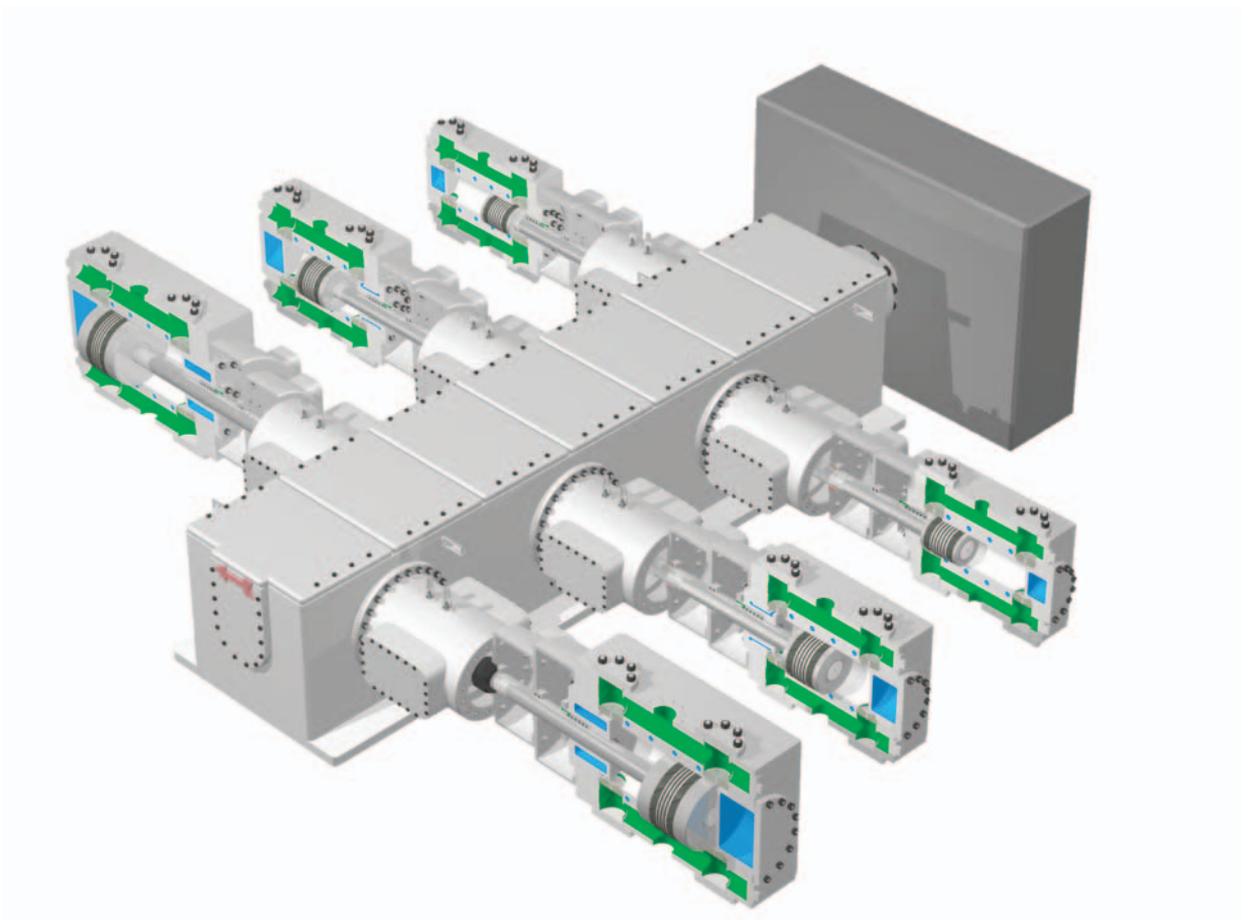# Impact/Impulse RulePak for System 1* Software

## Detecting mechanical looseness in reciprocating compressors

Detecting Mechanical Looseness in Reciprocating Compressors

Mechanical looseness, while not as common as valve or packing leaks, can result in costly issues for reciprocating compressors. When left undetected, an otherwise manageable problem may escalate into an unplanned shutdown. Unplanned downtime can cost more than $100,000 per day in lost production revenue—in addition to maintenance and repair expenses. GE Energy's Impact/Impulse RulePak for System 1* software uses both patented and patent pending diagnostic and signal processing technologies to quickly and positively identify mechanical looseness. This enables plant personnel to spend less time searching for faults and more time proactively maintaining your reciprocating compressors.

Condition monitoring systems help to improve the operations of reciprocating compressors by providing key data to manage your critical machines. Traditionally, protection bands from the Bently Nevada* 3500/70M monitor and threshold alarms from other 3500 monitors alert users to the problem areas within these data sets. The Impact/Impulse RulePak builds on this proven foundation to provide powerful real-time analytics on your reciprocating compressor data, integrating synchronized pressure, load, and vibration measurements.

The Impact/Impulse RulePak utilizes the 64 kHz sampled waveforms produced by the 3500 and synchronizes force events to impulse events in the vibration waveforms in order to determine if malfunctions exist. In real-time, the RulePak uses a proven deterministic methodology to find, track, and report critical looseness and impact events as they occur on the machine. These events include:

- Piston/piston nut looseness
- Crosshead nut looseness
- Crosshead pin bushing
- Cylinder liner looseness
- Cylinder valve looseness
- Liquid/debris ingestion
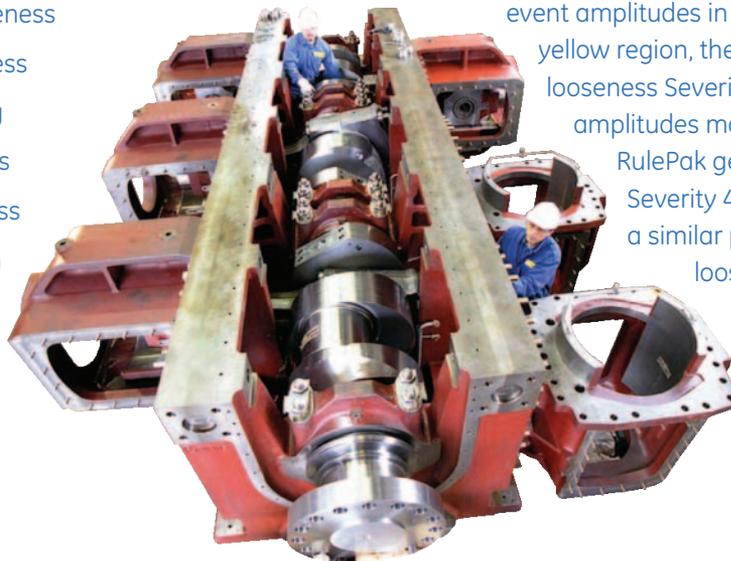
Load tracking, Real-time Dynamic Waveform Signal Analysis

Diagnostic engineers commonly review vibration data, searching for impulse events. When an event is located, the engineer attempts to correlate the impulse with a force crossing, such as gas load reversal or combined rod reversal, to determine if an impact has caused the impulse event.

The Impact/Impulse RulePak automates this process with an advanced RulePak technology called Dynamic Segmental Waveform Analysis (DSWA). As the RulePak processes waveforms associated with force and pressure, the DSWA discovers potential impact event locations and stores each crank angle. The RulePak then establishes alarm levels within each associated vibration waveform band based on the impact event location.

For example, Figure 1 illustrates the algorithm applied to data taken during a load change. The column on the left shows data at 100% load and the column on the right shows data at 80% load. The RulePak processes waveforms associated with force and pressure, such as the gas load curve shown in blue in the top plot of both columns.

The Impulse/Impact RulePak stores the degrees of crank angle at which the zero-force crossings occur, shown by the blue dots on the gas rod load curve. For each crossing, the RulePak establishes a band in the associated filtered crosshead acceleration and filtered piston rod vibration waveforms, as indicated by the green, yellow, and red threshold band alarms.

So long as the green band bounds the data, the RulePak does not generate an alert. However, if the impulse event amplitudes in all bands move into the yellow region, the RulePak generates a piston-looseness Severity 3 alert. If all impulse event amplitudes move into the red region, the RulePak generates a piston-looseness Severity 4 danger. The RulePak performs a similar process to identify other looseness and impact events.
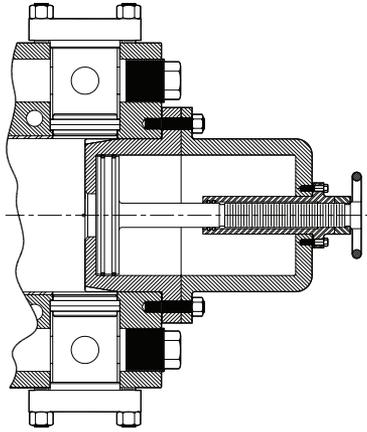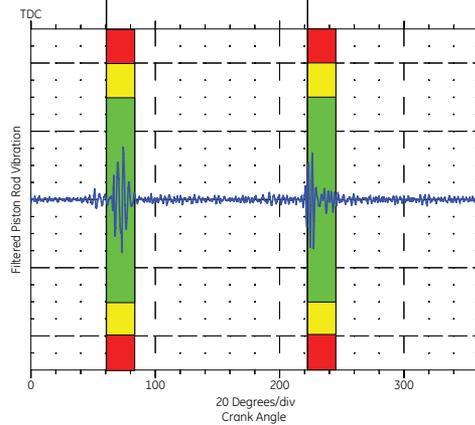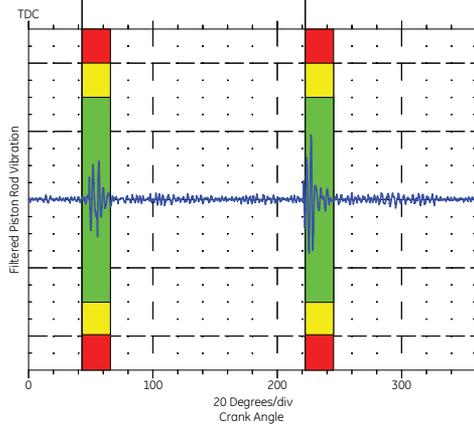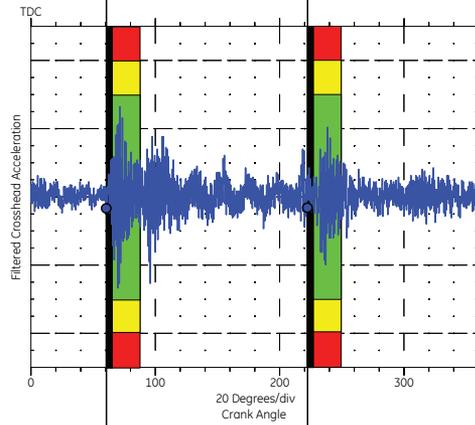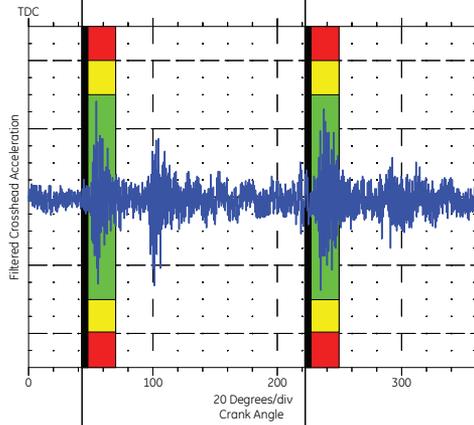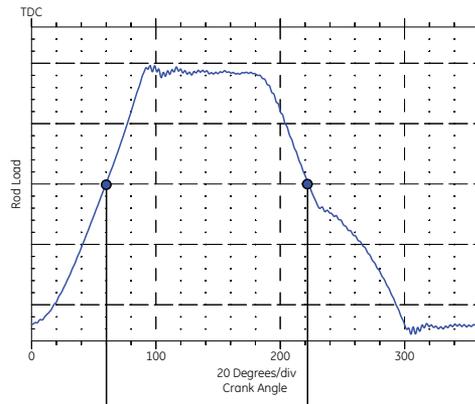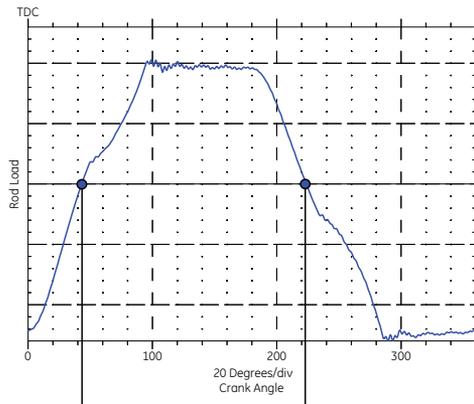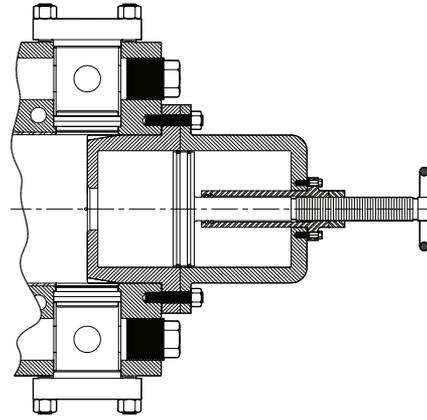
Figure 1

The Impact/Impulse RulePak is designed to be installed, configured, and operated on reciprocating compressor condition monitoring systems as per best practices, shown in Figure 2. For instrumentation arrangements that differ from best practices, consult your local sales and service representative.

The Impact/Impulse Rulepak is designed for System 1 version 6.5 SP2 or higher. The Impact/Impulse Rulepak is also designed for reciprocating compressors without "stepless unloaders."

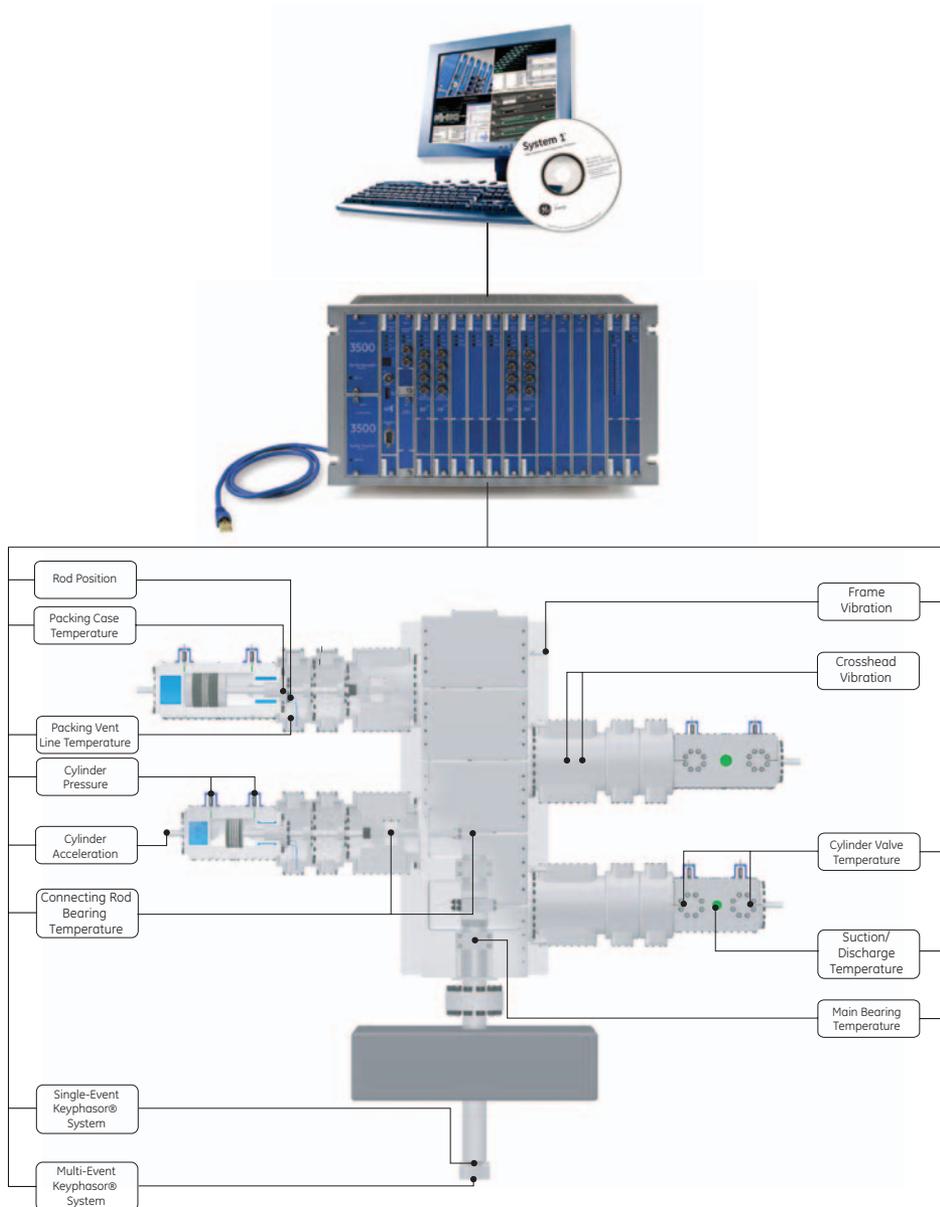For specific configuration and technical information about System 1 Rulepaks, please consult datasheet #175487.

Figure 2

GEA17921 (11/2009)