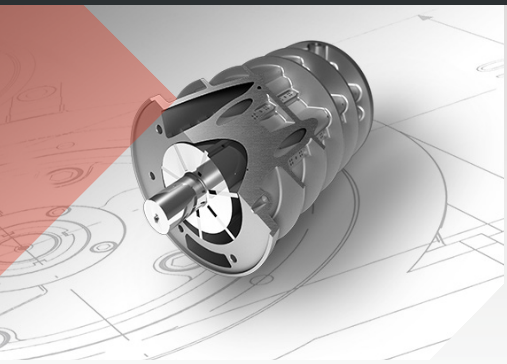
Long-Term Energy and Financial Advantages of Vane Compressors



Mattei is frequently asked why we manufacture rotary vane compressors, when most other manufacturers offer screw compressors. We encourage you to continue reading to learn more about rotary vane compressors and the performance and efficiency benefits they provide versus traditional rotary screw compressors.

What is a Rotary Vane Compressor?

A rotary vane compressor is a volumetric rotary compressor. It consists of a rotor that rotates in a stator, typically cylindrical. The rotor has longitudinal slots with each slot containing a sliding vane. The rotor is offset in the stator *(Figure 1)*. While the rotor turns on its axis, the vanes slide within their slots and are pushed against the stator by centrifugal force alone. Each section of adjacent vanes encloses a volume of air between them during rotation. This variable volume begins at its maximum value, corresponding to the maximum entrance of the vanes, and sweeps to its minimum value, at the point where the stator becomes tangential with the rotor, and vice-versa. The volume within the vanes increases during air intake. This increase in volume naturally draws air from the atmosphere into the pump. Just as the volume between the vanes reaches its maximum level, the vanes seal off the intake. After this, the volume progressively decreases during the compression stage. Its smallest volume (highest compression) occurs just as the delivery ports are uncovered by the vanes, forcing the highly compressed air out of the pump *(Figure 2)*.

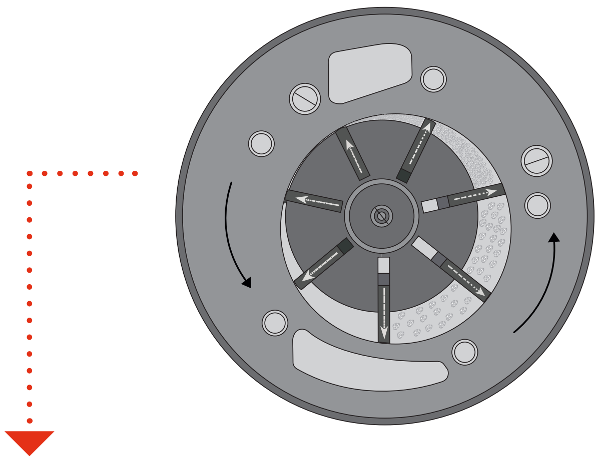


FIGURE 1

Centrifugal Force

When the rotor turns, centrifugal force holds the blades against the internal wall of the stator, which ensures perfect sealing of the air.

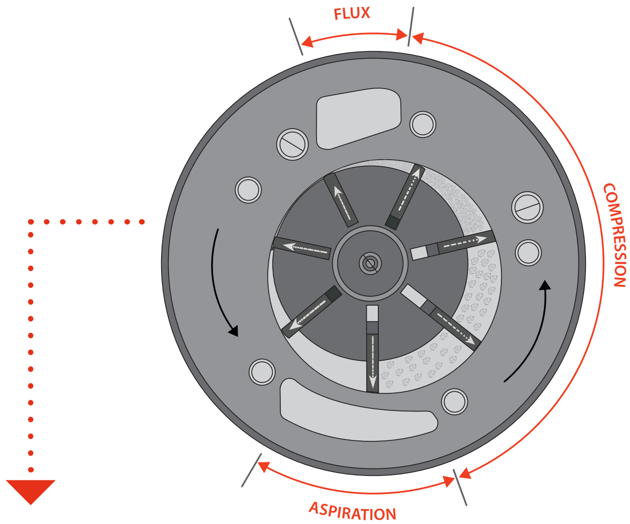


FIGURE 2

Compression – Intake

During the air intake phase, the air volume between two adjacent blades passes from the minimal value at the closest tolerance of the rotor in relation to the stator, to the maximum capacity in the diametrically opposed zone, and vice-versa during the compression phase.

Strada Padana Superiore, 307
20090 Vimodrone (MI)

Tel. +39 02 253051 • Fax +39 02 25305243
Info@mattei.it • www.matteigroup.com

What is a Screw Compressor?

The screw compressor is also a volumetric rotary compressor. It is composed of two parallel rotors with external helical profiles (screws). This enables the two rotors to engage smoothly, one into the other. The two rotors are closely fitted in a stator made from two cylinders which intersect longitudinally and in which the rotors turn with a highly critical minimum clearance *(Figure 3)*. The rotor shafts are supported by roller bearings and generally, one rotor drives the other by means of the interlocking helical profiles. Sometimes, they are driven by a pair of external gears. Although this can drive more power into the system, it requires the two rotors to be fully synchronized. During the rotation, the screw profiles uncover an intake orifice at one end of the stator. As the profiles open up across this orifice, it draws air into the expanding volume between the profiles. This air is then separated between the two screws and trapped against the stator wall as they rotate around their axis. On the opposite side, the screw profiles penetrate into each other, reducing the volume, compressing the air and delivering it to the uncovered outlet port.

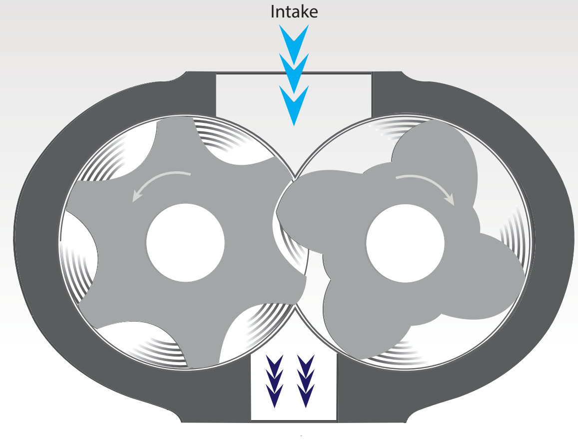


FIGURE 3

The rotors are fitted in a stator made from two cylinders which intersect longitudinally and in which the rotors turn with the minimum clearance.

Basic Similarities & Differences

Although the rotary mechanisms are different, most of the other components required for the operation of the compressors, such as oil coolant, separator, pressure regulating valves, non-return valves, etc., are common for both vane and screw compressors. The difference is in the compressor design adopted by each manufacturer, based on technical, economic and aesthetic considerations. This comparison will be limited to the vane and screw mechanisms, which are at the heart of each compressor.

Volumetric Efficiency

The relationship between the effective air delivery and the geometric volume defines the volumetric efficiency of a system. This efficiency is affected in each rotor stator unit by air leakage. This is most critical in the area under the highest pressure towards the intake. It is important that these leakages are kept to an absolute minimum. The energy required to recompress the air that leaks near the intake, is a loss. The smaller the internal leakage, the more the volumetric efficiency increases and the required power per measuring unit of delivered air is reduced (specific energy).

Air Escape Along the Stator Surface

In a rotary vane compressor, the vanes are always in contact with the internal surface of the stator *(Figure 1)*. The air seal is practically perfect. Because of minimum clearances due to machining tolerances and operation of the set, there is a slight possibility of escape along the surface where the rotor is at a tangent to the stator. Even when there is just one vane *(Figure 4)* between the delivery and the intake ports, this vane will prevent the air escaping from high to low pressure. In practice, the air leakage is greatest in a new rotary vane compressor when compared to older, well maintained, compressors. Over time, as the vanes sweep along the stator, they begin to polish down any microscopic surface irregularities along the wall. This creates a process in which the air seal becomes tighter over time.

Furthermore, the large volume of oil injected into the stator lubricates the moving parts and cools the air during compression. It also seals the clearances between the rotor, stator and end covers. It is along the surface where the rotor touches the stator (tangent point) that the oil, pushed by the air pressure, slips into the space between the delivery ports and the adjacent blade and seals it *(Figure 5)*. This is not the case in a screw compressor, where there must be a minimum clearance between the external profile of the rotors and the internal surface of the stator. This is necessary to allow the rotors to turn without touching the stator walls. It is, therefore, unavoidable that a certain volume of air leaks from the high pressure to the low-pressure area in a rotary screw compressor. This can only be limited but never eliminated, even by high precision machining *(Figure 6)*.

FIGURE 4

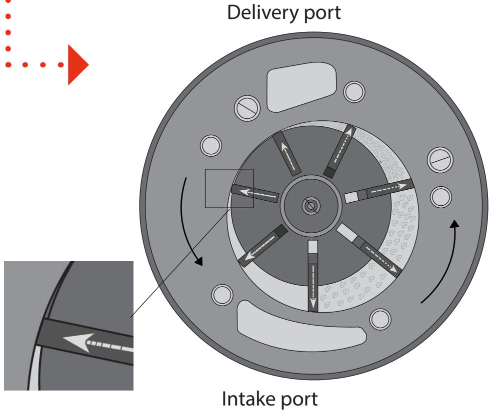
One blade between the intake and delivery port will prevent the air from passing from the high pressure to the low-pressure side.

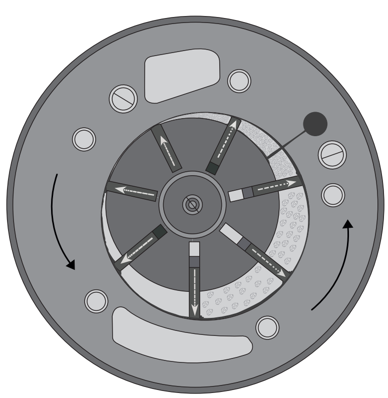
FIGURE 5

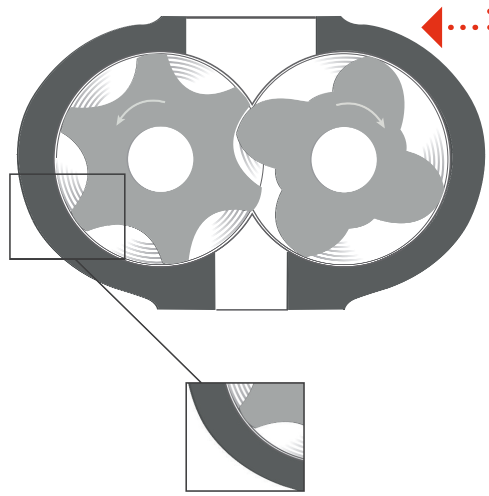
The oil injected into the stator lubricates the moving parts and cools the air during compression. It also seals the clearance between the rotor, stator and end covers.

FIGURE 6

Screw compressors need a very high degree of machining accuracy, otherwise the rotors might touch and seize or the compressor has a very low operating efficiency.







Leakage Along the Side Planes

Due to its geometry, the air under pressure in a screw compressor produces axial thrust. This makes the rotors reduce their side clearance at the intake side, but increases its clearance at the delivery side, where sealing is most critical *(Figure 7)*. The side thrust is borne by roller bearings, preventing the rotors from touching the surface of the end cover. The air sealing is guaranteed by resistance, the quality of the bearings, as well as the machining accuracy of the couplings.

The vane compressor has no axial thrust pushing the rotor against either end cover. It is, therefore, unnecessary to control its axial position by means of bearings or thrust bearings. The rotor is free to move axially and is kept equally spaced from the end covers by means of an oil film, which comes out, under pressure, through holes in the end covers. This film prevents contact and provides efficient sealing *(Figure 8)*.

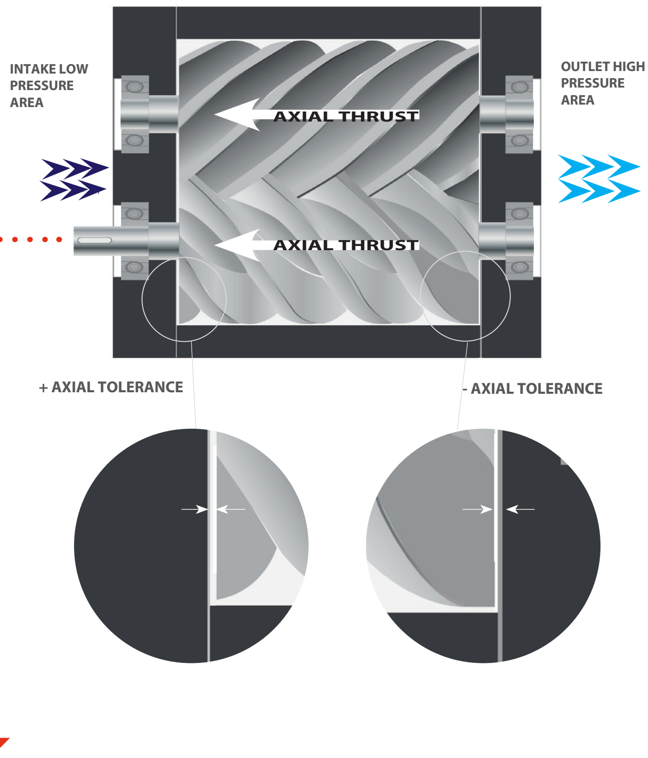


FIGURE 7

In a screw compressor, the air under pressure produces axial thrust, which reduces the clearance at the intake side and increases the clearance at the delivery side where sealing is most critical.

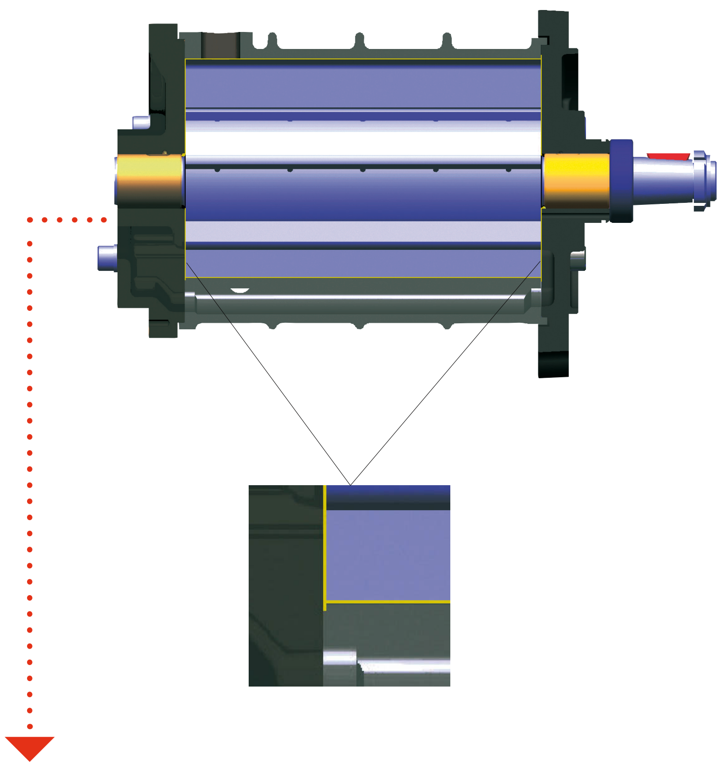


FIGURE 8

There is no axial thrust in a rotary vane compressor. The rotor is free to move axially and is kept equally spaced from the end covers by means of an oil film, which is injected under pressure. The injected oil prevents the air from escaping along the side planes.

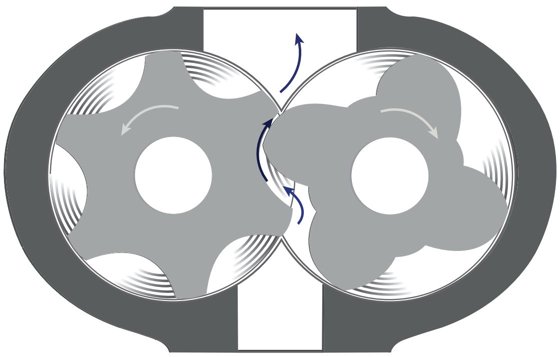
"Blow Hole"

The "blow hole" is unique to the screw compressor. It does not exist in a vane compressor. The "blow hole" is a gap where the profiles of the rotors meet at the intersection of the cylinders in which they rotate *(Figure 9)*. The geometries of the screws create this gap, in the exact location where the air under the greatest pressure is able to return to the area of lowest pressure. This technical problem is caused by the geometry of the screw compressors. All screw manufacturers have tried to reduce the effect of the "blow hole" by analyzing and redesigning rotor profiles to create smaller openings at this crucial point. However, the "blow holes" complete elimination is impossible.

It is possible to partially solve this problem by increasing the rotational speed of the rotors. This maintains the level of escape while increasing the air delivery. However, an increase in speed requires an increase of specific energy, higher wear and a shorter life span of the compressor. In air sealing and volumetric efficiency, the vane compressor is superior to the screw compressor. The volumetric efficiency of Mattei compressors is approximately 90%.

FIGURE 9

The "blow hole" in a screw compressor is where the external profiles of the rotors meet at the intersection of the cylinders in which they rotate. The air under pressure returns to an area of lower pressure through this hole.



Energy Consumption

This is the most important feature of any air compressor. It is defined by the energy required to compress a given volume of air to a certain pressure. Manufacturers continue to attempt to produce compressors with the lowest possible energy consumption. This results in higher compressor efficiency and lower operating costs for the user. Often highly efficient models can offset their purchasing costs by the accumulated energy savings in just a few years.

The table below illustrates the cost savings between a screw compressor and Mattei's MAXIMA rotary vane compressor.

As detailed in the table, a traditional oil-free screw air compressor uses an average of 8,2 kW/m³/min. If a company's screw compressor operates at 8,2 kW/m³/min for 8,000 hours per year with a cost of electricity of 0,15 Euro per kWh, the total cost for energy consumption would be €147.600 per year.

On the other side, Mattei's MAXIMA Xtreme rotary vane compressor uses an average of 5,2 kW/m³/min. Given the same scenario, if the MAXIMA Xtreme operates at 5,2 kW/m³/min for 8000 hours, and the cost of electricity is 0,15 Euro per kWh, the energy consumption for one year would be €93.600.

In one year, the cost savings of Mattei's MAXIMA Xtreme versus an oil-free screw compressor would be €54.000. In five-years, the cost savings would amount to approximately €270.000.

ENERGY CONSUMPTION COST SAVINGS BY TYPE OF AIR COMPRESSOR			
COMPRESSOR TYPE	**AVERAGE ENERGY CONSUMPTION**	**ENERGY CONSUMPTION IF YOU REQUIRE:** 15 kW/m³/min FOR 8000 HOURS AT 0,15 Eur PER kWh	**ENERGY CONSUMPTION IN 5-YEARS' TIME**
Oil-Free Screw	8,2 kW/m³/min	8,2 kW/m³/min (8,2 x 15 x 8000 x 0,15) = €147.600	€738.000
Oil-Flooded Screw	7,0 kW/m³/min	7,0 kW/m³/min (7,0 x 15 x 8000 x 0,15) = €126.000	€630.000
Oil-Flooded Rotary Vane: MAXIMA	5,5 kW/m³/min	5,5 kW/m³/min (5,5 x 15 x 8000 x 0,15) = €99.000	€495.000
Oil-Flooded Rotary Vane: MAXIMA Xtreme	5,2 kW/m³/min	5,2 kW/m³/min (5,2 x 15 x 8000 x 0,15) = €93.600	€468.000

One of the greatest energy losses in a compressor is internal air leakages. It is vital to keep these as small as possible, because the air lost during compression is lost energy. During the compression cycle, the air warms, as is defined by the Ideal Gas Law. With the increase in temperature comes an increase in the specific energy required to continue compressing the gas. This depends on the efficiency of cooling the system. In theory, the most efficient method of the reducing energy requirements is when compression occurs at a steady temperature with sufficient cooling. The more efficient the air-cooling the lower the power required.

Both vane and screw compressors are oil injected for cooling. The cooling takes place by introducing oil into the stator during the compression stage. This process is the same for both vane and screw machines. The quality/functionality oil cooling systems can be evaluated by the temperature of the oil: the lower the oil temperature the better the thermodynamic efficiency of the compressor.

Strada Padana Superiore, 307
20090 Vimodrone (MI)

Tel. +39 02 253051 • Fax +39 02 25305243
Info@mattei.it • www.matteigroup.com

Friction & Power Loss

Mechanical losses due to friction and power transmission increase with rotational speed. Screw compressors must run at high speeds to reduce the problems of unavoidable air leakages whilst vane compressors can work at comparatively lower speeds without encountering the same issues. A vane compressor can run at 1000 rpm while the average screw compressor must run at 3000 rpm. This is a great advantage for vane compressors as far as power consumption is concerned. Additionally, screw compressors are often fitted with speed increasing gears or belt transmissions to boost the screw speed, with respect to the electric motor. These gears cause additional energy losses as the power absorbed can exceed 5% of the transmitted power.

Vane compressors will work efficiently at the same speed as the electric motor. The compressor is connected to the electric motor with a flexible coupling, which does not cause any power loss *(Figure 10)*.

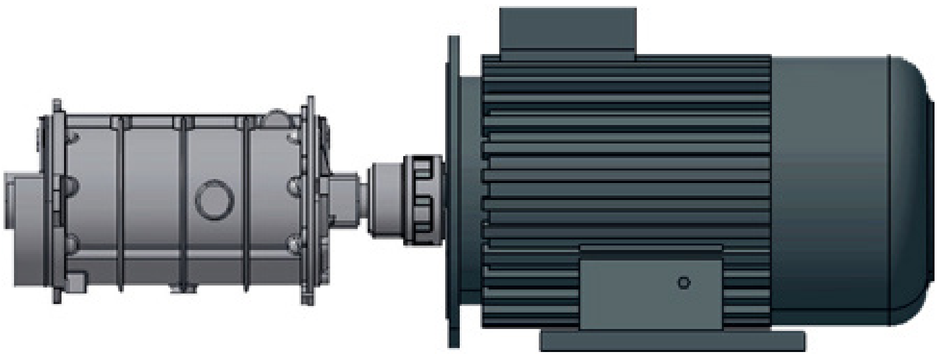


FIGURE 10

Rotary vane compressors work at the same speed as electric motors. They are connected to the electric motors through flexible couplings, which do not cause any power loss.

In order to better compare a vane or a screw compressor it is important to know the specific energy requirements at a given delivery pressure. Unfortunately, many factors are difficult to obtain when trying to make this comparison.

- **First**, manufacturers rarely state the actual power absorbed by their compressor and they usually only quote the rated motor output. Many times this is lower than the absorbed power because the electric motor is overloaded in comparison with the rated output (service factor).
- **Second**, some compressors are cooled by an auxiliary fan fitted directly onto the compressor shaft, while on others the fan is driven by a separate electric motor. In this case, it is necessary to consider the power adsorbed by the fan and add it to the total required power.
- **Third**, the stated performance might refer to the air end only without the necessary air filters and separation or to the complete unit including all fittings needed for the operation of the compressor. The air filter restricts the air inlet and reduces the airflow creating energy drag on the system as well.
- **Fourth**, all other fittings downstream of the air end, such as oil separator, non-return valve, after cooler and condensate separator will cause a significant drop in air pressure. Therefore, the power required by the compressor will be lower if the delivery pressure refers only to the outlet from the air-end instead of the downstream of the complete unit.

The average specific energy of a Mattei rotary vane compressor of the latest generation, including the cooling fan, is 15.49 kW per 2.83 m^3/min of free air delivered at the delivery pressure of 8 bar measured downstream of the moisture separator.

ISO specification 1217 gives a 5% allowance on the declared air delivery, and a 6% allowance on the specific energy. The specific energy for a compressor must be clearly stated. It can be roughly calculated by dividing the rated output quoted by the declared air delivery. However, since the rated output can be off by as much as 15% and the declared air-delivery usually has an error of 5%, an unrealistic value is easily calculated, being as much as 20% less than the actual energy required.

The quality of the performance of every Mattei rotary vane compressor is the same, without any significant differences between the various models – besides the obvious. The free air delivery is not affected by the machining accuracy or by the clearances between the fixed and rotating parts. The blades, moved by centrifugal force, are constantly in contact with the stator and always seal *(Figure 11)*. Even the axial clearances do not need great accuracy because they are sealed by the oil, which is injected under pressure through the side covers *(Figure 8)*.

In a screw compressor, the air seal is extremely sensitive to the accuracy of the machining of the rotor (the rotors should perfectly seal along the contact line), the accuracy of the center distance, to the clearance between the two rotors and the stator, as well as to the axial clearance, which is regulated by the thrust bearings *(Figure 6)*. There can be several differences between the operating capabilities within the same models of screw compressors, based solely on the precision of their machined rotors. For this reason, we talk about first choice and second choice screw compressors.

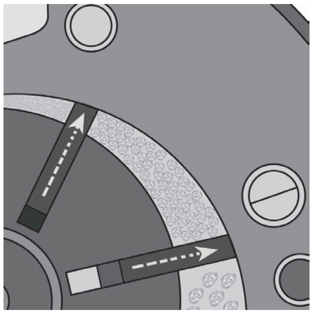
Reliability & Operating Life Expectancy

Time does not reduce the performance of a well-maintained rotary vane compressor. Their rounded edges and abundant lubrication during rotation ensure that the vanes slide on an oil film preventing direct contact with the internal surface of the stator. This results in only negligible wear of the vanes. The working life of the vanes is practically unlimited: they can operate for over 100,000 hours without wear. In fact, some Mattei vane compressors have been known to last well over 230,000 hours. Even a slight wear of the vanes does not affect the seal. The vanes are made with a great degree of freedom to slide in the rotor slots; this is the reason they are always in contact with the stator *(Figure 11)*.

In a rotary screw compressor, the rotors are subject to friction on the flutes, due to the thrust caused by the male rotor on the female rotor when rotating. As the contact between the two rotors occurs along a tangential line, meaning very limited surface contact, the specific pressure can be so high as to break the lubricating oil film. If this occurs, metal will grind on metal and wear is unavoidable. *(Figure 13)*.

FIGURE 11

The blades move freely in the rotor slots and always seal against the stator wall. They do not need high machining accuracy and their performance does not deteriorate even after many thousands of operating hours.



To reiterate, a rotary vane compressor has no axial thrust and therefore no wear on the side surfaces of the rotor against the cover plates *(Figure 8)*. Furthermore, there is no contact between the rotor and the stator. The internal oil pressure prevents the rotor from touching the stator *(Figure 14)*. The same cannot be said for rotary screw compressors. The minimum clearance and the control of the axial thrust depend on the bearing fitted onto the rotor shafts, which turn with the minimum clearance. Should there be the slightest wear or relaxation of the bearings, the rotor would be pushed by pressure against the opposite side and touch the stator. This contact can result in severe consequences *(Figure 15)*.

FIGURE 12

There is no direct contact between the blades and the stator wall due to the profile of the blades. They slide on a film of oil and their operating life is virtually unlimited.

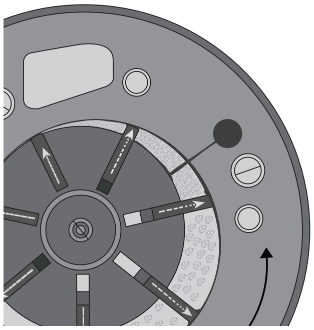


FIGURE 13

In screw compressors, the rotors are subject to friction on the flutes due to the thrust caused by the male rotor on the female rotor. The pressure can be so high as to break the lubricating film.

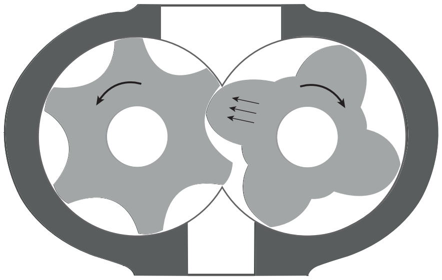
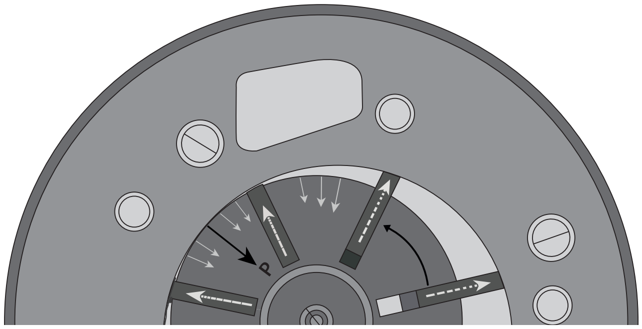


FIGURE 14

Internal air pressure prevents the rotor from making contact with the stator wall.



Simplicity of Design

In a vane compressor, the rotor shaft is supported by white metal bearings, which ensure a quiet and longer operating life than compressors with roller bearings, as are seen in screw compressors. Roller or taper bearings are needed in a screw compressor because the rotors have to operate at high speed with high axial accuracy and minimal clearances between the rotors, housing and endplates. If the two screws touch or make contact with the stator, the compressor will seize *(Figure 16)*.

It is common to have the need to replace screw compressors bearings after only 24,000 hours of operation. With a vane compressor, the clearance between shaft and bearings is constant during the life of the compressor. Lubrication of the bearings is ensured by oil under innate pressure, without the requirement of any mechanical circulating pump, removing any risk of pump failure. It can be said that lubrication is proportional to the air pressure and consequently to the radial loads generated by the same: the higher the air pressure the more oil will be injected and the higher the oil pressure.

FIGURE 15

As soon as the roller or taper bearings start wearing in a screw compressor, radial pressure pushes the rotors against the diametrically opposite sides of the cylinder.

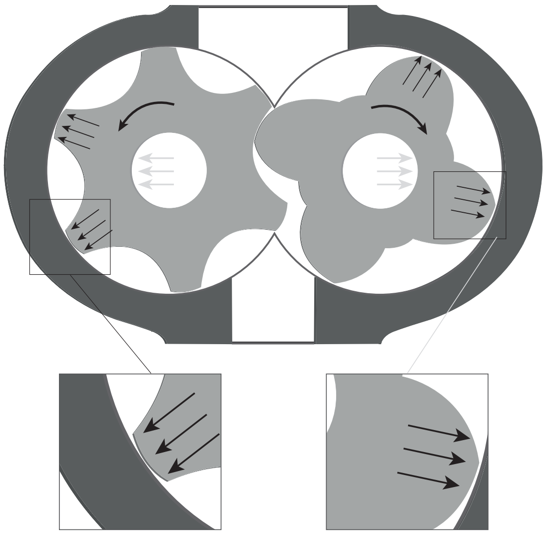
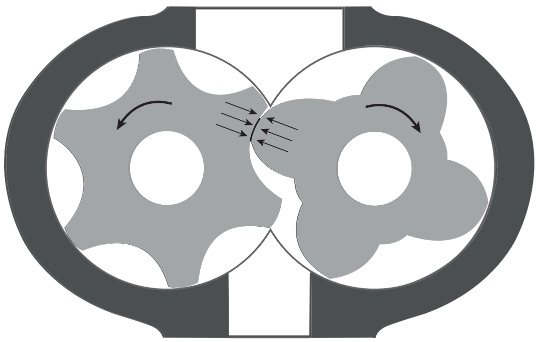


FIGURE 16

If the two rotors make contact, or touch, the stator the compressor will seize.



Strada Padana Superiore, 307
20090 Vimodrone (MI)

Tel. +39 02 253051 • Fax +39 02 25305243
Info@mattei.it • www.matteigroup.com

Metal Forming

The machining of the rotors for screw compressors must be carried out with special and expensive machine tools. The rotors of the screw compressor need to be made from very easily machinable steel. This is due to the large amount of metal removal and numerous machining operations required to form them. This type of steel is prone to galling under marginal lubrication conditions. Screw rotors that have been in service for under 2000 hours will have gaps and scars on surfaces. A screw compressor is at its highest efficiency when it is new. The clearances and leakages are at a minimum. As the compressor wears, the clearances enlarge.

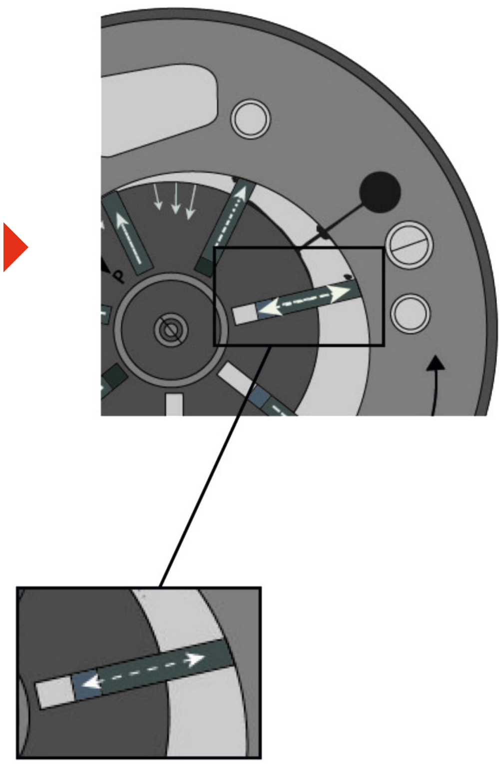
Machining of any part of the vane compressor can be performed with quality machine tools to ensure accuracy and inter-changeability of the parts. Any component in a vane compressor can be replaced without changing the part to which it is adjacent. This is not the same for screw compressors: the rotors are a 'matched pair'. A vane compressor is made from high quality cast iron. Cast iron is a perfect material for compressors. The highly porous surface retains oil protecting it at every engagement. Due to its geometry and metal configuration, the vane compressor actually improves with usage. With time, the blades will settle in on the stator and rotor slots. This reduces leakage and increase power efficiency. Eventually the compressor stabilizes at a level of 5 to 10% higher efficiency than when new.

Repair Costs

In screw compressors, the wearing parts are normally the rotors, the roller bearings, the gearbox, bearings and even the stator. Due to the inevitable wear of the bearings, the rotors eventually touch the cylinders in which they rotate. When this occurs the air end will require replacement. The failure of the air-end can cost up to forty percent of the cost of a brand new unit, while a full set of vane compressor blades costs less than 10 percent. Due to the additional cost of the screw air-end, there is usually a waiting time of several days or weeks, as the parts need to be ordered and manufactured upon request, whereas the vane compressor parts are inexpensive enough that dealers usually carry them on the shelf.

FIGURE 17

During rotation, the vanes follow the cylinder profile.



Why Choose a Mattei Rotary Vane Compressor?

Mattei's rotary vane air compressors are the leading solution for many commercial, industrial, OEM and transit applications throughout a diverse range of industries—and our value proposition says it all.

1. THE INDUSTRY'S LOWEST LIFECYCLE COST

Looking to cut costs? Look no further. Mattei's ultra-efficient rotary vane compressors won't leave your wallet empty. By combining a superior design and our innovative vane technology, we have developed the most reliable, durable and efficient vane air compressors available today. So what does this mean exactly?

- **Unmatched Efficiency:** Mattei systems are the most energy efficient compressors available on the market. The low rotational speed of the compressor unit, the high volumetric efficiency and the complete absence of roller or thrust bearings, results in an energy savings of more than 15%.

- **Superior Design:** The design of Mattei compressors is the result of more than 95 years' experience in the field of industrial air compressors. They produce THE most energy efficient, single stage, air and gas compressors in the world. Headquartered in Milan, Italy, Mattei's products are supplied throughout the world to a wide variety of industrial users ranging from small artisans to multinational food and pharma companies, for applications where energy costs, reliability and clean dry air are critical.

  The superior design of Mattei's rotary vane compressors ensures they are reliable and durable—and can reach 100,000 hours life without the need to replace any blades or other metal parts. The long operating life of a Mattei compressor is assured by high quality machining, which is the essence of rotary vane air compressors. Mattei's rotary vane air compressors are also incredibly silent and compact, so require little space and can be installed quickly and easily. Additionally, their accessible design makes maintenance operations simple and straightforward.

- **Unrivaled Performance:** All Mattei's compressors have a 1:1 ratio between the electric motor speed and that of the airend, which means enhanced performance and efficiency. Furthermore, the durable design of Mattei units means you won't see a reduction in their performance over time. With a Mattei, you will be buying your last air compressor first.

2. CUSTOMIZABLE HIGHLY INTEGRATED SOLUTIONS

Mattei has the solution you need. Our rotary vane air compressors are the leading systems for commercial, industrial, OEM and transit applications.

- AC Series sets a new standard in air compressors with sophisticated high-efficiency performance, quiet dependable operation and low maintenance

- The BLADE Series compressor range, with operating pressures from 8 to 13 bar, is the ideal solution for the needs of small and medium sized companies as well as artisan businesses

- Our ERC Series are traditional open-frame air compressors designed for performance and value. Known for reliability, each features sleek in-line construction, simple controls, quiet dependable operation and low maintenance.

- The MAXIMA Series offers reliable delivery of air, during continuous use. This energy saver is ideal as a base load machine and unrivaled in combination when using an energy saving OPTIMA compressor at variable speed as a trim machine.
- The OPTIMA compressors are Mattei's variable speed range. These compressors leverage Mattei's exclusive linear kW-to-capacity efficiencies to match their operation to suit the load profile required by the compressed air system, thus reducing the overall operations costs.
- Mattei also offers Air & Gas compressors for special applications.
- In addition to our rotary vane systems engineered for OEM use, we also offer custom-tailored solutions to meet our customers' unique and specific requirements.

3. OVER 100 YEARS OF HERITAGE IN COMPRESSORS

Mattei is the only 1.5 to 250 kW rotary vane manufacturer in the world. Through more than 90 years, we have successfully provided high-quality compressed air solutions for countless industries and markets throughout the world. Nearly a century of experience, combined with our rotary vane expertise, means we can provide you with the best high-quality solution for your unique application.

Product Quality

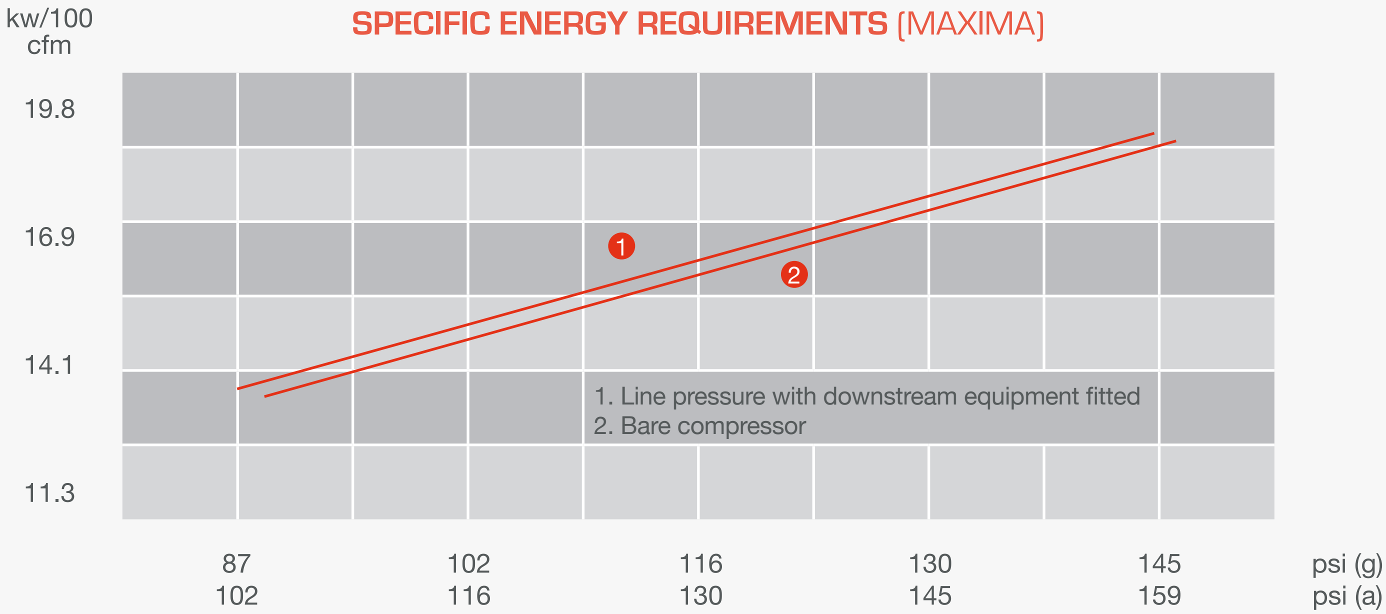
The rotors are made from cast iron, and so are the stator and vanes to ensure long operating life and stability. The vanes are lightened by deep parallel holes with a curved surface, easing their slide within the stator slots. These are real mechanical "jewels."

Performance of Mattei Compressors

The required power for a given unit of delivered air in Mattei rotary compressors is amongst the lowest that can be found in any modern screw or vane compressor. This is due to the continuous improvements of the rotor/stator unit. Mattei compressors have reached a power requirement of 5.2 kW/m^3/min of free air delivered at the delivery pressure of 7 bar (Maxima Xtreme).

Special attention is paid to the size of the air treatment equipment downstream of the compressor, such as oil separator, non-return valve, air final cooler, condensate separator and relevant connecting pipe, which are required for the final treatment of the compressed air. These are all designed specifically to reduce the pressure drop, because, the higher the pressure drop the higher the energy consumption. In Mattei Compressors, all fittings are an integral part of the compressor. The total pressure drop from these fittings is between 4-6 psig. The power required to compensate for this pressure drop does not exceed 3% of the total power requirement *(Figure 18)*. This is better than most other makes of compressor.

FIGURE 18: With Mattei compressors, the pressure drop through downstream fitting is minimal.



Oil Separation & Air Cooling

In Mattei compressors, the oil separation occurs in several stages and gives an exceptionally low oil carryover. The primary separation occurs in the oil chamber, at the outlet of the rotor/stator unit, along a labyrinth made by the external fins of the stator and the internal fins of the oil chamber. Secondary separation occurs at the inlet of the final separator, before the separator elements through the expansion and change in direction of the airflow. The final separation is effected through the filters themselves, removing the remaining oil vapor from the compressed air. This is a unique separation system not found in other brands' of compressors. By installing final oil removing filters, Mattei rotary vane compressors can be used in oil-free applications.

Effective oil cooling is imperative to the design of an air compressor, both for the performance (air delivered and power required) and for the safe operation of the compressor. By keeping the oil temperature low, its lubricating properties remain unchanged for extended periods, and the gaskets and seals will keep their flexibility for longer. This reduces the need for maintenance or repairs and the compressor will have a longer lifetime.

The oil temperature of Mattei air-cooled compressors normally does not exceed 55°C over ambient. This means that Mattei compressors can safely operate even at an ambient temperature of 45-50°C. On the other hand, it is always advisable that the oil temperature remains at the designated operating temperature, to ensure the efficient operation of the compressor and avoid condensation under particular operating conditions. Mattei compressors are also equipped with thermostatic valves, ensuring that the oil rapidly reaches its efficient working temperature.

In compressors without after coolers, the compressed air leaving the compressor is 44°C above ambient. In compressors with after coolers, the temperature of the air leaving the compressor is only 4-6°C above ambient. The more efficient the cooling of the compressed air, the more efficient will be the separation and removal of condensed water.

Capacity Regulation & Energy Saving Under Partial Load

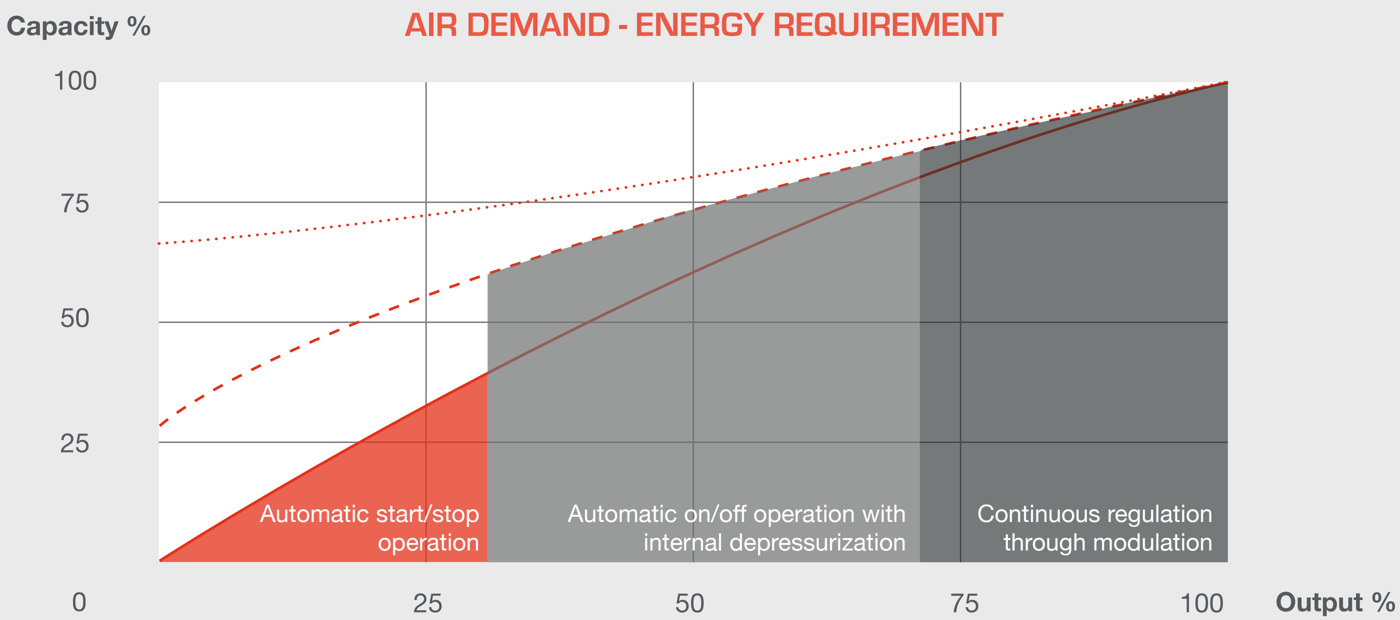
In order to obtain the maximum energy saving under partial load conditions (for air demands lower than effective capacity), Mattei compressors are equipped with combined regulation regimes, occurring in three stages *(Figure 19)*.

- **The first stage** is the continuous modulated flow, obtained by throttling the intake valve of the compressor, based on the air demand. This is most convenient when the air demand exceeds two thirds of the compressor capacity. It keeps the delivery pressure steady to avoid excessive energy losses due to the frequent starting and stopping of the compressor.

- **During the second stage** the compressor operates ‘on load - off load’ with depressurization (blow down). When the air demand decreases the compressor turns automatically to the ‘off load’ regulation. The intake shuts completely when the set pressure is reached and consequently the compressor runs off load until the line pressure falls to the minimum set value. To reduce the energy consumption during off load operation the internal pressure is exhausted.

- **The third stage** occurs when the air delivery reduces further (normally one-third of the free air delivery) and the air demand is satisfied and the compressor will stop.

FIGURE 19: Energy savings through automatic selection of the mode of regulation.



Maintenance & Overhaul

Assembling and dismantling of Mattei compressors can be carried out quickly by using standard tools. It is also made easier by the lightweight of the main components, the majority of which are made from aluminum. The ease of dismantling the machine into subassemblies, such as rotor/stator unit, regulating valves, oil separator, cooler, etc., makes fault diagnosis simple and routine. The only preventative maintenance required is to change the oil, clean or replace the air and oil filters and clean the radiators.

About Mattei

Mattei pioneered the development of the rotary vane compressor in the early 1960's. For more than 55 years, these machines have been used worldwide. Recent patents generated by Mattei's Research & Development Department are evidence of our drive to continually exploit proprietary vane technology and its performance and efficiency benefits, versus traditional rotary screw compressor systems.