Wärtsilä Alignment & Measurement Services

BUSINESS WHITE PAPER

CONTENTS

Introduction **2**

Causes and effects **3**

Conventional methods **3**

Wärtsilä Portable Control Based Monitoring System **4**

Pre-warnings of possible breakdowns **6**

Identifying a failure **6**

Summary **7**

Introduction

A misaligned shaft line can lead to serious equipment damage.

More than ever before, operational efficiency is occupying the foreground in the marine industry. This has meant that shaft alignment is seldom seen as a top priority for ship owners and operators.

A failure to address misalignment issues, however, can result in serious equipment damage and costly, time-consuming repairs - especially if a ship has to be taken out of service for any length of time - which of course undermines intentions to optimise the operational efficiency of a vessel.

In this paper, we delve into the details of shaft alignment and define its role in realising operational efficiency. We do this by comparing conventional methods with the Wärtsilä Portable Condition Based Monitoring (PCBM) system, a state-of-the-art dynamic monitoring system for vessel equipment.

Causes and **effects**

— Many factors can contribute to shaft line misalignment.

Today's vessel designs increasingly utilise shorter shaft lines with the engine(s) located further aft, thus allowing the hull to accommodate additional cargo. While this enables more cargo to be transported, it can also give rise to a new set of problems.

With heavier and more efficient propellers now being used, the shorter shaft line has a greater tendency to bend, which not only compromises alignment, but can also cause serious damage to shaft line equipment. Ships are often running at slower speeds in order to save fuel, which creates a higher friction coefficient on the wearing parts and increases the likelihood of mechanical faults.

Other factors that can impact on shaft alignment and cause damage include how cargo is loaded; changes in speed and rpm; engine de-rating; shallow water running; installation of a new propeller; switching to EAL lubricating oil; and hull deflection.

Hull deflection occurs as a result of stress placed on the structure of a vessel's hull, which in turn compromises the capabilities of the bearings in supporting the propulsion shaft. One major cause of stress is loading conditions and ballasting arrangements. It is increasingly apparent that, with recent ship design, modern hulls are more flexible and more prone to bending.

This makes alignment of utmost importance to propulsion performance and equipment lifecycle. In the likelihood of serious shaft line equipment damage, significant costs may be incurred by repercussions of withdrawing a vessel from service for repairs.

Conventional **methods**

— Traditional methods of alignment are no longer up to standard requirements.

Generally, ships are designed to meet specific operational requirements. The necessary calculations for the design are made based, for the most part, on data supplied by the equipment manufacturers, the owner's requested specifications, and on experience.

A ship may last for decades, during which ownership might change along with operational profile and design requirements. Drastic structural and operational changes can engender shaft misalignment and lead to extensive bearing wear, leaking seals and even major breakdowns.

Until now, the traditional and conventional way of checking the shaft line alignment has been by static checks. This involves checking the bearing loads and using piano wire or laser beams to determine the line of sight among the relevant points. Because of the limited accuracy the available tools have been able to provide, root cause investigations of misalignments have often been based on the visual inspection of parts after a failure has occurred. Such investigations have, not surprisingly, frequently resulted in inconclusive or incorrect assumptions.

Static alignment measurements can, at best, only give a view of the static shaft. They cannot, therefore, measure the different forces impacting the shaft during 'real-life' day-to-day operations. Nor can they indicate at all the various operational effects on the hull. For true accuracy in detecting any vertical or horizontal misalignment, and to know exactly how the equipment is performing under daily operating conditions, modern dynamic measuring is necessary.

Wärtsilä Portable Condition Based Monitoring System

Real life measurements for determining true alignment.

To overcome the shortcomings of inadequate measuring tools and practices, Wärtsilä has developed the Portable Condition Based Monitoring (PCBM) System. This offers a dynamic approach to measuring tail shaft alignment using state-of-the-art technology. It delivers detailed root cause information on vibration levels, temperatures, shaft runout, whirling, movement, torque, stress, and equipment positioning. These parameters are set in real-time operating conditions.

By comprehensively measuring the set parameters, the PCBM System is able to ensure that investigational conclusions are based on substantiated facts derived from the entire shaft line assembly. These measurements are all stored in the system's data logger and can be extracted at any time.

The installation of the equipment can be performed by a single service engineer and data logging is carried out while the ship is in operation, with no downtime being imposed. Installation can be carried out while the ship is in port and the data collected for analysis at the next port-of-call.

Measurements are carried out using class-approved methodology. In addition analysis is made by senior technical specialists in accordance with classification society requirements. The reporting procedure provides a record of the measurements along with a proposal for the corrective actions.

Wärtsilä Portable Condition Based Monitoring (PCBM) System

Are you well aligned?

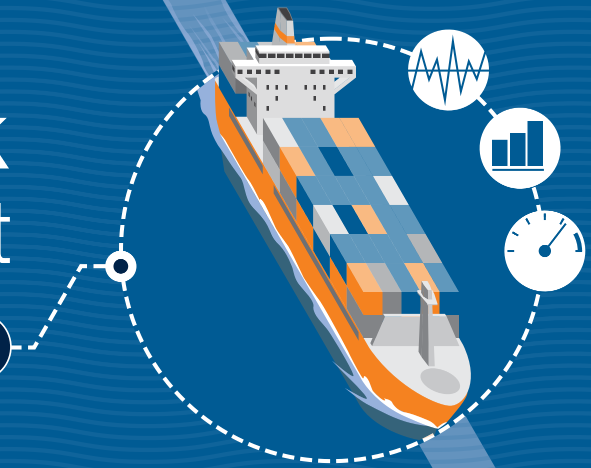
Find out in just one journey

1 Quickly install the PCBM system whilst preparing for your next voyage.

Wärtsilä PCBM — Real life measurements to determine true alignment

A state of the art portable system that accurately measures and records real dynamic data to determine the true alignment of equipment during actual operating conditions.

2 When your vessel sets sail, the PCBM system collects dynamic data.



Alignment Health Check from port to port

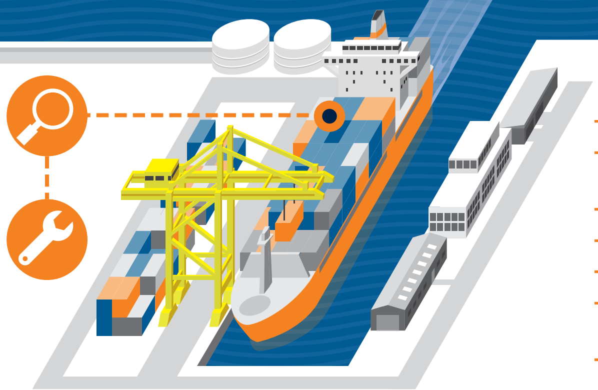
Applicable to all shaft line systems. Investigating alignment by measuring:

- Vibration levels
- Temperature
- Runout
- Whirling
- Positions and movement
- Stress and strain

3 Next time the vessel comes into port, the data is downloaded and the PCBM system is removed with no interruption to you or your onward voyage.

Wärtsilä Shaft Line Solutions alignment experts analyse your data and present you with the results.

Let us give you the all clear!



Benefits

- Fast, flexible and affordable.
- Accurate real life measurements to determine true alignment in actual conditions.
- Reduce the risk of failures and breakdowns.
- Printouts and live visual displays provided.
- Increases component lifetimes.
- Increases vessel up time, operating time and productivity.
- Peace of mind.

Pre-warnings of possible breakdowns

— Indications earlier than ever before.

As indicated earlier in this paper, in addition to negatively impacting propulsion efficiency, shaft line misalignment can result in equipment damage and lead to serious breakdown. Typical warning signs include:

- leaking seals;
- high bearing temperatures;
- excessive vibration;
- extensive wear to parts;
- contaminated oil; and
- ingress of water to the system.

Such symptoms should be taken seriously. Often, fairly minor adjustments can resolve the issue, but failure to act could result in major problems.

Identifying a failure

— Wärtsilä PCBM System monitors performance and we provide accurate feedback, so you're always ready for operation.

A typical incidence of a fault being identified through the use of the Wärtsilä PCBM System would be the following hypothetical case:

Issue: A new stern tube seal is found to be leaking

Detection: By using the data produced by a Wärtsilä PCBM System, analysts can determine whether there is significant runout on the propeller shaft, which is causing high levels of vibration.

Cause: Analysis identifies the cause of the runout as being misaligned shaft line bearings.

Remedy: With the shaft re-aligned and the stern tube lip seals replaced, the cause of the problem is fixed and the seals are back to full functionality.

Conclusion: By measuring the tail shaft system under actual operating conditions, the Wärtsilä PCBM System was able to quickly identify the reason for the leaking seal, thereby enabling repairwork to be carried out to prevent problems from becoming bigger ones. A conventional static alignment check would have taken much longer and may have mis-diagnosed the problem.

Note: On rotating machinery, runout is defined as the degree to which a shaft or coupling deviates from true circular rotation. Every shaft or coupling has a center of rotation, or centerline. Any stray from concentricity is considered runout.

Summary

Wärtsilä Shaft Line Solutions alignment experts analyse your data and present you with the results.

Full propulsion efficiency is essential for ships to achieve optimal operational costs, and to provide reliability, safety and onboard comfort. Such efficiency cannot be gained if there is misalignment of the shaft line equipment. Modern ship design, emphasising shorter shaft lines and often heavier, more efficient, propellers increases the challenge to maintain full alignment. However, whether the measurement service is for a modern vessel with a shorter shaft, or for an older ship with a more traditional length of shaft, full alignment is essential for efficient operation.

To enable a vessel to run at a consistently efficient level throughout its lifecycle, maintenance at all levels is required. This includes repairs and overhauls of the engines, regular inspection of the navigation system and other onboard equipment, and not least, shaft line alignment checks.

The conventional static method of checking alignment can be time-consuming and costly, can interrupt a ship's sailing schedule and cannot always be relied upon to deliver accurate assessments. In contrast, Wärtsilä's Portable Condition-based Monitoring System dynamically detects faulty alignment, provides highly accurate data on the full assembly and determines precisely the working condition of the equipment.

The portability aspect of the Wärtsilä system means that the PCBM can be quickly and easily installed and removed. It requires no vessel downtime as it carries out the measurements whilst the ship is in normal operation.

This innovative system provides a solution for achieving accurate measurements and full tail shaft alignment. The data produced is analysed by highly qualified specialists who then deliver a full report with any necessary recommendations. The Wärtsilä PCBM System is a tool that brings shaft line alignment checks into the modern era.

An industry leader in shaft line components Wärtsilä Shaft Line Solutions delivers a portfolio of end-to-end services and integrated solutions for the marine markets that builds on our core values: lifecycle efficiency, risk reduction, environmental leadership and design excellence. As an original equipment manufacturer operating in 75 countries, we have the capabilities to support customers on a global scale, and remain committed to providing in-country and round-the-clock expertise.

wartsila.com/shaft-line-solutions

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