INNOVATIVE ECONOMY
NATIONAL COHESION STRATEGY

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

CENTRIFUGAL TURBO BLOWER ON AIR FOIL BEARINGS

Aspamet

TurboMAX

Aspamet

Certificates.

Registration Certificate

This is to certify that the Management Systems of

TurboMax Co., Ltd.

have been assessed by AJA Registrars and registered against the requirements of

ISO 9001:2008/KS Q ISO 9001:2009

Certificate No. : **AJA10/14274** Date of Original Registration : **23/03/2010**

Expiry Date : **22/03/2016** Date of Re-Registration : **22/03/2013**

UKAS MANAGEMENT SYSTEMS 0059 · IAF · Joint Chief Executives, AJA Registrars · AJA REGISTRARS

This certificate is issued in respect of the locations & scope of registration detailed in the Associated Registration Schedule. This certificate has been issued by AJA Registrars Limited Unit 6 Gordano Court Gordano Gate Business Park Serbert Close Portishead Bristol UK BS20 7FS

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Certificate No. : **AJA10/14337** Date of Original Registration : **27/04/2010**

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TÜV NORD

Certificate of conformity with the following European Directives

Registered No.: **K1747/E09**

Electromagnetic Compatibility Directive 2004/108/EC

This is to certify that the following products comply to the essential requirements (Annex 1) of the above mentioned European Directive and the following standards, taking into account the German national deviations:

Product: Turbo Blowers

Type designation: MAX y (y = 30, 50, 75, 100, 150, 200, 300)

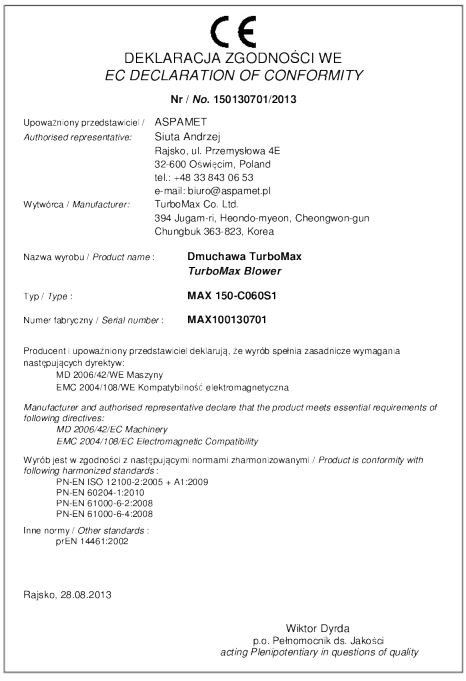
Applicant: TurboMAX. Co., Ltd. 394 Jugam-ri, Hyeondo-myeon, Cheongwon-gun, Chungbuk 363-823, Korea

Standard(s): EN 61800-3:2004

This Certificate of conformity is based on the evaluation of samples of the product. It does not imply an assessment of the production and it does not permit the use of a mark of conformity or of a safety mark of the TÜV NORD CERT. The holder of this certificate may use this Certificate together with his EC-Declaration of Conformity.

Certification Body for Product Safety

CE The CE marking can be affixed on the product if all relevant and effective Directives are complied with. CE



CE

DEKLARACJA ZGODNOŚCI WE

EC DECLARATION OF CONFORMITY

Nr / *No.* 150130701/2013

Upoważniony przedstawiciel / *Authorised representative:* ASPAMET Siuta Andrzej, Rajsko, ul. Przemysłowa 4E, 32-600 Oświęcim, Poland, tel.: +48 33 843 06 53, e-mail: biuro@aspamet.pl

Wytwórca / *Manufacturer:* TurboMax Co. Ltd. 394 Jugam-ri, Heondo-myeon, Cheongwon-gun Chungbuk 363-823, Korea

Nazwa wyrobu / *Product name*: **Dmuchawa TurboMax** ***TurboMax Blower***

Typ / *Type*: **MAX 150-C060S1**

Numer fabryczny / *Serial number*: **MAX100130701**

Producent i upoważniony przedstawiciel deklarują, że wyrób spełnia zasadnicze wymagania następujących dyrektyw:
MD 2006/42/WE Maszyny
EMC 2004/108/WE Kompatybilność elektromagnetyczna

Manufacturer and authorised representative declare that the product meets essential requirements of following directives:
MD 2006/42/EC Machinery
EMC 2004/108/EC Electromagnetic Compatibility

Wyrób jest w zgodności z następującymi normami zharmonizowanymi / *Product is conformity with following harmonized standards*:
PN-EN ISO 12100-2:2005 + A1:2009
PN-EN 60204-1:2010
PN-EN 61000-6-2:2008
PN-EN 61000-6-4:2008

Inne normy / *Other standards*:
prEN 14461:2002

Rajsko, 28.08.2013

Wiktor Dyrda
p.o. Pełnomocnik ds. Jakości
acting Plenipotentiary in questions of quality

Introduction.

The new blowers presented to you in this catalogue use the air bearings technology and are currently the most modern devices of that type in the world.

The core of the blower is an air bearings system and a synchronous motor with permanent magnets embedded in its impeller. These bearings, often called "air bearings" or "foil bearings" (due to the very thin metal sheets of special alloys which they are made of), are used in various high-revolution turbines which operate within the range of 10,000 and 120,000 rpm. In TurboMAX blowers, the foil bearings work in the range of 18,000 and 40,000 rpm. Another structural distinguishing feature of TurboMAX blowers is the new generation of AC synchronous motor, the so-called Permanent Magnet Synchronous Motor, whose impeller has two permanent rare-earth magnets (neodymium magnets). Such magnets create a very strong magnetic field and do not lose their features during operation. This motor structure caused the elimination of wear rings and brushes supplying current to the impeller. A single stage radial turbine was mounted directly on the impeller shaft. The motor is supplied with current from a commercial alternating current frequency inverter. Only frequency inverters produced by well-known companies, such as KEB Germany or Yaskawa Japan, which allow for the operation of the blower with frequencies up to 800 Hz are used in TurboMAX blowers. This really simple structure makes the TurboMAX blowers small, silent and reliable, according to the principle "The less complex is the structure, the more reliable, and easier to handle and repair."

TurboMAX blowers are also equipped with an own embedded controller and control panel, which can cooperate with supervisory control system (SCADA). The blower operator's panel displays a menu, error messages, and a log file in Polish language.

Aspamet Siuta Andrzej provides support at the design stage, and full sales and maintenance services for TurboMAX blowers.

The producer of TurboMAX blowers - TurboMAX Ltd. from South Korea.

Design and development bureau, and research and test station.

Production plant.

Final assembly of blowers.

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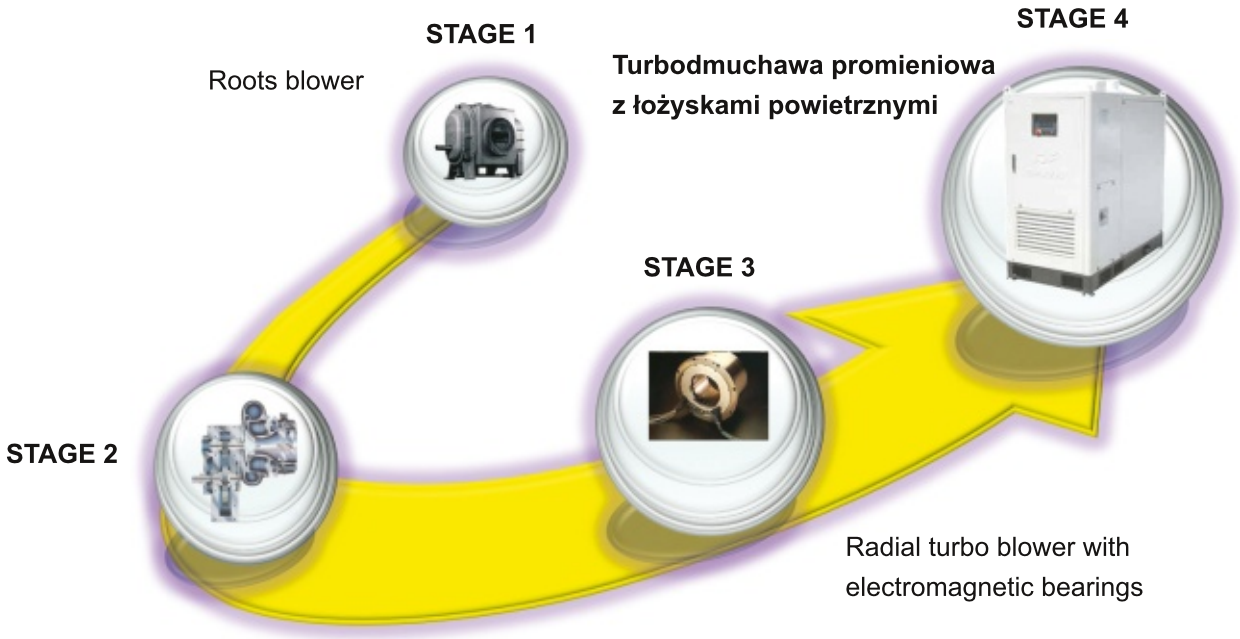
Technology in air supply
- development and evolution of air blowers.

"Development is a continuous improvement, striving for perfection."



Radial blower with mechanical multiplier

Stage 1 The second half of the 19th century - Roots-type positive-displacement blowers.

The beginnings of blower production reach as far behind as the second half of the 19th century. The structure was elaborated by two brothers and inventors, Philander and Francis Roots, the founders of Roots Blower Company.

Currently, they are produced by numerous companies all over the world. Throughout decades, the structure was improved, mainly by using more and more durable materials and better induction motors.

Roots blowers operate based on two or more overlapping profiled cylinders which rotate in opposite directions, and push air to a common collector. The air supplied in this way has a significant pulsatory character.

These are still some of the most popular blowers used in industry and sewage treatment. Their popularity comes from their low price and long standing presence on the market.

They are characterised by the lowest efficiency among all presented devices; efficiency that declines along with the increase of the blowers' power. That is why these blowers are used mainly as units which require less efficiency. To provide the same volume of air as TurboMAX blowers, they consume about 30% more electrical power. Regulation of efficiency requires additionally equipping the device in a frequency inverter.

From the user's point of view, these blowers require more frequent technical controls, regular changes of oil, filters, and V-belts. Moreover, quite often they need to have the compressor renovated, and the ball bearings in the motor replaced. They generate a high level of vibrations, and without equipping them in an additional sound-absorbing casing, their noise emissions are also at a high level. In case of adding the sound-absorbing casing, there might be a problem with excessive heat extraction.

Stage 2 The 1980s. - Centrifugal blowers, radial, with standard induction motor, with mechanical multiplier and oil wear bearings.

The final shape, which is also known today, was given to those blowers in the 1980s. These blowers used the best available at that time technical solutions, and in many respects, they are an example of perfectly developed engineering.

The compression is carried out by the centrifugal turbine which rotates with a speed of twenty thousand revolutions per minute. The air is supplied in a continuous manner, without pulsation which characterises Roots blowers. The regulation of air flow is done using mechanical shutters and vanes.

The efficiency of centrifugal blowers compared to positive-displacement blowers is much higher. The quite complex structure and significant cost of materials in the process of production are one of the biggest obstacles in propagating this type of blowers. The whole structure weighs several tonnes, it is equipped with an induction motor which uses a mechanical transmission (multiplier) to power the radial turbine mounted on the final shaft.

Both the multiplier and the bearings require lubrication using oil and other lubricants. They also require a highly qualified technical personnel.

Stage 3 The 1990s. - Centrifugal blowers, radial, with high-revolution asynchronous motor or a motor with permanent magnets and contactless electromagnetic bearing.

Much smaller in size, compact and the first one totally oil-free structure which appeared in the 1990s. It benefits from the industrial dissemination of subassemblies, such as frequency inverters and efficient computing systems.

As was the case in the former example, this device also uses centrifugal compression.

The whole blower, however, has a much smaller size and weight, mainly because of the removal of mechanical transmission. The turbine was mounted directly on the shaft of the high-revolution motor which thanks to the electromagnetic bearings can rotate with speeds of tens of thousands revolutions per minute.

The flow is regulated by means of the motor's rotational speed regulation. A disadvantage of those devices is a complex electromagnetic bearing system which requires constant supply of electrical power and additional emergency bearings, which act as a safety measure.

These blowers require also a separate controller dedicated to creating an electromagnetic field and a sensor system, and any potential repairs of this system, due to very wide use of advanced electronics, may be expensive.

Stage 4 Beginning of the 21st century. - Centrifugal blowers, radial, with high-revolution synchronous motor with permanent rare-earth magnets and contactless air bearings.

Further development in the field of material sciences made it possible to use air bearings at an industrial scale, the type that up to then was applied only in laboratories and aviation. Increased mining of rare-earth magnets in China caused a significant decline in prices of this material; thanks to that, the motors with currently the highest level of efficiency, synchronous motors with permanent rare-earth magnets embedded in the impeller, became available. Introduction of these two changes allowed for considerable simplification of the blower structure.

First implementations of those devices were done in 2004 in USA, Canada and in the developed Asian countries, such as South Korea. The first implementation on the Polish market was achieved in 2009, thanks to the efforts of Aspamet.

The structure of this type of blower will be explained in detail further in this catalogue.

Blowers at the heart of a sewage treatment plant
-practical aspects of energy efficiency.

"How large an income is thrift!" - Cicero

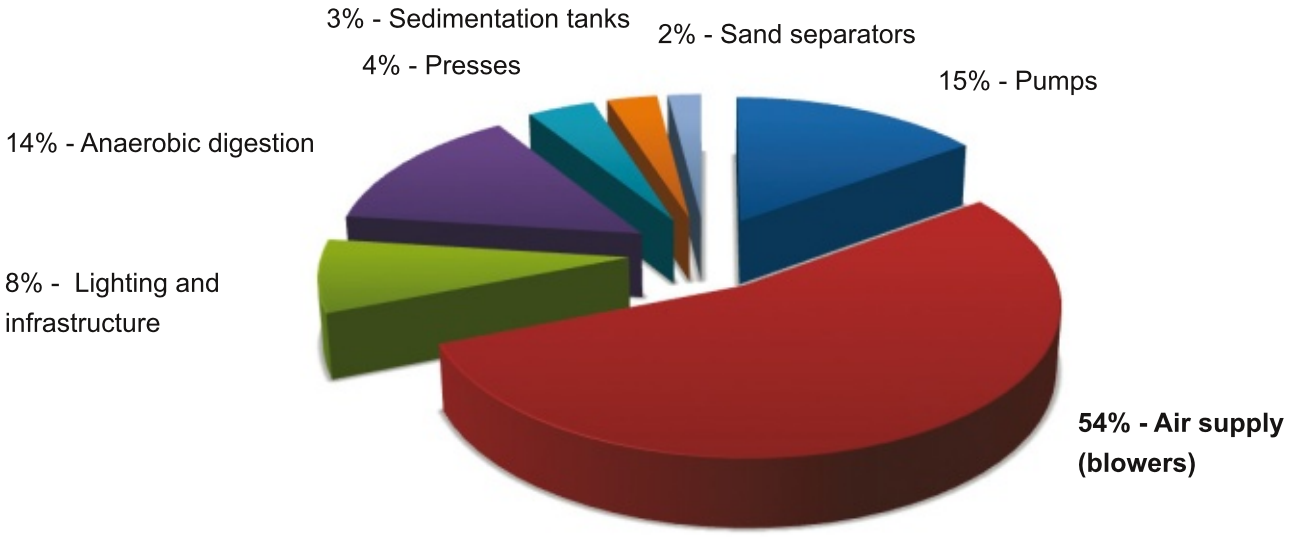


Diagram - Layout of electrical power consumption in a standard sewage treatment.

Why is the energy efficiency of blowers so important?

The blowers unit is the most energy-consuming system in every standard sewage treatment plant. The share of blowers in the whole cost of electrical power, and as a result, in the maintenance cost and profitability of the whole system, is substantial. So high power consumption by the blowers unit is related to the very high added motor capacity of devices installed therein, the energy consumption of the whole air supply process and the need to constantly supply air. Installed capacity of blowers units in smaller sewage treatment plants usually starts at about 100 kW, and may reach up to about 3,000 kW in large urban treatment plants.

Therefore, facing a modernisation and having a choice between positive-displacement blowers and new radial blowers, it is sensible to ponder on the matter and choose a solution that may not be the cheapest at the moment of purchase, but ensures lowest costs of functioning of the whole construction in a longer time horizon.

As an example, on the next page you will find a simulation of falling costs of functioning of the whole sewage treatment plant after implementation of high-efficiency blowers.

The simulation of falling costs of the treatment plant thanks to the application of maintenance-free high-efficiency turbo blowers.

In an exemplary unit, the blowers consume around 200 kW of power per working hour annually. Assuming that thanks to using blowers with only 20% higher efficiency (for TurboMAX blowers this is a very conservative estimate, the tests carried out in sewage treatment plants in Poland proved a reduction of power consumption at a level of 20-30% compared to positive-displacement blowers), we will save 20% on the cost of purchased electrical power.
40 kW (difference in energy consumption between old and new devices) 0.35 PLN (price per kWh)
8,640 hours (time of blowers operation per annum) =
120,960.00 PLN saved on the reduction of electrical power costs in the first and every subsequent year of operation.

Biological sewage treatment: aeration tanks.

The process of biological sewage treatment is the most important part of the whole technological chain. It is similar to the process of self-purification of natural waters. However, in sewage treatment plants it is carried out in a small, closed area of aeration tanks and is much faster. The tanks are constantly aerated, and thus a great amount of water-dissolved oxygen is provided. The conditions are also perfect for the development of bacteria and other micro-organisms which live in water. They create highly concentrated colonies which feed on the contents of sewage.

Aspamet

Technical and economic characteristics of TurboMAX blowers - highly efficient and maintenance-free blower.

Energy efficiency.

• Tests carried out in sewage treatment plants in Poland have proven that the electrical power consumption by TurboMAX blowers is about 10~30% lower than the still most common positive-displacement blowers.

• Therefore, taking into account only the cost of electrical power and the considerable capacities of installed blower systems, it can be assumed that the return on initial investments will be possible within a few year, based solely on the savings on much lower electrical power costs.

Users' opinions.

"During the current TurboMAX blowers performance there have been no technical problems, devices work seamlessly and flawlessly." (...) "The biannual new blowers operation confirmed energy savings of several percent and a significant reduction in noise compared to the previously operated Roots blowers."
"AQUA" S.A., 43-300 Bielsko-Biała

"RCGW SA decided to equip blower stations, operated by C-Tech reactors, with blowers offered by Aspamet Siuta Andrzej having in mind almost 2 years of trouble-free operation of the TurboMAX MAX75-C060 blower model at the treatment plant in Urbanowicach" (...) "The operation of this blower confirmed the savings of electric energy consumption by 30% compared to previously utilized Roots-type blowers and the noise reduction by approx. 20 dB."
RCGW S.A., Tychy 43-100

Substantial reduction of operation costs.

• TurboMAX blowers, without exaggeration, can be called fully maintenance-free.
• Regular operational activities carried out by the personnel are limited to periodical change of inlet air filters (once every 1 to 3 months on average, depending on the size of the blower and the purity level of air in the place of installation).
• In the whole blower there is absolutely no trace of oil or any other lubricant. As a result, there are no costs or activities related to the periodical change and utilization of oil, oil filters, pumps or indicators. We also get rid of the risk of oil leakage, and downtimes and costs related to such breakdowns.
• As it was described in the part covering the construction of the blower, **the air compressing turbine is mounted directly on the shaft of the high-revolution motor. There are no transmitting components, carrying the torque from the motor to the compressor.** Thanks to that, we get rid of costs related to periodical exchange of the set of transmission belts and blower downtime in case of their sudden break, as is the case with positive-displacement blowers. We also avoid the costly renovations of mechanical transmission (multiplier) which is an integral part of radial blowers of the last generation.
• TurboMAX blower motor shaft is supported on contactless air bearings. The durability of such a bearing system is at least 22,000 starts and stops of the blower, which usually corresponds to **10-12 years of operation until the first renovation is required**. In comparison to ball bearings, even those strengthened, ceramic bearings, used in asynchronous motors and mechanical transmissions must be replaced every few years and under constant operational care. The electromagnetic bearing system appears only slightly better given this background. Its durability, in fact, is not limited by the number of start and stops, but the process of production, monitoring and controlling the electromagnetic field of those bearings requires the application of many electronic components and actuators which are not necessary in blowers with air bearings. Some of those components are a dedicated controller used only for real-time control of bearing electromagnetic field, a unit of sensors monitoring the position of the shaft, regulated dedicated power supply for bearings, electromagnetic bearings with coils and the inseparable emergency bearing system with limited durability. Such accumulation of electronics can cause not only an increased risk of system failure, but also is related to the periodical necessity of replacing all electronic components and actuators. As the blowers are intended for continuous operation, and in practice are operated in such manner, the load on this additional devices is considerable, which directly corresponds to their durability and periods of time between replacements of those components, as well as related significant costs.

The structure of TurboMAX blowers
- simplicity as a source of low operation costs and reliability.

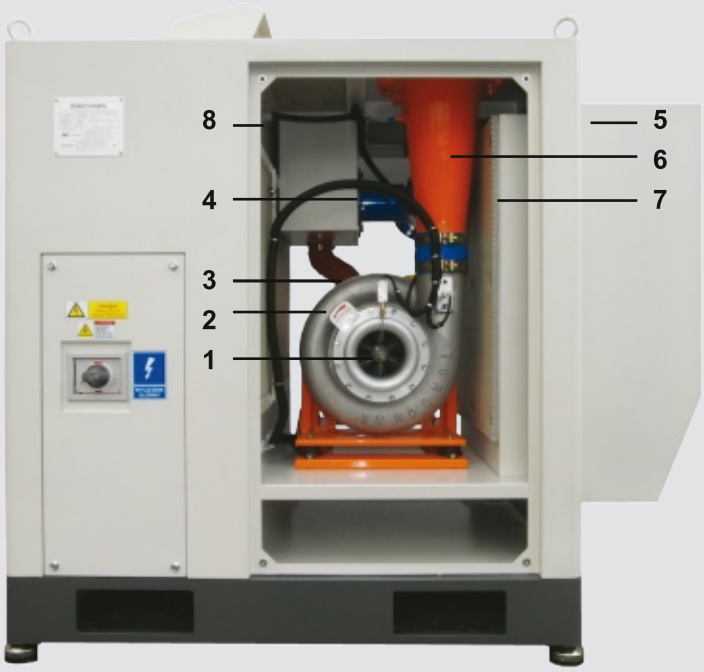
COMPACT STRUCTURE

• All functional elements of the blower are embedded in a common soundproof casing.
• The blower is delivered as a complete "Plug & Play" device, it can be used immediately after supplying power and connecting the outlet pipeline.
• It does not require an additional external systems.
• The blower does not require even anchoring to the base, because of the low level of vibrations, it only has levelling feet. Also, it is not necessary to execute an expansion joint in the floor.
• Because of the small size and weight it does not need to be placed on any specially reinforced foundations. Usually, it can be positioned on the old blower foundation without the need of any adaptation.

TurboMAX blower - external view.

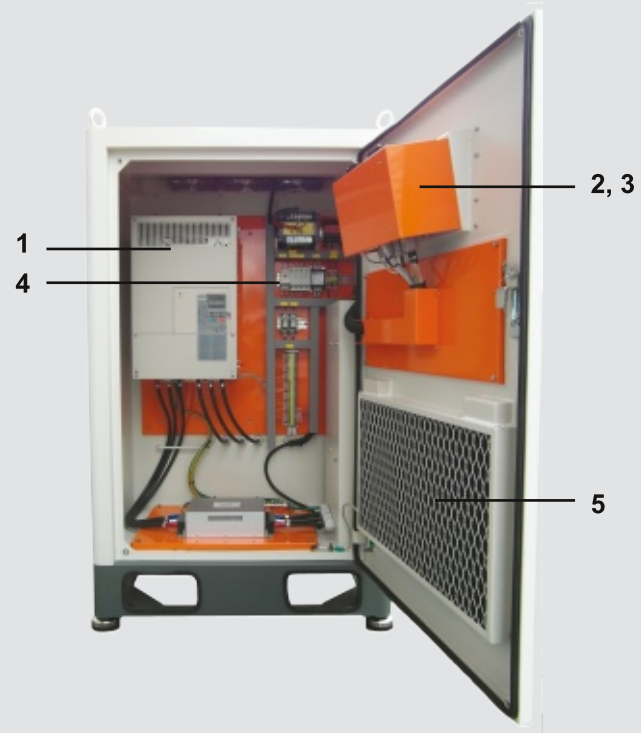
MAIN STRUCTURAL COMPONENTS

• TurboMAX blower is a part of the family of high-revolution radial blowers which are more and more commonly jointly described as "turbo blowers". This description is related to the very high rotational speeds at which the blower operates, i.e. 18,000 to 40,000 rpm.
• It is currently the most modern structure among air blowers, which combines high efficiency and performance culture with minimal operational costs.
• Air compression is carried out by a centrifugal radial turbine which is mounted directly on the shaft of a high-revolution synchronous AC motor, whose impeller is equipped with strong permanent rare-earth magnets (so-called neodymium magnets). It should be emphasized that there are no additional, wearable elements between the turbine and the motor, such as a clutch or mechanical multiplier (transmission). Also in the motor itself, there are no wearable parts, such as brushes or wear rings supplying power to the impeller windings; the embedded permanent rare-earth magnets are responsible for creating an electromagnetic field of the impeller.
• The motor of the blower is controlled by an AC high-frequency inverter. In order to reach a rotational speed of the motor in the range of 18,000 to 40,000 rpm (maximum and minimum speeds are different for different types of blowers), the scope of output frequency from the inverter is regulated within the range of 300-660 Hz. Only commercial inverters made by well-known producers, such as KEB Germany and Yaskawa Japan, are used in TurboMAX blowers.
• Due to the very high rotational speeds, the newest contactless bearings were used in TurboMAX blowers, the so-called air bearings.



TurboMAX blower - mechanical compartment

1 - radial centrifugal turbine
2 - synchronous, brush-free, motor with permanent rare-earth magnets embedded in the impeller and with air bearings (not visible on the picture, it is located directly behind the turbine)
3 - cooling system using a fan located directly on the rear part of the motor shaft, heated air discharged from the blower, this air does not reach the compressor which would lower the efficiency of the device
4 - starting air and blow-off valve with silencer
5 - inlet silencer on the suction side
6 - outlet diffuser on the discharge side
7 - internal soundproofing of the casing
8 - compressor filter (in the rear part of the casing)



TurboMAX blower - electrical compartment

1 - alternating current high-frequency inverter
2 - controller
3 - local control panel: touch screen located on the front of the casing
4 - filters, packing glands, blower's own transformer 400/230 V, electrical equipment
5 - electrical compartment cooling filter

The structure of TurboMAX blowers
- list of basic structural components.

• **High-revolution AC synchronous motor with permanent rare-earth magnets embedded in the impeller.**

• Provides for the highest efficiency among all currently produced electrical motors - about 96-97%.

• **Motor impeller shaft with air pushing turbine and motor cooling fan directly mounted on both its ends.**

• Strong rare-earth magnets (neodymium magnets) are embedded in the impeller shaft, and responsible for creating a magnetic fields of the impeller. There are no easily wearable parts in the motor, such as brushes, or wear rings.

• The turbine in use is a radial, centrifugal turbine with optimised size and geometry for the required operational parameters, i.e. pressure and flow.

• The system operates at rotational speeds within the range of 18,000-40,000 rpm.

• Rotational speed is regulated directly using an AC inverter.

• **Air bearing system provides for contactless operation of the rotating unit.**

• The system consists of radial bearings which provide support of the rotating unit: motor shaft + turbine and axial bearings stabilising the turbine in the axial plane.

• During the operation, a stable air gap is intrinsically created between the rotating elements and the shaft, and eliminates friction.

• Air bearings need no additional components for operation.

Construction of TurboMAX blowers
- detailed presentation of individual components.

1. Air Bearings.

TECHNOLOGY THAT ALREADY CONFIRMED ITS RELIABILITY AND DURABILITY

Air-foil bearings are the subject of research and development laboratory centers located around the world. With the greatest progress of works crowned with the development of long-life- bearings and high performance operating parameters, centers from the US and South Korea institutes can boast and with which TurboMAX company, as the blowers manufacturer, cooperates.

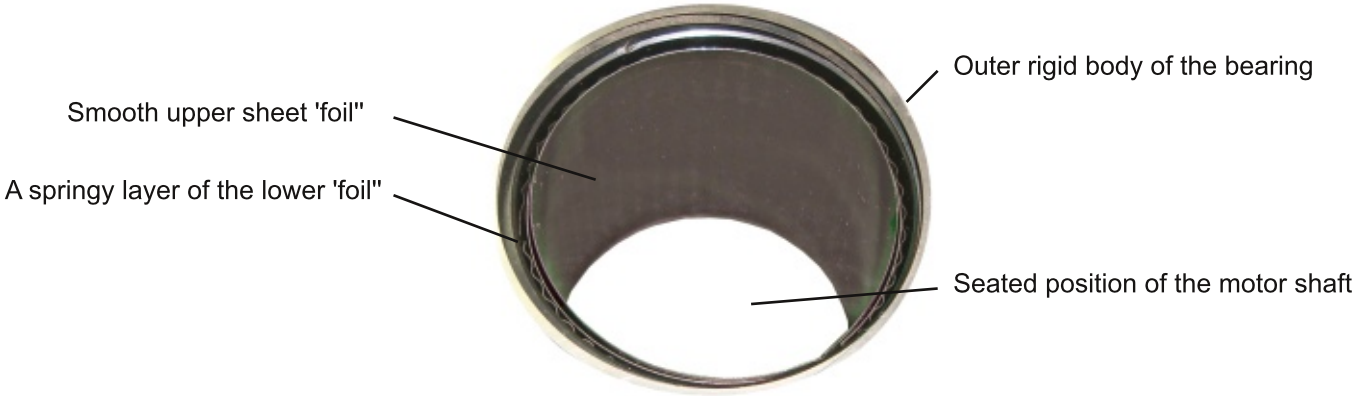
The first generation of air bearings was developed in the US in the late 50s of the twentieth century for use in military and aerospace industry. For the first time they were commercially used in turbine cooling in Boeing 727 and Boeing 737 in the mid 60s. Currently, they have become a permanent supply for ACM (Air Cycle Machines) used in air-conditioning and pressure control in airplanes which is the best confirmation of high-quality of air-foil bearings technology. They were used in all US military aircraft, where, thanks to their excellent operational and reliability parameters they replaced traditional oil-lubricated roller bearings which were used previously. The natural stage of development was the systematic development of newer and newer generations of air-foil bearings which are characterized by an increasing number of tolerated starts and stops of a rotating system and increased load capacity.

New applications were gradually sought for these types of bearings whose very successful example are TurboMAX high speed oil-free centrifugal blowers which were developed and first used commercially in the early twenty-first century in South Korea.

CONSTRUCTION

Air-foil bearings are a type of hydrodynamic bearings, which use as a lubricant the ambient gas and do not require any additional materials or lubricating systems.

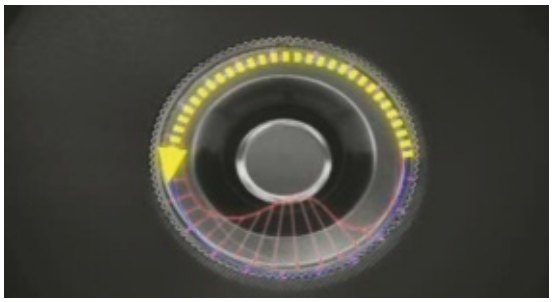
The bearing itself is made of smooth enfolding a sheet shaft made of special alloys pressed against an accommodating and corrugated outer layer of the bearing acting as a spring bearing pressure. The springy foil in turn is enclosed in a rigid, non-deformable outer body. Bearings are entirely made of special metal alloys, but due to their relatively small thickness are colloquially referred to as "foil".



Construction of air-foil bearing as the example of the radial bearing.

OPERATION OF THE AIR-FOIL BEARING

As a result of the rotating speed of the shaft, the pressure of the working gas which is spontaneously formed between the rotating shaft and the smooth part of the air bearing will push the smooth sheet from the surface of the shaft and generate spontaneously an air gap. This occurs through the ingestion of air into the bearing thanks to the gas viscosity.

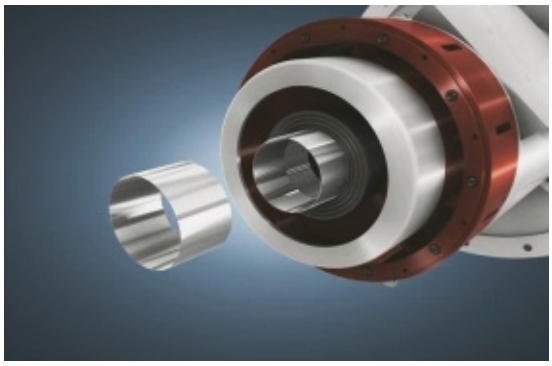


Generating hydrodynamic pressure in the air bearing.

Geometry of aerodynamic film of little thickness, which is intrinsically forced to close to the cylindrical shape. The film eliminates friction between the shaft and the bearing, and consequently ensures their non-contact work.

Hydrodynamic air-foil bearings used in TurboMAX blowers are completely autonomous and independent at all working stages: from a standstill through start-up, from normal operation to stop and restart.

The axial air bearings – they assure the stabilization of the turbine in an axial surface.



Radial air bearings - provide support and non-contact work of the shaft.

FEATURES OF AIR-FOIL BEARINGS

• Very low (negligible) hydrodynamic friction losses and therefore a very high efficiency.
• Structure simplification and keeping absolutely clean working air in the blower through the complete elimination of oil from the system.
• Stability of working fluid in the bearings without its evaporation, cavitation, solidification and ignition in a wide range of temperatures.
• The bearings used in TurboMAX blowers are hydrodynamic bearings, as opposed to hydrostatic air bearings and they do not require any external pressurized gas delivery systems.
• Very high load capacity and excellent resistance to shock states.
• Lack of any scheduled maintenance.
• The bearings can operate at speeds up to 100,000 rotations / minute, wherein in the case of TurboMAX blowers typical speed range from 18,000 to 40,000 rotations / minute.
• Guaranteed lifetime of air-foil bearings for blowers is at least 22 000 starts and stops and stops of the blowers (10-12 years of operation).

2. The high-speed Permament Magnet Synchronous Motor (PMSM).

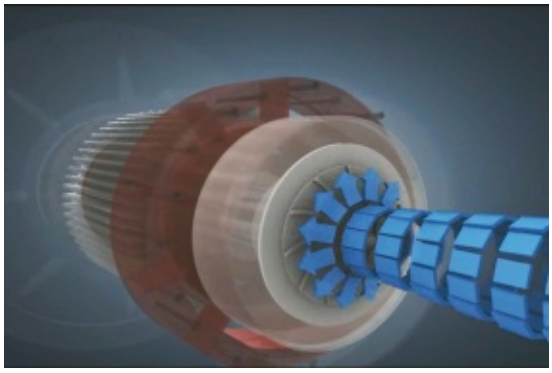
• Permament Magnet Synchronous Motor.
• It is characterized by the highest efficiency among all types of commercially available engines, with 96-97% efficiency.
• Generates a very high performance from a small footprint. Sample weight of PMSM motor with a power of 80 kW is only 60 kg while the induction motor of the same power weighs 250 kg.
• Allows a very precise control of rotating speed.
• It has a built up-sleeve with permanent magnets pressed in on the rotor shaft, responsible for the formation of the magnetic field of the rotor.
• This is the optimum design of the engine for high rotation speeds, maintaining very good properties in the area of weak stream which occurs when working with very high frequency (300 - 660 Hz).
• The motor requires no scheduled maintenance. In its design it does not have any wearing parts such as brushes supplying voltage to the rotor windings or slip rings.

3. High frequency sinusoidal current inverter.

• In TurboMAX blowers are used only high-end commercial inverters from renowned manufacturers such as German KEB or Japanese Yaskawa.
• These are the sinusoidal current frequency converters dedicated to work with synchronous high-speed motors with permanent magnets of great power built-in in the rotor.
• The provide precise setting and control of the speed of the blower.
• They are characterized by a very good response to sudden load changes which occur while the blower operation.
• The frequency converter is an integral part of the blower TurboMAX and is included in the standard delivery.
• Both KEB and Yaskawa have independent service centers on Polish territory.

High-frequency inverter: KEB Germany.

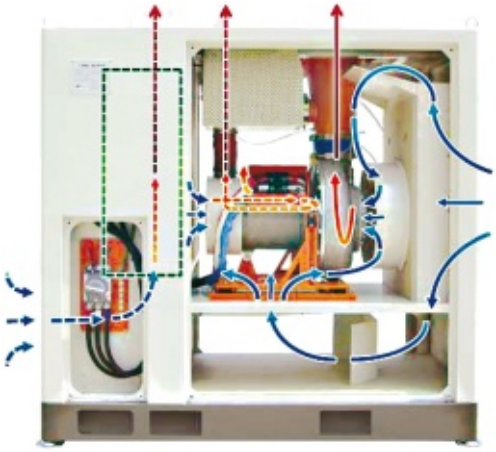
4. Cooling system.



The cooling fan is mounted directly on the motor shaft.

• **The patented engine cooling system used in high speed TurboMAX blowers does not require any additional components in the cooling system,** such as an additional fan installed in some blowers which forces the air to circulate through the engine fins along the piping system and dedicated, regulated power supply.

Patent # 10-0675821 - 'The cooling system for turbo machines equipped with high-speed motor.'
Patent # 10-0781298 - 'Air blower'.



Circulation of the process and cooling air in the TurboMAX blower.

• **The fan that is responsible for cooling the engine is mounted directly on its shaft, which considerably increases the reliability of the cooling system and eliminates the need for its scheduled maintenance.**

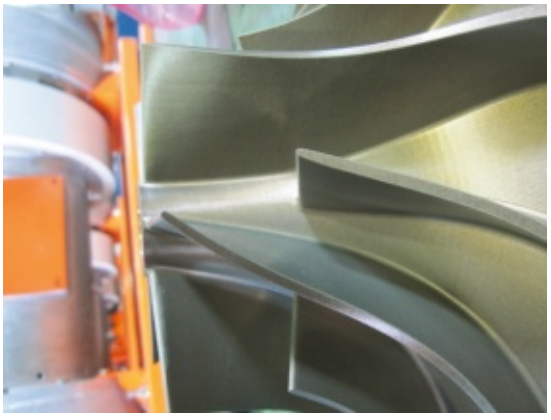
• The heated air is released from the interior of the fan outside the sound-absorbing casing, thus avoiding a reduction in blower efficiency due to the increase of air temperature fed to the degree of compression.
• Releasing of heated air is finished with a connection flange. In winter, warm air can be optionally used to heat the blowers hall, while in the summer released out of the room (see photo). And wherein the additional piping system raises the initial investment costs, and from our experience it is justified only at low cubature blower station buildings which are directly sunlit in the summer. At the buildings of larger cubature, it can be omitted without adversely affecting the operation of the devices.
• In the case of small and medium-sized models of TurboMAX blowers, the process of cooling of the high-speed motor is done only with the air, and the largest blower models are equipped with an additional water jacket on the engine. The entire system of the water-to-air heat exchanger is mounted in a compact blower case and does not require connection to any external circuits.

Optional piping to release the heated air from the engine cooling system outside the room with a switch (manual two damper system) winter-summer.

5. Centrifugal radial turbine.

• **The turbine is mounted directly on the motor shaft** without clutches or mechanical transmissions, power transmission efficiency is 100%.

• For each blower size and each value of operating pressure of the blower there is selected a different turbine geometry shape providing optimum operating parameters.
• In each case the geometry of the turbine is highly resistant to the phenomenon of compressor stall and provides a large operating pressure margin and a range of the generated flow.
• It is made on a 5-axis machining center from a monolithic block of forged aluminum alloy.
This method of production does not only provide high precision but very high mechanical strength, guaranteeing reliability when working at very high rotation speeds.
In contrast to the cast rotors we eliminate the risks caused by internal flaws and inconsistencies in the cast material, resulting in the formation of additional forces and the weakening of the material as a result of internal stresses.



6. The controller with the external color touch screen to communicate with the user.

A sample PLC driver including instrumentation and the touch panel built into the blower.

• Each fan is equipped with its own controller and the color touch screen installed on the front of the case.

• There following types of drivers are available: Mi-Com TurboMAX, PLC Allen Bradley, PLC Siemens.

• Remote communication with the blower and control its performance are possible using 4-20mA analog signals, communication protocols Modbus TCP, Modbus RTU or PROFIBUS DP.

• The controller has regulatory and diagnostics functions to keep monitoring the parameters of the blower. Through the touch panel you can read on a number of parameters of the current blower operation such as flow, pressure, power consumption and many others. All parameters can also be read remotely.

Friendly maintenance

- the simplicity of design means a minimum of maintenance.

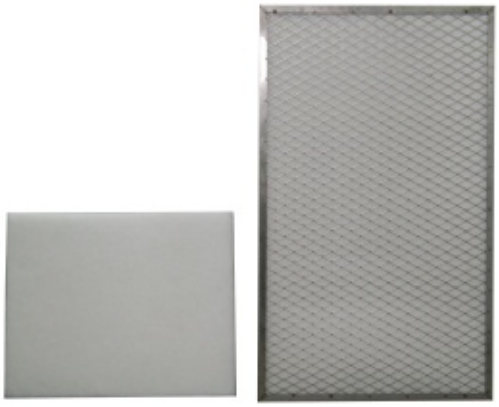
Easy replacement of the main filter.

Easy replacement of the electrical section filter.

• Only the air intake filter requires regular replacements.
• The status of the filter dirt is updated and monitored by the blower. The need to replace the filter each time is indicated on the blower display.
• The blower has two filters: the main filter at the air inlet of the blower and the electrical section filter.
• The filter fabric, which meets the relevant standards, is used for filters. The fabric is placed in stainless steel frames.
• It is very easy to replace the filters and it takes no more than a few minutes for untrained staff to do that.

• In biggest models of blowers equipped with the integrated water and air cooling system you should still make periodic visual inspection of the cooling fluid state, and if necessary to make the refilling.
• A plain glycol is used as coolant which is used commonly in automobiles cooling systems.

The blower TurboMAX has not an ounce of oil or any lubricants. Therefore, there is no need to control the state of the oil and filters, their replacements or disposal. The blower has no V-belts and mechanical transmissions, thanks to its direct-drive turbines have we not only achieved outstanding energy efficiency of the machine, but also eliminated a number of intermediate elements, which may be the source of a failure, so to maintain them in a good condition generates significant costs.



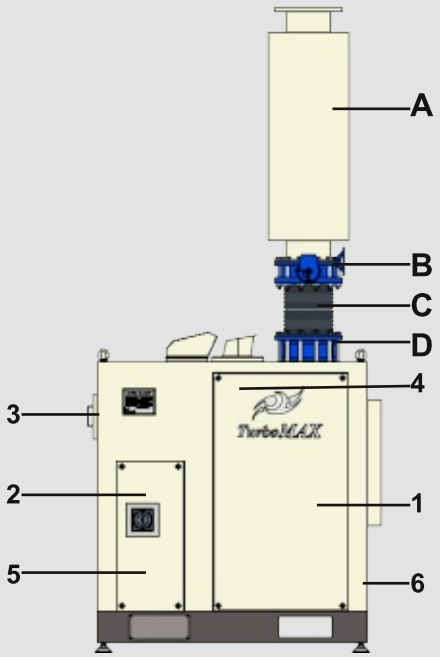
TurboMAX blower filter set: the electrical section filter and the main filter.

Aspamet

Models and the range and scope of TurboMAX blowers delivery.

Type	Model	Dimensions			Discharge	BOV		
		width	length	height	diameter	diameter	Weight	Power
		mm	mm	mm	mm	mm	kg	kW
MAX20	MAX20-C060, C080	700	1050	1000	150	100	270	16,4
MAX30	MAX30-C060, C080	700	1050	1000	150	100	290	24,5
MAX50	MAX50-C040	850	1300	1350	200	125	450	40,9
	MAX50-C060, C080	700	1050	1000	150	100	300	40,9
MAX75	MAX75-C040	800	1300	1350	200	125	650	61,3
	MAX75-C060, C070, C080, C090	800	1300	1350	200	125	450	61,3
MAX100	MAX100-C040	850	1800	1600	250	150	810	81,8
	MAX100-C050, C070, C080, C0100	850	1300	1600	200	125	650	81,8
MAX150	MAX150-C040	850	1800	1600	300	150	810	122,7
	MAX150-C060, C070, C080, C100, C120	850	1800	1600	250	150	810	122,7
MAX200	MAX200-C060S, C70S/80S, C100S/120S	900	1850	1700	300	150	900	163,5
MAX250	MAX250-C060S, C080S, C100S	900	2050	1800	300	150	1100	204,4
MAX300	MAX300-C060S	1300	1900	2050	400	150	1500	245,3
	MAX300-C080S, C100S/C120S	1300	1900	2050	350	150	1500	245,3
MAX350	MAX350-C060T	1300	2000	2050	450	150	1700	286,2
	MAX350-C080S	1300	1900	2050	400	150	1600	286,2
	MAX350-C100S/C120S	1300	1900	2050	350	150	1600	286,2
MAX400	MAX400-C060T	1300	2000	2050	450	150	1700	327,1
	MAX400-C080S	1300	1900	2050	400	150	1600	327,1
	MAX400-C100S/C120S	1300	1900	2050	350	150	1600	327,1
MAX500	MAX500D-C060S	1700	2400	2000	500	150	2400	408,8
	MAX500D-C080S, C100S/C120S	1700	2400	2000	450	150	2400	408,8
MAX600	MAX600D-C060S	2100	2750	2250	600	150	3000	490,6
	MAX600D-C080S	2100	2750	2250	500	150	3000	490,6
	MAX600D-C100S	2100	2750	2250	450	150	3000	490,6
MAX800	MAX800D-C060T	2100	2750	2250	600	150	3400	654,1
	MAX800D-C060S	2100	2750	2250	600	150	3200	654,1
	MAX800D-C100S	2100	2750	2250	500	150	3200	654,1

Discharge pressure mbar	MAX20	MAX30	MAX50	MAX75	MAX100	MAX150	MAX200	MAX250	MAX300	MAX400	MAX500	MAX600	MAX800
	Flow m3/min												
300	18	26	47	76	107	130	174	243	258	348	486	516	696
400	14	23	43	68	86	122	164	217	242	328	434	484	656
500	16	20	38	55	74	113	148	195	225	296	390	450	592
600	12	18	33	49	66	104	132	160	200	264	320	400	528
700		17	26	44	58	92	116	145	180	232	290	360	464
800		12	23	40	54	82	108	135	162	216	270	324	432
900			18	37	50	69	92	115	137	184	230	274	368
1000				31	42	62	86	108	125	172	215	250	344



Standard accessories for TurboMAX blowers:
A - Exhaust silencer;
B - Manual shut-off valve;
C - Compensation connector;
D - Valve.

The standard delivery includes a complete, compact blower, consisting of:
1 - Turbine with the PMSM motor;
2 - The frequency converter;
3 - Controller with the touch panel;
4 - Starting-exhaust valve with a silencer;
5 - Electrical and mechanical equipment;
6 - The whole enclosed in a soundproof case.

TurboMAX blowers are available in two basic casing versions different in a manner of intaking air by the machine.
• In the version equipped with an inlet shutter, the air is drawn directly from the room in which the blowers are located. In this case the building must be equipped with ventilation air inlet probes.
• In the version provided with a flange on the inlet side, the air is sucked through the pipeline whose inlet is positioned outside the building.


The casing version of the inlet shutter.


The casing version with a flange for connecting a pipeline on the suction side.

Reference installations in Poland.

2009. O.Ś. Tychy - Urbanowice
blower station No. 1
blowers: 1 pc. MAX75

2009. O.Ś. Tychy - Urbanowice
blower station No. 2
blowers: 5 pcs. MAX100

2011 r. O.Ś. Bielsko-Biała - Komorowice, blower station No. 1
blowers: 2 pcs. MAX75

2013 r. O.Ś. Bielsko-Biała - Komorowice, blower station No. 2
blowers: 2 pcs. MAX250

2013 r. O.Ś. Bielsko-Biała - Wapienica
blowers: 2 pcs. MAX100

2013 r. O.Ś. Olkusz
blowers: 1 pc. MAX100

2011 r. O.Ś. Dębica
blowers: 4 pcs. MAX90

2012 r. O.Ś. Dąbrowa Górnicza
blowers: 2 pcs. MAX75

2013 r. O.Ś. Piekary gm. Liszki pod Krakowem
blowers: 5 pcs. MAX50

2013 r. O.Ś. Krosno
blowers: 2 pcs. MAX150

2014 r. O.Ś. Kościan
blowers: 2 pcs. MAX75

2013 r. O.Ś. Iwano-Frankiwsk Ukraina
blowers: 2 pcs. MAX150, 2 pcs. MAX200

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