good VIBRATIONS

VIBRATION ANALYSIS CAN BE AN ESSENTIAL TOOL FOR PREDICTING EQUIPMENT FAILURE AND INCREASING VESSEL EFFICIENCY.

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VIBRATION OFTEN IS TRIVIALIZED as a cosmetic issue, an annoyance that the owner and guests complain about. In reality, vibration is a symptom of more serious mechanical issues or it's a precursor to a problem that could cause debilitating downtime. It also means you're wasting a lot of money on fuel and pumping unnecessary CO_2 into the atmosphere.

Unless you've been living under a rock for the past few years, you're well aware that green is the new black. In yachting, being "green" means more than money or being earth friendly, it means your machinery is always running as efficiently as possible and you always have solutions to optimize its performance.

One of the best ways to gauge how efficiently you're operating is simply by listening. Vibration, by definition, refers to mechanical oscillations in relation to a set point of equilibrium. It's usually classified as aggravating noise and a waste of energy. These undesirable vibrations are most commonly caused by things such as misalignment, imbalances and uneven wear of mechanical parts. Vibration analysis is used to detect the early precursors to machine failure, allowing machinery to be repaired or replaced before an expensive failure occurs. All rotating equipment vibrates to some degree, but as older bearings and components reach the end of their product life, they begin to vibrate more dramatically and in distinct ways. Vibration analysis can cut out the guesswork of choosing what repairs should be made. All in all, implementing a simple maintenance program that includes annual vibration analysis after an initial baseline survey will reduce your vessel's carbon footprint while saving you money and downtime headaches.

The process of vibration analysis has been used to monitor machinery since the 1950s. Those initial meters are quite primitive compared to today's portable, computerized models. But the same basic principles still apply.

Ideally, it's best to begin vibration analysis when the boat is new or just being sold. This initial survey can provide baseline data for acceptance testing and provide quick and easy diagnosis of future problems. If this initial survey is not done, you can still reap plenty of benefits from doing vibration surveys later in your vessel's life. For instance, periodic vibration monitoring provides trending that can forecast unplanned downtime and catastrophic failures.

Vibration analysts will record data in the marine environment by placing sensors on machinery as well as the hull and structure. The data collected can pinpoint the cause of faults before expensive stays at a shipyard are scheduled. This data provides a thorough machine condition evaluation and, using known frequencies specific to the vessel, can detect a multitude of problems, such as:

- Misalignment of shaft couplings, flexible machine couplings
- Misalignment of underwater running gear such as propeller struts
- Propeller defects
- Shaft bends
- Unbalance of rotating components
- Main engine misfire problems
- Looseness
- Deterioration of rolling-element bearings within transmissions and thrust bearings
- Gear wear
- Rubbing
- Resonance
- Machinery soft-foot conditions

Analysts should readily provide you with a full written report with detailed findings, conclusions and recommendations to remedy any defects or possible issues. Ongoing monitoring of machinery will keep these signs of wear and damage easily identifiable well before the damage becomes an expensive problem. The development of any new vibrations would signify wear at very early stages.

Misalignment is often the cause of vibration. Shaft couplings, flexible machine couplings, running gear and struts are some mechanical components that frequently become misaligned. The most efficient and economical way to correct misalignment is through laser alignment. Optical alignment often is used in conjunction with the laser for "rough" alignment for optimal results. Nearly all yachts will have to deal with some form of misalignment during their life span. Misalignment causes an increase in energy cost and creates an increase in vibration that will shorten the life of the affected machinery. It's also linked to repetitive shaft seal failure, repetitive motor bearing failure and coupling damage. Additionally, misalignment can take a huge toll on engine mounts.

Today's lasers have come a long way from their early predecessor, the piano wire. Some old school mariners may refer to the piano wire as old faithful, but the reality is there is no comparison to today's industry leading laser, the Rotalign Ultra. This laser is so precise, it can align to tolerances of one 1,000th of a millimeter. This is done with incredible ease in only minutes. With lasers, sag is never a concern. When skillfully implemented, laser technology reduces the possibility of error by limiting the human element to only the setup. This allows technicians to concentrate on interpreting readings and developing solutions rather than focusing on tasks easily taken over by the computer.



Today's portable laser systems are compact, lightweight and computerized, making laser alignment that much more economical and efficient.

Precision alignment extends the life of machinery and markedly improves its quality of operations by reducing the energy required to overcome the misalignment condition and provide drive for the bearings under extra load. Laser and optical alignment programs administered by qualified service technicians and engineers will greatly improve the productivity of machinery by increasing efficiency and preventing premature failure. Proper precision alignment has been shown to prevent engine overloading, increase fuel efficiency and avoid excessive wear on bearings. The result is a smoother, quieter and more efficiently running machine. Routine alignment checks should be scheduled periodically in your maintenance program along with vibration analysis to help ensure longer machine operation with greater reliability. With reduction in repairs, downtime and outages, your equipment will provide a better return on your investment.

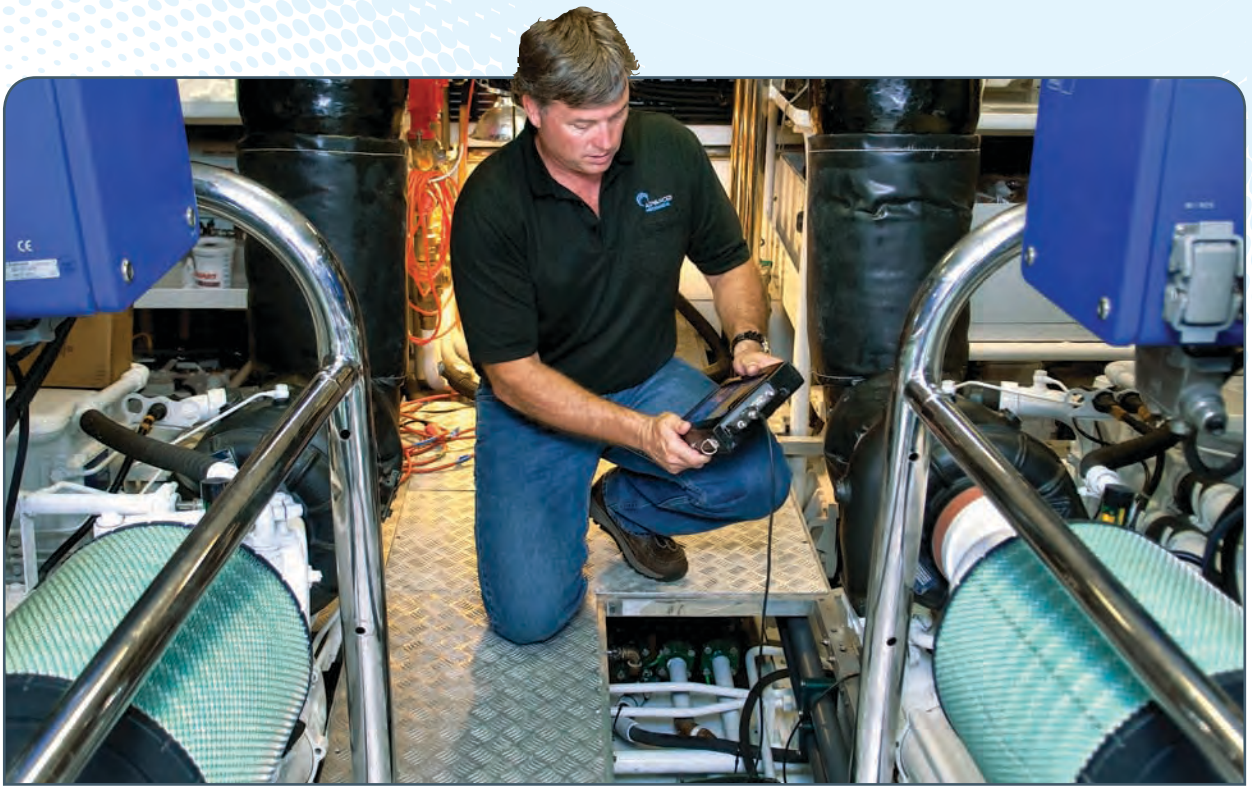
The chart below demonstrates how misalignment can accelerate the wear of machinery components.

ESTIMATED MACHINERY FAILURE TIME DUE TO MISALIGNMENT

Misalignment (mil/inch)	Estimated time to failure
0.2	250 months
1	60 months
5	10 months
10	6 months
50	2 months
100	0.6 months

NOTE:

- Misalignment is mil/inch (Milradian)
- Six inches of distance between shafts and 0.2 mil/inch tolerance is equal to 1.2/1000" of offset at the center of the shafts.



Vibration analysis performed on a yacht during a sea trial can provide valuable data that can specifically diagnose where your machinery needs attention before it experiences a catastrophic failure.

The establishment and implementation of ongoing maintenance programs is one of the best things you can do to extend the life of your vessel's machinery. Vibration analysis and laser alignment are cost effective services that pay for themselves time and time again by helping to avoid expensive catastrophic failures that would otherwise go undetected.

Saving the Environment

Besides being good to your wallet, vibration analysis and laser alignment also are environmentally friendly. Misalignment causes extra load on bearings and on gear teeth, which causes extra heat to be generated from prime movers, i.e. motors, which in turn make the machine draw more current. Reciprocating engines use more fuel and are harder for components to overcome the misalignment condition, thus using more fuel to function. The more fuel being used, the more carbon emissions you're responsible for. Through precision alignment, it's been noted that a one to three percent reduction in energy consumption can be achieved.

You need to be aware of your vessel's carbon output so you can see where changes can be made or, if changes were already implemented, you can measure how effective they are. Most yacht manufacturers readily provide specs and statistics regarding the amount of fuel their boats burn per hour. Simply multiply the amount of fuel burned in an hour by the amount of hours you cruise. You can easily figure out what your vessel's carbon emissions are — they directly correlate to the amount of fuel that's burned by the motor. It's generally accepted that burning a gallon of gasoline produces 19.564 pounds of carbon dioxide, so multiplying the two figures will give you a good idea of what your vessel is expelling into the environment. Keep in mind, this number is probably significantly higher if the yacht is not running at peak performance…again, a good indicator of this? Vibration.

This number means a lot, especially when you consider that a gallon of gasoline weighs only 6.3 pounds. The output is a direct result of the burning process that introduces fuel to oxygen at many times its weight. Emissions such as these have been scientifically linked to global warming and climate change. You should know what your emissions are before and after vibration analysis and laser alignment are performed to see what type of return you're getting on your investment.

When your machinery is in good running order, it's running at optimum efficiency. Your vessel's running at top speeds while burning less fuel. Less fuel means a smaller fuel bill (and fewer carbon emissions). Likewise, when machinery undergoes continuous preventative and predictive maintenance, you stop wasting money on unnecessary repairs and, of course, downtime. Keep an eye (and ear) on your machinery and you'll stay on track with manageable maintenance and you'll simultaneously help the environment. ***DW***

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