ENGINEERING
TOMORROW

Data sheet

iSave® Energy Recovery Device

iSave® 50 / iSave® 70

PRELIMINARY

ro-solutiions.com

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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 corrowive 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 pumps are based on the vane pump principle enabling a very light and compact design. 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.

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. Ulike a centrifugal pump, it produces the same flow at a given speed no matter what discharge pressure.

The iSave is an active ERD. It is operated by an electric motor which provides speed control of both the pressure exchanger and the high-pressure booster pump - preventing overspin/overflushing. By using a variable frequency drive (VFD), the motor applies a constant torque from low speed to maximum speed.

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)

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
Geometric displacement	cm^3/rev.	1426	1426
	in^3/rev.	87	87
Pressure			
Differential pressure HP out - HP in max. [1]	barg	5	5
	psig	72	72
HP min. outlet pressure	barg	40	40
	psig	580	580
HP max. outlet pressure	barg	80	70
	psig	1160	1015
HP inlet min. pressure, intermittent [2] [3]	barg	On request	On request
	psig	On request	On request
LP inlet max. pressure	barg	5	5
	psig	72	72
LP inlet max. pressure intermittent [3]	barg	10	10
	psig	145	145
LP inlet min. pressure	barg	2	2
	psig	29	29
LP differential LP in - out at HP max. flow	barg	On request	On request
	psig	On request	On request
Design pressure	barg	On request	On request
	psig	On request	On request
Speed			
Min. speed	rpm	525	625
Max. speed	rpm	650	875
Typical flow [4]			
Flow at min. speed	m^3/h	41	50
	gpm	180	220
Flow at max. speed	m^3/h	52	70
	gpm	228	308
Lubrication flow at 60 barg (871 psig) max.	m^3/h	On request	On request
	gpm	On request	On request
LP max. inlet flow	m^3/h	On request	On request
	gpm	On request	On request
Typical motor size			
Max. speed at 3 barg (43.5 psig) differential pressure	kW	18.5	18.5
	HP	30	30
Efficiency			
Max. speed at 60 bar [7]	%	93	92

Technical specifications			
Torque at max. differential pressure operation [1]	Nm	On request	On request
	lbf-ft	On request	On request
Max. starting torque (stick-slip)	Nm	On request	On request
	lbf-ft	On request	On request
Media temperature [5]	°C	2-40	2-40
	°F	36-104	36-104
Ambient temperature	°C	0-50	0-50
	°F	32-122	32-122
Filtration requirements (nominal) [6]		3 micron melt-blown	
Salinity increase at membrane at 40% recovery rate		2-3%	
Weight	kg	156	156
	lb	344	344
Footprint with IEC3 motor	m^2	0.44	0.44
	$Foot^2$	4.71	4.71

1) Continuous torque above max. differential pressure will reduce the lifetime of the iSave.
2) Pressure can reach this pressure level at start-up and permeate flush.
3) Intermittent pressure is acceptable for less than 10 minutes within a period of 6 hours.
4) Typical average HP outlet flow at 60 bar and max. differential pressure
5) Dependent on NaCl concentation.
6) Please see section 7.2 filtration.
7) Typical efficiency for pressure exchanger, booster pump, electrical motor and VFD at max. pressure after a system has been commissioned and run in

5. Performance curves

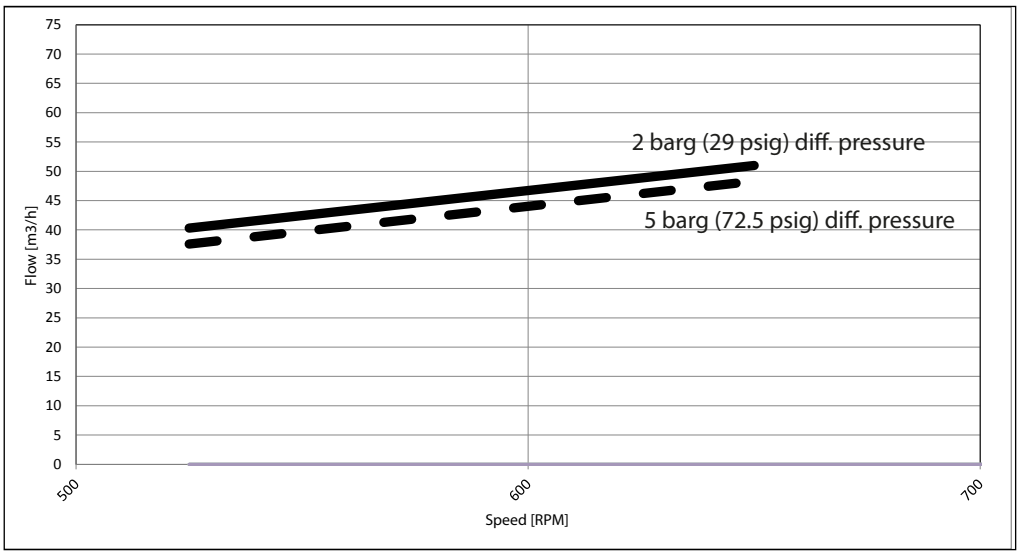
5.1 Flow at different rpm

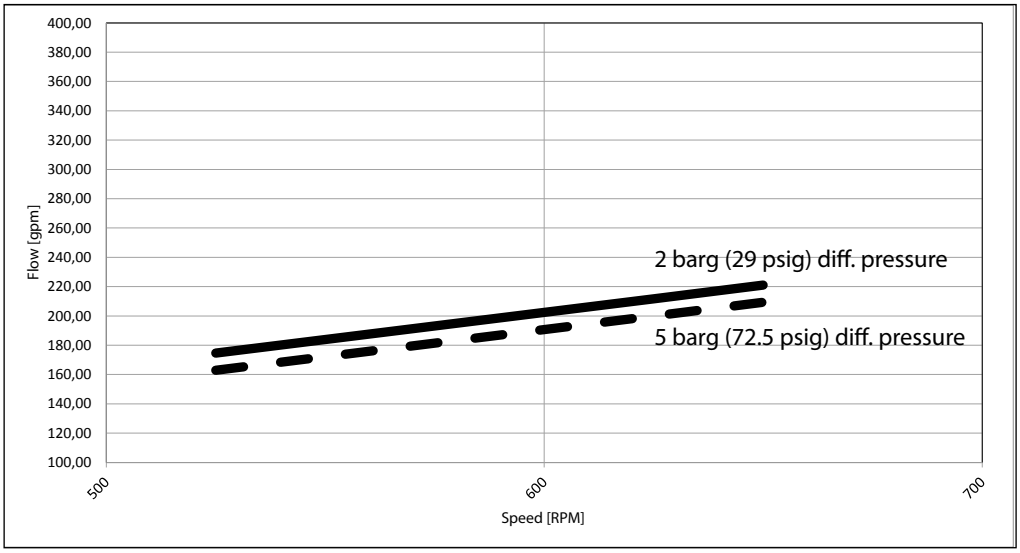
The diagram shows that the HP flow can be changed by changing the rotation speed of the iSave. The flow/rpm ratio is constant, the required flow is obtainable by changing the rotation speed to a required value.

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

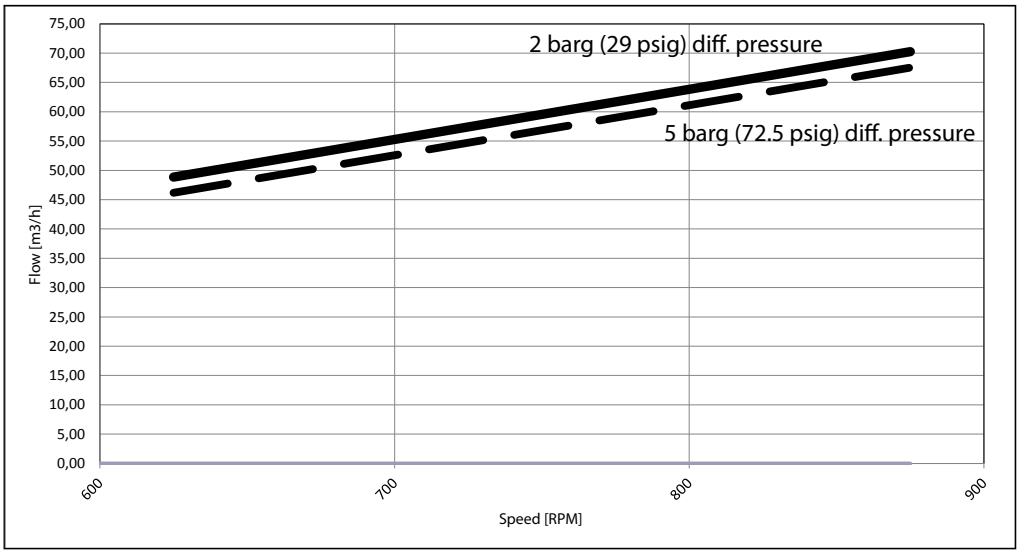
The iSave is delivered with a 3.1 performance certificate according to EN10204.

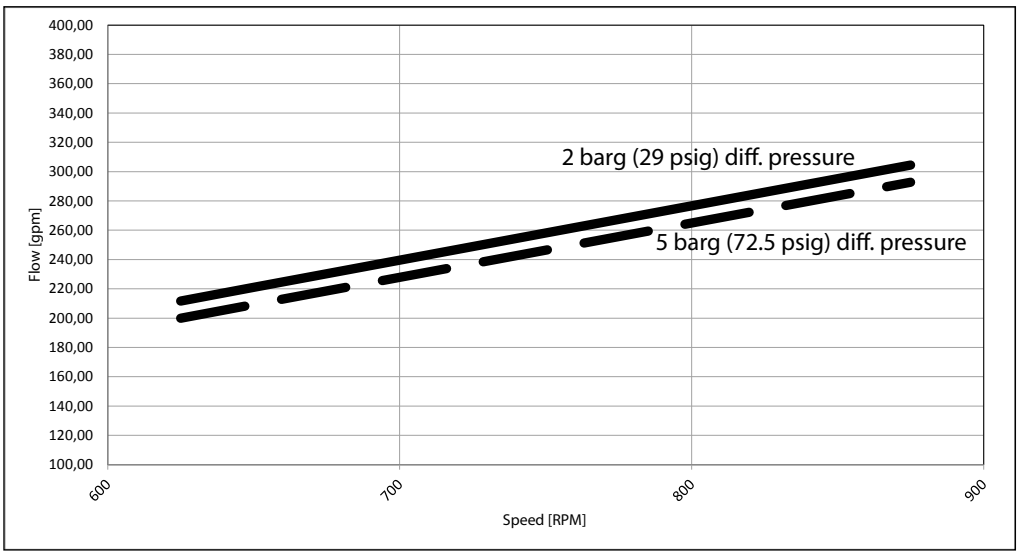
5.2 iSave 50 flow curves





5.3 iSave 70 flow curves



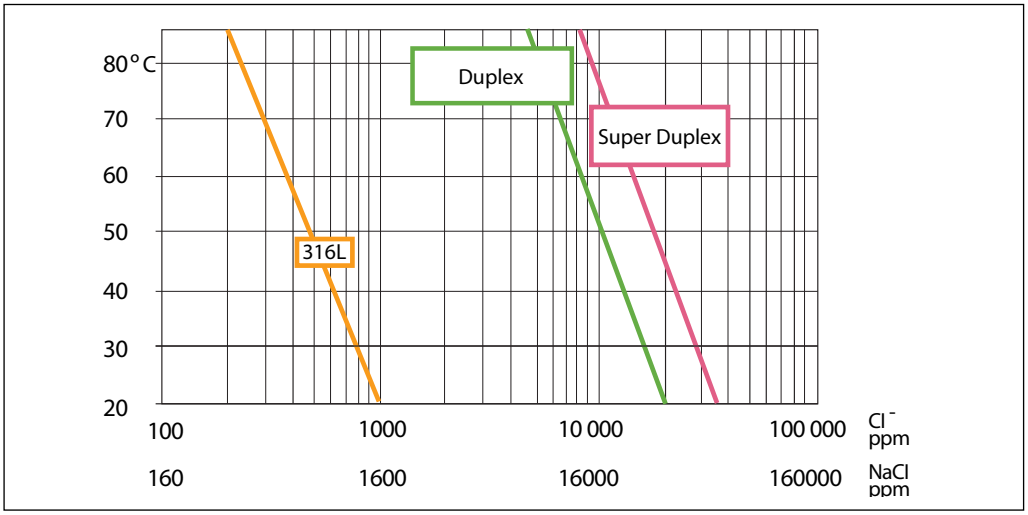


6. Temperature and corrosion

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 the like.

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



7. Installation

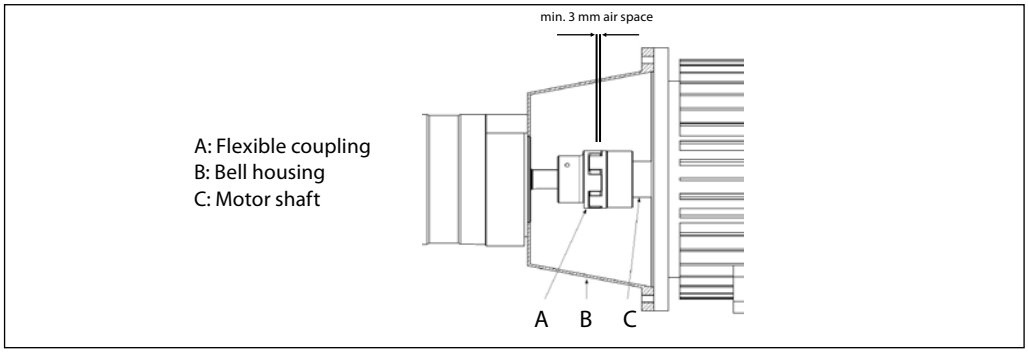
7.1 Orientation and mounting

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

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

Please note that VFD or a soft staerter must be used (required for ramp up and constant torque throughout ther performance area)..

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



7.2 Filtration

It is important that the incoming water is filtered properly to ensure optimum service life of RO system components. for the iSave, a true graded density, melt-blown depth filter cartridge rated at 3 µm nominal is required in front of the iSave. This will also protect the iSave from unintended inflow of particles, e.g. in connection with filter maintenance.

In some locations improved filtration will lengthen the lifetime of wear parts in the iSave. Therefore, it is recommended to consider a 10 µm absolute filter to provide greater protection.

It is important with selection of a proper 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. Please see section 7.4, “RO systems with an iSave”, for installation of filter. 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.

7.3 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 stongly 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.

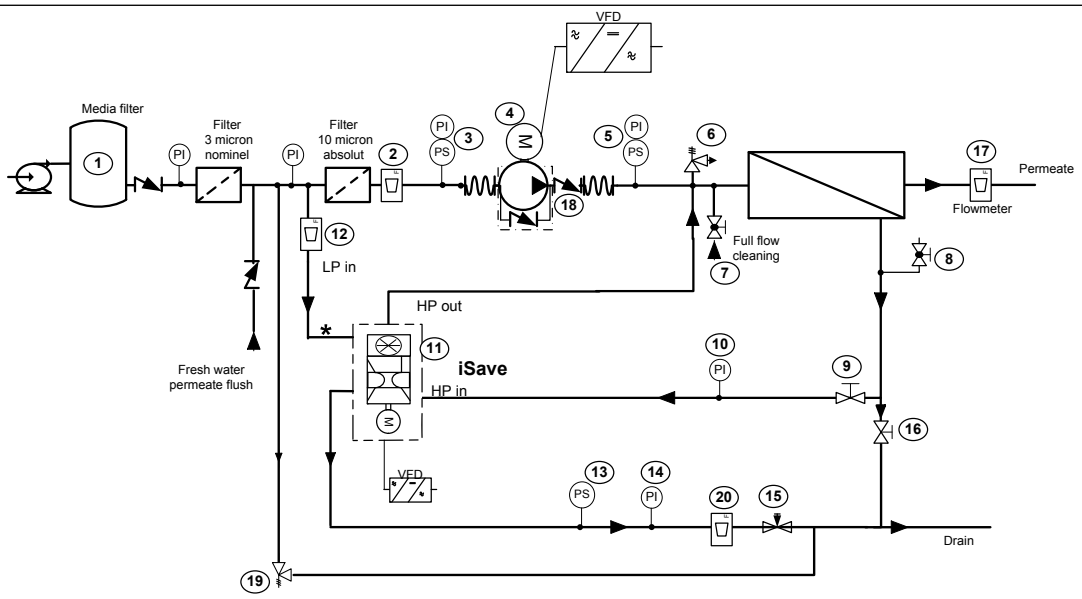
Mounting:

- 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.

7.4 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. Place inlet filters on LP string in front of the iSave (11). Please consult section 7, "Filtration" for guidance on how to select the right filter. 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. Place a monitoring pressure switch set (3) at minimum inlet pressure between filter and pump inlet. The monitoring switch must stop the iSave (11) and the high-pressure pump (4) at pressures lower than minimum inlet pressure.

C. 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.

D. To balance the flow between high-pressure in and low-pressure in, place a variable area flow meter (12) on low-pressure inlet to the iSave.

E. In order to eliminate the risk of damage and cavitation, a positive pressure at the low-pressure outlet from the iSave is always to be maintained at a minimum and maximum pressure (please inquire for details). It is recommended to install monitoring pressure switch (13) in order to prevent high/low-pressure.

F. Install a VFD to control the speed of the iSave.

G. Install a pressure and flow control valve (15) to control pressure in low-pressure out.

H. Install an air bleed valve (8) on the highest point of the high-pressure piping to ensure proper bleeding.

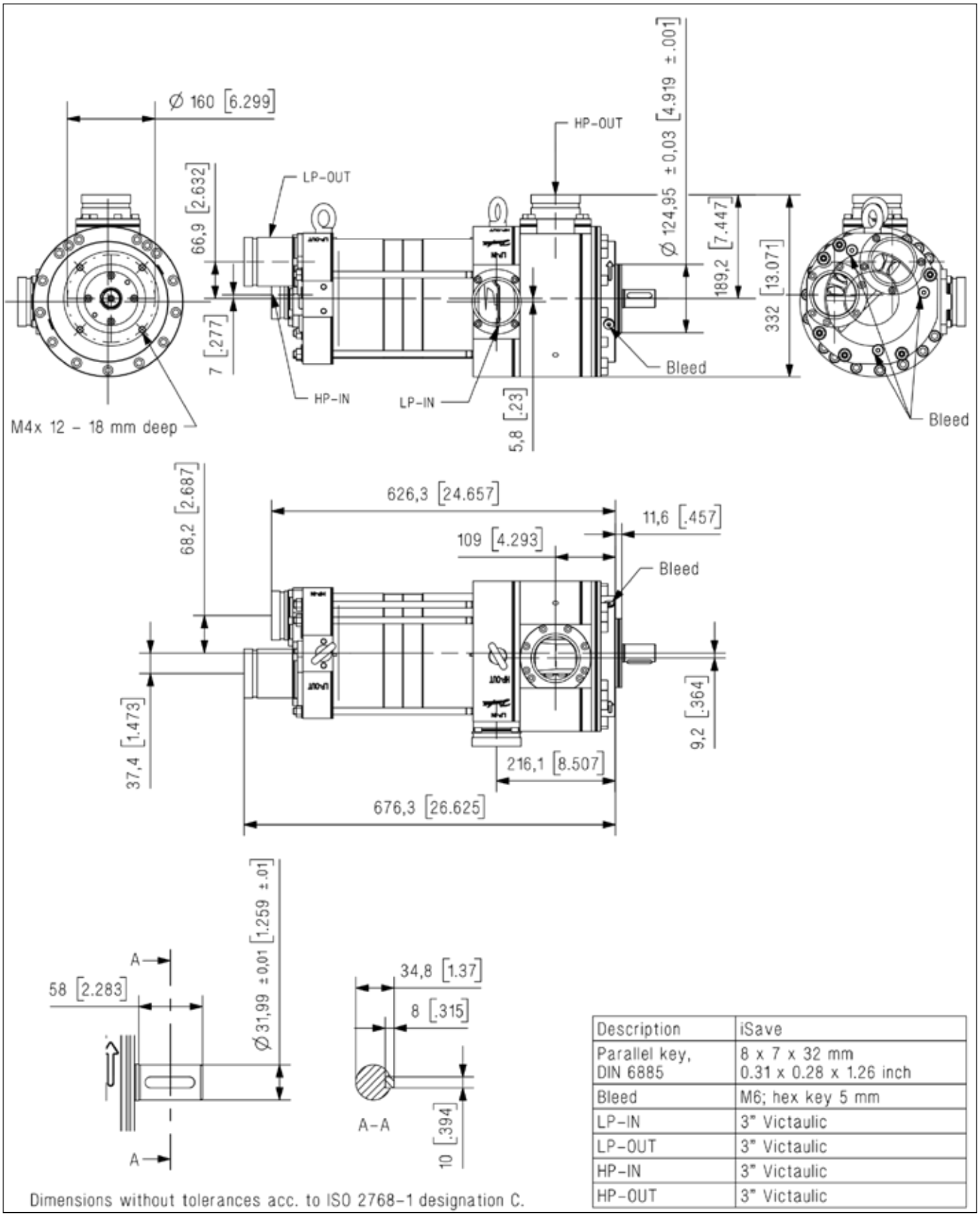
I. The pressure relief valve (6) protects the whole system against pressure overload and relieves the water if the pressure exceeds the maximum set pressure. If the high-pressure pump is a positive displacement pump, the pump can built up a very high pressure that will exceed mechanical strength of the membrane housing, pipes and other accessories.

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

For alternative P&ID setup, please contact Danfoss High Pressure Pumps sales organisation.

8. iSave drawings

8.1 Assembled iSave 50-70 without electric motor



Description	iSave
Parallel key, DIN 6885	8 x 7 x 32 mm 0.31 x 0.28 x 1.26 inch
Bleed	M6; hex key 5 mm
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.

9. Accessories

Description	Type	Code no.
3" Inlet hose kit - 2 m (79") 6 barg (87 psig)	3" Vic . , style 77	180Z0144
3" Outlet hose - 1 m (39.4") 80 barg (1160 psig)	3" Vic . , style 77	180Z0611
Coupling iSave 50 - 70	Softex 55H7-32H7	180Z0248
Coupling kit iSave 50-70 inc. bell housing	ø400/204	On request
Base plate horizontal	IEC200	On request
Base plate vertical	IEC200	On request

10. Service

10.1 Warranty

The Danfoss iSave is designed for long operation, low maintenance and reduced lifecycle costs. The iSave comes with a warranty of 18 months from date of production, provided that the iSave has been running according to the Danfoss specifications.

The iSave is made of materials with excellent corrosion properties. It is, however, always required to flush the iSave with freshwater when the system is shut down.

10.2 Operational conditions of concern

The life of an iSave may be greatly shortened if Danfoss recommendations concerning system design are not followed.
Futhermore, particular attention should be paid to the following factors to avoid increased wear and spare parts costs:

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

10.3 Maintenance

Danfoss recommends periodic inspection and service to ensure wear parts, e.g. rotor elements are replaced in due time. This is done in order to prevent a potential breakdown of the iSave. If the wear parts are not replaced, it is required to carry out more frequent inspections.

10.4 Repair

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

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