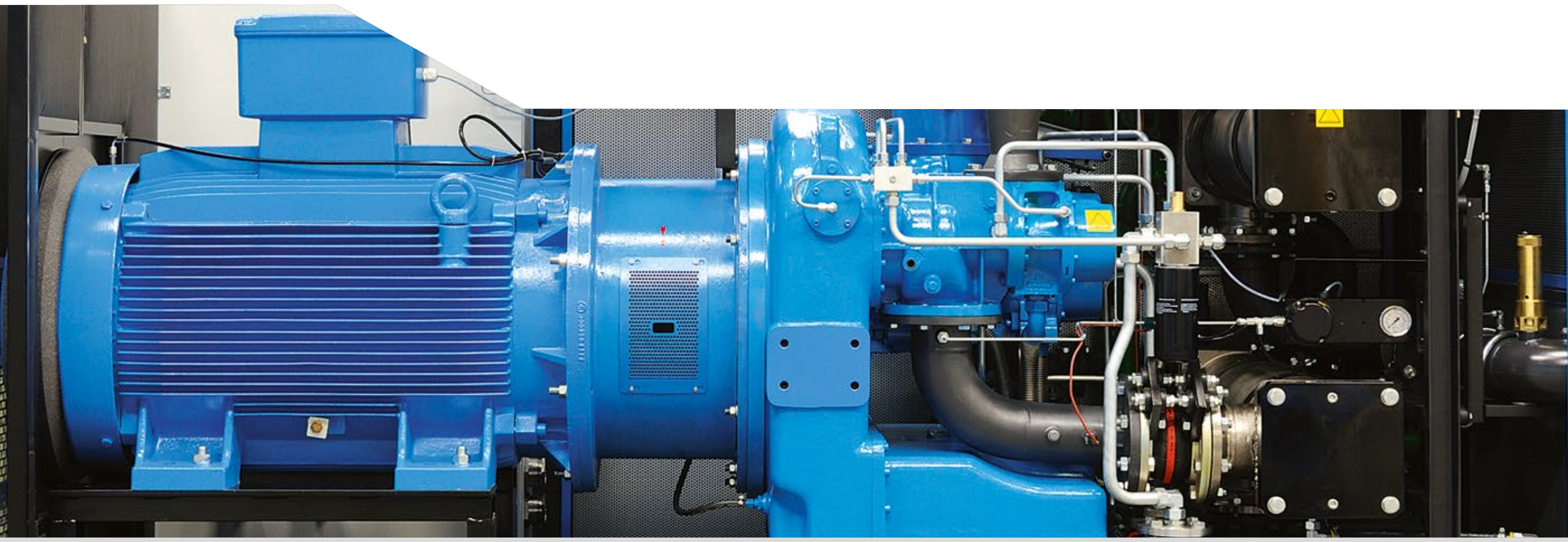
BOGE AIR. THE AIR TO WORK.

BOGE COMPRESSED AIR SYSTEMS

Oil-free compressed air systems explained



Compressed air is generated by either of two operating principles, positive displacement compression, or dynamic compression.

These two forms of compressing air work in different ways: a dynamic compressor converts speed energy into pressure energy, while a displacement compressor creates pressure by volume reduction. There are several kinds of air compressor, but essentially, they come in two broad ranges – oil-injected and oil-free.

An oil-injected air compressor works by injecting oil into the compression cavities of the unit. This does two things – it helps seal the unit (thus, reduces pressure drops caused by escaping air) and provides cooling (because compressing air produces heat that must be dissipated).

With an oil-free air compressor, the air is compressed entirely via the action of rotary screws (two meshing helical screws, known as rotors). In other words, it is a 'dry running unit' whose compression chamber is not lubricated and whose screws operate contact free. This means there is no oil to contaminate the compressed air.

Most oil-free compressors are of the rotary screw type. These are commonly used where large volumes of high-pressure air is needed, for example, in commercial or industrial applications.

Air is pulled into the compressor and 'squeezed' to a defined pressure in the compression chamber before being released into the wider compressed air system. Since this air does not come into contact with oil, it is clean and is therefore ideal for use in applications requiring high levels of hygiene such as food and drink processing and pharmaceutical manufacturing.

However, the name 'oil-free compressor' is something of a misnomer because this technology does, in fact, contain oil – but only for lubrication. Unlike oil-injected compressors, highly-efficient seals ensure no oil can get into the part of the compressor that comes into contact with the air, namely, the compression chamber.

A second type of compressor commonly used in industrial and commercial applications is the reciprocating or piston compressor. Piston compressors also come in oil-injected and oil-free versions. As the name suggests, they use a piston to compress gases to high pressure. In oil-free piston compressors, bearings are filled with grease and encapsulated.

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Also available are very large process compressors – otherwise known as turbo compressors – which are normally centrifugal. The key component that makes a compressor centrifugal is its impeller, which contains a set of rotating blades that gradually raise the energy of the air. This type of compressor is always oil-free.

However, there is a problem – although oil-free compressors don't introduce oil into the compression process, what about impurities, including oil, suspended in the ambient air? If you are drawing this contaminated air into the compressor and sending it out at a higher pressure, you are effectively processing dirty air.

Some compressor manufacturers, including BOGE, overcome this problem by installing a catalytic converter on the outlet of the compressor. Any residual oil content in the compressed air is run through the catalyst directly after leaving the compressor where the long chain hydrocarbons (chemical compounds whose main feature is an extended chain of carbon atoms bonded to hydrogen atoms) are 'opened' until only carbon dioxide and water, which occur naturally in ambient air, are left.

The result is oil-free compressed air and the elimination of the expensive downstream condensate treatment that would otherwise be necessary.

Because a catalytic converter is not subject to wear, has a service life of 15,000 or 20,000 operating hours and does not require filtration (so filter element changes are eliminated), maintenance is reduced to a minimum.

Oil-free compressors do have maintenance costs associated with them and these are typically higher than oil-injected compressors. However, the latest compressor developed by BOGE has lower maintenance costs than both oil-free and oil-injected compressors.

BOGE's High-Speed Turbo (HST) compressor – launched at the Hannover Fair in Germany in 2015 – uses an impeller driven at very high speeds. It is, essentially, a mini version of the turbo compressor mentioned earlier.

The BOGE HST contains no oil so, clearly, it needs no oil changes or oil filter replacements. On top of this, there are no gears in the machine and fewer components to change overall; indeed, it has only one moving part.

There is also a dramatic reduction in the number of bearings (which are wearing parts); the HST contains just six bearings compared with 19 in a typical oil-free screw compressor.

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Furthermore, the HST is quieter than a screw compressor, it requires less ‘off load’ power than conventional compressors and it weighs less than a third of an oil-free screw compressor.

Selecting the right compressed air system depends on a wide range of factors. Ideally, before the system has even been designed you should be considering what the compressed air is to be used for; what air quality, flow and pressure you need; and what future considerations there are in terms of expansion – in other words, how modular does it need to be?

You also need to look at the ambient conditions and whether you have enough power on site to run the compressed air system. Even relative humidity and altitude can impact on the specification in some circumstances.

So, specifying the best system is clearly a complex and time-consuming exercise requiring extensive knowledge of what’s available. That’s why it’s always worth consulting the experts before making a final decision. The best people to approach include compressor manufacturers such as BOGE, the British Compressed Air Society in the UK, and the Compressed Air and Gas Institute in the United States.

Turnkey solutions: the engineering element

If off-the-shelf compressed air systems just won’t do, manufacturers such as BOGE can offer customised packages. These might encompass design and project management, and the bespoke package itself might be a containerised or skid-mounted system completely kitted out as a ‘plug-and-play’ solution.

A customised compressed air package requirement is more common in oil-free applications than in others because oil-free systems are highly engineered and may need to meet specific compliance standards or certification.

Customisation can take many forms. One example is nitrogen generation systems (which require oil-free compressed air), which can be bolted onto compressor packages.

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Making savings

The next consideration is how to make your compressed air systems more energy efficient? After all, 75% of the total lifetime cost of a compressor is typically spent on energy (the remainder comprises an approximate 15% and 10% split between capital cost and maintenance respectively).

There are several ways you can save energy in a compressed air system. They include using:

Smooth bore pipes: This reduces friction losses in pipes so there is less of a pressure drop across the system. The lower the pressure drop, the less air you have to generate at source and the more energy you save. For every 1 bar reduction in pressure generation you can save 7% in energy costs.

Variable speed drives: These can be either fitted on a compressor or as a retrofit to a fixed speed compressor; they automatically slow down or speed up the compressor to match demand.

A fixed-speed compressor can run 'loaded' which means it is drawing in air, compressing it and delivering it, or 'unloaded'. Here, the system pressure builds until a setpoint is reached and the compressor begins to unload; the pressure then falls as the compressor vents its internal pressure before reloading and returning to its full capacity and producing compressed air.

This is governed by pressure control; in other words, the compressed air system will have a pre-set maximum and minimum pressure. When the system reaches its maximum pressure and air is being delivered, but not all being used, it runs 'unloaded'.

When a compressor is running unloaded, it shuts the intake valve, but the motor continues to turn even though there is no load on it. This means that, although there is a reduction in power consumption, the system continues to use some power – typically, 20% to 40% of the input power is still consumed unloaded.

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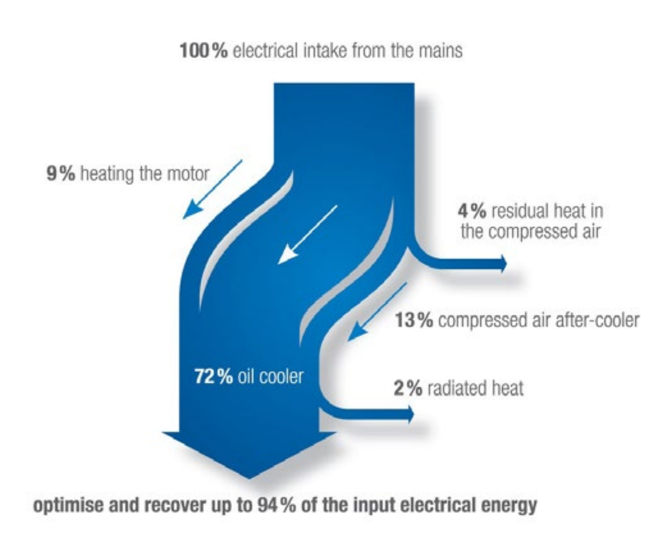

If, on the other hand, a fixed-speed compressor continues to use air, the pressure will fall to its minimum and the system will then ramp up again. If you were to record the pressure on a graph it would be in the shape of a shark's tooth, which isn't very energy efficient.

However, by employing variable speed technology, unloaded running is eliminated because it operates to a single constant target pressure, delivering only the compressed air required by demand. In other words, it does away with the shark's-tooth graph.

Heat recovery: More than 90% of electrical energy used by a typical air compressor is lost as heat, according to the British Compressed Air Society. However, this heat can be recovered and reused. You can recover this heat for space heating, for example, by venting hot air out of the roof of the compressor and ducting it directly to where you want the heat. By adding heat exchangers, waste heat can also be used to boost the temperature of water – to around 70 degrees C on an oil-injected air compressor and 95 degrees C on an oil-free compressor.

The potential savings are impressive. For example, say you have a 160kW compressor that runs at 70% capacity on average and 90% of the input energy can be recovered in heat. The calculation would be: 160kW x 70% x 90% = 100kW. So, you are recovering 100kW out of 160kW.

You can turn this calculation into money: Say you are running the compressor for 6,000 hours and your electricity tariff is 10p per kW/hour – that works out at 100kW x 6,000 hours x £0.10 = £60,000 savings.

To find out more about BOGE Compressors and specialist oil-free systems, please contact us or visit our website:
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