Return to session menu

DYNAMIC POSITIONING CONFERENCE

October 9-10, 2012

Thrusters

Challenges in Ship Design to Maintain Thrusters inside Ship

Tom Nylund and Timo Rintala

Beacon Finland

DP Conference - Challenges in Ship Design to maintain thrusters inside ship

Abstract/Objectives of the presentation

In hydrocarbon exploration the target is to have the drilling process running 24/7. The DP System enables the vessel to keep the position and operating. When the thrusters, as part of the total positioning system, require maintenance and service, this ideal 24/7 target is threatened. There are anyhow a number of solutions to overcome these threats. By designing and installing a thruster container ("canister") into the vessel, the maintenance work and even more demanding service work can be done with no operating downtime.

This presentation will cover the principles and function of the original thruster container ("1st generation canister") and the more advanced new versions ("2nd generation canisters"). It will also include the requirements the different versions of the thruster container, that the ship design needs to meet.

The thruster container enables the retraction of the thruster inside the vessel for maintenance and inspection. The thruster can in more advanced versions be retracted and moved to a separate dry service space, which can be situated even below water line, for total overhaul.

In the design phase of the vessel the designer needs to know the service operations that will be done in the vessel´s maintenance profile. Does the owner plan to use the canister for minor maintenance purposes or more demanding maintenance work? Is the purpose of the thruster containers only to enable transit in shallow waters or when drydocking the vessel? All these things, and many other, have an impact on the design.

Role of the Thrusters in Dynamic Positioning and Maintenance & Service Situations

The thrusters have an essential role in enabling the exact position for continuous drilling on the oil well in deep water operation. DP operation, depending on DP Notation, allows one of the thrusters to be out of operation for maintenance without losing DP capability and thus not interrupting the production. Even if e.g. one of six thrusters is not in use, the positioning is still exact enough and does not in that sense form a risk for the uninterrupted production. This fact permits the maintenance and service of one thruster at a time. Even a more demanding service operation is possible.

Possible service and maintenance situation, independent of installation type

The most common recurring maintenance need is the change of the propeller shaft seal. The estimated life time can be 3 – 5 years. This maintenance work must be done above water level.

Thruster overhaul requirement from classification point of view is five years. Depending on condition monitoring or equal the classification period can be extended up to 10 years. It requires removal of the thruster unit as an underwater mounting operation. The operation is time consuming and stops the drilling operation and correspondingly results in loss of money as the drilling rig goes on down time status.

Although less likely, the service need may also occur as a consequence of an underwater collision or due to other unexpected situations. Normally these situations cause larger damage and the propulsion unit needs to be removed for repair, it might need replacement with a spare thruster unit or alternatively the vessel needs to be taken to a drydock.

There have been solutions available for years, eliminating or minimizing operating downtime and reducing time for service and maintenance work of thrusters. Already in 2000 the first readily retractable canisters were installed into two drillships to enable smaller maintenance work of the thrusters, including replacement of shaft seals and anodes. Although the first canisters have worked well, the real interest for the canisters aroused a couple of years ago. Now the canister solution gives a respectable additional feature on many drilling vessels. There are also more developed versions available of the original canister, which entitles more advanced service operations of the thruster; the version with service space above waterline and the service space for maintenance situated below water line.

Canisters and Service space presentation

Conventional Canisters

There are some retractable thruster solutions available, which are designed only for use during transit of the vessel to reduce the resistance This presentation is not covering that kind of solutions, although they might be called “canisters” or “capsules”. The following description of canisters, service space above and service space below waterline, is concentrating on solutions with main feature to enable maintenance and service of thrusters in the original place instead of being moved to another place, during drilling operations and without the requirement to stop the other thrusters or require commercial diver assistance.

The Original Canister designed for maintenance purposes

<u>Basic principles and functionality of the original canister</u>

1. to retract an azimuth thruster vertically inside the ship for shallow water operation. There are situations where the propulsion unit should be lifted above the bottom line to reduce the total draft of the ship. Especially when calling ports with draft restrictions or for drydocking.
2. to reduce vessel resistance in transit
3. to retract the azimuth thruster vertically into the maintenance position. In the maintenance position, the propeller is accessible at a location above the water line allowing maintenance and repair of the thruster. The thruster can be returned quickly to its deployed position. The propulsion unit needs some maintenance for the underwater part e.g. replacement of worn or failed propeller shaft seal, right angle gear inspection, anode replacement, cleaning and inspection of propeller, etc.. The best way is to lift the unit above water line and thereby gain full access.

Having these features, there must be a jacking system to allow lifting and lowering of the canister in a controlled way. In operational position the canister must be locked to the ship’s structure to take all the forces coming from the sea and the thruster.

In order to have the trunk space dry when the canister is in the operation position, there shall be a seal arrangement at the bottom of the canister.

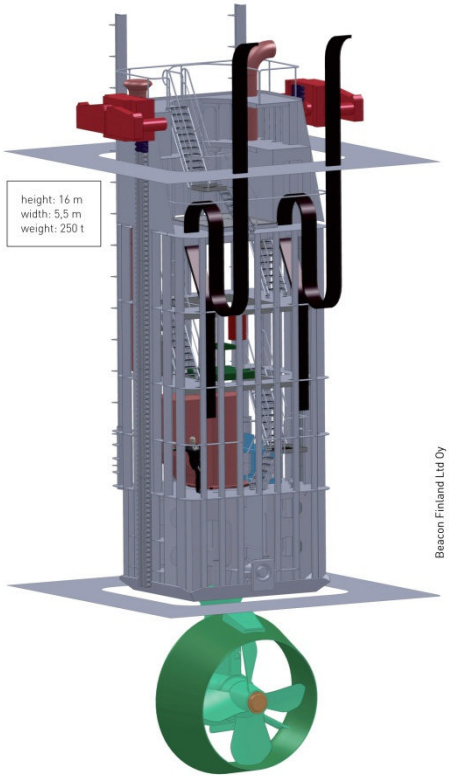
Fig. Installation preparation of a thruster canister

The idea is to have all thruster functions inside of the canister. Those functions are:

- main drive
- lubrication system
- steering hydraulics
- control of thrusters and main drive
- other auxiliaries

Canister operation system

The operation of canister is to move it vertically up and down in ship's trunk by a rack and pinion type jacking system. The drive of the jacking system can be accomplished by hydraulic or electric drive. The drive system should ideally be located on the ship side and the racks on the canister side, however the opposite has been used successfully. The canister must be independently locked in operation position without reliance on the canister jacking system.



To be able to operate all systems in canister there must be arranged supply to all functions. The supplies to the canister are e.g.

- cooling water
- lubrication oil
- power supplies
- control cable
- ventilation
- bilge system
- etc.

These must be carried through umbilicals to the canister. From operational point of view the umbilical is important. The umbilical is the navel cord for the canister functions. It must be able to take all loads not only from the up / down movement but as well from the sea and ship movement.

It is recommended to have forced ventilation to the canister from the trunk space via a ventilation fan, situated in the canister, and the exhaust air is led to the ship´s ventilation system and out to the weather. There are also alternative ventilation systems in use, for example when the canister is elevated

The canister must as well have a safe staircase arrangement with platforms inside the canister.

Locking system

The locking system is arranged in the canister side and counter flange, socket piece, arrangement in the trunk. The system can be operated either hydraulically or electrically. In both cases the structure must take all forces from the thruster operation and from the sea, both in the canister and in the trunk. If a hydraulic system is selected, the hydraulic power unit (HPU) may be located inside the canister or a single shared HPU may be remotely located, serving all canisters on one end of the vessel.

Guide system

To be able to operate the canister up and down there must be a guiding system to support the canister during its lifting and lowering.

Access to Canister

The access to the canister must be arranged both in retracted and operation position. The safety inside canister is performed with normal engine room safety arrangement as alarming etc. One notable issue is the bilge pump system to discharge possible leakage through bilge pump arrangement connected to the ship´s own oily water system.

Strand Jack system

There must be a possibility to arrange strand jacks on top of the canister to have the feature to take the azimuth thruster out of the canister from below when the ship is afloat. The strand jack cables are led through the canister and connected to the thruster.

The canister shall be locked by a secondary locking system before starting the underwater mounting procedure.

Sealing arrangement

The trunk is isolated from the sea by a seal arrangement. It enables the trunk space to remain dry in operational mode. There shall be a bilge pump arrangement in the trunk space at ship side to empty the space after the canister has been jacked down to its operation position.

The use of the described original canister concept has so far mainly been limited to drillships and other special vessels, which are not intended for regular drydocking.

New canister designs

Maintenance space – short canister with maintenance space above water level

This canister version is a shorter version of the original canister, with mainly the same features. In this solution all supporting functions as lubrication power pack, steering hydraulic power pack, etc. are situated outside the canister on ship side. The canister is watertight and submerged during the lifting operation. When the canister is fully retracted it is locked into the retracted position by the secondary locking system.

Differences compared to original canister concept

- possible to install into vessels with smaller depth
- fits inside the hull in retracted position
- no need for additional supporting constructions in maintenance mode
- possibility to do the maintenance work during ship´s operation
- lighter steel construction

Maintenance possibilities, depending on available space inside the vessel

- maintenance of underwater parts of the thruster, e.g. propeller, and change of propeller shaft seal
- anode change
- annual inspections

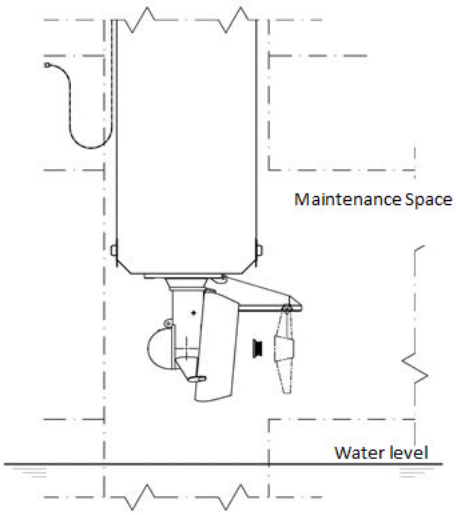


Fig. Replacement of Propeller Seal

The Maintenance space – short canister is feasible for drillships. The short canister allows also classification inspections.

There are various short canister concepts or other concepts for thruster maintenance available, depending on the use, service demands and the space available. These demands are clarified in the discussions between the owner and the canister designer in the concept phase.

Underwater Service Space

The Underwater Service Space is a concept consisting of a vertical thruster trunk, a maintenance space and a short canister. The thruster trunk is separated from the service space with a watertight bulkhead door. The trunk will be closed by watertight bottom hatches. The sea water is pumped out of the trunk. As the trunk is empty the watertight bulkhead door is opened and the service space is ready for use. The watertight door is closed during the total overhauling. Access to the compartment is arranged from the top of the maintenance space through a stair case or from the top of the trunk trough a hauling shaft. Depending on the work scope, the ship arrangement must be designed to support the maintenance work with sufficient space and lifting tools. This canister concept allows more demanding service and overhauling tasks. In case of several trunks one maintenance space can serve them all.

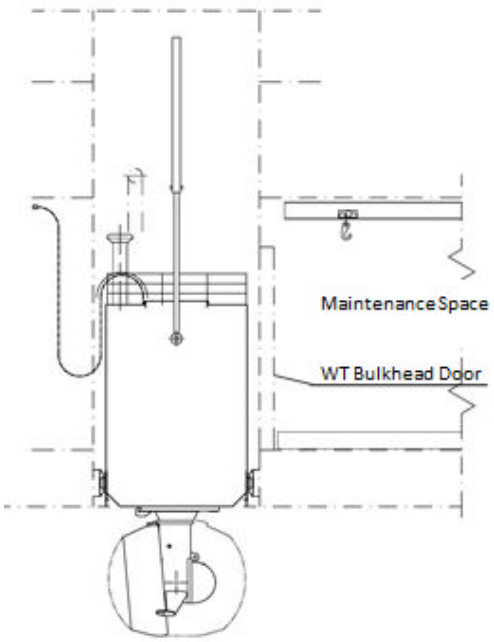


Fig. Operation mode

The concept allows **full service** of the thruster and separate maintenance operations like

- propeller change
- propeller shaft change
- anodes change
- check of possible leakages
- check of possible damages on thruster unit
- classification inspections

Differences to the original canister concept

- maintenance work is less independent of sea state
- allows also more demanding service and overhauling work
- fits inside the ship´s hull
- is furnished with more advanced security equipment
- the more demanding services might require additional lifting equipment for moving the thruster and thruster parts
- larger space required for lifting and service work

The Underwater Service Space is feasible for drillships, FPSO, FPDSO, FLNG, etc.

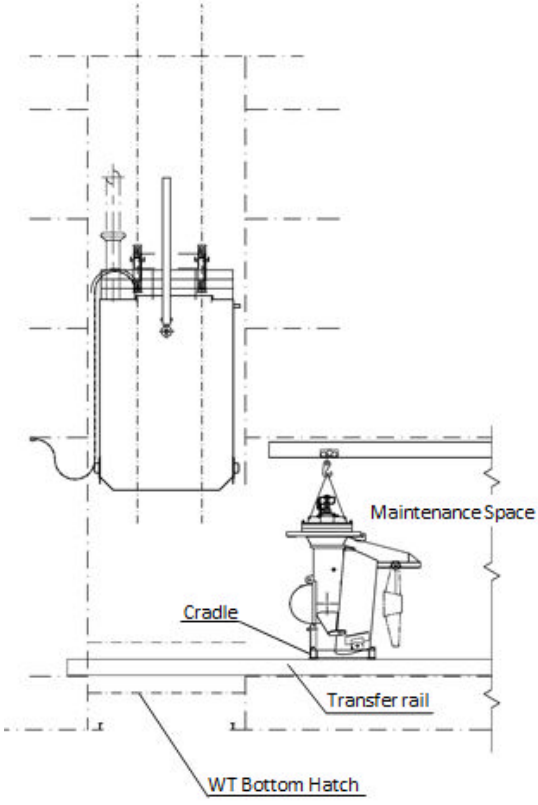


Fig. Dismantling of Thruster Unit

Challenges in the Design of a Canister and Service Spaces above or below waterline

The operational requirement must be the starting point for the canister design. The best possible result of installing a canister is achieved by involving the owner of the vessel and the canister designer at the very beginning of the concept design process. It verifies the awareness of all parties' demands, preferences, restrictions, Classification societies' requirements and operational conditions for the vessel. If the owner is not familiar with the basic concept itself, it is of great advantage to reflect the experiences an accomplished designer has.

The type of the thrusters has to be decided in an early stage, as the thruster size determines the basic dimension of the canister or service space and the trunk itself. The thruster supplier has the best knowledge of the maintenance and more advanced service demands that might occur during the use of the thruster. Additionally, the necessary equipment to operate the canister, to lift the removed thruster, etc. all has an impact on the surroundings of the canister and the space requirement.

One challenging task for the designers is that the requirements and wishes from the owner's side often changes during the development and design phase. The impact of a "minor change" in the canister might be almost impossible to evaluate, as it often creates a chain of changes to many things. In worst case the changes might influence on the structure of the vessel. Therefore the involvement of skilled and experienced designers is extremely important in order to avoid as much inconvenience as possible for both the ship builders and the owner. The thorough presentation of the canister, the possible features that can be included and detailed discussion about the owner's demands and preferences is the best guarantee to a successful process and an optimal canister solution, generating efficient and cost saving thruster maintenance and service.

In case the retraction of the canister will require space above the deck, it is important to plan and design the on-deck equipment accordingly. The retracted canister that is lifted above waterline, also need some supporting construction above the weather deck to stabilize the canister. Without a supporting construction the sway might cause damage to the canister and the vessel constructions next to the retracted canister. There are obviously strictly defined weather and sea conditions in which the retraction and service is possible to do, in order to avoid unnecessary risks.

The designs have a challenging task when optimizing the space dedicated to the canister. As the space under and above deck is in use only during the service phase, it should be optimized for the right purpose and thereby size. The space has to be a compromise between many requirements and demands. This underlines the importance of the definition of the purposes of the canister and the service and maintenance operations it will be designed for. The owner has to prioritize the features of the canister, e.g. easy access to the service space, generous working space for the service staff, etc. Adding features during the design phase will influence the canister design, but also the structure of the vessel.

Besides the space the canister itself requires, one has to take into consideration all the space requirements that the critical auxiliaries require. In order to retract the canister properly the rack and pinion system has to have the right and optimal dimensions. The mover that enables the moving of the canister is defined according to a safe and functional movement of the canister. The canister concept with closing hatches need some dedicated auxiliaries and the necessary hosting space during the non-use period.

The maintenance procedure must be well described also in sense of defining necessary space for taking the components apart, maintaining them and reinstallation. Some of the parts have to be moved inside the area, totally removed from the place or even replaced with new ones. The service personnel also require good access to the area and the possibility to move parts around. The safety requirements also determine much about the space features.

Summary

The original canister concept has been alive since the end of 90's. The concept has during the last few years reached the level of recognition that it deserves. The advantages the canister offers, mainly cost savings and the possibility to continuous production and thereby better earnings, although the thruster on board need to be maintained or serviced, speaks for themselves. Still the concept is not that well known among the ship owners, designers and shipyards. The basic concept has been developed for even more demanding service task and therefore a thorough presentation and discussion between all the parties is a necessity already in an early stage of the design, to avoid difficult obstacles and optimize the benefits of the canister.

The possibility to adapt the concept to customer specific needs requires involvement of experienced designers. The designing process with experts involved will shorten the total design phase drastically, as there are a lot of unrecognized pitfalls on the way to the best solution. The only limitation for reaching the best solution for each individual customer is the limited space available for the canisters. Here again the experience and use of experts will help.

Fig. Drillship Deepwater Champion / OwnerTransocean Ltd.

Drillship furnished with six canisters

Contact Information

Mr. Timo Rintala, timo.rintala@beaconfinland.com