

## What's shakin' with your HVAC system?

### Application Note

#### Senior HVAC technician Ron Auvil checks out a chiller, a noisy pump, and a couple of shaky compressors with the Fluke 810 Vibration Tester

The new Fluke 810 Vibration Tester was designed to enable technicians with no training in vibration measurement and analysis to test pumps, motors, compressors, and other HVAC equipment and get both diagnoses and recommendations for required

action on the spot within just a few minutes. I took an 810 with me on recent visits to a couple of facilities with critical HVAC applications to learn how it works and to try it out under real-world conditions.



#### Beating bad bearings

My first stop was a late-night visit to the chilled water plant of a local hospital. A reliable supply of chilled water to cool the hospital's emergency rooms and data center is a big priority there, so they test the system along with the emergency backup generator every month. Before we shut down the system for testing, we did a walk-through and gave the primary chilled water pumps and other equipment a good visual inspection. While we were doing so, one of the hospital technicians told me that one of the 2,000-gallon-per-minute chilled water pumps seemed to be running a little loud. I agreed, but although an experienced ear is an important troubleshooting tool, this symptom was troublesome but not conclusive. This seemed like a great opportunity to try out the Fluke 810 for the first time.

It took me about ten minutes to read the 810's instruction manual and get set up. The first thing the 810 prompted me to do was to enter some basic information about the drive train setup, such as motor horsepower, RPM, and pump layout. I was able to get a lot of this information from the motor nameplate. To measure the running speed (RPMs), I plugged in the laser tachometer that comes with the 810 and pointed it at the motor shaft. It gave me a reading of 1,711 RPM, which was automatically entered into the 810.

After I finished entering the setup information, I attached the 810's vibration sensor while the hospital technician looked on so he would be able to do it in the future. There are two ways that you can attach the 810's three-axis vibration sensor. The first and easiest way is to use the sensor's powerful magnetic mounting. The other way is to

epoxy one of the metal mounting pads that come with the 810 onto the piece of machinery and attach the sensor to the pad. The second method provides the 810 with higher quality data, but the data collection takes a little longer. It's the preferred method for attaching the sensor to equipment that you plan to test regularly because once you have a pad attached, you can quickly attach the sensor in the exact same place the next time, making the process as quick, consistent, and accurate as possible.

Since this was our first experience using the Fluke 810, we decided to use the sensor's magnetic mount so we could get some readings without delay. The graphical display on the Fluke 810 showed us the two places where we should attach the sensor to the pump, which we did. After the sensor was attached, it took less than a minute to take a measurement. That was it! The Fluke 810's onboard diagnostics indicated on the color display that the pump bearings had high wear and recommended that we replace them. Since we were testing the equipment late at night during the minimum usage period (2 AM!), we scheduled the pump repair for the next

day. When it was time for the repair, the chilled water system was run on the backup pump while the bearings on the main pump were changed. The repair was a routine bearing replacement and went smoothly, which is exactly the kind of repair you want. If the primary pump had gone down, it might have caused the entire chiller plant to shut down, which could have caused overheating computers in the data center to shut down and the operating rooms to lose their cooling, which could be life-threatening.

### **Chiller commissioning**

During my visit, the hospital was in the process of adding a new 1,250-ton centrifugal chiller to its chiller rotation. When a new machine is being brought online, it's the ideal time to take baseline vibration measurements that you can compare against measurements that you take in the future. Getting good baseline measurements like this for the owner's records is an important step when setting up a centrifugal chiller control system.

I should mention that although we used the 810 Vibration Tester to take baseline vibration measurements, the 810 does not require baseline measurements to evaluate a piece of machinery.

Instead, the 810 makes a diagnosis by comparing the vibration measurements that you take against a "synthetic baseline" of vibration information for a machine similar to the one that you are testing. This synthetic baseline is part of the 810's onboard "expert system" that was developed by Fluke and a partner firm who developed its vibration expertise during many years of vibration analysis of industrial and military equipment.

Since we knew that we would be taking vibration readings on the new chiller again, we decided not to use the sensor's magnetic mount this time and instead to epoxy four of the mounting pads included with the 810 onto the chiller in the locations indicated in the 810's manual. After we entered the required information (horsepower from the motor nameplate, RPM, use of a variable speed drive, etc.), we attached the vibration sensor and took our readings. The 810 indicated that the new chiller was operating perfectly! Later we used the 810's USB port to transfer our vibration readings from the 810 to a computer for storage.

## **Common HVAC applications for vibration testers**

### **Air conditioning and cooling systems**

- Centrifugal chillers
- Reciprocating chillers
- Chilled water pumps
- Condenser water pumps
- Cooling tower fans
- Fans and pumps on variable speed systems

### **Air handlers**

- Supply fan motors
- Return fan motors
- Fan motors on variable speed systems

### **Heating systems**

- Hot water pumps
- Condensate pumps
- Makeup water pumps
- Pumps on variable speed systems

### **Product refrigeration**

- Refrigerant pumps
- Screw chillers
- Motors on variable speed systems

**A vibration tester even an expert can love**

One of my favorite sites to visit is a large arena that is home to an NBA team and both professional and college hockey teams. The site also regularly hosts ice skating shows and competitions. Several large reciprocating compressors are used to make the ice for these events. (Interestingly, the ice used for hockey is kept at a different temperature than the ice used for figure skating. The ice temperature for both, however, is kept to tight tolerances, and before an event starts, compliance is verified by officials using a Fluke infrared thermometer.)

When we visited the rink, its cooling system was being checked in preparation for the busy season ahead. As part of the equipment overhaul and checkout, we decided use the Fluke 810 Vibration Tester to perform a thorough vibration test on the ice system reciprocating compressors. Since I knew we would want to check the equipment again in the future, we epoxied the provided mounting pads onto the proper locations on the compressors.

We decided to check the pump first. On pump startup, we used the 810's laser tachometer to measure the motor RPMs and enter the other required data with the keypad, and then took our vibration measurements. Next we did the same for the reciprocating compressors.

Although the Fluke 810 Vibration Tester was developed for people with no vibration measurement experience, it also has features that people with vibration expertise will

appreciate. For example, the 810 generates a graph of the vibration spectra that you can examine right on its color screen. (You can also download the vibration data from the 810 to a computer and examine it with the included Viewer PC software.) This enables vibration consultants and others with vibration expertise to evaluate vibration data visually. Doing so, we were able to see a truncated waveform for the piston stroke and top dead center timing at the end of the stroke on one of the compressors. Experience indicated that this was caused by some looseness in rod end bearings. We repaired these and then rechecked. All was well!

When we tested a second, identical compressor, the 810 indicated some structural looseness. When we re-torqued the hold-down bolts and rechecked with the 810, the vibration problem had disappeared.

By measuring and evaluating the vibration data for these two machines with the Fluke 810, we were able to detect and correct problems that could have caused real problems.

**Something for everyone**

You don't have to be a pro to appreciate the Fluke 810 Vibration Tester, because the expertise is built into the device. We were able to read the manual, attach the sensor, enter the required information, and get understandable and useful diagnostic information within minutes of opening the box. By just following the prompts that appear on the screen you can start saving thousands of dollars in reduced downtime and emergency maintenance.



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Printed in U.S.A. 10/2010 3941896B A-EN-N

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