FINDING AND FIXING LEAKS

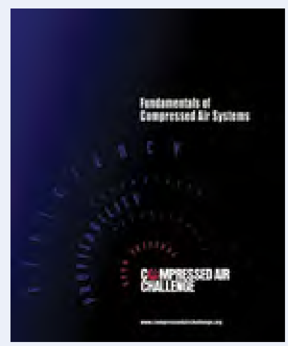
BY RON MARSHALL, PDC COMMITTEE MEMBER,
COMPRESSED AIR CHALLENGE®

Participants of the **Compressed Air Challenge® Fundamentals of Compressed Air Systems** seminar learn about the high cost of producing compressed air and the inherent inefficiencies in the compressor room. Understanding the supply side of the system is important, but more important is first looking at compressed air demand. One demand that is consistently in need of attention in industrial facilities is the air flow caused by leaks.

The CAC® training stresses the importance of baselining plant leaks and doing leak surveys. "Leak surveys are important because they normally offer the largest demand side opportunity," says Chris Beals, a compressed air system design consultant and Certified CAC® instructor. "During leak surveys, we recommend collecting sufficient data so the leaks can be sorted by location and by the component that is leaking. This additional information allows personnel to determine where to focus their efforts and how to best rectify leaks."

"First, a plant engineer or maintenance supervisor must realize that leak repair is a journey, not a destination. An ongoing compressed air leak monitoring and repair program should be in place in any plant that has a compressed air system," explains Paul Shaw, a general manager for Scales Industrial Technologies' Air Compressor Division and an Advanced CAC® Instructor. "Leak identification and remediation with a high- quality repair can lead to substantial energy savings that typically have a very rapid payback, usually a year or less," he continues. "In the hundreds of leak audits and repairs that we have done, we've found that the quality of the repair is critical to ensuring the customer receives the most value for his investment and that the leak remains repaired for as long as possible. From there, constantly monitoring for compressed air leaks and repairing them as they occur can help the plant continue to reap the energy benefits."

In addition to the seminar, **Compressed Air Challenge®** has a wealth of information on leaks and other related issues and is available for download at our **website library**. The following is an excerpt from "**Best Practices for Compressed Air Systems**", Appendix 4.E.1. This 325-page manual is available at our **bookstore**.



The Compressed Air Challenge® (CAC) is pleased to announce the second version of Fundamentals of Compressed Air Systems WE (web edition) on May 14, 2010. Led by Frank Moskowitz and Tom Taranto, 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 the CAC® web site today (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 or call 301-751-0115.

> A good compressed air system leak repair program is very important in maintaining the efficiency, reliability, stability and cost effectiveness of any compressed air system.

Finding and Fixing Leaks and Establishing a Leak Prevention Program

Leaks can be a significant source of wasted energy in an industrial compressed air system, sometimes wasting 20–30% of a compressor's output. A typical plant that has not been well maintained will likely have a leak rate equal to 20% of total compressed air production capacity. On the other hand, proactive leak detection and repair can reduce leaks to less than 10% of compressor output.

In addition to being a source of wasted energy, leaks can also contribute to other operating losses. Leaks cause a drop in system pressure, which can make air tools function less efficiently, adversely affecting production. In addition, by forcing the equipment to cycle more frequently, leaks shorten the life of almost all system equipment (including the compressor package itself). Increased running time can also lead to additional maintenance requirements and increased unscheduled downtime. Finally, leaks can lead to adding unnecessary compressor capacity.

FINDING AND FIXING LEAKS

CAC Qualified Instructor Profile

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Half of Chris's 30 years in the compressed air industry were spent as owner of a compressor distributorship in Denver, Colorado. Since selling his distributorship in 1998, Chris has been active as a consultant, designing compressed air systems and conducting compressed air system audits and seminars throughout North America and Europe. As a member of the Compressed Air Challenge®, he is one of five members of the Core-Technical Group, which wrote the material contained in the Compressed Air Challenge® seminars. In addition, he has written many articles for trade magazines.

There are two types of air leaks — planned and unplanned. The planned air leaks are the ones that have been designed into the system. These leaks are the blowing, drying, sparging, etc. used in the production process. Many times, these have been installed as a quick fix for a production problem. Some leaks take the form of "coolers", which are used to cool production staff or equipment. The CAC® document, "**Potentially Inappropriate Uses of Compressed Air**" at our web site has more detail on planned leaks.

The unplanned leaks are ongoing maintenance issues and can appear in any part of the system. These leaks require an ongoing air leak detection and repair program. While leakage can come from any part of the system, the most common problem areas are:

- Couplings, hoses, tubes and fittings — tubes and push-to-lock fittings are common problems
- Disconnects — O-rings required to complete the seal may be missing
- Filters, regulators and lubricators (FRLs) — low first-cost improperly installed FRLs often leak
- Open condensate traps — improperly operating solenoids and dirty seals are often problem areas
- Pipe joints — missed welds are a common problem
- Control and shut-off valves — worn packing through the stem can cause leaks
- Point-of-use devices — old or poorly maintained tools can have internal leaks
- Flanges — missed welds are a common problem
- Cylinder rod packing — worn packing materials can cause leaks
- Thread sealants — incorrect and/or improperly applied thread sealants cause leaks. Use the highest-quality materials and apply them per the instructions

Estimating the Amount of Leakage

For compressors that have start/stop controls, there is an easy way to estimate the amount of leakage in the system. This method involves starting the compressor when there are no demands on the system (when all the air-operated end-use equipment is turned off). A number of measurements are taken to determine the average time it takes to load and unload the compressor. The compressor will load and unload because the air leaks will cause the compressor to cycle on and off as the pressure drops from air escaping through the leaks. Total leakage (percentage) can be calculated as follows:

$$\text{Leakage } (\%) = [(T \times 100)/(T + t)]$$

Where: T = on-load time (minutes)
t = off-load time (minutes)

Leakage will be expressed in terms of the percentage of compressor capacity lost. The percentage lost to leakage should be less than 10% in a well-maintained system. Poorly maintained systems can have losses as high as 20–30% of air capacity and power.

Leakage can be estimated in systems with other control strategies if there is a pressure gauge downstream of the receiver. This method requires an estimate of total system volume, including any downstream secondary air receivers, air mains and piping (V, in cubic feet). The system is started and brought to the normal operating pressure (P1). Measurements should then be taken of the time (T) it takes for the system to drop to a lower pressure (P2), which should be a point equal to about one-half the operating pressure.

Leakage can be calculated as follows:

Leakage (cfm free air) =

$$(V \times (P1-P2)/T \times 14.7) \times 1.25$$

Where: V is in cubic feet
P1 and P2 are in psig
T is in minutes

The 1.25 multiplier corrects leakage to normal system pressure, allowing for reduced leakage with falling system pressure. Again, leakage of greater than 10% indicates that the system can likely be improved. These tests should be carried out quarterly as part of a regular leak detection and repair program.

Leak Detection

Since air leaks are almost impossible to see, other methods must be used to locate them. The best way to detect leaks is to use an ultrasonic acoustic detector, which can recognize the high-frequency hissing sounds associated with air leaks. These portable units consist of directional microphones, amplifiers and audio filters, and usually have either visual indicators or earphones to detect leaks.

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>
> — Paul Shaw, a General Manager for Scales Industrial Technologies' Air Compressor Division and an Advanced CAC® Instructor.

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Currently a general manager for Scales Industrial Technologies' Air Compressor Division, one of the nation's leading compressor distributors, Paul Shaw has more than 29 years in the compressed air industry, in positions that have included: engineering, sales, sales management, service technician and service management.

In his career in the compressor industry, he has saved more than a thousand small, medium and large companies millions of dollars in wasted compressor energy by improving compressor and dryer efficiency, and he is particularly adept at reducing demand through proper compressed air management and process and production machinery improvements. He has performed more than 250 major compressed air assessments and leak surveys, from which he brings many real life examples and solutions to help participants gain the most from his seminars.

Mr. Shaw contributed to and is an instructor for both Fundamentals and Advanced Compressed Air System Training. He consults for and speaks regularly to many engineering organizations, corporations and utilities on the subject of compressed air and energy efficiency.

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Ultrasonic leak detection is probably the most versatile form of leak detection. Due to its capabilities, it readily adapts to a variety of leak detection situations. The principle behind ultrasonic leak detection is simple: In a pressure or vacuum leak, the leak flows from a high-pressure laminar flow to a low-pressure turbulence. The turbulence generates a white noise, which contains a broad spectrum of sound, ranging from audible to inaudible frequencies. An ultrasonic sensor focuses in on the ultrasonic elements in the noise. Since ultrasound is a short wave signal, the sound level will be loudest at the leak site. Ultrasonic detectors are generally unaffected by background noises in the audible range because these signals are filtered out. This means leaks can be heard in even the noisiest environments.

The advantages of ultrasonic leak detection include versatility, speed, ease of use, the ability to perform tests while equipment is running and the ability to find a wide variety of leaks. They require minimum training, and operators often become competent within 15 minutes.

Due to the nature of ultrasound, it is directional in transmission. For this reason, the signal is loudest at its source. By generally scanning around a test area, it is possible to very quickly hone in on a leak site and pinpoint its location. For this reason, ultrasonic leak detection is not only fast, it is also very accurate.

How to Fix Leaks

Leaks occur most often at joints and connections at end-use applications. Stopping leaks can be as simple as tightening a connection or as complex as replacing faulty equipment such as couplings, fittings, pipe sections, hoses, joints, drains and traps. In many cases, leaks are caused by bad or improperly applied thread sealant. Always select high-quality fittings, disconnects, hoses and tubing and install them properly with appropriate thread sealant.

Non-operating equipment can be an additional source of leaks. Equipment no longer in use should be isolated with a valve in the distribution system.

Another way to reduce leaks is to lower the demand air pressure of the system. The lower the pressure differential across an orifice or leak, the lower the rate of flow, so reduced system pressure will result in reduced leakage rates. Stabilizing the system header pressure at its lowest practical range will minimize the leakage rate for the system.

Once leaks have been repaired, the compressor control system should be re-evaluated and adjusted, if necessary, to realize the total savings potential.

Establishing a Leak Prevention Program

A good leak prevention program will include the following components: identification (including tagging), tracking, repair, verification and employee involvement. All facilities with compressed air systems should establish an aggressive leak reduction program. A cross-cutting team, involving decision-making representatives from production, should be formed.

A leak prevention program should be part of an overall program aimed at improving the performance of compressed air systems. Once the leaks are found and repaired, the system should be re-evaluated.

A good compressed air system leak repair program is very important in maintaining the efficiency, reliability, stability and cost effectiveness of any compressed air system.

Note: A more comprehensive explanation of how to establish a leak prevention program appears in the Best Practices for Compressed Air Systems. Get yours today! BP

www.compressedairchallenge.org

LITERATURE & SERVICES PICKS

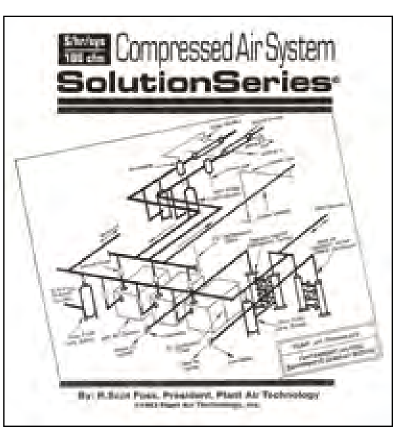
The Compressed Air System Solution Series©

Scot Foss has provided his expertise to many of the world's leading manufacturing and processing corporations by finding solutions to their problems. Foss is one of the world's leading experts in compressed air systems, known for his sometimes-controversial approach to the issues that face plant engineers, maintenance managers and production engineers.

Written in a conversational format, this 1,100-page book with 165 illustrations brings you solutions with a straight on, common sense approach supported by technology. The author focuses on concepts and applications, which are guaranteed to improve production results and energy efficiency. The chapters of the book are as follows:

1. Change Your Way of Thinking about Compressed Air
2. Designing a New System
3. Troubleshooting the System
4. Instrumentation and Information Management
5. Compressed Air Storage and Using Potential Energy
6. Piping and Piping Systems
7. Compressor and System's Controls
8. The Business of Demand
9. Supply Energy
10. Cleaning Up Compressed Air
11. Standards and Specification

The cost of the book is $195.99. To order the book, make a check or PO out to: Air's a Gas, Inc., 3728 Berenstain Drive, St. Augustine, FL 32092, or call 904-940-6940, fax 904-940-6941 or e-mail: airsagas@aol.com. A portion of the proceeds from this book will be donated to selected children's charities.



New Edition of "Best Practices for Compressed Air Systems®" from the Compressed Air Challenge®

The Compressed Air Challenge® has released the Second Edition of their authoritative "Best Practices for Compressed Air Systems®."* The Best Practices manual provides tools needed to reduce operating costs associated with compressed air and to improve the reliability of the entire system. The 325-page manual addresses the improvement opportunities from air entering the compressor inlet filter, through the compressor and to storage, treatment, distribution and end uses, both appropriate and potentially inappropriate. Numerous examples of how to efficiently control existing and new multiple compressor systems are provided in one of the many appendices.

The Best Practices manual created by the Compressed Air Challenge® begins with the considerations for analyzing existing systems or designing new ones. The reader can determine how to use measurements to audit their own system, how to calculate the cost of compressed air and even how interpret electric utility bills. Best practice recommendations for selection, installation, maintenance and operation of all the equipment are included in each section. BP

**The Best Practices for Compressed Air Systems® manual is a product of the Compressed Air Challenge®, co-authored by Bill Scales and David McCulloch and is not associated with Compressed Air Best Practices® Magazine.*

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