ENGINEERING
TOMORROW

Operating guide

Energy Recovery Device

iSave 50-70
Installation, Operation and
Maintenance Manual

hpp.danfoss.com

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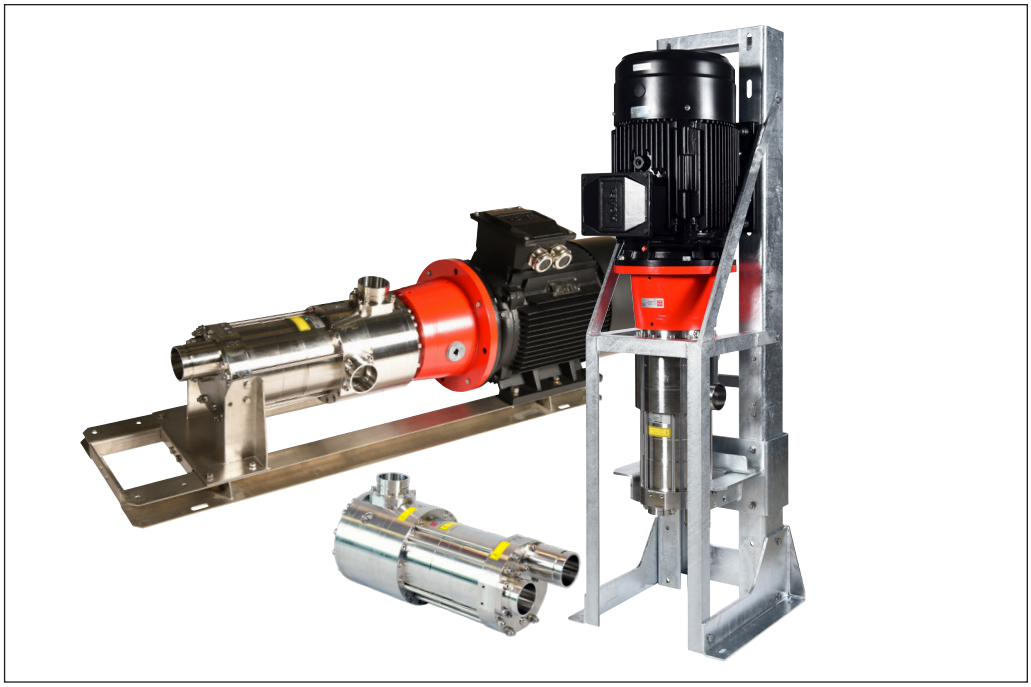

1. Validity

Document information and copyright
Installation, Operation and Maintenance Manual.
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.

This manual is valid for iSave 50 -70

Code No./Description	Serial no.
180F7020 iSave 50 without motor	XXXXXX02-XXX
180F7021 iSave 70 without motor	XXXXXX02-XXX
180F7038 iSave 50 Vertical (IEC motor)	XXXXXX02-XXX
180F7023 iSave 50 horizontal (IEC motor)	XXXXXX02-XXX
180F7040 iSave 70 vertical (IEC motor)	XXXXXX02-XXX
180F7025 iSave 70 horizontal (IEC motor)	XXXXXX02-XXX

The serial number is referring to the Serial no. on the product label. The digits shown (02) indicate the version number of the pump.
This document is only valid for ERD version 2 and upwards.

2. Introduction

2.1 General

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

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:

- Transporting of the iSave unit.
- Lifting the unit.
- Installing the iSave unit on a frame.
- Connecting the iSave unit to the fluid system.
- Connecting the electrical motor and instrumentation.
- Commissioning the unit.
- Servicing the iSave unit, mechanics and electrics.
- 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.

If the recommendations in the manual are not followed, Danfoss reserves the right to void the warranty.

2.3 Symbols

Indicates something to be noted by the reader.

Indicates a situation which will or couldresult 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

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High Pressure Pumps
DK-6430 Nordborg, Dinamarca
Tel.: +45 7488 2222
E-mail: highpressurepumps@danfoss.com
Homepage: hpp.danfoss.com

2.5 Country specific information

2.5.1 United Kingdom

Danfoss Ltd.
22 Wycombe End
HP9 1NB Beaconsfield
United Kingdom

2.6 Additional technical documents

Below documents are not present in this Operating guide. Please contact Danfoss.

Document name	Content
Service guide: 180R9387 Disassembling and assembling	Description of how to disassemble and assemble the iSave
Design guide: 180R9367 Pipe connection	Design guide on how to make har piping with Victaulic clamps
Guide line: 180R9371 Pressure safety valve in SWRO systems	Guide line on how to evaluate if a safty valve is needed in a SWRO system
Guide line: 180R9370 Review sheet P&ID	Detailed description about the need for each individual component in the preferred P&ID

3. Safety

3.1 General

The iSave must not be used for other purposes than those recommended and specified 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 judgment in the operation and care of this product and its components.

This 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 over-pressure 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.
- 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 not 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.

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

For application range see data sheet 521B1378 available in appendix 10.1.

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

3.4 Preferred system design

Danfoss recommends building systems with a high degree of safety. Our preferred system design can be found in the data heet in appendix 10.1.

- 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.

4. Arrival inspection, handling and storage

4.1 Arrival inspection

The iSave is packed in a wood container.
The iSave ports connector are protected by plastic caps that protect the iSave against dust and particles. Do not remove the caps before the system have been flushed and the iSave can be installed.

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 o 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 fig. 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 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 coordinate the shipment with your local authorized distributor or contact anfoss direct to obtain a return shipping address.

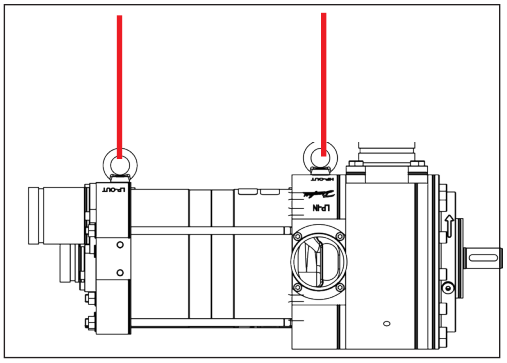
4.3 Transport and Handling

- Personnel involved in lifting and transportation of 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 can be found in the datasheet.
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.

Do not use connections/nozzles for lifting. Do not use only one sling! Make sure that the load is balanced before attempting the lift.

When lifting the ERD without motor use the lifting eyes.

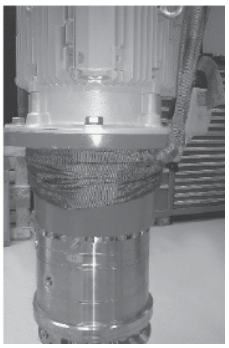


When you have finished using the lifting eyes, remove them to prevent corrosion.

When the iSave is mounted with an electric motor (horizontal), it must not be lifted in the lifting eye. An iSave assembled with motor (horizontal) must be handled by using two slings around the unit. One sling must be attached to the electric motor and one sling around the iSave. Make sure that the unit/load is balanced before lifting. The centre of the mass may vary.

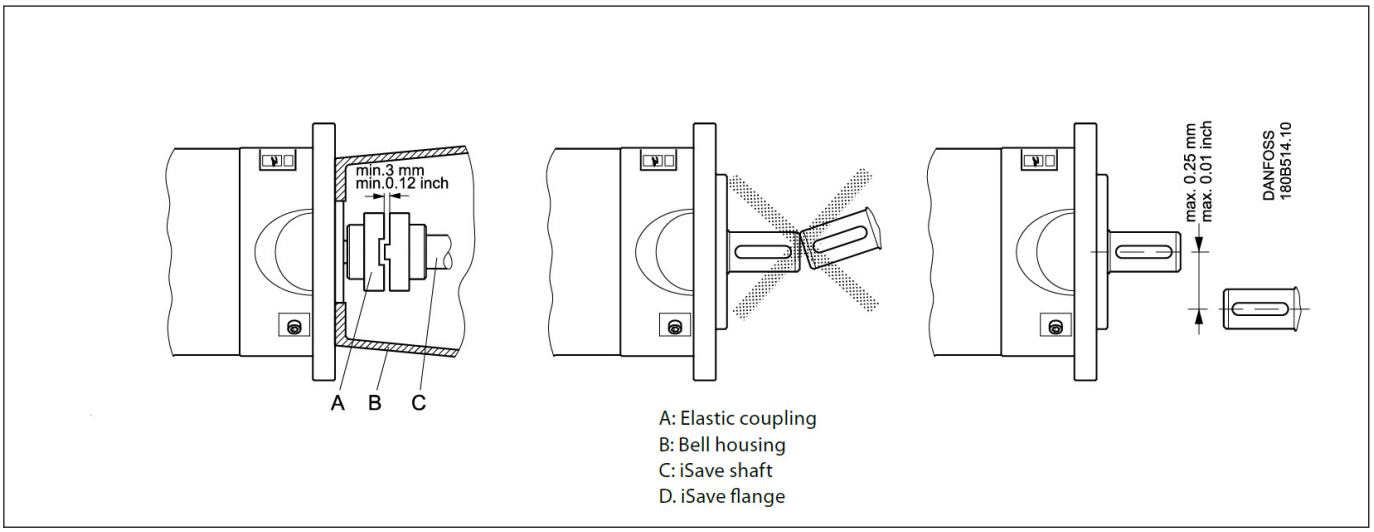
Some motors and pumps have specific lifting eyes.
Do not use connections/nozzles for lifting!
Always use two slings.

Lifting the iSave with electric motor (vertical):
The two lifting belts around the bell housing before lifting the unit.



Lift the iSave unit with only one fastening point. Incorrect lifting can result in personal injury and/or damage of the unit.

4.4 Assembly iSave to electric motor



1. Mount the coupling flush or maximum 1 mm offset from the iSave shaft end. Ensure an air gap between coupling parts of 3-5 mm (0.12-0.2 inch).
2. Mount the bell housing on iSave. Secure nuts with the right torque.
3. Measure the longest distance “A” from top of bell housing to the button of coupling claw.
4. Mount the coupling on motor shaft. Ensure the coupling and motor flange are not in contact with each other.
5. Measure from motor flange to the top of the coupling. That measurement “B” shall be 3-5 mm (0.12-0.2 inch) shorter than the measure ment “A”.

(“A” and “B” can be found on the next page).

6. Adjust respectively, verify the measure ment, and secure both couplings with the right torques on the locking screws (see coupling operation & mounting instruc tion).
7. Mount the elastic gear ring and mount the bell housing/iSave on the motor. After mounting it must be possible to move the elastic gear ring 3-5 mm (0.12 - 0.2 inch) axial “C”. The check can be done through the inspection hole of bell housing. Secure flange bolts with the right torque.

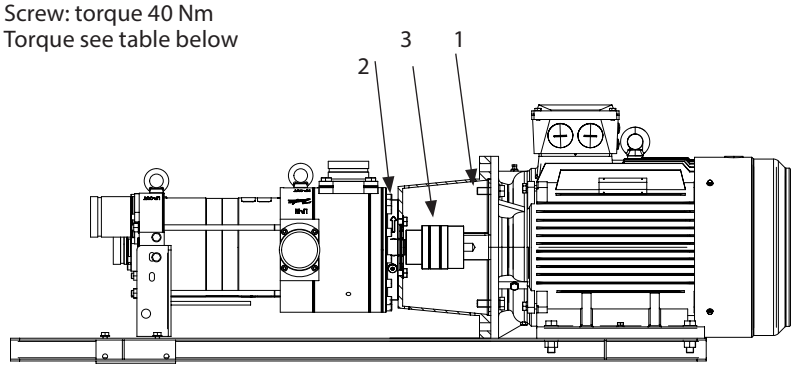
If alternative mounting is desired, please contact Danfoss High Pressure Pumps.

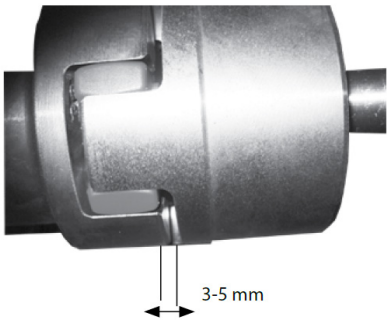
Choose proper tolerances to ensure an easy mounting of the elastic coupling without use of tools.

Please take care to observe the recommended length tolerances of the chosen coupling, as an axial force on the pump will damage the pump.

(“C” can be found on the drawing below).

1: Bolts: torque 100 Nm
2: Screw: torque 40 Nm
3: Torque see table below





Thread size	M5	M6	M8	M10
Torque (Nm)	2	4.8	10	17

Details on how to install iSave 50/70 on Danfoss vertical and horizontal frame can be found in the Service guide 180R9387.

4.5 Storage

When each iSave is tested before shipment in demineralized water. When tested the iSave is emptied and “plugged”, this will prevent frost damages.
The storage temperature is is:
-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 fluids at temperatures below 1 °C .

Storage of iSave that have been in operation:
For shorter periods of storage flush the iSave with permeate and store.
For long term storage (more than 2 months) Danfoss recommends servicing the product and clean any biological growth of the surfaces. Store the pump dry witout water inside.

Danfoss recommends using DOWFROST from DOW Chemical Company or Chillsafe mono propylene glycol from Arco Chemical Company.

For further information on anti-freeze media, please contact Danfoss High Pressure Pumps.

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

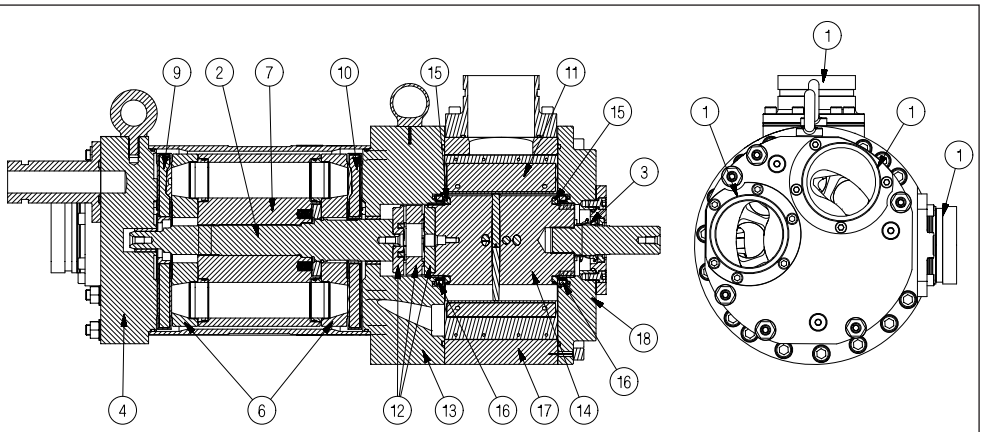
4.6 Outdoor Storage

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
6: Valve plate
7: Cylinder drum
9: Port plate (brine)
10: Port pllate (sea water)
11: Vanes
12: Coupling
13: Intermediate flange
14: Rotor
15: Rotor element
16: Sealing plate
17: Stator
18: Motor end flange



5.2 Sound level of the iSave

The A-weighted sound pressure level @ 1m, $L_{PA, 1M}$ is for the iSave including the iSave motor.

Measurement are according to EN ISO 3744:2010. The test is made under following conditions:

1. iSave and electrical motor mounted on Danfoss base plate.
2. Baseplate is isolated from concrete ground by rubber vibration dampers.
3. Flexible hoses are used on high pressure and low pressure sides of the iSave.
4. Rotation speed is max. rpm
5. System pressure max. allowable working pressure and a booster pressure of 3 barg.

Influences

Since the iSave is mounted on a base plate and connected to the electromotor 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 dampers 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" - 180R9084 in chapter10.5 and Guide line Pipe connections 180R9367.
Alternative use multiple flexible Victaulic® couplings on the hard piping.
Alternativamente, emplee acoplamientos Victaulic® flexibles en la tubería rígida.

The noise level is influenced by:

- The speed of the iSave. High speed creates more noise than low speed.
- Rigid mounting of the iSave baseplate generates more noise than flexible mounting
- Pipe mounting directly to the iSave increases the noise level compared to flexible hoses.
- Higher pressure provides higher sound level.

5.3 Materials

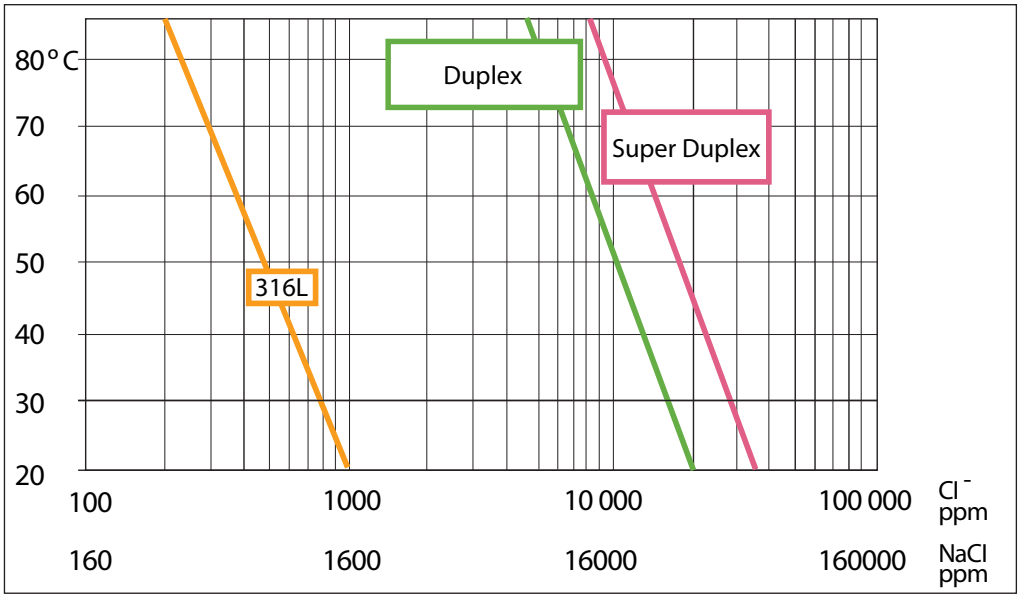
All critical parts of the iSave are made of super-duplex 1.4410/UN S32750/1.4462/ UN S32205/S31803 or the like.
Non-critical parts that are not in contact with sea water are made of AISI 316.
The shaft to the electrical motor is sealed by a standardised mechanical seal.

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 y 50 °C (35,6 °F y 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 the iSave datasheet. See appendix 10.1

5.6 Electrical motor data

See datasheet in appendix 10.1 and “Operating and Maintenance instructions, electric motor” in appendix 10.7

5.7 How does the iSave work?

Figure 5.1 shows a section view of the iSave.

The iSave consists of a rotating isobargic 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.

5.8 Seawater quality

5.81 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 omponents in the RO system.

It is important to use a proper filter housing that allows a good seal between housing and filter cartridge. If there is a high risk of water by-pass it is recommended to use a second stage filter solution.

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

Danfoss High Pressure Pumps 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", AI317041322125en-000201 which also will provide you with an explanation of filtration definitions and guidance on how to select the right filter.

5.8.2 Air bubbles

Large bubbles in a pressurised RO system can result in damage to piping and equipment. All air must be bleed 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 can be flushed with biocide like the membranes. The biocide must be compatible with the materials used in the iSave.
iSave material can be found in the parts list, appendix 10.6.

5.8.4 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 essential that the water used for the final pre-flush is pre-filtered to a level described in chapter 5.8
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.
Strainers do not eliminate the need for thoroughly pipe flushing before commissioning.

Also see "Instruction for start and stop of the SWRO with iSave unit" - 180R9213 in appendix 10.2.

5.9 Initial start up and settings of safety equipment

The system designer is responsible to design the equipment according to the local regulations where the equipment is running. According to PED 2014/68/ EU a risk assessment must be made to identify and evaluate hazards which apply to his equipment on account of pressure.

Where under reasonable foreseeable conditions, the allowable limits could be exceeded, the pressure equipment must be fitted with, or provision made for fitting of a suitable protective device.
Dischage pressure on the pump is generated only by the restriction in the pipelines, valves and membranes.

The pump can build up pressure that will exceed the mechanical strength of the membrane vessels, pipes and other accessories.
The pressure rise can be fast and may exceed the response time for electrical safety equipment, like pressure switch and control loop.

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.

5.10 Flushing

RO membranes require periodic flushing to limit biological fouling.
There are two types of flushing: feed water (Seawater) flush and fresh water (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.

Follow the guide line 180R9213 "Start and stop of the SWRO with iSave in appendix 10.2.

It is required to flush with permeate:
- After chemical treatment
- For stop more than 1 day the iSave must be rotated during permeate flush
- Before long time shut down

It is required to flush with fresh sea water prior to every shut down.

NB!

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 P line (7) drops below 2 bargs. This can be avoided by reducing the speed of the iSave and keeping the pressurein the HP line at the minimum of 2 barg.
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.

5.11 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 permeate.

The flush water coming out of the membranes may consist of a large amount of suspended inorganic particles. It is important to assure that hese particles must not enter the iSave as the waste product of flushing exceed the iSave filtration.

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

5.12 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.trado HP.

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

5.13 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..

5.14 Over-pressurisation caused by the high-pressure pump.

Discharge pressure on the pump is generated only by the restriction in the pipelines, valves and membranes. The pump can build up pressure that will exceed the mechanical strength of the membrane vessels, pipes and other accessories. The pressure rise can be fast and may exceed the response time for electrical safety equipment, like pressure switch and control loop.

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.

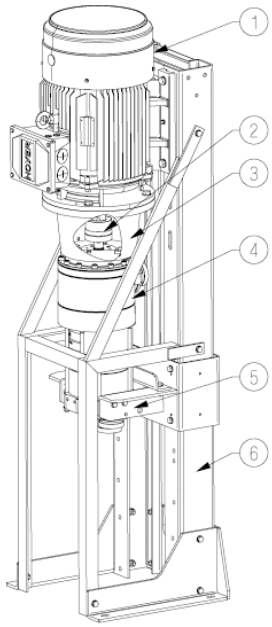
5.15 Explanation of P&ID set-up

See data sheet in appendix 10.1.

6. On-site installation

6.1 Design details
For safety instruction see chapter 3.

6.2 Installation and alignment
The figure below illustrates the major iSave components.



1: Motor
2: Flexible coupling
3: Bellhousing
4: iSave
5: Mounting bracket
6: Base frame

The iSave is connected to the electric motor by the bell housing and a flexible coupling. If not using Danfoss base frame both the iSave and the motor must be supported without applying stress/load to the bell housing.
Danfoss provides the iSave with a base frame and support brackets. Although the base frame is of a sturdy design, it can flex or bend when it is bolted to the foundation. The base frame thus requires a solid foundation such as concrete or rigid steel frame. The base frame itself must be aligned to avoid bending caused by bolting to an uneven foundation.
A rigid foundation for the iSave assembly is important, and must fulfil Eurocode 2: EN1992-1-1, and the iSave assembly must be bolted to the foundation with M12 bolts. The bolts used must be of proper design and must be installed in accordance with bolt manufacturer's recommendations.
To reduce noise it is recommended to use resilient mounts between the baseplate 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 frame to the iSave may cause stress and/or damage.

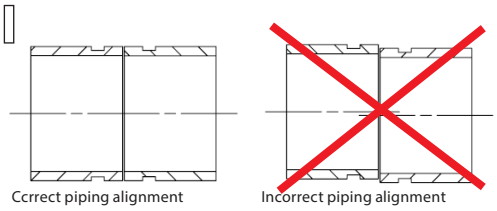
6.3 Orientation
The iSave can be mounted horizontally and vertically.

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 connection must be aligned as shown in the figures next page. Don't use the iSave as a strain for hard piping.



Ccrrect piping alignment Incorrect piping alignment

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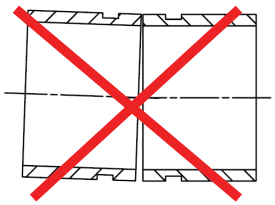


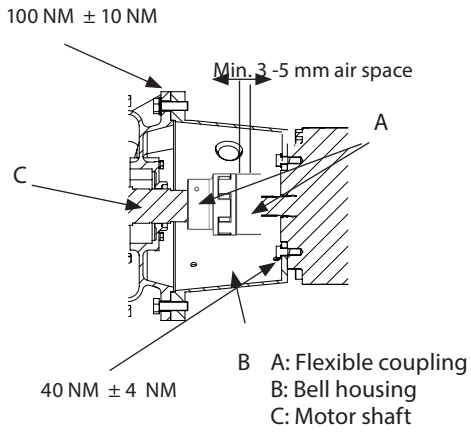
The hard piping and connections used must be of proper design and must be installed in accordance with the manufacturer's recommendations.

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

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

6.5 Mounting of coupling

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



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

6.6 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 for safe lifting of the equipment, with no risk for personal injury and/or damage to the iSave.

6.7 Drives

6.7.1 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.

6.7.2 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. The rotation can only be checked with water connected and iSave bleeded. 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 un-intended 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.

6.7.3 Starting torque for the iSave

Because of the inertia and stick-slip friction of the iSave internal parts, the torque may 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. See Danfoss guide line 180R9372 "APP pumps and iSave overload protection".

6.7.4 Torque overload protection on the iSave

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

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

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

If more electric motors are powered by the same 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 suitable-for VFD control.

The electric motor and iSave must always be protected against overload.
See Danfoss guide line 180R9372 "APP pumps and iSave overload protection" in the appendix 10.4.

If 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 quipped with all protection devices in accordance with EN 60204-1
- Check that all motor protections are properly set.
- All safety equipment, auxiliary equipment and connection required are properly connected and operational.
- Check all bolts in all connections and in the foundation of the iSave and the pumps.

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 highpressure pump, make sure the following requirements are met:

- All pipes are flushed, free from debris and full of water.
- The iSave has been bled and is full of water.
- At pressure lower that 10 barg, 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.

- If pressure relief valve is present, 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.
- **"Start and stop procedure" Guide line 180R9213. - appendix 10.2.**

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 main switch 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.

- Assure correct settings of safety equipment before start-up.
- When the system is re-started after service and maintenance follow the instruction in chapter 8 and in “Start and stop procedures” in guide line 180R9213 in appendix 10.2.

8.2 Support

Danfoss A/S offers commissioning and service at the system manufacturer’s location.
Tates/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.

1. Replace filters if necessary.
2. 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.

1. Replace filters if necessary.
2. Clean the filter housing and install the new filter. Make sure no debris enters the system.
3. Audibly inspect the iSave assembly. If there is irregular sounds or vibration inspect the internal parts of the iSave and replace if necessary.

Half year:

1. For vertical mounted electric motor lubricate motor bearings.

Annually:

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.

1. Replace filters if necessary.
2. Clean the filter housing and nstall the new filter. Make sure no debris enters the system.
3. Visually inspect iSave coupling and replace if necessary.
4. Audibly inspect the iSave assembly. If there is irregular sounds or vibrations inspect the internals parts of the iSave and replace if necessary.
5. Check power consumption. If there are irregular parts of the iSave and replace if necessary.
6. Lubricate motor bearings.

8.4 Recommended service intervals on internal parts

Se below table.
For detailed information on parts see Service guide 180R9392 Parts list.

Description	Service interval	Service interval (2nd, 3rd)
Tool kit		
Screw and seal kit	32.000 hours	26.000 hours
Shaft seal kit	32.000 hours	26.000 hours
Coupling kit	56.000 hours	56.000 hours
Port plate kit (PE), iSave 50	32.000 hours	26.000 hours
Port plate kit (PE), iSave 70	32.000 hours	26.000 hours
Vane kit (8 pcs)	56,000 hours	56,000 hours
Valve kit, Pressure exchanger	32.000 hours	26.000 hours
Rotor element and sealing plates kt	32.000 hours	26.000 hours

8.5 Lubrication of bearings in electric motor

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

For electric motors in vertical mount; grease every 6 months.

For electric motor in horizontal mount; grease every 12 months.

If the motor has increased vibrations or sound check the bearings.

Follow manufacturer's recommendations for electric motor service and maintenance, see appendix 10.7.

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 lowpressure side.
- The water in all connected pipes must be drained.

The numbers in () correspond to the preferred system design and P&ID (see data sheet)

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 sufficient start torque	Choose a VFD that is designed for sufficient start torque. See guide line 180R9372
	Ramp-up settings in the VFD are not correct. VFD is tilting	Set ramp-up parameters correct. See guide line 180R9372
	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
	Pressure on the membranes (5) is too low	Incorrect speed on the HP pump
		Check the HP pump and repair, if necessary

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ENGINEERING
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Appendices

Energy Recovery Device

iSave 50-70

Appendices - Installation, Operation and Maintenance Manual

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Appendices

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Data sheet

iSave® Energy Recovery Device

iSave 50 / iSave 70

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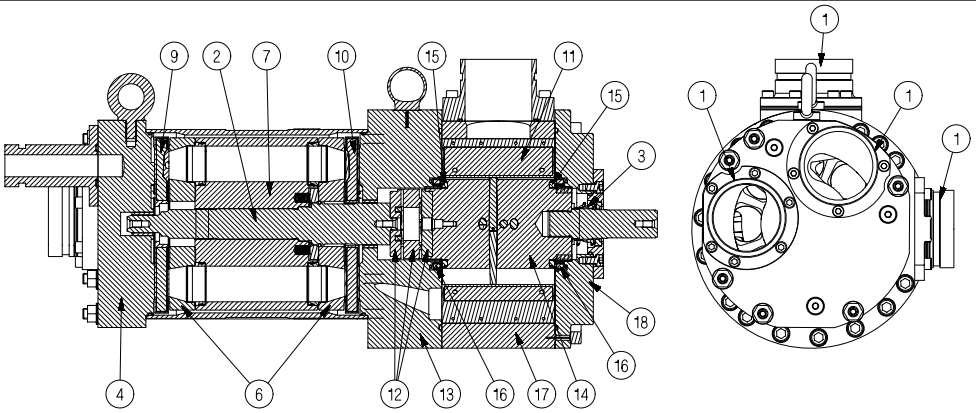
1. General information

Energy Recovery Devices (ERD) are used in reverse osmosis (RO) systems to recycle the energy held in discharged brine from the membranes. Thus, iSave 50 and iSave 70 are designed for use with low viscosity and corrosive fluid such as sea water.

The Danfoss iSave Energy Recovery Devices all consist of an isobaric pressure exchanger and a positive displacement pump combined into one compact unit. The high-pressure booster pump is based on the vane pump principle enabling a very light and compact design. The vane pumps are fixed displacement pumps in which the flow is proportional to the number of revolutions (rpm) of the driving shaft – enabling flow control. Speed control is made by a VFD. The iSave design ensures lubrication of the moving parts by the fluid itself.
All parts included in the iSave 50 & 70 are designed to provide long service life with a constant high efficiency and minimum service required.
Unlike a centrifugal pump, it produces a similar flow at a given speed no matter what discharge pressure.

1. 3" Victaulic connections
2. Shaft
3. Low pressure shaft seal
4. Port flange
6. Valve plate
7. Cylinder barrel
9. Port plate (brine)
10. Port plate (sea water)
11. Vanes
12. Coupling
13. Intermediate flange
14. Rotor
15. Rotor element
16. Sealing plate
17. Stator
18. Motor end flange



2. Benefits

- Significant power savings and low specific energy consumption (SEC)
- Simple and space-saving installation with both pump and pressure exchanger in one unit
- Simple system design and monitoring without requirement for high-pressure flow meters
- Simple operation with design that prevents overspin/overflushing
- Easy modular service
- Corrossion resistance (all wetted parts are made of high corrosion-resistant materials e.g. Super Duplex or Duplex)
- Fewer components

3. Applications

Danfoss iSave ERDs are built into a broad range of RO desalination plant around the world.
Typical applications for iSave 50 - 70 will be:

- Containerized solutions for hotels and resorts on islands as well as coastal regions
- Onboard systems for ships
- Offshore platforms for the oil and gas industry
- Municipal and private waterworks

4. Technical data

4.1 iSave without motor

iSave size		iSave 50	iSave 70
Code number		180F7020	180F7021
Pressure			
Max. differential pressure (HP out - HP in)	barg	5	5
	psig	72	72
Min. pressure HP out (min. allowable working pressure)	barg	40	40
	psig	580	580
Max. pressure HP out (Max. allowable working pressure, MAWP) [1]	barg	83	83
	psig	1200	1200
Min. pressure on HP in, intermittent [2] [3]	barg	2	2
	psig	29	29
Max. pressure LP in (MAWP) [1]	barg	5	5
	psig	72	72
Max. pressure LP in, peak	barg	10	10
	psig	145	145
Min. allowable working pressure LP in	barg	2	2
	psig	29	29
Max. differential pressure (LP in - LP out)	barg	0.53	0.79
	psig	7.69	11.46
Max. static test pressure (HP in and HP out)	barg	108	108
	psig	1566	1566
Max. static test pressure (LP in and LP out)	barg	13	13
	psig	189	189
Speed			
Min. speed	rpm	525	625
Max. speed	rpm	650	875
Typical flow [4]			
Flow at min. speed, HP out	m^3/h	42	50
	gpm	184	220
Flow at max. speed. HP out	m^3/h	52	70
	gpm	228	308
Max. lubrication flow at 60 barg (871 psig)	l/min	25	25
	gpm	6.6	6.6
Peak flow, LP in [10]	m^3/h	120	120
	gpm	528	528
Max. allowable working flow, LP in [7]	m^3/h	57.2	70
	gpm	252	308

Technical specifications			
Media temperature [5]	°C	2-35	2-35
	°F	36-95	36-95
Ambient temperature	°C	0-50	0-50
	°F	32-122	32-122
Filtration requirements (nominal) [6]	µm	5 micron melt-blown	
Salinity increase at membrane at 40% recovery rate at balanced flow [9]		2-3%	
Weight (dry)	kg	164	164
	lb	362	362
Weight (operation with water)	kg	172	172
	lb	379	379
Noise			
Sound pressure level L_{PA} 1 m [8]	dB(A)	83	86
Torque data			
Max. allowable working torque	Nm	170	190
	lbf-ft	125	140
Max. starting torque (stick/slip)	Nm	180	180
	lbf-ft	132	132

1) Max. allowable working pressure of continous operation. For lower and higher pressure, please contact Danfoss.
2) Typical 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 and 3 barg differential pressure
5) Dependent on NaCl concentation.
6) Please see section 7.4 filtration.
7) Continuous operation: iSave can operate continuously with up to 10% over flush with the limitation that the flow rate at LP inlet shall not exceed 70 m^3/h.
8) A-weighted sound pressure level at 1 m from the pump unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurements are performed acc. to EN ISO 3744:2010 on a motor-pump-unit at max. pressure and rpm.
9) Balanced flow: The mixing rate is defined at balanced flow when HP-out is equal to LP-in.
10) At system start-up: iSave can run for up to 10 min. with 150% of max. rated flow at LP inlet. The time where max. rated flow is exceeded should be kept as short as possible to minimize wear.

4.2 iSave with IEC motor

[i] iSave size		iSave 50	iSave 70
Code number (vertical)		180F7038	180F7040
Code number (horizontal)		180F7023	180F7025
Pressure, Speed, Flow, Temperature and Torwue are identical with		**180F7020 and**	**180F7021**
Efficiency			
Efficiency at max. speed at 60 barg (871 psig)	%	93.7	92.4
Technical specifications			
Media temperature [5]	°C	2-35	2-35
	°F	36-95	36-95
Filtration requirements (nominal) [6]		5 micron melt-blown	
Weight (dry) vertical/horizontal	kg	441/463	441/463
	lb	972/1021	972/1021
Weight (operation with water) vertical/ horizontal	kg	470/471	470/471
	lb	1036/1038	1036/1038
Noise			
Sound pressure level L_{PA} 1 m [2]	dB(A)	83	86
Footprint			
Footprint (vertical position) [3]	m^2	0.44	0.44
	$foot^2$	4.71	4.71
Footprint (horizontal position) [3]	m^2	0.76	0.76
	$foot^2$	8.14	8.14
Torque data			
Max. allowable working torque	Nm	170	177
	lbf-ft	125	130.5
Max. starting torque (stick/slip)	Nm	180	180
	lbf-ft	132	132
Motor data			
Nominal speed	rpm	985	985
Rated current at 400V	A	37	37
Motor size	kW	18.5	18.5
	HP	30.0	30.0
Frame size	IEC	200 L	200 L
	Poles	6	6
Rated motor torque at nominal speed	Nm	177	177
	lbf-ft	130.5	130.5
Rated motor ambient temperature [4]	°C	40	40
	°F	104	104
Motor insulation	Class	B	B
Motor degrees of protection	IP	55	55

[2] A-weighted sound pressure level at 1 m from the ERD unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurement are performed acc. to EN ISO 3744:2010 on an ERD with motor (motor pump unit) from min. to max. pressure and speed.

3 Area covered with recommended IE3 motor configurations (excl. of space to service the ERD)[1]

[4] For higher temperature, contact Danfoss.

[5] Dependent on NaCl concentation.

[6] Please see section 7.4 Filtration

[7] Typical efficiency for pressure exchanger, booster pump, electrical motor and VFD at 3 barg differential pressure after a system has been commissioned and run in.

4.3 iSave with NEMA motor

iSave size		iSave 50	iSave 70
Code number (vertical)		180U0062	180U0064
Code number (horizontal)		180U0003	180U0005
Pressure, Speed, Flow, Temperatue and Torque are identical with		**180F7020**	**180F7021**
Efficiency			
Efficiency at max. speed at 60 barg (871 psig) [7]	%	93.7	92.4
Technical specifications			
Media temperature [5]	°C	2-35	2-35
	°F	36-95	36-95
Filtration requirements (nominal) [6]		5 micron melt-blown	
Weight (dry) vertical/horizontal	kg	484/506	484/506
	lb	1067/1116	1067/1116
Weight (operation with water) vertical/ horizontal	kg	513/535	513/535
	lb	1131/1179	1131/1179
Noise			
Sound pressure level L_{PA} 1 m [2]	dB(A)	83	86
Footprint			
Footprint (vertical position) [3]	m^2	0.44	0.44
	$foot^2$	4.71	4.71
Footprint (horizontal position) [3]	m^2	0.76	0.76
	$foot^2$	8.14	8.14
Torque data			
Max. allowable working torque	Nm	170	177
	lbf-ft	125	130.5
Max. starting torque (stick/slip)	Nm	180	180
	lbf-ft	132	132
Motor data			
Nominal speed	rpm	1180	1180
Rated current at 400V	A	36.2	36.2
Motor size	kW	22.5	22.5
	HP	30.0	30.0
Frame size	NEMA	324/6T	324/6T
	Poles	6	6
Rated motor torque at nominal speed	Nm	179	179
	lbf-ft	132	132
Rated motor ambient temperature [4]	°C	40	40
	°F	104	104
Motor insulation	Class	B	B
Motor degrees of protection	IP	55	55

2) A-weighted sound pressure level at 1 m from the ERD unit surfaces (reference box) acc. to EN ISO 20361 section 6.2. The noise measurement are performed acc. to EN ISO 3744:2010 on an ERD with motor (motor pump unit) from min. to max. pressure and speed.

3 Area covered with recommended IE3 motor configurations (excl. of space to service the ERD)

4) For higher temperature, contact Danfoss.

5) Dependent on NaCl concentation.

6) Please see section 7.4 Filtration

7) Typical efficiency for pressure exchanger, booster pump, electrical motor and VFD at 3 barg differential pressure after a system has been commissioned and run in.

5. Performance curves

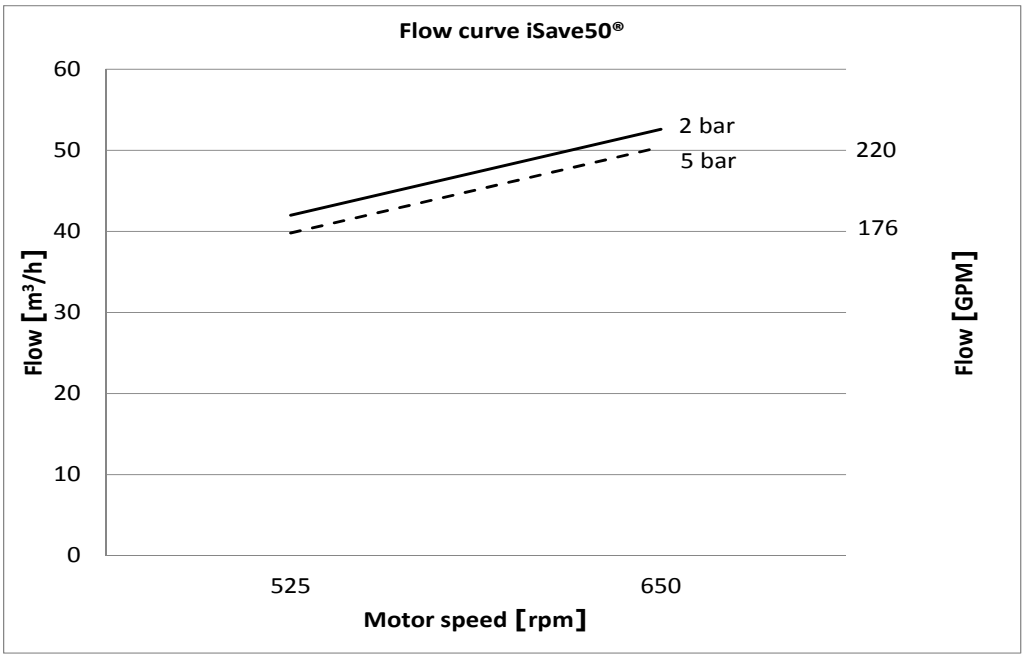
5.1 Flow at different rpm

The diagram shows that the HP flow can be changed by changing the rotation speed of the iSave. The flow/rpm ratio is constant, the required flow is obtainable by changing the rotation speed to a required value.

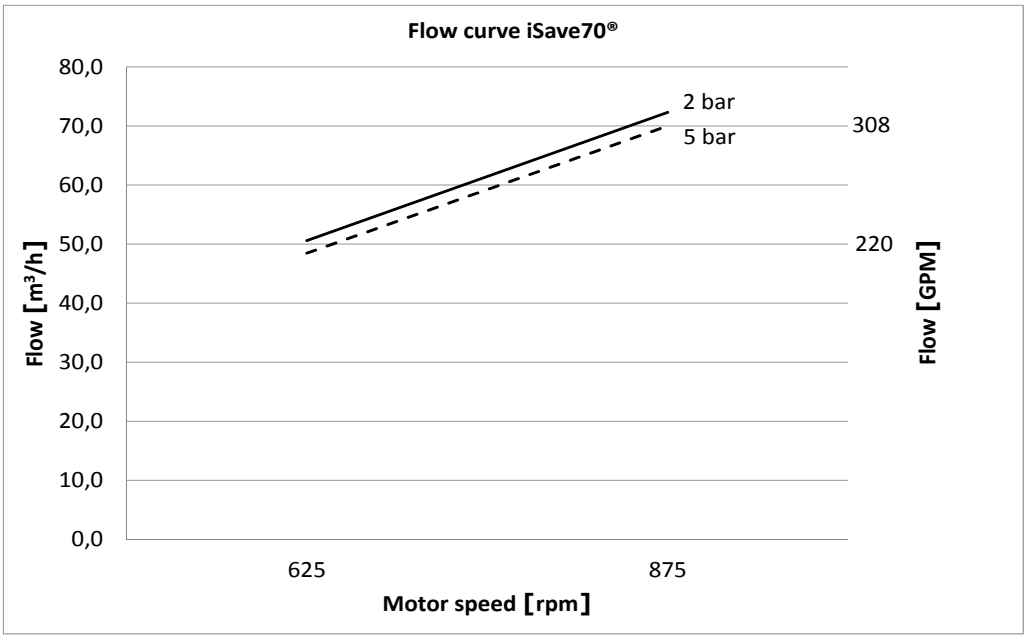
For accurate data and advise, please contact Danfoss High Pressure Pumps.

The iSave is delivered with a 3.1 performance certificate according to EN10204.

5.2 iSave 50 flow curves

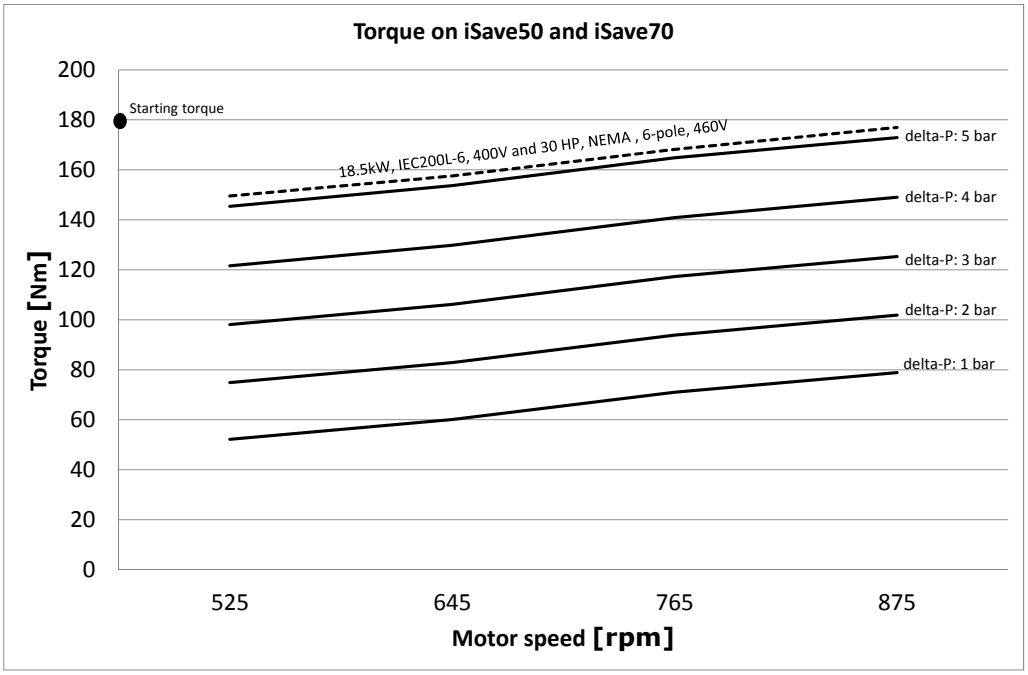


5.3 iSave 70 flow curves

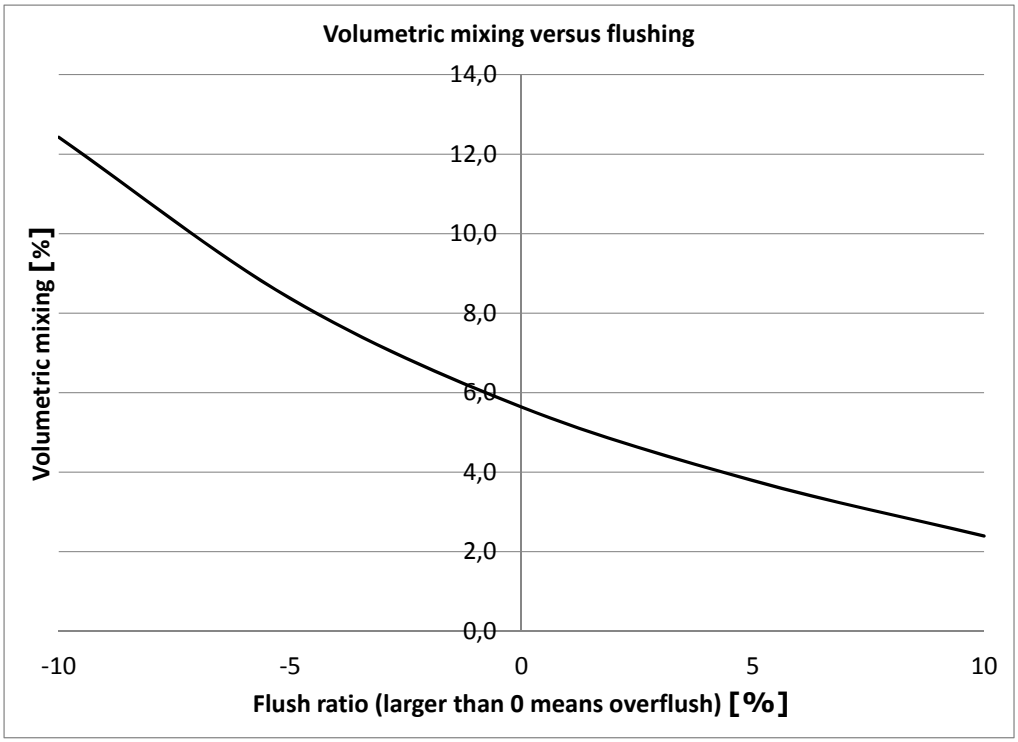


5.4 Torque curve for iSave 50 and iSave 70

Below curve illustrates typical values.



5.5 Mixing curve

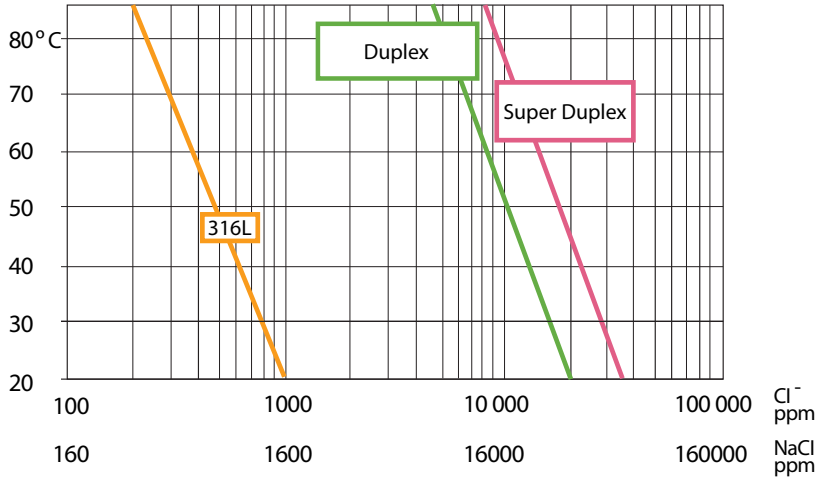


6. Temperature and corrosion

6.1 Operation

The chart below illustrates the corrosive resistance of different types of stainless steel related to NaCl concentration and temperature. All critical parts of the iSave is made of Super Duplex 1.4410/UNS 32 750 or Duplex 1.4462/UNS 32803.

Always flush the iSave with fresh water at operation stop in order to minimize the risk of crevice corrosion.



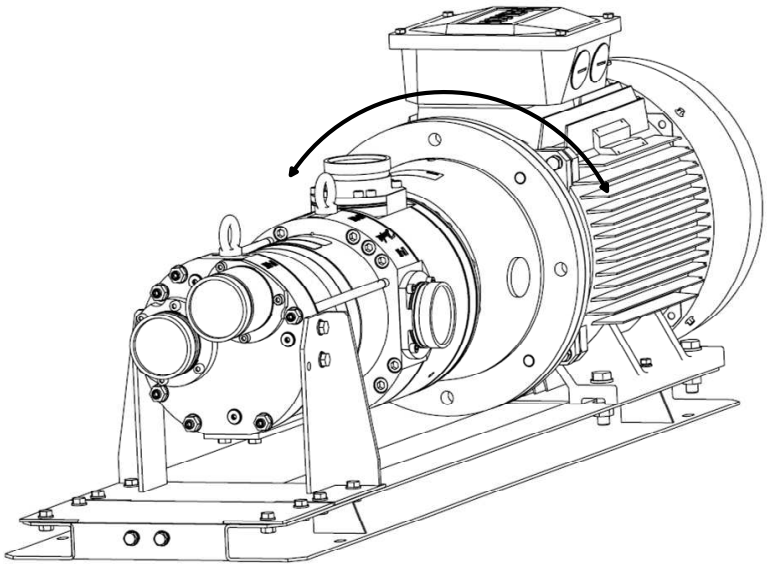
7. Installation

7.1 Operation and mounting

The iSave 50 and iSave 70 can be mounted horizontally and vertically. When mounted vertically, the electric motor must be placed at the top of the iSave

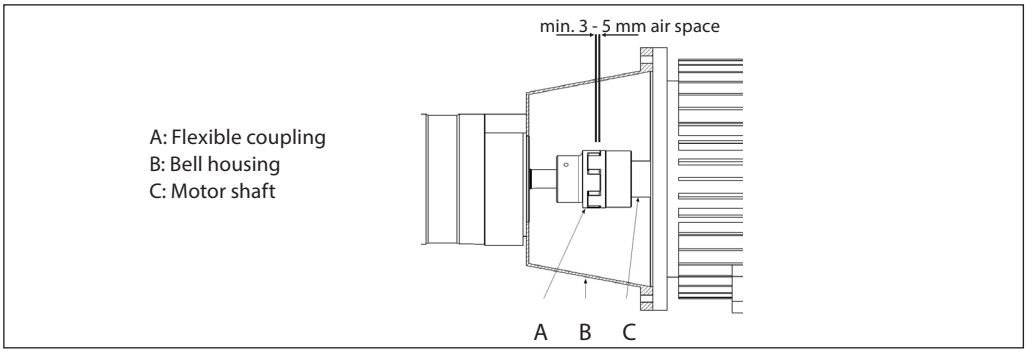
7.2 Horizontal mount

The iSave is delivered with a standard port orientation. The port orientation can be changed by the customer by rotating the combined iSave and bell housing around the center of the motor shaft.



See example below on how to mount the pump and connect it to an electrical motor.

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



7.3 Connection to inlet or discharge ports:

- When using hard piping, it is important to follow the Guideline 180R9367 - Pipe connection.
- When using flexible hoses, it is recommened to use Hose Whip Restraint. Also follow the guideline 180R9084 - Right and Wrong Hose assembly.

7.4 Filtration

High quality water extends the service life of the whole system.
Water to the iSave must be filtered to 5 µm nominal, using melt-blown depth filter with good end sealings. Consult Danfoss for correct choice of filter.

It is important with selection of a proper filter and filter housing to ensure good cartridge end sealing.
If there is a high risk of water by-pass it is recommended to use a second stage filter solution.

As the various filters on the market differ greatly, Danfoss High Pressure Pumps recommends using cartridges with consistent, reliable performance and high efficiency and where fibres are blown continuously onto a central support core. High Pressure Pumps does not recommend cartridges requiring any type of binders or resins.

Filters can be purchased from Danfoss High Pressure Pumps. For more information on the importance of proper filtration, please consult our publication "Filtration" (code number 521B1009), which also will provide you with an explanation of filtration definitions and a guidance on how to select the right filter.

7.5 Noise

Since the iSave is mounted on a bell housing and electric motor, the noise level should be determined for a complete system. To minimize vibrations and noise throughout the system, it is improtant that a horizontal iSave unit is mounted correctly on a frame with dampeners.

Rigid designs with metal pipes cause vibration and noise. It is therefore recommended to use high-pressure flexible hoses between the hard piping in the RO-plant and the iSave or to used multiple connections with Victaulic clamps where possible.

The noise level is influenced by:

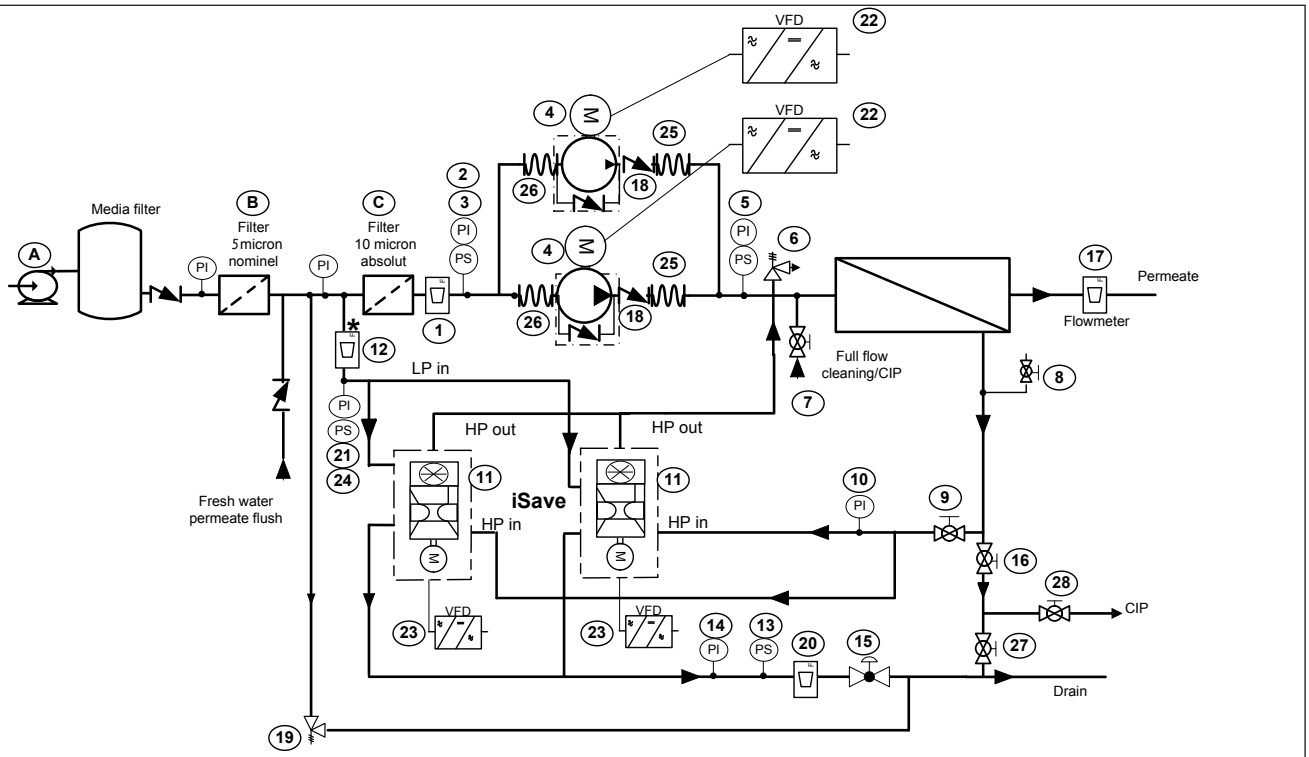
Speed:
- High rpm makes more fluid/structure-borne pulsations/vibrations than low rpm due to higher frequency.

Pressure:
- High pressure makes more noise than low pressure.

Mounting:
- Rigid mounting makes more noise than flexible mounting due to structure-borne vibrations.

Connections to iSave:
- Pipes connected directly to the iSave make more noise than flexible hoses due to structure-borne vibrations.
- Variable frequency drives (VFD):
  Motors regulated by VFDs can increase noise level if the VFD does not have the right settings.

7.5 RO systems with an iSave



* **Second stage filter:** If recommended housing design and cartridges are not used, a second stage filter is required

Explanation of P&ID setup

A. **Inlet filter:**
Place inlet filters on LP string in front of the iSave (11). Please see Guide line 521B1009 on Filtration.
If recommended housing design and cartridges are not used, a second stage filter is required, see above (*).
Thoroughly clean pipes and flush system prior to start-up.

B. **Inlet pressure:**
Must assure that iSave is running according to specifications. Refer to iSave data sheet.
Required: Must assure min. pressure to avoid cavitation.
Recommended: Must assure max. pressure to avoid hydraulic and mechanical overload.
(13) used for iSave 21 and iSave 40.
(24) used for iSave 50 and iSave 70.

C. **Piping and hoses:**
Dimension the piping to obtain minimum pressure loss (large flow, minimum pipe length, minimum number of bends/ connections and fittings to prevent pressure loss and flow turbulence). Use flexible hoses to minimize vibrations and noise. Please consult the Danfoss Hoses and Hose Fittings data sheet (521B0909) and Right and wrong Hose assembly (180R9084) for guidance.

D. **Inlet flow control and mixing:**
To balance LP flow up against HP flow on the iSave and control mixing, place a flowmeter on low-pressure inlet (12) or low pressure outlet (20) of the iSave.

E. **Outlet pressure control:**
In order to control the inlet pressure needed a back pressure valve (15) must be installed in the common outlet pipe from the iSaves. The valve should be designed to control flow.
It is recommended to use a manual valve with lock function or an automatic controlled valve.

F. **Variable speed and overload protection:**
Install a VFD to control the speed of the iSave and protect it against mechanical overload. See instruction 180R9372 for guidance of VFD settings.

G. **LP discharge flow control:**
See “E”.

H. **Air venting:**
Install an air bleed valve (8) on the highest point of the high-pressure piping to ensure the air is purged from the system before startup.

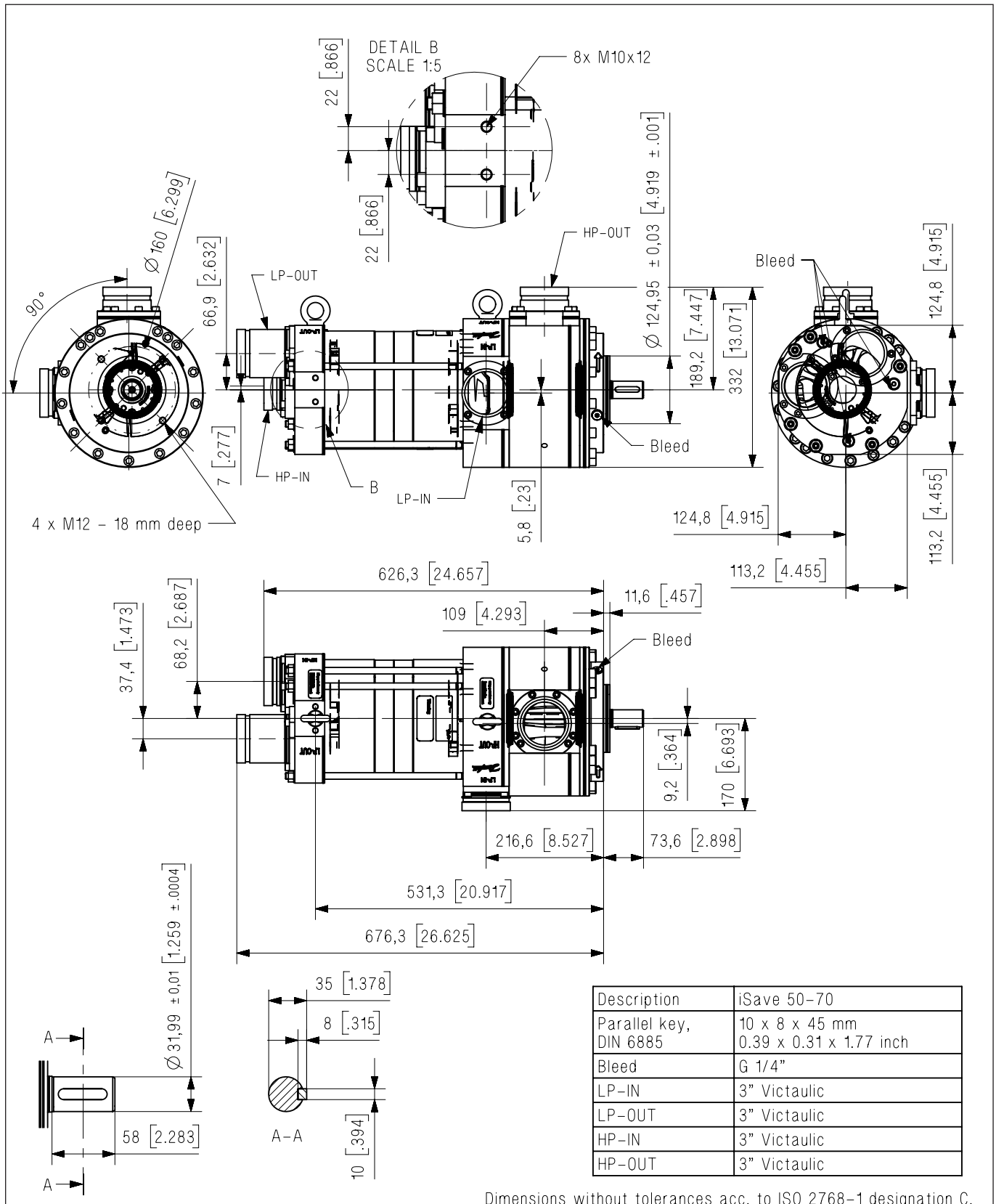
I. **Pressure relief (high pressure):**
The pressure relief valve (6) protects the whole system against pressure overload and relieves the water if the pressure exceeds the maximum set pressure. If the high-pressure pump is a positive displacement pump, the pump can built up a very high pressure that will exceed mechanical strength of the membrane housing, pipes and other accessories. When using Danfoss APP pumps with Danfoss VCM check valves, it is recommended to place a pressure relief valve or pressure safety valve as illustrated. In case the Danfoss check valves are not used, the valve must be placed between pump and check valve (See 180R9371, Design Guide Pressure saftey valve in seawater RO sytem for more details).

J. **Pressure relief (low pressure):**
The pressure relief valve or pressure safety valve (19) protects the low-pressure pipes against pressure overload and relieves the water if the pressure exceeds the maximum allowable pressure.

For a more eleborate description of the P&ID setup, please consult the Danfoss Design Guide Piping & Instrumentation Diagram (P&ID) (180R9370) or contact Danfoss.

The iSave 50 and iSave 70 can be mounted in parallel. For more information, please see "Design Guide Parallel-coupled APP and iSave" -180R9354 or contact Danfoss.

8. Dimensions and connections 8.1 iSave 50-70 without electric motor

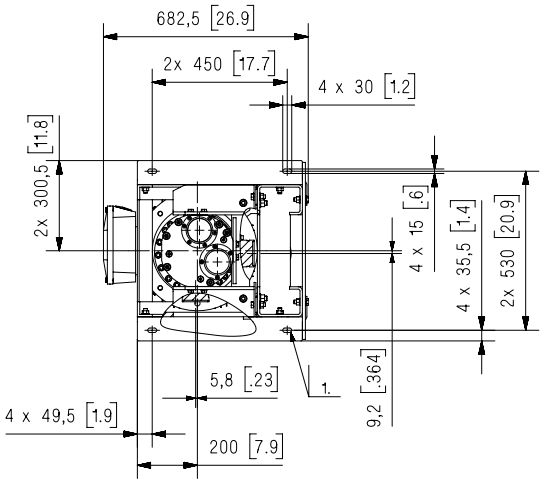


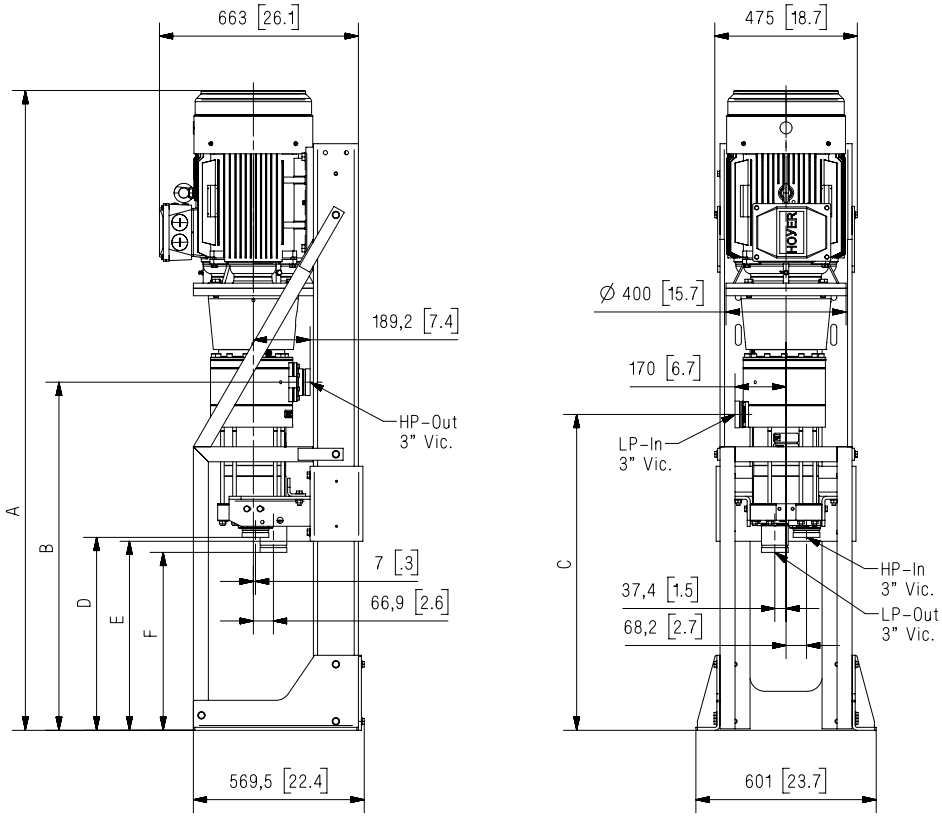
Description	iSave 50–70
Parallel key, DIN 6885	10 x 8 x 45 mm 0.39 x 0.31 x 1.77 inch
Bleed	G 1/4"
LP–IN	3" Victaulic
LP–OUT	3" Victaulic
HP–IN	3" Victaulic
HP–OUT	3" Victaulic

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

8.2 iSave 50-70 with with IE3 motor 18.5 kW on base frame vertical_front mounted

1. M12 anchoring/bolts.
   Bolt quality min. class 8.8.
   Torqued acc. to recommendation from bolt supplier.
   Foundation/anchoring acc. to Eurocode 2: 1992-1-1.





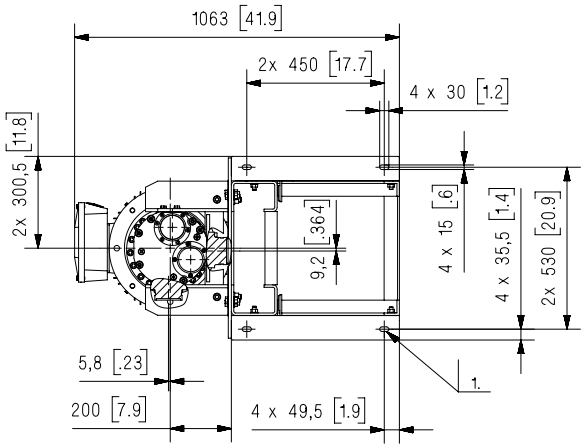
Dimensions without tolerances acc. to ISO 2768-1 designation C.
Positions 1, 2 and 3 refers to the three different heights where the iSave can be mounted on the baseframe.

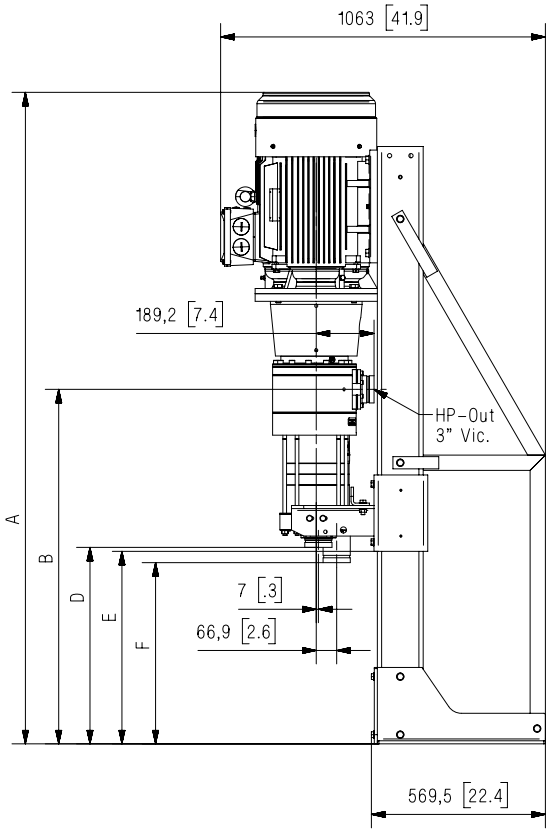
Dimension	Position 1	Position 2	Position 3 *
A	2132,3 [83.9]	1979,8 [77.9]	1827,3 [71.9]
B	1160,2 [45.7]	1007,7 [39.7]	855,2 [33.7]
C	1052,7 [41.4]	900,2 [35.4]	747,7 [29.4]
D	643 [25.3]	490,5 [19.3]	338 [13.3]
E	630 [24.8]	477,5 [18.8]	325 [12.8]
F	593 [23.3]	440,5 [17.3]	288 [11.3]

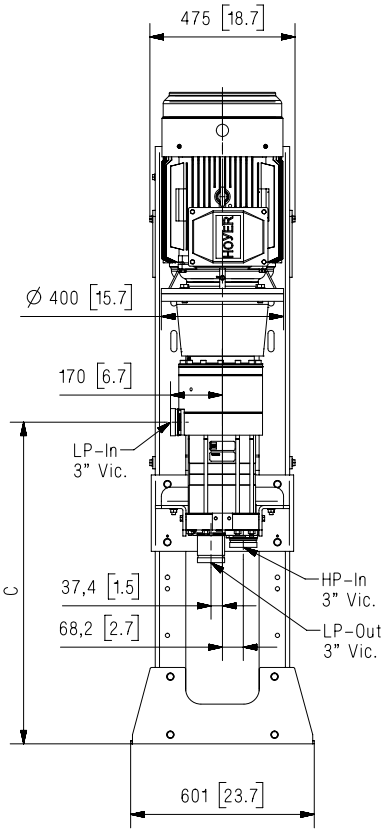
* Unit is delivered in position 3!

8.3 iSave 50-70 with with IE3 motor 18.5 kW on base frame vertical_back mounted

1. M12 anchoring/bolts.
Bolt quality min. class 8.8.
Torqued acc. to recommendation from bolt supplier.
Foundation/anchoring acc. to Eurocode 2: 1992-1-1.





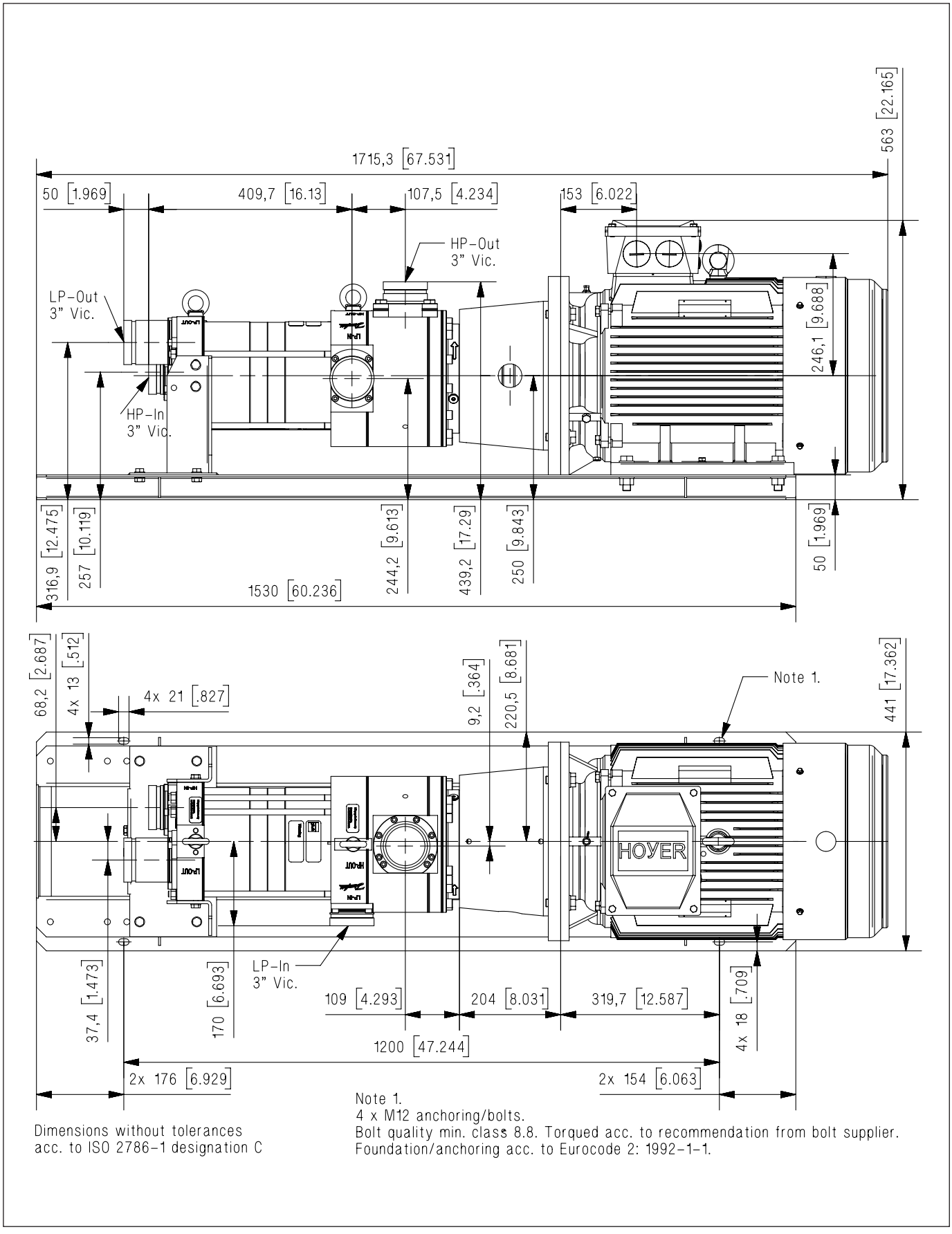


Dimensions without tolerances acc. to ISO 2768-1 designation C.
Positions 1, 2 and 3 refers to the three different heights where the iSave can be mounted on the baseframe.

Dimension	Position 1	Position 2	Position 3
A	2132,3 [83.9]	1979,8 [77.9]	1827,3 [71.9]
B	1160,2 [45.7]	1007,7 [39.7]	855,2 [33.7]
C	1052,7 [41.4]	900,2 [35.4]	747,7 [29.4]
D	643 [25.3]	490,5 [19.3]	338 [13.3]
E	630 [24.8]	477,5 [18.8]	325 [12.8]
F	593 [23.3]	440,5 [17.3]	288 [11.3]

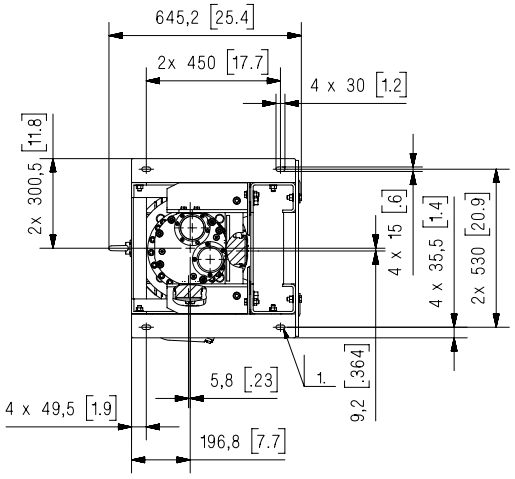
* Unit is delivered in position 3!

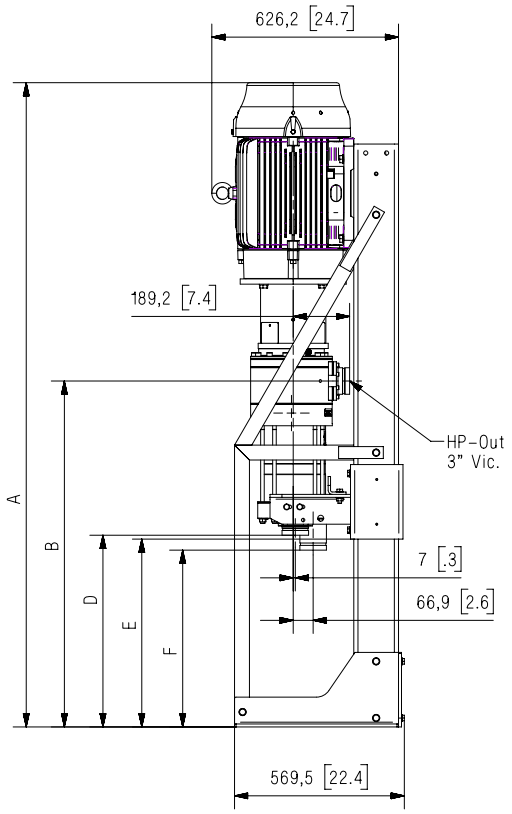
8.4 iSave 50-70 with with IE3 motor 18.5 kW on base frame horizontal

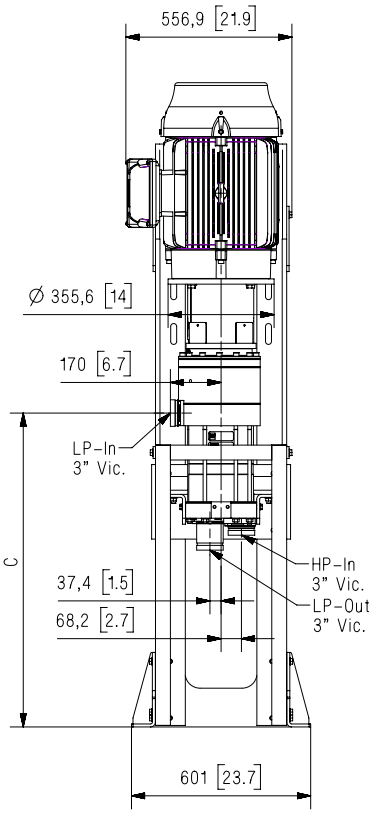


8.4 iSave 50-70 with NEMA motor 30 HP on base frame vertical - front mounted

1. M12 anchoring/bolts.
   Bolt quality min. class 8.8.
   Torqued acc. to recommendation from bolt supplier.
   Foundation/anchoring acc. to Eurocode 2: 1992-1-1.







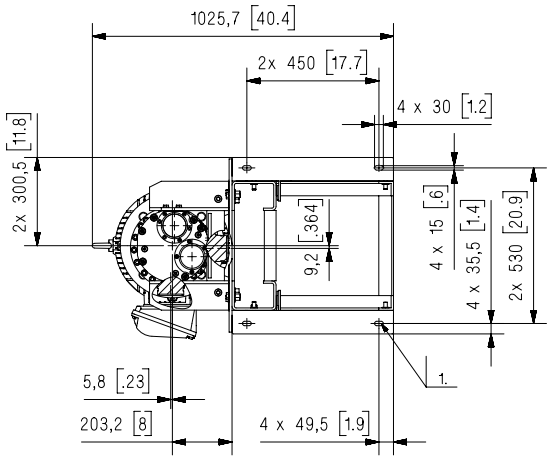
Dimensions without tolerances acc. to ISO 2768-1 designation C.
Positions 1, 2 and 3 refers to the three different heights where the iSave can be mounted on the baseframe.

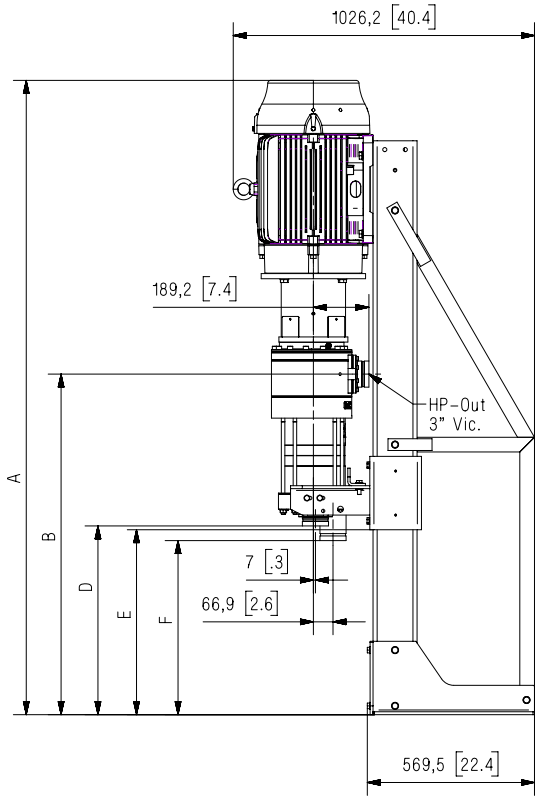
Dimension	Position 1	Position 2	Position 3
A	2160,8 [85,1]	2008,3 [79,1]	1855,8 [73.1]
B	1160,2 [45.7]	1007,7 [39.7]	855,2 [33.7]
C	1052,7 [41.4]	900,2 [35.4]	747,7 [29.4]
D	643 [25.3]	490,5 [19.3]	338 [13.3]
E	630 [24.8]	477,5 [18.8]	325 [12.8]
F	593 [23.3]	440,5 [17.3]	288 [11.3]

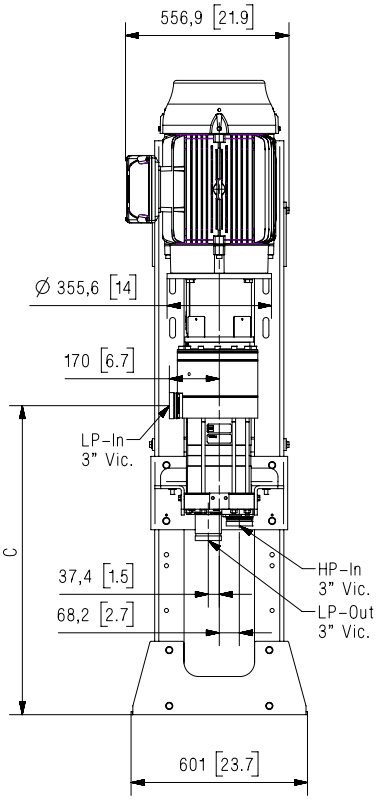
* Unit is delivered in position 3!

8.5 iSave 50-70 with NEMA motor 30 HP on base frame vertical - back mounted

1. M12 anchoring/bolts.
Bolt quality min. class 8.8.
Torqued acc. to recommendation from bolt supplier.
Foundation/anchoring acc. to Eurocode 2: 1992-1-1.





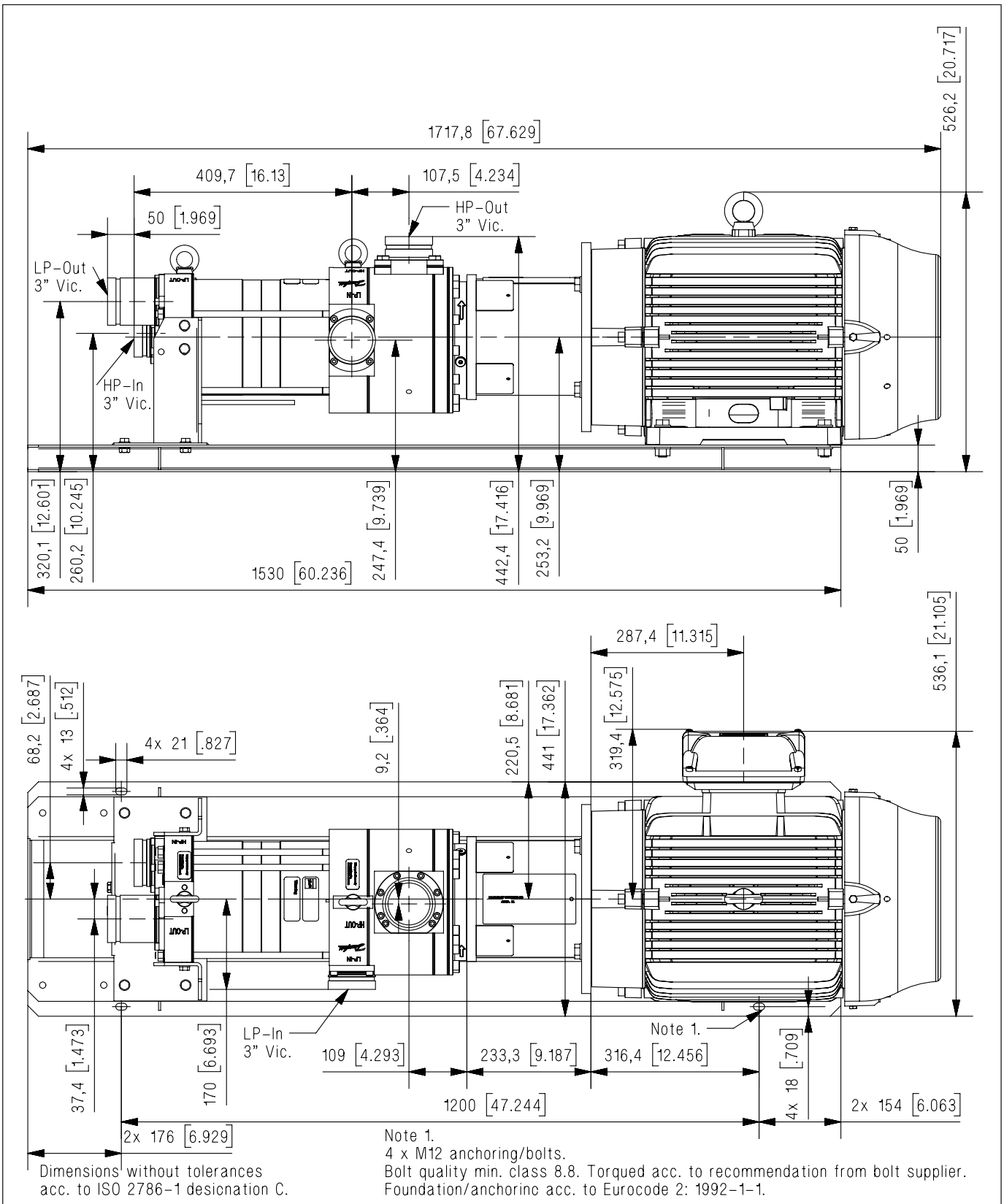


Dimensions without tolerances acc. to ISO 2768-1 designation C.
Positions 1, 2 and 3 refers to the three different heights where the iSave can be mounted on the baseframe.

Dimension	Position 1	Position 2	Position 3
A	2160,8 [85,1]	2008,3 [79,1]	1855,8 [73.1]
B	1160,2 [45.7]	1007,7 [39.7]	855,2 [33.7]
C	1052,7 [41.4]	900,2 [35.4]	747,7 [29.4]
D	643 [25.3]	490,5 [19.3]	338 [13.3]
E	630 [24.8]	477,5 [18.8]	325 [12.8]
F	593 [23.3]	440,5 [17.3]	288 [11.3]

* Unit is delivered in position 3!

8.5 iSave 50-70 with NEMA motor 30 HP on base frame horizontal



9. Service

9.1 Warranty

The Danfoss iSave is designed for long operation, low maintenance and reduced lifecycle costs.

Provided that the iSave has been running according to the Danfoss specifications, Danfoss guarantees one year service-free operation, however, max. 18 months from date of production.

9.2 Operational conditions of concern

Particular attention should be paid to the following factors to avoid increased wear and spare parts costs:

- Insufficient filtration
- Insufficient bleeding and venting
- Running at speeds outside specificat tions
- Wrong direction of rotation
- Insufficient flushing or periods of standstill with sea water inside the iSave.

9.3 Maintenance

Periodic inspections are required to ensure worn parts (if any), are replaced in due time. Operational conditions such as water quality should be taken into consideration when determining the frequency of the inspections. Danfoss recommends yearly inspections.

It is recommended to order the purpose-designed tool kit.

9.4 Repair assistance

In case of irregular function of the Danfoss RO components, please contact Danfoss High Pressure Pumps.

10. Accessories

Description	Type	Code no.
3" Inlet hose kit - 2 m (79") 6 barg (87 psig)	3" Victaulic, style 77	180Z0144
3" Outlet hose - 1 m (39.4") 80 barg (1160 psig)	3" Victaulic, style 77	180Z0611
3" Outlet hose - 1.79 m (70.0") 80 barg (1160 psig)	3" Victaulic, style 77	180Z0612
Coupling iSave 50 - iSave 70	Softex 55H7-32H7	180Z4003
Base plate horizontal	IEC200/NEMA324TC	180Z4007
Base plate vertical	IEC200/NEMA324TC	180Z4025

11. Useful documents

Literature number	Description
180R9213	Start and stop of the SWRO with iSave
180R9214	Membrane cleaning of the RO system with the iSave
180R9354	Parallel coupled APP and iSave
180R9367	Pipe connections
180R9371	Pressure safety valve in the SWRO system
180R9372	APP and iSave overload protection
180R9370	Review sheet P&ID
521B1009	Filtration
	iSave selection tool (hpp.danfoss.com)

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ENGINEERING
TOMORROW

Design guide

iSave Energy Recovery Device

Start and stop of the SWRO with iSave

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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 page 5.

iSave can be both a single iSave and multiple iSaves in parallel.

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.
- The iSave (s) 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 (15) (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).
- Continuously operation:
- To minimize mixing, the flow on the low-pressure side can be adjusted up to 10% higher than the high-pressure flow with the limitation that the flow rate at LP inlet may not exceed 70 m^3/h.

Prior to start-up

High quality water extends the service life of the whole system.
Both the APP pump and iSave are sensitive to hard particles.
Before connecting any APP pump or iSave to a piping system **ALL** pipes must be thorough flushed with high quality pre-filtered water or mechanical cleaned.

1. Install all filter cartridges in the system.
2. With the iSave(s) and APP pump(s) *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(s) and APP pump(s) to the pipework. The iSave(s) and APP pump(s) are now ready for start-up.

Starting up the system

1. Make sure that all valves are set in normal operating positions.
2. Start the seawater supply pump (A).
3. Make sure all pipework is flushed with water. Vent all air from the system through air valve (8) and iSave unit (11). After venting, close valve (8).
   At initial start-up also bleed the iSave(s) and APP pump(s).

4. Start the iSave(s).
   In general: Only start the iSaves when the pressure "HP in" (10) is below 20 barg/290 psig. Always start the iSave unit before the high-pressure pump is started.

   There are in principle two ways to start multi ple iSaves:
   - Slowly ramp up all the iSaves at the same time.
   - Slowly ramp up one by one.

   Starting sequence - one by one:
   a) Start iSave #1.
   b) After 5 sec. start iSave #2.
   c) In a sequence of 5 sec. start the remaining iSaves.
   Comments:
   - Ramp up time on iSaves is set between 10 –15 sec.

   Starting sequence - Start all iSaves at the same time.
   Comments:
   - Ramp up time on iSaves is set between 10 –15 sec.

   If the pressure (10) at "HP in" drops below 3 barg/43.5 psig, the sound will change of the iSave. This is due to cavitation. "HP in" pressure at 3 barg/43.5 psig is acceptable for less than 10 min. within a period of 6 hours. Run the iSave at its min allowable speed during this period to reduce cavitation.

5. With a pressure control valve (15), adjust the back pressure of the "LP-out" to fulfill the minimum presure requested in the Data sheet. (May only be necessary at initial start up).

6. An "over flush" of the iSave can be done to bleed any remaining air from the system. Flush over a period of minimum 2 minutes.

7. Adjust the speed of the iSave unit to desired flow (rpm). The speed is controlled by a VFD.

8. Start the high-pressure pump(s) (4), and the system pressure (5) will rise until the permeate flow (17) almost equals the flow (2) from the high-pressure pump.

9. **For iSave 21 and iSave 40:**
   Check the low pressure flow rates (12), and if required, adjust flow with valve (15) to achieve balanced flow to the iSave(s).

   1. If the "LP-in" flow (12) is too low and the "LP-out" pressure (14) is higher than 1 barg/14.5 psig, increase flow and decrease pressure by opening the pressure control valve (15).
   2. If the "LP-in" flow (12) is too low and the "LP-out" pressure (14) is below 1 barg/ 14.5 psig, adjust the flow by raising the flow from the seawater supply pump (A).
   3. If the "LP-in" flow (12) is too high, reduce flow by closing the pressure control valve (15) or the flow from the seawater supply pump (A).

10. **For iSave 50 and iSave 70:**
    Check the low pressure flow rates (12), and if required, adjust flow with valve (15) to achieve balanced flow to the iSave(s).

    1. If the "LP-in" flow (12) is too low and the "LP-in" pressure (21) is higher than 2 barg/29 psig, increase flow and decrease pressure by opening the pressure control valve (15).
    2. If the "LP-in" flow (12) is too low and the "LP-in" pressure (21) is below 2 barg/ 29 psig, adjust the flow by raising the flow from the seawater supply pump (A).
    3. If the "LP-in" flow (12) is too high, reduce flow by closing the pressure control valve (15) or the flow from the seawater supply pump (A).

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(s) (11) running until the TDS in the high-pressure line is equal to the TDS in the low-pressure line.
   NB! If the pressure (10) at "HP in" drops below 3 barg/43.5 psig, the sound will change of the iSave. This is due to cavitation. "HP in" pressure at 3 barg/43.5 psig is acceptable for less than 10 minutes within a period of 6 hours. Run the iSave at its min allowable speed during this period to reduce cavitation.

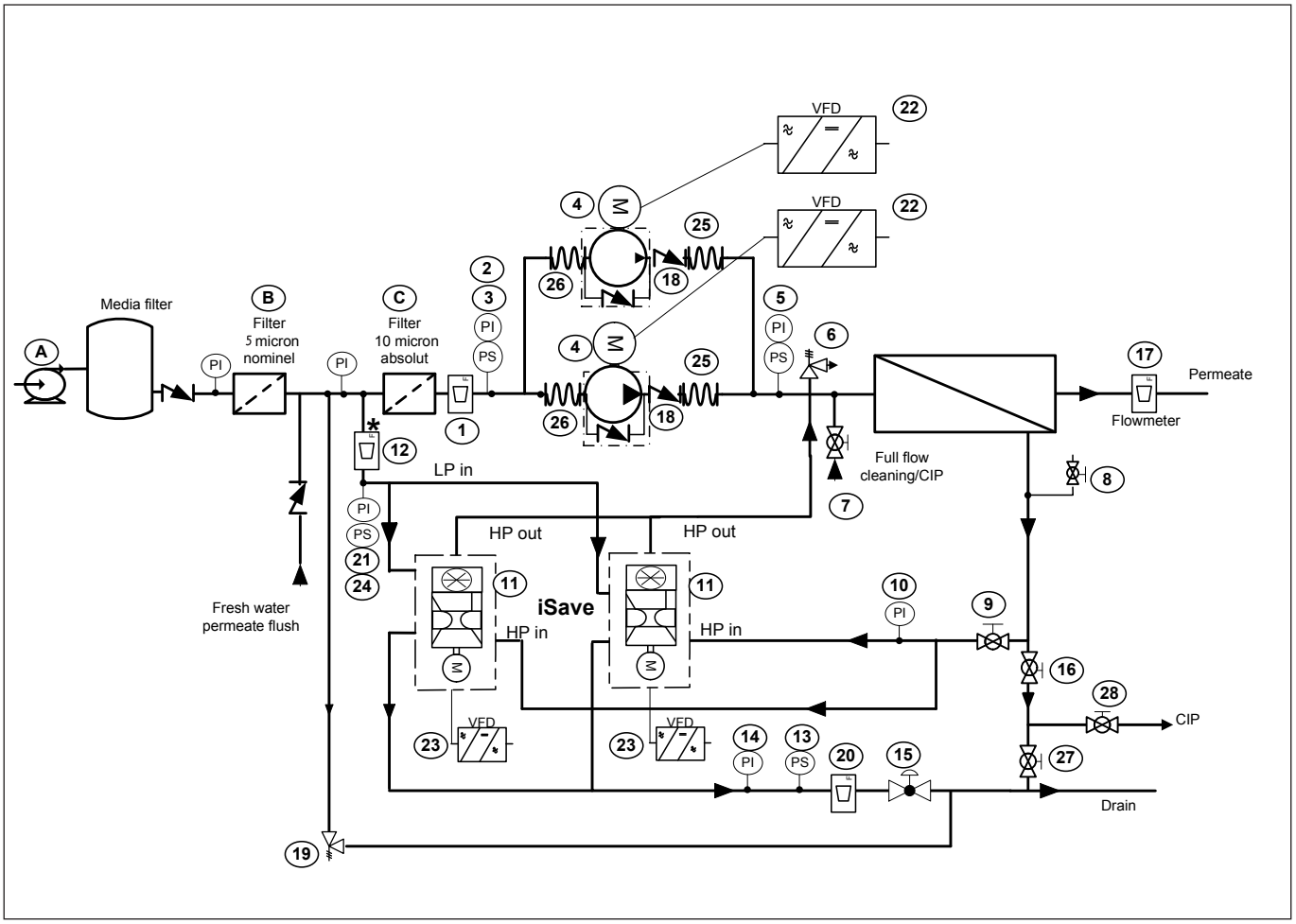
4. Stop the iSave(s)(11).

5. Stop the seawater supply pump (A).

More than one day system shutdown

1. Run the "daily system shutdown" procedure.
2. Supply permeate water to the SWRO system by using fresh water/permeate flush connection..
3. When the pressure "HP in" (10) is below 20 barg/ 290 psig start the iSave(s).

   NB! If the pressure (10) in "HP in" drops below 3 barg/43.5 psig, the sound will change of the iSave. This is due to cavitation. "HP in" pressure at 3 barg/43.5 psig is acceptable for less than 10 minutes within a period of 6 hours. Run the iSave at its minimum allowable speed during this period to reduce cavitation.
4. Start the APP pump(s) in a period of 5 sec. by using normal ramp-up settings.
5. Stop the APP pump(s) after 5 sec.
6. Run the iSave(s) until the TDS in the high-pressure line is equal to the TDS in the low-pressure line.
7. Stop iSave(s) and permeate water supply.



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ENGINEERING
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Design guide

Energy Recovery Device
iSave
Membrane cleaning of RO-system

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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 numbers marked in () refer to the diagram's below.

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(s) or pump(s).

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.

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(s) (4), and stop the iSave(s) (11).
2. Stop the seawater supply pump (A).
3. Close valve (9 and 27) and open valve (16 and 28), and feed cleaning solution through valve (7).
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 datasheet.

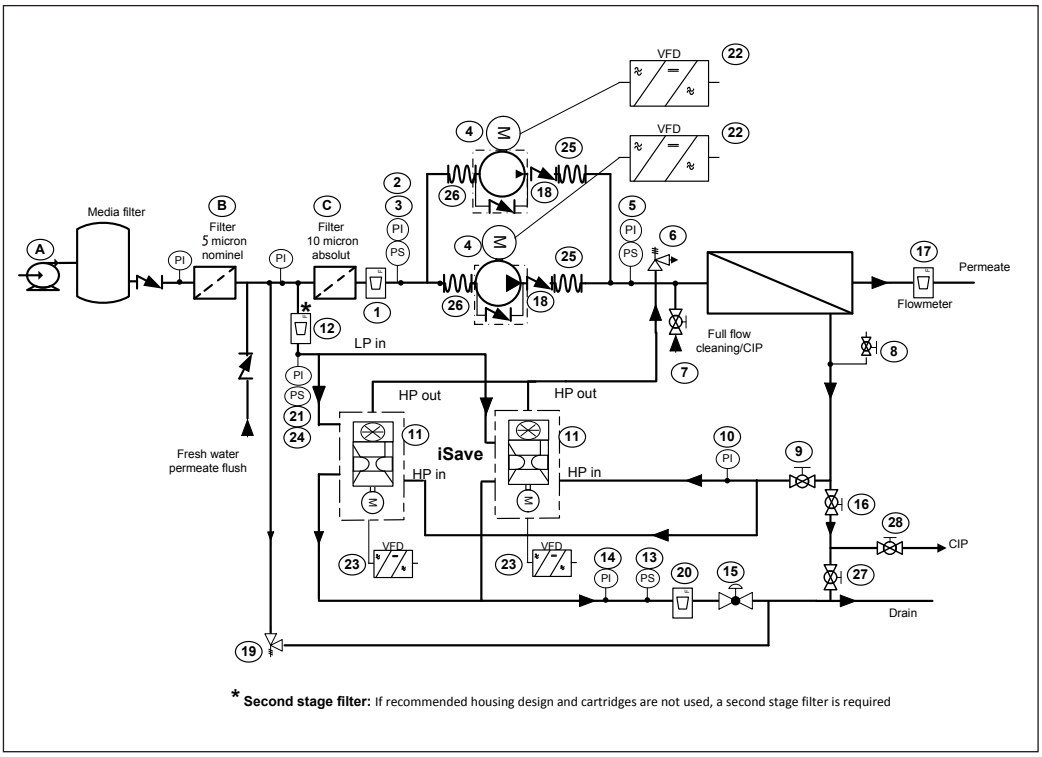
9. Open valve (9) and continue flushing. The iSave(s) may start to rotate backward – this is OK.

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 and 28).

12. Open valve (27)

P&ID no. 1



Below procedure is according P&ID no 2.

1. Stop the high-pressure pump(s) (4), and stop the iSave (11).

2. Stop the seawater supply pump (A).

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. Close valve (27) and open valve (28)

6. Pump mixed cleaning solutions through valve (7) 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.

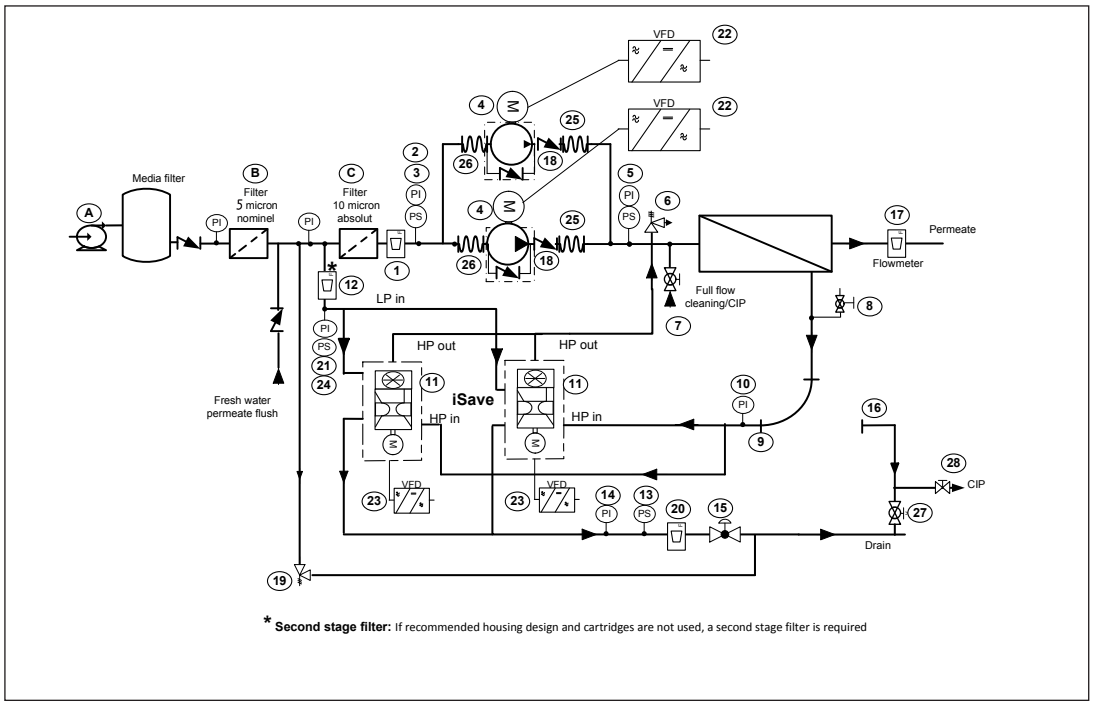
9. Feed the cleaning solution at high flow into the "full flow cleaning" adapter (7) on the feed side of the membrane. The high flow rate flushes out the foulants removed from the membrane surface by the cleaning.

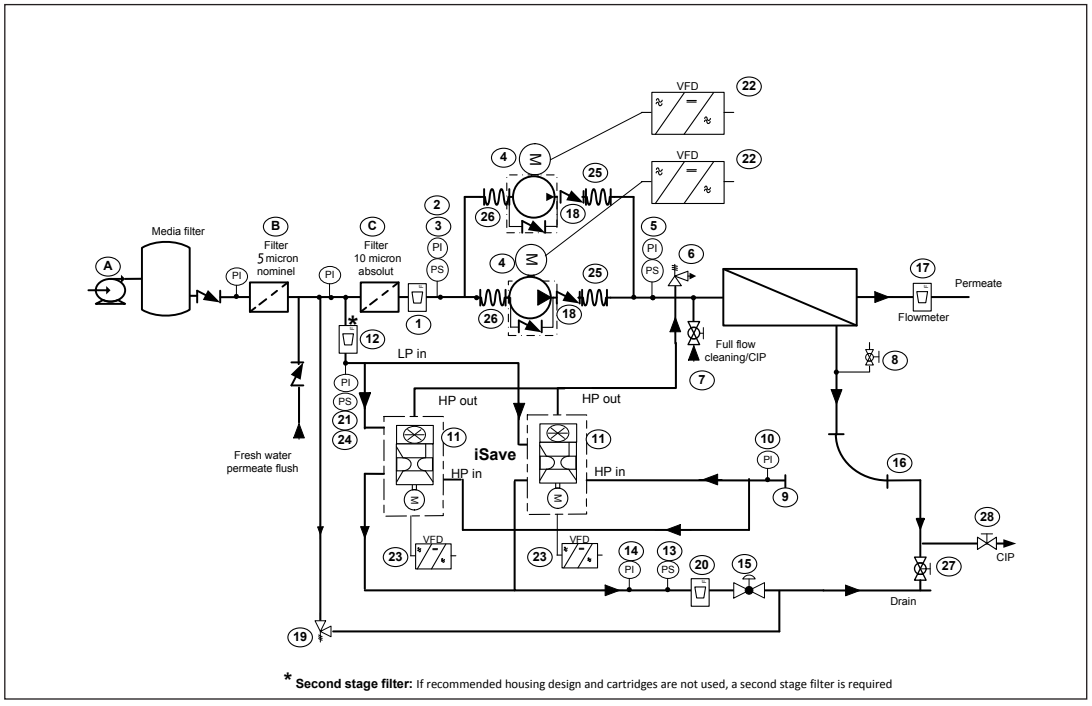
10. Flush RO permeate or deionised water into the "full flow cleaning" adapter (7) on the feed side of the membrane. Flush out the cleaning solution.
    It is essential that the water used for the final pre-flush is pre-filtered to a level described in the datasheet.

11. When flushing is finalised – Close the high pressure "full flow cleaning" valve (7) and close valve (28).

12. Connect the high pressure pipe to joint (9) again.

P&ID no. 2





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Design Guide

APP pumps and iSave® overload protection

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Table of Contents

Table of Contents

1. Introduction

This document shows what to consider when programming a VFD that can protect the APP pump and the iSave against overloads. It also shows how to program the Danfoss VLT FC 202 and FC 302 in connection with the APP pump and iSave.
Similar functions need to be available on other VFD brands.

There are principal two choiches that can be made when selecting the torque limits for the pump and iSave.

1. Protecting the pump or iSave against maximum allowable load, means maximum torque at maximum pressure. This choice may not give the possibility to detect additional critical torque caused by wear of internal parts. See graph in example #1 in chapter 2.1.
2. Protecting the pump or iSave against significant change in actual load. This choice gives you the possibility to detect additional critical torque caused by wear of internal parts. This means the torque limit typical will b set lower than maximum Allowable Operating Torque. See graph in example #2 in chapter 2.1.
Danfoss strongly recommend to use the possibility to detect significant change in actual load.

2. APP pump and iSave overload protection

When protecting the pump and iSave against overload **both the maximum torque and maximum pressure must be taken into account.**

- Maximum allowable operation torque is the maximum torque the product can handle in normal operation.
- Maximum allowable operation torque is the maximum torque the product need in a specificl operation.

2.1 Maximum torque

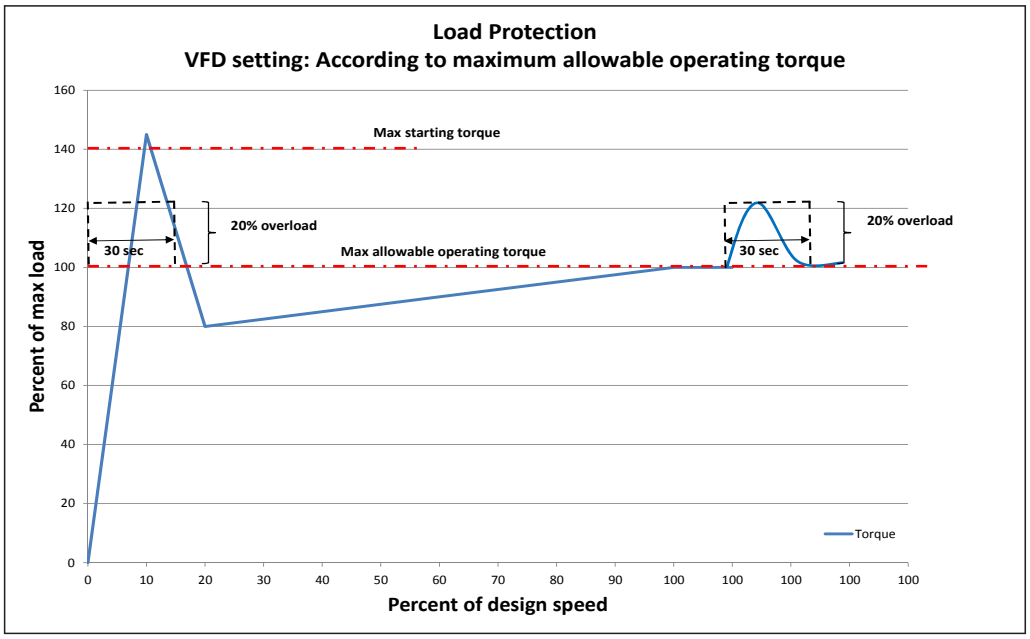
Start up:

- Ramp up speed from 0 to set-point
- The starting torque must not exceed maximum Starting Torque according to chapter 5.

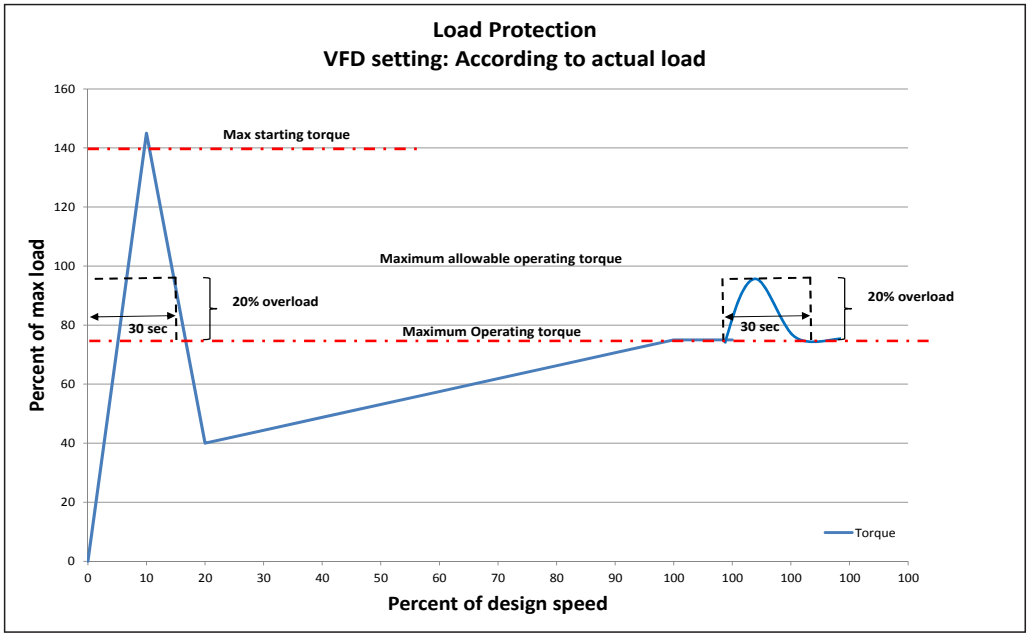
Ongoing operating:

- Continuously the torque must not exceed 120% of maximum Allowable Operating Torque for more than 30 sec.
- Periodically the torque can for a very short time go up to maximum Starting torque.

Example #1



Example #2



3. Standard preferred settings

3.1 VLT FC 202 and VLT FC 302

For detailed information on how to program a VLT FC 202 or FC 302 we refer to the "Programming Guide VLT Aqua Drive FC 202 and FC 302". vlt-drives.danfoss.com

To calculate setting for parameter 4-16 and 4-18 please contact Danfoss.

Programming VLT:		
Parameter 0-01	"Language"	Set language
Parameter 0-02	"Motor speed unit"	Set to rpm
Parameter 0-20	"LCD Display"	Choose rom, Amp, kW, Hz, Torque
Parameter 1-03	"Torque characteristic"	Set to 0 (Constant torque)
Parameter 1-06	"Clockwise direction"	Set to inverse (Clockwise)
Parameter 1-20	"Motor power kW"	According to motor name plate
Parameter 1-22	"Motor voltage"	According to motor name plate
Parameter 1-23	"Motor frequency"	According to motor name plate
Parameter 1-24	"Motor current"	According to motor name plate
Parameter 1-25	"Motor nominel speed"	Rpm according to name plate
Parameter 1-29	"Automatic motor adaption AMA"	Run full AMA. (Remember to fuse terminals 12 and 27. Push hand on. Remove fuse after AMA)
Parameter 1-71	"Start delay"	Set in sec. (See chapter 5.3)
Parameter 1-72	"Start function"	Set to 0. (DC hold/delay/time)
Parameter 2-00	"DC hold current"	Set in % (please contact Danfoss or see chapter 5.2 for iSave)
Parameter 3-02	"Minimum reference"	Set to 0
Parameter 3-03	"Maximum reference"	Set needed rpm. For application
Parameter 3-41	"Ramp 1. Ramp up time"	Motor ramp up time. Pump: 10-60 sec. = 1 barg/sec. iSave: 10.15 sec.
Parameter 3-42	"Ramp 1. Ramp down time"	Motor ramp down time. Pump: 10-60 sec. = 1 barg/sec. iSave: 10-15 sec.
Parameter 4-11	"Motor speed low limit"	Set low limit [rpm] for product according to chapter 5
Parameter 4-13	"Motor speed high limit"	Set max. limit [rpm] for product according to chapter 5
Parameter 4-19	"Max. output frequency"	[Hz] Set max. output for product
Torque limit		
Parameter 4-16	"Torque limit motor mode"	Set in [%] (please contact Danfoss or see chapter 5.2 for iSave)
Parameter 14-25	"Trip delay at torque limit"	Set to 30 sec.
Current limit		
Parameter 4-18	"Current limit"	Set in [%] (Par. 4-18 must always be larger or equal to Par. 4-16), (please contact Danfoss or see chapter 5.2 for iSave)

4. Examples of VLT overload limit settings

Below is two examples of how to calculate the torque limit settings for an APP pump.
All calculations are made in the Danfoss HPP calculation tool (please contact Danfoss HPP for help).

Example 1:
Settings are made according to actual operating pressure (see graph #2 in chapeter 2.1).

- 77 m³/h and 60 barg max. operating pressure
- **Design pressure 60 barg**

√ Calculated operating torque: 934 Nm at 1,490 rpm and 60 barg.
√ Selected motor:
  - 160 kW, 4 pole
  - Efficiency: 95.8%
  - Power factor (cosφ): 0.87
  - Power supply: 400 [V]
  - Rated speed: 1,490 rpm
  - Max. current: 275 [A]
  - Max. operating torque: 1,026 Nm

√ Calculate torque at 20% higher than 934 Nm = > 1,121 Nm
Parameter 4-16 setting = 107%
√ Calculate starting torque at 40% higher than 934 Nm = > 1,308 Nm
Parameter 4-18 setting = 121%
√ Calculated DC-hold: Parameter 2-00 is 49%
√ Selected delay before start
Parameter 1-71 is 4
(see chapter 5.3)
√ Trip delay torque limit:
Parameter 14-25 is 30 sec.
√ Calculated starting current: 334 [A]
√ Calculated operating current at 60 barg: 257 [A]

Example 2:
Settings are made according to maximum allowable operating pressure (see graph #1 in chapter 2.1)

- 77 m³/h and 60 barg max. operating pressure
- **Design pressure 80 barg**

√ Calculated maximum operating torque: 1,246 Nm at 1,490 rpm and 80 barg.
√ Calculated operatin torque: 934 Nm at 1,490 rpm and 60 barg.
√ Selected motor:
  - 200 kW, 4 pole
  - Efficiency: 96%
  - Power factor (cosφ): 0.88
  - Power supply: 400 [V]
  - Rated speed: 1,490 rpm
  - Max. current: 340 [A]
  - Max. operating torque: 1,282 Nm

√ Calculate torque at 20% higher than 934 Nm = > 1,121 Nm
Parameter 4-16 setting = 90%
√ Calculate starting torque at 40% higher than 934 Nm = > 1,308 Nm
Parameter 4-18 setting = 102%
√ Calculated DC-hold:
Parameter 2-00 is 47%
√ Selected delay before start
Parameter 1-71 is 4.5
√ Trip delay torque limit:
Parameter 14-25 is 30 sec.
√ Calculated starting current: 345 [A]
√ Calculated operating current at 60 barg: 271 [A]

5. APP and iSave maximum load and speed limit

5.1 APP pumps

APP pump	Code number	Max. starting torque Use without VFD control	Max. starting torque Use in Parameter 4-18	Max. allowable operating torque Use in Parameter 4-16	Max. allowable operating pressure	Operational speed (min.) Parameter 4-11	Operational speed (max.) Parameter 4-13
APP 86/1700	180B7802	1700 [Nm]	1155 [Nm]	1111 [Nm]	70 barg	700 rpm	1700 rpm
APP 78/1500	180B7800	1700 [Nm	1700 [Nm]	1246 [Nm]	80 barg	700 rpm	1500 rpm
APP 65/1500	180B7803	1700 [Nm	1541 [Nm]	1101 [Nm]	80 barg	700 rpm	1500 rpm
APP 53/1500	180B7801	1700 [Nm	1205 [Nm]	861 [Nm]	80 barg	700 rpm	1500 rpm
APP 43/1700	180B3072	851 [Nm]	764 [Nm]	546 [Nm]	70 barg	700 rpm	1700 rpm
APP 38/1500	180B3071	851 [Nm]	851 [Nm]	608 [Nm]	80 barg	700 rpm	1500 rpm
APP 30/1200	180B3060	851 [Nm]	851 [Nm]	608 [Nm]	80 barg	700 rpm	1200 rpm
APP 30/1500	180B3062	851 [Nm]	699 [Nm]	499 [Nm]	80 barg	700 rpm	1500 rpm
APP 26/1200	180B3056	851 [Nm]	738 [Nm]	527 [Nm]	80 barg	700 rpm	1200 rpm
APP 26/1500	180B3057	851 [Nm]	596 [Nm]	426 [Nm]	80 barg	700 rpm	1500 rpm
APP 24/1200	180B3054	851 [Nm]	685 [Nm]	489 [Nm]	80 barg	700 rpm	1200 rpm
APP 24/1500	180B3055	851 [Nm]	543 [Nm]	388 [Nm]	80 barg	700 rpm	1500 rpm
APP 21/1200	180B3051	851 [Nm]	585 [Nm]	418 [Nm]	80 barg	700 rpm	1200 rpm
APP 21/1500	180B3052	851 [Nm]	497 [Nm]	355 [Nm]	80 barg	700 rpm	1500 rpm
APP 22/1200	180B3257	596 [Nm]	596 [Nm]	426 [Nm]	80 barg	700 rpm	1200 rpm
APP 22/1500	180B3253	596 [Nm]	427 [Nm]	305 [Nm]	70 barg	700 rpm	1500 rpm
APP 19/1200	180B3256	596 [Nm]	521 [Nm]	372 [Nm]	80 barg	700 rpm	1200 rpm
APP 19/1500	180B3252	596 [Nm]	368 [Nm]	263 [Nm]	70 barg	700 rpm	1500 rpm
APP 17/1200	180B3255	596 [Nm]	480 [Nm]	343 [Nm]	80 barg	700 rpm	1200 rpm
APP 17/1500	180B3251	596 [Nm]	328 [Nm]	234 [Nm]	70 barg	700 rpm	1500 rpm
APP 16/1200	180B3254	596 [Nm]	442 [Nm]	316 [Nm]	80 barg	700 rpm	1200 rpm
APP 16/1500	180B3250	596 [Nm]	312 [Nm]	223 [Nm]	70 barg	700 rpm	1500 rpm
APP 13/1200	180B3214	384 [Nm]	384 [Nm]	274 [Nm]	80 barg	700 rpm	1200 rpm
APP 13/1500	180B3213	384 [Nm]	286 [Nm]	204 [Nm]	70 barg	700 rpm	1500 rpm
APP 11/1200	180B3212	384 [Nm]	321 [Nm]	229 [Nm]	80 barg	700 rpm	1200 rpm
APP 11/1500	180B3211	384 [Nm]	232 [Nm]	166 [Nm]	70 barg	700 rpm	1500 rpm

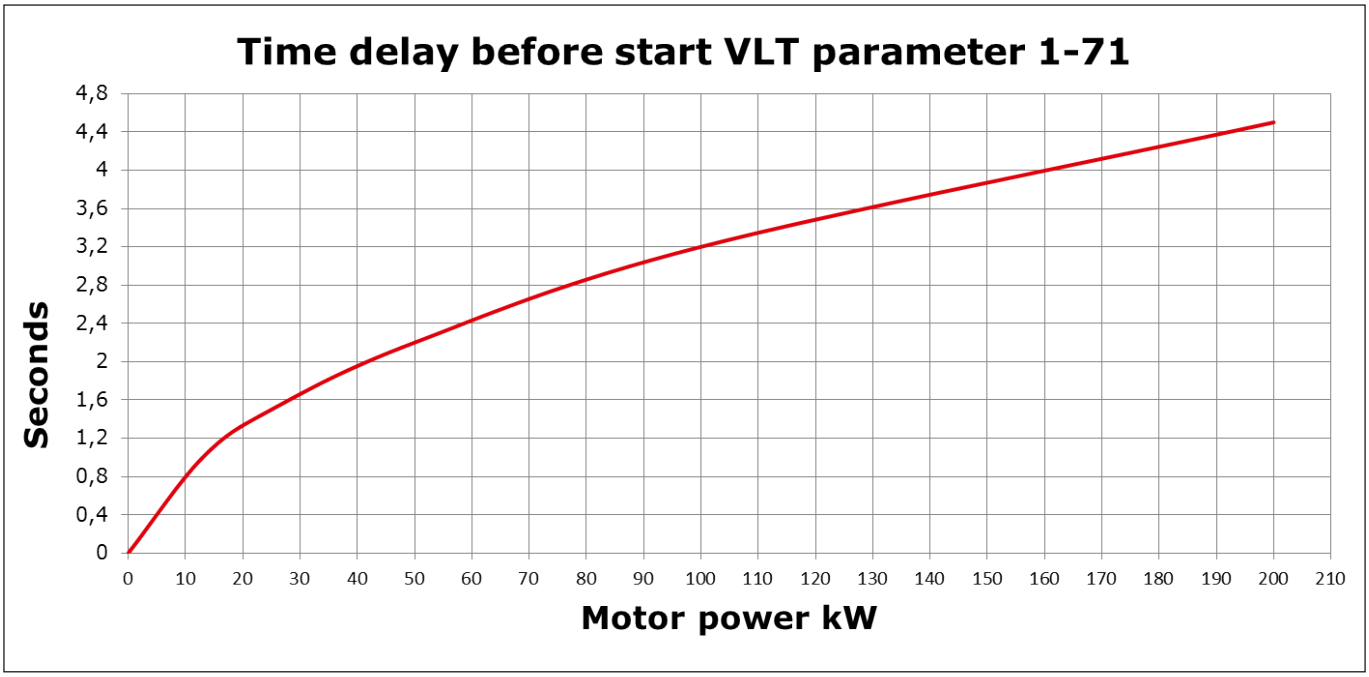
5.2 iSave energy recovery device

iSave	iSave 21 Plus	iSave 21 Plus	iSave 40	iSave 40	iSave 40
Code number	180F7016 180F7000[2)]	180F7017	180F7001 180F7003	180F7004 180F7005	180F011N206H 180F011N206V
Motor	5.5 kW IEC	7.5 kW IEC	11 kW IEC	15 kW IEC	20 HP NEMA
Max. allowable operating differential pressure	3 barg	5 barg	5 barg	5 barg	5 barg
Max. allowable operating torque	36 Nm	49 Nm	102 Nm	102 Nm	102 Nm
Max. starting torque	50 Nm	50 Nm	150 Nm	150 Nm	150 Nm
Delay before start **Parameter 1-71**	0.4 sec.	0.7 sec.	0.8 sec.	1.1 sec.	1.1 sec.
DC hold **Parameter 2-00**	54%	54%	61%	59%	53%
Max. starting torque **Parameter 4-18**	129%	114%	125%	89%	117%
Max. allowable operating torque **Parameter 4-16**	114%	102%	108%	101%	100%
Operational speed (Min.) **Parameter 4-11**	500	500	600	600	600
Operational speed (Max.) **Parameter 4-13**	1500	1500	1200	1200	1200
Delay torque limit **Parameter 14-25**	30 sec.	30 sec.	30 sec.	30 sec.	30 sec.

iSave	iSave 50	iSave 50	iSave 70	iSave 70
Code number	180F7022	NA	180F7024	NA
Motor	18.5 kW IEC	30 HP NEMA	18.5 kW IEC	30HP NEMA
Max. allowable operating differential pressure	5 barg	5 barg	5 barg	5 barg
Max. allowable operating torque	170 Nm	170 Nm	180 Nm[1)]	179 Nm[1)]
Max. starting torque	180 Nm	180 Nm	180 Nm	180 Nm
Delay before start **Parameter 1-71**	1.3 sec.	1.5 sec.	1.3 sec.	1.5 sec.
DC hold **Parameter 2-00**	59%	56%	59%	56%
Max. starting torque **Parameter 4-18**	109 %	110%	113%	114%
Max. allowable operating torque **Parameter 4-16**	109%	110%	113%	114%
Operational speed (Min.) **Parameter 4-11**	525	525	625	625
Operational speed (Max.) **Parameter 4-13**	650	650	875	875
Delay torque limit **Parameter 14-25**	30 sec.	30 sec.	30 sec.	30 sec.

[1)] Maximum torque the electric motor is able to operate with
[2)] iSave 21 old version

5.3 Time delay before start



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Instruction

Right and wrong
Hose assembly routing tips

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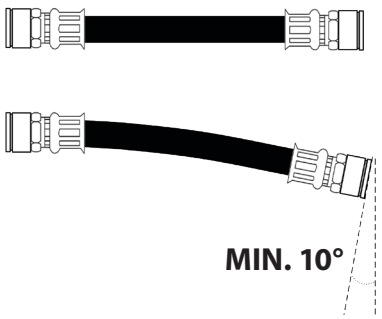
Correct hose installation is essential for safe and satisfactory performance. The size of the hoses impacts the installation recommendations. This manual has therefore been split in recommendation for hoses up to 2″ and recommendation larger than 2″.

Hose routing tips:
Danfoss recommends installing hose whip restraints whenever your pressurized hose assemblies are in proximity to personnel or crucial equipment.
Check with these examples when installing your hoses.

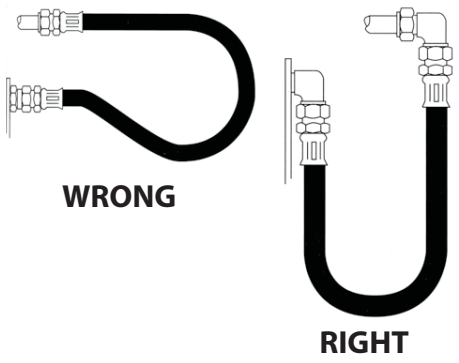
1. Hoses up to 2″

When installing hoses, avoid twisting the hose as the hose will try to straighten under pressure.

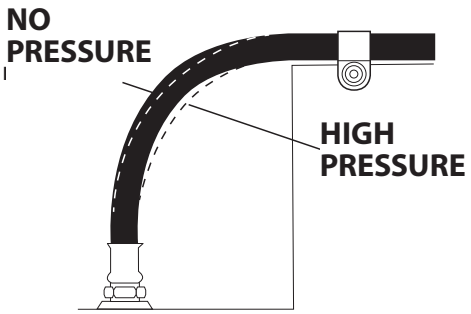
This can cause hose failure via hose blowout from the fitting and/or hose burst at the point of strain.



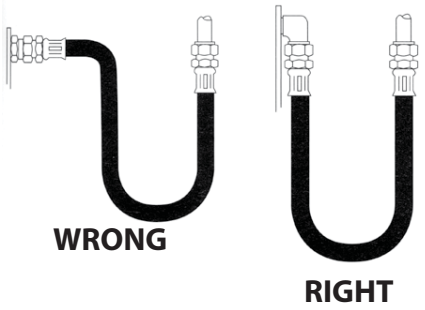
Always provide some angle on straight hose installations, this reduces forces and ensures that hose is only bending i one direction. The Hose must have some slack to compensate for hose length variations.



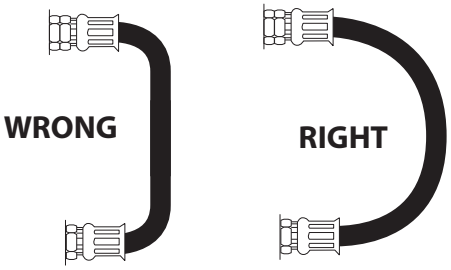
At radius below required minimum, angle adapters should be used to prevent sharp hose bends.



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



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

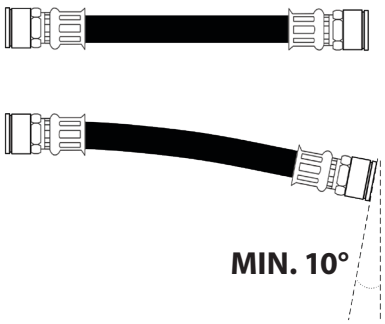


To prevent hose collapse and flow restriction, hose bend radii should be kept as large as possible. Tight bends can also compromise the hose reinforcement and cause premature hose failure. Refer to hose specification table on page 6 for minimum bend radii.

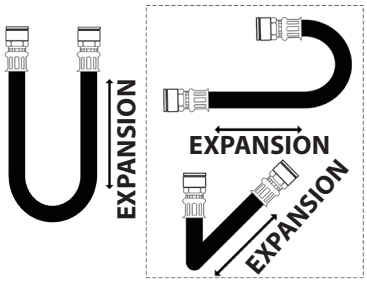
2. Hoses larger than 2”

Whenever possible, high pressure hoses should always be connected directly to Danfoss provided adapters and check valves. Elbows and distance pipes should be avoided to prevent excessive side loads.

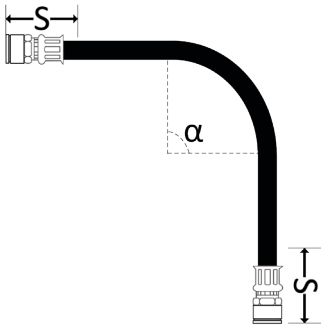
Danfoss 3” HP hoses are nylon reinforced; when using hoses that are not steel reinforced the connected items must be grounded to avoid electrical stray currents.



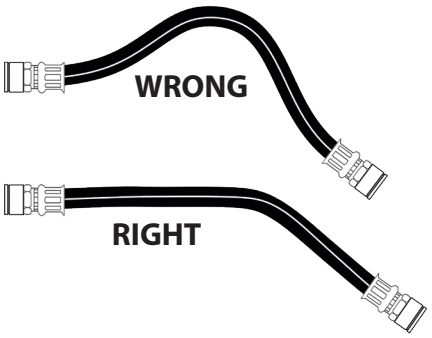
Always provide some slack on straight hose installations. This compensates for hose length variations with differences in internal fluid pressures. A small angle will reduce the forces from the hose and allow the hose to bend when pressurized.



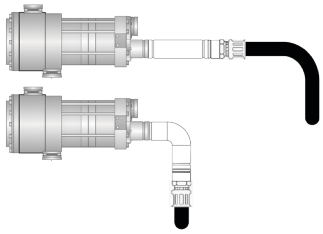
Flexing a metal hose in two separate planes of movement will torque the hose assembly. Always install the metal hose assembly so that flexing occurs in one plan only and this is the same plane in which bending occurs. If multiple planes of motion are required use a dog leg assembly.



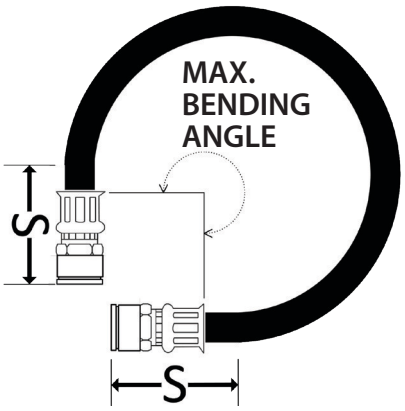
The installation should allow a straight distance S before bending the hose. Not doing so may compromise the hose reinforcement and cause hose failure. Max. bending angle and distance S can be found in table 1 on page 6.



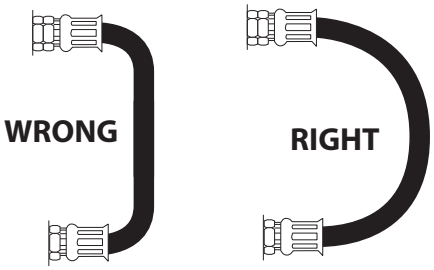
Hoses should not be twisted and should only have one bend.



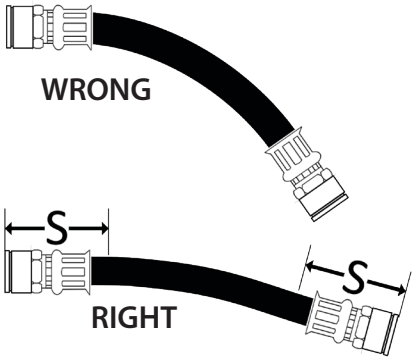
The use of pipe or fittings between pump and iSave connectors and hoses should be avoided. Such configurations can apply excessive loads on the connectors and can cause connector and/or connector bolt failure. If this cannot be avoided, the piping system must be protected by either hose whip restraints mounted directly to the frame or the hard piping must be fixed relative to any pump/iSave movements.



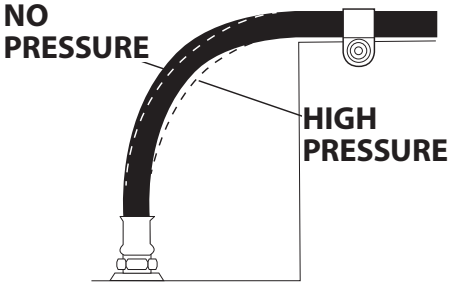
If hose is bent, ensure max. bending angle and distance S from each connector (see table 1 on page 5).



To prevent hose collapse and flow restriction, hose bend radii should be kept as large as possible. Tight bends can also compromise the hose reinforcement and cause premature hose failure. Refer to hose specification table on page 6 for minimum bend radii.



The hose must have a distance S before bending starts.

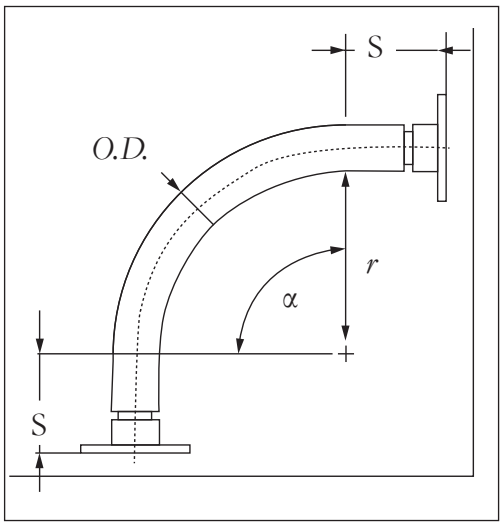


To allow the hose to expand when pressurized, clamps should not be used at bends. If possible, do not clamp high and low pressure lines together.

3. Hose specification table

High pressure hoses						
Code number	**Pipe connection[1)] [A]**	**Pipe connection material**	**Hose size Inner diameter**	**Hose length ISO 1436 [B]**	**Bending radius**	**S**
180Z0228	1.5" Vic. OGS	Super duplex EN 1.4410	25.4 mm (1.0")	0.66 m (26")	152 mm (6.08"), max. 90°	79 mm (3.11″)
180Z0229	1.5" Vic. OGS	Super duplex EN 1.4410	25.4 mm (1.0")	1.16 m (45.7")	152 mm (6.08"), max. 180°	79 mm (3.11″)
180Z0167	1.5" Vic. OGS	Super duplex EN 1.4410	38.0 mm (1.5")	1.16 m (45.7")	250 mm (9.84"), max. 180°	85 mm (3.35″)
180Z0140	2.0" Vic. OGS	Super duplex EN 1.4410	50 mm (2.0")	1.25 m (49")	630 mm (24.8"), max. 90°	115 mm (4.53″)
180Z0263	2.5" Vic. OGS[1)]	Super duplex EN 1.4410	50 mm (2.0")	1.78 m (70")	630 mm (24.8"), max. 180°	115 mm (4.53″)
180Z0280	2.5" Vic. OGS	Super duplex EN 1.4410	50 mm (2.0")	1.00 m (39.4")	630 mm (24.8"), max. 90°	115 mm (4.53″)
180Z0619	2.5" Vic. OGS	Super duplex EN 1.4410	65 mm (2.5")	1.78 m (70")	200 mm (7.87"), max. 270°	150 mm (5.90″)
180Z0618	2.5" Vic. OGS	Super duplex EN 1.4410	65 mm (2.5")	1.00 m (9.4")	200 mm (7.87"), max. 90°	150 mm (5.90″)
180Z0612	3.0" Vic. OGS	Super duplex EN 1.4410	76 mm (3.0")	1.79 m (70.5")	250 mm (9.84"), max. 270°	150 mm (5.90″)
180Z0611	3.0" Vic. OGS	Super duplex EN 1.4410	76 mm (3.0")	1.00 m (39.4")	250 mm (9.84"), max. 90°	150 mm (5.90″)
180Z1000	3.0" Vic. OGS	Super duplex EN 1.4410	76 mm (3.0")	1,25 m (49")	250 mm (9.84"), max. 180°	150 mm (5.90″)
180Z1001	3.0" Vic. OGS	Super duplex EN 1.4410	76 mm (3.0")	1,6 m (63")	250 mm (9.84"), max. 180°	150 mm (5.90″)
Low pressure hoses						
180Z0298	2.0″ Vic. OGS	Super duplex EN 1.4410		2.0 m (79″)		
180Z0144	3.0″ Vic. OGS	Super duplex EN 1.4410		2.0 m (79″)		

[1)] The installation instuction for Style 77DX is located in the Victaulic document I-100 Field Installation Handbook (htpp://static.victaulic.com)



When using flexible hoses, it is recommened to use Hose Whip Restraint.

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Data sheet

Headline Myriad Pro
max. 26/26 pt. and min. 18/18 pt.
max. 3 rows

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Climate Solutions • danfoss.com • +45 7488 2222

ENGINEERING
TOMORROW

Parts list

Energy recovery device
iSave 50 - 70

hpp.danfoss. com

Table of Contents

1. General

The parts list provides an overview of th content of the various service kits for the iSave 50-70 as well as exploded view of the iSave.

2. Parts list iSave 50-70

Pos.	Qty.	Description	Material	180F4133 Shaft Seal Kit iSave 50-70	180F4132 Screw and Seal Kit iSave 50-70	180F4134 Coupling Kit iSave 50-70	180F4135 Port Plate Kit PE iSave 50	180F4136 Port Plate Kit PE iSave 70	180F4137 Vane Kit iSave 50-70	180F4138 Valve Plate Kit PE iSave 50-70	180F4139 Rotor/side plade Kit iSave 50-70
1	4	Screw M8	AISI 316	X	X						
2	1	Cover	Super Duplex								
3	1	O-ring	NBR	X	X						
4	1	Shaft seal Ø35	NBR/hasteloy	X							
5	15	Screw M12	AISI 316		X						
6	2	Bleeding plug G1/4"	Super Duplex								
7	2	O-ring	NBR		X						
8	1	Ass. Motor flange	Super Duplex/PEEK								
10	2	O-ring	NBR		X						
11	2	Rotor stop mashined	PEEK								X
12	2	O-ring	NBR		X						
13	2	Side plate	Ceramic								X
14	2	O-ring	NBR		X						
15	2	Rotor element	Ceramic								X
16	2	O-ring	NBR		X						
17	1	Rotor	Super Duplex								
18	8	Vane	PEEK/Super Duplex						X		
19	8	Pin	PEEK						X		
20	1	Key	AISI 316		X						
21	1	Stator	Super Duplex								
22	4	Pin	AISI 316		X						
23	1	O-ring	NBR		X						
24	1	3" Vic. Connector, HP Out	Super Duplex								
25	8	Screw M8	AISI 316		X						
26	1	Intermediate flange	Super Duplex/PEEK								
27	15	Screw M12	AISI 316		X						
28	1	O-ring	NBR		X						
29	1	3" Vic. Connector, LP In	Super Duplex								
30	1	Lifting eye M12	AISI 316								
31	4	Screw M8	AISI 316		X						
101	2	O-ring	NBR		X						
102	4	Clips for retainer plate	PEEK		X						
103	4	Pin	Duplex		X						
104	1	Port plate (Feed)	PEEK/Super Duplex				X	X			
105	2	Valve plate	Super Duplex							X	
106	16	Back-up ring	PTFE		X						
107	16	O-ring	NBR		X						

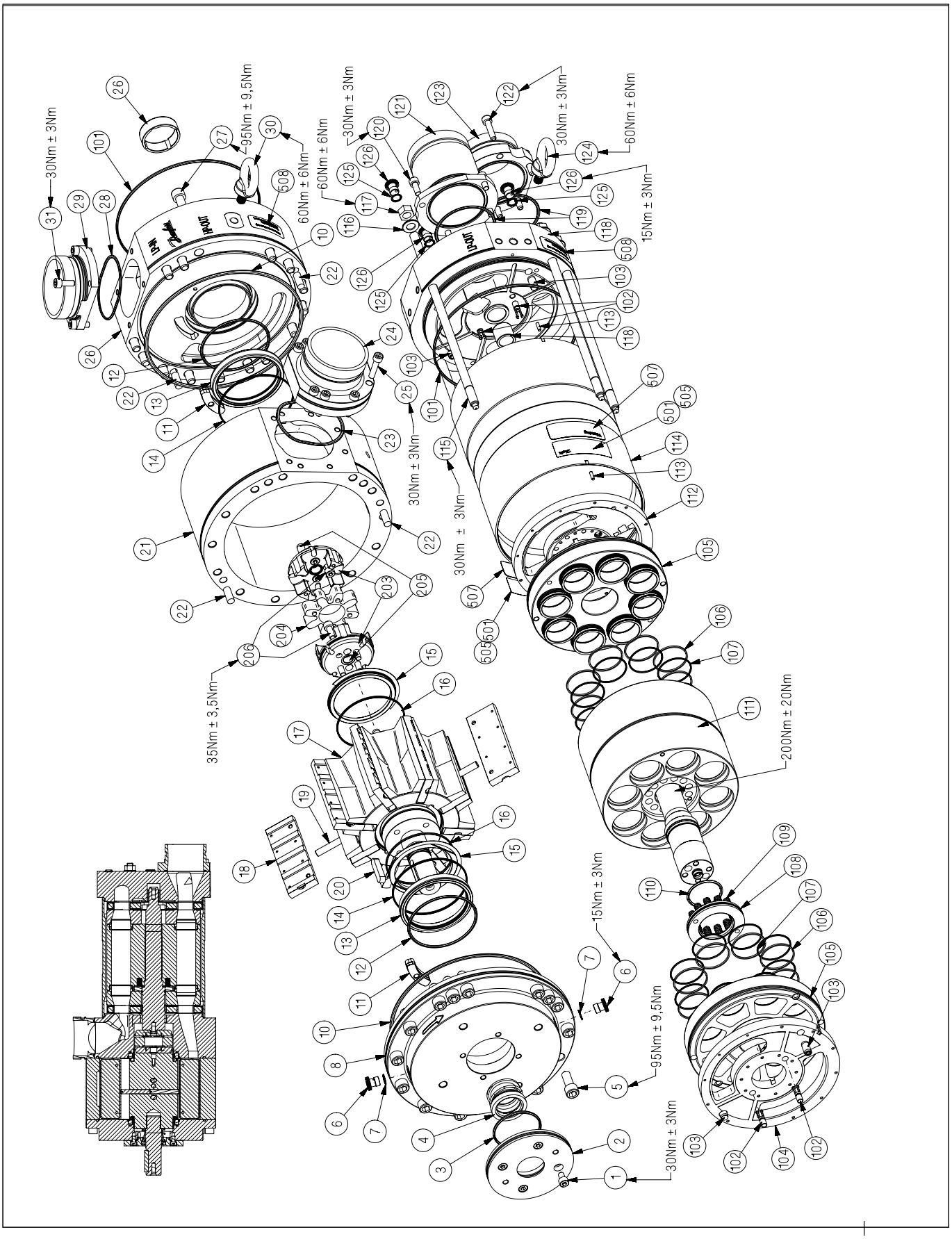
Note: Danfoss reccommends always to use seals and screw kit for inspection and repair.

2. Parts list cont. iSave 50-70

Pos.	Qty.	Description	Material	180F4133 Shaft Seal Kit iSave 50-70	180F4132 Screw and Seal Kit iSave 50-70	180F4134 Coupling Kit iSave 50-70	180F4135 Port Plate Kit PE iSave 50	180F4136 Port Plate Kit PE iSave 70	180F4137 Vane Kit iSave 50-70	180F4138 Valve Plate Kit PE iSave 50-70	180F4139 Rotor/side plade Kit iSave 50-70
108	1	Spring stop	Super Duplex								
109	12	Compression spring	Hastelloy C276							X	
110	1	O-ring	NBR		X						
111	1	Cylinder barrel	Super Duplex								
112	1	Port plate (Brine)	PEEK/Super Duplex				X	X			
113	2	Pin	AISI 316		X						
114	1	Housing	Duplex								
115	6	Stud bolt M12	Duplex								
116	6	Washer M12	AISI 316		X						
117	6	Nut	AISI 316		X						
118	1	Portflange	Super Duplex								
119	2	O-ring	NBR		X						
120	4	Screw M8	AISI 316		X						
121	1	3" Vic. connector LP Out	Super Duplex								
122	6	Screw M8	AISI 316		X						
123	1	3" Vic. connector HP IN	Super Duplex								
124	1	Lifting eye M12	AISI 316								
125	3	O-ring	NBR		X						
126	3	Bleeding plug G1/4"	Super Duplex		X						
203	2	Coupling	Super Duplex			X					
204	1	Softex 38/45	Hytrel			X					
205	4	Pin	Duplex			X					
206	8	Screw M8	Super Duplex			X					
	1	Service instruction		X	X	X	X	X	X	X	X

Note: Danfoss reccommends always to use seals and screw kit for inspection and repair.

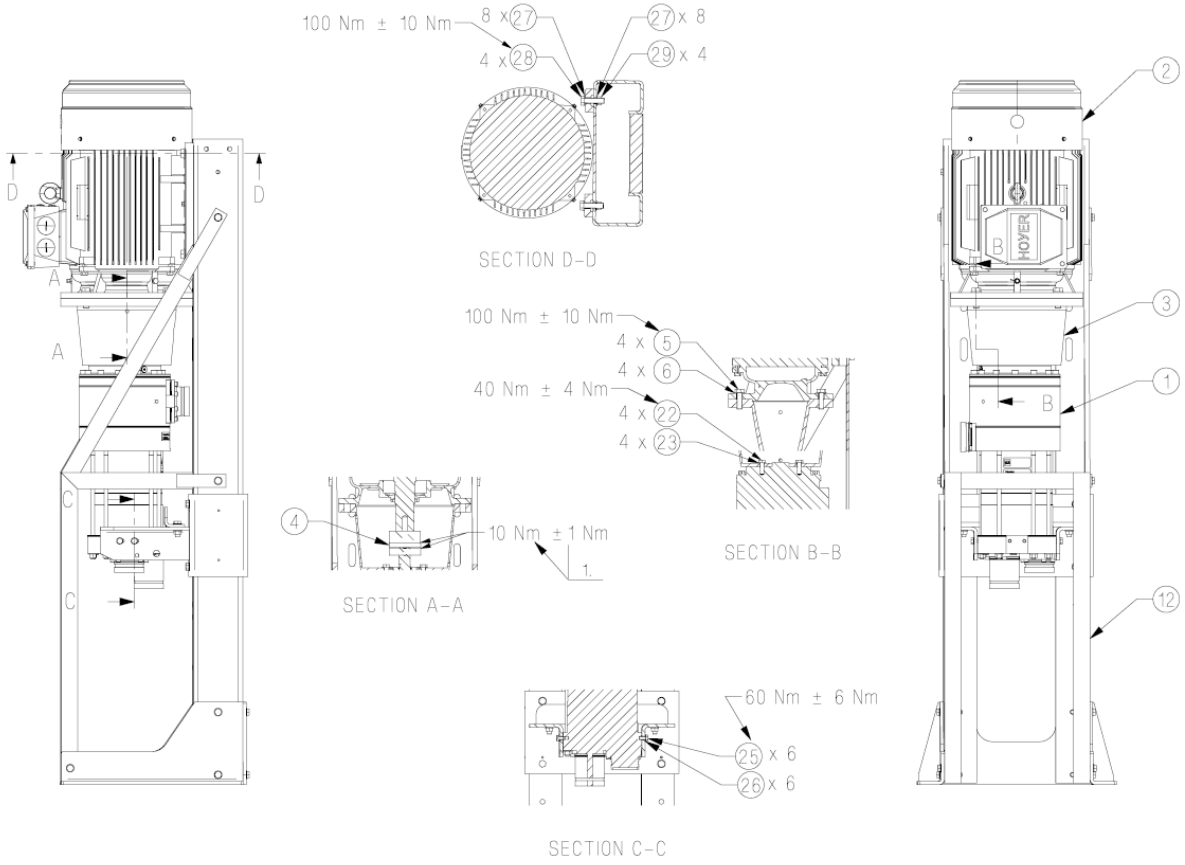
3. Exploded view iSave 50-70



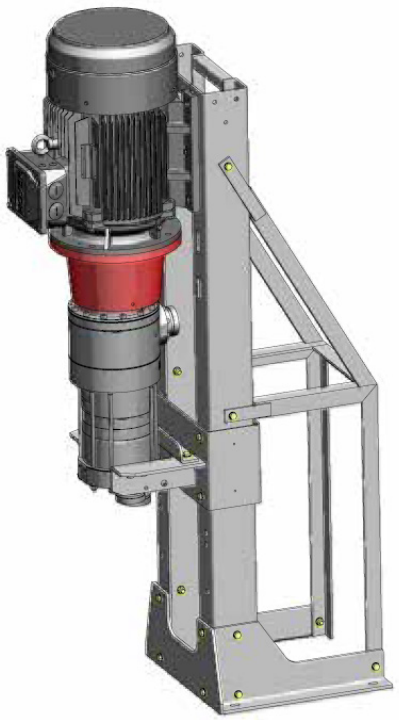
4. Assembly unit iSave 50-70 Vertical mounting

iSave 50-70 Assembly Unit - Vertical mounting			IEC	NEMA
Pos.	**Qty.**	**Description**	**Code No.**	**Code No.**
		iSave 50, Vertical, IEC200L, 18.5 kW	180F7022	
		iSave 50, Vertical, NEMA324/6T, 30HP		180U0004
		iSave 70, Vertical, IEC200L, 18.5 kW	180F7024	
		iSave 70, Vertical, NEMA324/6T, 30HP		180U0006
iSave 50-70 without motor				
1	1	iSave 50	180F7020	
1	1	iSave 70	180F7021	
Motor				
2	1	Motor 18.5 kW IEC200 6-pole 3x400 V IE3	180Z0530	
2	1	Motor 324TC 30 HP 3PH 1200 230/460/380		180U2370
5	4	Screw (not inluded in kit)		
6	4	Washer (not included in kit)		
iSave 50 - 70 coupling kit			**180Z4003**	**180U2309**
3	1	Bell housing	X	X
4	1	Coupling	X	X
22	4	Screw M12	X	X
23	4	Washer M12	X	X
24	1	Grommet sealing	X	X
Base frame vertical			**180Z4025**	
12	1	Base frame	X	X
13	2	Bracket, long	X	X
14	2	Bracket, short	X	X
15	4	Screw M12	X	X
16	8	Washer M12	X	X
17	4	Nut M12	X	X
18	4	Screw M10	X	X
19	16	Washer Ø10.5	X	X
20	4	Nut M10	X	X
21	8	Screw M10	X	X

5. Assembly unit drawing iSave 50-70 Vertical mounting



Support frame front mounted



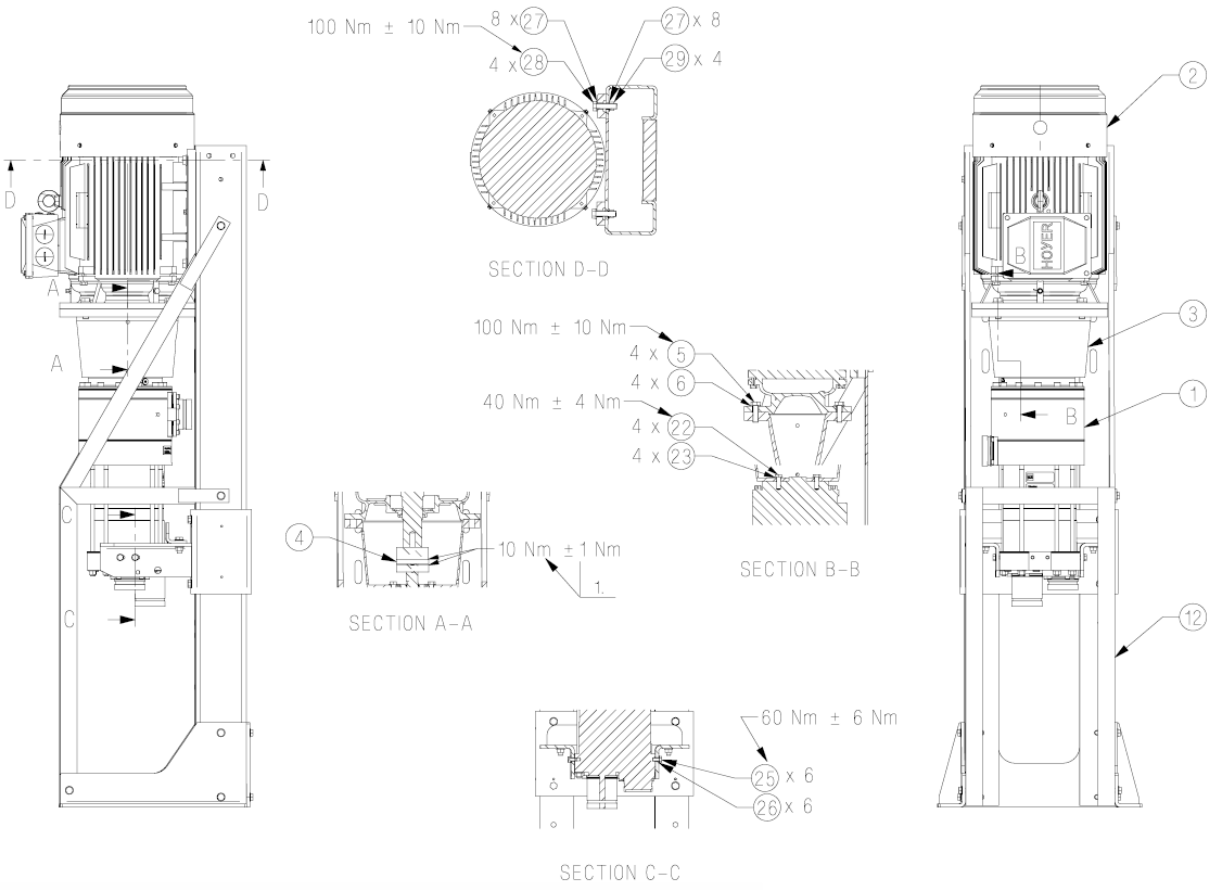
Support frame back mounted

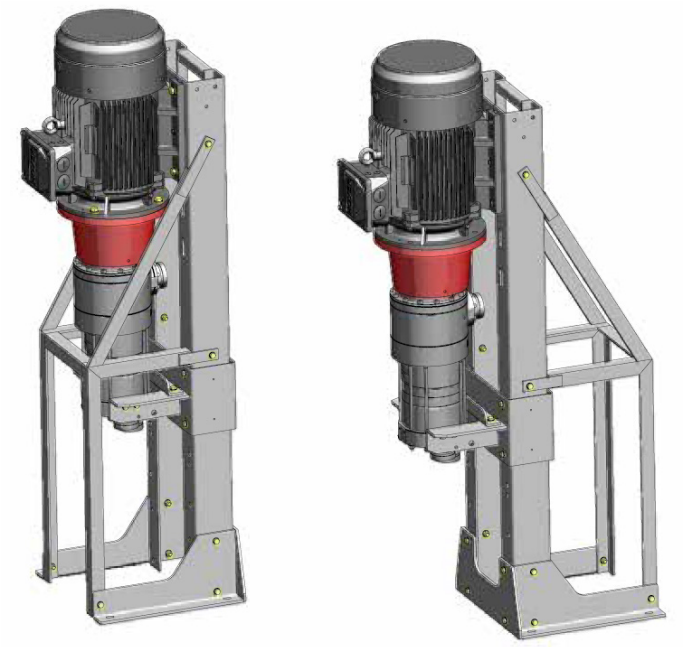
1. For mounting of coupling and bell housing – see IOM.

4. Assembly unit iSave 50-70 Vertical mounting

iSave 50-70 Assembly Unit - Vertical mounting			IEC	NEMA
Pos.	**Qty.**	**Description**	**Code No.**	**Code No.**
		iSave 50, Vertical, IEC200L, 18.5 kW	180F7022	
		iSave 50, Vertical, NEMA324/6T, 30HP		180U0004
		iSave 70, Vertical, IEC200L, 18.5 kW	180F7024	
		iSave 70, Vertical, NEMA324/6T, 30HP		180U0006
iSave 50-70 without motor				
1	1	iSave 50	180F7020	
1	1	iSave 70	180F7021	
Motor				
2	1	Motor 18.5 kW IEC200 6-pole 3x400 V IE3	180Z0530	
2	1	Motor 324TC 30 HP 3PH 1200 230/460/380		180U2370
5	4	Screw (not inluded in kit)		
6	4	Washer (not included in kit)		
iSave 50 - 70 coupling kit			**180Z4003**	**180U2309**
3	1	Bell housing	X	X
4	1	Coupling	X	X
22	4	Screw M12	X	X
23	4	Washer M12	X	X
24	1	Grommet sealing	X	X
Base frame vertical			**180Z4025**	
12	1	Base frame	X	X
13	2	Bracket, long	X	X
14	2	Bracket, short	X	X
15	4	Screw M12	X	X
16	8	Washer M12	X	X
17	4	Nut M12	X	X
18	4	Screw M10	X	X
19	16	Washer Ø10.5	X	X
20	4	Nut M10	X	X
21	8	Screw M10	X	X

5. Assembly unit drawing iSave 50-70 Vertical mounting





Support frame front mounted

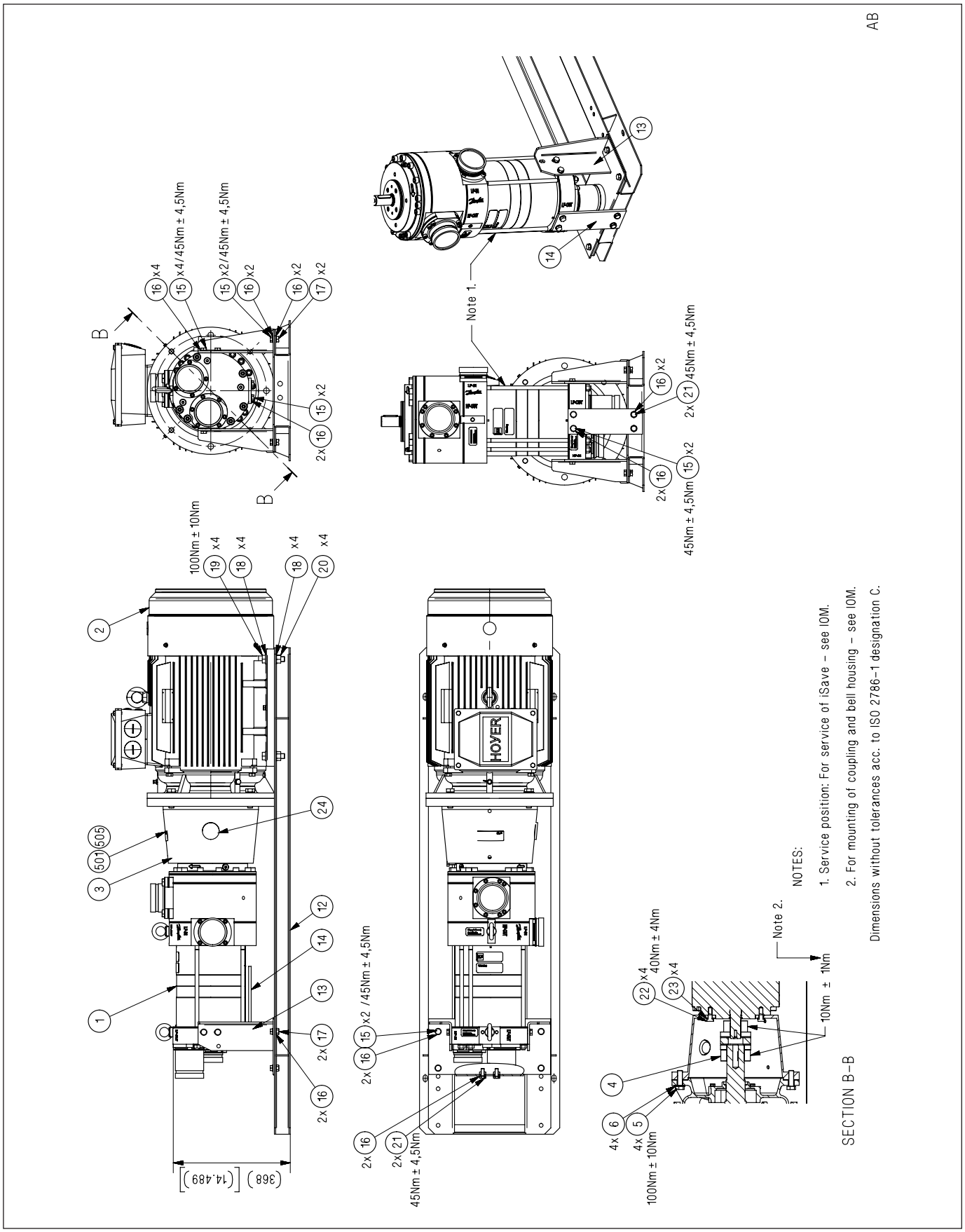
Support frame back mounted

1. For mounting of coupling and bell housing – see IOM.

6. Assembly unit iSave 50-70 Horizontal mounting

iSave 50-70 Assembly Unit - Horizontal mounting			IEC	NEMA
Pos.	**Qty.**	**Description**	**Code No.**	**Code No.**
		iSave 50, Horizontak, IEC200L, 18.5 kW	180F7023	
		iSave 50, Horizontal, NEMA324/6T, 30HP		180U0003
		iSave 70, Horizontal, IEC200L, 18.5 kW	180F7025	
		iSave 70, Horizontal, NEMA324/6T, 30HP		180U0005
iSave 50-70 without motor				
1	1	iSave 50	180F7020	
1	1	iSave 70	180F7021	
Motor				
2	1	Motor 18.5 kW IEC200 6-pole 3x400 V IE3	180Z0530	
2	1	Motor 324TC 30 HP 3PH 1200 230/460/380		180U2370
5	4	Screw (not inluded in kit)		
6	4	Washer (not included in kit)		
iSave 50 - 70 coupling kit			**180Z4003**	**180U2309**
3	1	Bell housing	X	X
4	1	Coupling	X	X
22	4	Screw M12	X	X
23	4	Washer M12	X	X
24	1	Grommet sealing	X	X
Base frame horizontal			**180Z4007**	
12	1	Base frame	X	X
13	1	Bracket, support	X	X
14	1	Bracket, service	X	X
15	10	Screw M10	X	X
16	16	Washer Ø10	X	X
17	4	Nut M10	X	X
18	8	Washer Ø17	X	X
19	4	Screw M16	X	X
20	4	Nut M16	X	X
21	2	Screw M10	X	X

7. Assembly unit drawing
iSave 50-70
Horizontal mounting



8. Tool set iSave 50-70

Qty.	Designation	180F4140 iSave 50-70 Tool kit
1	Back-up ring tool	x
2	Bushing for valve plate	x
2	M6 screw	x
2	Washer M6	x
2	Nut M6	x
2	M16 washer	x
2	M8 screw	x
1	M8 lifting eye	x
1	Shaft seal tool	x
1	24 mm crow foot socket	x
1	19 mm socket	x
1	3/8” extension	x
1	Torque wrench 3/8”	x
1	4 mm Allen key	x
2	Screw driver	x
1	10 mm HEX socket	x
1	6 mm HEX socket	x
1	Nylon hammer	x
1	10 mm fork wrench	x
1	Screw driver	x
1	16 mm socket	x
1	Service instruction	x

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Electric Motors

Motor Manual

hoyermotors.com

Manual

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MOTORS

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MOTORS

Motor Manual

General

This manual concerns the following types of standard induction motors from Hoyer:
HMA3, HMC3, 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 2014/35/EU.
Motors not fulfilling the IE3 efficiency level must be equipped with a variable speed drive when used in EU.

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 ≤ 10MΩ 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.

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.

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	M24
T.(Nm)	2.5	3.5	7	12	18	35	55	80

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

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 HMA3 and HMC3 is as standard with lifetime greased bearings in motors size ≤180 for cast iron and size ≤132 for aluminium. Motor types HMA2 and HMC2 is as standard with lifetime greased bearing in motors size ≤225.
Motor types MS and Y2E is as standard with lifetime greased bearing in motors 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%.

Special note for Atex Zone 22 and nA motors

Designation of motor according to IEC standard:
II 3D Ex tc IIIB T120°C
II 3G Ex nA IIC T3

The hazardous 3-phase asynchronous motors are in accordance with International standard IEC 60079-31 and IEC 60079-15.
Only one electrical installation may be installed in one specified area (zone).

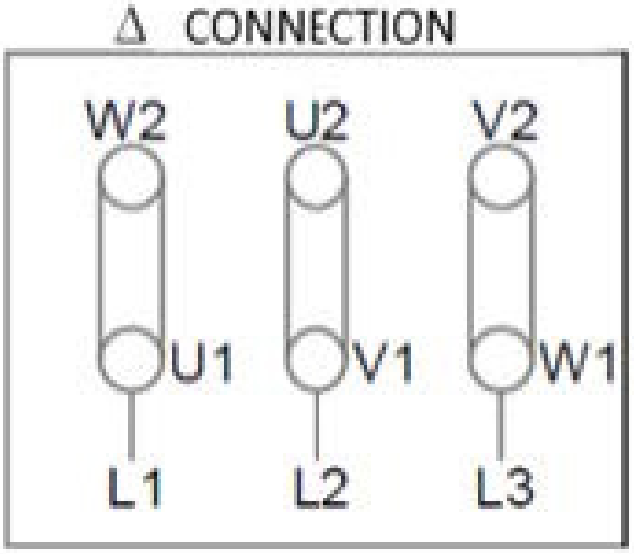
Only certificated cable glands may be used. Unused glands must be closed.
Connections must be made in such a way as to ensure that a permanently safe electrical connection is maintained, both for the main supply and earth connection.
Installations must be in accordance with actual standards for installation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

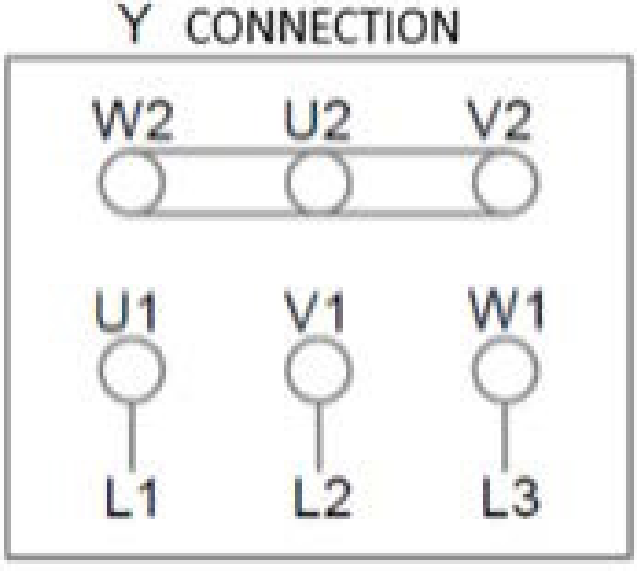
It is recommended that the IEC standard is followed according to temperature and dust on the motor surface.
The use of motors with so much surface dust that the motor temperature increases is not permitted.
Regularly cleaning is recommended.
The radial shaft sealing ring is part of the ATEX certification. 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 this type must only be carried out by qualified specialists.

Connection diagram
Anschlußdiagram
Anslutningdiagramm
Forbindelsesdiagram
Aansluitdiagram
Connection
Conexión
Collegamento
Schemat polacsen





EU Declaration of Conformity

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

Hereby declares that

The products: HOYER MOTORS, 3-phase induction motors

Aluminum motors	MS 56 - 180
	HMAx 56 – 180
Cast iron motors	Y2E2 80 - 400
	HMCx 80 – 400

HOYER MOTORS, 1-phase induction motors

Aluminum motors	ML 56 – 112
	MY 63 – 112

Are in conformity with the following:

Standards:	IEC/EN 60034 (All relevant standards on the IEC/EN 60034 series)
Directive:	Low Voltage Directive 2014/35/
EU	

Motor type HMAx and HMCx is also conformity with:

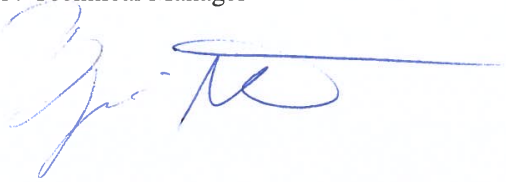
Standards:	IEC/EN 60079-0:2018, IEC/EN 60079-0/A11:2013,
	IEC/EN 60079-15:2010, IEC/EN 60079-31:2014
Directive:	Eco design for electrical motors 2009/640/EC and 2014/4EU
	ATEX directive 2014/34/EU
	Ex II 3D Ex tc IIIB T120°C
	Ex II 3G Ex nA IIC T3
CE marking:	CE

This declaration of conformity is issued under the sole responsibility of the manufacturer.

I hereby declare that the equipment's named above have been designed to comply with the relevant sections of the above referenced specifications.

Signed by: Bjarne Nør / Technical Manager

December 2018:



1/3

x = 2, 3

HOYER

EXCEEDING EXPECTATIONS

Hoyer Motors, Motor Manual, April 2019

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