June 2016

ASK THE EXPERTS: The Characteristics and Applications of the Ultrasonic Sensor (Part 1 – Compressors)

QUESTION: I recently had start-up assistance training on my Windrock analyzer. What are some of the best practices in regards to the ultrasonic sensor?

There are two main ways to utilize an ultrasonic sensor: collecting crank angle based vibration traces and listening to the signal with a set of frequency reducing audible headphones. By implementing these tools, down time can be reduced and the effectiveness of an overhaul maximized. This can be done by optimizing the time spent on a machine to identify known problem areas or replace and adjust only the deficient parts.

Ultrasonic testing of compressor and engine cylinders is an informative preventative maintenance practice. On compressors, ultrasonic readings can show problems such as leaking valves and valve opening/closing deficiencies.

Figure 1

The Windrock A6050-04-00 Ultrasonic Sensor (Figure 1) has a few key components that make it operate. Most importantly would be the piezoelectric microphone. This style microphone has a peak working range from 35 KHz – 45 KHz. Next is the rubber tip which blocks out surrounding noise, making it possible to isolate key signals being produced inside the unit and reference it to crank angle. Lastly, there is a gain adjustment knob for the sensitivity of the microphone. This is important in minimizing the floor noise in your ultrasonic traces as well as to avoid clipping on loud events.

The most important technique to follow when taking ultrasonic readings is to ensure there is an excellent seal between the rubber tip and the surface of the machine. Be sure to keep the probe body away from near-by objects, which can produce false ultrasonic activity in the trace. Also, PAY ATTENTION while collecting data to ensure the best results, and never adjust the gain in the middle of a collection route. The gain setting (Figure 2) on the ultrasonic sensor will be set between 2 and 9 while using the analyzer. However, while using the headphones and battery pack, most often the gain setting is near 2.

Gain Adjustment

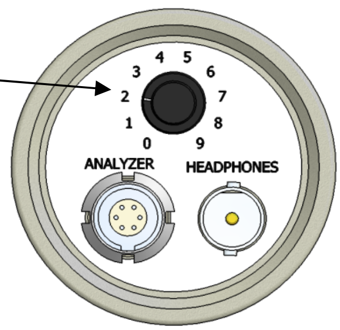

Figure 2

Table 1 describes some of the common faults identified with the ultrasonic sensor. Note there are two ways to use the ultrasonic sensor in "Stand Alone" mode. One is using the analyzer in conjunction with "Direct Channel Read" and the other is by using the headphones and battery pack. In "Stand Alone" mode, crank angle based data cannot be seen or stored.

External Leak Identification

Process line and vessel gasket leaks
Pneumatic control supply and shutdowns
Valve caps
Pocket stems
Unloader stems
Rod packing and packing gland gasket leaks

Internal Leakage Identification (Stand Alone)

By-pass valves
Relief valves
Compressor valves

Internal Leakage Identification & Mechanical Condition Indication (Crank Angle Related)

Ring blow-by
Liner scruffing
Compressor valve leakage
Compressor valve spring and lift deficiencies

Table 1

1832 MIDPARK DRIVE, SUITE 102 ● KNOXVILLE, TN 37921
PHONE 865-330-1100 ● FAX 865-330-1101● E-MAIL WINDROCK@WINDROCK.COM

On a compressor, ultrasonic readings are most useful in detecting faulty suction and discharge valves, along with leaking rings and packing. In order to find bad valves, first one must know how to translate what the trace is saying. Most causes of bad traces come from improper gain adjustment or a faulty seal of the rubber tip and the machine as shown in Figure 3. Good data collection technique is the first step in quality, actionable data analysis.

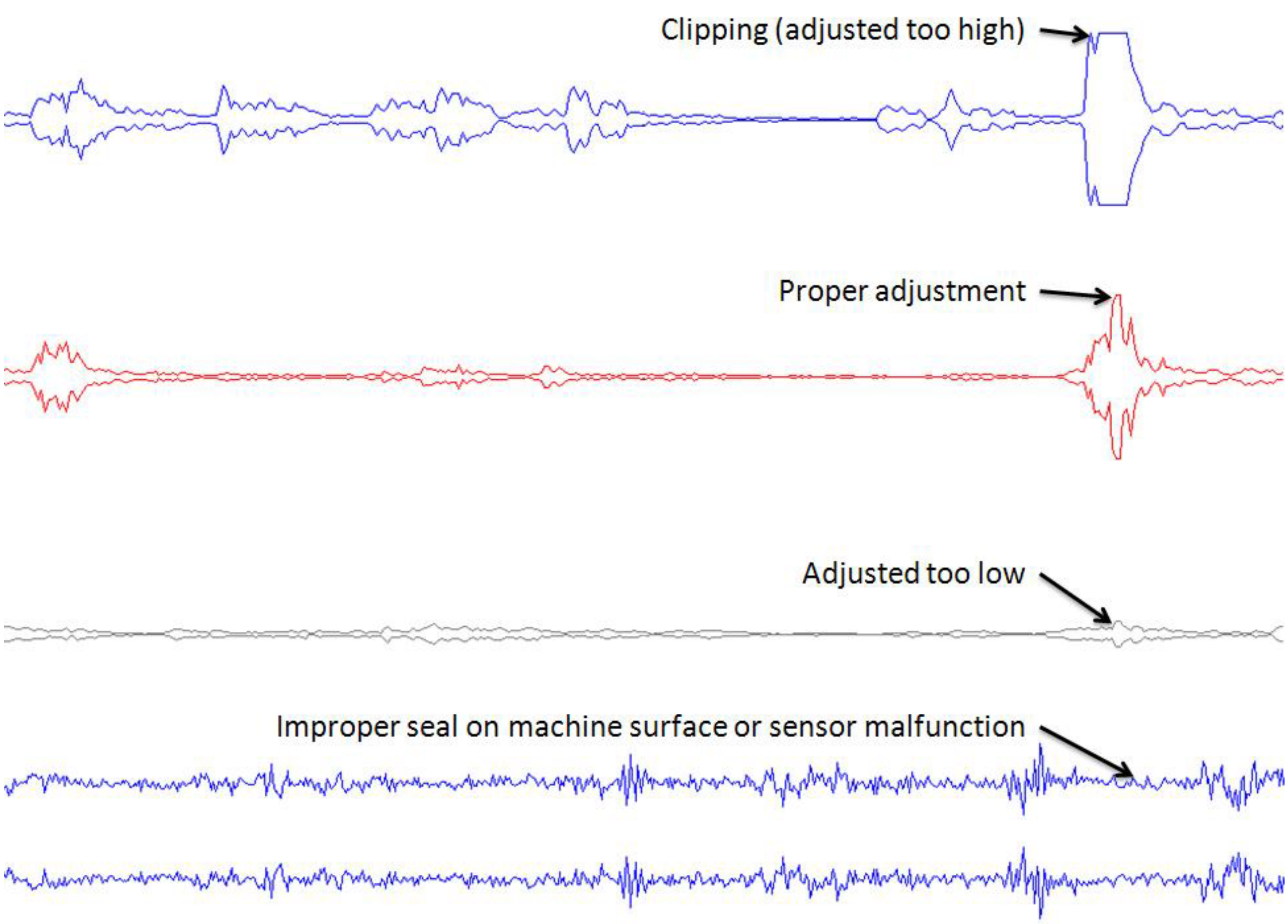

Figure 3

When taking ultrasonic data on compressor valves, it is recommended that the reading be taken in the radial direction as shown in Figure 4. Taking the reading in this way will ensure consistency from analysis to analysis. This is very important for trending purposes as well as identifying bad valves. Using the ultrasonic valve traces in conjunction with Pressure Volume plots (PV cards), Leak Index and the valve cap temperatures gives a higher success rate when identifying bad valves.

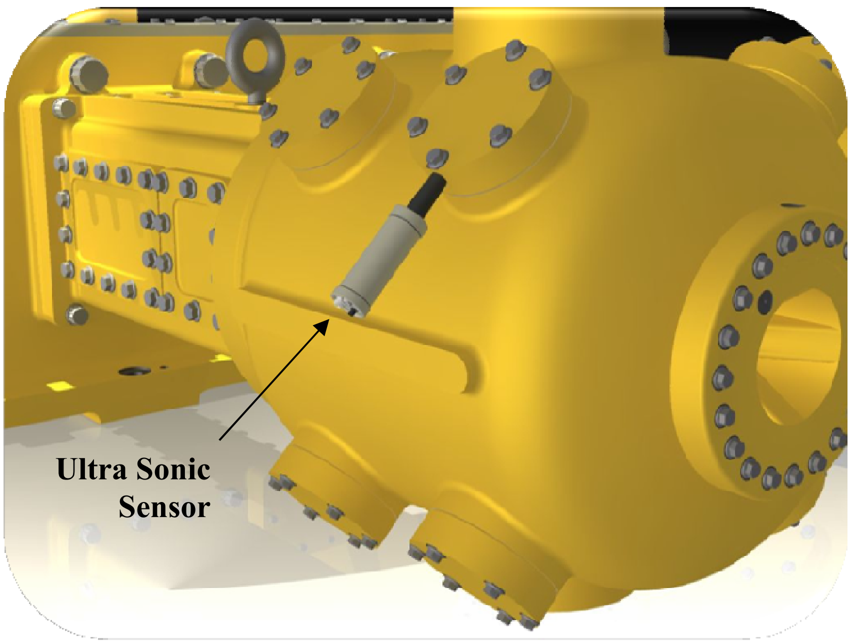

Figure 4

Figure 5 is an example of the difference between a leaking valve to a healthy valve on the Crank End (CE) of the cylinder. A "football" shape in your trace is a sure sign of valve leakage. A good seal with the valve cap and proper gain adjustment are essential.

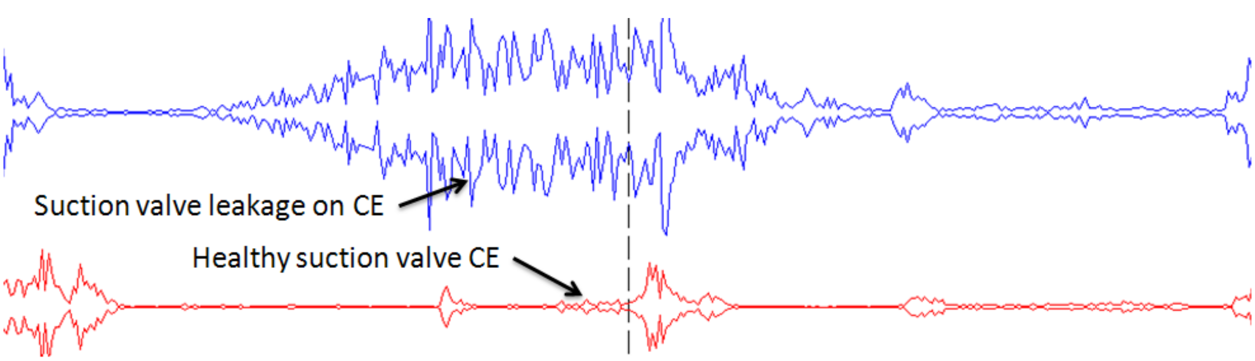

Figure 5

There are many applications for ultrasonic sensors and when used properly, it minimizes downtime and saves both time and money. When compared to an accelerometer, the ultrasonic sensor picks up high frequency air leaks that are outside of the accelerometer's frequency range. On a compressor, ultrasonic traces are a key component to identify in-cylinder leakage, such as bad suction or discharge valves. While using the headset, detection of packing, flange, and leaks to atmosphere are possible while singling out the origin of the noise. This means that it is also possible to quickly spot check points near a suspected problem source.

In the August 2016 newsletter, we will cover Part 2 of this topic. It will discuss the application of utilizing an ultrasonic sensor on engines.

If you have additional questions about the ultrasonic sensor or would like more information about other topics, please email **sales@windrock.com**.