Compressor Works

ACI Services, Inc.

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ACI Services, Inc. has moved to a new facility located at 125 Steubenville Ave. Cambridge, Ohio.

ACI and Syntech Co-develop Advanced Panel Add-on for Reciprocating Compressors

To meet the needs of compressor operators, Syntech (a division of Enerflex Ltd. located in Calgary, Canada) manufactures control panels for a wide variety of compressors. Recently, they have created a new add-on device, the RMX, which allows their panels to calculate complete reciprocating compressor performance, including full rod loads and pin reversals per throw. The RMX provides screens comparing real-time sensor data against expected theoretical values, predicts which load steps are safe to engage, as well as which ones are safe and ideal for current operations.

The RMX can alert the operator to operational issues based on running the unit at the current load step, including ***neighborhood predictions***. Neighborhood predictions provide the operator with the information they need in order to determine how well the unit can accommodate potential changes in operating conditions. This information is important when an operator must set the unit to a fixed load step for overnight, weekend, or extended unmanned absences.

The RMX incorporates algorithms based on ACI's eRCM™ Reciprocating Compressor Modeling Software. Unlike many PLCs that use simple algorithms, the RMX box uses the same advanced algorithms you expect from PC-based software. As such, the RMX can predict compressor performance ahead of time to let the operator know that certain load steps that might be available are actually unsafe to engage. Moreover, operators can quickly determine the flow rates possible from each safe load step, right there from the compressor panel.

Too often, PLCs allow operators to engage load steps without first checking them for safety issues. While some issues, like high temperatures and pressures would eventually be detected and alarmed, other issues like rod loads and pin reversals may not be detected until it is too late. Very few compressor units have direct sensors to measure items such as rod loads and pin reversals. Thus, these need to be inferred from other measured data.

For slow-speed units, it is common to take the gage pressures (adjusted for pressure drops between the gages and the cylinder flanges) and calculate the forces on the rod based on these static pressures. For high-speed units, the usual approach is to model dynamic internal pressures (all 360° of crank angle position) based on adjusted gage pressures. Then, these dynamic pressures, along with dynamic inertia forces, are used to determine rod load forces and degrees of pin reversal. Misapplication of these methods can create serious and potentially dangerous situations, as well likely invalidating the warranty of the packager/OEM. As indicated by Figure 1, the differences in the two calculation methods (static flange method for slow-speed units on left, internal gas pressure method for high-speed units on right) can be dramatic. When misapplied, a simple control panel's logic may shutdown the unit even though it is actually operating in safe territory, or worse, the panel might allow the unit to run in unsafe areas.

T#	C: Flange	T: Flange	C: Internal	T: Internal
#1:	10 %	49 %	29 %	72 %
#2:	6 %	46 %	16 %	54 %
#3:	10 %	49 %	29 %	72 %
#4:	[illegible]	[illegible]	[illegible]	[illegible]
#5:	73 %	49 %	101 %	75 %
#6:	[illegible]	46 %	[illegible]	56 %

Figure-1: Rod Loads

Fortunately, the RMX addresses these issues by providing a simple add-on for PLCs that can provide the user all of the information needed. Yet, the RMX does not require the PLC programmer to code (and possibly misapply) complex performance models. Finally, when desired the RMX can provide dynamic compressor performance curves within the user's HMI/SCADA software, or even directly on the panel's screen.

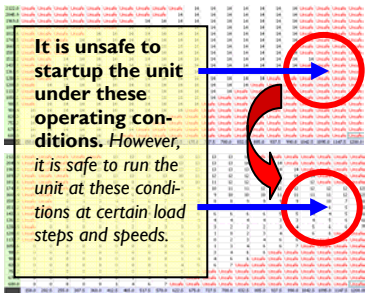
Inside this issue:

Look for ACI at these Events:

October 3-5 Gas Machinery Conference; Covington, KY

ACI is presenting a new short course, ***Performance Control of Reciprocating Compressors: Devices for Managing Load and Flow****, October 2005 at the Gas Machinery Conference in Covington, KY. This will include a comprehensive review of the methods and devices available for compressor control; an objective comparison of their relative benefits and limitations; and guidelines for comparing, selecting and economically justifying the optimal approach for a specific application.*

Compressor Performance and Optimization—Safe Startup Maps



An interesting aspect of reciprocating compressors is that while they may safely run at certain operating points, they may in fact not be able to startup at those same conditions. Usually, this occurs as a result of the unit experiencing excessive rod load or insufficient pin reversal during the startup sequence. For operators and automated controls, this creates an odd situation: the unit can be safely running at the current operating point, but if it needs to be stopped or shutdown, then trying to bring the unit back online via the normal startup sequence may lead to hardware failure.

A typical startup sequence for many reciprocating compressors is as follows:

- All volume pockets, if any, are **open**: all end deactivators, if any, are engaged (end is deactivated).
- Start and warm up driver according to OEM procedures.
- Bring driver to minimum speed (for variable speed drivers).
- Start to **open** Inlet Valve to compressor.
- Start to smoothly **close** Bypass (Recycle) Valve – about 45 seconds to fully close.
- Increase speed to full speed.
- Load unit via Load Step sequence until desired load is reached.

As such, during the startup sequence the unit is typically in the most unloaded load step, and running at the minimum operating speed. This arrangement is ideal in regards to minimizing the load on the driver as the bypass valve is closed, allowing load to be smoothly added to the driver.

However, rod loads and pin reversals are a function of operating speed. Thus, it is occasionally the case that at the lower speeds used during startup, that the unit might experience unsafe operating conditions.

The adjacent figure details a map of safe startup conditions (top table) and a map of safe ideal operating conditions (bottom table). In both, red areas indicate unsafe areas. If these two maps are dissimilar, then the unit operators, or control panel, must take care to not put the unit in unsafe areas during startup.

In short, if you need to operate at a certain condition, then check both issues: (a) Can the unit safely startup at this condition?, and (b) Can the unit safely run at this condition?

Next issue we will discuss how to use 3D Maps for reviewing compressor performance.

The new ACI custom engineered cylinder required a bottom mounting pad, top inlet and side discharge in order to "bolt-in" to existing foundations and piping.

Installing a new 20.5 in. (520.7 mm) bore, shrink fit liner into the bore of the new cylinder body. Prior to insertion, the liner was "soaked" in liquid N_2 to provide radial clearance for installation.

Project Success Story—20 -1/2" Pennsylvania Cylinder Replacement

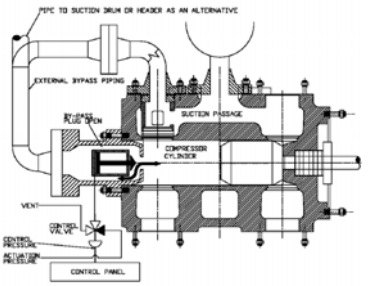
In the fourth quarter of 2004, a Pampa, Texas, U.S.A. chemical plant operator experienced gas leakage into the coolant jacket of an existing Pennsylvania compressor cylinder used in a critical process. The 20.5 in. (520.7 mm) bore diameter by 11 in. (279.4 mm) stroke non-lube cylinder had a ductile iron liner. Years of service with a process gas mixture that creates corrosive products inside the cylinder gas passage had resulted in corrosion of the cylinder walls, finally allowing gas to leak into the coolant jacket.

The cylinder was a unique, side discharge cylinder with narrow cooling passages that were prone to plugging. As a result, it was difficult to keep the cylinder cool enough during operation. Although the operator made a temporary repair to the original cylinder that allowed the plant to continue operating, there was an urgent need to replace the original cylinder. ACI Services investigated the existing cylinder and its service conditions in detail, working with plant operators and engineers to understand the limitations and problems that had been experienced with the original OEM cylinder.

ACI then custom designed a bolt-in 100 psig (6.9 bar) MAWP ductile iron replacement cylinder assembly with improved cooling passages. ACI designed the cylinder, heads and liner to reuse the existing original valves, valve caps, valve cages, piston, rod and packing case, which saved a significant amount of money for the customer. Of primary importance to the customer was the fact that ACI was able to design the new cylinder from scratch, procure a new pattern and casting, complete machining and hydrostatic test at 1.5 times the MAWP in only twenty (20) weeks. The new cylinder assembly was delivered in April 2005. It was installed during a planned maintenance cycle, allowing the operator to avoid having to shut the plant down for a prolonged period.

Based in part on this experience, the customer has recently placed an order for new replacement cylinders for one of its Ingersoll Rand process compressors in the same facility.

Product Highlight—Simplex™ Unloader



ACI SimPlex™ unloaders offer a simple and economical approach for compressor cylinder head end deactivation. The system utilizes external bypass piping combined with a new ACI style front head designed to replace the conventional cylinder head. Head end compression chamber gas is bypassed back to suction pressure for complete head end deactivation. Typically, the bypassed gas is routed to suction through a special ACI designed valve cap, or alternatively to the suction drum or header of the unit.

This bypass concept provides efficiency advantages by eliminating the need for suction valve plate depressors (finger unloaders) or plug type suction valve unloaders often used for end deactivation in other approaches. Operation may be either manual or pneumatic (air or gas), with local or remote control used to open and close the bypass plug. The ACI SimPlex™ system can be supplied on new OEM cylinders or may be custom designed for existing compressors.

With ACI's new eRCM™ performance software, ACI can evaluate the advantages of integrating the SimPlex™ unloading concept into an existing application. Additionally, ACI can develop the optimum unloading sequence, the software for automation, or even the complete automation system.

ACI's Simplex unloader assembly provides a reliable and efficient solution to end deactivation.

In Memoriam – Mike Hubbell

With sadness, we note the passing of Michael Ross Hubbell at the age of 58. Mike was born May 13, 1947 in Mount Vernon, Ohio and he died July 25, 2005 at his home in Zanesville, Ohio.

He spent the last few years of his life dealing with Amyotrophic lateral sclerosis (ALS). ALS, often referred to as "Lou Gehrig's disease," is a progressive neurodegenerative disease that affects nerve cells in the brain and the spinal cord.

Mike graduated from Mount Vernon High School in 1965 and completed training as a draftsman at Cooper Bessemer. He later progressed to designer and eventually to project engineer. His career spanned more than 35 years, specializing in compressor cylinder components, valves and unloaders. He joined Compressor Valve Services, the forerunner of ACI Services, in the mid-1970s. In the mid-1980s he moved on to Ajax Superior in Springfield, Ohio before rejoining ACI in 2002.

In addition to Mike's compressor engineering skills, we remember him as a soft-spoken, quick-witted family man who enjoyed landscaping, gardening, do-it-yourself projects, repairing cars, making stained glass art, and teaching Sunday School at his church.

Mike is survived by his mother, two brothers, his wife of 30 years (Susan), four children and five grandchildren.

For more information on ALS, please visit the ALS association at www.ALSA.org.

ACI Team Member Profile — Chuck Wiseman

ACI Services, Inc. is pleased to announce that Chuck Wiseman has joined the team as Director of Mechanical Design. Chuck comes to ACI with 17 years of experience in reciprocating and rotating compressor design. Most recently he was Senior Product Engineer for CompAir, responsible for applications, custom designs, and field engineering for LeROI gas products.

Chuck began his career in the gas equipment business through Cooper Industries' Engineering Training Program with various assignments at three Cooper manufacturing facilities before accepting a permanent position with Cooper's Superior product line. He earned his masters degree in mechanical engineering at Ohio University, specializing in fluid mechanics and thermodynamics.

Listening to and addressing the needs of customers is a goal that all ACI personnel are committed to. Chuck believes that the best design solutions come from interacting with the customer to understand their application or problem, and applying all of ACI's experience to address it. Chuck comments, "I don't know of any other company this size where you can find over 200 years combined experience in compressor design."

When he's not designing, Chuck enjoys spending time with his family, doing anything outdoors, and traveling.

Chuck Wiseman

Director, Mechanical Design

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ACI Services, Inc.

EFFECTIVE AUGUST 29, 2005
ACI SERVICES HAS MOVED TO A NEW LOCATION!

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Norm's Notes

What a summer it's been! With the significant growth that we've experienced in the past year, we quickly outgrew our building on the BSI Group campus in Derwent, Ohio. After looking at various options for expansion, we purchased a nice facility in Cambridge, Ohio. Following a number of building improvements, we moved in the last two weeks of August. The new 26,500 ft^2 (2462 m^2) facility allows our entire team to be located together. It also gives us extra space for some new growth initiatives that we are considering. I am grateful to our team and to Bi-Con Services and their subcontractors, who worked hard to get the building improvements completed in only six weeks time!

The ACI team continues to grow in support of our growing business. In August we welcomed Debbie Johnson, who comes to us with a number of years of experience as office manager for a local plumbing contractor. Debbie is helping with accounting, order management and procurement.

Our new on-line used equipment clearinghouse business, Compressor Connection, continues to gain momentum with new listings, inquiries and sales transactions. We now have nearly 18,000 used compressor and engine items listed, and we continue to develop the user-friendly equipment locator. Take a look at this exciting new service at www.CompressorConnection.com or connect through our main website at www.ACIServicesInc.com.

I encourage you to attend the new short course - *Performance Control of Reciprocating Compressors: Devices for Managing Load and Flow* - that ACI Services is presenting in October 2005 at the Gas Machinery Conference in Covington, KY. Dwayne Hickman, Chad Brahler, Ed Miller and I have worked hard to develop this course, which provides a comprehensive overview of reciprocating compressor performance control.

Finally, our thoughts and prayers go out to customers and associates affected by Hurricane Katrina. May they have patience, strength and hope as they navigate through the extensive clean-up and reconstruction process.

***We are all faced with great opportunities – brilliantly disguised as insurmountable problems*—John Gardner**