REVERSE OSMOSIS

IDROBIOS
just water

CONTENTS

Reverse osmosis

Reverse osmosis (R.O.) is a mechanism derived from the phenomenon of osmosis, which occurs in nature, whereby a fluid is concentrated by flowing through a semi-permeable membrane.
A large number of natural processes occur through osmosis, such as the way plants obtain nutritional substances though the root structure.
Direct osmosis (fig.1) occurs when two solutions at different concentrations are separated by a semi-permeable membrane that allows water having a lower concentration (of the substances contained) to be diffused to the other side of the membrane thereby diluting the more concentrated solution.
Once a state of equilibrium has been reached the liquid level will be higher in the compartment that previously contained the more saline solution, while the level in the compartment that contained the less concentrated solution will be lower.
The Δp (fig.2) between the two solutions represents the stabilisation of the concentration level and is called the **osmotic pressure** of the liquid. Osmotic pressure can therefore be defined as the **hydrostatic pressure** required to prevent transfer of a pure solvent in a solution by passing through a semi-permeable membrane.

The **reverse osmosis** mechanism (fig.3) is obtained taking account of the fact that the osmotic process is reversible, since applying a pressure higher than the osmotic pressure leads to an inversion of the natural process and causes migration of the pure water from the other side of the membrane.
With reference to the mechanism described note that the filtration process is performed without the use of chemicals and instead by exploiting an exclusively physical mechanism:

- The flow of water crosses the membrane in a tangential manner, separating into concentrate and permeate.
  The expression "permeate" refers to water whose salinity is eliminated (also called "osmotic water") so that it can be transferred to the user services, while the expression "concentrate" refers to the water whose salinity has been increased after the process and is therefore to be discarded.

fig.1

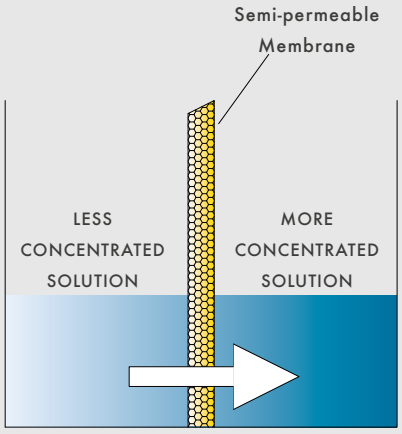


fig.2

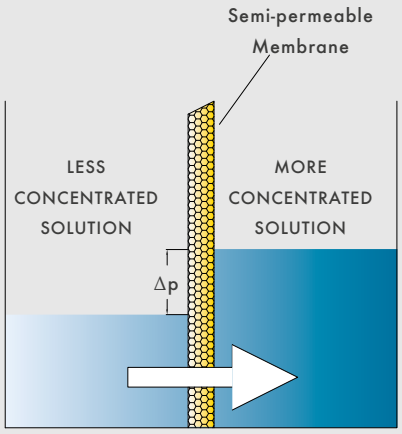
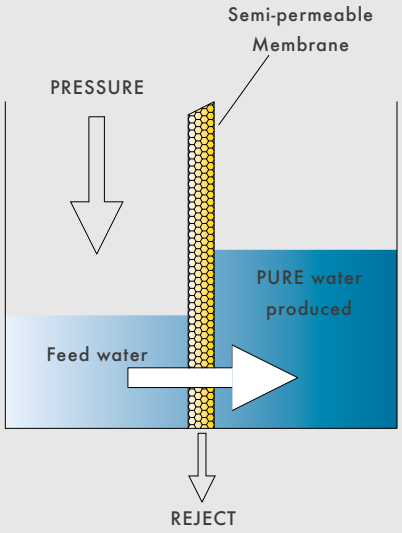


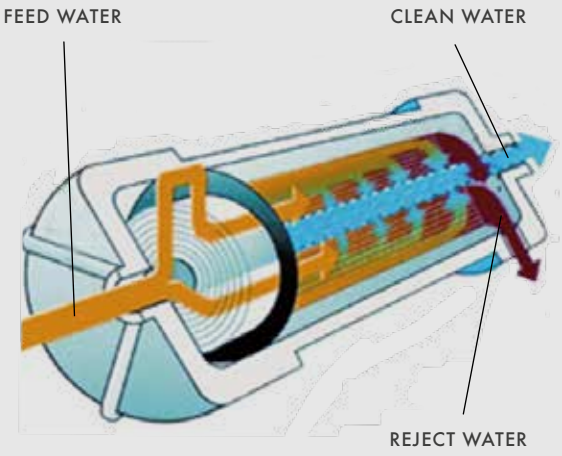
fig.3



This process is assisted by two factors: **concentration gradient** and **pressure gradient.**
Reverse osmosis systems are essentially composed of one or more semi-permeable membranes accommodated in specific vessels designed to support the operating pressure gradient in the system, created by a flow that, in turn, is determined by the flushing value of the individual membranes.
This pressure value is normally obtained with a multi-impeller electric pump configured in a single stage or in series (for high pressure values), able to boost the pressure to 16-20 bar in fresh water systems, from 20 to 40 bar in brine systems, and from 40 to 60 bar in sea water systems.

The **membranes** used in R.O. plants are composed of several sheets of film pressed together (TFC thin film) and arranged in a spiral configuration around a plastic pipe.
The filtered liquid (fig. 4 "CLEAN WATER") is designated **permeate**, while the retained and subsequently expelled water is designated **concentrate** (fig. 4 "REJECT WATER").
In a reverse osmosis plant only a given percentage of the inlet water is used, normally between 60 and 80% for plants with pre-treatment, and between 40 and 50% in the absence of pretreatment. The remaining water is discharged in the form of concentrate.

fig.4



The R.O. plant

The reverse osmosis process has significant benefits

- Applicability to water with any level of saline contents, from well water to sea water.
- No need to dispose of any depleted chemical products after the process.
- Relatively low running costs compared to resin bed systems in the presence of high effective salinity.
- Straightforward management, given that the process does not require periodic regeneration, unlike resin bed systems.

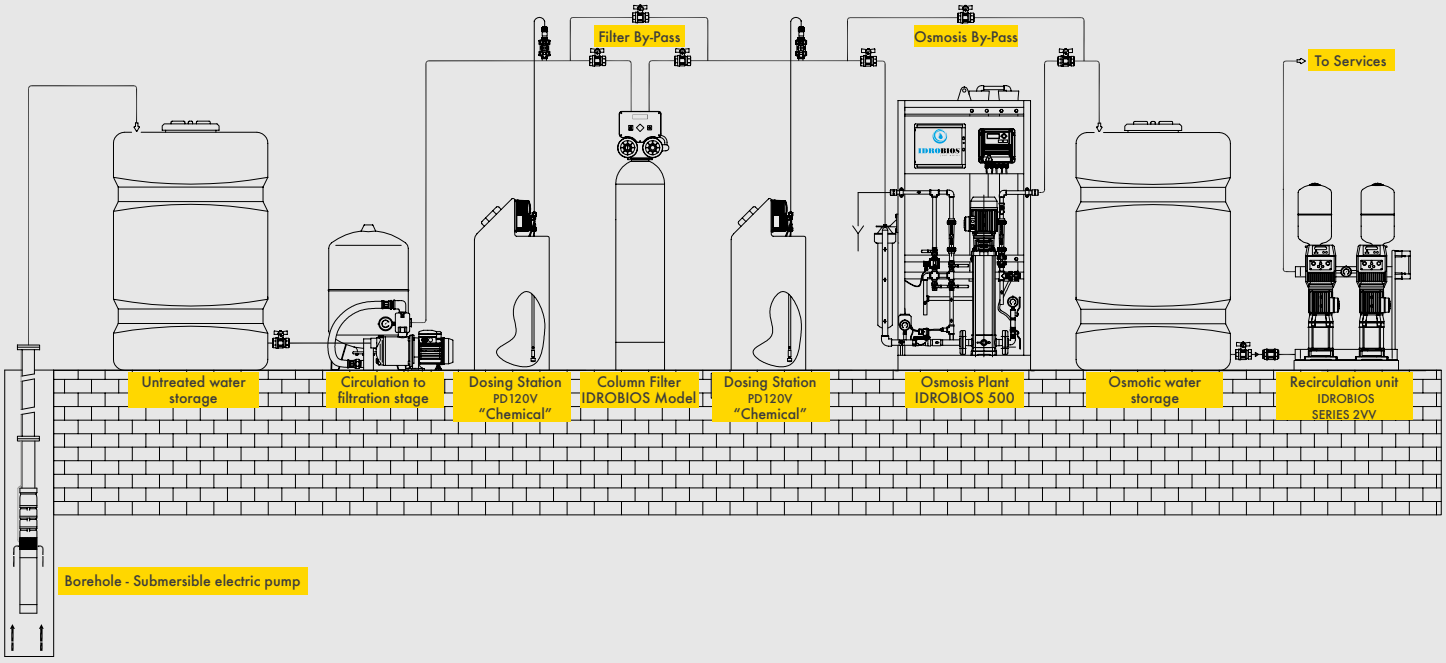
The R.O. system cannot always be fed with untreated water, because certain elements in the water (free chlorine, turbidity, hardness, iron) would impair the osmotic process, sometimes causing irreversible damage to the semi-permeable membrane.
In such cases an initial softening treatment or chemical conditioning process is required, depending on the characteristics of the untreated water. In addition, the temperature of the feed water must never exceed 35°C.

Uses of osmotic water

- Pharmaceutical and cosmetic industries
- Potable water treatment
- Surface water treatment
- Aquifer water treatment
- Water produced by the electronics industry, galvanic treatment processes and glass-making process
- Soda and bottling plants
- Water to feed boilers and steam injection
- Hospitals and laboratories
- Environment (recycling)
- Desalination

Designed and constructed in compliance with the highest standards of quality and safety and guaranteeing low noise levels, IDROBIOS R.O. plants are preassembled on a stainless steel skid complete with all the components required to supply a complete system built in accordance with best practices.
All materials and accessories in the plant, especially those in contact with the water, are of tested corrosion resistance and are completely free of migration effects.
In addition to series production (composed of the models shown below), thanks to its highly qualified technical personnel IDROBIOS can study and design specific plants able to meet the needs of individual customers.

Installation example



MICRO series

Standard equipment

- Stainless steel frame
- Fibreglass vessel
- 2" ½ or 4" membranes
- Inlet prefilter
- High pressure rotary pump
- Pressure gauges
- Inlet solenoid valve
- Safety minimum pressure switch
- Drain control valve
- Conductivity sensor
- Controller*
- Polyphosphates Dispenser (for versions up to M240)

On request

- Anti-scale dosing pump with tank
- Blending circuit with control valve
- Permeate flow meter

*Controller

- Backlit LCD graphic display
- Two on/off outputs
- Two proportional digital outputs
- Minimum and maximum reading alarm

Display read-out

- Temperature, (optional probe), date, time, conductivity
- Probe cleaning output
- Counter input for proportional dosage
- Permanent data storage
- Stand-by
- Serial output for printer or modem
- SMS text message transmission (optional GSM modem)
- Programmable output: conductivity 0.4÷20mA, temperature 0.4÷20mA
- Product tank dual level input
- Flow sensor input
- Probe input
- Password

OSMO M-80

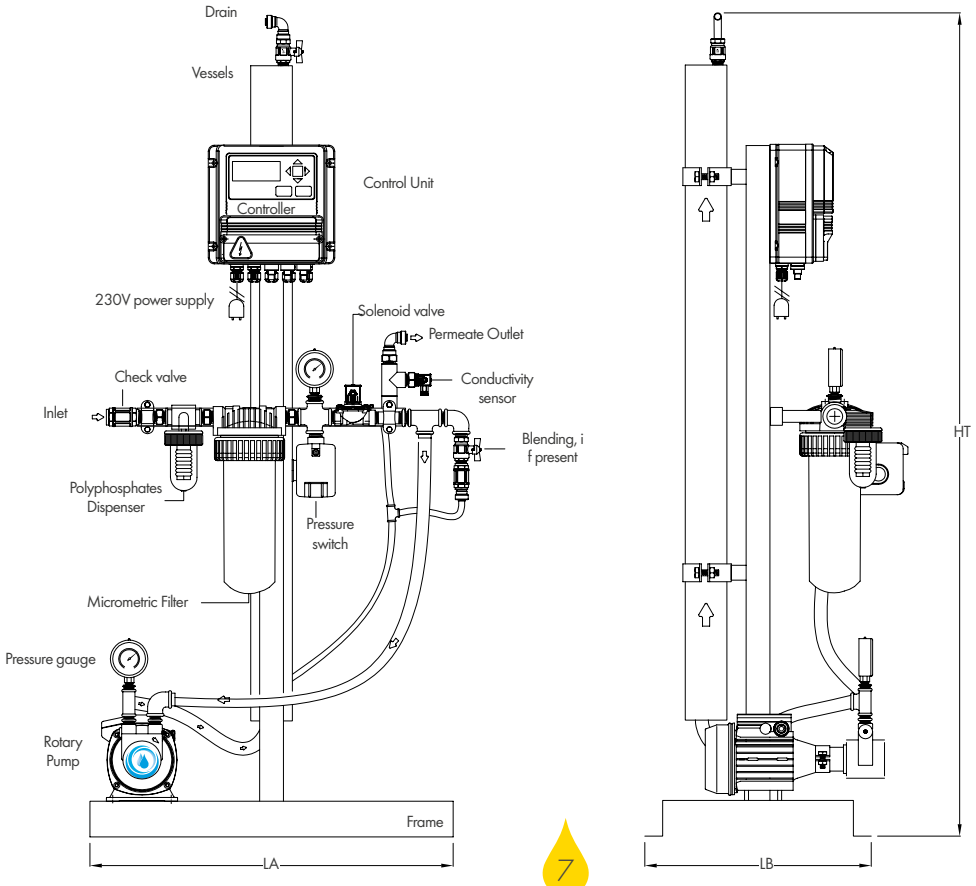
Technical data

Model	Permeate Flow Rate [l/h]		Reject [l/h]		Operating pressure [bar]	Installed power [kW]	Membranes		Vessels No.
	min	max	min	max			No.	ϕ	
OSMO M-80	60	80	40	60	12	0.24	1	2"1/2	1
OSMO M-150	120	150	80	150	12	0.37	2	2"1/2	2
OSMO M-240	200	250	180	250	14	0.37	1	4"	1
OSMO M-360	320	360	180	250	12	0.55	4	2"1/2	4
OSMO M-420	380	420	300	350	14	0.75	2	4"	2
OSMO M-800	780	820	500	620	12	2x0.75	4	4"	4

The flow rate data are referred to inlet water temperature of 15°C with 1000 mg/l salinity.
N.B. The flow rate can vary in accordance with inlet water temperature and salinity variations.

Dimensions and weights

DIMENSIONS [mm]				CONNECTIONS		
Model	LA	LB	HT	IN	OUT	DRAIN
OSMO M-80	600	400	1050	1/4"	ϕ10	1/4"
OSMO M-150	600	400	1050	1/2"	ϕ10	1/4"
OSMO M-240	600	400	1250	1/2"	1/2"	1/4"
OSMO M-360	600	400	1250	1/2"	1/2"	1/4"
OSMO M-420	610	380	1530	1/2"	1/2"	1/2"
OSMO M-800	610	380	1530	1/2"	1/2"	1/2"



LE/HR series

LE (Low Energy) series plants are equipped with membranes designed to operate at low pressure, thereby achieving high flow rates with saline rejection of 99.2%

HR (High Rejection) series plants are equipped with membranes designed to operate at higher pressure values, producing a quantity of water that is lower than that of the membranes used for the LE series, although allowing saline rejection of 99.7%.

OSMO 500

Standard equipment

- Stainless steel frame
- Fibreglass vessel
- 4" or 8" membranes
- Inlet prefilter
- Stainless steel multi-stage vertical electric pump
- Pressure gauges
- Inlet and flushing solenoid valves
- Safety pressure switches
- Drain control valve
- Recirculation control valve
- Conductivity sensor
- Flow meters

Each plant is supplied complete with:

- CE declaration of conformity
- Operating and maintenance manual
- General installation diagrams (hydraulic and electrical)

Controller

- Backlit LCD graphic display
- Two on/off outputs
- Two proportional digital outputs
- Minimum and maximum reading alarm

Display read-out

- Temperature, (optional probe), date, time, conductivity
- Probe cleaning output
- Counter input for dosage
- Permanent data storage
- Stand-by
- Serial output for printer or modem
- SMS text message transmission (optional GSM modem)
- Programmable output: conductivity 0.4÷20mA,
  temperature 0.4÷20mA
- Product tank dual level input (if installed)
- Flow sensor input
- Probe input
- Password

Series from 500 to 1250 l/h

General technical data

- Feed pressure 2.5 - 5 [bar]
- Ambient Temperature 5 - 40 °C
- Ambient relative humidity 80%

Untreated water

- Temperature: min +15°C - max +35 °C
- Total salinity no higher than 8000 [mg/l]
- PH 6 - 8
- Zero free chlorine
- SDI (Silt Density Index) < 3
- Zero Iron and Manganese Concentration

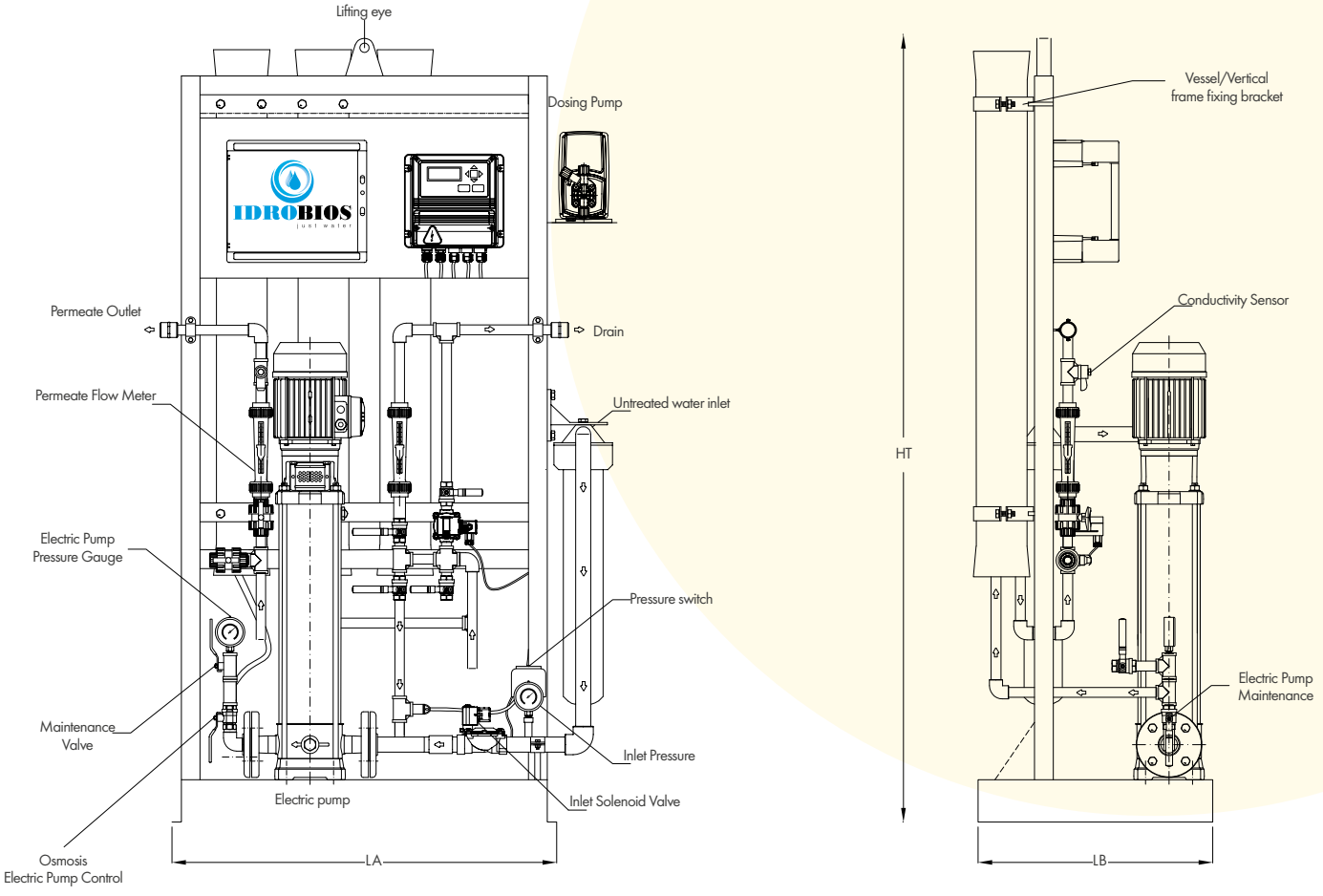
Technical data

Model	Feed water flow rate [l/h]		Max Permeate Flow Rate [l/h]		Recovery [%]		Operating pressure [bar]		Installed power [kW]		Membranes		Vessels No.
	min	max	HR	LE	min	max	HR	LE	HR	LE	No.	ϕ	
OSMO 500	670	1200	500	600	50	70	12-15	10	2.2	1.5	2	4"	2
OSMO 750	1000	1700	750	850			13-18	12	2.2	1.5	3		3
OSMO 1000	1350	2400	1000	1200			13-18	12	2.2	2.2	4		4
OSMO 1250	1670	2800	1250	1400		75	13-18	13	2.2	2.2	5		5

The values shown in the table were calculated with inlet water temperature of 15°C and 1000 mg/l salinity.
Reducing the temperature and increasing the salinity (value no higher than 8000 mg/l) results in a reduction of permeate.
The recovery factor depends on the inlet water characteristics, operating temperature and pressure, and must be established at the time of plant commissioning.

Dimensions and weights

DIMENSIONS [mm]				CONNECTIONS			WEIGHT [kg]
Model	LA	LB	HT	IN	OUT	DRAIN	
OSMO 500	850	550	1700	1″	1/2″	1/2″	110
OSMO 750	850	550	1,700	1″	1/2″	1/2″	130
OSMO 1000	850	550	1700	1″	1/2″	1/2″	150
OSMO 1250	1200	550	1700	1″	1″	1″	180



Series from 1500 to 28000 l/h

General technical data

- Feed pressure 2.5 - 5 [bar]
- Ambient temperature 5 - 40 °C
- Ambient relative humidity 80%

Untreated water

- Temperature: min +15°C - max +35 °C
- Total salinity no higher than 8000 [mg/l]
- PH 6 – 8
- Zero free chlorine
- SDI (Silt Density Index) < 3
- Zero Iron and Manganese Concentration

Technical data

Model	Feed water flow rate [l/h]		Max Permeate Flow Rate [l/h]		Recovery [%]		Operating pressure [bar]		Installed power [kW]		Membranes		Vessels No.
	min	max	HR	LE	min	max	HR	LE	HR	LE	No.	ϕ	
OSMO 06_03_40	2100	3600	1500	1800	50	75	13-15	12	3	2.2	6	4″	3
OSMO 09_03_40	2800	5000	1800	2500	50	75	13-15	12	3	3	9		3
OSMO 10_05_40	3300	5600	2000	2800	50	75	13-15	13	3	3	10		5
OSMO 03_01_80	4000	8400	3000	4200	50	75	14-16	14	5.5	5.5	3	8″	1
OSMO 04_02_80	5300	10000	4000	5000	50	75	14-16	12	7.5	5.5	4		2
OSMO 05_02_80	6700	12400	5000	6200	50	75	13-15	12	7.5	5.5	5		2
OSMO 06_02_80	8000	15000	6000	7500	50	75	14-17	12	7.5	7.5	6		2
OSMO 08_03_80	10670	20000	8000	10000	50	75	15-17	12	11	11	8		3
OSMO 09_03_80	12000	22400	9000	11200	50	75	13-16	12	15	11	9		3
OSMO 12_03_80	16000	25000	12000	15000	60	75	14-17	12	15	15	12		3
OSMO 15_03_80	20000	30000	15000	18000	60	75	14-17	12	18.5	15	15		3
OSMO 20_04_80	26670	40000	20000	24000	60	75	15-18	12	22	18.5	20		4
OSMO 25_05_80	33400	46670	25000	28000	60	75	15-18	12	30	22	25		5

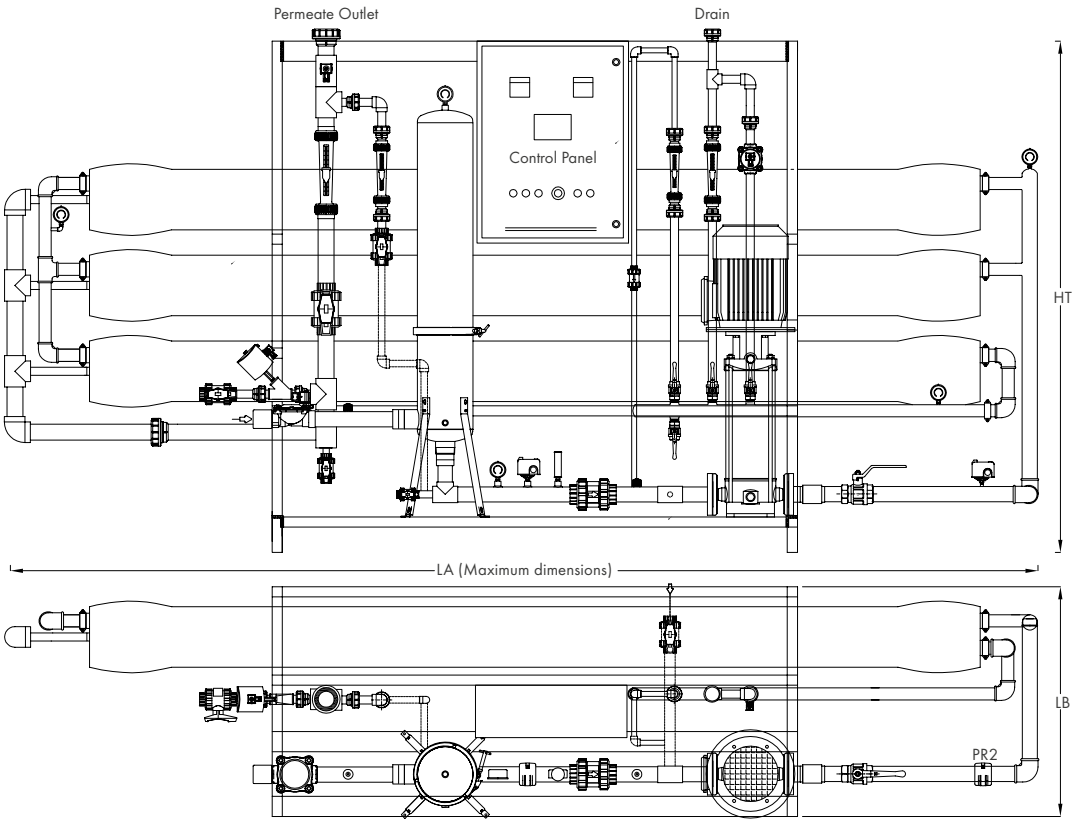
The values shown in the table were calculated with inlet water temperature of 15°C and 1000 mg/l salinity.
Reducing the temperature and increasing the salinity (value no higher than 8000 mg/l) results in a reduction of permeate.
The recovery factor depends on the inlet water characteristics, operating temperature and pressure, and must be established at the time of plant commissioning.

IDROBIOS just water

Dimensions and weights

DIMENSIONS [mm]				CONNECTIONS			Weight [kg]
Model	LA	LB	HT	IN	OUT	DRAIN	
OSMO 06_03_40	2300	800	1800	1"	1"	1"	250
OSMO 09_03_40	3300	800	1800	1"1/4	1"	1"	320
OSMO 10_05_40	2300	800	1800	1"1/4	1"	1"	350
OSMO 03_01_80	3900	950	1800	1"1/2	1"1/4	1"	400
OSMO 04_02_80	2900	950	1800	1"1/2	1"1/4	1"1/4	580
OSMO 05_02_80	3900	950	1900	2"	1"1/2	1"1/4	700
OSMO 06_02_80	3900	1000	1900	2"	1"1/2	1"1/2	780
OSMO 08_03_80	3900	1000	1900	2"	2"	1"1/2	850
OSMO 09_03_80	3900	1000	1900	2"	2"	1"1/2	950
OSMO 12_03_80	4900	1000	2000	2"1/2	2"1/2	2"	1200
OSMO 15_03_80	6000	1000	2000	DN80	2"1/2	2"	1350
OSMO 20_04_80	6000	1100	2100	DN100	2"1/2	2"1/2	1600
OSMO 25_05_80	6000	1100	2200	DN100	DN80	2"1/2	1950

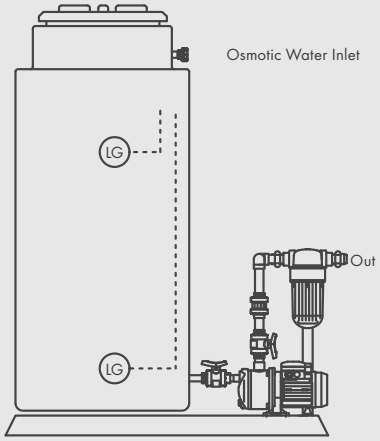
The osmosis system shown in the figure is given purely by way of example. This is a system for the production of 10m3/h in a non-standard version, complete with optional equipment.
The number of vessels for each model shown in the table will vary on the basis of the matters described.
Weight and dimensional data are guideline and may be subject to change without notice.



Accessories

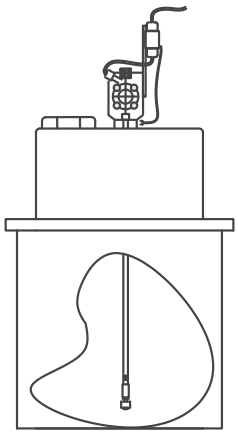
Flushing unit

The system is designed to transfer (by means of an electric pump) osmotic water (contained in the storage vessel) to the osmotic membranes at each plant stoppage, in such a way as to protect the membranes from salt precipitation or biological fouling.



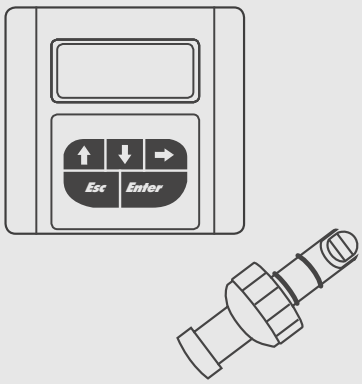
Dosing stations

In most cases the water must be supplied with conditioning products with the following functions: organic fouling prevention, water sanitisation, elimination of any chlorine contents, prevention of saline deposits on the membrane.
For this reason, the systems are used in conjunction with dosing stations and dosing pumps.



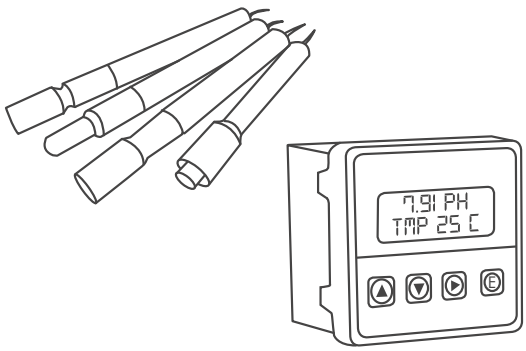
Hall effect **flow indicators and transmitters**

(FIT - Flow Indicator Transmitter).



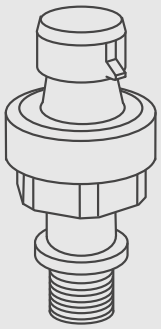
Probes

for monitoring of water (treated and untreated) parameters, including redox, ph, conductivity, chlorine and temperature, complete with instruments for display of the associated values on the control panel.



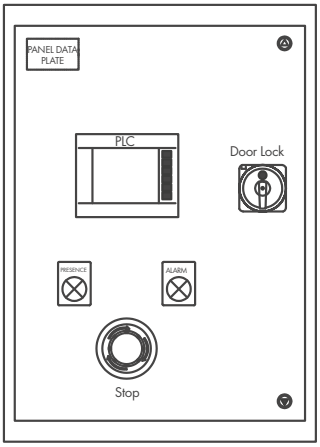
Pressure transmitter

with range from 0 to 25 bar, 4-20 mA output signal for display of the pressure value on the control panel



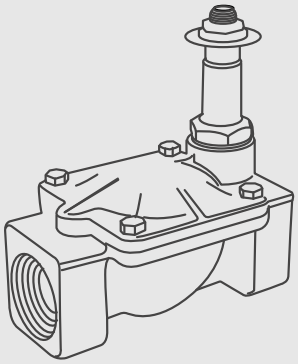
Control panels

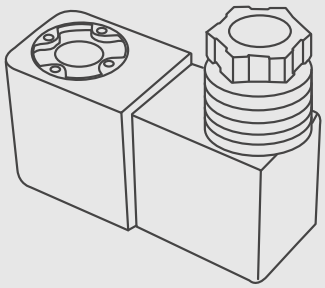
with PLC logic.



Solenoid valves

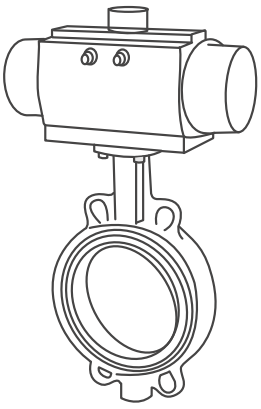
two way servo-driven valves with brass body.





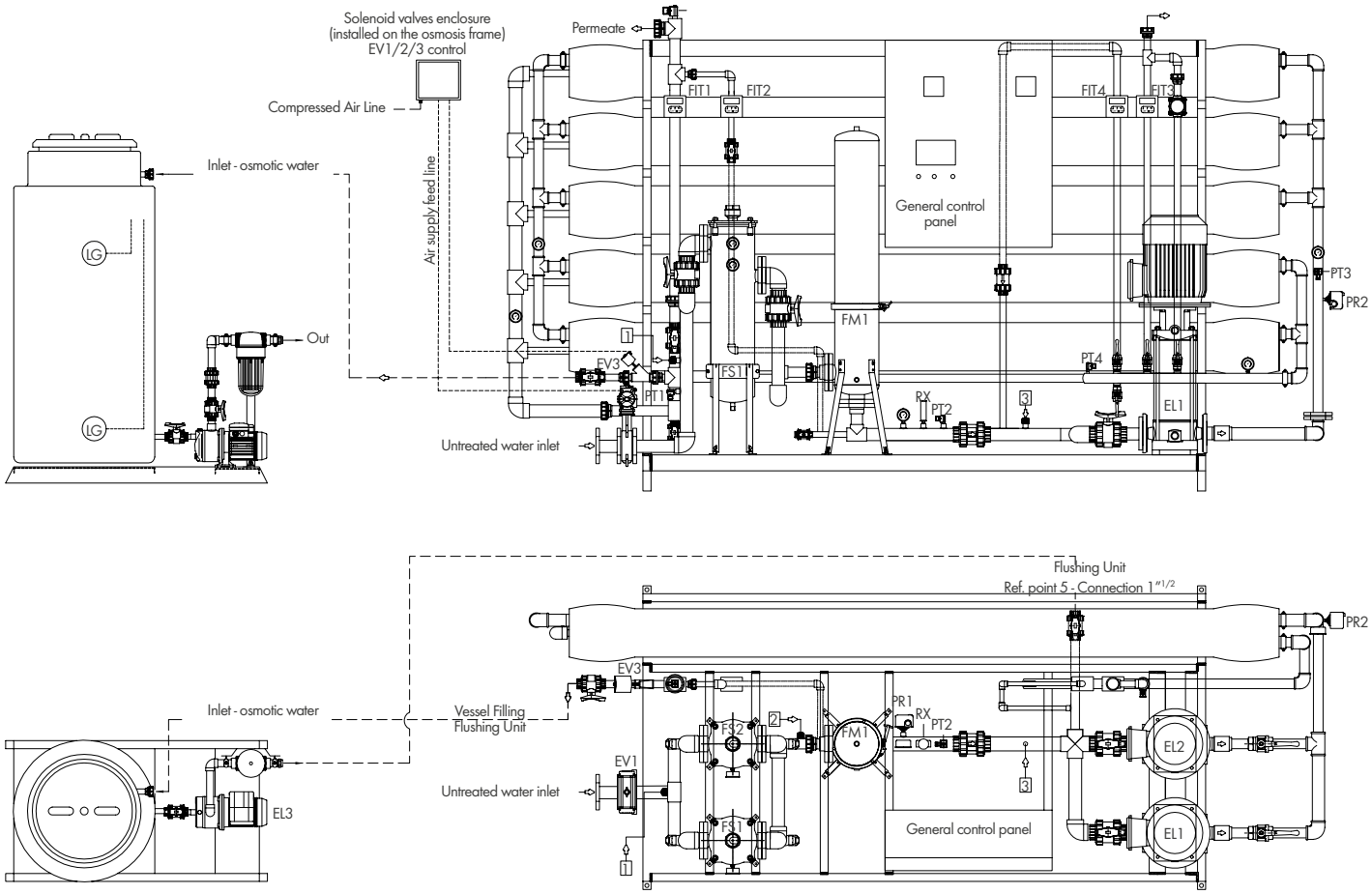
Wafer valves

with pneumatic actuator.



Customised configurations

In addition to the standard models shown in the preceding sections, depending on the specific water quality requirements, available space, and operating mode, our engineering department can design the most suitable solution in relation to customer requirements. The following diagram shows a 15 m3/h plant with PLC control logic.



Key:

(EV) Inlet, flushing and flushing vessel filling solenoid valves
(PT) Pressure transducers
(PR) Pressure switch for low water pressure and membrane fouling
(FIT) Flow meters for permeate, blending, drain and recirculation
(VSF) Flushing vessel filling ball valve
(RX) Redox probe
(FS) Prefiltration with 2 bag filters
(FM) Prefiltration with 1 multi-cartridge filter
(EL) Osmosis electric pump
(MA) Pressure gauges
(VNR) Check valves

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