GE
Oil & Gas

Acoustic Emission System
for Cylinder Valve Monitoring

Benefits

□□□ Increased production
■□□ **Higher efficiency**
□□□ Compliance with environmental regulations
■■■ **Availability and Reliability**
■□□ **Life extension**

Cylinder valve monitoring using the acoustic emissions kit provides important support for predictive maintenance, as it allows detection of:

- Valve back flow and fluttering
- Leakage due to valve seat and poppet damage
- Growing deposits of hard polymers
- Valve malfunctioning due to excessive cylinder lube oil

The acoustic emissions kit also delivers the following benefits:

- Avoidance of major cylinder failure
- Reduction of overall maintenance cost
- Stable efficient operation

What it is

The cylinder valves are probably the most critical parts of reciprocating compressors. They must open and close automatically at every cycle and their behaviour determines, to a large extent, the overall performance of the compressor. Ineffective maintenance of these components will result in a significant loss in performance for the entire process plant. In fact, malfunctioning cylinder valves can reduce compressor throughput, increase adsorbed power, damage cylinder components, and reduce compressor availability.
Up to a few years ago cylinder valve behavior was evaluated on the basis of the intuition and personal experience of the operators responsible for the operation and maintenance of the machines.
Recently, more sophisticated tools have been developed which are able to detect incipient malfunctions. This helps operators plan valve maintenance activities, thereby reducing or eliminating unnecessary repairs, preventing catastrophic failures and increasing plant profitability.
The most effective tool for this purpose detect the ultrasonic high frequency emissions (acoustic emissions) that are generated when a fluid leaks through a restricted orifice.

How it works

Vibrations below 20 Hz are normally referred to as low frequency vibrations. The range from 20 Hz to 20 kHz covers the audible range of vibrations. Vibrations exceeding 20 kHz are not audible and for this reason are called Ultrasonic.
Any gas or liquid that passes through a restricted orifice (including cracks, pinholes, failed seals, etc.) generates a turbulent flow and the emission of high frequency vibrations (100 to 1,000 kHz). This high frequency "signature" can be readily identified using ultrasonic techniques and provides an ideal method for detecting leaks in valves, piping and other process equipment.
In particular, the use of ultrasonic sensors (500 to 1,000 kHz) at reciprocating compressor valve covers or cylinder heads can help diagnose the condition of the valves.
Figure 1 shows a valve operating correctly: as the valve opens and closes it produces acoustic vibrations which are detected by the sensor and represent a signature for normal operation. If a valve starts to malfunction it produces a leak that generates a different acoustic signature during the time it is supposed to be closed. *Figure 2* shows an event of this type.

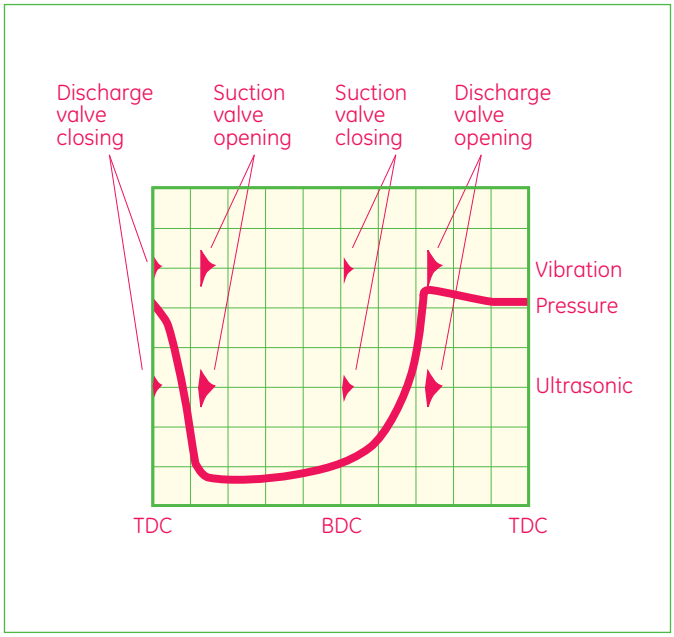


Figure 1

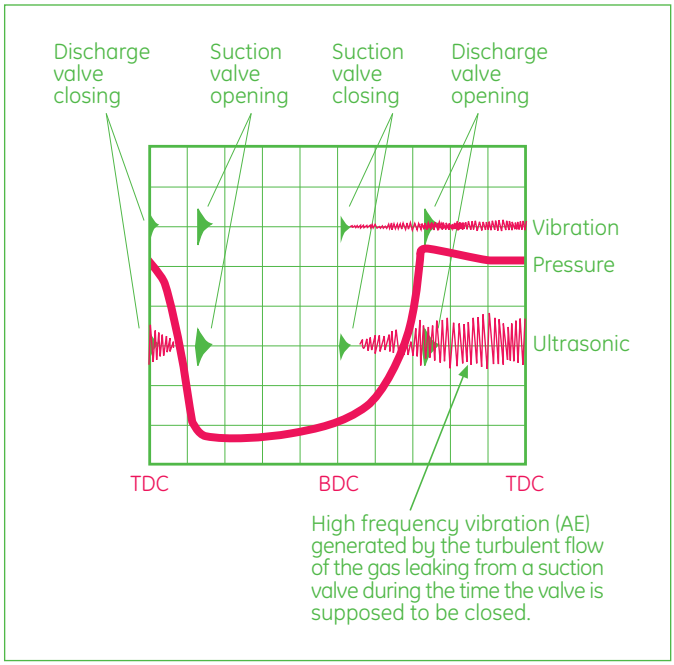


Figure 2

How it works

The sensor measurement is not analyzed in the frequency domain. Instead, the total signal is enveloped and the envelop curve is compared with the earlier curves to analyze the trend (*see Figure 3*).
This diagnostic tool can be employed on all reciprocating compressors but it is particularly valuable for the hypercompressors used in Low Density Polyethylene Plants (LDPE). In these machines, wear or damage of the valve seat or poppet causes back flow (leakage) of the compressed gas producing ultrasonic acoustic emissions that can be detected by a special sensor. Other malfunctions of hypercompressors that can also be detected by acoustic emissions include:

- defective valve opening and closure due to growing deposits of hard polymer on valve components
- valve spring damage
- valve fluttering
- defective valve operation due to excessive cylinder lube oil

The use of acoustic emissions in combination with a cylinder P/V diagram gives even more information on the valve operating conditions, and enhances the ability to develop a predictive maintenance program for this critical compressor component.

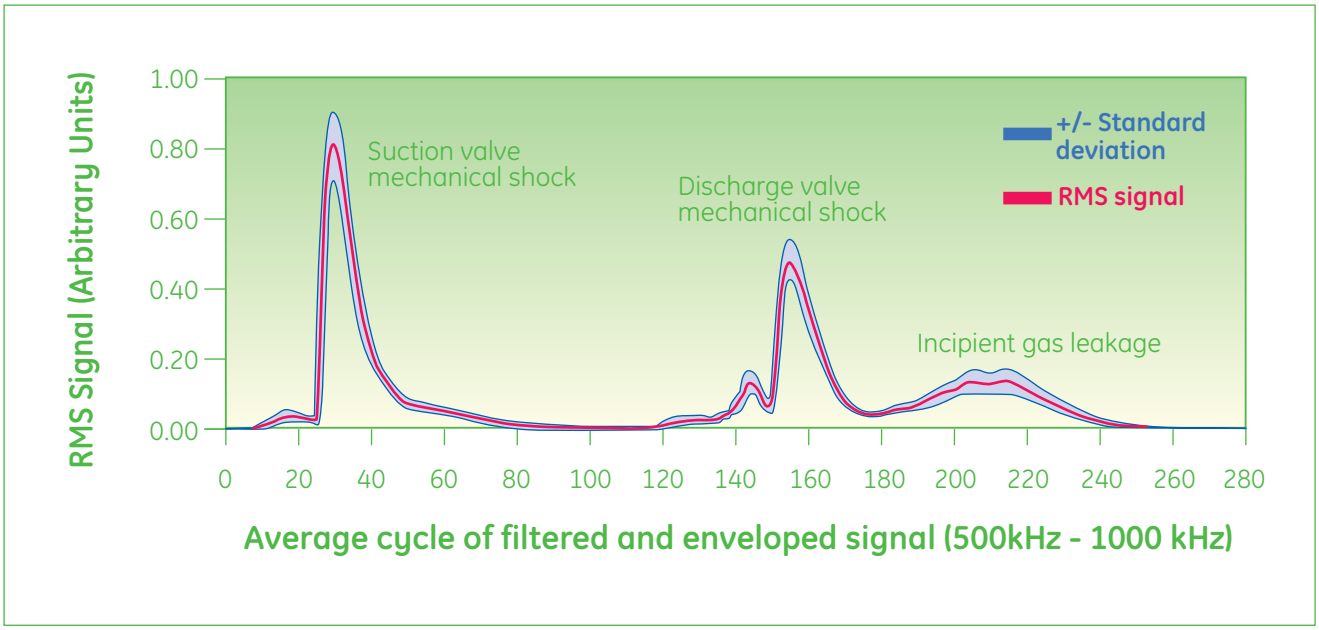
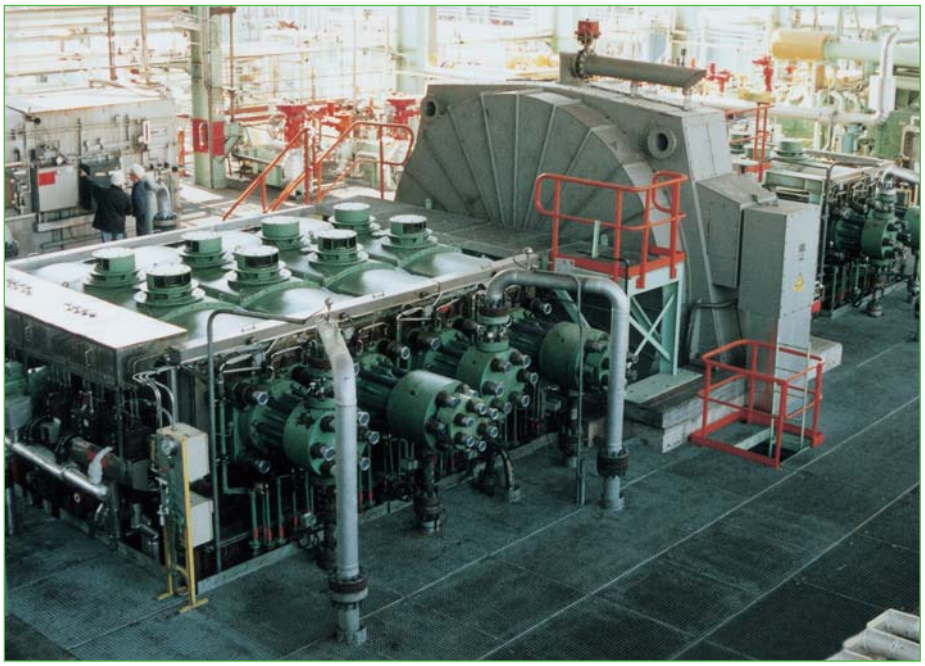


Figure 3



How it works

Acoustic Emission Monitoring System
GE Oil & Gas has developed a monitoring system based on acoustic emissions to monitor the cylinder valve operation in hypercompressors for LDPE plants. The schematic of this system is shown in *Figure 4*.
The sensors are positioned on the cylinder heads and their signals, together with the key phasor signal, are collected in a junction box suitable for hazardous areas. The signals are conditioned (filtered, integrated and voltage transformed to current) and exported to the cabinet in the control room where the signals are transformed back to voltage.

The analog voltage signals are then converted to digital signals and are acquired by the data acquisition system, which produces the acoustic emission envelop curve. This curve is analyzed, searching for four peaks and the integrated area included within the four peaks. The values of the peaks and the subtended areas are monitored to detect and assess trends. Data is recorded and stored at predefined time intervals.
Data can also be sent, via narrow band signal transmission, to GE Oil & Gas for more detailed analysis by experts as part of a machinery health care package.

Scope of Supply

The typical scope of supply of an acoustic emission monitoring system for a hypercompressor consists of:

- Acoustic emission sensors (one per cylinder)
- A key phasor (proximity probe)
- Junction box
- Cabinet
- CD of VMS (Valve Monitoring System) software
- Engineering activities for design, manufacture and implementation
- Remote monitoring & diagnostic service from the GE Oil & Gas iCenter

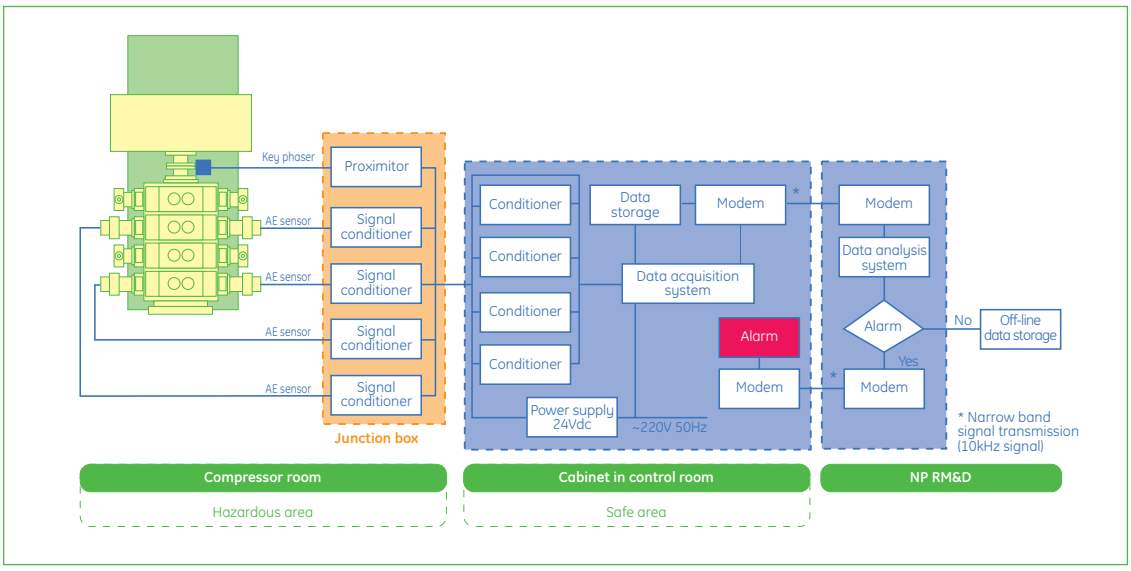
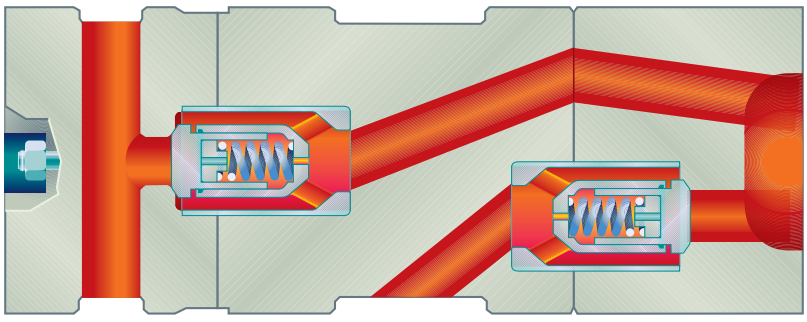


Figure 4



Typical hypercompressor valve arrangement

GE imagination at work

GE Oil & Gas
via F. Matteucci, 2
50127 Florence - Italy
T +39 055 4272500
F +39 055 4232800

E customer.service.center@ge.com
www.ge.com/oilandgas

Nuovo Pignone S.p.A.

COMK/MARK 839/II - Designed by: Studio Tre Fasi
Printed by: Sagraf - 1-2008