THE BIGGEST & WORST:

Tales from a Compressed Air System Auditor's personal notebook

BY CHRIS E. BEALS, PRESIDENT OF AIR SYSTEM MANAGEMENT, INC.

KNOW PRESSURE COMPRESSED AIR CHALLENGE®

Before venturing off into compressed air consulting myself, I listened to compressed air consultants' stories about the amazing things they encountered during their compressed air system reviews. At that point, without having any system experience myself, I thought they might be making these things up or at least exaggerating them; however, after conducting compressed air system reviews for the past 13-years I can confirm I have encountered everything they mentioned and more. And some things, such as, being able to shut off ALL the compressors and dryers in a large oil refinery were inconceivable before I encountered them.

You may have heard some of the following stories if you've attended one of the Compressed Air Challenge's "Fundamentals of Compressed Air Systems" seminars offered by the Compressed Air Challenge throughout the US and Canada. If not, I hope these items will at least make you smile.

Maybe You Don't Need Those Controls That Come On Your Compressor

Manufacturers supply compressors with controls so it can efficiently match the supply to the demand and most importantly operate safely, and prevent damage to various compressor components or operators. However, some plants erroneously choose to operate without them. For example, a steel mill had six 600 hp lubricated rotary screw compressors. When we tried to determine the operating set points of each compressor by slowly closing its isolation valve while measuring the amps and pressure; the pressure and amps kept rising until the safety relief valve blew. When the second compressor did the same thing we asked the operator, "How do you control the compressors?" to which he answered, "When we hear the safety relief valves blowing we shut one down". You might think this was an isolated case; however, in a paper mill when we couldn't find any controls on several large reciprocating compressors we asked the operators, "How do you control the compressors?" to which they answered, "When we hear the safety relief valves blowing we shut one down".

AIR BEST PRACTICES™

Our record for the biggest pressure drop across a coalescing filter is 51 psi.

Fundamentals of Compressed Air Systems WE (web-edition)

Join us for the next session of *Fundamentals of Compressed Air Systems WE* (web-edition) coming February 20th, 2012. Led by our experienced instructors, this web-based version of the popular *Fundamentals of Compressed Air Systems* training uses an interactive format that enables the instructor to diagram examples, give pop quizzes and answer students' questions in real time. Participation is limited to 25 students. Please visit **www.compressedairchallenge.org**, to access online registration and for more information about the training.

If you have additional questions about the new web-based training or other CAC® training opportunities, please contact the CAC® at **info@compressedairchallenge.org**.

BIGGEST Pressure Drop across Inlet Filters and Piping

Years ago, while managing the service department of my compressor distributorship, I received a call from a nearby customer who told me his 200 hp compressor wouldn't make any air. When I arrived at the plant I found the inlet air filter differential indicator showing "Red", which indicates the filter element was dirty. When I pointed this out the maintenance manager said he had just changed the filter element; however, when I removed the element the compressor immediately started making air. He then admitted that the element was one that they had simply washed out approximately seven times before. Unwittingly, when he tried to save money by cleaning the filter element he was increasing his energy cost several times more than the cost of the element.

Our record for the biggest pressure drop across the inlet filter and piping on a centrifugal compressor is 4.2 psi measured upstream of the inlet valve. High inlet pressure differential on the inlet side of a centrifugal compressor reduces its capacity, lowers the natural surge pressure, and limits the turndown making them unstable and inefficient. In one case, we encountered a new centrifugal compressor that had been sitting idle for five years because it surged at its design operating pressure. We found piping for intake air undersized. After increasing the inlet pipe size the compressor now operates fine. In another case, we found that personnel had left the startup strainers, used during startup to prevent welding slag and other debris from damaging the compressor, in the inlet piping to their centrifugal compressors for years.

THE BIGGEST & WORST

After removing the strainers and load-sharing across the operating compressors, the total power reduced by over 200 kW.

BIGGEST Air/Oil Separator Pressure Drop

Our record for the biggest pressure drop across an air/oil separator in a lubricated rotary screw compressor is 34 psi and the compressor next to it had a 22 psi drop. The air/oil separator is used to separate the majority of the oil from the air before the air exits the compressor. Typically, an air/oil separator allows between 1 and 5 ppm of oil per cubic feet of air to carry over into the system; however, as the pressure drop increases the velocity through the air/oil receiver increases, which increases the oil carryover. These large pressure drops shouldn't have occurred because the compressor controls were supposed to shut the compressor off when the pressure drop reached 15 psi. In addition, given this pressure drop the motor overloads should have shut down the compressor. Needless to say these safeties were dangerously bypassed. In another plant, bypassing the motor overloads when the air/oil separator had an excessive pressure drop proved just how dangerous this can be. We found a 75 hp compressor pulling power equal to 100 hp. We told plant personnel there was a serious problem with the compressor, but two weeks later the compressor exploded – luckily no one was hurt.

BIGGEST Pressure Drop across an Orifice Plate

Our record for the biggest pressure drop across an orifice plate in an orifice style flow meter is 27 psi instead of the expected 1.5 to 2.0 psi. We have also found orifice plates with pressure drops of 9 and 18 psi. In addition, in many plants we encounter pressure drops caused by installing several orifice style flow meters in series.

BIGGEST Pressure Drop across a Coalescing Filter

Our record for the biggest pressure drop across a coalescing filter is 51 psi. One of our clients requires an audit of a plant before that plant can install an additional compressor, so we were sent there to review the compressed air system. When we arrived the compressor was operating at 116 psi; the plant pressure was only 55 psi. The pressure drop across the dryer and filter measured 61 psi with 51 psi across the filter only. Needless to say the filter wasn't installed with a pressure differential indicator.

BIGGEST Pressure Drop across a Desiccant Dryer

Our record for the biggest pressure drop across a desiccant dryer is 34 psi. The system pressure in the instrument air system was 55 psi. Not knowing why the pressure was so low, personnel started operating critical control valves off the optional wet plant air headers.

BIGGEST Pressure Drop in Headers

We have found over 60 psi drop in a few main headers, which were caused by:

- A broken 2-inch header that was leaking 845 scfm to atmosphere
- An open 2-inch valve blowing 740 scfm to atmosphere
- 625 scfm of purge air blowing into a boiler to prevent the catalyst from blowing out

The first two items can also be considered the biggest single air leaks we've found.

Another plant had what appeared to be two separate compressor systems because one was operating at 115 psi, while the other operated at 67 psi. We questioned personnel when they told us the systems were connected; but they showed us the 300 ft 2-inch header connecting the systems. The flow in the 2-inch header was 1067 scfm rather than the typical 180 scfm.

BIGGEST Demand Side Reduction

In a refinery, we found personnel using 2525 scfm to cool the view ports, on their waste heat boilers, at an annual cost of $169,300. Personnel were able to reduce the cooling air flow to 261 scfm.

CAC® Qualified Instructor Profile

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Chris is designated as an **Energy Expert** for Compressed Air by the United States Department of Energy and is a founding member of the Compressed Air Challenge. In addition, Chris is Air Master Certified, a CAC Certified L1 instructor, and was a member of the Core Technical Group responsible for developing the training materials for the Compressed Air Challenge Seminars.

BIGGEST Dust Collector Demand Reduction

In the converting department of a paper mill we were able the reduce the dust collector demand by 1100 scfm by installing dedicated storage with metered recovery and pulsing them off a Photohelic gauge. We did almost as well at a copper mine when we reduced their dust collector demand by 800 scfm.

BIGGEST Number of Compressors Shut Down in One Plant

Our record is six compressors and no they didn't install any new ones. They had 11 compressors all load sharing – or possibly operating in modulation and load sharing. We achieved this by automating the compressors, operating them in load/unload mode, and by reducing demand. We have equaled this record at two other plants.

BIGGEST Single Compressor Shutdown

In a refinery, we were able to shut off one of six 2000 hp 8000 cfm compressors that operated fully loaded with no blow off. This also qualifies as our record for the most total horsepower turned off and which we have equaled one other time.

BIGGEST Artificial Demand Reduction

By reducing the pressure, by 10 psi, in a paper mill that consumed over 20,000 scfm we were able to reduce demand by almost 2,000 scfm, because little of the air was regulated.

BIGGEST Number of Leaks

Our record of 2703 leaks occurred in a refinery; which also captured the biggest leak rate of 6,916 scfm. We have also found a leak rate of 6,519 scfm in a tire manufacturing plant.

BIGGEST Surprises or Most Amazing Results

A refinery wanted to reduce their emissions so we were asked to review the compressed air system and then size two new electric-motor driven compressors to replace the two 2000 cfm natural-gas driven reciprocating compressors. After the review, we told them they didn't need any new compressors and all they need to do to reduce their emissions was to shut off the two compressors. When personnel shut off the compressors the pressure dropped 3 psi and then stabilized. At another refinery, after the review we showed personnel how to shut off all of their compressors and dryers.

How you ask? Before we could make these recommendations we had to visit the nitrogen plants that supplied nitrogen to each refinery. In many cases, the nitrogen plants also supply compressed air. In the first case, we found that the nitrogen plant was blowing off 4795 scfm, to atmosphere, because the pressure in the refinery was too high, so when personnel shut off the natural-gas driven compressors the pressure dropped 3 psi and the air that was being blow off flowed into the refinery. In the second case, the nitrogen plant had a contract with the refinery to supply 26,000 scfm of compressed air; the headers, between the plants, were too small so the refinery could only take 7650 scfm, of compressed air, from the nitrogen plant. We designed a new header system that would allow the refinery to access the full capacity of the nitrogen plant and shut down their compressors and dryers and save $1,923,425 annually. BP