Vibration Comparison of Scroll & Rotary vs. Reciprocating Technology

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Abstract

Compressor vibration is a source of noise and reliability problems if proper care is not taken in the condensing unit design to compensate for the vibration levels. Compressor vibration can be transmitted through the condensing unit base plate or tubes to generate noise. Vibration can also cause tubes to break if not properly designed. The manufacturers of scroll compressors market them as having lower vibration than reciprocating compressors. This study compares the vibration levels of two scroll compressors, a rotary compressor, and a reciprocating compressor.

Background

Scroll and rotary compressors both use compression mechanisms that orbit about the axis of rotation. These mechanisms can be both statically and dynamically balanced to cancel vibration, whereas a reciprocating mechanism cannot. This fact has been used to claim that scroll and rotary compressors have lower vibration levels than reciprocation compressors. However, the Oldham coupling in scrolls and the vanes in rotaries are reciprocating mass that cannot be fully balanced. In addition, the effects of the compression process are difficult to eliminate. These effects can, for example, introduce tangential vibrations due to the varying torque produced by the motor.

Reciprocating compressors are mounted internally on springs and use a discharge shock loop to isolate vibrations from the housing. Scroll and rotary compressors are rigidly attached to their housings so they transmit all vibrations to the condensing unit.

Compression Technology Effect

So, how do the different compressor technologies compare in actual practice? Scroll compressors from two different manufacturers, a rotary compressor, and a reciprocating compressor were tested to compare vibration levels. All the compressors were 2 Ton capacity. Vibration was measured in three axes (tangential, radial, vertical) at the mounting feet and suction and discharge tubes. Each compressor was tested at 20 different conditions across the operating envelope. The saturated evaporating temperatures ranged from -10 °F to 55 °F. The saturated condensing temperatures ranged from 80 °F to 140 °F. A few tests were repeated on each sample to ensure the testing was repeatable.

For ease of comparison, the highest vibration levels for each location and condition were compared across the samples. An average was then found for each location. Figure 1 compares the average vibration level of the 20 points between the four samples. Clearly, the reciprocating machine had lower average vibration levels than the other samples.

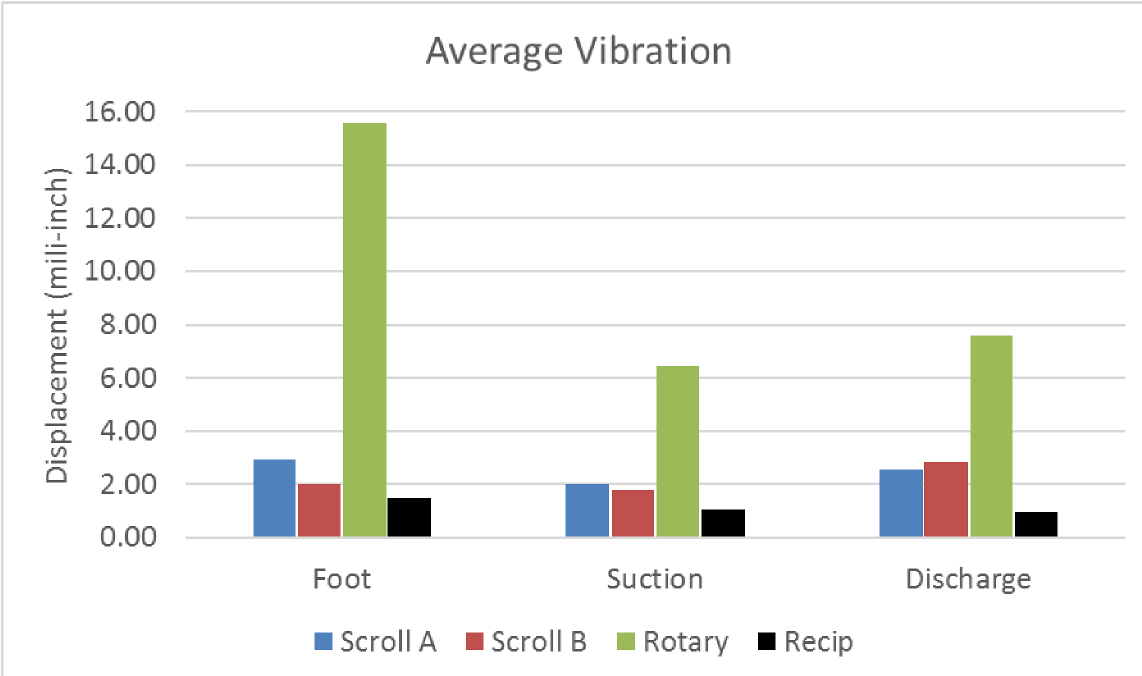

Figure 1

The scroll and rotary compressors tended to have slightly higher levels of vibration at high pressure conditions while the reciprocating compressor vibration was constant across conditions.

Conclusion

On average, the reciprocating compressor vibrates at half the level of the equivalent scroll compressors and also has significantly lower vibration than the rotary compressor tested. The rotary vibrated at 3 times the level of the scrolls and 6 times the level of the reciprocating machine. The data shows that the reciprocating compressor transmits much less energy into the condensing unit than either scroll or rotary compressors. Vibration is a source of noise and potential reliability concerns in an application, and extra care must be taken in the design of mounting and tubing in condensing units using scroll or rotary compressors in comparison to reciprocating compressors.