Shell and Tube
Heat Exchangers for
Electric & Hybrid Marine Propulsion

BOWMAN®

100 YEARS OF HEAT TRANSFER TECHNOLOGY

Bowman Marine Heat Exchangers.
The efficient, reliable cooling solution for
Electric and hybrid

Bowman shell and tube heat exchangers are now a proven solution for cooling electric and hybrid marine propulsion systems and charging stations.

For over 80 years, Bowman heat exchangers have provided cooling solutions for the marine industry.

Now, as the industry moves towards renewable energy power systems, Bowman is again at the forefront, providing reliable, high quality heat exchangers for electric and hybrid marine propulsion.

Electric Propulsion
Cooling applications include: the battery pack and on-board charger (where fitted), AC-DC converter, DC-DC converter, electric drive motor, plus battery charging stations.

Hybrid Propulsion
Cooling applications include: the Hybrid Control Unit, the combined Electric Motor/Generator, plus cooling for the engine jacket water and lubrication systems (please see our Marine Cooling brochure for more information on engine and transmission cooling).

Comprehensive Range
In addition to Bowman's standard marine heat exchangers, the company has developed a new titanium range. Designed specifically for electric and hybrid marine applications, the units offer design, performance and commercial benefits compared to models of similar specification.

Shell and Tube Design
Easily removable end covers enable the tube stack to be quickly withdrawn, making cleaning and maintenance simple and straightforward.

Fully Floating Tube Stack
The precision engineered, fully floating tube stack minimises thermal stresses and provides efficient heat transfer, with low pressure drop.

Compact Design
The compact design of Bowman heat exchangers enables them to be integrated more easily in to the cooling circuit.

Extensive Range
With over 40 models in the standard marine range, plus 15 more in the titanium range, Bowman have heat exchangers providing heat dissipation from 3kW to 701kW.

Advanced Engineering
3D CAD models are available for all heat exchangers.

Premium Quality
All heat exchangers are UK manufactured, using high quality components for long operational life.

Product Support
Bowman heat exchangers are supported with comprehensive technical data, a comprehensive replacement parts programme and a global network of distributors.

propulsion systems

Product Selection and Integration

Although all systems require different levels of heat dissipation, the following guidelines can be applied to establish the typical size of the heat exchanger required:

An electric motor will commonly lose 6% of the rated power in the form of heat. Therefore, a 100kW motor may need a cooler capable of transferring 6kW of thermal energy. The associated components including transformers, inverters, chargers etc will typically require an additional 3% of the motor power to be dissipated. Additional cooling may also be required for the batteries.

These figures should only be used to estimate the size of cooler required and where possible the correct heat exchanger should be selected by Bowman who can perform thermal calculations considering the heat dissipation requirements, fluids, temperatures and flow rates of the equipment which has been specified. See below for more information.

Selection Guidance

Electric and Hybrid systems are often designed to operate with sea water temperatures of 30°C plus, making selecting the right heat exchanger critical. Whilst the tables on pages 4 and 8 list typical performance examples at given temperatures and flow rates, they are intended as a general guide only. However, by supplying the following information, we can provide a computer aided product selection, to recommend the most appropriate heat exchanger for your requirements:

Coolant type and concentration
Heat to be dissipated (in kW)
Required coolant outlet temperature (in °C)
Coolant flow (in l/min)
Seawater temperature (in °C)

Electric and Hybrid Marine Heat Exchangers Standard Range

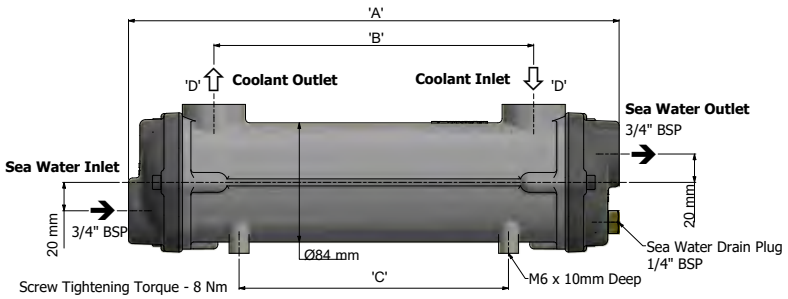
Bowman's standard marine heat exchanger range is proven worldwide in a wide range of electric and hybrid marine installations.

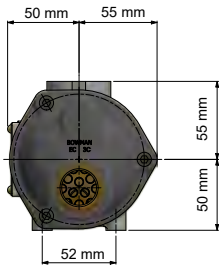
The table below is intended to provide a general guide to their typical performance when used with;

Coolant type: 50/50 water/glycol
Coolant outlet temperature: 40°C
Seawater inlet temperature: 30°C

Type	Heat Dissipated	Coolant Flow	Sea Water Flow	Internal Coolant Volume	Internal Sea Water Volume
	kW	l/min	l/min	Litre	Litre
EC 80-3875-1	3	40	40	0.26	0.31
EC100-3875-2	7	50	50	0.49	0.44
EC120-3875-3	11	50	50	0.74	0.57
EC140-3875-4	15	50	50	0.97	0.71
EC160-3875-5	19	50	50	1.30	0.91
FC 80-3876-1	11	80	80	0.75	0.65
FC100-3876-2	16	80	80	1.10	0.84
FC120-3876-3	22	80	80	1.50	1.06
FC140-3876-4	29	80	80	2.00	1.35
FC160-3876-5	37	80	80	2.60	1.68
FG 80-3877-1	24	120	120	1.64	1.26
FG100-3877-2	32	120	120	2.40	1.56
FG120-3877-3	43	120	120	3.00	1.96
FG140-3877-4	53	120	120	3.90	2.42
FG160-3877-5	65	120	120	5.00	2.97
GL140-3878-2	50	200	200	3.60	3.10
GL180-3878-3	66	200	200	4.80	3.80
GL240-3878-4	82	200	200	6.30	4.60
GL320-3878-5	100	200	200	8.00	5.50
GL400-3878-6	121	200	200	10.00	6.60
GL480-3878-7	136	200	200	12.20	7.70
GK190-3879-3	98	300	300	7.00	6.30
GK250-3879-4	125	300	300	9.00	7.50
GK320-3879-5	153	300	300	11.60	9.00
GK400-3879-6	181	300	300	14.60	10.60
GK480-3879-7	206	300	300	17.40	12.30
GK600-3879-8	238	300	300	22.10	14.70
JK190-3881-3	121	400	400	9.70	8.80
JK250-3881-4	157	400	400	12.50	10.40
JK320-3881-5	195	400	400	16.10	12.50
JK400-3881-6	233	400	400	20.30	14.70
JK480-3881-7	267	400	400	24.20	17.10
JK600-3881-8	306	400	400	30.70	20.40
PK190-3880-3	117	650	650	13.60	16.00
PK250-3880-4	238	650	650	17.70	18.60
PK320-3880-5	303	650	650	22.60	21.80
PK400-3880-6	367	650	650	28.50	25.30
PK480-3880-7	424	650	650	34.00	29.00
PK600-3880-8	501	650	650	42.50	34.40
RK400-5882-6	524	900	900	43.40	37.90
RK600-5882-8	701	900	900	65.20	50.10

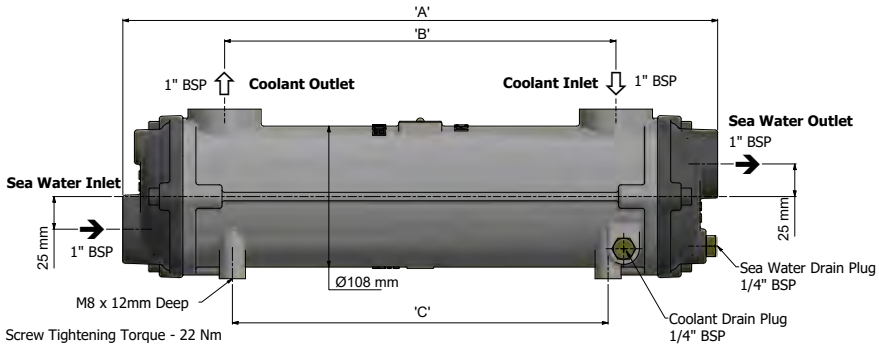
EC Range

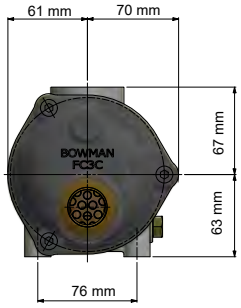




Type	Weight	A	B	C	D
	kg	mm	mm	mm	BSP
EC 80-3875-1	2.4	174	60	60	1/2"
EC 100-3875-2	3.2	260	140	104	3/4"
EC 120-3875-3	3.8	346	226	190	3/4"
EC 140-3875-4	4.8	444	324	288	3/4"
EC 160-3875-5	5.7	572	452	416	3/4"

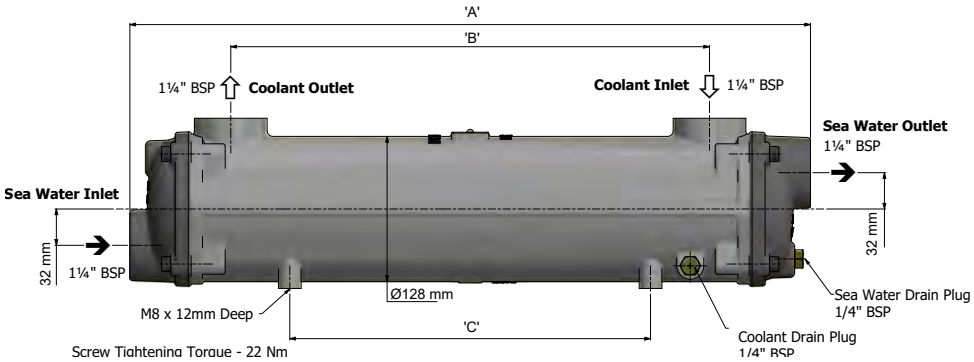
FC Range

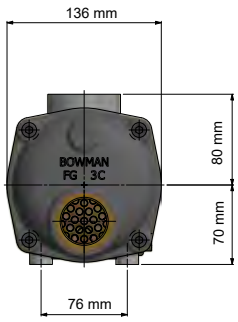




Type	Weight	A	B	C
	kg	mm	mm	mm
FC 80-3876-1	5.5	272	116	104
FC 100-3876-2	6.3	358	202	190
FC 120 -3876-3	7.3	456	300	288
FC 140-3876-4	9.4	584	428	288
FC 160-3876-5	11.0	730	574	434

FG Range

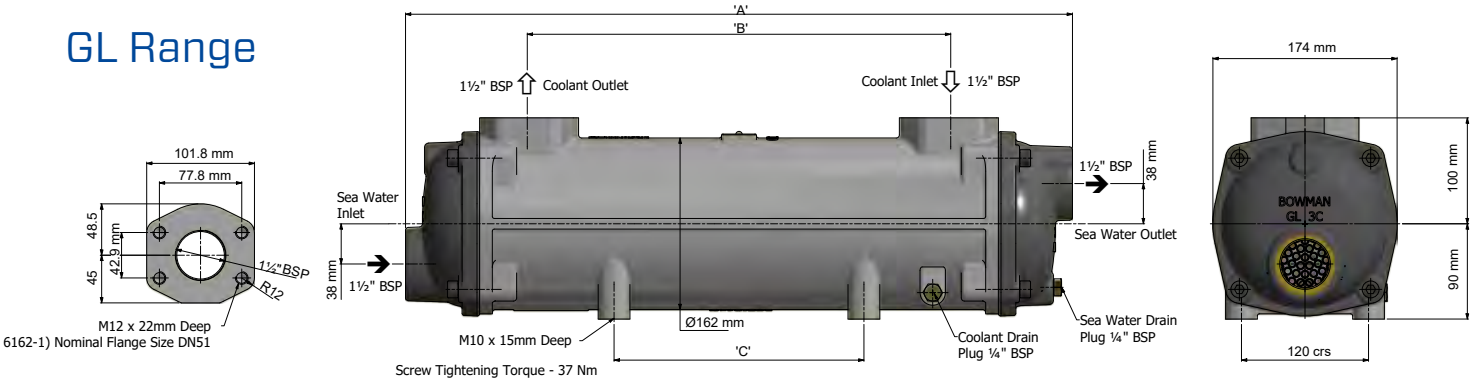




Type	Weight	A	B	C
	kg	mm	mm	mm
FG 80-3877-1	8.5	374	196	92
FG 100-3877-2	10.0	472	294	190
FG 120-3877-3	12.0	600	422	318
FG 140-3877-4	14.5	746	568	464
FG 160-3877-5	17.5	924	746	642

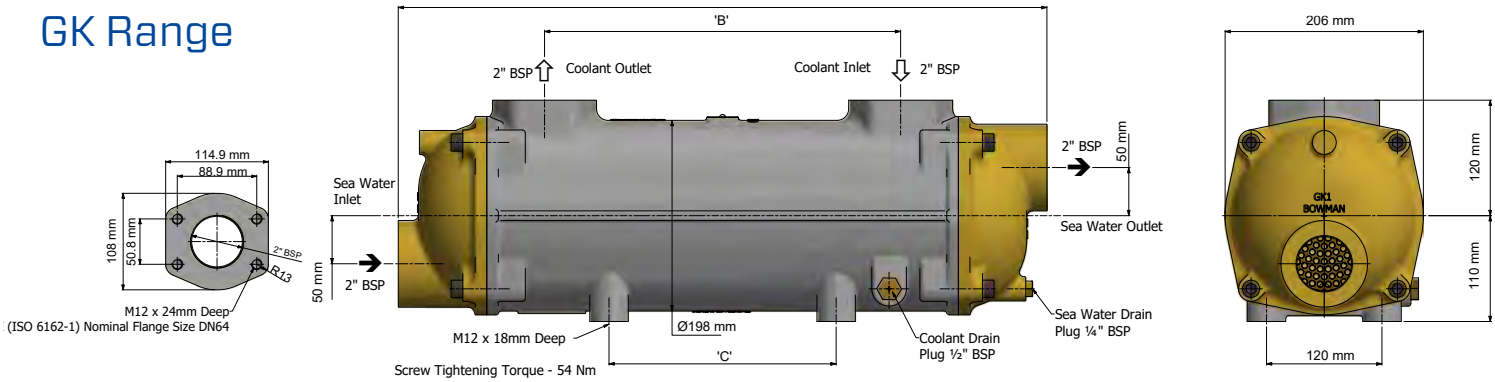
Maximum working coolant pressure 20 bar.
Maximum working sea water pressure 16 bar.
Maximum working coolant temperature 110°C.

GL Range



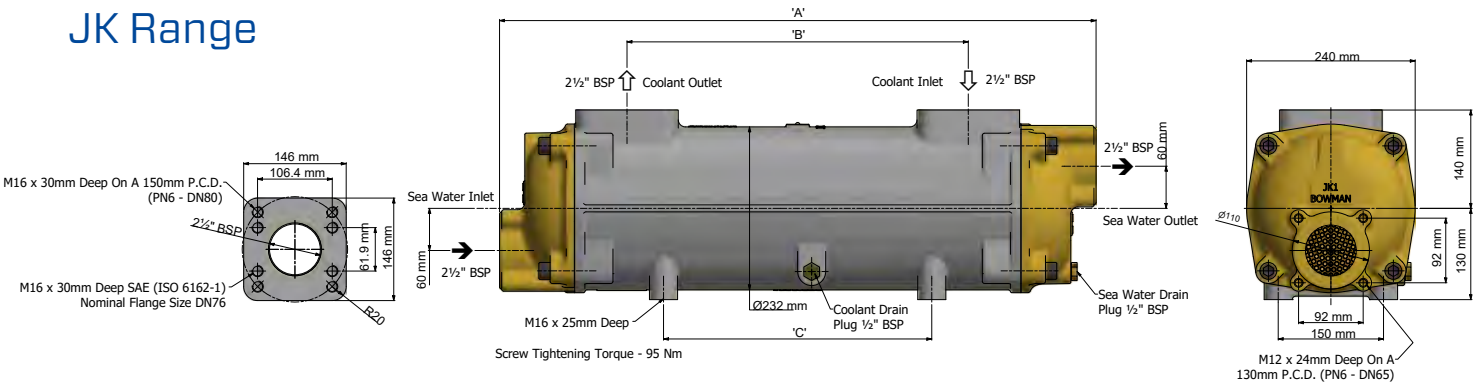
Type	Weight	A	B	C
	kg	mm	mm	mm
GL 140-3878-2	18	502	272	108
GL 180-3878-3	21	630	400	236
GL 240-3878-4	25	776	546	382
GL 320-3878-5	30	954	724	560
GL 400-3878-6	36	1156	926	762
GL 480-3878-7	42	1360	1130	966

GK Range



Type	Weight	A	B	C
	kg	mm	mm	mm
GK 190-3879-3	34	674	370	236
GK 250-3879-4	39	820	516	382
GK 320-3879-5	46	998	694	560
GK 400-3879-6	54	1200	896	762
GK 480-3879-7	62	1404	1100	966
GK 600-3879-8	74	1708	1404	1270

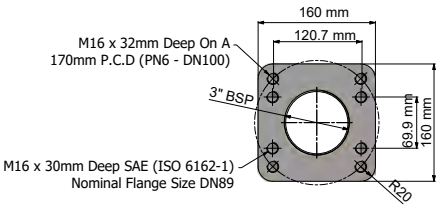
JK Range

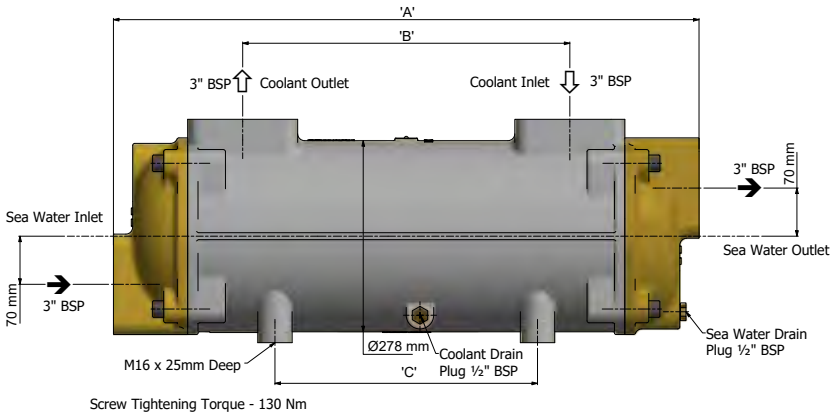


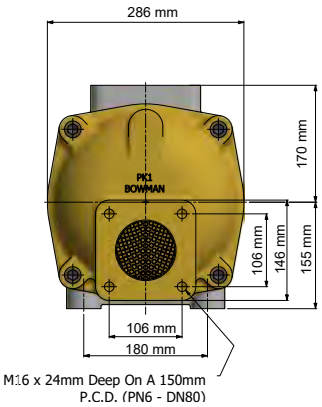
Type	Weight	A	B	C
	kg	mm	mm	mm
JK 190-3881-3	58	704	340	236
JK 250-3881-4	66	850	486	382
JK 320-3881-5	78	1028	664	560
JK 400-3881-6	92	1230	866	762
JK 480-3881-7	105	1434	1070	966
JK 600-3881-8	126	1738	1374	1270

Maximum working coolant pressure 20 bar.
Maximum working sea water pressure 16 bar.
Maximum working coolant temperature 110°C.

PK Range

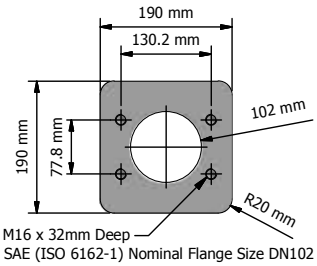


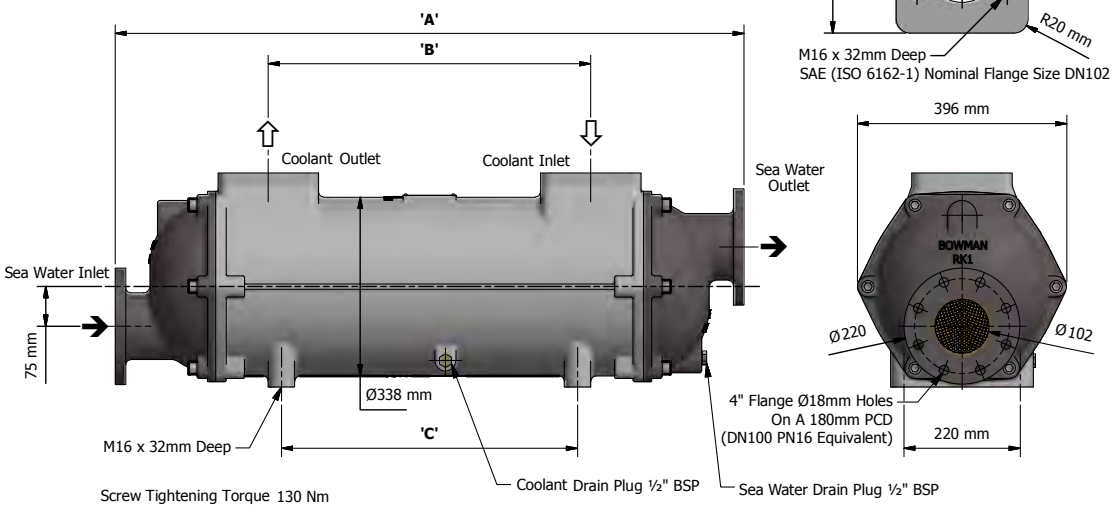




Type	Weight	A	B	C
	kg	mm	mm	mm
PK 190-3880-3	81	754	330	236
PK 250-3880-4	94	900	476	382
PK 320-3880-5	110	1078	654	560
PK 400-3880-6	125	1280	856	762
PK 480-3880-7	140	1484	1060	966
PK 600-3880-8	158	1788	1364	1270

RK Range





Type	Weight	A	B	C
	kg	mm	mm	mm
RK 400-5882-6	186	1392	812	762
RK 600-5882-8	246	1900	1320	1270

Maximum working coolant pressure 20 bar.
Maximum working sea water pressure 16 bar.
Maximum working coolant temperature 110°C.

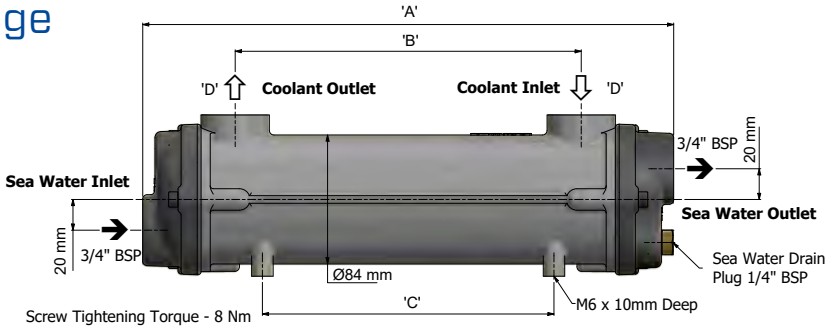
Electric and Hybrid Marine Heat Exchangers Titanium Range

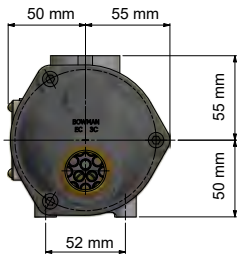
Bowman's titanium heat exchanger range has been developed for electric and hybrid marine applications and combines performance and light weight in an attractive commercial package.

The table below is intended to provide a general guide to their typical performance, when used with;
Coolant: 50/50 water/glycol
Coolant outlet temperature: 40°C
Seawater inlet temperature: 30°C

Type	Heat Dissipated	Coolant Flow	Sea Water Flow	Internal Coolant Volume	Internal Sea Water Volume
	kW	l/min	l/min	Litre	Litre
EC 80-5204-1	3	40	40	0.17	0.27
EC100-5204-2	7	50	50	0.41	0.39
EC120-5204-3	11	50	50	0.63	0.52
EC140-5204-4	15	50	50	0.89	0.66
EC160-5204-5	19	50	50	1.22	0.84
FC 80-5205-1	11	80	80	0.70	0.63
FC100-5205-2	16	80	80	0.97	0.83
FC120-5205-3	22	80	80	1.37	1.04
FC140-5205-4	29	80	80	1.90	1.30
FC160-5205-5	37	80	80	2.50	1.62
FG 80-5206-1	24	120	120	1.41	1.21
FG100-5206-2	32	120	120	2.00	1.50
FG120-5206-3	43	120	120	2.80	1.88
FG140-5206-4	53	120	120	3.68	2.31
FG160-5206-5	65	120	120	4.97	2.84

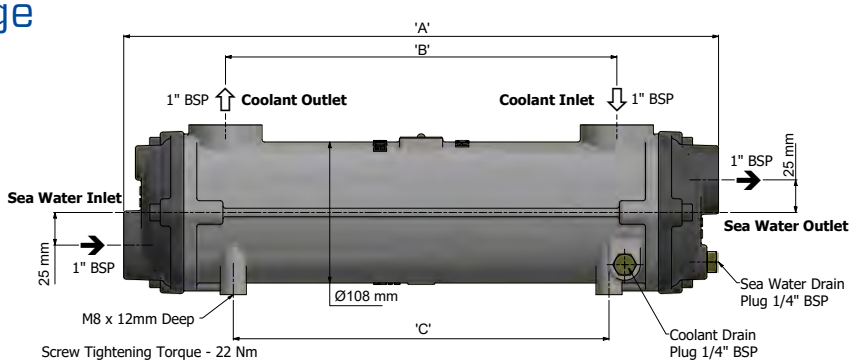
EC Range

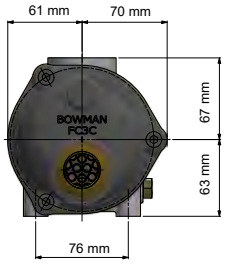




Type	Weight	A	B	C	D
	kg	mm	mm	mm	BSP
EC 80-5204-1	1.5	174	60	60	1/2"
EC 100-5204-2	2.1	260	140	104	3/4"
EC 120-5204-3	2.6	346	226	190	3/4"
EC 140-5204-4	3.2	444	324	288	3/4"
EC 160-5204-5	3.8	572	452	416	3/4"

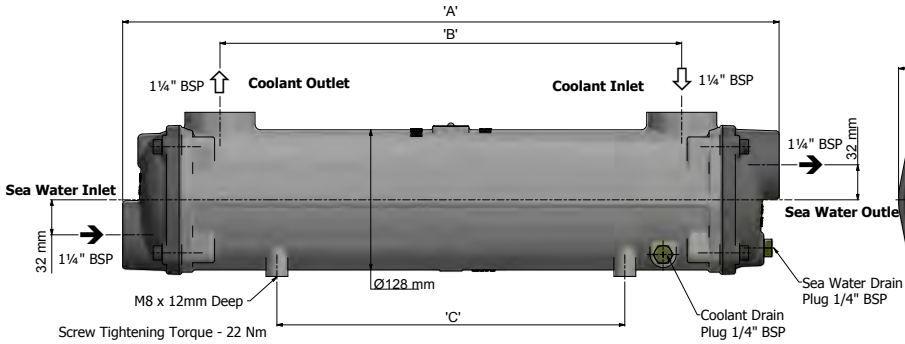
FC Range

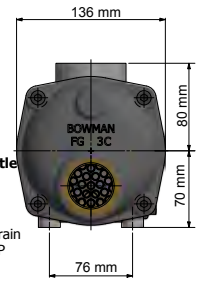




Type	Weight	A	B	C
	kg	mm	mm	mm
FC 80-5205-1	3.5	272	116	104
FC 100-5205-2	4.2	358	202	190
FC 120-5205-3	5.2	456	300	288
FC 140-5205-4	6.5	584	428	288
FC 160-5205-5	8.0	730	574	434

FG Range





Type	Weight	A	B	C
	kg	mm	mm	mm
FG 80-5206-1	5.7	374	196	92
FG 100-5206-2	7.0	472	294	190
FG 120-5206-3	8.4	600	422	318
FG 140-5206-4	10.4	746	568	464
FG 160-5206-5	12.6	924	746	642

Maximum working coolant pressure 4 bar.
Maximum working sea water pressure 4 bar.
Maximum working coolant temperature 95°C.

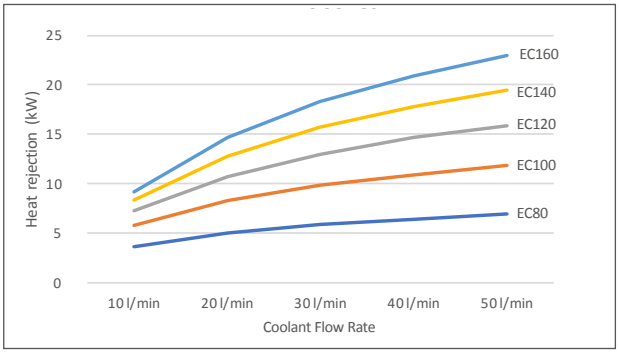
Heat Transfer

Coolant flow rates can significantly affect the performance of a heat exchanger and usually vary from one electrical system to another. Whilst general performance figures are provided on pages 4 and 8, referral to the tables below is also recommended, to check the flow rates of the system the heat exchanger will be cooling.

Please note, these figures have been generated using fixed seawater flow rates and the temperature of the coolant entering the heat exchanger, so the figures should only be used as a guide. If exact figures - as outlined on page 3 – are known, please contact the sales team who can provide a computer aided product selection, to recommend the most appropriate heat exchanger.

EC Series

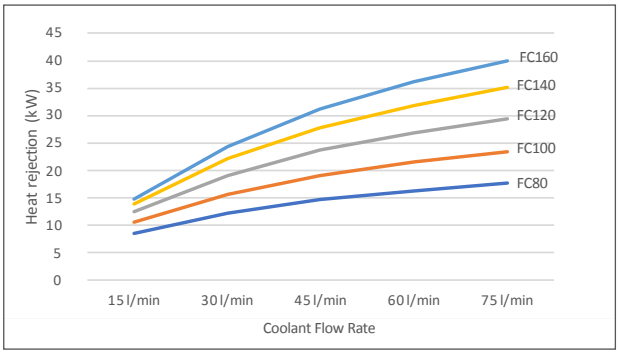
	Coolant Flow Rate				
Model	10 l/min	20 l/min	30 l/min	40 l/min	50 l/min
EC80	3.7	5.0	5.9	6.5	7.0
EC100	5.8	8.3	9.9	11.0	11.9
EC120	7.3	10.8	13.0	14.6	15.9
EC140	8.4	12.8	15.8	17.9	19.5
EC160	9.2	14.6	18.3	20.9	23.0



Figures based upon: Coolant type: 50/50 water/glycol. Seawater inlet temperature: 30 deg C at 50 l/min. Coolant inlet temperature: 50 deg C

FC Series

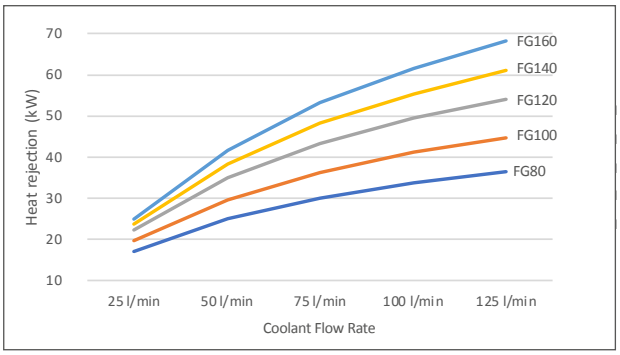
	Coolant Flow Rate				
Model	15 l/min	30 l/min	45 l/min	60 l/min	75 l/min
FC80	8.5	12.2	14.6	16.3	17.7
FC100	10.5	15.7	19.0	21.5	23.4
FC120	12.5	19.2	23.6	26.8	29.4
FC140	13.9	22.1	27.8	31.9	35.1
FC160	14.7	24.4	31.1	36.1	39.9



Figures based upon: Coolant type: 50/50 water/glycol. Seawater inlet temperature: 30 deg C at 80 l/min. Coolant inlet temperature: 50 deg C

FG Series

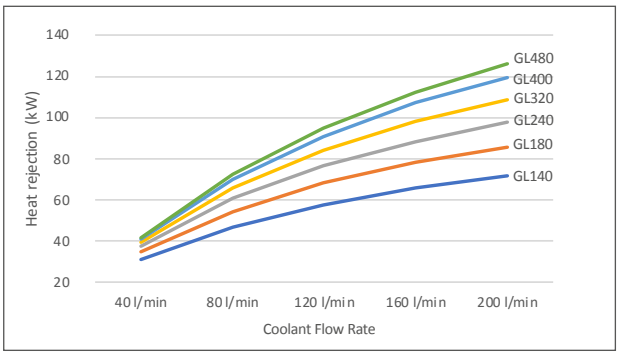
	Coolant Flow Rate				
Model	25 l/min	50 l/min	75 l/min	100 l/min	125 l/min
FG80	17.0	24.9	30.0	33.6	36.4
FG100	19.7	29.7	36.2	41.0	44.6
FG120	22.3	34.9	43.2	49.3	54.0
FG140	23.7	38.3	48.2	55.4	61.0
FG160	24.9	41.5	53.1	61.6	68.2



Figures based upon: Coolant type: 50/50 water/glycol. Seawater inlet temperature: 30 deg C at 120 l/min. Coolant inlet temperature: 50 deg C

GL Series

	Coolant Flow Rate				
Model	40 l/min	80 l/min	120 l/min	160 l/min	200 l/min
GL140	31.0	47.0	57.6	65.5	71.6
GL180	34.7	54.5	67.9	77.8	85.5
GL240	37.4	60.6	76.5	88.4	97.7
GL320	39.3	65.5	83.9	97.7	108.6
GL400	40.9	70.0	91.0	106.9	119.3
GL480	41.5	72.4	95.1	112.4	126.1



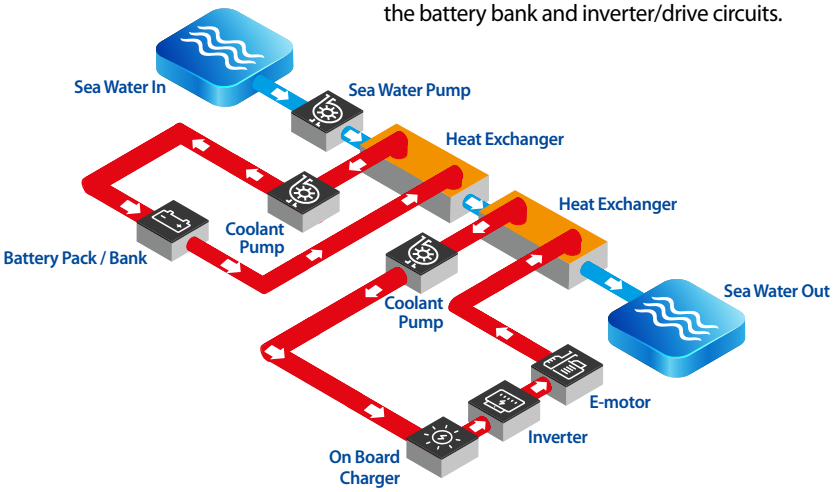
Figures based upon: Coolant type: 50/50 water/glycol. Seawater inlet temperature: 30 deg C at 200 l/min. Coolant inlet temperature: 50 deg C

Installation Examples

Below are some examples of typical installations where Bowman heat exchangers are used to cool electric powered marine propulsions systems.
They are provided for general information and not intended as installation recommendations.

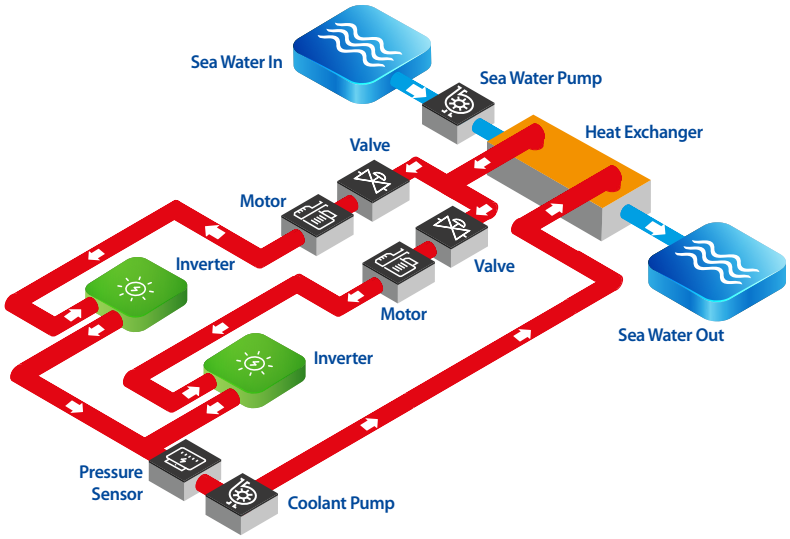
Cooling System

Two heat exchangers, installed in series, control the differing cooling requirements for the battery bank and inverter/drive circuits.



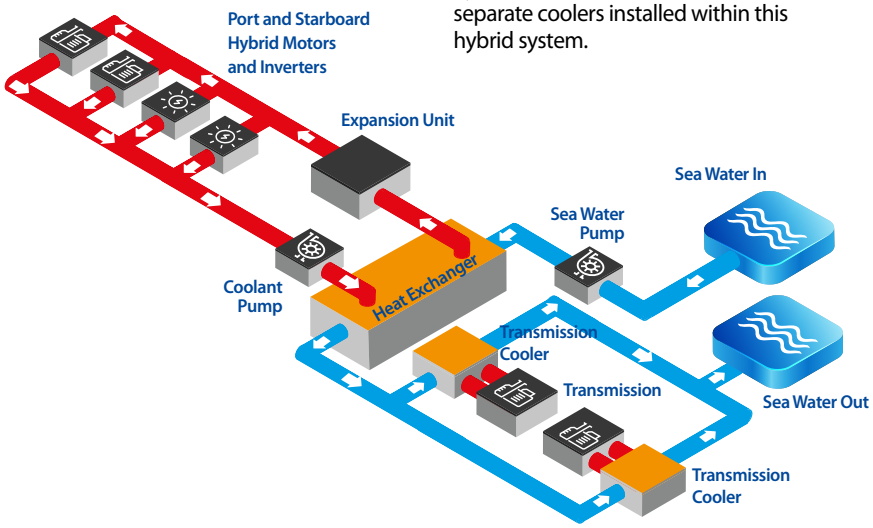
Cooling System

A single heat exchanger is used to cool the dual inverter/drive circuits in this installation.



Hybrid Control Unit

A single heat exchanger cools both the hybrid motors and inverters, plus two separate coolers installed within this hybrid system.



Installation

For maximum heat transfer, Bowman heat exchangers must be installed in a counterflow arrangement, where the seawater flows in the opposite direction to the coolant – see installation examples opposite.

For more information, download the installation guide from www.ej-bowman.com

Seal Options

Bowman heat exchangers are supplied with Nitrile seals as standard. However, for applications where coolant escape could harm the marine life, either Ethylene Propylene or Viton seals can be provided as an option at additional cost. To specify this option, a suffix should be added to the oil cooler type number when ordering, as follows:
EP – Ethylene Propylene; or VT - Viton

Warranty

Bowman heat exchangers are guaranteed against manufacturing and material defects for 12 months from the date of delivery.

Replacement Parts

Replacement parts are available for all Bowman heat exchangers. These include end covers and fixings, 'O' rings, seals, tube stacks and bodies.

Servicing the unit

Removing the end cover retaining screws enables the tube stack to be withdrawn for routine maintenance. On reassembly, new 'O' rings should be used to ensure a watertight seal.

A world of applications

Bowman heat exchangers can be found cooling traditional marine propulsion systems, hydraulic control systems throughout the world. They are renowned for excellent heat transfer, plus long operational life, in even the most demanding applications.

Now Bowman heat exchangers have become the go to solution for electric and hybrid marine propulsion systems.

Electric Propulsion

This leading European manufacture of electric propulsion systems specifies Bowman for cooling its larger, 100 kW plus propulsion products.

Battery Cooling

In Scandinavia, a superfast charging system, used to re-charge commercial ferry batteries, is being cooled by Bowman heat exchangers, preventing the heat loads generated from damaging the batteries.

Passenger Ferries

In Thailand, a fleet of electric ferries are reducing pollution along Bangkok's waterways. Four Bowman heat exchangers are installed in each ferry to control heat generated in the propulsion system.

All Bowman marine heat exchangers are produced to the highest quality in our UK manufacturing facility. With 100 years' experience producing efficient heat transfer solutions, you can have complete confidence when you specify Bowman marine heat exchangers.

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