ENGINEERING
TOMORROW

Data sheet

Energy Recovery Device
MPE S 70

hpp.danfoss.com

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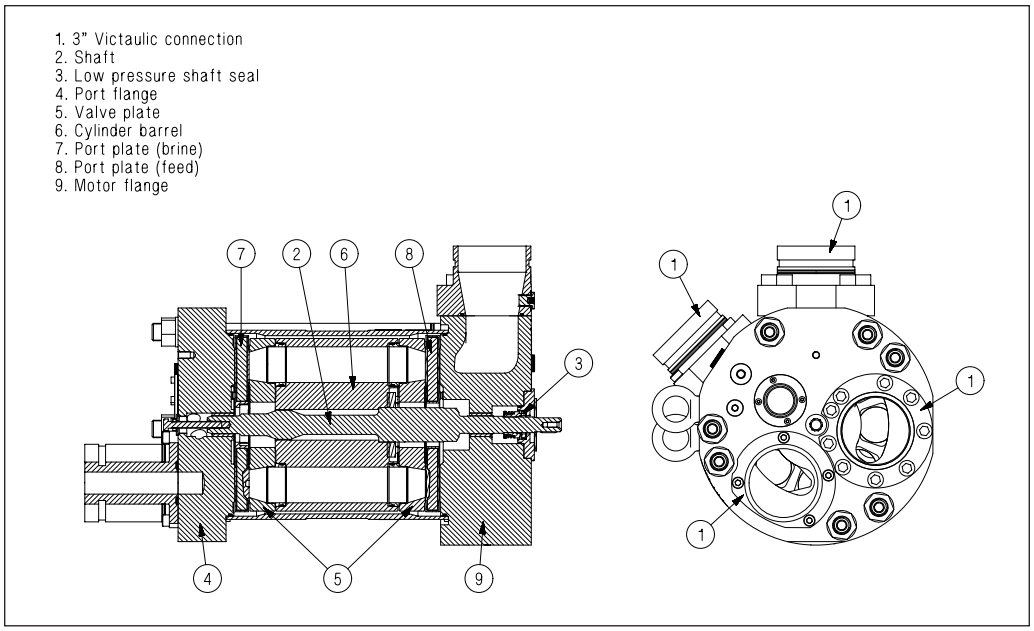
1. General information

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

The Danfoss MPE S 70 consists of an isobaric pressure exchanger driven by an electrical motor. It offers unique benefits from the electrical control combined with the high efficiency from the isobaric pressure exchanger.

The MPE S 70 design ensures lubrication of all moving parts by the fluid itself.

All parts included in the MPE S 70 are designed to provide long service life with a constant high efficiency and minimum service required.



2. Benefits

Significant power savings and low specific energy consumption (SEC)
Simple operation with design that prevents overspin
Full control of pressure exchanger through VFD control
Long and predictive service intervals
Corrossion resistance (all wetted parts are made of high corrosion-resistant materials e.g. Super Duplex or Hastelloy)
Build to operate continually at full capacity

3. Applications

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

Municipal and private waterworks

4. Technical data

4.1 MPE S 70 with and without motor

MPE S 70		MPE S 70	MPE S 70 with IEC motor
Code number		**180F7171**	**180F7066**
Pressure			
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. diff. pressure HP in, - HP out	barg	0.66	0.66
	psig	9.6	9.6
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	0.74	0.74
	psig	10,73	10.73
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	625	625
Max. speed	rpm	875	875
Flow rates			
Flow at min. speed, HP out	m^3/h	50	50
	gpm	220	220
Flow at max. speed. HP out	m^3/h	70	70
	gpm	308	308
Typical lubrication flow at 60 barg (871 psig)	l/min	16	16
	gpm	4.2	4.2
Peak flow, LP in [4]	m^3/h	105	105
	gpm	462	462
Max. allowable working flow, LP in [5]	m^3/h	70	70
	gpm	308	308
Efficiency			
Total efficiency [6]	%	96	96
Technical specifications			
Media temperature [7]	°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) [8]		5 µm melt blown	
Salinity increase at membrane at 40% recovery rate at balanced flow [9]		2 - 3%	2 - 3%

Technical specifications		MPE S 70	MPE S 70 with IEC motor
Weight (dry)	kg	114	151
	lb	251	333
Weight (operation with water)	kg	119	156
	lb	262	344
Noise			
Sound pressure level L_{PA} 1 m [10]	dB(A)	85	85
Footprint			
Footprint (vertical position) [11]			0.175
			1.9
Torque data			
Max. allowable working torque	Nm	15	15
	lbf-ft	11	11
Max. starting torque (stick/slip)	Nm	90	90
	lbf-ft	66	66
Motor data			
Nominal speed	rpm		970
Rated current at 400V	A		5.7
Motor size	kW		2.2 [12]
Frame size	IEC		112
	Poles		6
Rated motor torque at nominal speed	Nm		21.8
	lbf-ft		16.07
Rated motor ambient temperature [12]	°C		40
	°F		104
Motor insulation	Class		F/B
Motor degrees of protection	IP		55
Motor efficiency	%		84.3
Painting RAL9005			C3L
Variable Frequency Drive (VFD) data [13]			
Must be able to operate at constant torque over the whole range of speeds. Must be able to deliver start current of 23.5 A. For a Danfoss FC 51 micro drive a 7.5 kW drive is required to deliver this current. If other drives are used make sure it can provide the start current required.			

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) At system start-up: MPE S 70 can run for up to 10min. 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.
5) Continuous operation: MPE S 70 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.
6) Efficiency measured at 70 m^3/h, balanced flow, 60 bar(g) on HP out. Power consumption of Motor and Variable Frequency Drive included.
7) Dependent on NaCl concentation.
8) Please see section 7.5 filtration.
9) Balanced flow: The mixing rate is defined at balanced flow when HP-out is equal to LP-in.
10) MPE S 70 sound pressure level at 60 barg and max. flow.
11) Area recommended with IE3 motor configurations (excl. of space to serviece MPE)
12) For higher temperature contact Danfoss
13) A special attention must be taken when selecting the frequency drive. See Variable Frequency Data comments in the table above.

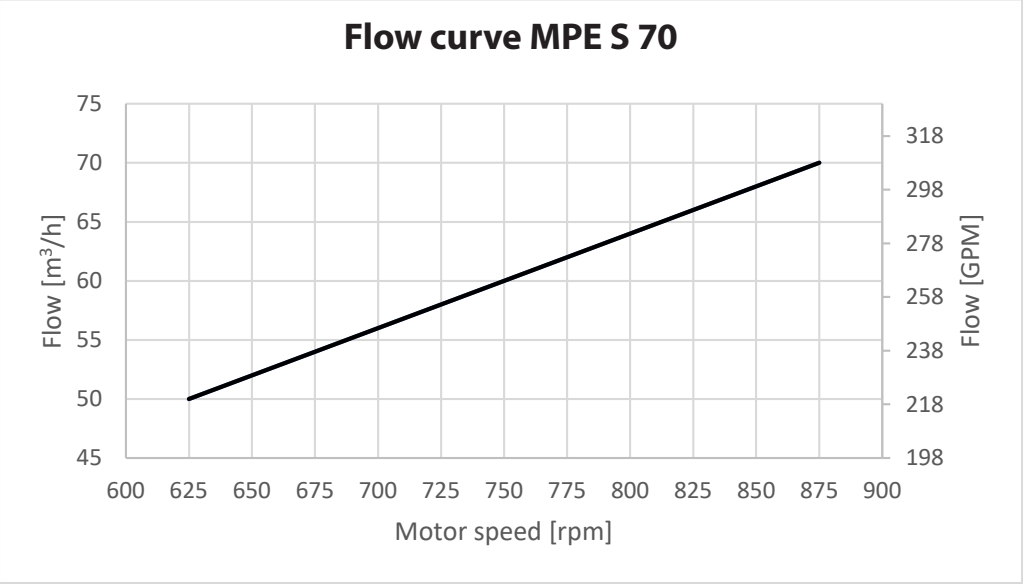
5. Performance curves

5.1 MPE flow curves

The diagram below shows the minimum speed needed for the required flow.

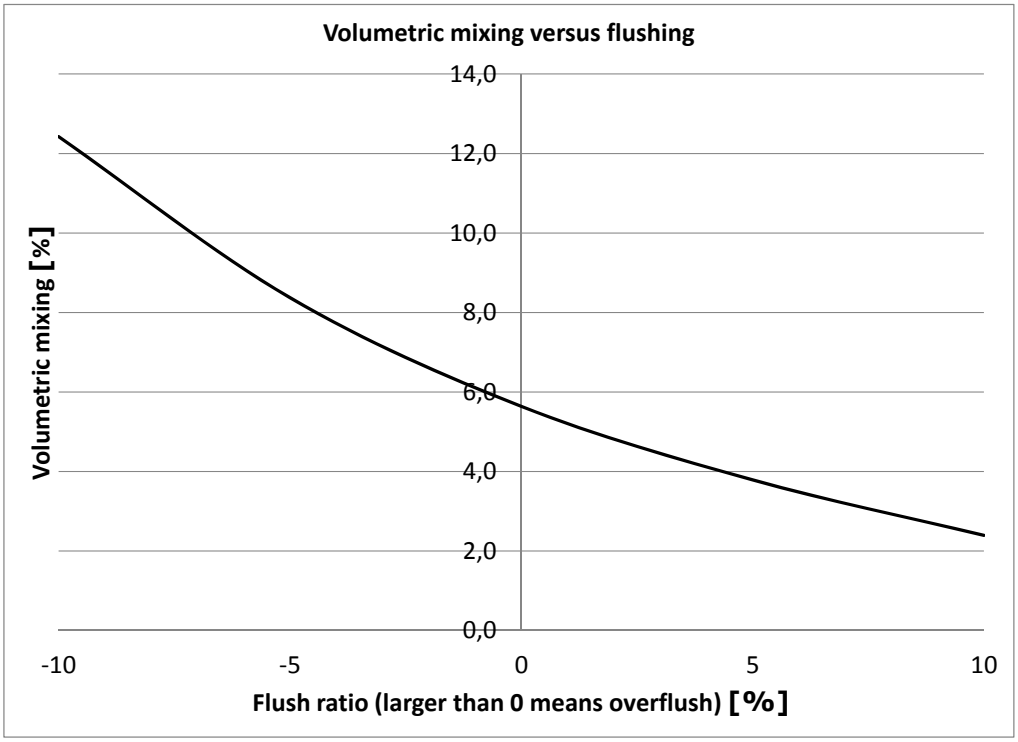
For detailed overview please use the MPE selection tool.

The MPE S 70 is delivered with a 3.1 performance certificate according to EN10204.



5.2 Mixing curve

The curve below shows the mixing during operation. Flush rate of 0 is when LP-in flow equals HP-out (Balanced flow).

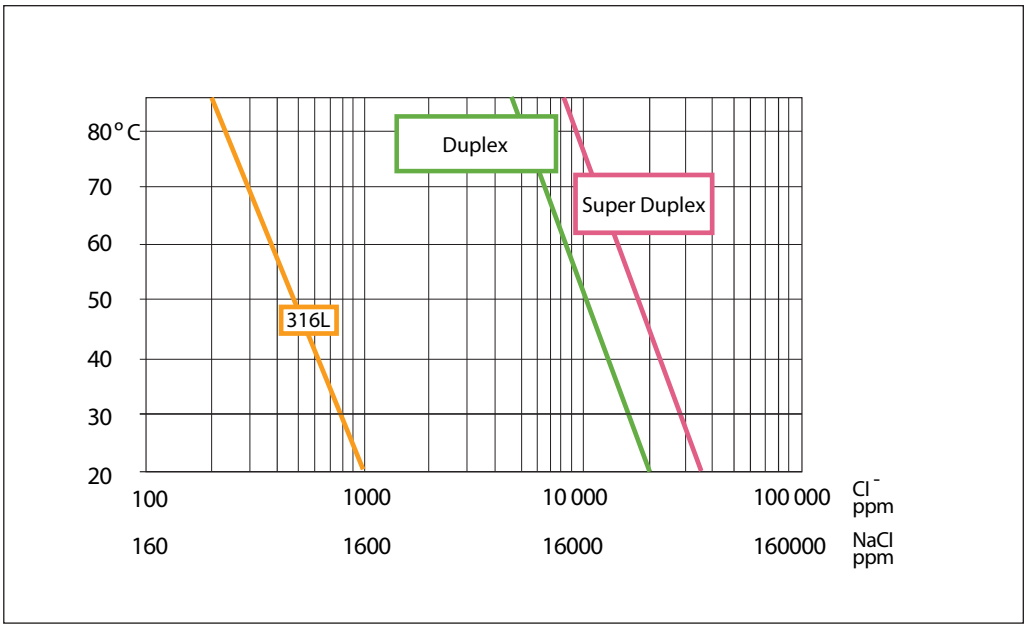


6. Temperature and corrosion

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 MPE S 70 is made of Super Duplex 1.4410/UNS 32 750 or Hastelloy C276

Always flush the MPE S 70 with fresh water at operation stop in order to minimize the risk of crevice corrosion.



7. Installation

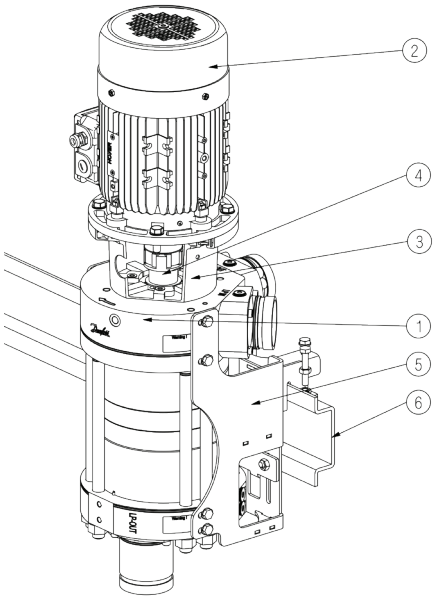
7.1 Operation and mounting

The MPE S 70 is build for vertical installation. The MPE S 70 is connected to the electric motor by a bell housing. The bell housing keeps the motor and bell housing perfectly aligned.

To install the MPE and motor to a frame Danfoss have created a bracket and rail system that makes the installation easy and flexible. The alignment between the manifolds and MPE S 70 is easily done via the adjustable bracket that keeps the MPE S 70 in place.

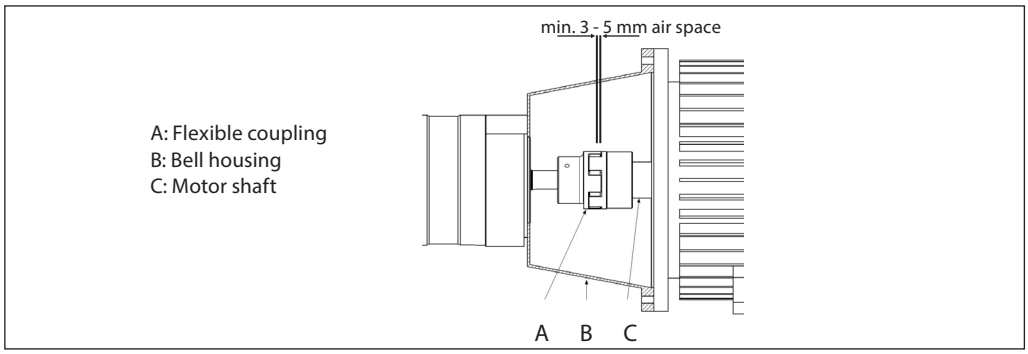
MPE S 70 mounted vertically

1: MPE S 70
2: Motor
3: Bell housing
4: Flexible coupling
5: Support bracket
6: Rail



7.2 Mounting MPE to motor

The MPE is attached to the electric motor by a bellhousing. The bellhousing centers the shafts of motor and MPE and additionally serve as coupling protection. The shafts are connected through a flexible jaw coupling.



7.3 Connection to system

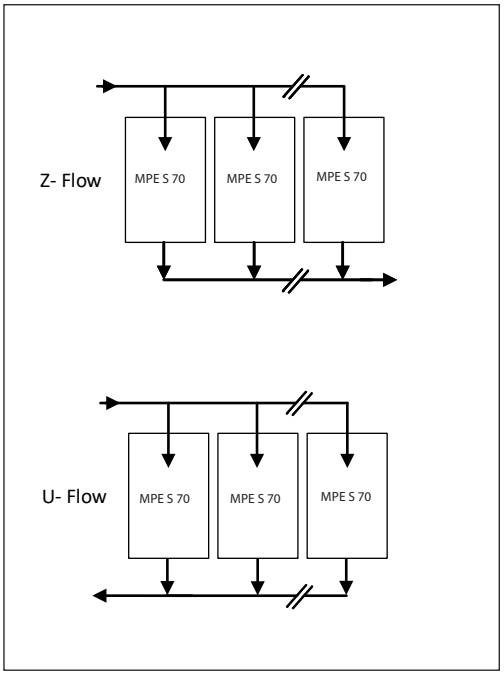
The MPE connection ports are designed for hard piping. Danfoss recommends to follow the Guideline 180R9367 - Pipe connection.

7.4 Design Configuration for Manifolds

When setting up MPE S 70 in parallel Danfoss recommends U flow for manifold designs and a maximum flow velocity of 3,8 m/s.

The MPE S 70 speed is not affected by the flow but it is preferred to have a even flow distribution among the MPE S 70 units and investigations done by Danfoss shows that Z-Flow requires a lower flow velocity to get an even distribution. If for some reason Z flow is selected Danfoss recommends to reduce the flow velocity to 2 m/s

Below sketch shows the concept of U-Flow design and Z flow design



7.5 Filtration

High quality water extends the service life of the whole system.
Water to the MPE S 70 must be filtered to 5 µm nominal, using melt-blown depth filter with a proven efficiency of min. 85%. Consult Danfoss for correct choice of filter.

It is important when selecting the filter and filter housing to ensure good cartridge end sealings.

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. Danfoss High-pressure pumps does not recommend cartridges requiring any type of binders or resins.

7.6 Noise

Since the MPE is mounted on a bell housing and electric motor, the noise level should be determined for a complete system.

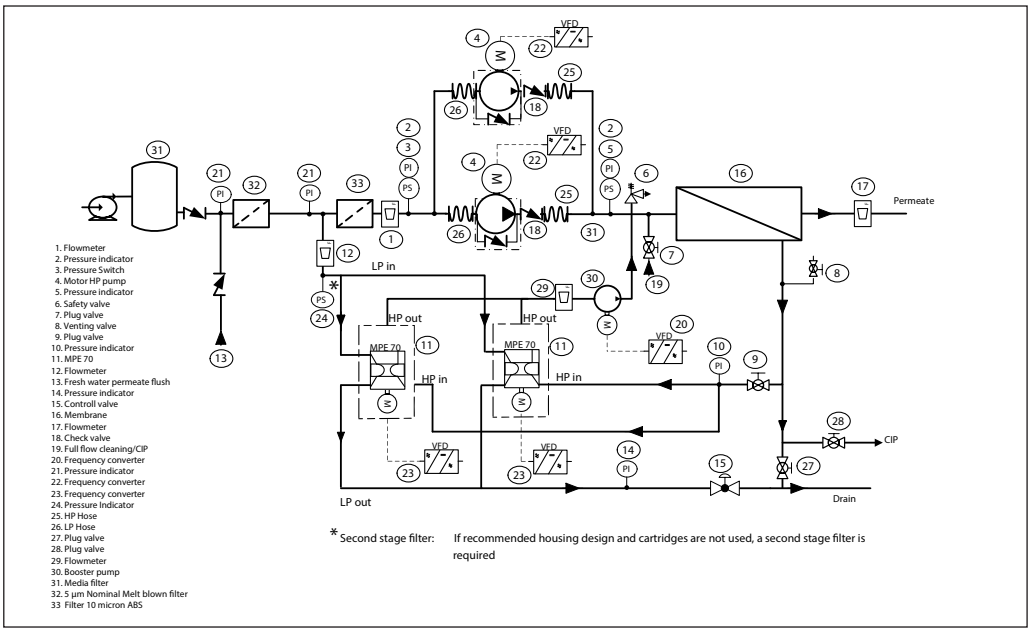
It is recommended to use multiple Victaulic clamps to avoid structural noise.

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.

Connections to MPE:
- Variable frequency drives (VFD):
  Motors regulated by VFDs can increase noise level if the VFD does not have the right settings.

7.7 RO systems with an MPE S 70



Explanation of P&ID setup

A. **Inlet filter:**
Place inlet filters (32) on LP string in front of the MPE S 70 (11). Please see Guide line (AI317041322125en-000101) on Filtration. Thoroughly clean pipes and flush system prior to start-up.

B. **Inlet pressure:**
The max. and min. inlet pressure must be controlled according to specifications in datasheet for MPE S 70.

C. **Piping:**
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). .

D. **Inlet flow control and mixing:**
To balance LP flow up against HP flow on the MPE S 70 and control mixing, place flowmeters on low-pressure inlet (12) of the MPE S 70 and on highpressure output (29).

E. HP flow control:
To adjust the recovery rate and the HP flow of the MPE S 70. Regulate the speed of the booster pump (30). Adjust the speed of the MPE S 70 if needed.

F. **Low pressure flow control:**
In order to control the low pressure flow, a flow control valve (15) must be installed in the common low pressure outlet pipe from the MPE S 70s. The valve should be designed to control flow.
It is recommended to use a manual valve with lock function or an automatic controlled valve.

G. **Variable speed and overload protection:**
Install a VFD to control the speed of the MPE S 70. The speed is defined by HP flow given by the flowmeter (29.)

H. **Membrane cleaning**
Valves pos. 9, 27 and 28 are used for by-passing the MPE S 70 when CIP cleaning.

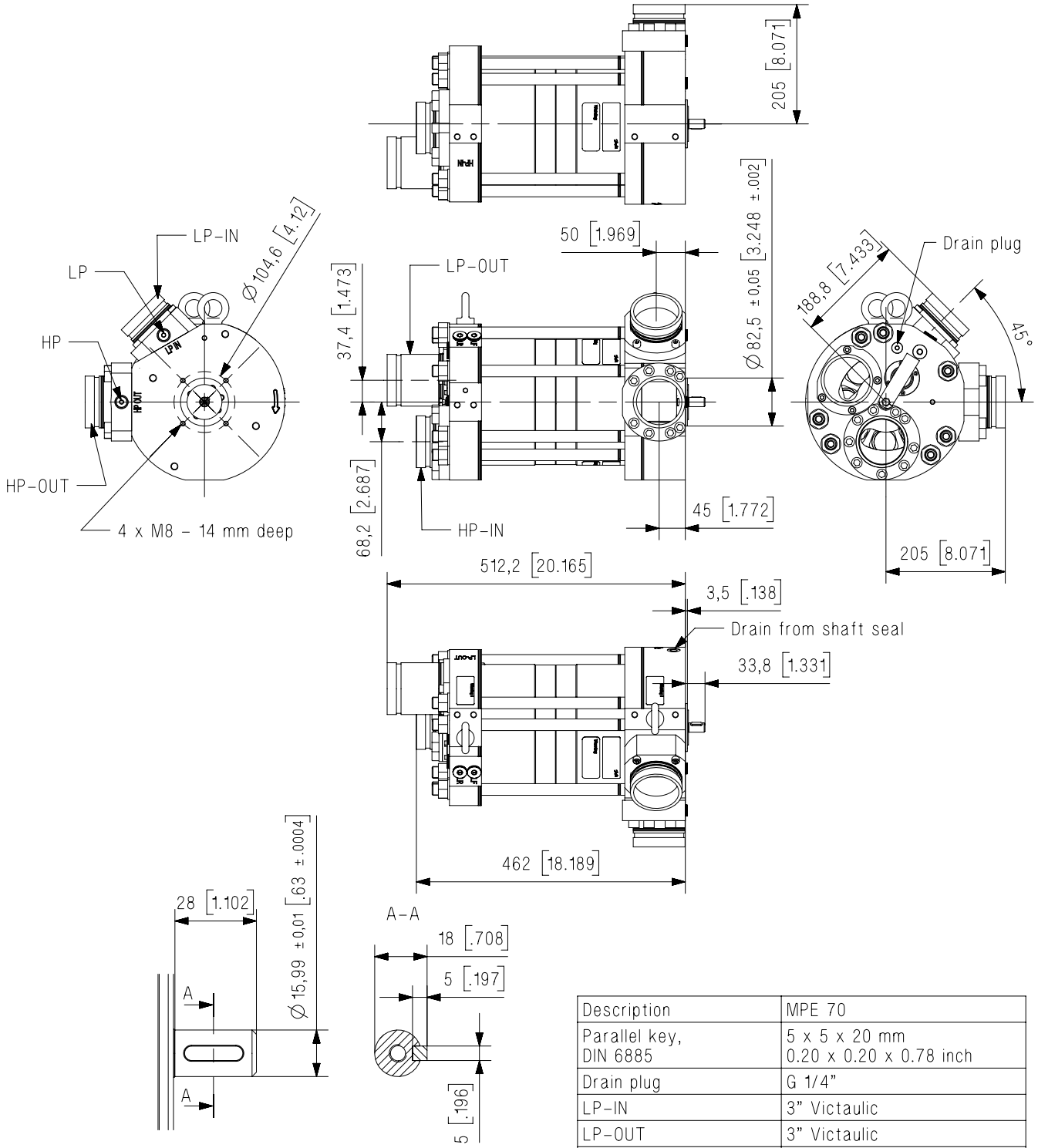
I. **Air venting:**
Install an air bleed valve (8) at the highest point of the high-pressure piping to ensure the air is purged from the system before startup.

J. **Pressure relief (high pressure):**
The pressure relief valve (6) protects the HP streams in the 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 safety valve in seawater RO sytem for more details).

For a more elaborate description of the P&ID setup, please consult the Danfoss Design Guide Piping & Instrumentation Diagram (P&ID) (AJ362145037077en-000101) or contact Danfoss.

8. Dimensions and connections

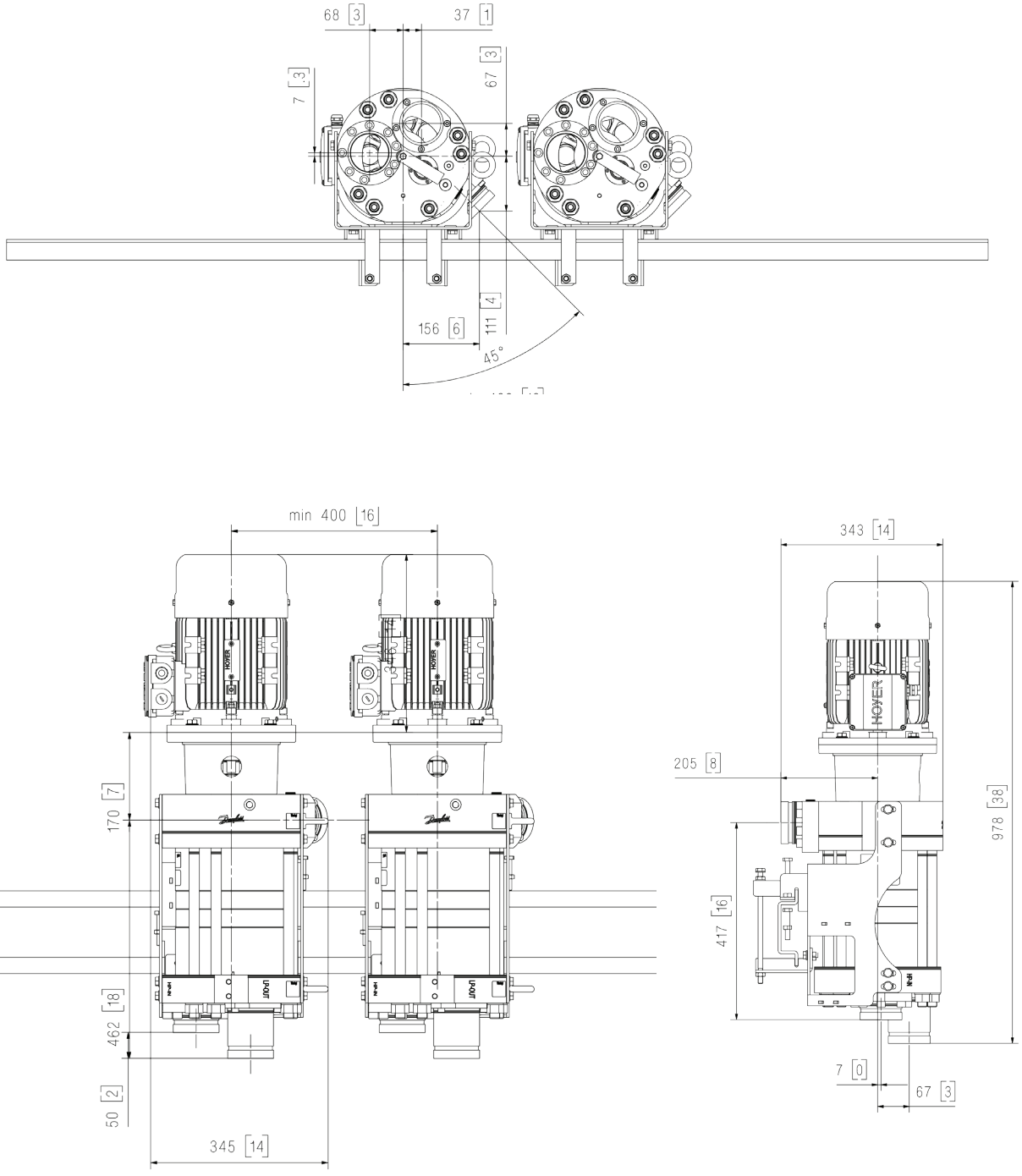
8.1 MPE S 70 without electric motor



Description	MPE 70
Parallel key, DIN 6885	5 x 5 x 20 mm 0.20 x 0.20 x 0.78 inch
Drain plug	G 1/4"
LP-IN	3" Victaulic
LP-OUT	3" Victaulic
HP-IN	3" Victaulic
HP-OUT	3" Victaulic
Drain from Shaft seal	G 1/4"

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

8.2 MPE S 70 with IE3 motor 2.2 kW on base frame vertical - front mounted



9. Accessories

Description	Type	Code no.
MPE S 70 coupling kit		180Z4110
MPE S 70 coupling		180Z4106
Bracket for 1 MPE S 70		180Z4107
2 m rail without bracket		180Z4108
Electrical motor	IEC112M 2.2 kW 6 pole	180Z4109

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