Operational optimisation measures for companies: Compressed air

swissenergy

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Compressed air

Compressed air leaks cost you precious money

Even well-maintained compressed air systems are not free of leaks. They must be inspected every year and the leaks must be rectified – but at the latest when the compressor leaps into action for no reason during the night even though the plant is inactive.

Action

Inspect the compressed air pipe system for leaks every year. Mark the leaks and seal as many of them as possible.

Requirement

You have a compressed air system that operates for at least 4 hours every day.

In a poorly maintained compressed air network, an average of 40 percent of the air is lost through leaks.

What to do

1. Track down the leaks

- Use the leak detector to systematically check pipes, connections and plants. You will find most leaks in the last few metres near the end consumers.
- Note down the leaks you find on a leak record (there is a model in the "4-step check to optimise a compressed air system" – see the additional information).

2. Repair the leaks

Rectify the leaks you have identified:

- If possible, seal the leaks immediately – for example, by tightening up screwed connections.
- Use a coloured label to identify leaks that cannot be rectified immediately. Note the location of the leak and the materials needed to rectify it.
- Order the materials needed to rectify the leak.
- Once the materials have been delivered, seal the leaks.

3. Repeat annually

The compressed air system must be checked for leaks at yearly intervals – because it's inevitable that new leaks will occur all the time.

Costs – effort

- Your own labour (detecting and sealing leaks):
  - 1 working day per year for small systems
  - 3 to 5 working days per year for larger systems
- Foam leak detector: approx. CHF 20 per can
- Leak detector: purchase prices start at CHF 1000
- Leak detector, weekly rental price: approx. CHF 150

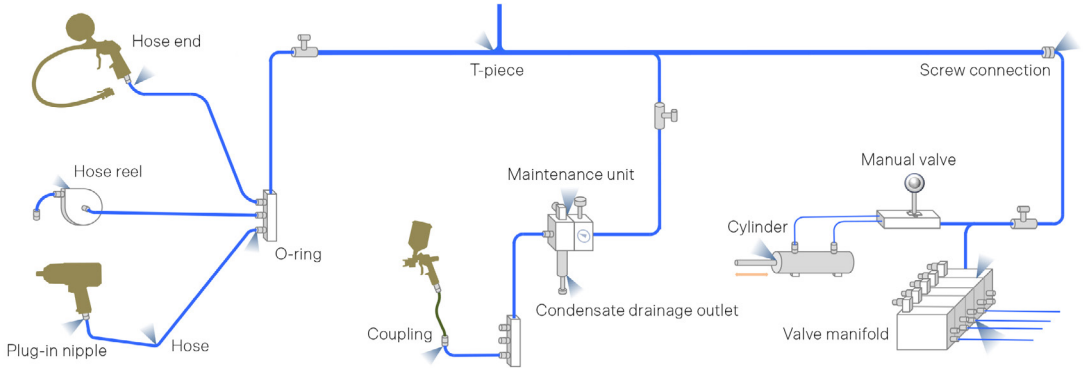
Please note!

- Compressed air is a form of energy that can be used universally – but it is also a very expensive form of energy.
- It is difficult to quantify the size of leaks because the volume of the noise created by escaping air (leakage noise) does not indicate how much air is being lost.
- It is hardly worth sealing leaks that are only active for a few minutes each day. Examples of these include faulty seals on a door opening cylinder when the door is open if the door is only open for 15 minutes per day.

Additional explanations

Typical weak points

Most leaks are found near the end consumers. It is particularly worthwhile to examine these areas:



100 percent airtight is not always possible

It is only possible to eliminate all leaks in a very small minority of cases. There are often leakage points that would take too much time and effort to seal. So: focus on those leaks that can be sealed easily and quickly.

How to rectify leaks

- Tighten loose screwed connections and replace old screwed connections that are not airtight
- Fit O-rings correctly and replace damaged O-rings
- Replace leaky couplings and plug-in nipples
- Tighten or replace hose clips
- Shorten or replace brittle hoses that are not airtight
- Have non-airtight valves and cylinders repaired or replaced by a specialist
- If components such as maintenance units have leaks, replace the seals or replace the entire unit

Hemp-sealed connections

Pipe systems with hemp-sealed pipe connections have an exceptionally high risk of leaks. The hemp paste dries out over time so the pipe connections are no longer airtight. Leaking screwed connections can often be sealed with Teflon tape. Check whether it would pay off to gradually replace the hemp-sealed pipe system with a modern, gap-free distribution system.

How to locate leaks

Use your ears: If all consumers are switched off, you will already be able to hear many leaks with your own ears. This method does not work in facilities with noise emissions that operate on a 24/7 basis – and it is also unsuitable for leaks outside of the audible range.

With foam leak detector: A simple method for small systems with few end consumers. The foam leak detector also allows detection of the exact location of leaks that could not be tracked down accurately with other methods (e.g. on valve manifolds).

With an ultrasonic measuring instrument: This method allows leaks to be located while production continues to operate, even in production halls with very high noise emissions. Models with a horn are better at focusing the sound waves, and they can locate leaks more accurately. A headset also makes it possible to hear the leaks. In addition, there are models that quantify the leakage rate in litres/minute and can even calculate the annual savings potential in francs.

Additional information

- Guideline on optimising compressed air: actions and tips
- 4-step check to optimise a compressed air system
- Efficient compressed air platform

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Shut the compressed air system down at night – and cut costs while you sleep

If production ceases at night or during weekends and there is no need to supply any equipment that consumes compressed air, the entire compressed air system can be switched off during these periods.

Action

An automatic start-up device automatically switches the compressed air system off and back on again. When switching off, it disconnects the pipe network with an electrically operated ball valve, so it turns off the compressor as well as the dryer.

Requirement

Ensure that the system does not have to supply any continuous consumers of compressed air such as ventilation flaps, diaphragm pumps, slide valves for water pipes, etc.

What to do

- From your supplier, obtain an automatic start-up device and a ball valve that can be controlled with a time switch. The ball valve should have the same dimensions as the outlet of the compressed air line downstream of the dryer.
- Install the ball valve downstream of the dryer.
- Ask the supplier to install the automatic start-up device.
- Programme the automatic start-up device so that it:
  - Switches off the pipe network, the compressor and the dryer with the ball valve 30 minutes after the end of operation (closing time).
  - Switches on the dryer and compressor 30 minutes before the start of operation (opening time). The ball valve is set to open slowly 15 minutes later.

Costs – outlay

- Depending on the size of the plant, installation of an automatic start-up device with a ball valve costs between CHF 2000 and 3000.
- For large systems with many leaks, the amortisation period for your investment is 1 1/2 years. For small systems with few leaks, the amortisation period is somewhat longer.

Please note

- The control requires a manual switch that makes it easy to start operating the compressed air system outside the programmed operating times.
- Important: a slow-opening ball valve must be used. Solenoid valves open too quickly, so they are not suitable for switching entire systems or sub-systems off and on. This is because switching the equipment on quickly causes what are known as pressure shocks or surges; these can cause major damage (ripped filters, water in the compressed air network, etc.).

Additional explanations

Switching the compressed air system on and off manually

The compressed air system can also be switched off and back on manually. But be careful to avoid errors when switching on and off manually, because if the ball valve is wrenched open when switching on instead of being opened slowly, the system can be damaged. Filters can be torn, and water or oil can penetrate the pipe network and cause serious damage to the machines. Experience also shows that people repeatedly forget to switch off manually. The compressed air system continues to operate even though no compressed air consumers are active. You can find instructions on switching on and off manually in the Guideline on optimising compressed air from SwissEnergy.

Screw compressors

Screw compressors must still “run on” after they are switched off and for this reason, they must not be switched off via the network connection. They must be switched off and on via the internal control, and an expert should be engaged to make the connection correctly.

Automatic disconnection of compressed air distribution from the generator

95% of leaks are located in the compressed air network and on the equipment that consumes compressed air. The compressed air generating system (compressor, preparation unit) is only responsible for 5% of leaks. If the compressed air distribution network is disconnected from the generator, most of the losses will be avoided. A somewhat less costly variant is to disconnect the compressed air distribution network from the generator. In this case, only a time-controlled ball valve is installed downstream of the preparation unit. Since compressed air preparation continues to operate during the night, this solution saves somewhat less energy. The Guideline on optimising compressed air from SwissEnergy describes this variant in detail.

Additional information

- Short film: Energy efficiency in companies: switch off the compressed air

- Guideline on optimising compressed air, information for staff responsible for compressed air
- 4-step check to optimise a compressed air system, work instrument for staff responsible for compressed air
- Guidance on compressed air, boosting efficiency in compressed air systems

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Images: zweiweg

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Optimise the network pressure

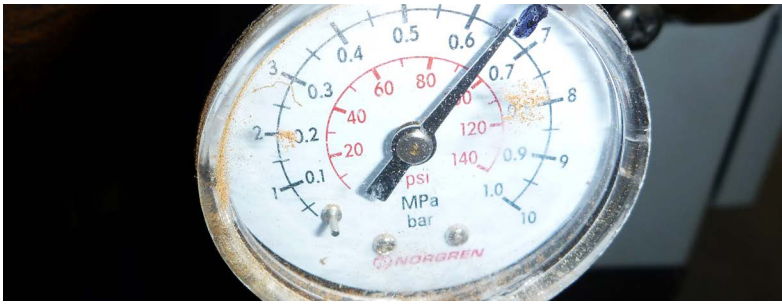
If the pressure in the compressed air network is too high, the costs of compressed air and energy will rise with no additional benefit. Leakage losses will also increase, and tools that use compressed air will wear out faster.

Action

Adjust the network pressure on the compressor to the actual requirements.

Requirement

If the network pressure is below 5 bar, there is virtually no further scope for optimisation. For optimisation of the network pressure to be (financially) worthwhile, the pressure should be above 7 bar.



What to do

- Read the pressure setting on the compressor (e.g. 9 bar).
- Note the operating pressure for every application (machine, compressed air tool or systems).
- The main applications (90% of consumption) determine the nominal pressure required in the compressed air network (e.g. 6 bar). According to a rule of thumb, the pressure set on the compressor should be about 1 bar higher (e.g. 7 bar). This compensates for pressure losses in the lines.
- For applications that require higher pressure (9 bar), you can install a pressure intensifier or a booster-compressor. If the high pressure is required because the compressed air cylinders are too small, you could also replace them with larger ones.
- If large consumers require a lower pressure (e.g. 2 bar), consider a second compressed air system.

Costs – outlay

- If the pressure in the pipe system is 1 bar too high, the energy costs increase by 7% – without any additional benefit.

Please note

- Excessively high pressure on the tool shortens its lifetime as well as increasing wear and operating costs.
- Optimising the network pressure of complex systems with multiple compressors is a challenging task that requires experience. In case of doubt, it is advisable to call in an expert.
- Higher pressure means more leakage losses – so less pressure automatically reduces the leakage losses.
- Users often keep the pressure high because it gives them more reserve energy in the compressed air reservoir. If the reserve energy is required, another option is to install an additional larger reservoir so the pressure can be reduced.

Additional explanations

Connection accessories: minimise pressure losses

Consistently and continuously replace old hoses for equipment that requires high air consumption with modern PU (polyurethane) hoses. Follow these basic rules:

- Short, straight hoses
- Large inner diameters for hoses
- Only use spiral hoses for the final 3 to 5 metres in front of the work location
- No unused metres of hose on the hose reel
- Couplings compliant with the European standard, with diameters of 7.2 mm, instead of couplers that meet the Swiss standard with diameters of only 5.5 mm.

You can find more information in the Guideline on optimising compressed air from SwissEnergy.

Only use spiral hoses for the final metres.

High-pressure jet nozzles

If you use jet nozzles that require high pressure, you should check whether you could use a nozzle with a larger diameter and lower pressure.

Check whether the workshop needs to be integrated

Almost every workshop uses compressed air – for example, to paint or varnish workpieces, blow chips away at the lathe, pump up the company van's tyres, or blow off the filter mats from the ventilation system. To keep things simple, the workshop is often connected directly to the production department's existing compressed air network.

In practice, however, experts frequently encounter systems that are set only for the workshop's requirements, at a pressure of 6.3 bar (or more) – even though the production plant could operate at 4.9 bar without any problems. These 2 bars of "surplus" pressure increase energy costs by 14% – or even more if the leakage rate is high.

So, check whether the workshop really does need to be connected to the compressed air network. A small decentralised compressor is often a much more suitable solution for the workshop.

Additional information

- Short film: Energy efficiency in companies: maximum performance from pneumatic tools

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Switch off sub-systems at night and weekends – and save costs

95% of leaks occur in the pipe network. This makes it worthwhile to disconnect sub-systems without permanent consumers from the compressed air network during the night and at weekends, when production ceases.

Action

Disconnect complete sub-systems and machines from the compressed air generator when no compressed air is required.

Requirement

You must make sure that no continuous consumers of compressed air (such as ventilation flaps, diaphragm pumps, slide valves for water pipes, etc.) are integrated into the sub-systems.

What to do

- In your compressed air distribution system, look for sub-systems that do not require compressed air after the end of operating hours (closing time).
- From your supplier, obtain a ball valve that can be controlled with a time switch. The ball valve should have the same dimensions as the compressed air pipe at the position where it is installed.
- Programme the time switch so that it closes the ball valve 30 minutes after the end of the operating period, and opens it again 30 minutes before operation restarts.

Costs – outlay

- Suppliers' prices for an electrical ball valve with a time switch start at CHF 350. The installation costs have to be added to this.
- The amortisation period for the investment depends on the size of the system and the number of leaks. Empirical values indicate that the investment pays for itself in about one year.

Please note

- If you intend to use this solution to disconnect the entire compressed air network, install the ball valve at the point where the compressed air line exits from the compressor chamber.
- Important: A slow-opening ball valve must be used. Solenoid valves are not suitable because they open too quickly. This causes what are known as pressure shocks or surges, which can cause major damage (ripped filters, water or oil in the pipe network).

Additional explanations

Disconnect machines with a solenoid valve from the compressed air network

Many machines operate with uncontrolled continuous consumers of compressed air, and they have leaks. They still consume compressed air when the machine is not operating.

In most cases, therefore, the machine can be disconnected from the compressed air supply when it is not operating. For this purpose, a solenoid valve is installed in the compressed air supply line upstream of the machine. The valve opens as soon as the machine starts operating, and closes when the machine is turned off. In case of doubt, ask your machine supplier whether the machine can be disconnected outside operating times. You can find more information in the Guideline on optimising compressed air from SwissEnergy.

A solenoid valve automatically disconnects a machine from the compressed air network.

Switching sub-systems or the entire compressed air system on and off manually

Individual sub-systems or the entire compressed air system can also be switched off and back on manually.

But be careful to avoid errors when switching on and off manually, because if the ball valve is wrenched open when switching on instead of being opened slowly, the system can be damaged. Filters can be torn, and water or oil can penetrate the pipe network and cause serious damage to the machines.

Experience also shows that people repeatedly forget to switch off manually. The compressed air system continues to operate even though no compressed air consumers are active.

You can find instructions on switching on and off manually in the Guideline on optimising compressed air from SwissEnergy.

Additional information

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