How to implement leak detection techniques in compressed air

Compressed air is probably the most expensive ‘energy’ source on your site. Of the total energy supplied to a compressor, as little as 8-10 per cent may be converted into useful energy at the point of use. To minimise inefficiencies, it is recommended to check for leaks regularly and repair them.

The average leak rate in the United Kingdom is estimated to be between 20% and 50%. This represents a significant cost to a company as well unnecessary carbon emissions. The detection of leaks and their repair is generally within the competencies of most industrial maintenance staff, however there are contractors who can supply the necessary expertise to assist with any repairs.

The benefits of fixing leaks are obvious, not only in cost savings but also in helping to reduce your carbon footprint.

The technology

There are three basic methods of detecting air leaks:

- Simply listening for a ‘hissing’ sound.
- Using a soap solution to identify leaks.
- Carrying out an ultra-sonic survey of all the compressed air system.

Listening for a ‘hissing’ sound

This is only possible with the production processes shutdown (e.g. after hours) and is only really effective if the compressed air pipe work is close to the ground. It does not give a quantitative evaluation of the leaks, only an indication of where they are occurring.

Use a soap solution to detect a leak

Manually apply a soap solution along the pipes. The more bubbles, the larger the leak. This method will not allow a quantitative calculation of the leaks, but will show where they are and which ones are the worst.

Ultra-sonic leak detection

This can be undertaken at any time as it does not need the production process to be stopped. The main advantage of this method is that it is possible to quantify each leak and decide upon the priority of repair. The use of an ultra-sonic leak detector is simple but you need to decide whether to:

- Use a contractor to carry out the survey.
- Hire the instrument to carry out the survey yourself.
- Purchase the unit and its software.

The ultimate choice will depend on the size and complexity of the site to be surveyed.

The scales on the instrument allow the size of the leak to be determined and hence its costs can be calculated. Table 1 is a summary of results that can be calculated from an ultra-sonic survey.

There are a number of suppliers who can either sell ultra-sonic leak detection equipment or carry out the survey and report the results. Ultra-sonic detection is the quickest method of carrying out a survey of a site. Any leaks found should be fitted with a tag to identify it and given a number so that once it is repaired, it can be shown on the summary as repaired.
How to implement leak detection techniques in compressed air

Table 1 Example output from an ultra-sonic survey

<table>
<thead>
<tr>
<th>Page &amp; Area</th>
<th>Number of Leaks</th>
<th>CFM</th>
<th>Estimated Cost Of Leaks p.a.</th>
<th>Remaining Leaks</th>
<th>Number</th>
<th>CFM</th>
<th>Cost</th>
<th>Repaired Leaks</th>
<th>Number</th>
<th>CFM</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Page 1, Compressor House</td>
<td>5</td>
<td>15.5</td>
<td>£ 1,103</td>
<td>5</td>
<td>15.5</td>
<td>£ 1,103</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>£</td>
</tr>
<tr>
<td>Page 2, Engineers workshop</td>
<td>4</td>
<td>18.5</td>
<td>£ 1,371</td>
<td>4</td>
<td>2.5</td>
<td>£ 178</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>£</td>
</tr>
<tr>
<td>TOTALS</td>
<td>9</td>
<td>44.9</td>
<td>£ 4,413</td>
<td>9</td>
<td>1.06</td>
<td>£ 413</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>£</td>
</tr>
</tbody>
</table>

N.B. CFM is cubic feet of free air per minute. This can be expressed in litres/sec or m³ per min. But the above example is typical of the units used in the industry.

**Application**

The above approaches can be applied to any compressed air system regardless of the size, from small garage systems to major chemical plants. The size of the system will dictate the technology to be used. Small systems will not need an ultra-sonic survey, but large ones will be able to justify the costs.

**Specification checklist**

Table 2 lists the key areas that need to be defined to detect any air leaks.

<table>
<thead>
<tr>
<th>Item No</th>
<th>Parameter</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In-house or contractor to carry out the leak detection.</td>
<td>Do you have the resources in-house?</td>
</tr>
<tr>
<td>2</td>
<td>Are there times when production is stopped?</td>
<td>This will allow a choice of methods to be used.</td>
</tr>
<tr>
<td>3</td>
<td>If no production stoppage is possible, then use ultra-sonics or the soap solution method.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>If in-house, hire or purchase an ultra-sonic leak detector.</td>
<td>This depends upon the size of the site and the expected number of times it will be used.</td>
</tr>
<tr>
<td>5</td>
<td>If using a contractor, obtain references or reports from their previous work.</td>
<td></td>
</tr>
</tbody>
</table>
**Commissioning procedures**

The set-up of the compressed air system will depend upon which method is chosen to detect the leaks. The use of a contractor conversant with the technologies given in the technology section will reduce any training time.

- Have a drawing of the compressed air distribution system available.
- Have tags available to identify leaks.
- If an ultra-sonic detector is to be used, ensure it has an in-date calibration certificate.
- 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**

The detection of leaks is easier if all the production plant is closed down, but there are some common problems that may occur.

- If an ultra-sonic survey is being undertaken, other noise sources, such as steam leaks can give a false result.
- The use of the soap solution does not always give an accurate level of the leak, as the solution can be blown off a large leak.
- Multiple leaks on a system can make it difficult to determine the largest one.
- Leaks at high level may be hard to detect unless access equipment is provided.

- Check whether sections of pipe work are ‘valved’ off. If they are there will be no pressure in the line and leaks will not be evident.
- Drawings of the air distribution system may not have been updated, meaning parts of the system are not shown.

**Finding a supplier**

The British Compressed Air Society is the main trade organisation for the compressed air industry. The organisation provides technical help and has a list of companies that can provide inspection and maintenance services. You can contact the British Compressed Air Society on 0207 935 2464, or visit www.britishcompressedair.co.uk

**The business case**

The use of a contractor to carry out a survey on your site will normally cost approximately £500 per day. The leak survey shown in ‘The technology’ section took half a day to complete.

The cost of purchasing ultra-sonic detectors can vary from £750 to £5,000 for complex ones. The cost of hiring the instrument will again depend upon the complexity of the instrument, but the cost should not exceed £150 per week.

Leaks can be costly as Figure 1 below shows; note that the costs of leaks will vary depending on energy costs and operating hours.

A policy of implementing a leak detection programme will show good business benefits, from both a cost and energy saving viewpoint. The cost of repair of the leaks detected will vary, but typically a simple payback of less than one year can be achieved.

---

**Figure 1** Approximate electricity costs per year Vs size of leak

![Graph showing electricity costs vs size of leak](image)