# The right blower for your processes

How to find the optimum low-pressure solution for your requirements

## Great potential for efficiency gains: How you can optimize your air blower in terms of energy

Aeration, pneumatic conveying processes, mixing, cooling, cleaning and drying, anyone who uses compressed air for these processes, a comparatively low operating overpressure of 0.3 to 4 bar is required. Which blower is best suited for its application? The requirements can vary greatly according to the project and segment.

From the planning of the low pressure air supply to the selection of the suitable low pressure systems through retrofitting and funding opportunities, we have included all important points about low pressure compressor solutions in this white paper.

At some points in the document, links are directed to further information that you might search the topic on the Internet.



## Which low pressure compressor solutions are suitable for my need? How do I build the optimum air supply for my processes?

Many industrial applications and processes require compressed air with a relatively low operating overpressure of about 0.3 to 4 bar (differential pressure to normal atmospheric pressure). In this range we name it low pressure. What companies need during planning and system selection processes and how users should optimize their air blower with greater efficiency and higher reliability, we have developed a new guide in the following chapters:

1. Industrial applications of blowers and low-pressure compressors
2. Aeration of sewage treatment plants: municipal and industrial applications for blowers in biological clarifiers
3. Correct planning of the air blower supply: Everything you need for planning, designing, maintenance and servicing of blowers and low-pressure compressors
4. Technology selection: rotary, screw or turbo blower?
5. For harsh environments: applications and advantages of rotary blowers
6. The all-rounders: applications and advantages of screw blowers
7. The energy savers: how turbo-blowers work, advantages and disadvantages
8. How to modernize air supply of your blower: retrofitting increases efficiency

# 1. Industrial applications of blowers and low pressure compressors

Many industrial applications and processes require compressed air with a relatively low operating overpressure of about 0.3 to 4 bar (differential pressure to normal atmospheric pressure). In this range we name it low pressure. In pneumatic conveying processes, cleaning and drying compressed air is required. For the aeration of clarification tanks or the flue gas desulphurization, compressed air can be supplied by air blowers and low pressure compressors, which are produced by using various compression technologies. Depending on the requirements for pressure, volume flow and operating times, rotary piston (lobe) blowers, screw blowers or turbo blowers are suitable (click here for a system comparison). When selecting the systems of compressed air supply, user demands on reliability, efficiency and life cycle cost play an important role.

In many industries, air blowers are used to supply their low-pressure processes with compressed air supply. Some examples:

» Building materials industry
» Chemical industry
» Power generation
» Beverage industry
» Food industry
» Pulp and paper industry
» Pharmaceutical industry
» Textile industry

As a rule, a clean air flow generated as efficiently and reliably as possible is required - in other words, high quality compressed air. Users can, for example use Atlas Copco Z-Series blowers and low-pressure compressors, which are oil-free air compressors and therefore deliver absolutely clean compressed air compliant to ISO 8573-1 (2010), class 0.

» What you need to know about compressed air quality and its Classification you will find here.

## 1.2 Pneumatic conveying with blowers

One of the most important applications for blowers and low-pressure compressors is the pneumatic conveying. In the food industry, the building materials industry, in the manufacture of tires, glass, plastics or soap, powders, granulates or semi-finished products, compressed air which is generally gentler than a mechanical conveying is used to convey the bulk material, so that the quality of the material is maintained during conveying process while a large material flow is preserved. In the food, pet food or pharmaceutical industry, it is require to maintain the quality and purity of the conveying air at very high level and to eliminate any risk of contamination.



Silo vehicles that transport powders or granulates to their destination, are extinguished by compressed air - for this purpose, mobile compressors are installed on the vehicles. On the other hand, the building materials manufacturers allows cement and other building materials to be transported by stationary low-pressure compressors from trucks to its silos. This solution make the quality of bulk materials increased while the compressor deliver ultra-pure and dry air at a constant air flow into the silo. Also, you don't need to worry about the frequent maintenance work on the silos.

## 1.3 Water treatment and flotation with blowers

In industrial and municipal sewage treatment plants, low-pressure compressors and blowers are used, for example, to clean the open basins where bacteria treat the wastewater (more information on applications in sewage treatment plants can be found in chapter 2). In the aerobic zones, aerators partially take over the mixing and thus replace more energy-intensive agitators. Also in public swimming pools or large aquaria, blowers are in use.

In flotation, fine-grained solids are separated by exploiting their different surface wettability from each other. The process usually takes place in water with a supply of air.

## 1.4 Mixing, cooling, cleaning and drying with compressed air

With compressed air generated by low-pressure compressors and blowers, powder and very sensitive products can also be mixed or dried. For example, seeds in the silo can be dried by the air supply which keeps it free flowing and dry.

Compressed air with a maximum operating pressure of 4 bar is also used for fittings and instruments: A leading glass manufacturer in Middle East switches, for example, the batching plant, in which the pre-products from the silos can be mixed according to specific recipes, with low pressure air.

Many companies also use low pressure air for drying, cleaning and cooling of products, tools or work surfaces. Thus, glass panes can be used after production and cleaning after being dried with blow air. High purity air blows away small dust particles from printed circuit boards and sensitive electronic components. With compressed air, components of different sizes can be cooled or dry.

The aeration of composting plants and the supply of compressed air to firing systems are more areas of application. Glass manufacturers use the compressed air with an operating overpressure of 3.5 bar for cooling the burners in the melting tanks.

# 2. Aeration of sewage treatment plants: Municipal and industrial applications for blowers in biological clarification tanks

Municipal and industrial wastewater treatment plants use blowers to treat wastewater: In the biological treatment stage when the tanks are aerated during the aerobic degradation processes. In addition, aerators can also mix the water and replace more energy-intensive agitators. But not only waste water from households, also for industry, waste water is treated in sewage treatment plants. Also leachate from landfills must be collected for treatment. In rural areas, treatment ponds will be used to pre-treat wastewater. By aerating in such wastewater ponds, their surface area can be reduced - in addition, the cleaning performance is increased while the aeration is increased.

About 70% of the energy is consumed by ventilation systems in a sewage treatment plant. An energy-efficient compressed air supply is therefore a suitable way to reduce operating costs. Not only municipal sewage treatment plants can benefit from, but also many dairies, paper manufacturers, breweries or bottlers operate sewage treatment plants will relief the burden from municipal facilities.

Atlas Copco has rotary piston (lobe), screw and turbo blowers in its low-pressure portfolio and thus offers the right solution for every requirement on compressed air. An overview of the technologies is given in chapter 4.

## 2.1 Bacteria want to survive: Reliable operation of the compressed air supply is indispensable in sewage treatment plants

For which blower or generally low-pressure system you can choose for a sewage treatment plant: The reliable supply of the activated sludge tanks and thus the supply of compressed air according to demand must always be guaranteed. Because the bacteria responsible for the degradation processes only survive for a short time without oxygen. The used blowers should be low-maintenance and run reliably - Operators in case of any doubt should have a redundancy plan according to your requirements. Depending on treatment plant, the inflow of wastewater can vary - and so can the compressed air requirement. Blower systems are suitable for this purpose, which have a variable speed control to meet air flow requirements. Atlas Copco offers blowers with fixed and variable speed. This means that individual machines can be used just as well as a combination of several blowers ensures energy-efficient operation and meet every need.

The ideal location for the blowers and equipment for air treatment is a separate room or container (more information about planning and design of the blow air supply can be found in chapter 3). For some applications, Atlas Copco blowers can also be set up on the outdoor area at the ambient temperatures between -20 and 50 degrees Celsius.



## 2.2 Ensure water quality with oil-free blowers

When aerating tanks in waste water treatment, impurities must be avoided by using lubricant oil. The blowers offered by Atlas Copco to waste water treatment plants are ISO 8573-1 (2010) Class 0 certified. During compression, air is free from oil contaminated. This is what Tüv has tested all Atlas Copco blowers and Z series compressors and confirmed by awarding the certificate. Companies and local authorities, who are looking for a solution for their septic tank aeration using “oil-free compressed air” is therefore always on the safe side.

## 2.3 Blowers for sewage treatment plants: How the reduction of operating costs impact on life cycle costs

The purchase cost of a blower is lower than its operating cost in the life cycle, in addition the maintenance costs especially the energy consumption need to take into account when investing in a new plant. Since waste water treatment consumes a lot of energy, municipal and some industrial wastewater treatment plants start investing in more energy efficient technologies. Read more about this in chapter 9: What the new municipal directive means for sewage treatment plants and how you can secure your investment.

It is worthwhile to invest in an energy-efficient compressed air supply to save energy and to improve the $CO_2$ balance. For high air demand in waste water treatment, it is recommended to use turbo-blowers (chapter 7) and screw blower (chapter 6) are most likely to be used if the compressed air is produced in an energy-efficient way in the long term. Roots blowers (chapter 5) are particularly interesting especially if the purchase budgets are very low. A comparison of the respective advantages and characteristics of the different low-pressure technologies can be found in chapter 4: Blow air supply: Rotary piston (lobe), screw or turbo blower - Which technology is the right one for my low pressure application?

## 2.4 Advantages of speed control and higher-level control in the blow air supply

For further energy savings and thus lower life cycle costs, the capacity of compressed air can also be adjusted with speed-controlled machines. All compressors and blowers from Atlas Copco, which are equipped with speed control, are marked with the abbreviation “VSD”. (= “Variable Speed Drive”, variable speed of the drive motor). With this solution, the volume flow is automatically adjusted to the air demand in adaption to the clarifier. This eliminates energetically poor idle times, and less compressed air is blown off, which was previously produced at high cost. A further measure to improve energy efficiency is to connect the blower with a higher-level control system. Such as the Optimizer 4.0 from Atlas Copco, it should be installed in compressed air room with more than one compressor and set up the most efficient compressor system. Blowers with speed control can be controlled preferentially to meet the respective compressed air requirements precisely and thus efficiently. Higher-level control systems can also be retrofitted (chapter 8) to upgrade in an existing compressed air room to make the system even more efficient.

# 3. Plan the blow air supply correctly: Everything you need to know about planning, designing, maintenance and servicing of blowers and low pressure compressors

In order to plan the blow air supply correctly and to design the compressed air room according to requirements, the first step is to analyze under which conditions the new low pressure compressor is working. The energy costs count a big amount in the blower's life cycle costs. Therefore, the system design should focus on the energy efficiency of the plant. You can plan from the very beginning also includes the expenditure for maintenance and servicing in order to maximize energy efficiency and reliability of your blower station over its service life and have an idea of the costs incurred.

## 3.1 The first step in planning the low-pressure compressor room

Before investing in the new low-pressure compressors or blowers, you need to know whether you are expanding an existing compressor room, or you are planning a completely new compressed air system for your processes? In any case, you should know the following key tips in order to optimally adapt the low-pressure systems to your requirements.

### 3.1.1 Correct volume flow of air blower is the basis

The volume flow of a compressor or blower is measured in cubic metres per minute or hour (m3/min and m3/h) or also in litres per second (l/s). It indicates how much air - in a defined physical condition - the machine sucks and compresses per time unit. The volume flow is therefore an important factor for the design of compressor room. Processes that require high but variable volume flows for example in sewage treatment plants, where the aeration tanks contain large quantity air at once, the volume flows of different blower can only be compared under the same conditions. For example, the blowers must have the same operating overpressure, relative humidity and suction pressure and temperature.

### 3.1.2 Determining the required operating overpressure

Blowers and low-pressure compressors supply air at an operating overpressure approximately between 0.3 and 4 bar (300 to 4000 millibar). Depending on which air pressure your processes require, there are different technologies (see chapter 4) available. The ZE-3S compressors from Atlas Copco, for example, compressed air in the range from 1.5 to 2.5 bar (operating overpressure), are suitable for the conveying of bulk material as well as the ZS 4 VSD⁺ series screw blowers with operating pressures up to 1.5 bar. The respective process requirements decide on which blowers are best suited. Lower pressures between 300 and 1000 millibar are common in waste water treatment.



### 3.1.3 Load of the blowers

Expected system load is crucial for the design of compressed air system. In sensitive processes continuously in need of compressed air, such as the aerobic processes in wastewater treatment, operators should keep backup blower for scheduled maintenance work or unexpected failures so that the air supply is not interrupted. If the compressed air demand fluctuates, the capacity can vary up to maintain balance to a certain extent even with large air tanks. If you know in advance that there will be a lot of downtime, you can variable-speed blowers that only supply air when it is needed and will save a lot of energy.

### 3.1.4 AIRScan helps to determine the compressed air requirement

To help companies determine their actual air requirements, Atlas Copco offers the AIRScan service. Especially for existing blowers, it will conduct a reliable analysis and at the same time propose improvements on energy efficiency. With the various configurations of AIRScan, the operator will be able to find the best low-pressure compressor solution for their requirement and achieve the most economical and ecological performance.

## 3.2 Location, piping, plug-and-play, compressed air treatment

When planning the blower station, the location is another important factor, as well as the compressed air piping system and the required compressed air quality. Waste water treatment, just like pumping, food or building materials, oil-free compressed air is required to ensure the quality not to impair bulk material. Therefore, when investing in a Blower or a low-pressure compressor, mare sure that the compressor generate compressed air without oil.

By the way, all compressors and blowers of the Z-series from Atlas Copco are absolutely oil-free and supplies correspondingly pure compressed air according to ISO 8573-1 (2010), class 0. The oil-free ZE-3S compressors from Atlas Copco, for example, have the plug-and-play design for different indoor and outdoor applications. The motor is designed according to the IP55 protection class and completely encapsulated, so that it is protected the compressor against dust. When the blowers are working in dusty environments, contaminated air would be sucked in, which can be treated with air dryers and filters in order to meet to the air quality requirements.

# 4. Selection of your air blower: positive displacement, screw or turbo blower?

Classical air blower applications cover the range from about 0.3 to 1.5 bar operating overpressure. These pressure can basically be achieved with different compression technologies. However, efficiency, operating and investment costs varies among different technologies. It is therefore worthwhile to carry out the required compression and to analyze the possible solutions across their entire life cycle in terms of energy consumption, reliability and costs. For the compressed air supply in low pressure applications, either rotary piston (lobe), screw or turbo blowers can be used, also these technologies can work combined with each other.

## 4.1 Positive Displacement Blowers are inexpensive

Positive displacement blowers are built up with a comparatively simple technology at an initially low price: the investment costs are significantly lower than a screw blower or turbo compressor. However, the higher energy consumption and maintenance requirements of the rotary blowers turn this advantage into the opposite after only a few years.

The work principle of positive displacement blowers is external compression, so-called "positive displacement" which consist of a pair of two- or three-lobe rotors, housed in an internal oval casing. As the rotors rotate, air at the inlet side and pressed out on the outlet side against the system pressure. The volume of air inside the machine is not changed. The machine merely shifts the air from the intake side to the outlet side against the resistance of the connected system.

Positive displacement blowers have a V-belt drive, which is comparatively maintenance-prone and energy losses due to mechanical transmission with it. In addition, return flows between the rotary lobes as well as incompletely filled delivery chambers have a negative effect on efficiency out. The intake volume flow is usually only about 90 percent usable.

Positive displacement blowers are available with operating pressures up to about 1 bar. However, due to their low efficiency, it is generally not recommended if the application requires a pressure of more than 400 to 450 mbar. This is because the working principle of external compression makes operation uneconomical in the long term.

Read more about the technology of rotary blowers in chapter 5.

## 4.2 Screw blower: Efficient, reliable and quiet

Depending on the pressure increase, screw blowers are about one third more efficient than corresponding rotary blowers. This is mainly due to the fact that the machines operate on the principle of internal compression and have a direct drive in which the motor and compressor element form a single unit. Possible pressure increases are around 0.3 to 1.5 bar.



The screw blower is a positive displacement machine like the rotary lobe blower. It consists of main and secondary rotors, which are arranged one on top of the other and thus reduce the volume between rotor and housing. Each screw blower has a fixed, integrated internal pressure ratio between suction and discharge pressure, which is set at a precisely defined geometry based. The efficiency of the screw blower is higher and more precisely while the pressure generated internally matches the required operating pressure corresponds.

The direct drive of the screw blowers not only has a positive effect on their efficiency, but also reduces the frequency of failures and the maintenance effort. The maintenance effort is limited to oil and filter changes. The screw technology offers further advantages with regard to noise, vibrations and reliability. More about screw blower technology please read in chapter 6.

## 4.3 Turbo-blowers: higher investment costs pay off

Turbo blower has the initially highest investment cost among all the blower technologies. However, there are applications - especially in the area of large volume flows - where a turbo can work more efficiently than a screw blower.

This is always the case when the compressed air requirement is relatively constant and the control range is correspondingly small. Where demand fluctuates and the control range is large, the screw blower is generally the more efficient solution.

Unlike rotary lobe or screw blowers, turbo blowers are dynamic compressors. Turbos have one or more compression stages. For low-pressure applications, single-stage systems are usually sufficient. Read more about the technology of turbo blowers in chapter 7.

## 4.4 Which system is the right one for my low pressure application?

The most economical solution in terms of purchase does not automatically result in the lowest operating costs. It is therefore advisable, even in the conception phase not only to consider the investment costs alone, but to keep an eye on the necessary expenditure over the entire life cycle of the machines.

There are no generally applicable solutions for the low pressure range. This means that it is not possible to say in general terms when rotary lobe blowers, screw blowers or turbo blowers are best suited. Each task must be considered individually on site and analysed in terms of volume flow, operating pressure and fluctuations in demand. An exact analysis of requirements can be obtained from Atlas Copco under the name AIRScan. Above all, volume flow and pressure influence the performance to be installed and thus the energy consumption. For example, a 100 mbar lower pressure increase can be achieved with up to 15% less power consumption.

If the demand is subject to strong fluctuations, it makes sense to work with a speed-controlled system. The speed control system automatically adjusts the delivery quantity to the respective demand and thus helps to significantly reduce energy consumption.

There are several solution options for each compression task. These must be compared in terms of costs, energy efficiency and operational safety. In addition to the investment

costs, the specific energy consumption of the blowers and the resulting annual energy costs and maintenance costs can be included in the payback calculation. This results in the most cost-effective and energy-efficient solution in the long term. In many cases, an additional investment in screw blowers or turbo blowers is likely to be worthwhile, as the operating costs of these systems are lower in the long term.



# 5. For harsh environments: applications and advantages of positive displacement blowers

The technology of lobe compressors is as old as compressed air production itself. The air in the compressor is displaced by a lobe and thereby compressed ("displacement principle"). The compressor, also known as the roots blower, generates an air flow at low pressure. Roots blowers are often used to generate air in industrial sectors such as waste water treatment, municipal water treatment, pneumatic conveying or even in chemical applications, as the technology is considered to be stable and reliable. As the first piston compressors, modern rotary lobe blowers are the same on basic principle. Today there are single or double stage low pressure compressors - oil lubricated as well as oil free.

## 5.1 Positive displacement blowers have reliable technology and low purchase price

Compared to screw blowers, the technology of the rotary lobe blowers less efficient - but depending on the operator's requirements, it has their justification: for example, should the acquisition costs be low, the cost-effective rotary blowers are suitable for applications and processes that are reliably supplied with the right amount of air have to. The blowers of the ZL 1-4 VSD series from Atlas Copco, for example, deliver not only reliably certified by the Tüv, absolutely pure compressed air in accordance ISO 8573-1 (2010), class 0, but they are also supplied with control and frequency converters are supplied, making them very easy for the user to install and to be put into operation. The variable speed of the ZL, recognisable the abbreviation "VSD", as well as the integrated control system contribute to a cost-effective operation. Because this is how exactly the quantity of highly pure blower air which is required for the respective application.

At an operating overpressure of about 250 to 450 millibar and rather short operating time, the rotary blowers show their advantages. The simple and robust design proves its worth even in harsh environmental conditions. The ZL rotary lobe blowers from Atlas Copco, for example, are also can withstand high altitudes and high ambient temperatures very well, so that operators generally do not have a separate room for these machines need. The blowers are low maintenance and require little monitoring.

In the meantime, Atlas Copco's ZL series rotary lobe units are now available as a standard option in various versions. They can be supplied with fixed or variable speed as well as ready for the installation with an external frequency converter.

### 5.2 Limits of the applicability of positive displacement blowers

The low efficiency of rotary blowers in contrast to screw or turbo-blowers limits the economically viable use of these technologies. From a pressure increase of around 450 millibars, we recommend in principle, Atlas Copco prefers to use screw blowers. For high air requirements, such as those found in biological wastewater treatment, the slightly higher acquisition costs for the screw technology via the saved energy consumption quite quickly. For high volume flows, rotary lobe technology is not an economical solution.

At low air consumption and very low operating pressures by about 300 Millibar, on the other hand, the Roots blower can be a reasonable choice. The chosen solution should always be individually tailored to the respective process requirements and requirements of the operator. Another disadvantage of the Roots blowers is their relatively high noise level, which is due to the way air is compressed: this takes place at full counterpressure, which results in high sound pressure. In addition, rotary blowers operate with a belt drive, which can wear and tear over time. It thus loses efficiency and must be replaced.



# 6. The all-rounders: applications and advantages of screw blowers

Screw blowers are among the all-rounders in compressed air technology. They are capable of reliably producing large, reliable and durable parts even in continuous operation and under harsh conditions to supply volume flows of high-quality blower air. Due to their large control range they are flexible for many processes, they are easy to install and are characterised by low life cycle costs due to their good energy efficiency out. Screw blowers are used in biological waste water treatment of sewage treatment plants, for pneumatic conveying and for numerous Drying and cooling processes in industry.

### 6.1 How do screw blowers work?

Screw blowers operate on the positive displacement principle. Here the air volume is enclosed and continuously reduced, which increases the pressure. In screw blowers, this compression takes place in a screw element: the space between the screw-like rotors fills with air whose volume is reduced by rotation. The air is thus “compressed”, “squeezed” or “compacted”. The ZS screw blowers from Atlas Copco, for example, have a direct driven, single-stage screw element. Due to the internal compression they consume considerably less energy than rotary blowers.

Screw blowers usually have a wider control range than positive displacement blowers; this means that they can be operated economically over a wider range of requirements. Depending on the model and supplier, they achieve operating pressures between about 0.3 and 1.5 bar.

Somewhat higher, by the way, is a pressure range which is systematically also still classified as “low pressure” and which extends to pressure increases of between 1 and 4 bar above normal atmospheric pressure. These pressures are provided by the ZE and ZA compressors from Atlas Copco, for example. These machines also compress oil-free with screw profile rotors. However, the term “blower” would be misleading here, which is why the term “screw compressors” is used.

All screw compressors are capable of meeting a high demand permanently and efficiently. Depending on the pressure conditions they are used in the following industries or applications:

- Pneumatic conveying
- Tank aeration in sewage treatment plants
- Fermentation
- Glass blowing
- Flotation in wastewater treatment

» Ore processing

» Paper Recycling

### 6.2 Advantages of screw blowers: High efficiency, high flexibility, low operating costs

The biggest advantage of screw blowers compared to rotary Lobe technology is their efficiency. This is because up to 80 percent of the costs that a low-pressure blower causes over its entire service life are energy costs. While the oil-free ZS screw blowers are more efficient than conventional rotary lobes can already save about 30 percent of energy, can Regulation the speed by means of a frequency converter even further savings can be achieved. Because the speed control ensures that the motor speed and thus the quantity of compressed air produced is adapted to the respective demand adapted. The screw blowers from Atlas Copco are available with or without integrated Frequency converter available (VSD). This means that the screw blower either supplied as a plug-and-play machine or for an external frequency converter is prepared. With fluctuating air demand the speed control pays off particularly well, as the required speed is always quantity of compressed air is made available at the right time and the Low pressure compressor does not consume more energy than necessary.

The change from rotary Lobe to screw technology can be paid off within a short time due to its lower energy consumption. A practical example can be found at Union Cement in the Middle East, where previously used 200 kW rotary lobe blower for pneumatic conveying and combustion was replaced with 160 kW ZS screw blowers and another replacement of 37 kW and 132 kW for kiln feed. Since of this replacement, minimum 25% savings on operating cost was brought to the customer.

Screw blowers also offer a wide range of volume flow and printing, so that for every low-pressure application from drying or cooling via pneumatic conveying to biological wastewater treatment many processes can be operated. All low pressure Screw blowers that Atlas Copco has in its portfolio also compress oil-free. To prevent oil contamination and the consequent production losses the screw blowers must be classified according to ISO 8573-1 (2010), class 0 certified. Critical processes and sensitive products are thus reliable protected from oil contamination.

### 6.3 Efficiency of screw blowers are further improved by new technologies

Efficiency of screw blowers can be increased even further, shows the example of the new series from Atlas Copco: In the ZS 4 VSD⁺ the the manufacturer with a highly efficient motor still a bit on the efficiency screw turned. The new ZS blowers are driven by a permanent magnet motor driven, which can be controlled over the complete control range of the machine - also in partial load operation - a nearly constant high efficiency of up to 97 percent. Thus the IE5 reference values achieved and even exceeded.

### 6.4 Service and maintenance of screw blowers

Unlike Lobe blowers, which are equipped with a drive belt, the screw blower has a direct drive. The single-stage screw compressor technology is low-maintenance, so that only minimal downtime is required for maintenance.



## 7. The energy savers: how turbo-blowers work, advantages and disadvantages

Turbo-blowers are suitable for low-pressure applications in a wide range of industries, such as wastewater treatment, pneumatic conveying in the food, cosmetics or building materials industry, but also for flue gas desulphurization. In contrast to positive displacement machines, which have a constant volume flow have centrifugal machines (“turbo blowers”, “turbo compressors”) always with a constant pressure. Their advantages are particularly evident where high volume flows are required. Turbos can work more efficiently here as a screw blower, at least with relatively constant compressed air demand, if correspondingly little needs to be regulated. In the case of more fluctuating requirements and with the resulting large control range, screw blowers are usually more efficient.

### 7.1 Turbo-blowers: Dynamic compressors work with constant air flow

Unlike rotary lobe and screw blowers, turbo blowers are so-called “dynamic compressors”. The performance of a dynamic compressor is influenced by external conditions: for example, a change in inlet temperature leads to a change in capacity.

In turbo-blowers the air flows in a centrifugal direction towards the outlet. The air is sucked in by a rotating impeller with centrifugal impellers in its center and is directed by the centrifugal forces to the outer edge of the impeller. For this reason, turbo-blowers are also called centrifugal blowers. Kinetic energy is generated by the centrifugal movement of the air. The subsequent deceleration of the accelerated air in the diffuser causes the kinetic energy is converted into potential pressure energy.

### 7.2 Low pressure applications between 0.3 and 1.4 bar overpressure

Turbos have one or more compression stages. In this range the blowers used in low-pressure applications usually work with the single-stage with operating pressures up to 1 bar. Efficient turbo blowers can be found at Atlas Copco in the ZB series. For low pressure applications with pressure increases in the very popular range between 0.3 and 1.4 bar, the centrifugal blowers of the latest generation are suitable (ZB 5-6 VSD⁺) especially. The directly driven, speed-controlled machines - certified according to ISO 8573-1 (2010), class 0 work highly efficiently and compress oil-free, which means that no oil is blown through the blower. into the process. This is for sensitive sectors such as the food industry, the bottling of beverages or the pharmaceutical industry are important, to prevent the product from being contaminated in the process.

**Possible applications of turbo blowers:**

» Pneumatic conveying of bulk materials in the food industry processing or the chemical industry

» Fermentation and packaging in the food industry

» Aeration in municipal and industrial wastewater treatment

» Flue gas desulphurization in coal-fired power plants

» Oxidation air for processes in the chemical industry

» Metallurgical processes in blast furnaces or in the glass industry

» Cooling of products in the manufacturing process, for example (PET) synthetic fibers

## 7.3 Advantages of turbo-blowers: Demand-oriented, high air supply and low maintenance

Thanks to their direct drive, the ZB blowers provide a constant Volume flow, as is desired for pneumatic conveying, for example. Also for processes which depend on a continuous air supply, the turbo blower of ZB 5-6 VSD⁺ series are particularly suitable. Thanks to the VSD⁺ technology the centrifugal blowers are among the most efficient low pressure generators: The provided volume flow is always adjusted to the requirements of the of the respective process, so that a demand-oriented air supply is possible with low energy consumption. The life cycle costs of the ZB turbo blowers are correspondingly low.

Turbo blowers equipped with magnetic-bearing motors work absolutely reliable. Compared to rotary blowers, its power consumption by up to 60 percent lower. The turbos are operated with volume flows between 2000 and 11 100 cubic metres per hour, have high-speed drive and operate vibration-free and without gears, because the motor impeller is flanged directly onto the shaft. The omission of a gearbox enables excellent efficiency and reduces the maintenance effort.

In addition, air foil bearing turbo-blowers are also available. This technology is relatively old and, despite occasional improvements, generally less efficient than magnetic bearings with extreme reliability issues compared to magnetic bearings due to sensitivity to dust, temperature and mechanical deformation due to the mechanical braking of the rotors and limited turn downs. Despite the air foil bearings machines score points with lower investment costs and their compact design. frequency converter, Control and high-speed drive can also be integrated here. After all they are about 15 per cent more efficient than rotary blowers; but over a complete life cycle, the advantage is practically always magnetic turbo or a screw blower.

## 7.4 Please consider with Higher investment costs and smaller control range

The disadvantage with a turbo-blower, in addition to high and tendentially constant air demand is also the comparatively high investment costs. In common, the operating overpressure of turbo blowers is 0.3 to 1.4 bar. If the air demand is not well calculated, for example, because the volume of organic substances in a sewage treatment plant vary greatly, it is not suitable to use this blower efficiently. In this case, those who require large turndown range and are looking for long-term economic efficiency, screw technology is a better choice.



## 7.5 Practical example: Turbo compressors for continuous high demand from 2.5 bar most efficient

With the turbo technology, multi-stage machines are also available. For large quantities of oil-free compressed air and pressure increases above 2.5 bar, for example, the turbo compressors of ZH/ZH+ series from Atlas Copco are ideal. Due to the higher pressure, they are not considered to be blowers and are suitable for many processes with pressure increases up to 13 bar. However, there are also many applications at the lower end in the low pressure range.

The turbocompressors are used for low-pressure applications such as glass production. A leading glass manufacturer in the Middle East use 400 kW multiple turbo compressors from Atlas Copco on 4 bar network with certified oil-free compressed air according to ISO 8573-1 (2010), class 0. Mainly required for blowing processes, air is used to switch the mixing plant, in which the glass production requires materials (mixtures) from the various silos can be mixed according to recipes. And in the melting tanks serves They are used, among other things, as cooling air for the burners. Due to higher efficiency of this technology on constant load and reliability this package was approved.

# 8. How to upgrade your air blower: Retrofitting increases efficiency

The refurbishment of an outdated air blower system is worthwhile. Because modern compression and control technology can drastically reduce the energy requirement. First and foremost, a detailed requirements analysis should be provided, on the basis of which the most efficient solution for retrofitting can be determined.

As an example, municipal sewage treatment plant shows the savings potential, which is often the refurbishment or retrofitting of an outdated blower air supply system: Any waste water treatment accounts on average for more than half of the electricity costs to the aeration of the biological treatment tanks. With the use of an energy-efficient, upgrade system, these costs can be quickly reduced by a quarter or more. This results, for example, for a compressor capacity of 200 kilowatts and an electricity price of 0.12 euros per kilowatt-hour, an annual Electricity cost will be saved with more than 50,000 euros.

## 8.1 Every upgrade should start with a needs assessment

Anyone wishing to upgrade their air blower system should start with a needs analysis. This should not provide the assumption that the installed power but must be replaced one to one. Because new technology is more efficient, gets more air out of the same amount of energy. Also leakages or an inefficient piping system can become a real problem. Therefore, the exact demand during operation must be measured for several days. Such an analysis can be used by all compressors and blower manufacturers. At Atlas Copco, this service is called AIRScan. As a rule, the following are performed during a complete week, measure the actual power consumption and the available, usable Volume flows. From the sizes and fluctuations result of the control requirement of the plant as well as its individual characteristic, this Information provides a good basis for optimizing the station.

**From the required volume flow and the control requirement follows the energy consumption point of view and technically optimal combination of the machines (hybrid ).** Different screw blowers can be used, but also turbo blowers or a combination of the two technologies can work. **All technologies used in the low pressure range blowers are not suitable for energy reasons.** In exceptional cases or for very low Pressure Increases approximately below 450 mbar lobe they may be considered. The systems are inexpensive for purchase due to its simple technology, however, the operating principle of these blowers are comparatively inefficient.

An overview of the different compaction principles can be found in chapter 4.



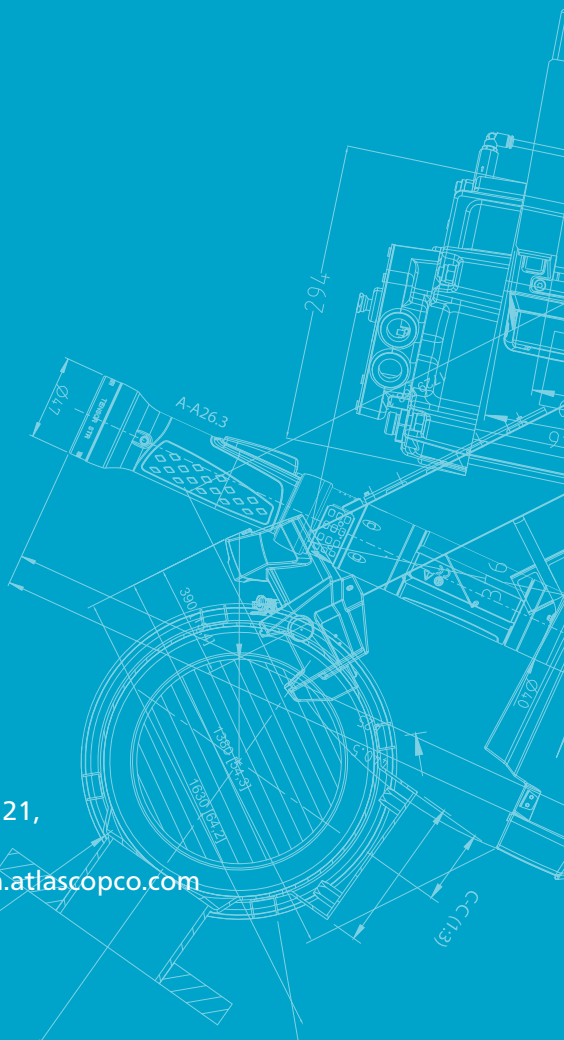
## 8.2 Renovation also possible and practical step by step on a small budget

In the event that a user who does not find the best option and buys a blower for financial consideration, can take the efficiency-enhancing solutions into account. The first step is to choose the solution that immediately saves the most from electricity cost and which is subsequently also sustainable. This approach is useful if the manufacturer you trust has a full range of air blower technologies with different power gradings - like Atlas Copco. Also a mixed arrangement for example with old rotary lobe blowers and one or more new screw blower is technically no problem and is already used in practice and implemented in many cases.

## 8.3 Use a modern advanced control and save money

Optimum control is always part of energy optimization. Already on its own, an advanced control system can be used to control and save 5 to 15 percent energy. Especially in old plants, the control systems are very often programmed by hand. Especially, if then new machines are added, the old controls can provide the optimum operating points of the entire station is not known at all. You would have to work with a lot of effort to re-program. It can therefore be useful to rehabilitation of the plant, including any existing control systems against a modern model to exchange.

Atlas Copco provides tailor-made central control systems “off the shelf” with its energy saving systems from the ES series and with the new Optimizer 4.0. All interfaces to higher-level control rooms are included in the systems, and it is ensured that the best solution - and that is the one with the lowest overall specific power consumption - is always sought.



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