

How to implement leak detection techniques in compressed air

Regularly checking for and repairing leaks in compressed air systems will save your organisation money and cut its carbon emissions.

Compressed air is probably the most expensive energy source on your site. Of the total energy supplied to a compressor, as little as 8% to 10% may be converted into useful energy. The average leak rate in the UK is estimated to be between 20% and 50%, which represents a major cost to businesses, as well as unnecessary carbon emissions.

The business case

Using a contractor to carry out a survey on your site costs around £500 a day. The leak survey shown in Figure 1 took half a day to complete.

Ultrasonic detectors cost between £750 and £5,000, depending on their sophistication. Hire costs again vary, depending on the complexity of the machine, but shouldn't be more than £150 per week.

Table 1 gives an indication of just how expensive leaks can be depending on their size. The real cost to your business, though, also depends on energy prices and your operating hours.

Introducing a programme of detecting and repairing leaks will save you money and – though costs vary – should pay for itself within a year.

Table 1 Annual cost of air leaks

Hole diameter (mm)	Air leakage at 7bar (g)		Power to air leaks ² (kW)	Cost of leak ³ (£ year)	
	litre/s	cfm ¹		48 hours /week	120 hours/ week
0.50	0.20	0.42	0.06	10	26
1.5	1.8	3.8	0.54	95	234
3.0	7.1	15	2.1	365	920
6.0	28	59	8.4	1460	3650

¹ Cubic feet per minute

² Based on 300W/l

³ based on 7.3p/kWh

The technology

Most industrial maintenance staff will have the ability to detect and repair leaks, but you can also choose to use specialist contractors. The three methods outlined below are the main ways to detect leaks.

Listening for a hissing sound

The simplest method. This is really only possible when production processes have stopped or in quieter areas. It doesn't give a detailed picture of how big the leaks are, but will indicate where they are.

Using soap solution

Apply a soap solution to joints. The more bubbles, the larger the leak. Again, you won't get a detailed picture, but you will see where the leaks are and which ones are the worst. This can be very time consuming and messy but can be useful to pinpoint multiple small leaks in a specific area.

Ultrasonic detection

You can use this method at any time, even with production processes running. Not only is it the quickest method, it gives an indication of how bad each leak is so that you can work out what the leak is costing you and prioritise repairs.

Figure 1 shows the sort of results you can get from an ultrasonic survey.

Ultrasonic detectors aren't difficult to use, but you need to decide whether to:

- Use a contractor to carry out the survey.
- Hire a detector to carry out the survey yourself.
- Or buy a detector and its software.

All three approaches can be used with any compressed air system – from small garages to major chemical plants. Your choice of detection method will depend on the size and complexity of the site you need to check. Small systems won't usually need an ultrasonic survey, but large ones will be able to justify the costs.

Figure 1 Example results from an ultrasonic survey

SUMMARY OF DEPARTMENTAL LEAK DETECTION RESULTS											
Calculations Based on the following:						Client: 0					
Annual Running Hours: 6000 hours						Location: 0					
Unit Electricity Cost: 7.7 p/kWh											
Generation Efficiency: 14.5 kW/100cfm											
Page & Area		Number Of Leaks	CFM	Estimated Cost Of Leakage p.a	Number	Remaining Leaks		Cost	Number	Repaired Leaks	
						CFM				CFM	Cost
Page1	Compressor House	5	15.5	£ 1,103	5	15.5	£	1,103	0	0	£ -
Page2	Engineers workshop	2	4	£ 285	0	0	£	-	0	0	£ -
Page3	Domino machine	4	18.5	£ 1,317	0	0	£	-	0	0	£ -
Page4	Jargenpurge	7	24	£ 1,708	1	2.5	£	178	0	0	£ -
TOTALS		18	62	£ 4,413	6	18	£	1,281	0	0.0	£ -
SUMMARY OF LEAKS BY SIZE											
Scale	Number	% of Total	Leakflow	TotFlow	LeakKW	TotkW	Leak£	Tot£			
1	0	0%	0.50	0.0	0.08	0.0	£ 36	£ -			
2	1	6%	1.50	1.5	0.23	0.2	£ 107	£ 107			
3	9	50%	2.50	22.5	0.39	3.5	£ 178	£ 1,601			
4	5	28%	4.00	20.0	0.62	3.1	£ 285	£ 1,424			
5	3	17%	6.00	18.0	0.92	2.8	£ 427	£ 1,281			
6	0	0%	8.00	0.0	1.23	0.0	£ 569	£ -			
7	0	0%	10.00	0.0	1.54	0.0	£ 712	£ -			
8	0	0%	15.00	0.0	2.31	0.0	£ 1,068	£ -			
9	0	0%	25.00	0.0	3.85	0.0	£ 1,779	£ -			
10	0	0%	100.00	0.0	15.41	0.0	£ 7,118	£ -			
Totals		18	100%	62.00	9.55	£	4,413	£			
									Total Cost of Leakage £ 4,413		
									Leakage Flow 62CFM		
									kW for Leakage 9.551875kW		

Specification checklist

Table 2 takes you through the stages of deciding how to detect leaks and then how to start the process.

Table 2 *Specification Checklist*

Consideration/Action	Comment
Will you use in-house staff or a contractor to carry out the leak detection?	Do you have the resources in-house?
Are there times when production is stopped?	If so, you can choose any of the three methods.
If production doesn't stop, use ultrasonics or the soap solution method.	Whether to hire or buy depends on the size of the site and how often you expect to use the detector.
If you've decided on in-house staff, hire or buy an ultrasonic detector.	

Commissioning checklist

If you decide not to use a contractor, you do need to allow time to train in-house staff and to carry out some basic preparation:

- Have a drawing of the compressed air distribution system available.
- Have tags available to identify any leaks you find.
- Carry out the survey.
- Mark the leak location on the drawings.
- Place a tag on each leak to identify it.
- Calculate the energy and cost losses from the leaks.

Common problems

Detecting leaks is easier if the production plant is closed down, but there are still some problems you may have to deal with;

- Other noises, such as steam leaks, can give false results in ultrasonic surveys.
- Soap solution isn't always an accurate indicator, as the solution can be blown off a large leak.
- Multiple leaks on a system can make it difficult to identify the largest one.
- Leaks at high level may be hard to detect without access equipment.

- If sections of pipework are valved off, there will be no pressure in the line and leaks will not show up.
- Out-of-date drawings of the air distribution system may not include all parts of the system.
- Guards or covers may need to be removed to access the leak.

It should also be remembered that over time new leaks develop and small ones worsen. Leak surveys should be repeated regularly to maintain low leakage levels.

Finding a supplier

You may already know of a good contractor. If not, the British Compressed Air Society may be able to help. They give technical advice and have a list of companies that offer inspection and maintenance services.

You can contact the British Compressed Air Society by phoning 020 7935 2464 or learn more about their services by visiting their website, www.bcas.org.uk