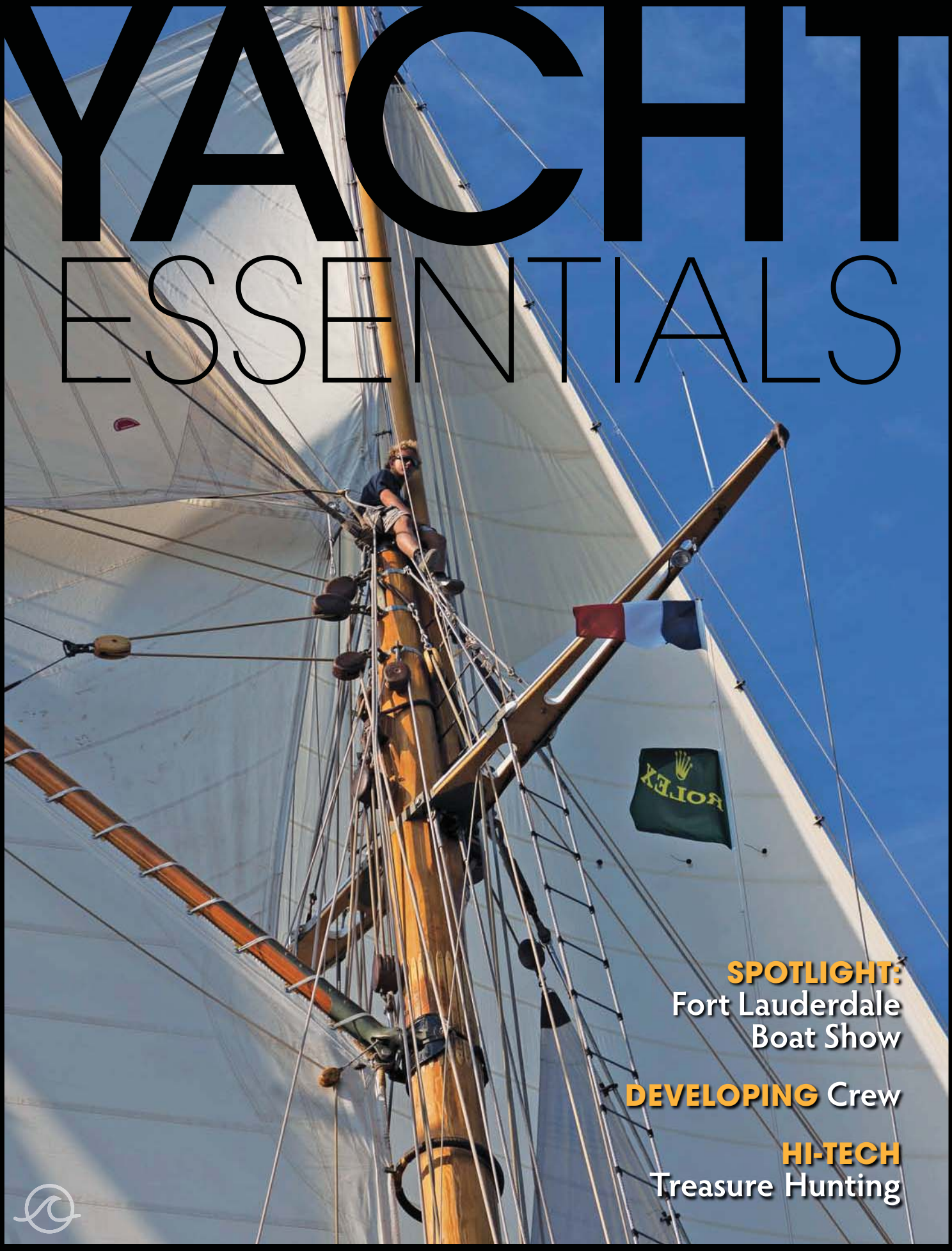
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ROLEX

VIBRATION ANALYSIS

Engineer's Corner

BY GLENN HAYES

Is there a vibration or shudder aboard that you just can't figure out? Frustrated with persisting noise that you just can't get rid of? Is there a piece of running gear or equipment that is about to fail, and if so, do you know about it? The growing field of vibration analysis can tell you all you need to know with the help of someone who speaks their language and can analyze them, helping you identify problems before it's too late.

Vibration in machinery and equipment can often be the earliest sign of trouble. Vibrations can come from many sources, including structural issues, running gear, engines and engine mounts, generators, trim tabs, harmonics, exhausts, and other equipment or hardware. Using vibration analysis can help cut maintenance costs, reduce vessel downtime due to costly repairs and avoid catastrophic damage. By carefully measuring the kind of vibration and



Vibration in machinery and equipment can often be the earliest sign of trouble.

the changes in vibration, early detection of all kinds of issues related to yachts and machinery can be diagnosed and pinpointed prior to the equipment failing.

Sure, there are many other test methods available, but vibration analysis can detect a wide variety of issues such as equipment out of balance, misalignment, bearing damage, gear failure, mechanical looseness or rubbing, cracking, leaking valve seats, and the cause of noises and harmonics. Initially used to make submarines stealthier, it was found that by reducing vibration there was also a reduction in maintenance. In some cases, the reduction in costs was up to a factor of seven.

Now commonly used in the upkeep of industrial plant equipment, vibration analysis is gaining in popularity as a valuable diagnosis tool in the yachting and maritime industry and has been proven to reduce maintenance costs drastically. Its accuracy in determining and pinpointing specific issues is proving to be a cost effective and worthwhile undertaking.

To truly understand how vibration analysis works, you must first understand the different kinds of vibration found on a vessel and, in turn, comprehend how they can reveal important information. "The simplest definition of vibration is movement about a reference," said Jeff Fridges of True Phase in Spring Valley, California.

Free vibration occurs when a force is applied and then the device is allowed to vibrate until it stops doing so. Ringing a bell would be an example. The ringer (the applied force) strikes the bell, and the bell vibrates until it stops on its own. Another example of free vibration occurs when a motor is turned on and vibrates on its own (mechanical vibration).





John Fridges of True Phase





Rich Merhige of Advanced Mechanical Enterprises

Vibration analysis and its discoveries lead to many success stories.

Forced vibration is when an alternate force is applied to a mechanical system. Ever had a washing machine try to shake itself apart when the load shifted to one side in the spin cycle? That's forced vibration. Felt a building shake in an earthquake? Again, forced vibration. Vibration can also be explained as whole body motion where the body or object is rigid and its center of gravity moves as a whole rigid mass. It can also be described as a pressure wave vibration. In this case, the body is not rigid and the vibration waves move through the body rather than moving the body itself.

Instruments can record the amount of vibration, known as amplitude, as well as the frequency of the vibration. Measurements can in addition can be taken to determine the phase of a vibration (the shift in the sine wave). All three of these parts of a vibration are specific to the item that produced them. A bearing can produce a vibration with a certain set of parameters at one speed, but that vibration can change as the speed changes. With the right equipment, the vibration the bearing gives off as it starts to fail can be differentiated from the range of vibrations it produces when operating normally. This will warn of an impending failure, and repairs can be done prior to an all-out failure.

Companies such as True Phase or Advanced Mechanical Enterprises (AME) of Ft. Lauderdale have experts standing by with the latest test and analysis equipment, along with huge analysis software databases that can pinpoint vibration issues and their causes. These specialists can come aboard your vessel with a minimal amount of equipment and unobtrusively analyze vibration, in some cases without leaving the dock.

The average time involved in collecting data for a vibration analysis be two to four hours dock to dock, according to Rich Merhige of AME (with a caveat that vibration analysis by nature varies from job to job). Of course, there's a lot of information that needs to be gathered on the equipment being tested to be able to enter the right data into the software. Then, a methodical process of measurements takes place.

Tools to measure vibration vary, but some of the more sophisticated equipment, such as an accelerometer attached to a digital signal analyzer and spectrum analyzers, are able to monitor and detect multiple vibrations and their components and can differentiate them from one another. A trained professional can study the results of these readings and can isolate the problem. "The analysis [of the vibration] is just like a tracker looking for

footprints in the mud. If it's an animal with a broken toe, it's pretty obvious," said Fridges.

"We have never had a job where we couldn't figure out the issue," said Merhige. Fridges reported the same. Many times, analysis not only discovers one issue, but many, and it becomes the decision of the yacht owner as to which issues to correct and in what order.

Vibration analysis and its discoveries lead to many success stories. When asked for examples of successes, Merhige had no problem listing several recent analyses that provided accurate results that had previously stymied multiple attempts at repair, and found issues that were overlooked or hidden from view, such as insufficient motor mounts and incorrectly mounted equipment.

When Fridges was asked, one story he cited was the time when he "saved a boat." Discovery of a catastrophic failure was identified prior to the need of an engine replacement, which would require cutting a hole in the hull to remove the old engine, thus effectively destroying the value of the yacht. Early diagnosis led to a simple repair that extended the life of the engine indefinitely.

Both True Phase and Advanced Mechanical typically get calls when a vibration problem occurs. The majority of their calls may be from a referral from an equipment manufacturer or vessel crew, but both companies are surprised that they don't see more pre-purchase vibration surveys. They do recognize this, however, as a growing part of their business. The obvious advantages of identifying issues that might otherwise be missed make it a valuable and viable option for a prospective buyer.

The other area of future growth both companies have identified is vessels having an ongoing vibration analysis program. This would help identify issues more accurately and give a possible timeline of necessary repairs. In the future, these may even be done wirelessly and downloaded for analysis.

Glenn Hayes is a freelance photographer and writer living in West Central Florida. A second-generation professional photographer and journalist, he specializes in marine photography and writing. He can be reached at www.hayesstudios.com.



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