



## Thruster oil contaminated with water

*By Steffen Nyman, Corporate Trainer and Marketing Manager, C.C.JENSEN INC*

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### **Can your vessel continue operation despite of water ingress in a thruster?**

Water in thruster oil systems is a serious problem costing marine and offshore vessel owners millions of dollars every year for thruster repairs, oil changes, down time and dockings. According to an IMCA survey thruster malfunctions accounted for 15% of all lost positions from 1991 to 1994 (not including computer and electrical failures). Another later survey proved that azimuth thrusters failed an average of 7.7 times per year and tunnel thrusters failed an average of 2.8 times per year.

This paper describes the reasons for water ingress in thrusters, solutions and cases. The main focus is on water in the gear oil, since this account for the majority of thruster breakdowns.

It is not necessary to accept the problems as unavoidable, as there are proven, efficient methods of removing water from the oil, making it possible to continue operating the vessel despite of water ingress in the thruster!



Picture 1. A platform supply vessel is highly depending on thruster operation



## Reasons for water ingress in thruster oil

Water ingress occurs mainly as a result of leakage of the main propeller shaft seal of the thruster, although there has been an impressive effort in recent years by the seal manufacturers to develop means to prevent this from occurring.

In theory the header tank should prevent water seepage into the thruster oil, but in reality the water contamination remains a major problem for the following reasons:

1. When the thruster is operating, the shaft seals can perform a pumping action that will overcome the static pressure from the header tank. This is generally known, but the mechanics of how it occurs has not been investigated fully.
2. The dynamic water pressure created by the pressure pulses from the propeller blades on the seal can be higher than the static head pressure on the oil, causing the water to ingress through the shaft seal.
3. Vibration in the ship can cause a slight curvature in a propeller shaft which will enable water to pass the shaft seal.
4. Fishing gear, rope or wire can get caught on the propeller shaft and destroy the seal.
5. If the seal is old, worn or otherwise damaged, water will ingress through it due to the loss of header pressure caused by the periodic heaving of the vessel in heavy seas.

Shaft seal wear is often caused by particle contamination in oil. Even particles less than one micron in size can have an abrasive effect on the seal, since its dynamic tolerance is less than 0.5 micron. This is an often overlooked factor that will shorten the expected lifetime and reduce the performance of the seal.

Though much effort has been put into improving the thruster shaft seal, the complexity of the associated problems means that developing the “perfect seal” is still in the future.

Due to lack of solutions, the thruster OEM's and many vessel operators have more or less accepted the problem of water contamination in thruster oil and the associated maintenance costs. However, water can be removed from thruster oil utilizing a simple, but highly effective solution.

## Offline filtration

An effective offline filter, also referred to as a kidney loop filter, can make a huge difference.

Offline filters specifically designed for thruster gear oil are capable of removing both submicron particle, varnish deposits and most importantly to separate water from oil continuously without the need for replacing blocked filters when a major leak happens.

Offline thruster filters are incorporating their own pump which should operate 24/7, typically turning over 10% of the sump capacity per hour, meaning the whole oil volume is filtered 2-3 times per day.

Most units are fitted with electrical preheaters for enhanced filtration and water separation from the oil when the vessel operates in cold waters, as well as a by-pass valve/pressure switch for safety when the insert need to be replaced. A drain tank is convenient and should be considered for larger filters.



Many marine and offshore vessel operators worldwide vouch for the performance of offline thruster filters since they have experienced reduced maintenance costs after less than 6 months operation.

**More importantly, a good thruster filter will allow the vessel to continue operation, despite of water ingress.**

The optimum is to remove sea water continuously without the need for changing out numerous water-logged filter inserts, and to avoid the salt concentration building up in the oil, which can occur if evaporative equipment is utilized.

Continuous water separation from thruster oil may be the edge needed to allow the vessel to continue working and defer the docking to a later date, especially for supply vessels and anchor handling tugs, this could mean the difference of being able to complete a delivery/contract without the need to come off-hire to fix the leak, as this usually means dry-docking the vessel.

As an extra benefit, a good thruster oil filter will also take care of the particle and varnish contamination in the oil, extending the life of the oil, the shaft seal(s), the gears, bearings and all other components in the system.

On most thrusters the oil pressure in the void space and the lower gearbox is not very high, but the operation draft can vary 5 – 15 meters on some types of vessels and drilling rigs, which will require higher pressurized gravity lines to compensate for this. Ask the thruster manufacturer if in doubt. This will necessitate the requirement for a higher pressure filter unit.

### **How offline filters are installed on thrusters**

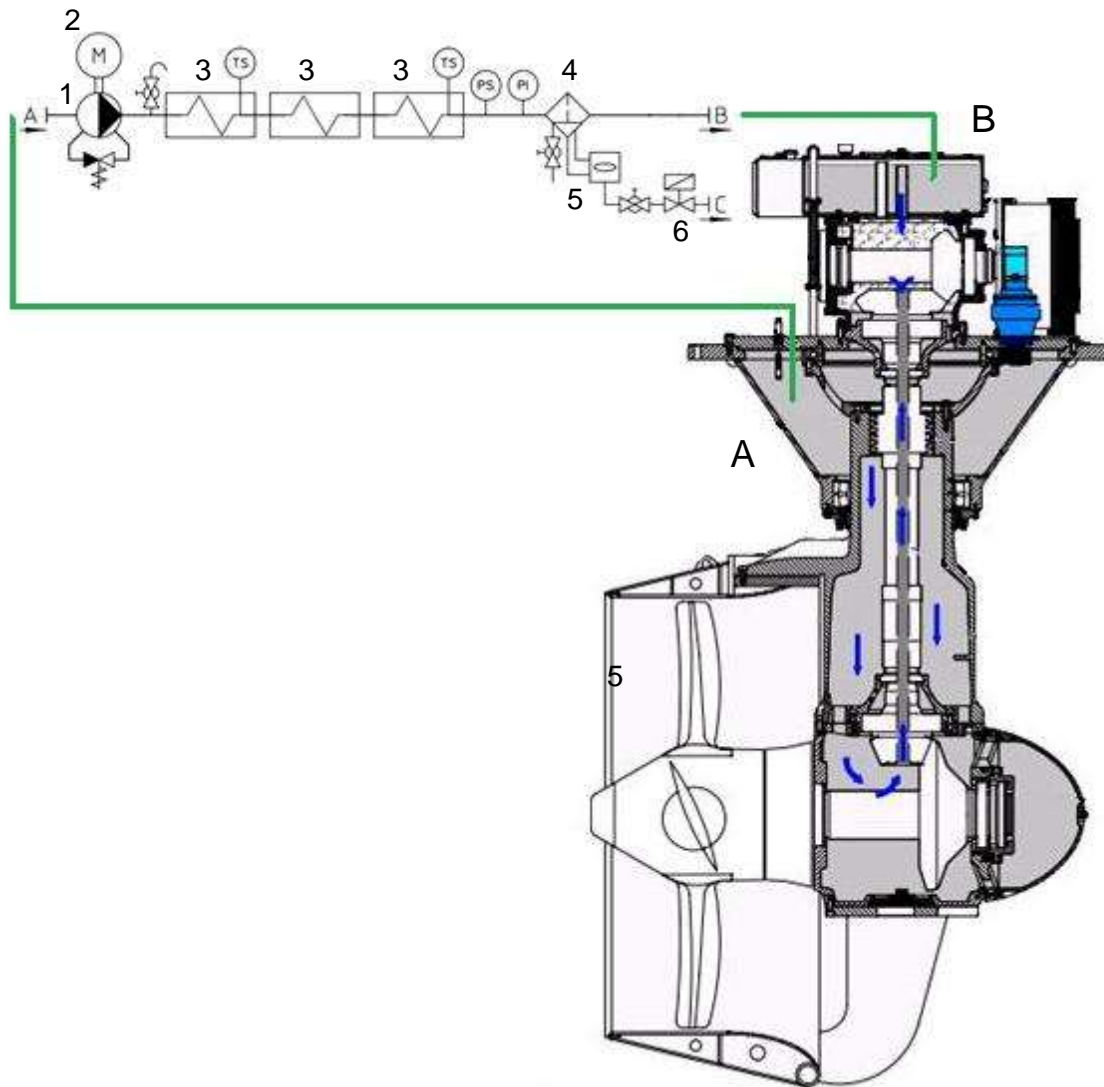
The ideal solution is to take suction from the lowest part of the lower gearbox. With fixed thrusters, such as tunnel thrusters, this is possible, but with azimuthing thrusters it is difficult due to the fact that they can rotate 360 degrees. However, the circulation of the oil is often enough to pick up dirt and water so that it can be removed with an offline thruster filter connected to the void space in the top.

The design of some azimuth thrusters do facilitate the connection of a continuous operating offline filter unit to take suction from the lower gear section where the build up of particles and water occur when the thruster is not running.

Please see installation drawings below.



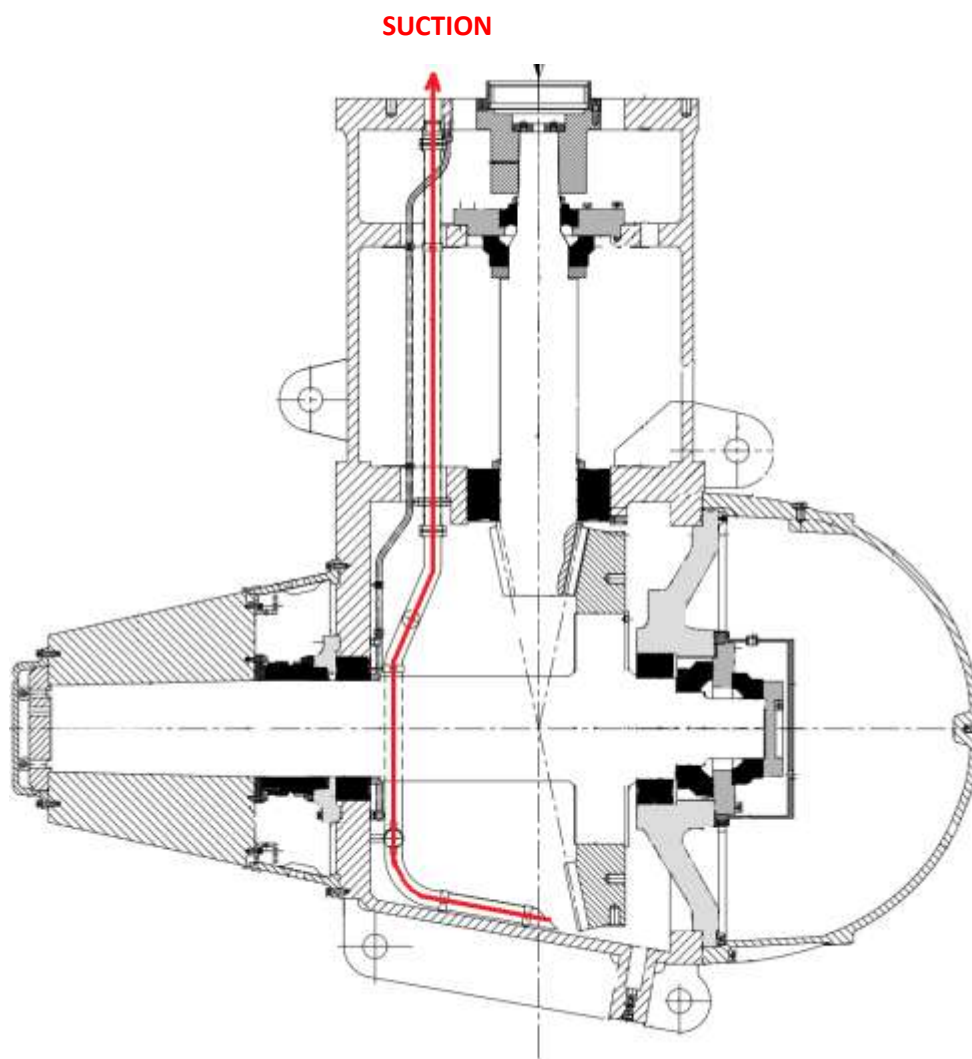
Picture 2, illustrates an offline thruster filter connected via the L.O. system. Suction can be taken from the void space (A), with the discharge either back to the same space or to the header tank (B). The offline filter consists of: pump (1), motor (2), preheaters (3), filter separator (4), float assembly (5), and water discharge solenoid (6).



Source: Schottel



Picture 3, shows an azimuth thruster with the capability of installing the suction for the offline filter reaching down to the lower gearbox to allow improved oil circulation during static conditions of the thruster. This solution may be possible on the larger thrusters, and some OEM's have decided to pre-install oil lines for installation of offline filters.



Source: Rolls-Royce



Picture 4, shows an offline thruster filter connected with suction and return hoses (CJC™ PTU2 27/27Thruster Filter with preheaters, auto water discharger and control box)



Picture 4 – installation photo (source C.C.JENSEN)

### **What can be expected when installing a quality offline thruster filter?**

Continuous operation will typically be able to keep the oil cleanliness in regards to particle contamination below ISO code 16/14/12 (NAS 5), and the water level in oil below 500 ppm (0.05%), depending on the efficiency of the installed offline filter system.

In many cases water levels lower than 500 ppm can be achieved, but here the rate of water ingress and the demulsibility of the oil plays an important role (the oil's ability to shed water).

### **Conclusion**

If thruster reliability is important for the operation of your vessel, then do not hesitate - find a quality and purpose built offline thruster filter and get peace of mind !

Please see attached application stories for results obtained in thruster oil systems utilizing offline filtration (C.C.JENSEN ASMA 7022 and ASMA 7019).



## Brief about the author

Steffen Nyman got his mechanical engineering degree in 1996 and was in technical sales for three and a half years. Since February 2000 he has been responsible for developing and conducting technical training and documentation for sales, service and technical staff. He is a certified Machinery Lubricant Analyst and 4-MAT trainer in adult teaching skills. He has worked as Corporate Trainer for C.C.JENSEN since 2004, conducting hundreds of customized seminars in understanding oil management including oil filtration systems for the Marine, Mining, Power, Off-Shore and Wind industries.

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