3 Design and operation

3.1 Operating modes

On-site operation

Operation of the machine is carried out directly on site.

Remote operation

Operation of the machine is carried out via control station.

Automatic operation

Automatic operation of the machine is carried out by sensors or a system switch.

Load operation

Load operation is the operating mode in which the machine processes the specified operating data.

3.2 Application ranges

3.2.1 Operating information for pneumatic conveyance

Pneumatic conveyance

When the machine is being used for the purposes of pneumatic conveyance, pressure surges must not occur when switching between different delivery lines.

Pressure surges can be prevented by making the switching process for the intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework. The gas can no longer accelerate suddenly. This prevents damage to the machine.

The distance between the switchover valve and the intake-side flange must be at least 10 x DN. DN = nominal diameter of the pipework.

This safety note applies to both positive pressure operation and vacuum operation.

3.2.2 Operating information for air-separation systems

Air-separation systems

When the machine is being used in air-separation systems with alternating air-separation columns, pressure surges must not occur when switching between different delivery lines.

Pressure surges can be prevented by making the switching process for the intake-side and discharge-side valves take at least five seconds. This pre-accelerates the gas column in the pipework. The gas can no longer accelerate suddenly. This prevents damage to the machine.

The distance between the switchover valve and the intake-side flange must be at least 10 x DN. DN = nominal diameter of the pipework.

This safety note applies to both positive pressure operation and vacuum operation.

3.2.3 Description of assemblies

For the purposes of explaining its functionality, the machine is divided into several assemblies. Each assembly consists of a number of components which, combined, perform a specific machine function. One assembly can consist of sub-assemblies and additional components.

3.2.3.1 Intake side

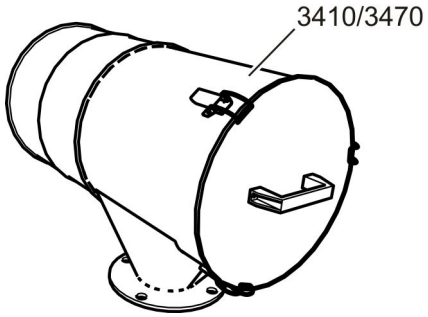


Fig. 17: Intake side

3410 Intake silencer, housing
3470 Intake silencer, filter element

The intake side assembly comprises the components of the conveying system's intake side. The intake side assembly includes all components located upstream of the machine stage gas inlet. The medium to be conveyed is drawn into the machine stage by these components. An intake silencer serves to reduce noise emissions. A filter ensures clean intake gas.

3.2.3.2 Machine stage

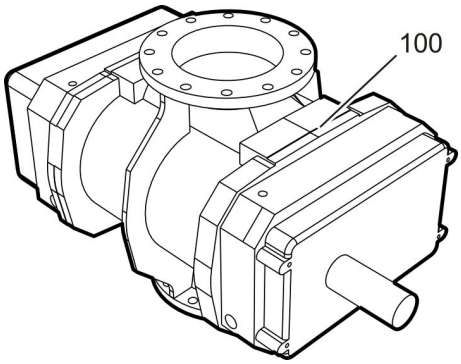
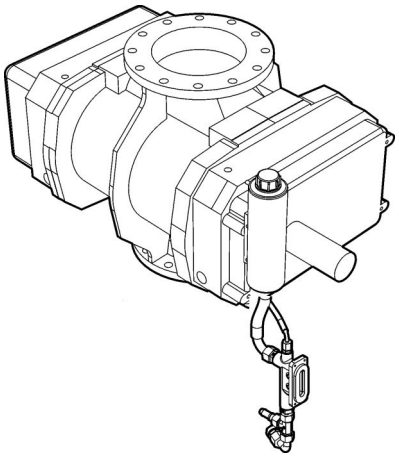


Fig. 18: Machine stage

100 Machine stage

The machine stage is the core of the machine and includes all components for gas compression. The gas compression process takes place in the machine stage.

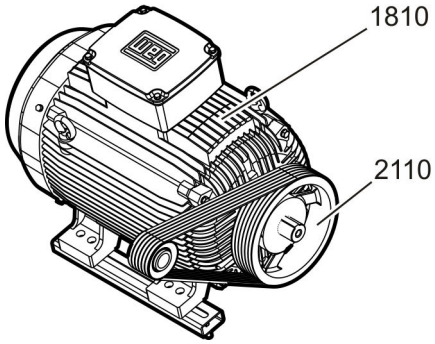
3.2.3.3 Oil system



The oil system contains all components necessary for providing lube oil to the machine stage.

Fig. 19: Oil system

3.2.3.4 Drive system

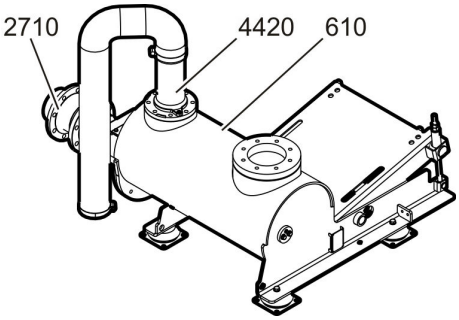


1810 Motor
2110 Belt drive

The drive system comprises the drive motor and the drive elements, e.g. the belts and sheaves. The drive system provides a high revolution speed for the rotational motion of the machine stage.

Fig. 20: Drive system

3.2.3.5 Discharge side



610 Base support
4420 Safety valve
2710 Flexible pipe connection

The discharge-side assembly represents the components of the discharge-side conveying system. The discharge-side assembly includes all components fitted downstream from the machine stage gas outlet. All components are pressurised during operation and have hot surfaces. A discharge silencer serves to reduce noise emissions.

Fig. 21: Discharge side with base support

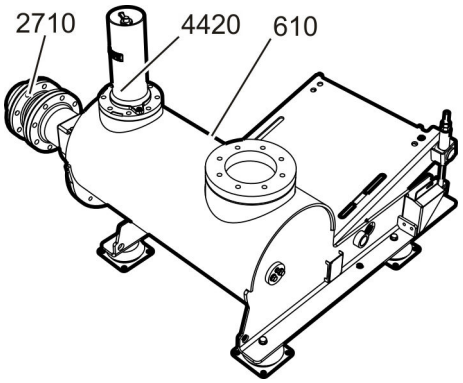


Fig. 22: Discharge side with base support

610 Base support
4420 Safety valve
2710 Flexible pipe connection

The discharge-side assembly represents the components of the discharge-side conveying system. The discharge-side assembly includes all components fitted downstream from the machine stage gas outlet. All components are pressurised during operation and have hot surfaces. A discharge silencer serves to reduce noise emissions.

3.3 Control elements (optional)

3.3.1 Factory-installed control element

Factory-installed control element

Observe the AERtronic instruction manual.

The AERtronic instruction manual is included with the product.

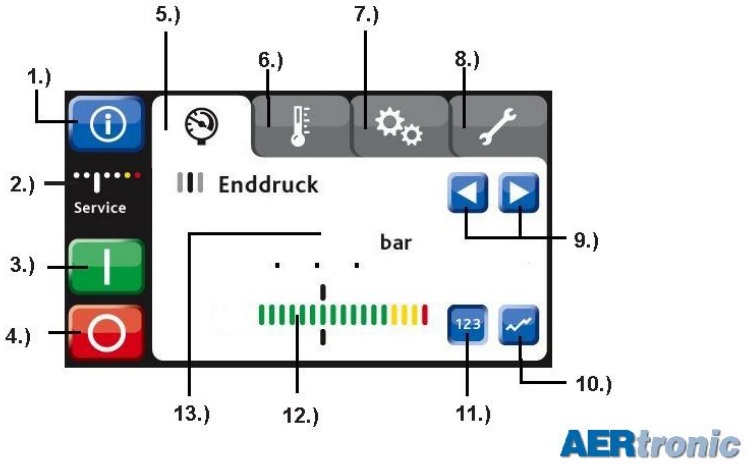


Fig. 23: Operator interface

1 Information menu
2 Service display
3 Local/LOCATION/START
4 Local/LOCATION/STOP
5 Pressure ranges register
6 Temperature ranges register
7 Additional operating parameters register
8 Service and setup register
9 Selection buttons of the given display menu within a register
10 Graphic representation
11 Numerical representation
12 Bar graph display
13 Measurement value display

3.3.2 Customer-installed control element

Customer-installed control element

Depending on the machine model and version - with or without a corresponding controller - the control elements are not part of the scope of delivery. The installation and design of the control elements is then the responsibility of the customer.

3.4 Accessories

The accessories are the total collection of components belonging to the machine or to the supplementary equipment.

3.4.1 Drive motor

Motor connection requirements

The cable and lead sheathing must be resistant to the normal wear expected due to the movement of the hinged motor support and the effects of contaminants in the atmosphere.

General requirements

- Fine-core cable is recommended for the connecting leads.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- Cables, leads and connection points must not be subjected to excessive bending and tensile forces. Install the connecting cable via a stayed cable bridge (not provided) to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The connecting cable must be resistant to light movements, e.g. the changes in the rotational speed of the motor.

General requirements

- Fine-core cable is recommended for the connecting leads.
- The connecting hardware must be suitable for the cross-section and type of the connecting leads.
- It may be necessary to remove the intake console and the acoustic hood cover to connect the motor, depending on the size and output of the machine.
- Cables, leads and connection points must not be subjected to excessive bending and tensile forces. Install the connecting cable via a stayed cable bridge (not provided) to prevent the terminal box being subjected to forces or stress.
- Install cables and leads in such a way that they cannot sustain any external damage.
- Avoid contact with the machine, excessive friction and excessive radiant heat.
- The connecting cable must be resistant to light movements, e.g. the changes in the rotational speed of the motor.

Requirements for the electricity network

NOTICE!

There is a risk of material damage from voltage fluctuations/drops!

Voltage fluctuations/voltage drops beyond the tolerance interval may lead to serious damage to the drive system.

Requirements for operating rotary piston machines with electric induction motors in a three-phase AC supply system:

- Use suitable protective equipment that will shut down the motor and safeguard it against an automatic restart in the event of impermissible electrical operating data.
- Connect the motor voltage and control voltage to a stable common three-phase network to ensure that the power contactor is no longer latched in the event of a power failure.
- Observe the voltage and frequency limits. *Chapter 11.9.1 „Voltage fluctuations“ on page 189*

Connection

- Only authorised electricians may perform the connection.
- Authorised electricians must observe all applicable regulations when connecting the drive motor.
- Observe the tightening torques of the terminal screws.
- Secure all connections against inadvertent release or loosening.
- Ensure that the nominal electrical data is complied with during operation.

Control circuit types

- Star-delta connection
- Pole changing
- Speed control using frequency converter
- Direct start

Permissible starting frequency

up to 160 kW	6 starts per hour
from 200 kW	3 cold starts or 2 warm starts per hour
Refer to the instruction manual provided by the drive motor manufacturer for further specifications and information.	

3.4.1.1 Factory installation of the drive motor

Factory installation

Observe the information on the rating plate and in the drive motor instruction manual.

Refer to the drive motor instruction manual for electrical operating data, maintenance intervals and suitable lubricants.

3.4.2 AERtronic

AERtronic



Fig. 24: AERtronic Display

The AERtronic is used as a control device and as a display and monitoring device.

The control device is fitted with a colour graphics display with a touch-screen interface.

When starting for the first time, these settings can be changed.

Other handling and operation of the controller is defined on the display; the user is guided through the menu by prompts in a structured manner.

The control device includes all the functions necessary for start and shut-down procedures and displays the operating parameters and prompts.

Observe the instruction manual for the purposes of commissioning and operation!

AERZEN reserves the right to change, expand or improve the hardware and software of this product as required. This does not include any obligation to update units already shipped.

3.4.3 Instrumentation

The instrumentation consists of several assemblies.

- Pressure and temperature sensors in conjunction with the AERZEN AERtronic control system.
- Switches for pressure and temperature in conjunction with display instruments.

Shut-down locking

- The shut-down devices are set at the factory.
- All shut-downs must be self-locking. Once the shut-down has been given clearance, the machine must not be able to start automatically.
- Prior to a restart, the cause of the malfunction must be determined and eliminated. Start-up must then be performed manually.

NOTICE!
The switching points of the switches/sensors are fixed and must not be changed.

Pressure and temperature switches

If intake pressure, discharge pressure or discharge temperature switches are used to safeguard the machine, the drive motor must be switched off when the limit switch is triggered.

Contacts open → Drive motor off.

Pressure switch (optional)

It is also possible to use an additional pressure switch. A calibrated gauge is used to adjust the switching limit point. The scale on the switch only serves as a guide.

3.4.4 Frequency converter

Description

Observe the frequency converter manufacturer's instruction manual!

NOTICE!
- If the electric motor is driven by frequency converters, we strongly recommend using an motor throttle and power choke. These are specifically designed for the frequency converter and filter dangerous harmonics from the drive current. This prevents damage to the motor winding. The electromagnetic compatibility of the system is also improved. Reactions of the frequency converter in the current are reduced.
- The maximum current limit of the motor must not be exceeded. Observe the information on the motor's rating plate.
- To prevent operational faults the function "Interception circuit" must not be parameterised in the control of the frequency converter. When the frequency converter is switched off, a restart should only be possible after a complete shut-down of the machine.
- The machine must shutdown without braking. The activation of a brake ramp or quick stop is not permissible.

For machine use, observe the following

- Take into account the electrical and mechanical properties of the drive motor.
- Set the fixed minimal frequency. This frequency must never fall below the fixed minimum during operation.
- The maximum frequency is to be set by taking into account the maximum rotational speed of the motor and the maximum machine speed.
- The run-up time of the drive motor from standstill up to minimum speed can be 3-6 seconds.
- The frequency converter must be designed with a constant load torque for operation with a working machine.
- Never exceed maximum or drop below minimum speed thresholds.
- When exceeding the value, e.g. due to excessively long cables, frequency converter type etc. a motor throttle or motor filter coil that matches the frequency converter is to be used.

NOTICE!

Not using the motor throttle or motor filter can lead to damage of the motor isolation and a motor breakdown.

- The highest admissible voltage increase speed of the motor is 1,200 V/µs.
- The rotational changeover speed must not exceed 1 Hz per second during operation.
- Minimum frequency = 20 Hz // maximum frequency = 50 Hz results in a control time of 30 seconds.

Pole changing

For a motor speed changeover from a high to a low speed, the drive motor must have reached zero rotational speed each time.

Changeover from a low to a high speed can take place directly and instantaneously.

3.4.5 Machine terminal box

Terminal box

The machine's terminal box contains the electrical and electronic components that are not located directly on the machine (e.g. sensors).

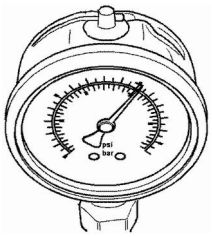
It contains terminals for connecting electrical and electronic components to the external power supply.

When the terminal box is closed, it is impossible to come into direct contact with live components, either accidentally or deliberately.

Since it contains internal components carrying dangerous voltage, the terminal box is locked. It can only be opened using special tools (terminal box key, triangular/square wrench).

3.4.6 Discharge pressure gauge

Positive pressure mode



The gauge displays the discharge pressure of the compressed gas.

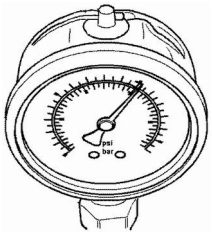
It is a display instrument without a switching function.

The gauge is connected on the discharge side.

Fig. 25: Pressure gauge

3.4.7 Nitrogen gauge

Nitrogen mode



The gauge is used when conveying nitrogen.

The gauge displays the pressure in the inlet pipe.

It is a display instrument without a switching function.

The gauge is connected on the intake side.

Fig. 26: Pressure gauge

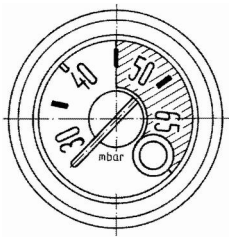
3.4.8 Maintenance indicator

Positive pressure mode

The maintenance indicator shows the dirt levels in the intake filter.

The maintenance requirements of the intake filter depend on the dirt levels of the medium taken in.

Replace the filter element when the following display values are reached and no later:



At -45 mbar (red display field), replace the intake filter.

After the filter has been changed, reset the pointer to its initial position by “pressing” the reset button.

Fig. 27: Version a)

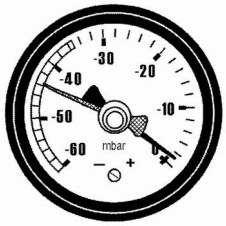


Fig. 28: Version b)

When the level of contamination increases, the red trailing pointer will be pulled over with the black pointer and stay at the maximum intake pressure.

Replace the filter element when the trailing pointer reaches the red area of the scale.

Once the filter has been replaced, reposition the trailing pointer between 0 and -10 mbar.

3.4.9 Intake silencer

Intake silencer

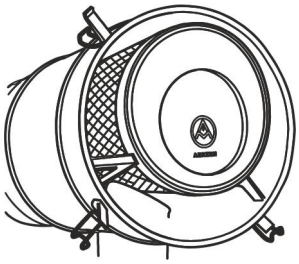


Fig. 29: Open intake silencer with filter

The intake silencer contains the intake filter. The intake filter prevents harmful particulate matter entering the conveying chamber of the machine.

The intake filter corresponds to filter class G4.

NOTICE!

Risk of machine damage! Never operate the machine without the intake filter.

Machine damage caused by the intake filter

NOTICE!

There is a risk of machine damage from the use of contaminated, damaged or non-original intake filters!

Heavily contaminated or damaged intake filters reduce performance. They affect functionality and may cause machine failure. Copies and reproductions of intake filters do not have the necessary properties.

– Inspect for damage.
– Comply with maintenance intervals.
– Only use original replacement parts.

3.4.10 Discharge silencer

Discharge silencer

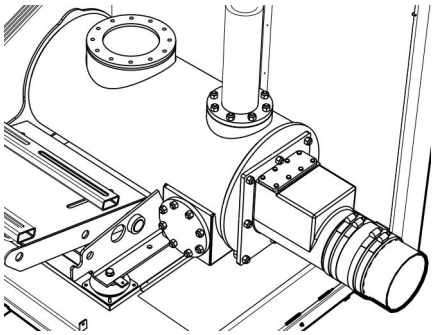


Fig. 30: Discharge silencer

The base support serves as the base for the whole bodywork of the machine. The base support also acts as a discharge silencer. The discharge silencer is an absorbtion-agent-free component. The acoustic energy inside the discharge silencer is reduced by means of air deflection.

3.4.11 AERZEN safety valve

AERZEN safety valve

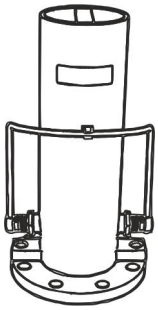


Fig. 31: Safety valve

Note the instruction manual for the safety valves. It is included with the product.

The safety valve is used for the conveyance of air.

The safety valve is set at the factory.

If the set value is exceeded, the safety valve opens and releases excess conveyed material into the atmosphere.

The safety valve is NOT a control component and is not to be used as such.

The safety valve can be used up to a temperature of 200°C.

NOTICE!

Risk of premature wear and failure!

The safety valve is not intended for controlling the operating data!

Disabling the safety valve, e.g. by setting a higher opening pressure, can cause serious material damage.

The outlet of the safety valve must not be made narrower or closed. Keep the cross-section unobstructed!

3.4.12 Start unloading device for DN80 to DN400

Start unloading device

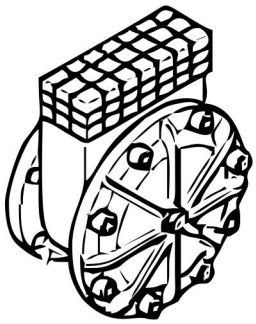


Fig. 32: DN 80 to DN 400

NOTICE!

Risk of premature wear and tear and breakdown! The start unloading device is not intended for controlling the operating data!

The use of the start unloading device as a controller for operating data leads to premature wear and tear and breakdown!

The start unloading device can be used in machines that are run by an electric motor with a “star-delta connection”.

This allows for a relieved start-up against existing mains pressure.

In the case of drives with pole-changing motors, it is also possible to use a start unloading device with a solenoid valve.

This provides a relieved start-up at higher speeds.

After a correct set-up, the start unloading device operates maintenance-free.

The start unloading device is not necessary for drives with frequency converters.

3.4.13 Start unloading device for DN50 to DN80

Start unloading device

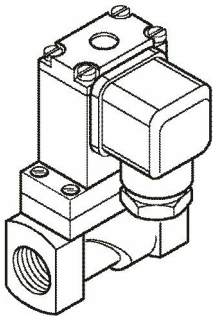


Fig. 33: DN 50 to DN 80

NOTICE!

Risk of premature wear and tear and breakdown! The start unloading device is not intended for controlling the operating data!

A solenoid valve offers the possibility of relieved start-up for DN 50 to DN 80 (“star-delta connection”). The valve closes if voltage is present.

The valve may only close after the switch from “star to delta”.

For pole changing: in “star-double-star starting”, the solenoid valve is to be switched so that it opens before the high-speed operation and closes after ramping up.

The start unloading device is not necessary for drives with frequency converters.

3.4.14 Belt drive

Belt drive

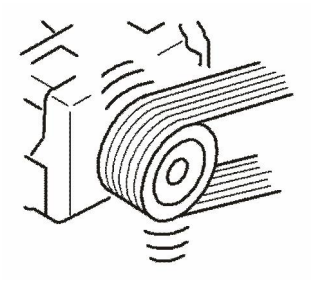


Fig. 34: Belt drive

The sheaves are mostly fitted and aligned in the factory.

The sheave for the machine stage is fitted to the drive shaft. The position and orientation of this sheave therefore affects the alignment of the drive motor pulley.

Check the alignment:

- Before first commissioning
- According to the maintenance plan
- After replacing the pulley(s)

The maximum permitted sheave offset is 0.5 mm.

It is extremely important that only original replacement parts be used for the purposes of belt-pulley operation!

Only use replacement and wear parts that are recommended and approved by AERZEN!

Original replacement parts

NOTICE!

Risk of material damage!

Pulleys must only come from one manufacturer and from one production batch.

– Otherwise varying belt tensions can occur which can result in uneven running and premature wear.
– As a result of a risk of snapping, the sheaves must be suitable for the peripheral speed encountered!

3.4.15 Acoustic hood

Acoustic hood

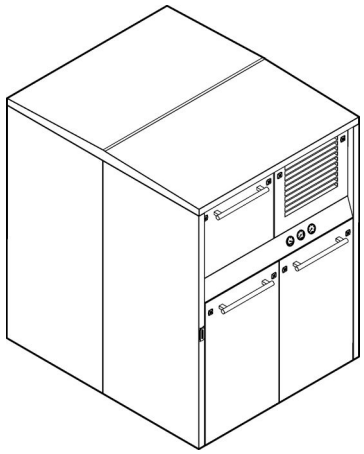


Fig. 35: Acoustic hood, version diagram

The acoustic hood serves to reduce noise and acts as a guard.

The acoustic hood is a component designed for product safety with lockable door elements.

Always keep the acoustic hood closed during operation.

The key must only be accessible for authorised personnel.

An earthing strap or threaded hole is located on the outer edge of the floor tray.

Lock

Operation with an open acoustic hood is not permissible!

- *Always lock the elements of the acoustic hood with the key provided.*
- *The key must only be accessible for authorised personnel.*

Fan

The acoustic hood is ventilated by a fan.

The fan is connected at the factory. The fan must be activated in parallel with a machine start.

Intake from a pipeline

The acoustic hood makes intake-side machine suction possible from the system pipeline.

The pipeline is guided through the acoustic hood to the machine through prefabricated openings.

The following steps must be complied with: *Chapter 5.3 „Alignment and dowelling“ on page 90*

Acoustic hood heater

NOTICE!

There is a risk of material damage from low ambient temperatures!

If there are temperatures of below –10 °C in the surrounding area, provide an acoustic hood heater!