

Portable Diagnostics Service

Benefits

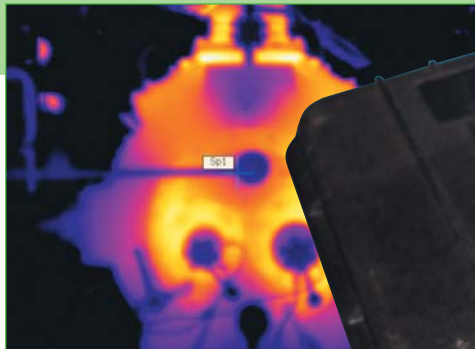
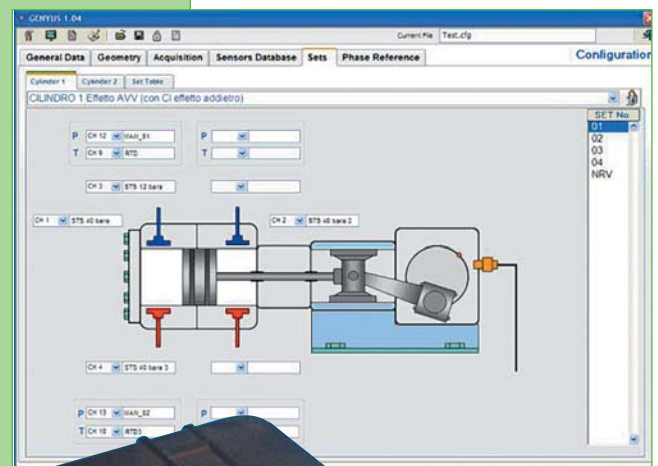
- Increased production
- Higher efficiency**
- Compliance with environmental regulations
- Availability and Reliability**
- Life extension

A step towards predictive maintenance:

- Periodic monitoring of the machinery's actual operating conditions is mandatory for predictive maintenance
- The on-board machinery supervisory systems currently installed in most process plants is inadequate to provide complete knowledge of compressor behaviour
- Monitoring readings without the interpretation of a compressor specialist are not very useful - unless an "on-board" Real Diagnostic System is provided
- Portable diagnostics are much less intrusive than on-board systems, in fact the number of on-board sensors is reduced
- Portable diagnostics create a fruitful link with the machine designer, which leads to machinery modernization (proactive maintenance)

Customer benefits include:

- Substantial elimination of failures
- Increased machine availability and reduced downtime
- Reduced maintenance costs
- Optimization of spare parts usage
- Energy savings



What it is

Diagnostic and maintenance services for reciprocating compressors have proven their value to customers. Our knowledge, experience and scientific approach are key to defining specific services that provide maximum economic advantages.

Machine and plant control guidance is provided through the use of dedicated transducers that monitor the efficiency and natural wear of machine components. Our diagnostic activities employ sophisticated instrumentation and information control systems. As a compressor manufacturer, we have the expertise and in-depth knowledge of design calculations to define needed modifications without impairing safety margins.

Thermodynamic and Mechanical Parameters

Even with regular monitoring of key parameters, it is often necessary to check thermodynamic and mechanical behaviour using portable instrumentation. Based on obtained results, the ability of the compressor to continue to operate until its next scheduled shutdown can be assessed. Thermodynamic and mechanical performance is checked by specialized technicians using dedicated instrumentation and calculations to determine the target operating parameters to be achieved at the site.

These measurements allow an assessment of:

- Pressure drops
- Filter condition
- Valve and cylinder operation
- Valve lifter operation
- Functioning of onboard instrumentation and equipment
- Sealing of piston rings
- Gas leakage from stuffing box
- Loosening of valves
- Gas leakage from seals
- Cooling
- Pressure pulsations

Electrical Parameters

A typical application is to measure electrical parameters including voltage, absorbed current, $\cos\varphi$ and power. These checks are performed with a power grid analyzer connected directly to the low voltage engine, or to the secondary transformer for high voltage engines.

These measurements allow an assessment of:

- Electrical feed
- Electrical engine cooling
- Absorbed power

Monitoring the Vibrations of the Compressor Casing and Components

Measurement and analysis of the vibration of reciprocating compressors is necessary in order to detect operating conditions that may rapidly become abnormal, and to keep track of the condition of mechanical components (for example, loosening of pipe brackets). Many failures show their development through variations in a machine's vibration signature.

Our experts measure vibrations using transducers connected to the portable diagnostic kit that operates as a spectrum analyzer. These piezoelectric transducers can be installed with magnetic or fixed supports on:

- Crankcases
- Cylinders
- Dampers
- Valve covers
- Piping
- Other components

The vibration measurements allow an assessment of:

- Balance problems
- Alignment problems
- Loosening of components (flywheel, tie rod, rod cross head, etc.)
- Correct connection of the compressor to the electric drive
- Assessment of the condition of the foundation
- Assessment of piping supports
- Correct operation and closing of the valves

- Assessment of the clearances and wear of components subject to sliding and rolling
- Condition of supports and bearings
- Excessive pressure pulsations

Transducer signals are sent to a spectrum analyser for processing, and the following performance data are supplied:

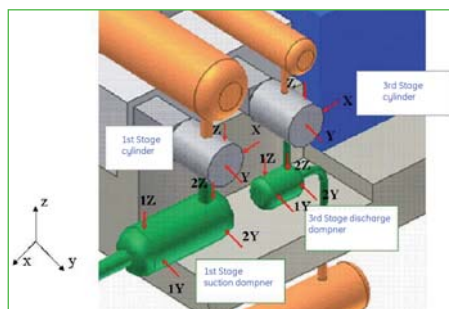
- Overall displacement, velocity or acceleration
- Frequency spectrum
- Pick values for key frequencies: synchronous frequency or other important critical frequencies
- Other parameters and/or dedicated processing

Data is collected for each measurement point and for all Cartesian directions.

Compressor Indicated Cycles

Even with regular monitoring of key parameters, it is often necessary to verify the actual P-V cycles using portable instrumentation (*Figure 1*). Based on results achieved during diagnostic testings, an assessment of whether the machine can continue to operate until its next scheduled shutdown can be made.

The analysis of the indicated cycle allows our diagnostic specialists to prepare a detailed report on the condition of the compressor to optimizing its use, evaluating the wear state, and to scheduling maintenance more effectively. Measurements are carried out by experts with dedicated instrumentation, and use mathematical/statistical models to determine the ideal operating parameters for the site.



Typical areas measured



Portable diagnostics kit

What it is

Specifically, pressure transducers are connected to the cylinder's compression chamber and the acquired data is synchronized with the shaft rotation to supply pressure trends during a complete rotation. Data includes:

Data includes:

- Suction and delivery pressure for each phase and effect
- Cylinder pressure for each effect
- Actual rotating speed of the machine

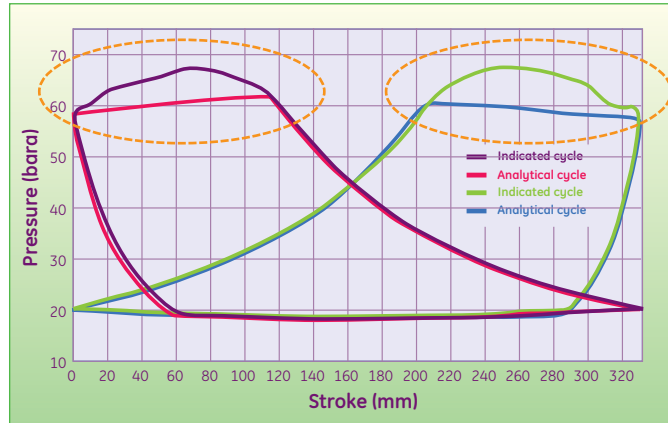
These measurements allow an assessment of:

- Excessive gas leakage from piston rings and stuffing box
- Delayed breakaway of valve shutters from their seat and counterseat due to excess lubricant or the presence of impurities in the gas
- Gas discharged to suction and delivery valves
- Valve lifter operation
- Gas leakage from seals
- Excessive pressure drops
- Condition of filters
- Pressure pulsations
- Absorbed power
- Cooling system functionality

Thermography

Thermography employs infrared technology, which is based on the fact that all objects emit electromagnetic energy as radiation at temperatures above absolute zero. The higher the temperature, the more electromagnetic energy is emitted. The electromagnetic spectrum is a continuum of all electromagnetic waves across their frequency and wavelength, and includes various frequency ranges of radiated energy, including Gamma rays, X-rays, ultraviolet, visible, infrared and radio. Infrared emissions cover the spectrum of 0.7 micron to 100 microns and are invisible without special instrumentation. The intensity of the infrared radiation from an object is a function of its surface temperature so that instruments that are able to measure this intensity can be used to determine the surface temperature of bodies. Three types of instruments can be used to measure thermal emission radiation:

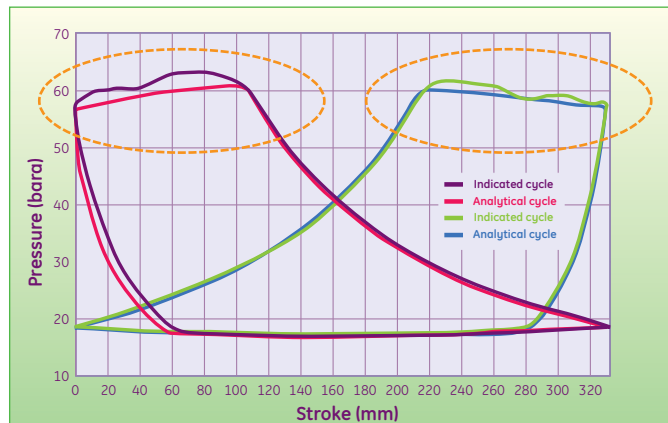
- Infrared thermometers or spot radiometers which are designed to provide the actual surface temperature at a single, relatively small point on a machine or surface



Anomalous cycle
(Possible discharge valves problems)



Discharge valve problems



Cycle measured after discharge replacement

What it is

- Line scanners which provide a single-dimensional scan or line of comparative radiation
- Thermal infrared imagers (see *Figure 2*) which, unlike other infrared techniques, can scan the infrared emissions from wide areas of a machine or process equipment in a very short time. The imaging systems function much like a video camera. The user can view the thermal emission profile of a broad area by simply looking through the instrument optics

The data collected by the infrared

Imager can be downloaded to a portable PC, transformed into digital data and processed into video images called thermograms.

Some functional deviations that can be detected by thermography are:

- high energy loss at cylinder valves due to valve plugging
- cylinder valve back flow
- high gas leakage at piston rings and piston rod packing
- defective operation of capacity control devices
- ineffective cylinder cooling
- abnormal crank mechanism friction heat generation

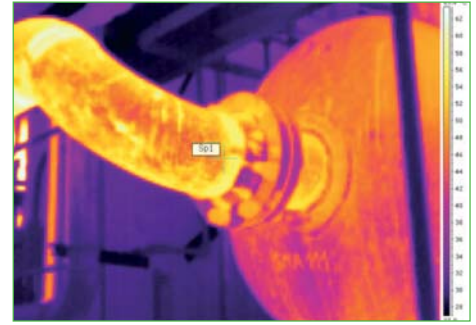


Figure 2: Thermal infrared images

How it works

In addition to the tools and instrumentation already illustrated we are able to provide:

- Specialized technicians using dedicated instrumentation to perform on-site measurements for a wide variety of machine types and/or operating conditions
- A diagnostic team at our Florence GE Oil & Gas headquarters analyzes the data to assess the condition of the machine
- Detailed reports on the status of the machine, operational irregularities, and recommendations for corrective action to improve performance or repairs
- Periodic reports based on the type of maintenance activity (periodic, scheduled, "on condition", etc.), that analyze the trends of the most significant or critical parameters
- Customer support via phone or e-mail from experts at our Florence facility



GE imagination at work