

HYDRAULIC OIL COOLER



Installation, Operation & Maintenance Guide

Foreword

Dear Customer,


BOWMAN[®] has been manufacturing high quality hydraulic oil coolers for over 60 years.

Your **BOWMAN**[®] Stockist/dealer will be happy to provide you with advice and practical assistance.

Please read these instructions fully and carefully.

Keep the Installation, Operation & Maintenance Guide for future reference to ensure the long lasting performance from your new Hydraulic Oil Cooler.

Copies of the Installation & Maintenance manual in other languages are available from:

French 

German 

Italian 

Spanish 

<http://www.ejbowman.co.uk/downloads.htm>

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Installation, Operation & Maintenance Guide

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1 Safety

1.1 Hazards when handling the heat exchanger

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 heat exchanger or
- Damage to property and equipment

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

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

The heat exchanger must only be used for its intended purpose.

In the event of breakdowns which may compromise safety a suitably qualified person must always be contacted.

1.2 Approved use

BOWMAN[®] Hydraulic Oil Coolers are only approved for cooling hydraulic oil. Any other use unless specified 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 (primary side) : 20 bar max.

Water (secondary side) : 20 bar max.

Applies to EC-PK three pass threaded connections only – for other versions please contact **BOWMAN**[®] for guidance.

The maximum permissible operating temperature must not exceed:

Oil (primary side) : 120 Deg.C

Cooling Water (secondary side) : 110 Deg.C

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

1.3 Potential hazards

Ensure the maximum permissible operating pressure on the primary or secondary side of the heat exchanger is not exceeded. The heat exchanger or surrounding equipment may be damaged.

NB: before the oil cooler is disconnected it must be allowed to cool sufficiently and be depressurized to prevent injury. The supply and returns to the heat exchanger should be isolated to minimise fluid loss.

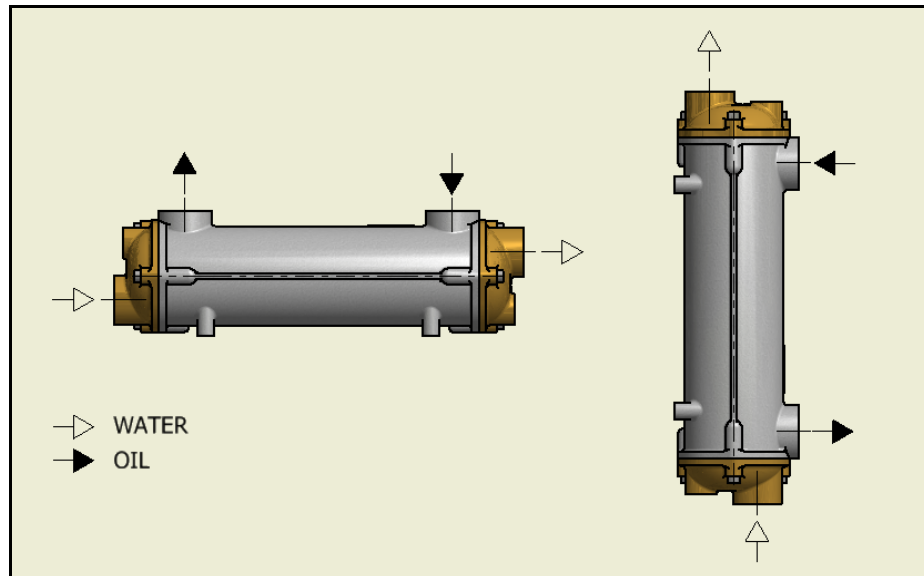
2 Installation

2.1 Transport / storage

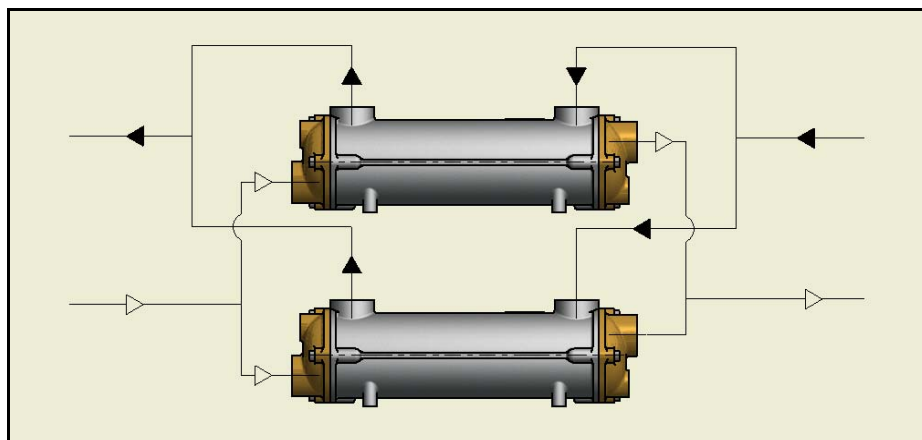
The heat exchanger must be fully drained down prior to transportation. Once drained and fully dry, the heat exchanger must only be stored indoors within a non aggressive atmosphere. The connections should be capped to avoid ingress of dirt and contaminants.

2.2 Fitting

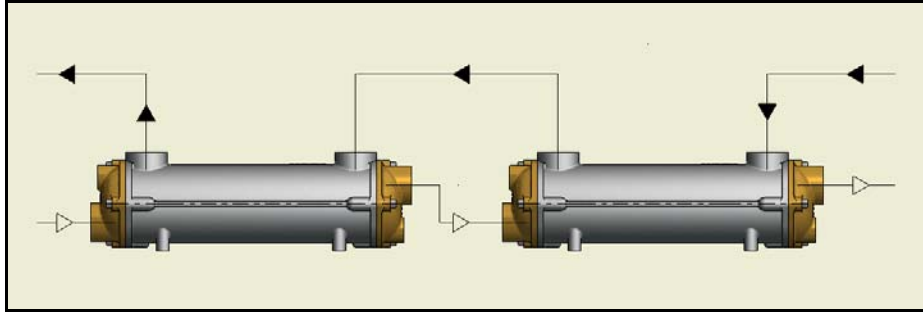
Before fitting, the heat exchanger should be checked for visible signs of damage. The oil cooler can be positioned horizontally or vertically and should be connected in counterflow so that the fluids flow in opposite directions, as shown below:



Multiple units can be connected in parallel:



Or in series:



A filter with a maximum permeability of 2.5mm should be used prior to the inlet of each circuit of the oil cooler.

Nothing should be welded to any part of the oil cooler. Each unit has threaded holes on its underside to facilitate mounting.

2.3 Connecting the heat exchanger

Shut off all drainage valves in the flow and return pipes of the primary and secondary circuits.

When fitting the heat exchanger into the pipe work care must be taken to ensure that no debris has been introduced into the primary or secondary circuit of the heat exchanger.

Unsupported lengths of pipework should be avoided so as not to subject the heat exchanger 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 heat exchanger.

If the sea water supply is taken from the ship's 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.

For our oil coolers, the maximum permitted sea water flow rates are as follows:

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

No oil cooler manufacturer can guarantee that his 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.

Three Pass Bowman Heat Exchangers											
Oil cooler series	Max. sea water flow l/min	Orifice diameter in mm for max. sea water flow									
		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	10.0	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	6	16	15
JK	400	32	27	24	22	21	20	20	19	18	18
PK	650	41	34	31	28	27	26	25	24	23	23

2.4 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 replaced with a fresh piece.

We do know that some manufacturers of heat exchangers, mostly those providing copies of the better known products, often fit zinc anodes incorrectly with copper nickel alloys in error.

3 Operation

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 fall below 7.2 or above 7.8.
- b) Maximum fluid velocity through the oil cooler of 2m/s for sea water (ideal sea water flow rates are detailed on page 7) or 3m/s for fresh water must not be exceeded. If in doubt contact **BOWMAN**[®] for guidance. For shipboard installations an information sheet with orifice plate sizes is available.
- c) Minimum water velocity of 1m/s should be used.
- d) Ensure compliance with water quality and maximum permissible pressure requirements.
- e) Air must be adequately vented from both circuits.
- f) 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 heat exchanger should not be undertaken until such time that this document has been fully read and understood.

The primary and secondary circuits of the heat exchanger must be fully closed prior to commissioning.

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

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.

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 fully draining down the heat exchanger or removing the heat exchanger completely from the installation throughout 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 maintained 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

Any cleaning solutions used must be compatible with the oil cooler materials. This should be confirmed with the chemical's supplier before use.

The chemical solution can be circulated through the heat exchanger or the unit can be disassembled and the tubestack submerged in a container filled with cleaning fluid.

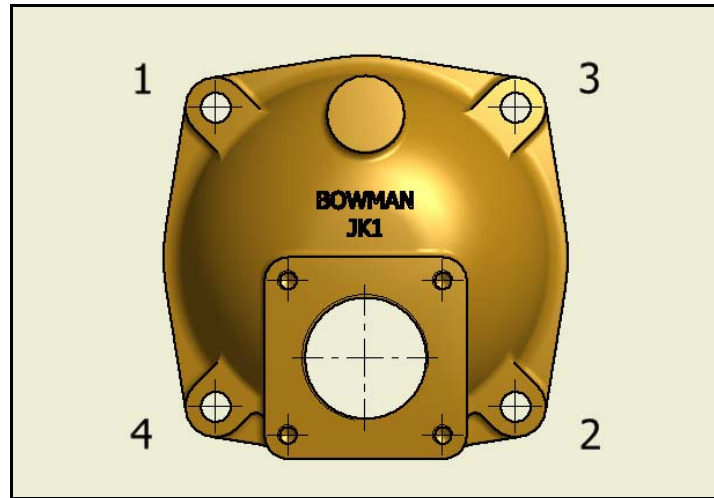
If necessary the fluid should be neutralized after cleaning and the unit should be flushed with fresh water and dried.

Small diameter rods and brushes for tube cleaning are available from companies such as Easy Products www.easyproductsltd.com

Replacement O rings should be fitted and the end cover bolts should be initially be hand tightened then tightened in the sequence and to the torque figures below:

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

5.4 End cover bolt tightening sequence



End covers must be refitted in the correct orientation to ensure correct performance.

6 Potential Service Issues

6.1 Tube failures

The majority of problems facing a heat exchanger are those of corrosion or erosion on the water side. Three common types of failure are:

a) Impingement attack (or corrosion/erosion)

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 built up by the tube 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 heat exchanger 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 heat exchanger 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.ejbowman.co.uk

8 Spare Parts

A comprehensive stock of spare parts is always available. Details are given in the Hydraulic Oil Coolers brochure which can be downloaded from:

<http://www.ejbowman.co.uk/products/HydraulicOilCoolers.htm>

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 97/23/EC and as such cannot be CE marked.