

Chapter 4

Propellers and Shafting for Sustainable Shipping

Stan Liviu-Constantin
Constanta Maritime University, Romania

ABSTRACT

The importance of the line shafting, tailshaft, propeller, and thrust shaft cannot be over-emphasised. Failure of any one of them will rend the ship inoperable with possible disastrous consequences. Single line shafting is used on the majority of ships, but not in passenger ships and on short voyage ro-ro services where twin screws are employed. Propellers, because they are outside the ship, are often neglected and are usually only inspected when the ship is in drydock. More frequent examination can be undertaken when a ship is alongside and the shafting is being rotated with the turning gear. Damage to the propeller blade can lead to vibrations being set up in the line shafting causing overheating of the shafting bearings, main thrust, etc. The selection of shafting and propeller materials is usually within manufacturers' specifications and complies with the various classification society requirements as well as the statutory requirements of governments.

INTRODUCTION

The movement of the vessels on the water is achieved due to pushing forces acting on the body of the ship's propulsion, overcoming water resistance that opposes its submission. Of the two types of propulsion: active and reactive, those ones, reactive, are the most common now.

If the active propulsion was abandoned, being used only for the sports craft, the reactive propulsion is used for all large maritime transport vessels, the choice of one type from the reactive propulsion category, depending on transport and handling conditions of the ship (Rawson and Tupper 2001).

This chapter introduces and details concepts related to propulsion category: shafting, tailshaft, main thrust, propellers.

DOI: 10.4018/978-1-4666-4317-8.ch004

INTERMEDIATE SHAFTING

These shafts are made by forging carbon or carbon-manganese steel where minimum tensile strength is within the range of 400-600 N/mm². Alloy steels can also be used depending upon the mechanical properties of the material and their chemical composition. If they are to be used their maximum tensile strength should not exceed 800 N/mm². The forgings used should be subjected to ultrasonic examination.

The diameter of an intermediate shaft is worked out by an empirical formula relating the power developed by the prime mover, various constants and the minimum tensile strength of the material to be used. Reference for this calculation can be made to any of the classification societies, bearing in mind that it usually gives the minimum diameter required.

Intermediate shafts are used to transmit the power from the main engine to the tailshaft, and as such must be supported on bearings. These bearings are also referred to as plummer blocks, tunnel bearings or line shaft bearings. The shafting may be supported on one or two bearings depending upon the design. The bearings are required to hold the shaft and support the shaft load as well as maintaining a satisfactory alignment.

Plummer blocks are individual bearings which usually have their own oil supply contained within the bearing. There are arrangements in which they can be supplied from an external source with their own oil supply and cooler system. Individual bearings, however, have a cooler contained within the plummer block, with cooling supplied from one of the sea water cooling systems.

Plummer block bearings are required to operate over the full range of speeds from 0 rev/min to the rated rev/min in both the ahead and astern directions. The bearings are expected to last the life of the ship, so the actual dimensions are much more substantial than the basic design (Buzbuchi and Stan, 2011).

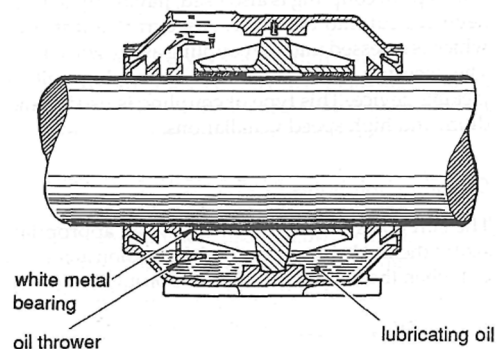
Plummer Block Bearings

There are two types of bearing used in the intermediate shafting. The first type, most familiar to engineers, is that of the steel shaft rotating in a white metal bearing which is oil lubricated. This type of arrangement is used in high powered installations. The second type, similar to bearings used in pumps etc., is a roller surface bearing. These bearings are split because of the difficulty in fitting them.

The aim of the first type of bearing is to provide a good hydrodynamic oil film for lubrication whilst the shaft is rotating, so avoiding metal-to-metal contact. The ability to produce the hydrodynamic oil film is governed by the peripheral speed of the shaft, the thickness or viscosity of the oil and the load on the shaft. The load is carried by the oil wedge. The casing which holds the bearing can either be cast or fabricated steel, and is split on the horizontal joint, allowing easy access for maintenance. Because the load is downward there may only be a white metal bearing in the bottom half of the casing, although complete bearings are also fitted (Figure 1).

Another type of bearing that works on the sliding surface principal has a bottom half bearing which is divided into three sections. These bearings have a pivoting pad mechanism which allows

Figure 1. Plummer block



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