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Vibration, poor performance and high fuel use can all be signs of problems with misalignment

Engineer's Angle
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No matter how diligent you are with your maintenance plan, almost all captains or crew will experience misalignment at one point or another. Misalignment presents itself in a multitude of ways, including vibration, loss of performance and increased fuel consumption.

In more serious cases, it also accounts for premature wear of shaft line components such as seals and bearings, and, if severe enough, mechanical outages or failures.

When applying alignment to marine applications, it's usually the engines or drivelines that are being referenced. Shaft alignment is defined as the positioning of two or more machines so that at the point of power transfer from one shaft to another, the axes of rotation should be collinear when the machine is running under normal conditions.

However, not all misalignment is the same. Misalignment falls under two main categories: parallel and angular misalignment.

With parallel misalignment, misalignment can be present in the vertical or horizontal planes.

Angular misalignment is a combination of vertical and horizontal misalignment.

There are several things that can cause shaft misalignment. Aging, worn, or incorrectly installed engine mounts is a common cause.

The rubber elements in engine mounts typically end their life cycle after 10 years.

This has nothing to do with operating hours, and more to do with the properties of the rubber which degrade over time and harden, making them lose their ability to properly isolate the forces from the engine.

The forces for the engine are also not properly isolated when they are incorrectly installed, or the incorrect mounts are used for the application at hand.

When not addressed, improper support of the engine will cause it to shift, which will jeopardize the running gear.

Suffering a grounding is another cause of misalignment. Even getting some line tangled in a propeller can shift the struts, causing them to become misaligned.

Other causes of misalignment include the changing of the hull shape (hull deflection), which is why pre- and post-hull deflection measurements are crucial for proper alignments. In this case, a final laser alignment check should be done once the vessel has been waterborne, and has had a chance to settle 24 hours.

Hull deflection is often overlooked during the build process, which can cause misalignment from the beginning of the vessel's life.

Since misalignment is a major source of vibration, the most accurate, efficient, and economic way to diagnose misalignment, is by way of a vibration analysis.

Vibration analysis identifies what mechanical issues a vessel is having and eliminates the guesswork that way

MISALIGNMENT, on back

What causes vibration?

- **Misalignment of shaft couplings, flexible machine couplings**
- **Misalignment of underwater running gear such as propeller struts**
- **Propeller defects**
- **Bent shafts**
- **Unbalance of rotating components**
- **Main engine misfire problems**
- **Mechanical looseness**
- **Deterioration of rolling-element bearings within transmissions and thrust bearings**
- **Gear tooth wear**
- **Mechanical rubbing**
- **Structural resonance**
- **Machinery soft-foot conditions**

Prevent misalignment with regular checks

MISALIGNMENT, from front

too often comes into play with repair services.

More specifically, it can determine exactly where the misalignment is. When the collected data is analyzed by an experienced professional, many problems can be diagnosed, including:

- Misalignment of shaft couplings, flexible machine couplings.
- Misalignment of underwater running gear such as propeller struts
- Propeller defects
- Bent shafts
- Unbalance of rotating components
- Main engine misfire problems
- Mechanical looseness
- Deterioration of rolling-element bearings within transmissions and thrust bearings
- Gear tooth wear
- Mechanical rubbing
- Structural resonance
- Machinery soft-foot conditions

Another way to diagnose misalignment is by conducting periodic alignment checks.

In accordance with good marine practice, alignment should be checked six months to a year after a new installation; when experiencing a shaft seal or bearing failure; or, when a bearing is replaced.

Once the data from a vibration analysis or laser check is analyzed, a proper course of action can be implemented, which, includes, an alignment procedure based on the mechanical arrangement of the components involved in the misalignment, as well as the specific issue at hand.

Generally speaking, misalignments are corrected with either laser and/or optical alignments.

Optical alignments are performed using optical borescopes, and must be done out of the water when the running gear has been removed.

Laser alignment is the process of measuring misalignment between mechanical components, usually one or more shafts. It is a precise way to align machinery while minimizing the likelihood of human error.

It uses laser beam transmitters and receivers to attain alignment within extremely high tolerances. Misalignment, regardless of its origin, can cause rapid wear on bearings, damage shafts requiring them to be repaired, and, in more extreme cases, replaced.

Extreme vibration can cause increased damage to engine mounts, and the reduction gears, sometimes even causing failure. Shaft sealing systems can also become damaged, and need to be replaced.

When machinery is correctly aligned, a 1 to 3 percent increase in energy efficiency can be achieved.

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