Hydraulic Oil Coolers

Heat Transfer Technology from Bowman

BOWMAN®

100 YEARS OF HEAT TRANSFER TECHNOLOGY

Proven durability, on land,

Bowman Hydraulic Oil Coolers

Efficient, reliable heat transfer performance for hydraulic oils, heat transfer fluids, plus lubricating and quenching oils.

Heat exchangers perform a vital role in maintaining the performance and reliability of hydraulic systems.

Excessive temperature will reduce the performance of the system and may lead to component failure.

Maintaining the correct oil temperature extends the life of the system, reducing downtime and servicing costs.

Bowman hydraulic oil coolers provide efficient heat transfer solutions for a wide range of hydraulic cooling requirements, ensuring they always operate at the desired temperature.

High quality
Bowman hydraulic oil coolers are high quality products incorporating the best materials and the latest technical features.

Wide range
Bowman have a comprehensive range of oil coolers including sizes for the very largest systems. Popular types are held in stock ready for immediate despatch.

Roller expanded tubes
Roller expanded tubes are available as an option, providing a highly durable joint.

Tube stack options
Cupro-nickel is the standard tube material on all units, but stainless steel or titanium are also available.

Normal and high flow
Normal flow is our preferred and standard arrangement. However if the oil flow is high relative to the required heat dissipation a 'High Flow' version can be supplied. They have a tube stack designed to reduce the oil pressure drop and also have larger oil connections as listed on pages 8 to 11.

SAE flanges
SAE oil flange connections are provided on the shell side for GL and larger Bowman oil cooler models.

on sea and deep underground

Marine & land based versions
Whether the cooling medium is sea water, fresh water, or mineral rich water, Bowman has a range of hydraulic oil coolers to suit all applications.

Fully floating tube stack
Bowman shell and tube oil coolers feature a precision engineered, fully floating tube stack, which minimises thermal stresses and provides efficient heat transfer and low pressure drop.

Advanced engineering
3D CAD models are available.

Simple to maintain
The end covers are easily removable allowing the tube stack to be withdrawn, making cleaning and routine maintenance simple and straightforward.

Fire resistant fluids
For applications with fire resistant fluids, the standard nitrile should can be changed for either Ethylene Propylene or Viton. To specify these seals, a suffix should be added to the oil cooler type number as follows:
EP (Ethylene Propylene); or VT (Viton).

IMPORTANT: when ordering replacement seals, always change the 'NT' suffix in the 'Replacement Parts' table to the correct suffix for the seal specification required.

Selection guidance
The tables on pages 4-7 list typical examples of cooler performance at given temperatures and flow rates. This information is only intended for general guidance, graphs are available which show how heat dissipation and pressure losses vary with oil and water flow.

With the following information, we can use our computer programme to recommend the most appropriate oil cooler:

Oil type (or its viscosity at a specified temperature)	cSt at ^{0}C
Oil flow	l/min
Required oil outlet temperature	^{0}C
Heat to be dissipated	kW
Temperature of cooling water	^{0}C

Land based Hydraulic Oil Coolers

Designed to provide a high quality cooling solution for hydraulic systems where fresh water is the cooling medium, they are also suitable for use with heat transfer fluids, lubricating and quenching oils.

Typical examples of oil cooler performance with;

Oil type	ISO VG 37
Oil outlet temperature	50°C
Oil pressure drop	100 kPa
Water inlet temperature	25°C
Water pressure drop	50 kPa

Type	Heat Dissipated	Maximum Oil Flow	Fresh Water Flow	Internal Oil Volume	Internal Water Volume
	kW	l/min	l/min	l (litre)	l (litre)
EC 80-1425-1	4	80	80	0.26	0.31
EC100-1425-2	9	92	80	0.49	0.44
EC120-1425-3	13	77	77	0.74	0.57
EC140-1425-4	17	68	72	0.97	0.71
EC160-1425-5	22	64	66	1.30	0.91
FC 80-1426-1	13	140	140	0.75	0.65
FC100-1426-2	19	145	135	1.10	0.84
FC120-1426-3	26	116	125	1.50	1.06
FC140-1426-4	35	105	120	2.00	1.35
FC160-1426-5	45	96	108	2.60	1.68
FG 80-1427-1	28	192	185	1.64	1.26
FG100-1427-2	37	190	175	2.40	1.56
FG120-1427-3	50	160	160	3.00	1.96
FG140-1427-4	62	160	150	3.90	2.42
FG160-1427-5	79	145	135	5.00	2.97
GL140-1428-2	56	300	300	3.60	3.10
GL180-1428-3	73	285	280	4.80	3.80
GL240-1428-4	93	280	260	6.30	4.60
GL320-1428-5	114	270	240	8.00	5.50
GL400-1428-6	146	240	220	10.00	6.60
GL480-1428-7	172	235	205	12.20	7.70
GK190-1658-3	112	460	420	7.00	6.30
GK250-1658-4	144	445	385	9.00	7.50
GK320-1658-5	181	430	355	11.60	9.00
GK400-1658-6	221	420	325	14.60	10.60
GK480-1658-7	259	400	300	17.40	12.30
GK600-1658-8	329	365	275	22.10	14.70
JK190-1661-3	145	830	650	9.70	8.80
JK250-1661-4	186	740	550	12.50	10.40
JK320-1661-5	232	690	500	16.10	12.50
JK400-1661-6	283	650	460	20.30	14.70
JK480-1661-7	335	620	430	24.20	17.10
JK600-1661-8	401	600	400	30.70	20.40
PK190-1669-3	212	1600	900	13.60	16.00
PK250-1669-4	270	1240	840	17.70	18.60
PK320-1669-5	336	1060	750	22.60	21.80
PK400-1669-6	414	950	700	28.50	25.30
PK480-1669-7	497	890	650	34.00	29.00
PK600-1669-8	660	750	600	42.50	34.40
RK400-1698-6	570	1450	1180	43.40	37.90
RK600-1698-8	900	1240	850	65.20	50.10

The table above gives performance figures for normal flow versions. For high flow versions, please contact our sales team.

Marine Hydraulic Oil Coolers

Marine specification hydraulic oil coolers are designed to withstand aggressive cooling media, such as sea, mineral rich or contaminated water.

Typical examples of oil cooler performance with,

Oil type	ISO VG 37
Oil outlet temperature	50°C
Oil pressure drop	100 kPa
Water inlet temperature	25°C
Water pressure drop	50 kPa

Type	Heat Dissipated	Maximum Oil Flow	Maximum Sea Water Flow	Internal Oil Volume	Internal Water Volume
	kW	l/min	l/min	l (litre)	l (litre)
EC 80-3875-1	4	80	50	0.26	0.31
EC100-3875-2	8	92	50	0.49	0.44
EC120-3875-3	12	77	50	0.74	0.57
EC140-3875-4	16	68	50	0.97	0.71
EC160-3875-5	20	64	50	1.30	0.91
FC 80-3876-1	12	140	80	0.75	0.65
FC100-3876-2	17	145	80	1.10	0.84
FC120-3876-3	23	116	80	1.50	1.06
FC140-3876-4	31	105	80	2.00	1.35
FC160-3876-5	40	96	80	2.60	1.68
FG 80-3877-1	25	192	110	1.64	1.26
FG100-3877-2	33	190	110	2.40	1.56
FG120-3877-3	44	160	110	3.00	1.96
FG140-3877-4	56	160	110	3.90	2.42
FG160-3877-5	72	145	110	5.00	2.97
GL140-3878-2	51	300	200	3.60	3.10
GL180-3878-3	67	285	200	4.80	3.80
GL240-3878-4	86	280	200	6.30	4.60
GL320-3878-5	107	270	200	8.00	5.50
GL400-3878-6	139	240	200	10.00	6.60
GL480-3878-7	167	235	200	12.20	7.70
GK190-3879-3	102	460	300	7.00	6.30
GK250-3879-4	133	445	300	9.00	7.50
GK320-3879-5	171	430	300	11.60	9.00
GK400-3879-6	211	420	300	14.60	10.60
GK480-3879-7	256	400	300	17.40	12.30
GK600-3879-8	343	365	300	22.10	14.70
JK190-3881-3	132	830	400	9.70	8.80
JK250-3881-4	169	740	400	12.50	10.40
JK320-3881-5	211	690	400	16.10	12.50
JK400-3881-6	265	650	400	20.30	14.70
JK480-3881-7	320	620	400	24.20	17.10
JK600-3881-8	395	600	400	30.70	20.40
PK190-3880-3	196	1600	650	13.60	16.00
PK250-3880-4	252	1240	650	17.70	18.60
PK320-3880-5	319	1060	650	22.60	21.80
PK400-3880-6	399	950	650	28.50	25.30
PK480-3880-7	491	890	650	34.00	29.00
PK600-3880-8	682	750	650	42.50	34.40
RK400-5882-6	570	1450	900	43.40	37.90
RK600-5882-8	900	1240	900	65.20	50.10

The table above gives performance figures for normal flow versions. For high flow versions, please contact our sales team.

High temperature oil up to 150ºC

For applications where the oil is at higher temperatures, Bowman offer a range of oil coolers suitable for temperatures up to 150ºC.

Type	Maximum Oil Flow	Fresh Water Flow	Internal Oil Volume	Internal Water Volume
	l/min	l/min	l (litre)	l (litre)
EC 80-3145-1	80	80	0.26	0.31
EC100-3145-2	92	80	0.49	0.44
EC120-3145-3	77	77	0.74	0.57
EC140-3145-4	68	72	0.97	0.71
EC160-3145-5	64	66	1.30	0.91
FC 80-3146-1	140	140	0.75	0.65
FC100-3146-2	145	135	1.10	0.84
FC120-3146-3	116	125	1.50	1.06
FC140-3146-4	105	120	2.00	1.35
FC160-3146-5	96	108	2.60	1.68
FG 80-3147-1	192	185	1.64	1.26
FG100-3147-2	190	175	2.40	1.56
FG120-3147-3	160	160	3.00	1.96
FG140-3147-4	160	150	3.90	2.42
FG160-3147-5	145	135	5.00	2.97
GL140-3148-2	300	300	3.60	3.10
GL180-3148-3	285	280	4.80	3.80
GL240-3148-4	280	260	6.30	4.60
GL320-3148-5	270	240	8.00	5.50
GL400-3148-6	240	220	10.00	6.60
GL480-3148-7	235	205	12.20	7.70
GK190-3149-3	460	420	7.00	6.30
GK250-3149-4	445	385	9.00	7.50
GK320-3149-5	430	355	11.60	9.00
GK400-3149-6	420	325	14.60	10.60
GK480-3149-7	400	300	17.40	12.30
GK600-3149-8	365	275	22.10	14.70
JK190-3152-3	830	600	9.70	8.80
JK250-3152-4	740	550	12.50	10.40
JK320-3152-5	690	500	16.10	12.50
JK400-3152-6	650	460	20.30	14.70
JK480-3152-7	620	430	24.20	17.10
JK600-3152-8	600	400	30.70	20.40
PK190-3150-3	1600	900	13.60	16.00
PK250-3150-4	1240	840	17.70	18.60
PK320-3150-5	1060	750	22.60	21.80
PK400-3150-6	950	700	28.50	25.30
PK480-3150-7	890	650	34.00	29.00
PK600-3150-8	750	600	42.50	34.40
RK400-3155-6	1450	1180	43.40	37.90
RK600-3155-8	1240	850	65.20	50.10

The table above gives performance figures for normal flow versions. For high flow versions, please contact our sales team.

Extreme temperature oil up to 200°C

For conditions with extreme oil temperatures, Bowman offer a range of oil coolers designed to operate at temperatures up to 200°C. These units feature a cast iron shell, Viton seals and a special tube stack.

Type	Maximum Oil Flow	Maximum Fresh Water Flow	Internal Oil Volume	Internal Water Volume
	l/min	l/min	l (litre)	l (litre)
EC120-3635-3	77	77	0.49	0.44
FC100-3636-2	145	135	1.10	0.84
FG100-3637-2	190	175	2.40	1.56
FG120-3637-3	160	160	3.00	1.96
FG140-3637-4	160	150	3.90	2.42
FG160-3637-5	145	135	5.00	2.97
GL140-3638-2	300	300	3.60	3.10
GL240-3638-4	285	280	6.30	4.60

The table above gives performance figures for normal flow versions. For high flow versions, please contact our sales team.

Mining Hydraulic Oil Coolers

For underground mining applications, a special range of oil coolers is available suitable for use with water pressures up to 35 bar. These units have a cast iron shell, strengthened end covers, Viton seals and a special tube stack.

Typical examples of oil cooler performance with,

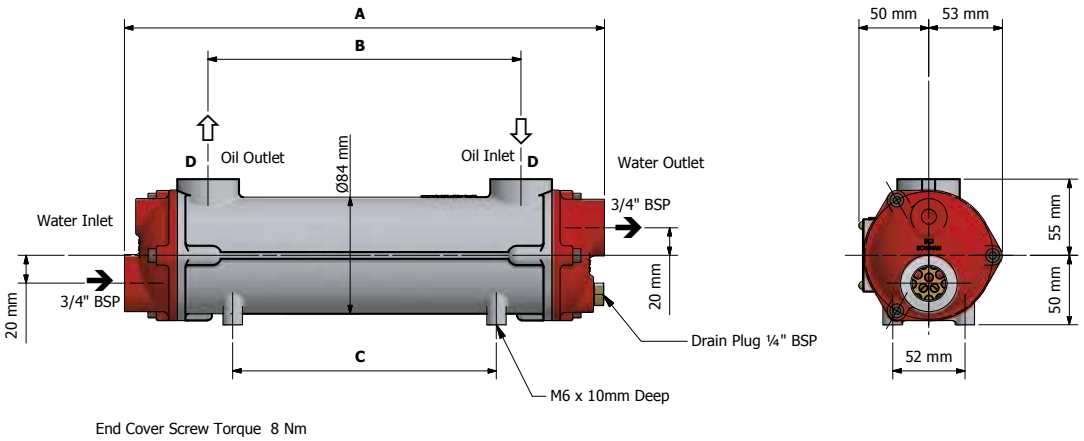
Oil type	ISO VG 37
Oil outlet temperature	50°C
Oil pressure drop	100 kPa
Water inlet temperature	25°C
Water pressure drop	50 kPa

Type	Heat Dissipated	Maximum Oil Flow	Maximum Fresh Water Flow	Internal Oil Volume	Internal Water Volume
	kW	l/min	l/min	l (litre)	l (litre)
EC120-3425-3	13	77	77	0.49	0.44
FC100-3426-2	19	145	135	1.10	0.94
FG100-3427-2	37	190	175	2.40	1.56
FG120-3427-3	50	160	160	3.00	1.96
FG140-3427-4	62	160	150	3.90	2.42
FG160-3427-5	79	145	135	5.00	2.97
GL140-3428-2	56	300	300	3.60	3.10
GL240-3428-4	93	280	260	6.30	4.60

The table above gives performance figures for normal flow versions. For high flow versions, please contact our sales team.

EC Range

Three pass version



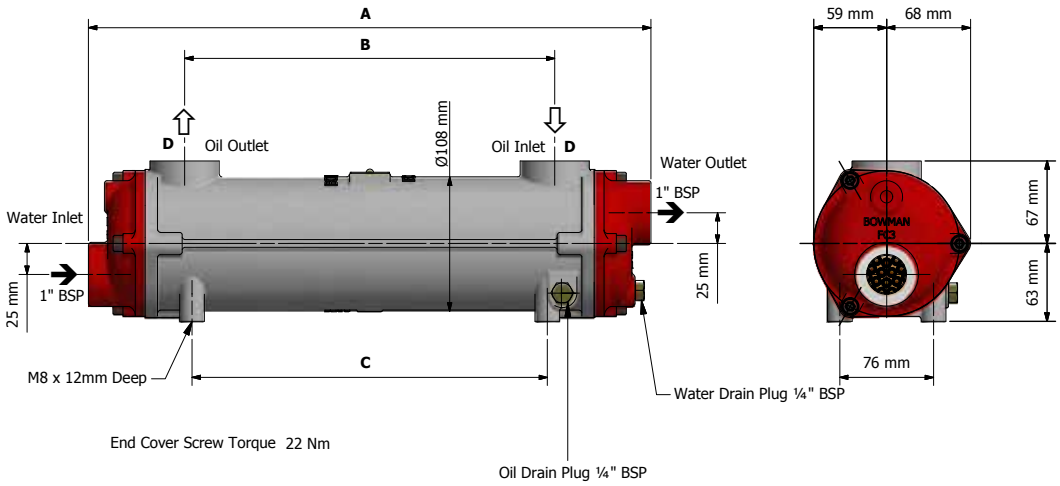
End Cover Screw Torque 8 Nm

Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	BSP	BSP
EC80	2.4	174	60	60	½"	N/A
EC100	3.2	260	140	104	¾"	1"
EC120	3.8	346	226	190	¾"	1"
EC140	4.8	444	324	288	¾"	1"
EC160	5.7	572	452	416	¾"	1"

Please note: dimensions marked D* are for high flow versions only. EC80 models are not available in high flow versions.

FC Range

Three pass version



End Cover Screw Torque 22 Nm

Oil Drain Plug ¼" BSP

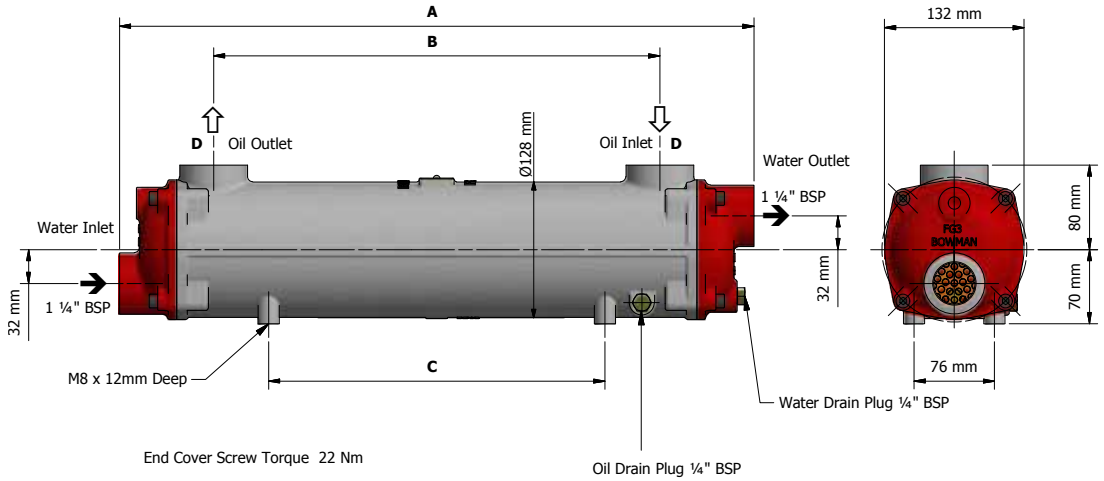
Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	BSP	BSP
FC80	5.5	272	116	104	1"	N/A
FC100	6.3	358	202	190	1"	1¼"
FC120	7.3	456	300	288	1"	1¼"
FC140	9.4	584	428	288	1"	1¼"
FC160	11.0	730	574	434	1"	1¼"

Please note: dimensions marked D* are for high flow versions only. FC80 models are not available in high flow versions.

Maximum working oil pressure	20 bar.	Maximum working oil temperature	120°C.
Maximum working water pressure	16 bar.	Maximum working water temperature	110°C.

FG Range

Three pass version

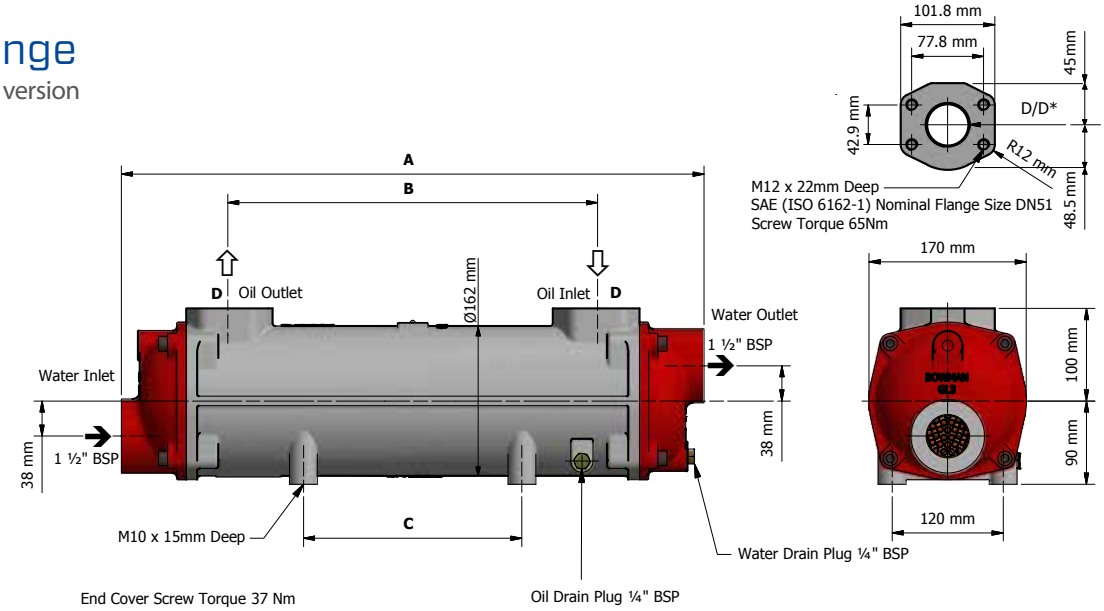


Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	BSP	BSP
FG80	8.5	374	196	92	1¼"	1½"
FG100	10.0	472	294	190	1¼"	1½"
FG120	12.0	600	422	318	1¼"	1½"
FG140	14.5	746	568	464	1¼"	1½"
FG160	17.5	924	746	642	1¼"	1½"

Please note: dimensions marked D* are for high flow versions only

GL Range

Three pass version



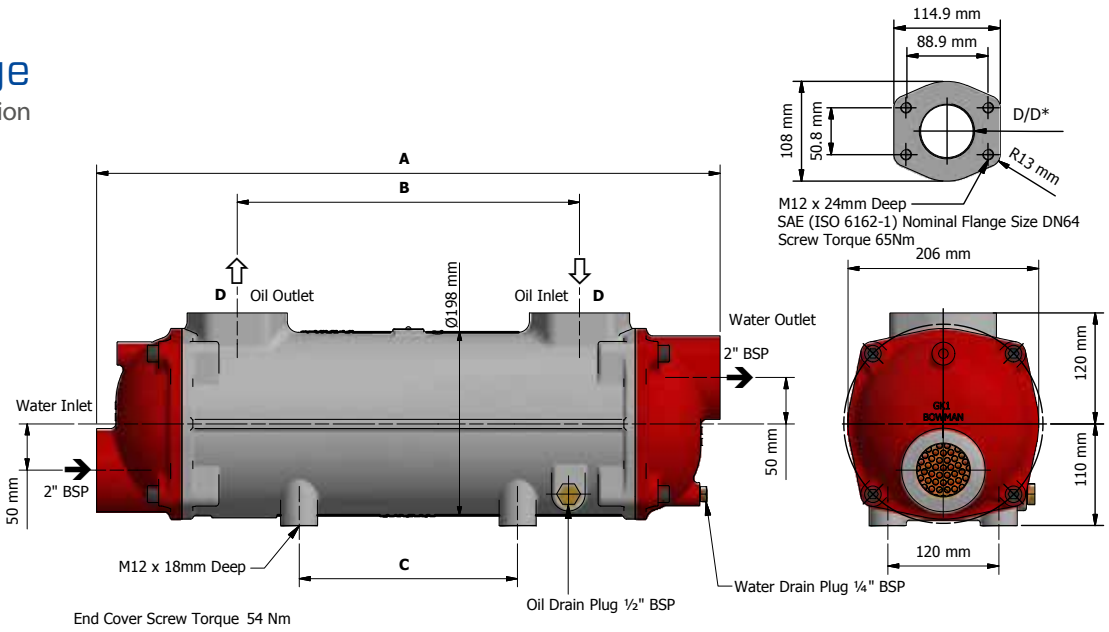
Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	BSP	mm
GL140	18	502	272	108	1½"	Ø 51 mm
GL180	21	630	400	236	1½"	Ø 51 mm
GL240	25	776	546	382	1½"	Ø 51 mm
GL320	30	954	724	560	1½"	Ø 51 mm
GL400	36	1156	926	762	1½"	Ø 51 mm
GL480	42	1360	1130	966	1½"	Ø 51 mm

Please note: dimensions marked D* are for high flow versions only

Maximum working oil pressure	20 bar.	Maximum working oil temperature	120°C.
Maximum working water pressure	16 bar.	Maximum working water temperature	110°C.

GK Range

Three pass version

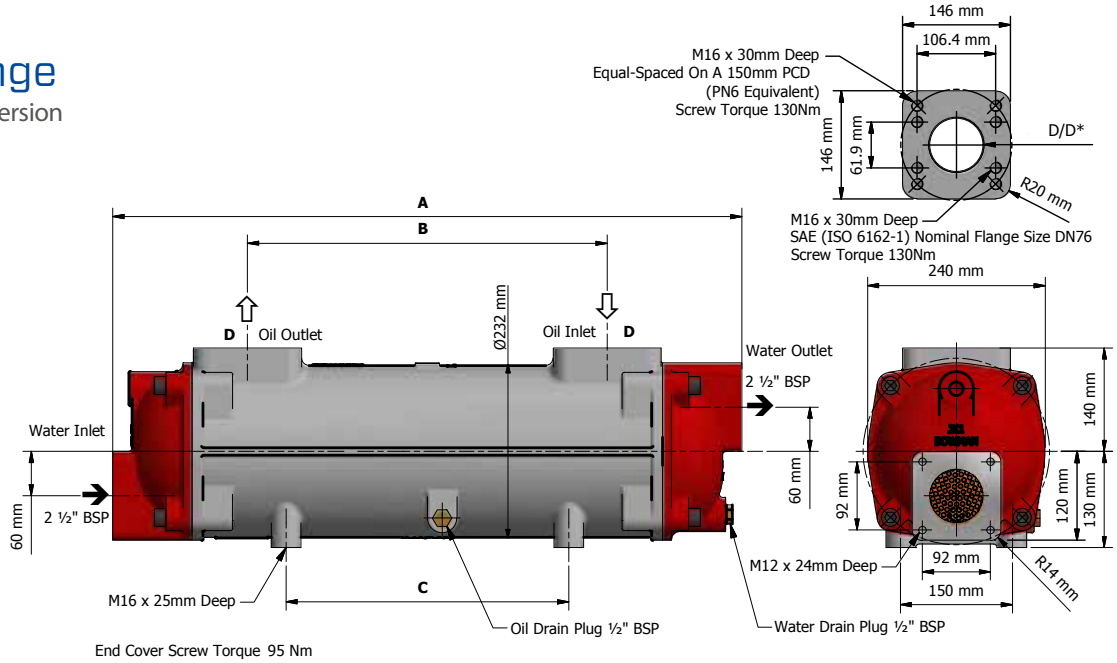


Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	BSP	mm
GK190	34	674	370	236	2"	Ø 64
GK250	39	820	516	382	2"	Ø 64
GK320	46	998	694	560	2"	Ø 64
GK400	54	1200	896	762	2"	Ø 64
GK480	62	1404	1100	966	2"	Ø 64
GK600	74	1708	1404	1270	2"	Ø 64

Please note: dimensions marked D* are for high flow versions only

JK Range

Three pass version



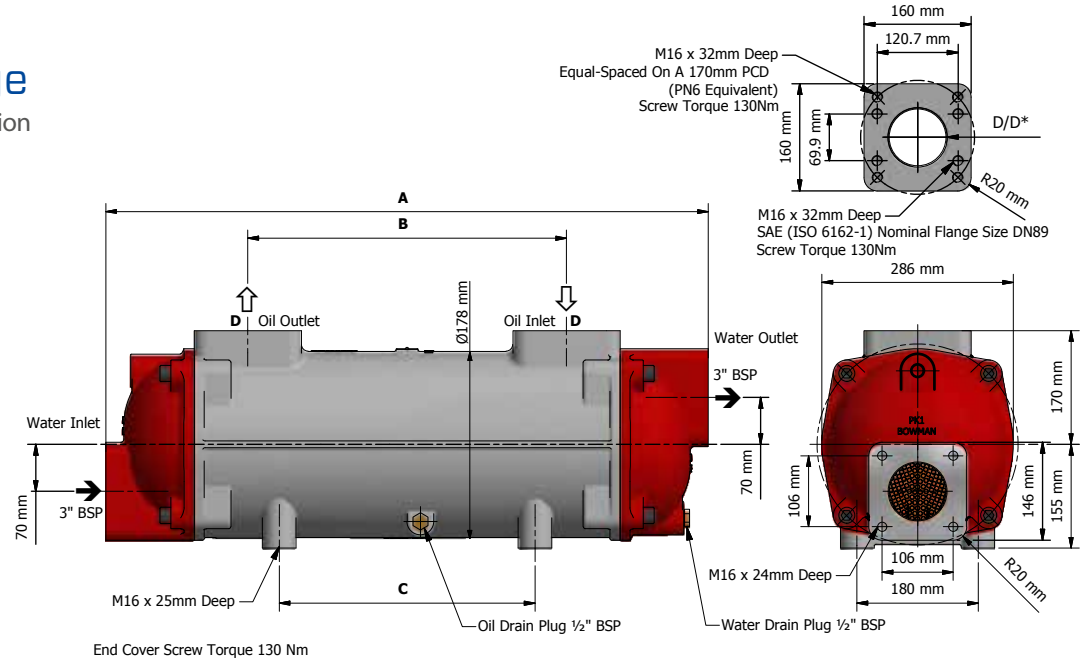
Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	BSP	MM
JK190	58	704	340	236	2½"	Ø 76
JK250	66	850	486	382	2½"	Ø 76
JK320	78	1028	664	560	2½"	Ø 76
JK400	92	1230	866	762	2½"	Ø 76
JK480	105	1434	1070	966	2½"	Ø 76
JK400	126	1738	1374	1270	2½"	Ø 76

Please note: dimensions marked D* are for high flow versions only

Maximum working oil pressure	20 bar.	Maximum working oil temperature	120°C.
Maximum working water pressure	16 bar.	Maximum working water temperature	110°C.

PK Range

Three pass version

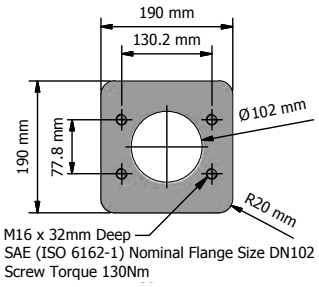


Type	Weight	A	A1	B	C	D	D*
	kg	mm	mm	mm	mm	BSP	mm
PK190	81	754	706	330	236	3"	Ø 108
PK250	94	900	852	476	382	3"	Ø 108
PK320	110	1078	1030	654	560	3"	Ø 108
PK400	125	1280	1232	856	762	3"	Ø 108
PK480	140	1484	1436	1060	966	3"	Ø 108
PK600	158	1788	1740	1364	1270	3"	Ø 108

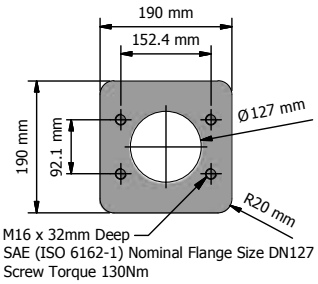
Please note: dimensions marked D* are for high flow versions only; dimensions marked A1 are for marine versions only.

RK Range

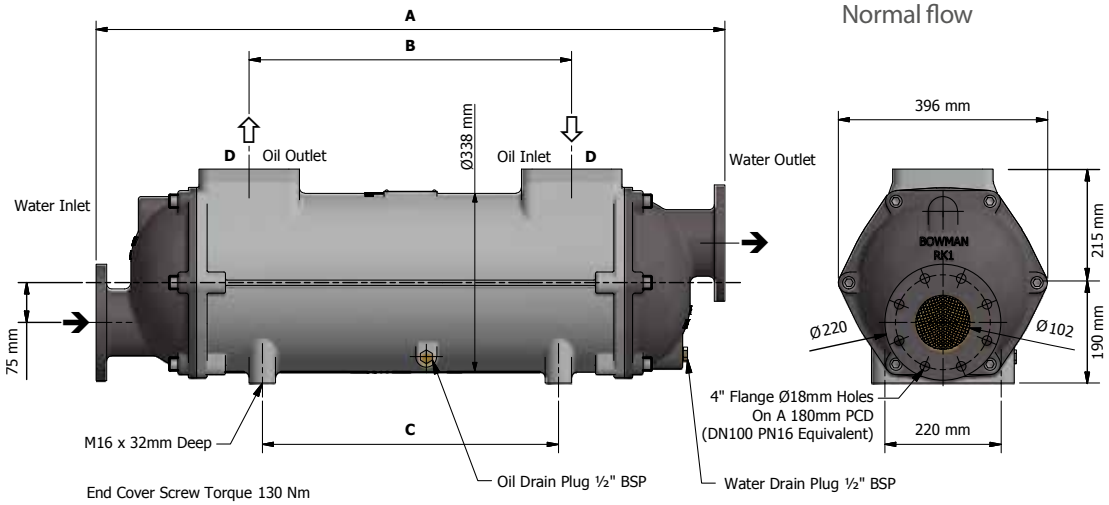
Three pass version



Normal flow



High flow



Type	Weight	A	B	C	D	D*
	kg	mm	mm	mm	mm	mm
RK400	186	1392	812	762	Ø 102	Ø 127
RK600	246	1900	1320	1320	Ø 102	Ø 127

Please note: dimensions marked D* are for high flow versions only

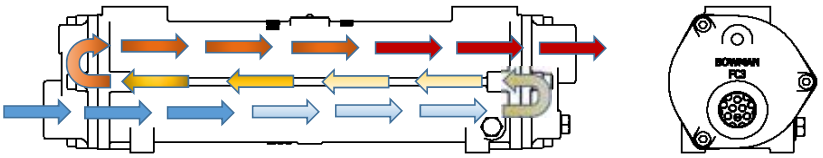
Maximum working oil pressure	20 bar.	Maximum working oil temperature	120°C.
Maximum working water pressure	16 bar.	Maximum working water temperature	110°C.

Three, Two and Single Pass Oil Coolers

There is the choice of three, two or single pass water flow to suit operating conditions.

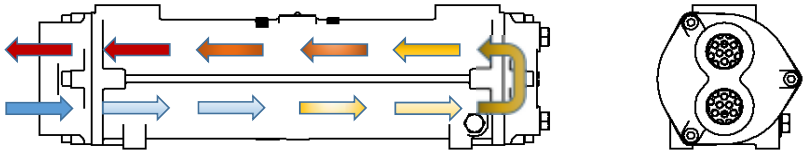
Three pass

This is our preferred and standard arrangement. Three pass units transfer more heat from a given water flow, splitting the internal area of the tube stack into three separate passes. Cooling water enters via the lower connection and passes through the first third of the tubes. It is then re-directed in a second pass, which returns the water back through the middle section, before the final third pass, leaving from the upper connection.



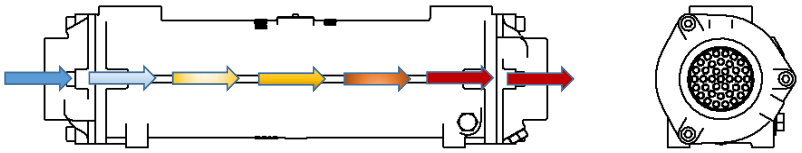
Two pass*

Ideal for applications where space is limited, two pass units have end covers which separate the internal area of the tube stack into two separate passes. Cooling water enters and leaves from connections on the same end cover, simplifying pipework. Two pass units can also accommodate higher flow rates than three pass units.



Single pass*

These units are only chosen when the cooling water flow rate is unavoidably high. The water passes through all of the tubes in a single pass.



*These units are available at extra cost and with longer delivery times. Please contact our sales team for details.

BOWMAN®

Double Seal Retaining Flange

Rising levels of waste material in the ocean are dictating that regular cleaning and maintenance are now important to ensure oil coolers operate at their peak efficiency.

However, cleaning hydraulic oil coolers on board ship can be time-consuming and potentially hazardous, as even when drained, the unit may still contain some fluid, which can spill onto the deck when the tube stack is removed.

To minimise down time and eliminate deck spillage hazards, Bowman has developed the Double Seal Retaining Flange (DSRF) for marine hydraulic cooling applications.

Available for the GL and larger sizes, the DSRF fits between the end cover and the heat exchanger body, enabling the cooling water side of the unit to be cleaned and inspected - without having to disturb the oil side.

For full product specification details, please contact our sales team on +44 (0) 121 359 5401.

Titanium Tube Stacks

Titanium is the ultimate 'fit and forget' solution for any application where very aggressive water conditions exist, such as salt, or contaminated/mineral rich fresh water. Titanium resists chemical attack and eliminates the risk of premature failure of the tube stack.

Titanium tube stacks are now available as an option for Bowman hydraulic oil coolers, providing a long life solution for the most demanding conditions.

Bowman Titanium tube stacks have a 10 year guarantee on all Titanium material and, as a further advantage, they can operate at higher flow rates compared to standard cupro-nickel, without the risk of tube erosion.

GUARANTEED 10 YEARS

Full 10 year guarantee on all titanium material in contact with cooling water.

BOWMAN®

Shipboard Installation of Marine Hydraulic Oil Coolers

Product Mounting

The oil cooler can be mounted either horizontally or vertically as illustrated.

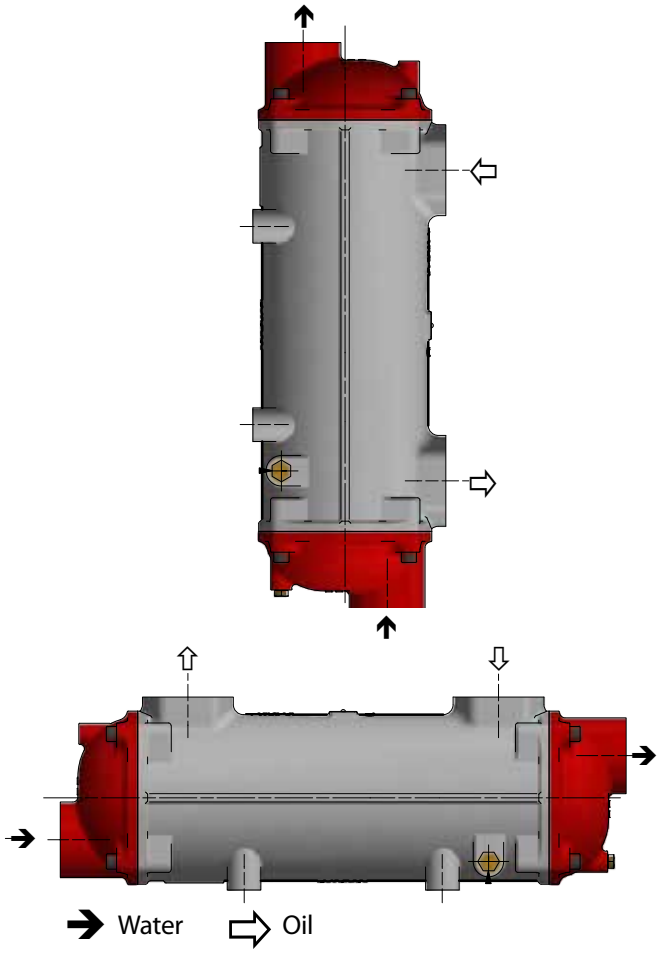
Counter Flow Installation

The oil cooler must always be installed in counter flow – i.e. where the sea water flows in the opposite direction to the oil, as illustrated.

Maximum Sea Water Flow Rates

The maximum permitted sea water flow rates for Bowman oil coolers are as follows:

EC range 50 l/min.
FC range 80 l/min.
FG range 110 l/min.
GL range 200 l/min.
GK range 300 l/min.
JK range 400 l/min.
PK range 650 l/min.
RK range 900 l/min.



Orifice Plates

If the sea water supply is taken from a ship's main, it is important to ensure that the recommended flow rate cannot be exceeded.

This will normally mean that an orifice plate must be fitted in the pipework at least 1m before the oil cooler, with the orifice size calculated to ensure that the maximum sea water flow rate cannot be exceeded.

The correct orifice diameter can be determined from the table below.

If this precaution is not taken, it is possible that the sea water flow through the cooler may be many times the recommended maximum, leading to rapid failure.

Recommended Orifice Plate Sizes

Oil Cooler Series	Max. sea water	Orifice diameter in mm for max. sea water flow								
	flow l/min	2 bar	3 bar	4 bar	5 bar	6 bar	7 bar	8 bar	9 bar	10 bar
EC	50	9.5	8.5	8.0	7.5	7.2	6.8	6.7	6.5	6.3
FC	80	12	11	10	9.5	9.0	8.7	8.4	8.2	8.0
FG	110	14	13	12	11	10	10	9.8	9.6	9.3
GL	200	19	17	16	15	14	14	13	13	13
GK	300	23	21	19	18	17	17	16	16	15
JK	400	27	24	22	21	20	20	19	18	18
PK	650	34	31	28	27	26	25	24	23	23
RK	900	40	36	34	32	30	29	28	27	26

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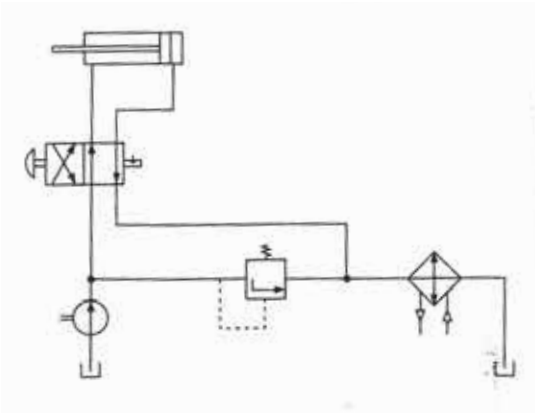
General Guidelines for Operation and Maintenance of Oil Coolers

Bowman oil coolers are renowned for combining excellent heat transfer, with long life. To ensure the unit continues to operate at its peak performance and to minimise the possibility of damage or premature failure, we suggest the following good practice:

1: For hydraulic applications, the oil cooler should be in the return pipe to tank as shown in the diagram. If the flow is subject to violent fluctuations in flow and pressure, it may be advisable to connect the cooler in a separate circuit with its own pump.

2: Oil coolers should be mounted as shown on page 14 to ensure that they operate full of water and should be connected for counter flow.



3: The water outlet pipe from the oil cooler should always have an uninterrupted run back to the waste or return water circuit.

4: Ensure that the maximum water flow rate is not exceeded and that the pH is between 7.2 and 7.8.

5: If a water flow control valve is used, it should be of the modulating type and fitted on the inlet side, so that the cooler is not pressurised when the system is shut down.

6: If the hydraulic system is not being used, isolate the oil cooler from water pressure.

7: Stainless steel water pipes and fittings should not be used adjacent to the oil cooler.

8: **Important note for marine applications:** during commissioning, shutdown and standby periods, if the oil cooler has not been used over a 4-6 day period, it should be drained, cleaned and kept dry. Where this procedure is not possible, drain the stagnant water and refill the oil cooler with clean sea or fresh water, which should be replaced with oxygenated sea water every 2-3 days to avoid further decomposition.

Before installing the oil cooler, always read the 'Installation, Operation & Maintenance Guide' which can be downloaded from our web site by visiting **www.ej-bowman.com/downloads.**

Special Cooling Requirements

Bowman offer one of the widest ranges of hydraulic oil coolers available, most applications can be covered from our standard range.

However, if you have a special application that is not listed in this brochure, please contact our sales team, who can advise on the most appropriate product.

For some applications where a single unit may be too small for the required oil flow, multiple units can be connected in parallel. We can also advise on installation, particularly for unusual or safety critical applications.

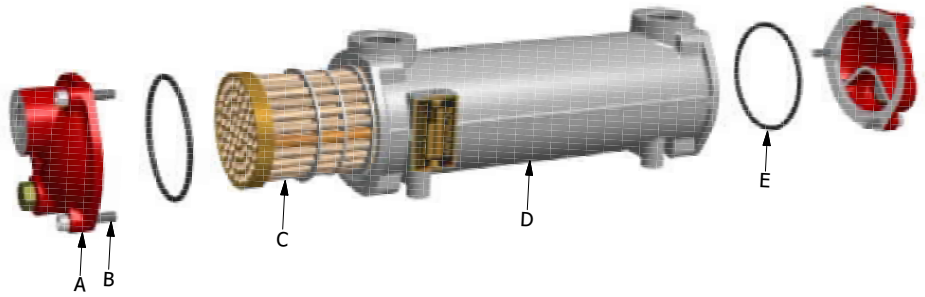
Servicing the Unit

By removing the end cover retaining screws, the tube stack can be removed from the body for routine cleaning and maintenance. On reassembly, it is recommended that the "O" seals are replaced to ensure a reliable joint. A comprehensive range of replacement parts is available for all Bowman hydraulic oil coolers, these are listed on pages 16 to 19.

NOTE: when ordering replacement parts, always quote the number on the nameplate.

BOWMAN®

Land based Hydraulic Oil Cooler Replacement Parts

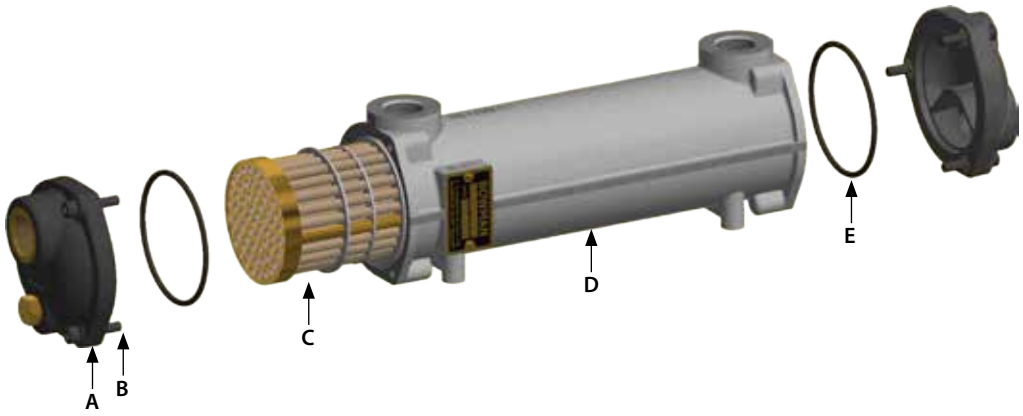


Type	End Covers (A)	Screws (B)	Tube stack (C)	Body (D)	"O" Seals (E)
EC 80-1425-1			785-1TN1A	EC21-978-AL2	
EC100-1425-2			785-2TN1A	EC10-783-2AL	
EC120-1425-3	EC3-1040CI	HS06X30DP	785-3TN1A	EC12-783-3AL	AN12NT
EC140-1425-4			785-4TN1A	EC14-783-4AL	
EC160-1425-5			785-5TN1A	EC16-783-5AL	
FC 80-1426-1			1530-1TN1A	FC 8-1200-1AL	
FC100-1426-2			1530-2TN1A	FC10-1200-2AL	
FC120-1426-3	FC3-1281CI	HS08X35DP	1530-3TN1A	FC12-1200-3AL	OS46NT
FC140-1426-4			1530-4TN1A	FC14-1200-4AL	
FC160-1426-5			1530-5TN1A	FC16-1200-5AL	
FG 80-1427-1			1959-1TN1A	FG 8-1650-1AL	
FG100-1427-2			1959-2TN1A	FG10-1650-2AL	
FG120-1427-3			1959-3TN1A	FG12-1650-3AL	
FG140-1427-4	FG3-1583CI	HS08X35DP	1959-4TN1A	FG14-1650-4AL	OS52NT
FG160-1427-5			1959-5TN1A	FG16-1650-5AL	
GL140-1428-2			1798-2TN1A	GL15-3136NF-2AL6	
GL180-1428-3			1798-3TN1A	GL19-3136NF-3AL6	
GL240-1428-4			1798-4TN1A	GL25-3136NF-4AL6	
GL320-1428-5	GL3-3141CI	HS10X40DP	1798-5TN1A	GL33-3136NF-5AL6	OS63NT
GL400-1428-6			1798-6TN1A	GL41-3136NF-6AL6	
GL480-1428-7			1798-7TN1A	GL49-3136NF-7AL6	
GK190-1658-3			2315-3TN1A	GK19-2865NF-3AL7	
GK250-1658-4			2315-4TN1A	GK25-2865NF-4AL7	
GK320-1658-5			2315-5TN1A	GK32-2865NF-5AL7	
GK400-1658-6	GK1-2864CI	HS12X50DP	2315-6TN1A	GK40-2865NF-6AL7	OS69NT
GK480-1658-7			2315-7TN1A	GK48-2865NF-7AL7	
GK600-1658-8			2315-8TN1A	GK60-2865NF-8AL7	
JK190-1661-3			3334-3TN1A	JK19-3332NF-3AL8	
JK250-1661-4			3334-4TN1A	JK25-3332NF-4AL8	
JK320-1661-5			3334-5TN1A	JK32-3332NF-5AL8	
JK400-1661-6	JK1-3333CI	HS16X70DP	3334-6TN1A	JK40-3332NF-6AL8	OS74NT
JK480-1661-7			3334-7TN1A	JK48-3332NF-7AL8	
JK600-1661-8			3334-8TN1A	JK60-3332NF-8AL8	
PK190-1669-3			2829-3TN1A	PK19-2919NF-3AL9	
PK250-1669-4			2829-4TN1A	PK25-2919NF-4AL9	
PK320-1669-5			2829-5TN1A	PK32-2919NF-5AL9	
PK400-1669-6	PK1-2918CI	HS16X70DP	2829-6TN1A	PK40-2919NF-6AL9	OS81NT
PK480-1669-7			2829-7TN1A	PK48-2919NF-7AL9	
PK600-1669-8			2829-8TN1A	PK60-2919NF-8AL9	
RK400-1698-6	RK1-5451CIC	HS16X70DP	5455-6TN1A	RK40-5450NF-6AL0	OS453NT
RK600-1698-8	RK1-5451CIC	HS16X70DP	5455-8TN1A	RK60-5450NF-8AL0	OS453NT

NOTE: when ordering replacement parts, always quote the number on the nameplate.
The table above lists replacement parts for normal flow versions. For high flow versions, please contact our sales team.

BOWMAN®

Marine Hydraulic Oil Cooler Replacement Parts

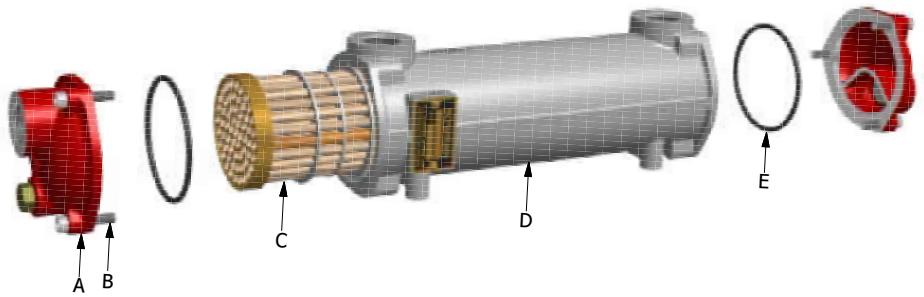


Type	End Covers (A)	Screws (B)	Tube stack (C)	Body (D)	"O" Seals (E)
EC 80-3875-1			785-1TN1A	EC21-978-AL2	
EC100-3875-2			785-2TN1A	EC10-783-2AL	
EC120-3875-3	EC3C-5480	HS06X30DP	785-3TN1A	EC12-783-3AL	AN12NT
EC140-3875-4			785-4TN1A	EC14-783-4AL	
EC160-3875-5			785-5TN1A	EC16-783-5AL	
FC 80-3876-1			1530-1TN1A	FC 8-1200-1AL	
FC100-3876-2			1530-2TN1A	FC10-1200-2AL	
FC120-3876-3	FC3C-5481	HS08X35DP	1530-3TN1A	FC12-1200-3AL	OS46NT
FC140-3876-4			1530-4TN1A	FC14-1200-4AL	
FC160-3876-5			1530-5TN1A	FC16-1200-5AL	
FG 80-3877-1			1959-1TN1A	FG 8-1650-1AL	
FG100-3877-2			1959-2TN1A	FG10-1650-2AL	
FG120-3877-3	FG3C-5482	HS08X35DP	1959-3TN1A	FG12-1650-3AL	OS52NT
FG140-3877-4			1959-4TN1A	FG14-1650-4AL	
FG160-3877-5			1959-5TN1A	FG16-1650-5AL	
GL140-3878-2			1798-2TN1A	GL15-3136NF-2AL6	
GL180-3878-3			1798-3TN1A	GL19-3136NF-3AL6	
GL240-3878-4			1798-4TN1A	GL25-3136NF-4AL6	
GL320-3878-5	GL3C-5483	HS10X40DP	1798-5TN1A	GL33-3136NF-5AL6	OS63NT
GL400-3878-6			1798-6TN1A	GL41-3136NF-6AL6	
GL480-3878-7			1798-7TN1A	GL49-3136NF-7AL6	
GK190-3879-3			2315-3TN1A	GK19-2865NF-3AL7	
GK250-3879-4			2315-4TN1A	GK25-2865NF-4AL7	
GK320-3879-5			2315-5TN1A	GK32-2865NF-5AL7	
GK400-3879-6	GK1-2864BR	HS12X50DP	2315-6TN1A	GK40-2865NF-6AL7	OS69NT
GK480-3879-7			2315-7TN1A	GK48-2865NF-7AL7	
GK600-3879-8			2315-8TN1A	GK60-2865NF-8AL7	
JK190-3881-3			3334-3TN1A	JK19-3332NF-3AL8	
JK250-3881-4			3334-4TN1A	JK25-3332NF-4AL8	
JK320-3881-5			3334-5TN1A	JK32-3332NF-5AL8	
JK400-3881-6	JK1-4353BR	HS16X70DP	3334-6TN1A	JK40-3332NF-6AL8	OS74NT
JK480-3881-7			3334-7TN1A	JK48-3332NF-7AL8	
JK600-3881-8			3334-8TN1A	JK60-3332NF-8AL8	
PK190-3880-3			2829-3TN1A	PK19-2919NF-3AL9	
PK250-3880-4			2829-4TN1A	PK25-2919NF-4AL9	
PK320-3880-5			2829-5TN1A	PK32-2919NF-5AL9	
PK400-3880-6	PK1-4352BR	HS16X70DP	2829-6TN1A	PK40-2919NF-6AL9	OS81NT
PK480-3880-7			2829-7TN1A	PK48-2919NF-7AL9	
PK600-3880-8			2829-8TN1A	PK60-2919NF-8AL9	
RK400-5882-6	RK1-5451CIC	HS16X70DP	5455-6TN1A	RK40-5450NF-6AL0	OS453NT
RK600-5882-8	RK1-5451CIC	HS16X70DP	5455-8TN1A	RK60-5450NF-8AL0	OS453NT

NOTE: when ordering replacement parts, always quote the number on the nameplate.
The table above lists replacement parts for normal flow versions. For high flow versions, please contact our sales team.

BOWMAN®

High Temperature Oil (to 150°C) Replacement Parts

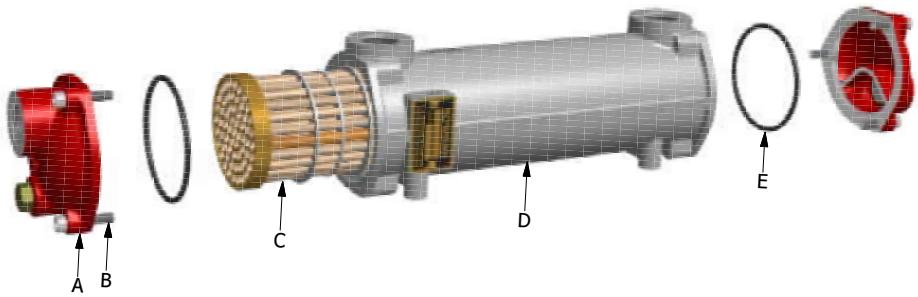


Type	End Covers (A)	Screws (B)	Tube stack (C)	Body (D)	"O" Seals (E)
EC 80-3145-1			785-1TN2A	EC21-978-AL2	
EC100-3145-2			785-2TN2A	EC10-783-2AL	
EC120-3145-3	EC3-1040CI	HS06X30DP	785-3TN2A	EC12-783-3AL	AN12VT
EC140-3145-4			785-4TN2A	EC14-783-4AL	
EC160-3145-5			785-5TN2A	EC16-783-5AL	
FC 80-3146-1			1530-1TN2A	FC 8-1200-1AL	
FC100-3146-2			1530-2TN2A	FC10-1200-2AL	
FC120-3146-3	FC3-1281CI	HS08X35DP	1530-3TN2A	FC12-1200-3AL	OS46VT
FC140-3146-4			1530-4TN2A	FC14-1200-4AL	
FC160-3146-5			1530-5TN2A	FC16-1200-5AL	
FG 80-3147-1			1959-1TN2A	FG 8-1650-1AL	
FG100-3147-2			1959-2TN2A	FG10-1650-2AL	
FG120-3147-3			1959-3TN2A	FG12-1650-3AL	
FG140-3147-4	FG3-1583CI	HS08X35DP	1959-4TN2A	FG14-1650-4AL	OS52VT
FG160-3147-5			1959-5TN2A	FG16-1650-5AL	
GL140-3148-2			1798-2TN2A	GL15-3136NF-2AL6	
GL180-3148-3			1798-3TN2A	GL19-3136NF-3AL6	
GL240-3148-4			1798-4TN2A	GL25-3136NF-4AL6	
GL320-3148-5	GL3-3141CI	HS10X40DP	1798-5TN2A	GL33-3136NF-5AL6	OS63VT
GL400-3148-6			1798-6TN2A	GL41-3136NF-6AL6	
GL480-3148-7			1798-7TN2A	GL49-3136NF-7AL6	
GK190-3149-3			2315-3TN2A	GK19-2865NF-3AL7	
GK250-3149-4			2315-4TN2A	GK25-2865NF-4AL7	
GK320-3149-5			2315-5TN2A	GK32-2865NF-5AL7	
GK400-3149-6	GK1-2864CI	HS12X50DP	2315-6TN2A	GK40-2865NF-6AL7	OS69VT
GK480-3149-7			2315-7TN2A	GK48-2865NF-7AL7	
GK600-3149-8			2315-8TN2A	GK60-2865NF-8AL7	
JK190-3152-3			3334-3TN2A	JK19-3332NF-3AL8	
JK250-3152-4			3334-4TN2A	JK25-3332NF-4AL8	
JK320-3152-5			3334-5TN2A	JK32-3332NF-5AL8	
JK400-3152-6	JK1-3333CI	HS16X70DP	3334-6TN2A	JK40-3332NF-6AL8	OS74VT
JK480-3152-7			3334-7TN2A	JK48-3332NF-7AL8	
JK600-3152-8			3334-8TN2A	JK60-3332NF-8AL8	
PK190-3150-3			2829-3TN2A	PK19-2919NF-3AL9	
PK250-3150-4			2829-4TN2A	PK25-2919NF-4AL9	
PK320-3150-5			2829-5TN2A	PK32-2919NF-5AL9	
PK400-3150-6	PK1-2918CI	HS16X70DP	2829-6TN2A	PK40-2919NF-6AL9	OS81VT
PK480-3150-7			2829-7TN2A	PK48-2919NF-7AL9	
PK600-3150-8			2829-8TN2A	PK60-2919NF-8AL9	
RK400-3153-6	RK1-5451CIC	HS16X70DP	5455-6TN2A	RK40-5450NF-6AL0	OS453VT
RK600-3153-8	RK1-5451CIC	HS16X70DP	5455-8TN2A	RK60-5450NF-8AL0	OS453VT

NOTE: when ordering replacement parts, always quote the number on the nameplate.
The table above lists replacement parts for normal flow versions. For high flow versions, please contact our sales team.

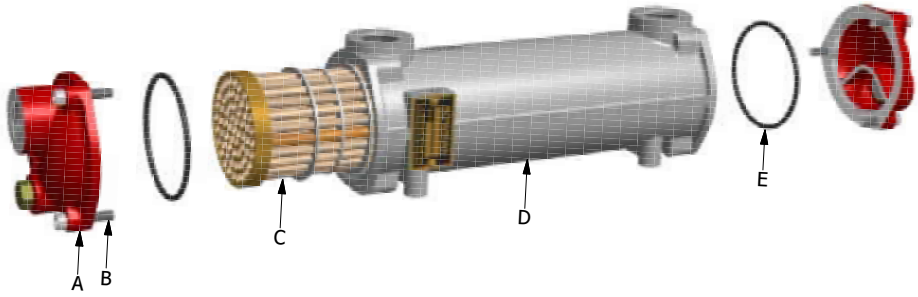
BOWMAN®

Extreme Temperature Oil (to 200°C) Replacement Parts



Type	End Covers (A)	Screws (B)	Tube stack (C)	Body (D)	"O" Seals (E)
EC120-3635-3	EC3-1040CI	HS06X30DP	785-3TN3B	EC71-4658-3CI	AN12VT
FC100-3636-2	FC3-1281CI	HS08X35DP	1530-2TN3B	FC70-4668-2CI	OS46VT
FG100-3637-2	FG3-1583CI	HS08X35DP	1959-2TN3B	FG10-1650-2CI	OS52VT
FG120-3637-3	FG3-1583CI	HS08X35DP	1959-3TN3B	FG12-1650-3CI	OS52VT
FG140-3637-4	FG3-1583CI	HS08X35DP	1959-4TN3B	FG14-1650-4CI	OS52VT
FG160-3637-5	FG3-1583CI	HS08X35DP	1959-5TN3B	FG16-1650-5CI	OS52VT
GL140-3638-2	GL3-3141CI	HS10X40DP	1798-2TN3B	GL15-3136-2CI	OS63VT
GL240-3638-4	GL3-3141CI	HS10X40DP	1798-4TN3B	GL25-3136-4CI	OS63VT

Mining Hydraulic Oil Cooler Replacement Parts



Type	End Covers (A)	Screws (B)	Tube stack (C)	Body (D)	"O" Seals (E)
EC120-3425-3	EC23-4033CI	HS06X30DP	785-3TN2B	EC71-4568-3CI	AN12VT
FC100-3426-2	FC23-4034CI	HS08X35DP	1530-2TN2B	FC70-4668-2CI	OS46VT
FG100-3427-2	FG23-4035CI	HS08X35DP	1959-2TN2B	FG10-1650-2CI	OS52VT
FG120-3427-3	FG23-4035CI	HS08X35DP	1959-3TN2B	FG12-1650-3CI	OS52VT
FG140-3427-4	FG23-4035CI	HS08X35DP	1959-4TN2B	FG14-1650-4CI	OS52VT
FG160-3427-5	FG23-4035CI	HS08X35DP	1959-5TN2B	FG16-1650-5CI	OS52VT
GL140-3428-2	GL23-4036CI	HS10A40DP	1798-2TN2B	GL15-3136NF-2CI6	OS63VT
GL240-3428-4	GL23-4036CI	HS10A40DP	1798-3TN2B	GL25-3136NF-4CI6	OS63VT

NOTE: when ordering replacement parts, always quote the number on the nameplate.
The table above lists replacement parts for normal flow versions. For high flow versions, please contact our sales team.

A world of applications

Bowman has been synonymous with hydraulic system cooling for over 50 years. Renowned for providing highly efficient, reliable heat transfer solutions, Bowman oil coolers can be found in an extremely wide range of applications, for marine and offshore industries, land based machines and equipment as well as deep underground mining equipment.

Industrial Machines & Equipment
Wherever hydraulic systems require fluid cooling, Bowman oil coolers can be found at the heart of the system, protecting equipment from excessive heat loads in applications as diverse as hydraulic presses, processing machinery, active fire protection systems, materials handling equipment and plastic injection moulding machines.

Deep Underground Mining
For deep mine operations, Bowman hydraulic oil coolers are the first choice for some of the world's leading machinery and equipment manufacturers, due to their efficient heat transfer and durability. Additionally, the choice of tube stack materials and construction enables the units to operate with all types of mine water conditions, including high salt content.

Marine Deck Machinery
Designed to combine extended service life with minimal running costs, this hydraulic propulsion system replaces conventional marine gearboxes to provide smooth, quiet operation for inland commercial charter boats. Extensively proven over 1,000s of hours, Bowman's oil cooling technology is at the heart of the system.

Marine Stabiliser and Thruster Systems
A pioneer in the development of advanced marine stabiliser technology and vessel roll reduction solutions, this leading USA manufacturer uses Bowman oil coolers in their hydraulic power packs to ensure the fluid power required to articulate the stabiliser fins is always kept at the optimum temperature.

All Bowman hydraulic oil coolers are produced to the highest quality in our UK manufacturing centre to ISO 9001:2008. With tens of thousands of units operating reliably and efficiently around the world, you can have complete confidence when you specify Bowman hydraulic oil coolers.

EJ Bowman (Birmingham) Ltd
Chester Street, Birmingham B6 4AP, UK
Tel: +44 (0) 121 359 5401
Fax: +44 (0) 121 359 7495
Email: sales@ej-bowman.com
www.ej-bowman.com

BOWMAN®
100 YEARS OF HEAT TRANSFER TECHNOLOGY

FM38224

Installation, Operation & Maintenance Guide

HYDRAULIC OIL COOLERS

BOWMAN®

100 YEARS OF HEAT TRANSFER TECHNOLOGY

Contents

Introduction

Thank you for purchasing a high quality Bowman hydraulic oil cooler.

Bowman® has been manufacturing hydraulic oil coolers for over 60 years and our products are renowned for their quality, heat transfer performance and durability.

Please read this 'Installation, Operation & Maintenance Guide' carefully before installation to ensure your hydraulic oil cooler operates efficiently and reliably.

Please keep this guide for future reference to ensure the long term performance of you Bowman hydraulic oil cooler.

Should you require advice or assistance, please contact your Bowman stockist or distributor.

Further copies of this 'Installation, Operation & Maintenance Guide' can be downloaded from our web site **www.ej-bowman.com**

1. Safety

1.1 Hazards When Handling the oil cooler

BOWMAN® Hydraulic Oil Coolers are constructed to current practice and recognised safety standards. Hazards may still arise from operation, such as:

- Injury of the operator or
- Third parties or
- Damage to the oil cooler or
- Damage to property and equipment

Any person involved with the installation, commissioning, operation, maintenance or repair of the cooler must be:

- Physically and mentally capable of performing such work
- Appropriately qualified
- Comply completely with the installation instructions

The oil cooler must only be used for its intended purpose.
In the event of breakdowns which may compromise safety, a qualified person must always be contacted.

1.2 Safety Instructions

The following symbols are used in these operating instructions:


Danger

This symbol indicates an immediate danger to health.
Failure to comply with this instruction may result in severe injury.


Caution

This symbol indicates a possible danger to health.
Failure to comply with this instruction may result in severe injury.


Take Care

This symbol indicates a possible risk to health.
Failure to comply with this instruction may result in injury or damage to property.

This symbol indicates important information about correct handling of the equipment
Failure to comply with this instruction may cause damage to the heat exchanger and/or its surroundings.

1.3 Approved use

BOWMAN® Hydraulic Oil Coolers are only approved for cooling hydraulic oil.
Any other use unless sanctioned by **BOWMAN®** is not approved.
BOWMAN® declines all liability for damage associated or arising from such use:

The maximum permissible operating pressure must not exceed:
Oil side: 20 bar max.
Water side: 16 bar max.
Applies to EC-RK three pass threaded connections only – for other versions please contact **BOWMAN®** for guidance.

The maximum permissible operating temperature must not exceed:

Oil side: 120° C
Cooling Water side: 110°C

Variants with higher temperature and pressure ratings are available. Please contact the Sales for further details

1.4 Potential Hazards

Caution

Ensure the maximum permissible operating pressures are not exceeded.

Take Care

NB: Before the oil cooler is disconnected it must be allowed to cool and be depressurized. The supply and return from the cooler should be isolated to minimise fluid loss.

2. Installation

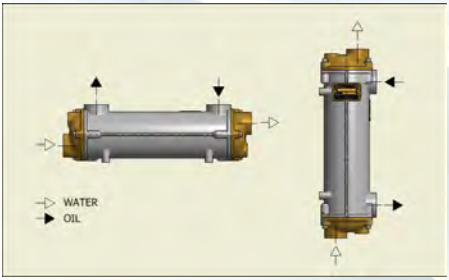
2.1 Transport / storage

The oil cooler must be drained prior to transportation. Once drained and dry, the oil cooler must only be stored indoors in a non-aggressive atmosphere. The connections should be capped to avoid ingress of dirt and contaminants.

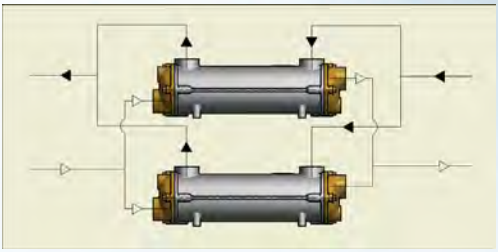
2.2 Fitting

Before fitting, the cooler should be checked for visible signs of damage. The oil cooler should be connected in counterflow so that the fluids flow in opposite directions, as shown in the illustration below:

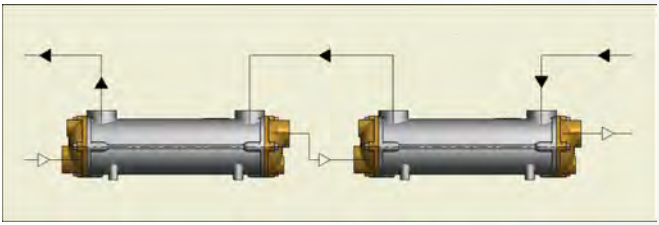
Take Care



Multiple units can be connected in parallel.



Or in series:



2.3 Connecting the oil cooler

Take Care

Shut off all drainage valves in the flow and return pipes in both circuits.

When fitting the oil cooler into the pipe work care must be taken to ensure that no debris has been introduced into the oil cooler.

Unsupported lengths of pipework should be avoided so as not to subject the oil cooler to excessive loads.

Water side pipework diameter should not reduce to less than the connection size within a distance of 1m from the oil cooler.

Measures should be taken to isolate the oil cooler from excessive vibration.

Taper fittings are not recommended as these can split the shell and end cover castings if over tightened.

The correct length of fitting should be used as too long a fitting will damage the tubestack.

Pipework materials must be compatible with the oil cooler materials. Stainless steel sea water pipes and fittings should not be used adjacent to the oil cooler.

If the sea water supply is taken from a ships main, ensure that the recommended flow rate cannot be exceeded. This will normally mean that an orifice plate must be fitted in the pipe work at least 1m before the cooler with the orifice size calculated to ensure that the maximum sea water flow rate cannot be exceeded. If these precautions are not taken, it is possible that the sea water flow rate through the cooler may be several times the recommended maximum which will lead to rapid failure.

2.4 Marine installation, recommendations

No oil cooler manufacturer can guarantee that their products will have an indefinite life and for this reason, we suggest that the cooling system is designed to minimise any damage caused by a leaking oil cooler. This can be achieved as follows:

1. The oil pressure should be higher than the sea water pressure, so that in the event of a leak occurring, the oil will not be contaminated.
2. When the hydraulic system is not being used, the coolers should be isolated from sea water pressure.
3. The sea water outlet pipe from the cooler should have a free run to waste.
4. Stainless steel sea water pipes and fittings should not be used adjacent to the oil cooler.
5. Important note for marine applications: during commisioning, shutdown and standby periods, if the oil cooler has not been used over 4-6 day period, it should be drained, cleaned and kept dry. Where this procedure is not possible, drain the stagnant water and refill the oil cooler with clean sea or fresh water, which should be replaced with oxygenated sea water every 2-3 days to avoid further decomposition.

2.5 Orifice Plates

If the sea water supply is taken from a ship's main, it is important to ensure that the recommended flow cannot be exceeded.

This will normally mean that an orifice plate must be fitted in the pipework at least 1m before the oil cooler, with the orifice size calculated to ensure that the maximum sea water flow rate cannot be exceeded.

The correct orifice diameter can be determined from the table below.

Three Pass Bowman Oil Coolers		Orifice diameter in mm for max. sea water flow									
Oil Cooler Series	Max. Sea water flow l/min	1 bar	2 bar	3 bar	4 bar	5 bar	6 bar	7 bar	8 bar	9 bar	10 bar
EC	50	11	9.5	8.5	8	7.5	7.2	6.8	6.7	6.5	6.3
FC	80	14	12	11	10	9.5	9	8.7	8.4	8.2	8
FG	110	17	14	13	12	11	10	10	9.8	9.6	9.3
GL	200	23	19	17	16	15	14	14	13	13	13
GK	300	28	23	21	19	18	17	17	16	16	15
JK	400	32	27	24	22	21	20	20	19	18	18
PK	500	41	34	31	28	27	26	25	24	23	23
RK	900	48	40	36	34	32	30	29	28	27	26

2.6 Composite end cover water pipe installation

For marine versions supplied with composite end covers, it is recommended that a bonded seal is used in conjunction with the fitting and tightened to the appropriate torque figure given below to ensure sufficient sealing.

Size	Torque (Nm)
EC range (3/4" BSP)	10
FC range (1" BSP)	15
FG range (1 ¼" BSP)	20
GL range (1 ½" BSP)	25

3. Operation

3.1 Maximum water flow rates

The following tables give maximum flow rates through the tube stack for either single, two or three pass configuration, using either sea or fresh water.

Take Care

Sea Water Application (Maximum 2 m/s)

Type	3-Pass	2-Pass	1-Pass
	Max Recommended Flowrate (l/min)	Max Recommended Flowrate (l/min)	Max Recommended Flowrate (l/min)
EC range	50	80	170
FC range	80	120	230
FG range	110	170	320
GL range	200	290	560
GK range	300	450	900
JK range	400	600	1200
PK range	650	1000	2000
RK range	900	1400	2800

Fresh water Application (Maximum 3 m/s)

Type	3-Pass	2-Pass	1-Pass
	Max Recommended Flowrate (l/min)	Max Recommended Flowrate (l/min)	Max Recommended Flowrate (l/min)
EC range	75	120	255
FC range	135	200	380
FG range	180	270	530
GL range	320	470	900
GK range	460	690	1400
JK range	660	1000	2000
PK range	1000	1500	3000
RK range	1400	2150	4300

3.2 General information

The oil cooler should be pressurized on the oil (shell) side such that it is at a higher pressure than the water (tube) side. This will ensure that if a leak occurs it will be detected by a reduction in the oil level and the oil will not be contaminated. A differential pressure of 2 bar would be sufficient. It is essential that the following instructions are followed to prevent corrosion/erosion of the heat exchanger:

a) Always maintain the water pH to within correct levels. The ideal water pH should be kept within 7.4 to 7.6. On no account should it be below 7.2 or above 7.8.

b) Minimum water velocity of 1m/s should be used.

c) Ensure compliance with water quality and maximum permissible pressure requirements.

d) Air must be adequately vented from both circuits.

e) Stagnant water should not be allowed to accumulate in the oil cooler. If it is not in use for any period of time the water should be drained off.

4. Commissioning

Commissioning of the oil cooler should not be undertaken until this document has been fully read and understood. Both circuits of the oil cooler must be closed prior to commissioning.

Danger

Adequate provision should be made to ensure that correct operating/service equipment along with personal protection equipment (PPE) in accordance with current standards/legislation is used prior to the commencement of any working.

Take Care

Cooling water should be introduced to the oil cooler prior to the gradual introduction of hot oil. Both circuits should be vented initially and again when operating temperatures and pressures are reached. The system should be checked for leaks.

Copper-nickel alloys have a very good resistance to seawater corrosion due to the formation of a thin protective film on the surface of the metal. This film starts to develop over the first few days after the metal has been in contact with clean, oxygenated seawater, and requires a further 3 months to develop fully. This is the most important part of the process to ensure long term corrosion resistance behaviour of copper nickel. The protective surface film of cuprous oxide is indicated by either a brown, greenish brown or blackish brown thin film layer. The process of ensuring that copper alloy receives an effective oxide coating prior to service is known as "conditioning" which is a very important stage for the alloy. Ferrous sulphate can be used if commissioning in clean sea water is not possible. Schedule cleaning may help to reduce the risk possibly with non-metallic brushes. Please refer to Copper Alliance webpage for more information: www.copper.org.

5. Maintenance / Repair

5.1 Winter shutdown in areas exposed to frost

Care should be taken to prevent frost damage from a winter shutdown in conditions exposed to frost. We recommend draining down the oil cooler or removing the it completely from the installation for the duration of the shutdown period.

5.2 General maintenance

While the unit is in operation, weekly inspection of the heat exchanger and its connections should be made for leaks and externally visible damage. **BOWMAN®** recommend that the tubestack should be cleaned and inspected annually and the o rings should be renewed at this time. Removal of the screws around the periphery of each end cover will allow the end covers and seals to be removed. The tubestack can then be withdrawn from either end of the body.

5.3 Cleaning

Whilst we strongly recommend that mechanical and chemical cleaning of the heat exchanger is carried out only by specialised companies, below are some general guidelines that may be useful;

a) Removing the end covers allows access to the tube stack, which can be removed from the body.

b) Wash the tube plates and tubes using a hand held hose or lance. An industrial steam cleaner can also be used if available.

c) Tube brushes can be used to clean through each tube to aid removing stubborn deposits. Small diameter rods and brushes for tube cleaning are available from companies such as Rico Industrial Services www.ricoservices.co.uk

d) Detergents or chemicals suitable for use with the tube material* can be used if fouling is severe. Allow time for the detergent or chemical cleaner to work, before hosing down with plenty of water. **Please refer to the spare parts list for details of the tube materials.*

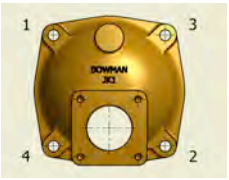
e) The tube stack should be flushed through with clean water to remove all traces of cleaning chemicals/detergents. If necessary, the cleaning fluid should be neutralised.

f) **When refitting the end covers after cleaning, new 'O' seals must be used**

5.4 End cover screw tightening sequence


Take Care

End covers must be refitted in their original orientation and tightened to the torque figures below.



Cooler Series	Screw Size	Torque (Nm)	Cooler Series	Screw Size	Torque (Nm)
EC	M6	8	GK	M12	54
FC	M8	22	JK	M16	95
FG	M8	22	PK	M16	130
GL	M10	37	RK	M16	130

6. Potential Service Issues

6.1 Tube failures

The majority of problems facing an oil cooler are those of corrosion or erosion on the water side. Three common types of failure are:

a) Impingement attack (or erosion corrosion)

This is caused by water containing air bubbles flowing at high speed through the tubes. The impingement of rapidly moving water may lead to a breakdown of the protective copper oxide film on the tubes thus allowing corrosion/erosion. This is worse with water containing sand or grit. The effect of these conditions would be pockmarking and pinholing of the tubes.

b) Oxide corrosion

This is caused by water containing organic matter such as that found in polluted estuaries. Usually this water produces hydrogen sulphide, which is very corrosive and can cause failure of the tubes, particularly if excessive water flows are used.

c) Pitting

This problem is caused by very aggressive sea water in the tubes, especially in partially filled coolers where the sea water is stagnant. Low sea water flow rates can create a high temperature rise on the sea water side. Under these conditions deposits may build or settle in the tube, allowing pitting corrosion to take place under the deposits.

This is only a brief introduction to corrosion problems. The subject is complex and the purpose of these notes is to outline in very general terms what may occur under extreme conditions.

6.2 Fault finding

Symptoms	Possible Causes	Remedy
Increase in temperature on shell side or excessive pressure loss	Oil sludging, tube scaling or build up of both resulting in an insulating film covering the tubes	The complete oil cooler should be thoroughly cleaned
Pressure loss is as expected, but the temperature of the oil rises	Film, scale or restrictions on the inside of the tubes	The complete oil cooler should be thoroughly cleaned
Oil leaking into the cooling water circuit or vice versa	Split or perforated tubes	Tubes should be blocked with hard wooden plugs as a temporary measure & the tubestack replaced asap
Inadequate performance	Flow rates too low Unit connected in parallel flow	Check flow rates & increase if necessary Reconnect in counterflow as per section 2.2

7. Warranty

All **BOWMAN®** Hydraulic Oil Coolers are guaranteed against manufacturing and material defects for a period of twelve months from the date of delivery.

BOWMAN® should be contacted immediately if a unit is received damaged. No attempt should be made to repair a faulty unit as this will invalidate the warranty.

For full warranty terms, please see the **BOWMAN®** Conditions of Sale. A copy of which is available on request or via download from the website: **www.ej-bowman.com**

8. Spare Parts List

A comprehensive stock of spare parts is always available. Details are given in the Hydraulic Oil Coolers brochure which can be downloaded from: **www.ej-bowman.com/downloads**
Please contact our sales department for price and availability or nearest stockist.

9. CE Marking Documentation

Heat exchangers are covered by the Pressure Equipment Directive 97/23/EC which is mandatory for all EU member states.. This manual is part of the compliance and points out all essential safety requirements to be observed.

BOWMAN® Hydraulic Oil Coolers fall within the Sound Engineering Practice category of the Pressure Equipment Directive 2014/68/EU and as such cannot be CE marked.

10. Notes on Zinc Anodes

The use of zinc anodes in heat exchangers has been employed for some years, generally by manufacturers using admiralty brass tube or its variants. The purpose of the zinc anode, or zinc pencil as it is sometimes called, is to prevent dezincification of the brass alloy tubes. As such zinc anode acts sacrificially in favour of the tube. There are a number of American and European manufacturers that use these anodes in their products.

BOWMAN®, do not fit zinc anodes as the tubes used in the construction of our coolers are of copper nickel alloy and as such do not require a zinc anode. It is possible that if this anode is fitted it can actually destroy the copper oxide film built up by the tube as a natural defence which can allow the tube material to be attacked. It is usual with the copper nickel alloys to use an iron anode which allows an iron oxide film to build up inside the tube which breaks down as a sacrificial element reducing the possibility of corrosion to the heat exchanger. In **BOWMAN®** designs it is not practical to fit iron anodes as their size has to be very generous.

Therefore as an alternative a piece of black iron pipework can be placed before the heat exchanger which in itself acts as sacrificial element protecting the cooler. The Royal Navy has often used this technique and when the black iron pipework corrodes, it is simply replace with a fresh piece.

We do know that some manufacturers of oil coolers, mostly those that are copies of better known products, often fit zinc anodes with copper nickel alloys in error.

Bowman heat transfer solutions

Bowman heat exchangers and oil coolers can be found in Active Fire Protection Systems, Automotive Testing, Combined Heat & Power, Hydraulic Systems, Marine Engineering, plus Mining Equipment and Machinery, in a range that includes:

Exhaust Gas Heat Exchangers

Hydraulic Oil Coolers

Swimming Pool Heat Exchangers

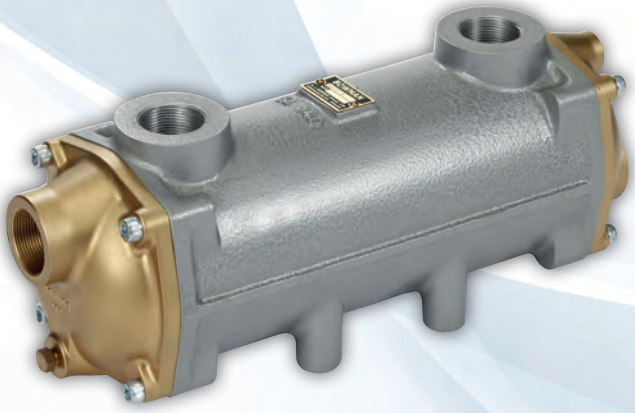
Stainless Steel Heat Exchangers

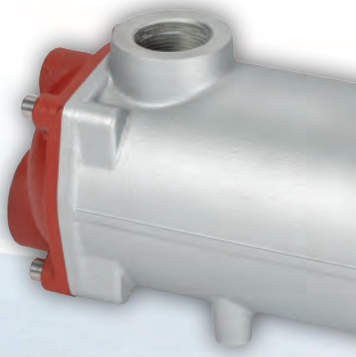
Header Tank Heat Exchangers

Plate Heat Exchangers

Engine Oil Coolers

Transmission Oil Coolers





EJ Bowman (Birmingham) Ltd
Chester Street, Birmingham B6 4AP, UK
Tel: +44 (0) 121 359 5401
Fax: +44 (0) 121 359 7495
Email: sales@ej-bowman.com
www.ej-bowman.com

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