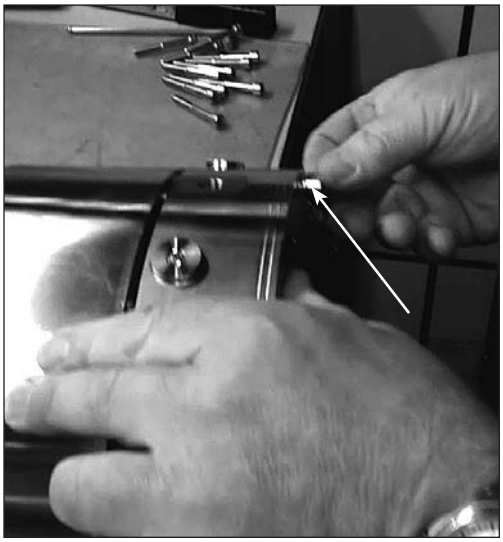
9. Position the port plate on the HP/LP flange using the two guide pins as guide. Only one port plate fits.



10. Position the guide pin into the casing.

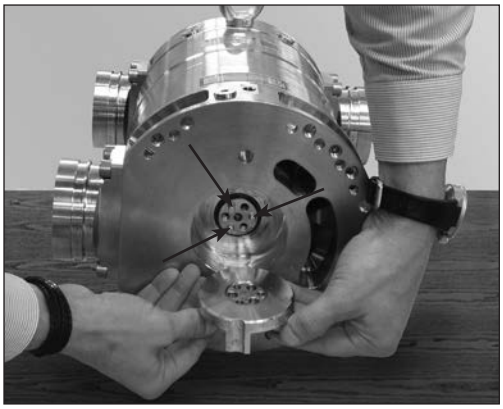
11. Carefully position the flange assembly onto the guide pin in the casing.

12. Carefully assemble a bolt into the casing to ensure that flange assembly stay in place.

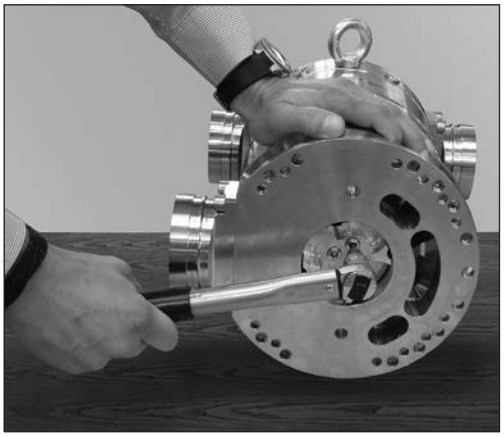


13. Assemble all the bolts and tighten them to a torque of 30 ±3 Nm.

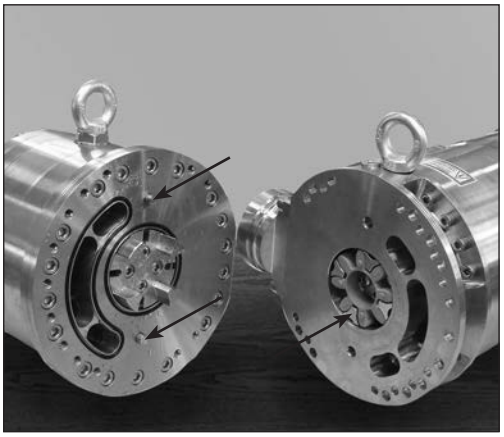
14. Mount the 3 pins in shaft and place the coupling part.



15. Tighten the bolts to a torque of 30 ±3 Nm.



16. Assemble booster pump and pressure exchanger. Mount the two guide pins and coupling spacer.

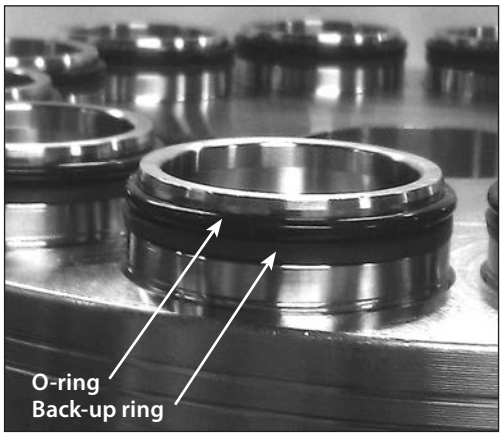


17. Tighten bolts to a torque of 60 ±6 Nm.

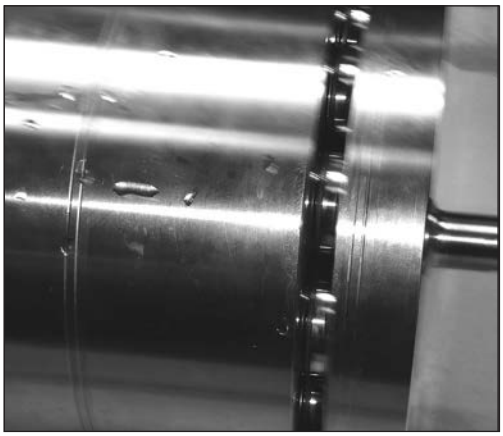
10.8.7 Assembling the cylinder barrel in pressure exchanger

The shaft is normally not a wear part and can only be changed by Danfoss.

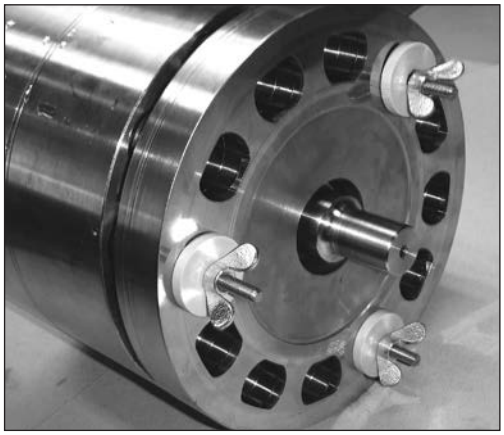
1. Assemble back-up rings and O-rings on the valve plates. Back-up rings first.



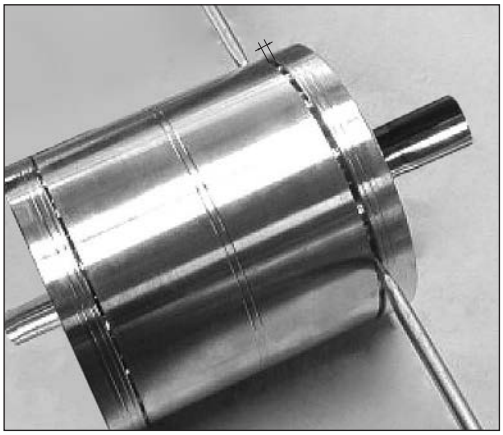
2. Lubricate the O-rings and back-up rings with clean filtered water and position the two valve plates into the rotor ends.



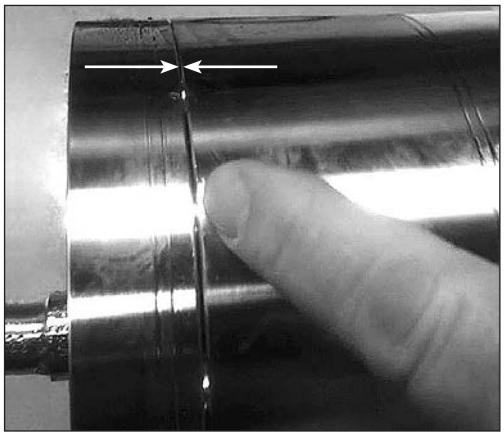
3. Using the tools provided gently screw in the valve plates.



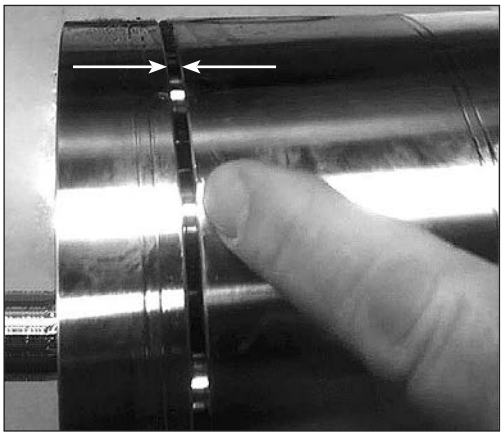
4. Check the distance between the two valve plates and the cylinder barrel. Adjust the distance if necessary.



Small shaft diameter: No distance.



Large shaft diameter: Distance 4-5 mm.



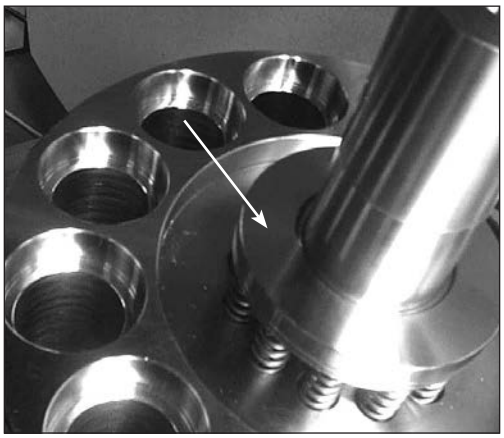
10.8.8 Changing spring in the rotor

It is basically not necessary to change the springs in the rotor. If needed, follow the guidelines below:

8.1 Disassembling
Using the tool provided, press down the retainer and remove/cut the O-ring, and remove retainer.

1. Replace springs in the rotor.

2. Assemble the retainer over the springs.



3. Assemble the O-ring over the retainer.

4. Using the tool provided, press down the retainer by tightening the nut until the O-ring is placed in the recess.

5. Carefully lever the bolt and tool assembly and check the O-ring assembly.

Electric Motors

Motor Manual

hoyermotors.com

HOYER MOTORS

1. General

This manual concerns the following types of standard induction motors from Hoyer:
HMA2, HMC2, HMD, HMT, MS, Y2E1, Y2E2, YDT
These motors are manufactured in accordance with IEC/EN 60034-4 and IEC/EN 60072.
Motors are rated for the ambient temperature range -20°C to +40°C and site altitudes ≤1000 m above sea level.
Low-voltage motors are components for installation in machinery. They are CE marked according to the Low Voltage Directive 2006/95/EC

2. Transport and storage

Check the motor for external damage immediately upon receipt and, if found, inform the forwarding agent right away. Check all rating plate data, and compare it with the requirement of the motor.
Turn the shaft by hand to check free rotation, remove transport locking if used.
Transport locking must be used again for internal transport also. It is also important that transport locking is used when motors are transported mounted on equipment.
All motors should be stored indoors, in dry, vibration- and dust-free conditions.

Lifting eyebolts must be tightened before use. Damaged eyebolts must not be used, check before use. Lifting eyes at motor must not be used to lift the motor when it is attached to other equipment.

Before commissioning, measure the insulation impedance. If values are ≤ 10M at 25°C, the winding must be oven dried. The insulation resistance reference is halved for each 20°C rise in motor temperature.
It is recommended that shafts are rotated periodically by hand to prevent grease migration.

3. Installation

The motor must be fixed on a stable, clear and flat foundation. It must be sufficiently rigid to withstand possible short circuit forces.
It is important to ensure that the mounting conditions do not cause resonance with the rotational frequency and the doubled supply frequency.
Only mount or remove drive components (pulley, coupling, etc.) using suitable tools, never hit the drive components with a hammer as this will cause damage to the bearing.
The motor are balancing with half key, ensure that the drive components are also the same.

Correct alignment is essential to avoid bearing, vibration and shaft failure.
Use appropriate methods for alignment.
Re-check the alignment after the final tightening of the bolts or studs.
Check that drain holes and plugs face downwards. We recommend opening the drain hole for motors placed outdoors and not running 24 hours / day, so that the motor can breathe, thus ensuring a dry motor.

4. Electrical connection

Work is only permitted to be carried out by qualified specialists and must to be carried out in accordance with local regulations.
Before work commences, ensure that all power is switched off and cannot be switched on again. This also applies to the auxiliary power circuits, e.g. anti-condense heaters.
Check that supply voltage and frequency are the same as rated data.
Motors can be used with a supply deviation of ± 5% voltage and ± 2% frequency, according to IEC60034-1

Connection diagrams for main supply and accessory as PTC or heater are located inside the terminal box.

Connections must be made in such a way as to ensure that a permanently safe electrical connection is maintained, both for the main supply and the earth connection.
We recommend that crimped connections are made in accordance with IEC 60352-2.

Tightening torques for terminal board screws:

Thread	M5	M6	M8	M10	M12	M16	M20
T.(Nm)	2.5	3.5	7	12	18	35	55

Ensure that the terminal box is clean and dry.
Unused glands must be closed.
Check the terminal box gasket before it is remounted.

5. Maintenance

Inspect the motor at regular intervals, keep it clean and ensure free ventilation air flow, check the condition of shaft seals and replace if necessary. Both electrical and mechanical connections must be checked and tightened if necessary.

Bearing size and type are specified on the rating plate. Motor types HMA2 and HMC2 is as standard with lifetime greased bearing with motor size ≤225.
Motor types MS and Y2E is as standard with lifetime greased bearing with motor size ≤160.

Typical duty hours for lifetime lubricated bearings.

Frame size	Poles	Typical lifetime
56 – 160	2 – 8	40.000h
180	2	35.000h
200	2	27.000h
225	2	23.000h
180 – 225	4 – 8	40.000h

Motors with a re-greasing system must be lubricated with high quality lithium complex grease, NLGI grade 2 or 3, with a temperature range of between -40°C to +150°C.

Motors are normal fitted with a data plate with greasing information; if it is missing use the following re-greasing intervals.

Frame size	Grease (g)	2 pole (h)	4 pole (h)	6 pole (h)	8 pole (h)
160	20	4200	7000	8500	8500
180	20	4200	7000	8500	8500
200	25	3100	6500	8500	8500
225	25	3100	6500	8500	8500
250	35	2000	6000	7000	7000
280	35	2000	6000	7000	7000
315	50	1500	5500	6500	6500
355	60	1000	4000	5000	6000
400	80	800	3000	4000	6000

Grease the motor while running, open the grease outlet plug and let the motor run 1-2 hours before the outlet grease plug is closed again.

Grease the motor for the first time during commissioning.

The following applies in general for both lifetime lubricated and re-lubricated bearings:
At 60Hz the time will be reduced by app. 20%.
Data for vertically mounted motors are half of the above values.

The table values are based on an ambient temperature of 25°C. The values must be halved for every 15K increase in bearing temperature.
Higher speed operations, e.g. frequency converter drive will require shorter greasing intervals. Typically, doubling the speed will reduce the values by 50%.

6. Special note for Atex Zone 22 motors.

Notice for the use of electrical equipment in areas with combustible dust.
Designation of motor according to EC directive:
Ex II 3D T125°C, IP55.

The dust hazardous 3-phase asynchronous motors are in accordance with European standard EN 50281-1-1. Combustible dust areas will be found in agricultural areas and in industrial environments.
Only one electrical installation may be installed in one specified area (zone).

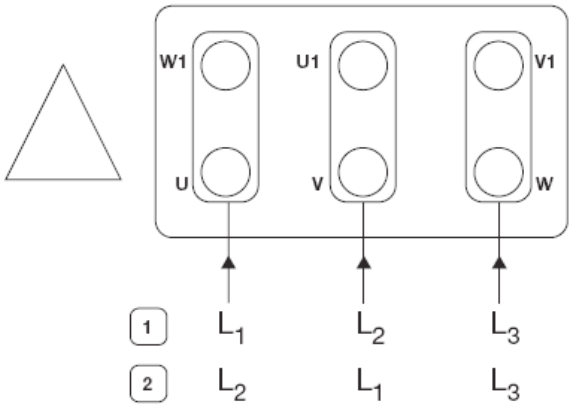
Only certificated cable glands for category 2D may be used. Unused glands must be closed.
Connections must be made in such a way as to ensure that a permanently safe electrical connection is maintained, both for the main supply and earth connection.
Installations must be in accordance with actual standards for installation in the Zone 22 area.

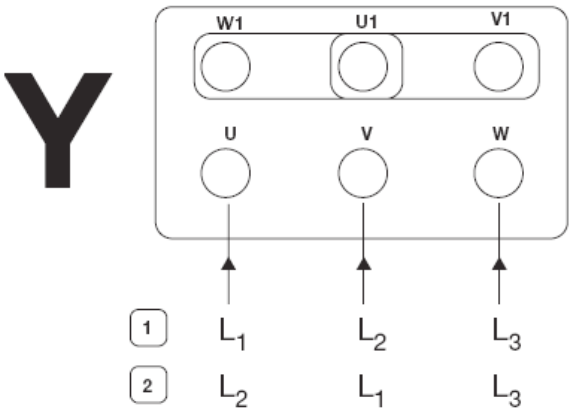
It is recommended that EN 50281-2 is followed according temperature and dust on the motor surface.
The use of motors with so much surface dust that the motor temperature increases is not permitted.
Regularly cleaning is recommended.
The radial shaft sealing ring is part of the ATEX certification. It is important that the ring is always intact.
The shaft sealing must be regularly checked, and if dry it must be lubricated. It is recommended that the seal is re-lubricated regularly.
Always use the original seal ring when replaced.
Replacing bearings also means replacing the seals.

All machines must be inspected regularly for mechanical damage.
The user is responsible for changing parts in accordance with the lifetime of parts, in particular:
bearings, grease and lubrication of shaft sealing.

Maintenance, repairs and replacement on zone 22 motors must only be carried out by qualified specialists.

Connection diagram
Anschlußdiagram
Anslutningdiagramm
Forbindelsesdiagram
Aansluitdiagram
Connection
Conexión
Collegamento
Схема соединений
Schemat polaczeń





4 Hoyer Motors, Motor Manual, October 2011

EC Declaration of Conformity

HOYER
EXCEEDING EXPECTATIONS

The Manufacturer: SVEND HØYER A/S
Over Hadstenvej 42
DK 8370 Hadsten
Denmark

Hereby declares that

The products: HOYER MOTORS, 3-phased induction motors

Aluminium motors	MS, A22 MS 56 - 180
	HMA*, A22 HMA* 56 – 180
Cast iron motors	Y2E*, A22 Y2E* 80 - 400
	HMC*, A22 HMC* 80 – 400

Are in conformity with the following:

Standards: EN 60 034-1 and EN 60 072

Directive: Low Voltage Directive 2006/95/EC

Year of CE marking: CE_{02}

Signed by

Lars Høyer
Managing Director

Date December 2010

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