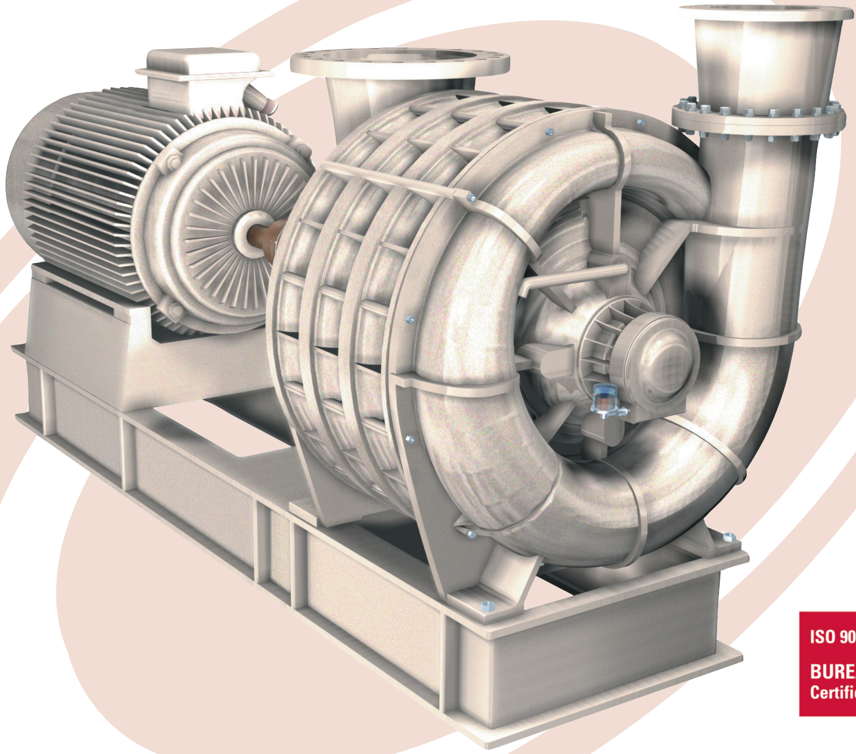
CONTINENTAL INDUSTRIE
Blowers & Exhausters
www.continental-industrie.com

INSTALLATION, USE & MAINTENANCE OF

BLOWERS & EXHAUSTERS



ISO 9001
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Certification

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REV 102007 - 2GB

CONTENTS

1.0.0 GENERALLY

CONTINENTAL turbo blowers and turbo exhausters are made in accordance with current safety regulations.

The various production phases undergo the checks provided for by the quality control plan to ensure that materials and assembly are free from defects. All machines are mechanically tested before dispatch.

1. 1. 1 Safety

Common sense must be used and general safety standards together with any special standards for the specific installation must be strictly observed when moving, installing, using and handling machinery. No operation or maneuver shall be carried out by inadequately qualified personnel.

In particular, the following are not permitted:

- the use of cables or eye-bolts which are damaged or have inadequate characteristics for lifting

- working on high-voltage electrical components if not specifically qualified for such work

- working on live electrical circuits or in the presence of charged capacitors

- working on machines connected to an electricity supply without having switched off the isolator or put out appropriate "works in progress" signs

- assuming that the precautions taken are definitely adequate and that checks do not need to be made, for example, where work is resumed after a halt

- operating machines with coupling or bearing housing guards removed

- operating machines with the inlet opening uncovered

- leaving machines in operation unsupervised in the presence of children or animals

- approaching rotating parts wearing ties or shirts.

1.2.1 Guarantee

CONTINENTAL turbo blowers and turbo exhausters, unless otherwise specified when ordering, are guaranteed for twelve months from their start-up, but for no more than eighteen months from their date of delivery to the original purchaser.

During this period, CONTINENTAL will replace or repair any part free of charge, free own works, provided that the tests made reveal material or manufacturing defects. To make a claim under guarantee, the machines and/or systems must have been used for their intended application and in compliance with CONTINENTAL's instructions.

The purchaser loses all guarantee rights if the machines and/or systems are repaired or modified, in whole or in part, by the purchaser or third parties, unless this has been agreed in writing by CONTINENTAL, who however do not accept any liability for the repair or modification thus authorized.

Transport expenses, including insurance costs, for the defective parts to and from CONTINENTAL's works will be borne by the purchaser.
The guarantee does not cover damage resulting from incorrect use (operation in unstable conditions, at inadmissible speeds of rotation, at inadmissible pressures or temperatures etc.), negligence, alterations and incidents.

Materials and/or components, such as motors, valves, gearboxes, electrical equipment etc. bought by CONTINENTAL from third parties are guaranteed by their respective suppliers and these guarantees are maintained in accordance with the above conditions.

CONTINENTAL reserves the right to invoice all replacements made due to material or manufacturing defects where repairs are carried out on site at the specific request of the customer.

1.3.1 Limit of liability

CONTINENTAL's liability in respect of claims of any kind, including negligence, consequential or associated loss or damage, or loss or damage resulting from the performance, design, manufacture, operation, use and likewise from any installation, technical installation instructions, inspection, maintenance or repair of any machine and/or system supplied, will not under any circumstances exceed the purchase price of the machine and/or system giving rise to that claim and ends at expiry of the guarantee period defined in item 1.2.1.

Under no circumstances, whether due to breach of the guarantee by CONTINENTAL or by manifest negligence, shall CONTINENTAL be responsible for special and consequential damages including, without this list being exhaustive, losses of profits or proceeds, loss of use of the machines and/or systems themselves or connected machinery, capital cost, cost of replacement machines and/or systems, tooling or services, costs for down time or customers' claims to the purchaser for such damages.

Unless expressly stated in writing, the machines produced by CONTINENTAL are not intended for use in nuclear systems or activities.

CONTINENTAL refuses any liability for any damages, injuries and nuclear pollution which may occur as a consequence of such unauthorized use and the customer shall indemnify CONTINENTAL for any claims deriving therefrom, including any attributed to negligence.

2.0.0 MACHINE ACCEPTANCE

2.1.1 Preliminary controls

When machinery is taken directly from the works or from a carrier's depot or when it is delivered by a carrier, the delivery and/or dispatch documents must first be checked to ensure that the equipment ordered has been received.

All packs comprising the supply, unless otherwise specified when ordering, are marked with the CONTINENTAL order number.

The packaging or the equipment itself, if it is visible, must be checked for any obvious signs of damage incurred during handling and transport. If such damage is found, this evidence must be put directly to the carrier and it must be ensured that the carrier notes this clearly on the delivery document before signing it. CONTINENTAL must also be informed promptly to avoid any disagreement and to guarantee rapid and satisfactory settlement of any damages.

2.2.1 Unloading and handling

The addressee is responsible and liable for unloading operations and shall therefore entrust supervision thereof to appropriately qualified personnel, selected on the basis of the size of the machinery and the difficulty presented by the operation.

2.2.2 Checks

A check shall be made promptly that all the equipment received corresponds to the order and any irregularities shall be advised to CONTINENTAL immediately for the necessary corrective action.

It is recommended in particular that the presence of all the fittings ordered and the supply voltage of any electric motors be checked.

2.3.1 Recommendations for lifting

In view of the number of models produced by CONTINENTAL and the special features possible for each individual order, there is a vast number of feasible cases and nothing therefore can replace the experience of personnel in the handling of machinery in general.

The sole recommendation is never to use bearing housings for the fixing of slings.

Where necessary, specific instructions for lifting and handling are provided separately.

2.4.1 Storage - short term

If a period of machine inactivity of not more than 60 days is planned, no particular precautions are required for storage. The protective devices provided directly by CONTINENTAL before its dispatch from the works are thus sufficient to keep it in good condition for this period, provided that it is kept under cover in a clean and dry environment and without the covers on the inlet and outlet openings being removed.

2.4.2 Storage - long term

For periods of inactivity of over 60 days, in addition to keeping the machinery under cover and in a clean and dry environment, the following precautions must also be taken:

- check that the inlet and outlet openings are properly sealed

- slacken any transmission belts

- fill any oil-lubricated bearing housings in accordance with the instructions given in item 12.2.2 - frequently check the condition of machined and unpainted surfaces (shaft ends, bearing services etc.) making good, where necessary, the protective coating provided in the works

- approximately every 30 days, rotate the machine and motor shafts manually for a few revolutions.

During storage, it is essential to prevent the machine being subject to vibrations produced by the operation of nearby machines and propagated via the bearing surfaces. Such vibrations applied for long periods could damage the machine and motor bearings.

It is also necessary to prevent the machine from being subject to frequent and/or sudden changes in temperature causing the formation of condensation, especially inside machines and motors and inside bearing housings. Where the possibility of condensation can be foreseen, the following shall be carried out:

- hang a bag of silica gel or another hygroscopic substance inside the inlet opening and inside the outlet opening, immediately replacing the respective protective covers

- place a bag of silica gel or another hygroscopic substance for the openings on every bearing housing

- isolate the machinery from the ambient atmosphere, if possible using sealed impermeable bags or using impermeable covers carefully placed to minimize air circulation.

3.0.0 STANDARD FITTING

The typical fittings for CONTINENTAL turbo blowers and turbo exhausters include a base-plate common to the machine and the motor, a series of foundation fixings, the machine/motor coupling and the protective guard over the coupling.

3.1.1 Base-plate

Small machines are generally given an OMEGA base-plate made of pressed steel plate strengthened with appropriate reinforcements - Fig. 3.1.

Other machines, in contrast, have an electro-welded steel section base-plate - Fig. 3.2.

All the base-plates have screws to align the motor and tighten any transmission belts. The base-plates must be level if the machine is to work correctly.

This should be checked with particular care in oil lubricated machines.

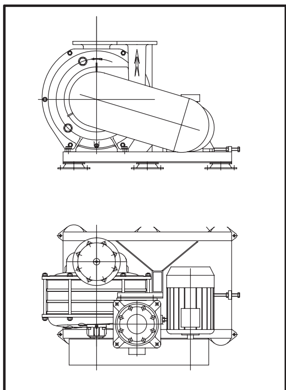


Fig. 3.1

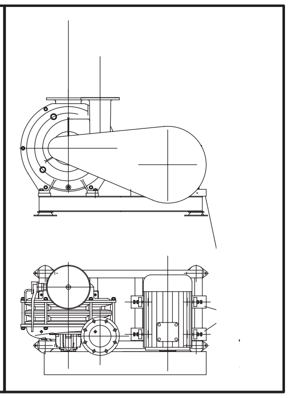


Fig. 3.2

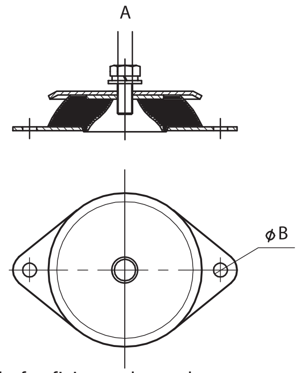
3.2.1 Shock-absorbing support blocks

CONTINENTAL machines can be installed by placing the shock-absorbing blocks included in the supply between the base-plate and the bearing surface - Fig. 3.3.

The type and the quantity of blocks required is defined by CONTINENTAL on the basis of machine characteristics.
The shock-absorbing support blocks enable the machine to be installed easily and rapidly without the need to make specific foundations.
This allows the machine to be connected while preventing the transmission to the surrounding environment of vibrations generated by it and likewise the transmission to the machine of any vibrations present in the surrounding environment.

If the machine is to operate correctly, all the shock-absorbing support blocks must be loaded uniformly.
At installation, it is therefore necessary to check that none of the shock absorbers has been left unloaded.

Irregularity in the bearing surface and the dimensional tolerances of the base-plate and the shock absorbers themselves almost always mean that corrections need to be made by placing shims between the shock absorber base and the bearing surface.



A = drill hole for fixing to base-plate
B = drill holes for fixing to bearing surfaces using expansion bolts

Fig 3.3

3.2.2 Levelling plates and fixing bolts

Fixing bolts and levelling plates can be provided instead of shock-absorbing support blocks.

The use of anchor bolts, more usual for machinery with higher installed power, involves the making of a plinth isolated from the rest of the foundations to prevent the transmission of vibrations.

Where anchor bolts are used, the base-plate shall be fitted in accordance with the following instructions:

1 - Make the plinth, if possible keeping it isolated from the rest of the foundation.
The upper surface shall be left rough so as to provide a good key with the grouting to be carried out subsequently.

2 - Raise the base-plate to approximately one meter above the plinth.
Fit the levelling screws and the anchor bolts as shown in detail A of Fig. 3.4.
Check the 15 mm and 50 mm overhangs indicated.

3 - Lower the base-plate to approximately 200 mm from the plinth, centering the anchor bolts in the pockets.
Position the 100 x 100 x 20 plates under the levelling screws.
Lower until the levelling screws come into contact with the plates.
Position the base-plate in its final location, longitudinally and transversally.
Center the plates under the levelling screws.
Wedge the plates which are not in contact with the adjustment screws.
Do not use the screws to make contact with the plates.

4 - Check that the anchor bolts are positioned correctly in the pockets.
Cement the anchor bolts into their pockets. Leave to harden as appropriate.

5 - Loosen all the locknuts of the anchor bolts and levelling screws. Slightly tension using the anchor bolt nuts and the levelling screws.

6 - Check that the base-plate is level by using a spirit level sensitive to 0.0,2 mm/m.
This check shall be made longitudinally and transversally on all finished surfaces.
It shall be level to 0.02 mm/m.
It is adjusted by using the spirit level on the finished surface as shown in detail B of Fig. 3.4 and using the

levelling screw/anchor bolt sets.

Each levelling screw/anchor bolt set can be used to raise or lower the base-plate and therefore the edge of the finished surface relative to the adjacent one.

9 - Cure the cement adequately for an appropriate number of days.

10 - Tighten all the anchor bolt nuts and the associated lock nuts before fitting the machines.

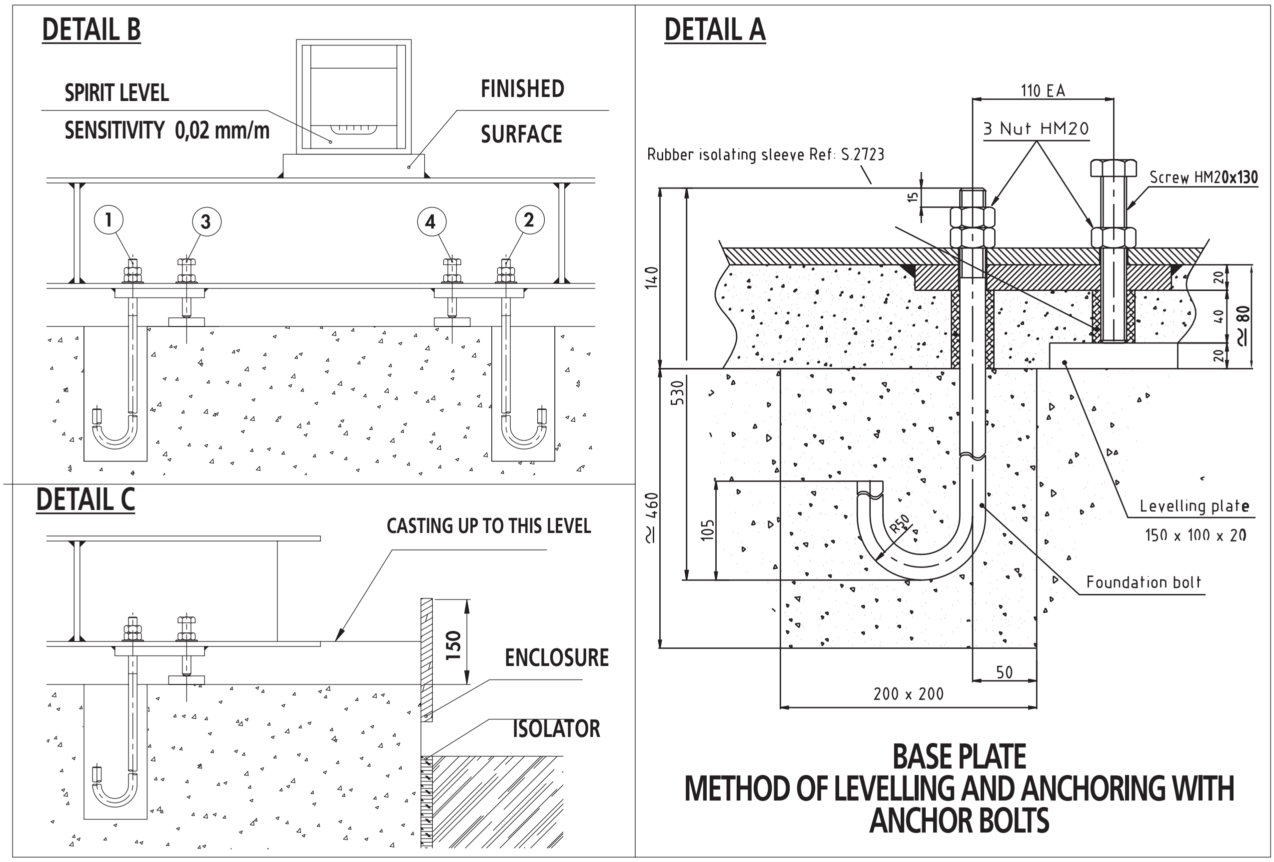


Fig. 3.4

In particular:

- for lowering, the levelling screw must be slackened and the anchor bolt nut tightened
- for raising, the anchor bolt nut must be slackened and the levelling screw tightened.

7 - When all surfaces are levelled transversally and longitudinally as specified, ensure that no screws or nuts are slack. If any are, they must be tightened manually so as not to disturb the level obtained.

All lock nuts are also to be tightened manually.

8 - Clean the surfaces of the plinth and prepare it for grouting. Provide an enclosure as shown in detail C of Fig. 3.4. If it is being installed in the open air, provide appropriate drainage for rainwater, taking account of the base-plate shape.

Pour grout under the base to the level indicated in detail C of Fig. 3.4. Avoid the use of mechanical vibrators so as not to disturb the level surface obtained. Instead, promote grout penetration with bars or chains.

3.3.1 Direct transmission using a coupling

Direct drive to the motor with a coupling is used where the speed of rotation of the machine is the same as that of the motor.
This is the case particularly with machines driven by 60 Hz electrical motors and for turbine-driven machines.
The couplings commonly used are of the geared or lamellar type.
A spacer is always fitted to enable the bearing at the coupling end to be replaced without disturbing the alignment.

IMPORTANT:
All gear-type couplings must be grease-lubricated.

Machines fitted with gear-type couplings at the factory are already greased and ready for use.
On the other hand, where the gear-type coupling is fitted by the client, the spaces between the teeth of the two hubs and the two sleeves must be completely filled with grease.
In models with holes for lubrication, once assembly is finished, the coupling must be completely filled by injecting grease under pressure until this escapes from the opposite hole.

The coupling is lubricated in the same way, at intervals which are multiples of those set for bearing lubrication.
As the lubricating power of the grease diminishes over a period of time, due to the effect of mechanical stresses, ageing and pollution (possible regardless of the presence of gaskets), the regular replacement of all the grease in the coupling is recommended.
With regard to the alignment of the transmission coupling, refer to item 12.5.2.

3.3.2 Transmission using pulleys and belts

Pulley and belt couplings are widely used as they enable a better speed of rotation to be selected and the machine can therefore be used close to the point of top output.
In many cases, it also allows 4-pole motors to be used to reduce the overall noise level of the unit and also enables the throttle curve of the machine to be changed to a certain extent by the simple replacement of the pulleys.
With regard to the alignment and tensioning of the transmission belts, refer to item 12.5.1.

3.3.3 Pulley/belt transmission with additional support

Where the tension of the belts on the machine bearing needs to be reduced, an additional support and a third bearing can be used.
This support is provided by a housing connected by screws to a wide flange which bolts onto the blower outlet head - Fig. 3.5.
The replacement of transmission belts, which must be carried out in accordance with the general instructions given in item 12.3.1, involves the removal of the housing.
With regard to the alignment and tensioning of the transmission belts, refer to item 12.5.1.
Thebeltsshallbeputundertensiononlywhenthe housing has been refitted.

3.3.4 Pulley/belt transmission with countershaft

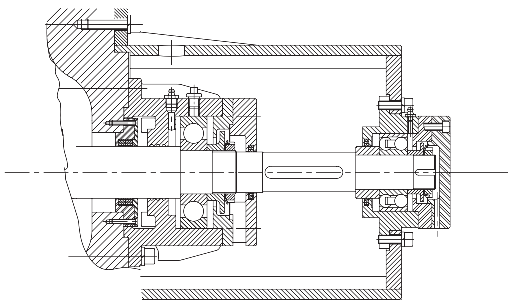


FIG. 3.5

Where high belt tension is required for power transmission, a countershaft is used which enables the tension to be accepted totally on its supports.
The connection between the machine and the countershaft is therefore made with a coupling, as described in item 3.3.1.
The transmission belts shall be aligned and tightened using only the motor in accordance with the general instructions given in item 12.5.1.
The transmission coupling shall be aligned using only the machine in accordance with the general instructions given in item 12.5.2.
Transmission belts shall be replaced in accordance with the general instructions given in item 12.3.1 but taking account of the fact that, in this case, the countershaft needs to be removed.
For rapid re-positioning of the shaft supports, the use of the adjusting screws provided for this purpose is recommended.

Whenever the transmission belts are replaced, it is also recommended that the coupling alignment be checked.

3.3.5 Transmission using a gearbox

Where the speed of rotation of the machine is greater than the speed of rotation of the motor and the value of the power to be transmitted does not allow for the use of belts, a gearbox is used.
Gearboxes with parallel shafts and helical or double helical gears are normally used.
Motor/slow shaft and fast shaft/machine connections are made with couplings as described in item 3.3.1.
The gearbox is fitted directly on one of the structural supports with the machined surfaces between the motor and the blower.
Its position with regard to the base-plate is fixed and thus no screws are provided for its alignment. There are sometimes two dowels for re-positioning the gearbox if it is removed.
It is aligned only by moving the machine and motor in lateral and longitudinal directions using the appropriate screws.
Any height correction is made by changing the settings of the shims under the feet of the blower and the motor.
The values of the distances to be kept between the shaft ends and the alignment tolerances, hot and cold, for the fast coupling and for the slow coupling are provided separately.
The use of a gearbox requires a forced lubrication circuit and cooling of the lubricating oil, generally achieved using a water/oil heat exchanger.
This also includes a safety system which provides an alarm signal and a shut-off signal if the lubricating oil pressure is too low.
The lubricating oil is generally held in the housing of the gearbox itself and is circulated by a gear pump driven by the slow shaft.
There is sometimes a separate lubricating unit which comprises a tank, any auxiliary and spare electrical pump required, the heat exchanger, the pressure accumulator etc.
Where necessary, specific instructions are provided separately for the use and the maintenance of the gearbox.
With regard to the alignment of the transmission couplings, refer to item 12.5.2.

3.4.1 Coupling guard

The coupling guard, whether for a direct coupling or a belt coupling, is made of steel or aluminum sheet and fixed using stirrup screws generally welded to the baseplate. Given the variety of shapes and dimensions possible, specific instructions cannot be given for removal, although this does not present any difficulty to the maintenance personnel.

3.4.2 Safety housing

In some cases (for example, biogas turbo blowers), the machine is fitted with a housing comprising two steel sheet half shells, held together with screws and nuts, which do not enclose the body.
All normal maintenance can be carried out without the need to remove it.

3.5.1 Painting

The standard painting of CONTINENTAL turbo blowers and turbo exhausters and their common accessories consists of a base coat applied after brushing and degreasing and a finishing coat in hammer finish grey, synthetic enamel RAL 7016.

4.0.0 SPECIAL APPLICATIONS

Machines can be supplied to specifications to meet the specific needs of certain individual applications.

4.1.1 Machines for high temperatures

Where machines are to operate at a high temperature, the following measures can be taken in addition to possible deviations from standard models with regard to tolerances and the materials for certain items:

- screens and/or spacers to reduce the heat transmitted to the bearings via the housings

- water-cooling circuit for bearings

- facility for sliding the outlet head feet in a longitudinal direction.

Where necessary, specific instructions will be provided separately with regard to the above features and the lubricants to be used.

4.1.2 Machines for low temperatures

Where machines are to operate at low temperatures, the following measures can be taken in addition to possible deviations from standard models with regard to the materials for certain items:

- circuit to preheat bearings before start-up.

Where necessary, specific instructions will be provided separately with regard to the above features and the lubricants to be used.

4.2.1 Gas machines

Where the fluid processed is a gas other than air, various measures can be adopted depending on the particular characteristics of the application and the gas itself:

- the inside of the machine body can be given a gas-proofing treatment to prevent gas losses to the environment via casting pores

- fitting of the machine safety housing described in item 3.4.2

- use of special belts and/or transmission couplings for the spark-proof models

- use of special coupling guards for the sparkproof models

- mechanical shaft sealing to minimize losses of the gas processed into the environment

- sealing of the shaft by injection of the same gas processed to prevent contamination of the gas by atmospheric air

- sealing of the shaft by the injection of inert gases to prevent losses of the gas processed into the environment

- use of special materials for rotors and/or the shaft

- use of protective coatings for rotors and/or the machine body interior.

- Where necessary, specific instructions are provided separately with regard to the above features.

5.0.0 MOTORS

The mechanical energy required to run CONTINENTAL turbo blowers and turbo exhausters is taken from a motor.

In most cases electric motors are used, but other types of motor can also be used.

5.1.1 Electric motors

IMPORTANT: all work on high-voltage electric motors must be carried out only by qualified personnel.

All electric motors must be individually earthed using an appropriately sized mains cable.
The electric motors commonly used run on three-phase alternating current.

In electric motors, the only parts subject to wear are the two bearings which support the rotor and which are normally grease-lubricated. Depending on the size, there can be two ball bearings or one ball bearing and one cylindrical roller bearing. Lubrication periods and the quantities and type of grease to be used for the bearings are usually given on the motor plate.
Refer to items 12.1.1 and 12.2.1 of this manual with regard to the lubrication and preventive maintenance of bearings.
Large motors can be fitted with plain bearings for which specific maintenance instructions are provided separately.
The windings of electric motors lead to 6 terminals in a terminal box which has holes for the passage of power cables. The terminal box is located on the top or to one side of the motor.
Often terminal boxes located on the top of motors can be orientated at 90 increments.
The terminals are arranged and designated as illustrated in figures 5.1 and 5.2.
In some cases, there can also be terminals to connect special devices such as anti-condensation resistance (heaters) or platinum probes to measure the temperature of the windings.
The main characteristic data is stamped on a metal plate fitted on every motor.
Motors must always be connected down line from suitable protection against short circuits and overloads.
Not all motors are designed to operate in either direction of rotation. Often the cooling fan blades are orientated to be more efficient and cause less noise.

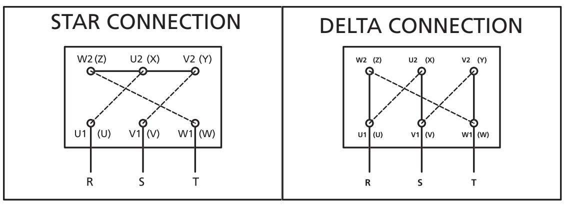


Fig. 5.1 Fig. 5.2

5.1 2 Star connection

The star connection is used where the line voltage is the same as the higher of the two voltages given on the plate (the line voltage is the potential difference between two of the three conductors R, S and T).

The three links fitted in the terminal box must be set out as shown in Fig. 5.1.

At the first start-up, the direction of rotation must always be checked as, if necessary, it can be reversed quite simply by swapping two of the three supply cables R, S and T.

5.1.3 Delta connection

The delta connection is used where the line voltage is the same as the lower of the two voltages given on the plate (the line voltage is the potential difference between two of the three conductors R, S and T).
The three plates fitted in the motor must be set out as shown in Fig. 5.2 (two overlap).
At the first start-up, the direction of rotation must always be checked as, if necessary, it can be reversed quite simply by swapping two of the three supply cables R, S and T.

5.1.4 Direct start-up

Apart from factors regarding the electricity supply line, there are no objections to a direct start-up of electric motors coupled to CONTINENTAL turbo blowers and turbo exhausters.
Direct start-up consists of powering the motor directly at normal operating voltage.
This allows the motor to develop the maximum acceleration torque and thus to reduce to a minimum the time required to reach the nominal speed of rotation.
Naturally, maximum current absorption corresponds to the maximum acceleration torque.

5 1.5 Star/delta start-up

To reduce the load on the supply line and to contain the absorption "peaks", star/delta start-up is sometimes used, but only for power over 7.5 kW.
The star/delta start-up consists of powering the motor at a voltage lower than that of its normal operation until its speed of rotation is close to nominal (a few seconds) and then moving to a full voltage supply.
This is possible only where the line voltage is the lower of the two voltages given on the plate (the line voltage is the potential difference between two of the three conductors R, S and T).

In the first mode, the motor has a star connection and therefore the line voltage is 1.73 times lower than its nominal supply voltage. The current absorption and the acceleration torque are approximately one third of their maximum value and therefore the time required to reach values close to the nominal speed of rotation is longer than with direct start-up.

In the second mode, the motor has a delta connection and therefore the line voltage is equal to the nominal supply voltage. Absorption and acceleration torque may now reach their maximum values but the machine is already close to its nominal speed of rotation and requires only a small final acceleration.

The star/delta start-up involves the movement of the terminal box links and the connection of six separate cables, one for each terminal.
To reverse the direction of rotation, two of the three cables connected to one side of the terminal box and the two opposite cables on the other side of the terminal box must be swapped.

In view of the relatively long start-up times typical for multistage centrifugal blowers and exhausters, the use of thermal protection is recommended in the control panel.

5.1.6 Reduced voltage start-up

Reduced voltage start-up is basically the same as the star/delta start-up described in item 5.1.5 with the difference that the delta-connection motor, is powered in the two modes at two different voltages; the lower of the mis generally obtained by means of an auto-transformer.

5.2.1 Turbines

Direct turbine coupling is generally used because of the specific characteristics of the installation. The special instructions required are provided separately.

5.3.1 Internal combustion engines

The use of internal combustion engines is generally restricted to machines installed on self-propelled equipment and machines in fixed installations where there are plenty of natural or biological gases.
A clutch is inserted between the motor and the transmission which can be made by belts and pulleys or by a gearbox.
The special instructions required are provided separately.

5.4.1 Hydraulic motors

The use of hydraulic motors is generally restricted to machines installed on self-propelled equipment.

The hydraulic motor is supplied with pressurized oil by the main motor of the equipment itself.
Transmission is usually by means of belts and pulleys.
The special instructions required are provided separately.

6 0.0 TYPICAL FITTINGS

Depending on the application for which CONTINENTAL turbo blowers and turbo exhausters are intended, they can be provided with certain fittings to enhance the installation and enable it to be used correctly.
As the machine ports must not be stressed with forces and/or moments greater than limits depending on their size, it may be necessary to provide for the support of certain fittings.
The values of the static stresses admissible on the openings are given in item 8.3.1.

6.1.1 Flanged adaptor

The flanged adaptor, comprising a piece of tube welded to a mating flange, is used together with a flexible sleeve to connect the inlet and/or outlet port to the piping of the system to be served.
The connection thus made prevents the transmission of vibrations from and to the machine and enables thermal expansion to be absorbed.
The fittings and the pipes connected above the adapter must be appropriately fixed so that they do not rest on the adapter itself.

6.2.1 Flexible sleeve

The flexible sleeve (fig 6.1), made of reinforced rubber, is intended for fitting with the flanged adaptor described in item 6.1.1.
The flexible sleeve is secured to both the tubes connected by two straps.

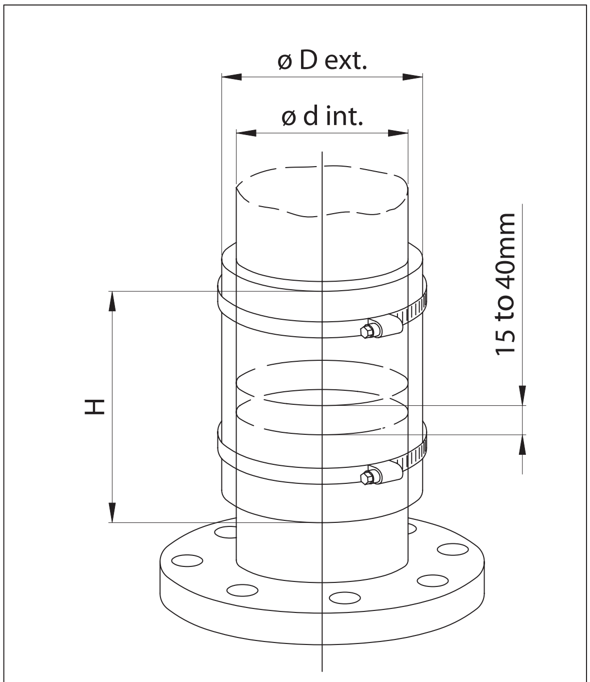


Fig 6.1

6.3.1 Expansion compensator

For working temperatures of up to 110°, the expansion compensator is made of reinforced rubber with an omega section; for higher temperatures, the use of a stainless steel compensator is preferred.(See fig 6.2)

It is for connecting the ports of the machine to pipes and/or flanged fittings.

The compensator enables thermal expansion to be absorbed and prevents the transmission of vibrations from and to the machine. The fittings and the pipes linked above the compensator must be appropriately fixed so that they do not rest on the joint itself.

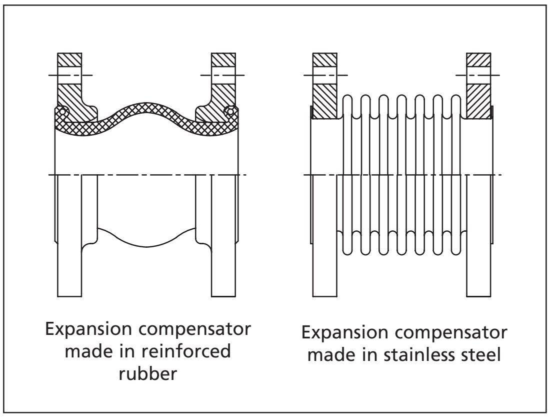


Fig 6.2

6.4.1 Butterfly valves - manual operation

A butterfly valve is generally found in all installations to cut the machine off from the system and/or to control its operation.
In most installations, it is preferable to fit the valve directly on the inlet opening; however, specific instructions on controlling operation by means of the butterfly valve are found in item 10.1.1.
"Wafer" type butterfly valves can be fitted directly on the machine ports before the flanged adaptor or the expansion compensator.

Generally, valves have an operating lever lock system.

6.4.2 Butterfly valve - pneumatic operation

This valve has the same function as that described in item 6.4.1 but is operated by compressed air.
It can also be used as an overflow valve in anti-surge systems.
Valves intended for on-off operation generally have servocontrols with a double-acting cylinder powered by a solenoid valve.
The compressed air supplied must have a pressure of between 5 and 8 bars and must be filtered and lubricated.
Operating speed can be controlled directly using the throttles on solenoid valve discharges. There may be adjustable mechanical limits for fixing the maximum open and/or maximum closed positions of the butterfly.

There may be SPDT end-of-run contacts, which can be positioned with mechanical limits, for use in the startup sequence or for other controls and/or signals.
Valves intended for regulation have servocontrols which are single- or double-acting with a positioner.
In addition to the compressed air supply, these also require an adjustment signal, range 3 - 15 psi (0.2 - 1 bar).

There are also pneumatic drives which require electrical regulation signals, range 4 - 20 mA or 0 to 20 V.

Where necessary, specific instructions are provided separately.

6.4.3 Butterfly valve - electrical operation

This valve has the same function as that described in item 6.4.1 but is operated using an electric motor.
It can also be used as an overflow valve in anti-surge systems.
Its operating speed is fixed.
The maximum open and maximum closed positions can be controlled using two end-of-run contacts.
The valve is suitable both for on-off operation and for regulation. Naturally, where used for regulation, the signal from the system must be processed by a suitable electric circuit. Where necessary, specific instructions are provided separately.

6.5.1 Non-return or check valve

The check valve is used wherever the return of the gas processed needs to be prevented.
The most common case is where two or more turbo blowers or two or more turbo exhausters are connected in parallel.

A very common non-return valve comprises a disc fixed to the body at a single point on its circumference. This must always be fitted with a vertical axis and so as to remain normally closed due to the effect of the force of gravity alone. Therefore, this valve must always be fitted on the process side of both turbo blowers and turbo exhausters. (fig 6.3)

Another type of non-return valve comprises two flaps fitted diametrically on to the body and loaded with two springs which keep them closed in any position. There are therefore no restrictions with regard to its fitting.

"Wafer" body non-return valves can be fitted directly on the machine ports before the flanged adaptor or the expansion compensator.

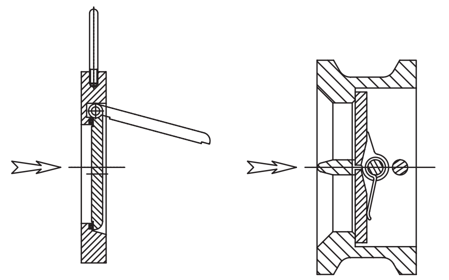


Fig 6.3

6.6.1 Inlet filter - silencer filter

The inlet filter is for use with air. The standard filter comprises a flanged body which has a structure for supporting and fixing the filtering elements.

Depending on the size of the turbo blower and its capacity, the filter can take one to six filtering elements.
The dry filtering element is a cylindrical cartridge made of inert material which includes one fitting at each end such that they can be placed on top of each other.

Each cartridge or pair of cartridges is fixed to the filter using a central rod, a disc and a wing nut.
Depending on the nature of the pollutant, it is possible to clean the cartridge with varying degrees of ease.
Clean as normal with a jet of compressed air or wash in water with detergent and rinse thoroughly.
It is important to wait until the cartridge is perfectly dry before re-using it.
Filtering elements need to be cleaned or replaced when their pressure drop reaches a value of 80 - 100 mm H_2O.
The inlet filter can be fitted with a protective cover for installation in the open air. The cover must be removed for maintenance.

The filter silencer has a sound-absorbent cover which must be removed for maintenance.

Inlet filters must be fitted where there is easy access for inspection and maintenance. It may be necessary to provide appropriate service platforms.

For non-standard inlet filters, specific instructions are provided separately where necessary.

6.7.1 Silencers

IMPORTANT:
An arrow on the silencer body indicates that the flow is one-directional and that the silencer must be placed in the right direction.

The inlet, the outlet and any overflow valves are the major sources of noise in the machine.

The purpose of the silencer is to attenuate the propagation of this noise into the atmosphere.
Absorption, full flow or annular silencers and low pressure drop silencers are generally used on inlet and outlet or discharge lines.
On overflow lines, in certain special cases, combined type silencers may be preferred.
The silencing of the inlet line must be given priority for turbo blowers as it is in direct communication with the atmosphere.
For the same reason, the silencing of the discharge line must be given priority in turbo exhausters.
Inlet and outlet or discharge silencers must be isolated from the machine by expansion joints or flexible sleeves and must be fixed with suitable brackets. These must be fitted as close as possible to the respective openings.
Flanged silencers are often used at one end with a flexible sleeve and a flanged adaptor at the other.
These must be fitted with the flexible sleeve nearer to the machine opening.
Silencers on overflows to the atmosphere used in the anti-surge circuit of turbo blowers must be fitted as close as possible to the overflow valve.
If a piece of pipe needs to be fitted to connect the overflow valve and the silencer, the use of very thick pipe is recommended.
At the end of the discharge, silencers on overflows to the atmosphere must have a fluted curve and a protective wire mesh.
Overflow silencers used in the anti-surge circuit of turbo exhausters must be fitted as close as possible to the overflow valve.
If a piece of pipe needs to be fitted to connect the overflow valve and the silencer, the use of very thick pipe is recommended.
At the end of the inlet, overflow silencers for turbo exhausters must have a filter and, if installed in the open air, they must be protected from rain.

6.8.1 Anti-surge valve

Where the fluid processed is air and where system characteristics so allow, the anti-surge valve can be used to prevent the machine operating at capacities lower than the minimum admissible, to prevent surge coming into operation.
In turbo blowers, the valve must be fitted immediately down line from the outlet opening to allow air to be discharged into the atmosphere.
In turbo exhausters, the valve must be fitted immediately up line from the inlet opening to allow air to be taken directly from the atmosphere.

IMPORTANT:
In some cases, the efficiency of the antisurge valve can be impeded by the operation of the cutoff/regulation butterfly valve fitted at the machine inlet.

The anti-surge valve prevents the machine operating at pressures/negative pressures greater than the design pressure and thus prevents the capacity falling correspondingly.

The valve must be calibrated in the field. Calibration is carried out as follows:

- start up the system and run at its nominal capacity

- gradually reduce the capacity so that it starts surging (surging is identified by a characteristic pulsing noise and can be confirmed by the movement of the needle of an ammeter connected to the machine's electric motor)

- use the tare nut of the valve spring to obtain sufficient opening to start surging

- continue alternating between reducing the capacity and adjusting the tension of the spring until the surging stops.

6 8.2 Anti-surge circuit

Where the specific characteristics of the system (for example, operation at constant pressure) do not allow the use of the anti-surge valve described in item 6.8.1, an anti-surge circuit can be used.
An anti-surge circuit is also often used in the start-up sequence of medium and large machines.
Some anti-surge circuits operate on the basis of current absorption from the electric motor: the circuit prevents the operation of the machine below a minimum current absorption value which can be set using an appropriate electrical circuit.
Other anti-surge circuits operate on the basis of the actual measurement of the flow rate processed.

Where necessary, specific instructions are provided separately.

7.0.0 INSTRUMENTS

CONTINENTAL turbo blowers and turbo exhausters can be connected to instruments to display some of the operating parameters and also to provide signals used for regulation and/or alarms and cut-off in the case of breakdown.

7.1.1 Ammeter

This is installed mainly to have an approximate indication of the capacity of the machine driven by the electric motor.

The change in the current absorbed by the electric motor is directly proportional to the capacity handled by the machine.

Using any minimum and maximum adjustable contacts in the ammeter, it is possible to obtain signals at surge limit and maximum load operation.

These signals can be used in alarm and cut-off or regulation circuits.

The ammeter transformer can be fitted to any of the three supply conductors. Where there is a star/delta motor, the transformer can be connected to one of the three conductors, up line from the motor, or to a pair of conductors down line from the motor, more precisely to a conductor at the outlet of the delta contactor connected to that phase.

To prevent damage to the instrument, the ammeter must be shunted during the start-up mode.
However, normally ammeters can be found with a logarithmic scale able to tolerate any peak currents.

7.2.1 Capacity meter

In some processes, it is necessary to have an accurate measurement of the volume processed by the machine in order to regulate its performance.

Volume measurements are generally obtained from the value of the differential pressure generated via Pitot tubes (Annubar), Venturi tubes or calibrated diaphragms. In order to control regulation devices, the signal received from one of the above items must be processed and possibly compensated via an appropriate pneumatic, electronic or mixed circuit.

7.3.1 Pressure gauge - vacuum gauge

The pressure gauge can be used to determine the value of pressure generated by a turboblower.

If fitted immediately down line from the outlet opening, it provides the total value of pressure produced by the passage of the air flow into the system served down line from the machine.

The vacuum meter is used to find the value of the negative pressure developed by a turbo exhauster.

If fitted immediately up line from the inlet opening, it gives the total value of vacuum produced by the passage of the air flow into the system served up line from the machine.

7.4.1 Pressure regulator

In some processes, it is necessary to keep the supply pressure constant.

This is generally regulated using a pressure transmitter, the signals from which are processed and possibly compensated by an appropriate pneumatic, electronic or mixed circuit.

7.5.1 Thermometer - thermostat

In some cases, it can be useful to have a continuous indication of certain temperatures to check that the machine is operating correctly.

The most significant temperatures are:

- temperature of air supplied or discharged - temperature of plain bearings of the gearbox

- temperature of the lubricating oil of the gearbox at the outlet of the heat exchanger

- temperature of ball bearings of the turbo blower or turbo exhauster where water-cooled.

Thermostats can be used to give signals for alarms and/ or cut-outs, if pre-set temperatures are exceeded.

With the exception of water-cooled ball bearings, there is generally no practical advantage in keeping a display of their temperature.

Only after a ball bearing has been replaced is it advisable to check the temperature. To this end, the housings have a hole which is normally closed by a threaded plug to allow direct access to the bearing outer ring for temperature measurement.

7.6.1 Pressurestat

Electric pressurestats are most commonly used in alarm and cut-off circuits for low pressure of lubricating oil of gearbox.

7.7.1 Bearing temperature probes

If required, it is possible to fit CONTINENTAL turbo blowers and turbo exhausters with probes to monitor constantly the temperature of the two ball bearings. These probes are connected to an appropriate electric alarm and cut-out circuit.

The probes are fitted in the threaded holes provided in the housings described in item 7.3.1.

With the exception of water-cooled bearings, an increase in the temperature of a bearing above the normal limit is, in almost all cases, due to inadequate lubrication and occurs so suddenly that it is in practice impossible to use any device able to limit consequential damage.

The presence of an adequate quantity of lubricant must be ensured by regular preventive maintenance.

7.8.1 Bearing vibration probes

The need to have measurements of the vibration level of ball bearings is illustrated in item 12.1.1.

It is possible to avoid having to make regular readings with portable instruments by fitting each housing with an individual probe linked to a suitable electric alarm or cut-out circuit.

The alarm level is generally set to a value close to the maximum admissible value so that there is still sufficient time to programme and carry out the necessary replacement operation.

Sensors measuring velocity and acceleration can be used for this and are generally fitted to monitor vibrations in a vertical direction.

8.0.0 INSTALLATION

Throughout the installation phases, both the machine flanges must be kept well sealed by means of suitable protective devices provided directly by the works.

Before commencing installation, the following items must be read:

2.2.1 Unloading and handling
2.3.1 Recommendations for lifting
3.1.1 Base-plate
3.2.1 Shock-absorbing support blocks
3.2.2 Levelling plates and fixing bolts

8.1.1 Characteristics of the installation site

CONTINENTAL turbo blowers and turbo exhausters, provided that they are intended for almost continuous operation, can be installed in the open air at practically any latitude without the need for any special protective devices.

If installed in a closed environment, adequate ventilation must be provided.

The machine must be positioned such that there is easy access for preventive, routine and non-routine maintenance works.

8.2.1 Fittings

Before installing any fittings, the following items need to be read:

6.0.0 Typical fittings
8.3.1 Admissible static stresses on flanges

8.3.1 Admissible static stresses on flanges

Although it is always preferable to avoid passing on to machines the weight of fittings and piping, inlet and outlet or discharge openings with a vertical axis and facing upwards can tolerate static stresses with forces and moments, with reference to their center of gravity, not exceeding the values given in tables 8.1 and 8.2 and in Fig. 8.3.

Flanges with a non-vertical axis or with a vertical axis but facing downwards must not be stressed.

It is important to bear in mind that if not correctly fitted, fittings and piping can produce far higher stresses than their weight due to the effect of expansion produced by the increase in temperature during operation.

Values in Kg	INLET			OUTLET		
MODEL	FV	FH	FA	FV	FH	FA
2	30	20	10	30	20	10
8	50	40	15	35	25	15
20	75	60	30	65	50	25
31	75	60	30	75	60	30
51	75	60	30	75	60	30
77	100	80	40	100	80	40
151	150	120	60	150	120	60
251	175	140	70	175	140	70
400	225	80	90	175	140	70
500	225	180	90	200	160	80
600	300	240	120	250	200	100
700	370	290	140	300	240	120

Table 8.1 - Admissible forces on vertical flanges - kg

Values in Kg	INLET			OUTLET		
MODEL	Mv	Mh	Ma	Mv	Mh	Ma
2	8	8	16	8	8	16
8	15	15	30	9	9	18
20	22	22	45	18	18	36
31	22	22	45	22	22	45
51	22	22	45	22	22	45
77	30	30	60	30	30	60
151	45	45	90	45	45	90
251	52	52	105	52	52	105
400	67	67	135	52	52	105
500	67	67	135	60	60	120
600	90	90	180	75	75	150
700	105	105	230	90	90	180

Table 8.2 - Admissible moments on vertical flanges - kg

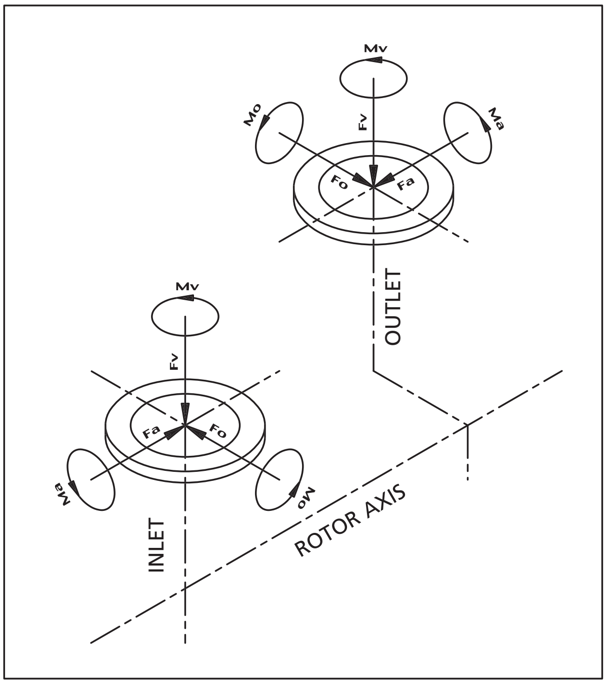


Fig 8.3

8.4.1 Piping

Piping must be accurately designed so that its dimensions are appropriate for the nominal performances of the machine served.

An excessive pressure drop produced by the passage of the nominal capacity would reduce the performance available for the consumer.

Normally, piping is fitted after having put the machine in its final position.

Before erecting piping, it is essential to isolate the machine by inserting a sheet metal disc between each flange and the element immediately adjacent to it (valve, flanged adaptor, expansion joint etc.).

This prevents foreign bodies from getting into the machine during this phase.

Piping must be erected with care and must be appropriately fixed so that it does not generate stresses on the machine flanges or during operation, this being at nominal temperature and pressure conditions.

9.0.0 CONNECTIONS

Once the machine has been installed and connected to the system served using the inlet and outlet or discharge piping, the other connections required for its operation can be made.

9.1.1 Electricity supply

The connection of the motor and other electrical components present must be carried out on the basis of any electrical diagrams and instructions given in the following chapters:

1.0.0 - General
5.0.0 - Motors
6.0.0 - Typical fittings
7.0.0 - Instruments

9.1.2 Steam

Where machines are driven by steam turbines and/ or in the presence of steam-driven fittings, specific instructions are provided separately.

9.2.1 Lubrication system

Where the machine has a separate system for the circulation, filtering and cooling of lubricating oil, for example where there are gearboxes for high power levels, specific instructions are provided separately.

9.3.1 Cooling water

Cooling water is required where heat exchangers are used to cool the lubricating oil and/or where there are cooled bearing housings. In these circumstances, the machine must be connected to the water supply and the drainage system.

The connection to the water supply system must have an isolating valve. An electric isolating valve can be used which allows water to circulate only to the machine in operation. For safety reasons, it is advisable to use an electric valve which is normally open or to fit the circuit with an alarm and cut-off system in case of breakdown.

The connection to the drains system must be such that it allows a direct view of the water drained.
The capacity must be adjusted with a valve fitted up line from the exchanger or the housing so that it can be kept under pressure during operation.

9.4.1 Compressed air

Connection to the compressed air system is required where there are pneumatically operated valves and/or pneumatic instruments. It may be preferable to connect for each consumer or for each logical group of consumers.

Every connection shall be fitted with an isolating valve and a filtering and adjustment set complete with pressure gauge.

Compressed air intended for valve actuators must be lubricated.

Lubrication of compressed air for instruments is not recommended.

9.5.1 Instrumentation

Any instruments must be connected in accordance with the instructions given in section 7.0.0.

10.0.0 PERFORMANCE

CONTINENTAL INDUSTRIE centrifugal blowers and exhausters are rotating machines intended for the transfer of an aeriform liquid from one environment to another at a higher pressure by taking the energy required from a motor.
Their performance is therefore defined in terms of volume, pressure difference and current absorption.

As no wearing parts are in contact which can compromise the volume output, their performance is absolutely constant throughout their whole life.

Performance is only reduced where there is an accumulation of deposits inside the machine which reduce openings (spaces in the impellers and diffusers), but if cleaned whenever necessary the original performance is restored.

Machine performance is naturally affected by changes in pressure and temperature which affect the two environments linked (intake and supply) and by changes in the molecular weight of the fluid processed.

For this reason, it is extremely important that, in the design phase, allowance is made for limit conditions between which the nominal performances are to be guaranteed.

10.1.1 Operation as a turbo blower

Operation as a turbo blower is characterized by a constant intake pressure and variable supply pressure depending on capacity.

The lower capacity limit is generally defined by the surge limit and more rarely by the temperature limit of the fluid to the supply.

The upper limit, on the other hand, is generally defined by the size of the motor which must not be overloaded.

Changes in pressure and temperature at intake affect the density of the fluid processed and can produce substantial reductions in the mass capacity where the volumetric capacity remains the same.

In processes where it is necessary to ensure the quantity of O_2, it is essential to take account of the maximum ranges of temperature and pressure at intake and the humidity which results in a change in the apparent molecular weight of the fluid.

If left to operate with a completely free intake, the turbo blower provides the performance given on its throttle curve, thus drawing in the volume corresponding to the discharge pressure applied on the outlet opening and absorbing the energy shown on the curve for this capacity.

The density of the fluid drawn in is constant at any value of volume and discharge pressure.

Changes in the discharge pressure applied on its outlet cause the capacity and power absorption to change precisely along the above-mentioned throttle curve.

Thus the changing of the discharge pressure, achieved for example by means of a butterfly valve, can constitute a valid method of controlling machine capacity.

If, on the other hand, a pressure drop is introduced at inlet, for example by means of a butterfly valve, the inlet pressure is reduced and is variable depending on the capacity drawn in.
In this case, the density of the fluid drawn in varies as

the volume varies, if the volumetric capacity remains the same, resulting in a reduction in the mass capacity.

The discharge pressure also falls due to the effect of the increase in the compression ratio following the reduction in the inlet pressure.

A new throttle curve is thus created which starts close to the previous one but moves further away from it as the volume increases.
The greater the scale of the pressure drop introduced at intake, the more rapid is the new curve shift from the previous one.

Similarly to the new throttle curve, a new power absorption curve is also produced, likewise lower than the previous one.

The changing of the inlet pressure too, achieved for example by means of a butterfly valve, can constitute a valid method of controlling machine capacity.

The choice of the type of regulation is generally determined by the characteristics of the application; however, where possible, regulation at inlet is preferred as this allows for greater energy economy.
This is because with regulation at outlet, the power absorption reduction shown in the basic curve is obtained whereas with inlet regulation, for the above-mentioned reduced fluid density, the power absorption curve obtained is lower than that of the standard curve.
This is illustrated by Figs. 10.1 and 10.2 below.

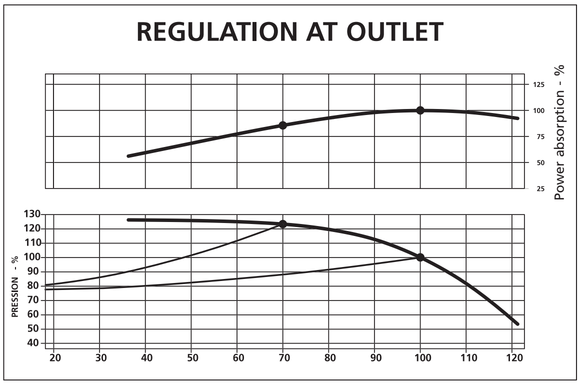


Fig 10.1

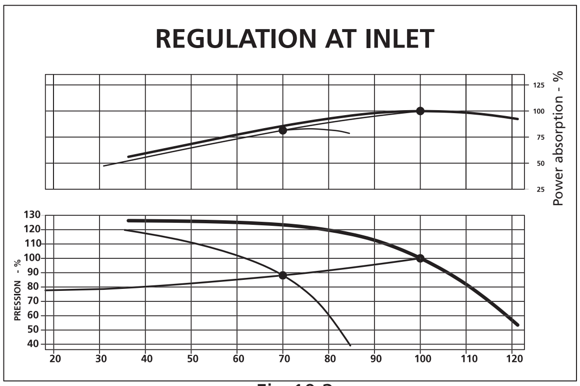


Fig 10.2

10.1.2 Operation as a turbo exhauster

Operation as a turbo exhauster is characterized by constant pressure at discharge and variable inlet pressure depending on capacity.
Changes in pressure and temperature at inlet affect the density of the fluid processed and can produce substantial reductions in the mass capacity where the volumetric capacity remains the same.
For the turbo exhauster too, the lower capacity limit is generally defined by the surge limit and more rarely by the temperature limit of the fluid at discharge.

The upper limit, on the other hand, is generally defined by the size of the motor installed which must not be overloaded.
If left to operate with the discharge completely free, the turbo exhauster provides the performance shown on the throttle curve and thus draws in the capacity corresponding to the negative pressure applied on the inlet opening and absorbs the energy shown on the curve for this capacity.
The density of the fluid drawn in, however, varies as the capacity varies. Its operation is therefore comparable with that of a turbo blower regulated at inlet.

Increases in the pressure applied at discharge, achieved for example by means of a butterfly valve, reduce the performances of the machine both in terms of attainable relative negative pressure and volume.

Reductions in inlet pressure too, and thus increases in negative pressure, obtained in the same way, reduce machine performances.

When being used as a turbo exhauster too, the choice of regulation type is generally determined by the characteristics of the application; however, where possible, regulation at inlet is preferable as it allows for greater energy economy.

10.1.3 Mixed operation

If pressures are measured in absolute values, there is no reason to use the term "exhauster".
However, in normal practice, barometric pressure is taken as a reference and machines which inlet at a pressure lower than barometric pressure are defined by the term "exhauster" and those which inlet at a pressure equal to or higher than barometric pressure are defined by the term "compressor".
Multistage centrifugal machines can therefore operate simultaneously as turbo-aspirators and turboblowers.
The performance of machines thus used is naturally affected by all the factors described in items 10.1.1 and 10.1.2.

10.2.1 Surge limit

Centrifugal machines are characterized by a limit capacity, below which they are no longer able to develop the pressure or negative pressure required for transferring the fluid from the environment at a lower pressure to that at a higher pressure.
Below this capacity, there is a flow reversal which affects the pressures of the two environments and enables the machine to operate until a similar condition is reached.
The phenomenon repeats itself cyclically, generally with a very low frequency (a few Hz), depending on the installation, until action is taken to increase the capacity.

Operation in these conditions must be absolutely avoided as, when the flow reverses, there is a reversal in the axial thrust on the shaft which subjects the bearing on the inlet side to fatigue.

In large machines with high compression ratios, surging can even be violent enough to produce irreversible damage to impellers and piping. An appropriate safety circuit (escape into the atmosphere) must therefore be provided which must also be used when the unit is started up.

11.0.0 STARTING UP

The instructions given below are generic and must be completed by the technician responsible for start-up on the basis of the specific characteristics of the machine, installations and system served.

11.1.1 Preparation

To prepare the machine for start-up, the following must be carried out:

- clean the inlet and outlet or discharge piping internally to prevent any extraneous matter reaching the inside of the machine;

- remove the fitting closest to the inlet opening and the outlet or discharge opening, taking care to leave the sheet metal discs protecting the openings in position, fitted in accordance with the instructions given in item 8.4.1;

- carefully remove all the material trapped by the discs;

- remove the discs and any bags of hygroscopic material fixed in the machine openings for storage;

- refit the two above-mentioned fittings;

- remove any bags of hygroscopic material in the openings on the bearing housings;

- where there may be liquid inside the machine, remove the drainage plugs on the base of each intermediate part and the outlet or discharge head and re-insert them when drainage is completed;

- align and tighten the transmission belts as instructed in item 12.5.1;

- align the transmission couplings as instructed in item 12.5.2;

- fill the housings and oil feeders as instructed in item 12.2.2;

- adjust the thermal safety device on the electric starter motor and those on any fittings.

11.2.1 Checks

Immediately prior to starting up the machine, it is advisable to make the following checks:

- check that the base-plate of the machine has been installed as instructed in items 3.1.1, 3.2.1 and 3.2.2;

-check the supply voltage to the electric motor and to any electrically powered fittings and/or instruments;

-check the connections on the electric motor and any electrically powered fittings and/or instruments, referring to the instructions given in sections 5.0.0 and 7.0.0;

-check the installation of fittings, referring to the instructions given in section 6.0.0;

-check any service fluid connections, referring to the instructions given in section 9.0.0;

-check that the inlet line has been fitted correctly and that all flanges are tight;

-check that the outlet or discharge line has been fitted correctly and that all the flanges are tight;

-check that the screws anchoring the machine to the base-plate are tight;

- check that the screws anchoring the motor to the base-plate are tight;

- check that the screws on all transmission couplings have been correctly tightened;

- check that any brackets and gauges used for alignment have been removed;

- check that there is lubricating oil in the oil feeders of the bearing housings and in any other oil-lubricated components;

- check that there is grease inside the gear couplings;

- check that the shaft of the machine can be rotated freely by hand;

- check that the shaft of the motor can be rotated freely by hand;

- check that all protective housings have been correctly fitted.

11.3.1 Valve settings

All the valves in the system must be checked and appropriately set:

manual isolation and regulation valves for any service fluids must be opened and adjusted;

- isolation valves for any instruments used must be open;

- valves which affect the flow of the fluid processed must be appropriately set for purposes of:

* controlling the flow of fluid processed depending on the specific requirements of the system served;

* allowing the machine to be started up in the shortest time possible;

* preventing the machine from surge operation (see item 10.2.1).

11.3.2 BUTTERFLY VALVE MOUNTING

Refer to herewith drawing for the mounting of butterfly valves.
In particular, the following points shall be checked :
- Shaft of the butterfly mounted perpendicularly to the blower shaft
- Opening of the valve towards the outside of the blower.

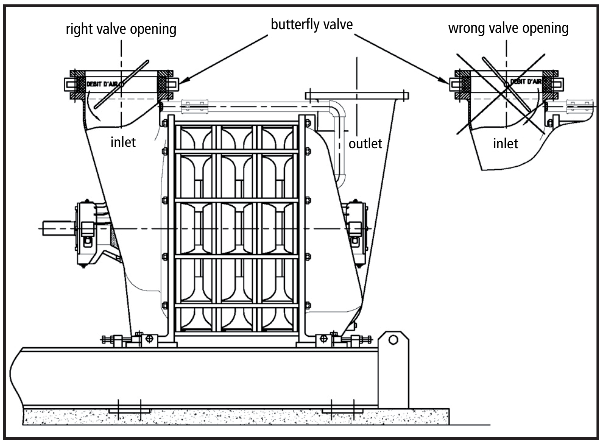


Fig 11.3

These instructions shall be carefully observed in order to ensure the good aeraulic operation of the blower.
Non observation of these instructions may void factory warranty.

Butterfly valve at inlet

* the degree to which this valve is opened determines the capacity value whereas the overflow valve to the atmosphere and/or the outlet or discharge valve are left open;

* to keep the start-up time close to the minimum value possible, the valve must be set to its minimum aperture;

* excessive closing of the valve causes the machine to go into surge operation.
Small machines can be started up with the valve closed as they are characterized by non-violent surging.
Medium and large machines, on the other hand, must be started up with the inlet valve set for a capacity slightly greater than that provided for surging.
As this setting can only be determined experimentally, the first start-up should be with an opening of 15° and subsequently modified.

OVERFLOW VALVE is found in systems with protection against surge operation and is actuated automatically by an appropriate electrical circuit.

BUTTERFLY VALVE at outlet in the first start-up phase, it is advisable to use a butterfly valve at inlet to control capacity; however, this valve must be kept open if the system served can take the fluid processed; otherwise an overflow to the atmosphere or an appropriate bypass must be provided.

11.4.1 Direction of rotation

The machine shaft must rotate as indicated by the arrow on the outlet or discharge head.

For high power electric motors, it is preferable to ensure the correct direction of rotation when connecting the motor and electrical equipment to the supply cable. The direction of rotation can also be checked when the motor is uncoupled.

For machines with a more modest power, on the other hand, it is possible to check the direction of rotation of the electric motor by observing the cooling fan after a short supply impulse.

The direction of rotation can be corrected by following the instructions given in section 5.0.0.

11.5.1 Commissioning

- start up any pumps and compressors which ensure the circulation of any service fluids (lubricating oil, cooling water, compressed air etc.);

- start up the machine, paying particular attention during the start-up and during the first seconds of operation, to irregular noise and/or high levels of vibration, in which case stop the machine immediately and carry out the necessary checks;

- check the start-up time to optimize timer regulation for changeover to delta in the case of star/delta start-up;

- check power absorption and correct as follows:

- if power absorption is unstable, the machine is in surge operation and volume must be increased using the valves;

- if power absorption is excessive, the volume needs to be reduced by means of valve regulation;

- let the machine run for approximately 30 mn., then check the vibration level and temperatures (see section 13.0.0);

- if everything is normal, let the machine run for a further 30 mn., then stop it and carry out the following operations:

- check the tensioning of the belts as instructed in item 12.5.1;

- check the alignment of transmission couplings when hot as instructed in item 12.5.2.

12.0.0 MAINTENANCE

The intrinsic design characteristics of CONTINENTAL turbo blowers and turbo exhausters are such as to allow maintenance operations to be kept to a minimum.

12.1.1 Preventive maintenance

If, during the normal routine maintenance programme to keep the machine efficient, the condition of the few components subject to wear is assessed, it is possible to obtain information to allow non-routine maintenance operations to be programmed and unexpected stoppages, with their attendant inconvenience, to be avoided.

Therefore, in addition to the normal lubrication operations to be carried out at pre-set intervals, it is advisable to keep a log for each machine, on which a record is kept of the progress over time of parameters which reflect the condition of the parts more commonly subject to wear.

In particular, it is recommended that the vibration level on the bearing housings is measured regularly; a study of the large number of readings thus obtained gives valuable information for assessing the need for replacement and thus for programming this operation.

The above also applies to the electric motor bearings.

The level of wear of transmission belts, assessed visually, must also be recorded so that the replacement operation can be carried out at programmed intervals.

12.2.1 Grease lubrication

The main purposes of the lubrication of the ball bearings fitted on the machine (and normally the electric motor too) are:

- to avoid metal-to-metal contact between the rolling bodies, tracks and cage;

- to protect the bearings from corrosion and wear.

In comparison with oil, grease has the advantage of being more easy to handle in situ and therefore better suited to the function of protection against impurities and corrosion.

Therefore, the use of grease is preferable wherever the use of oil is not essential.

Lubricating greases are composed of mineral oils or synthetic fluids dispersed in a thickening agent which determines its consistency, normally assessed in accordance with the NLGI classification (National Lubricating Grease Institute).

The consistency, the range of temperatures of use and the rust-proofing properties are the main determining factors when choosing a grease.

The operating characteristics of CONTINENTAL machines require a consistency 3 grease which can be used in the temperature range of -20 - +140.C.

Characteristics of grease used with CONTINENTAL INDUSTRIE blowers and exhausters of standard construction.

HP-ST Grease

Density at 15°C	: 0.900
Melting point	: 200°C
Ash content	: 0.8 %
Soap	: Lithium
Temperature range	-20°C to 140°C
EQUIVALENT GREASES	
ESSO :	BEACON 3
ELF :	ROLEXA 3
TOTAL :	MULTIS TIR
SHELL :	ALVANIA EP3
MOBIL :	MOBILUX EP3

Generally, lithium soap greases, with the addition of rust-proofing additives or EP, are able to meet the above requirements.

When choosing a grease, it is, however, important to check that the consistency does not change excessively under the effect of mechanical stresses or temperature changes; this is because an excessive increase in consistency at low temperatures can impede the rotation of the bearing, whereas its excessive reduction at high temperatures can result in the escape of all the grease held in the housing, leaving the bearing without any lubrication.

To keep the operating temperature of a bearing at its lowest possible value, and thus to obtain the maximum service life possible, the quantity of grease has to be kept to that strictly essential for purposes of effective lubrication.

In practice, however, it is sufficient that the grease present does not take up more than 30 - 50% of the free space in the housing.

If there is excess grease, the temperature of the bearing increases suddenly, which substantially reduces its service life and can cause irreversible damage.

In such conditions therefore, and in the more favorable of the two scenarios, the bearing has to operate at temperatures far higher than those considered when it was designed and therefore is subject to premature wear

But the excessive rise in temperature may also reduce the consistency of the grease to values such that it is completely discharged from the housing and the bearing then continues to operate without any lubricant.

Re-lubrication with greases of a different type is not recommended as this creates the risk of mixing incompatible greases with each other; this generally results in a fall in consistency and maximum admissible temperature values to below the typical values of the individual greases mixed.

The bearings in CONTINENTAL machines are lubricated in the works for mechanical testing and therefore no relubrication is needed before the machine is first brought into operation.

The lubrication periods shown in table 12.1 below are defined on the basis of bearing size, characteristics of use and the type of service for which the machine is intended.

The quantity of grease required for re-lubrication of each bearing is shown in the same table.

	RE-LUBRICATION PERIODS -HOURS			
	HEAVY DUTY	MEDIUM DUTY	LIGHT DUTY	Qty/ball bearing in gr
08	750	1500	3000	5
20	750	1500	3000	5
31	750	1500	3000	10
51	750	1500	3000	10
77	750	1500	3000	20

Table 12.1 - Re-lubrication periods - grease

If no re-lubrication period is shown in the table, this means that bearings with protective shields, lubricated for life, have been used.

The level of use needs to be assessed by the maintenance personnel who can refer to the following information:

Heavy-duty: - continuous operation (24 hours/day);

- operation in humid, dusty or chemically aggressive atmosphere;

- installation in open air;

- operation at high supply temperatures;

Light-duty:

- non-continuous operation (4 hours/day or less) in clean and protected environment and with supply temperatures not exceeding 100.C.

The bearing housings for all CONTINENTAL machines are fitted with lubricators with ball valves and relubrication is therefore carried out at pressure.

All bearings in CONTINENTAL machines are fitted with a grease valve to allow for re-lubrication while the machine is in operation and to prevent the accumulation of grease in the housing and the consequent overheating of the bearing.

However, it is advisable to re-lubricate with the grease quantities shown in the table.

As the lubricating power of grease reduces over time under the effect of mechanical stresses, ageing and pollution (dust, humidity, metal particles), it is recommended that all the grease in the housing be changed regularly.

The presence of the above-mentioned grease valve means that this operation can be carried out without the need to halt the machine.

12.2.2 Oil lubrication

Oil lubrication is used where the speed of rotation of the rolling bodies and/or their operating temperature reach values which make the use of grease no longer advisable.

It is clear, therefore, that with equal speeds of rotation of the rotors, smaller machines can be grease-lubricated whereas larger machines need to be oillubricated.

All oil-lubricated CONTINENTAL machines are fitted with a sump, placed directly in the bearing housing, in which the oil level is maintained by means of a constant level oil feeder and a oil nozzle disc.
During operation, this system produces actual oil circulation inside the housing which, in addition to providing the obvious lubricating functions, has an effective cooling action on the bearing and immediately removes any pollutants which may affect it.

Particle pollutants of a magnetic nature are dealt with by appropriate magnetic plugs placed in the housing drains while other pollutants settle at the bottom of the sump.

For the lubrication of ball bearings, mineral oils are generally used with the addition of additives to improve resistance to oxidation and the resistance of the lubricating film.

Viscosity is one of the main characteristics of a lubricating oil and is that which, in our case, is a decisive factor when choosing an oil.

Viscosity, like consistency with greases, falls as the temperature rises.

Therefore when choosing an oil, it is essential to check that at the maximum foreseeable operating temperature, the viscosity remains at values which enable a lubricating film of an adequate thickness to be formed.

Technical characteristics of the oil used by CONTINENTAL INDUSTRIE on the standard blowers and exhausters

JAROGEAR Z.150 :
Extreme-pressure oil …………… Service API - GL5

Properties :
Extreme pressure, anti oxydating, anti corrosive, anti foam, anti-rust.
Resistant to alteration at high temperature.

Medium characteristics :

Density at 15°C	0.892/0.917
Cinematic viscosity in Cst :	
at 40°C ……………	143/148
at 100°C ……………	14.3/15.5
Viscosity index …………………………………	103
Flash point VO……………………………	> *or* = 215°C
Flow point ………………………………	< *or* = -24°C

List of other equivalent oils :

ESSO :………………...	SPARTAN EP 150
ELF :……………………	REDUCTELF SP 150
TOTAL: ………………	CARTER EP 150
SHELL: ………………	OMALA 150

The level of use needs to be assessed by the maintenance personnel with reference to the following information:

Heavy duty:
- continuous operation (24 hours/day);
- operation in humid, dusty or chemically aggressive atmosphere;
- installation in open air;

Light-duty:
- non-continuous operation (4 hours/day or less) in a clean and protected environment.

Regardless of operating hours and level of use, the lubricating oil needs to be changed at least once per year.

With oil lubrication too, excess lubricant is damaging as it causes a rise in the operating temperature of the bearing and thus reduces its useful life.
In this regard, it is important that when the housing is refilled the necessary precautions are always taken to ensure that the level inside it does not exceed that maintained by the action of the constant-level oil feeder.

The housing can be correctly filled by introducing the oil via the opening made by removing plug 1 - see Fig. 12.3 - until a few drops emerge from the opening made by removing plug 2.

Once this level has been reached, plugs 1 and 2 can be replaced and oil can continue to be added via the transparent bulb in the oil feeder - as shown in Fig. 12.4 - until the level in the bulb itself stabilizes.

Oil must be filled into the bulb in accordance with the method shown in Fig. 12.4.

It is recommended that when filling, the same oil should be used as that used to fill the housing, to avoid the danger of mixing oils which are incompatible with each other.

Bearing housings in CONTINENTAL machines are drained after mechanical testing to prevent oil leaks during transport.

The housings must therefore be refilled as described above before the machine is brought into operation for the first time.

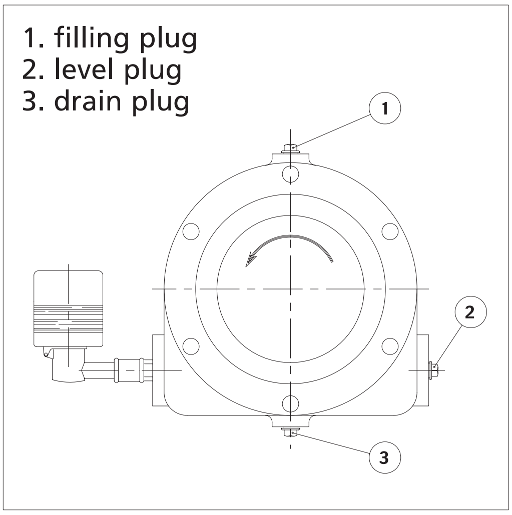


Fig.12.3

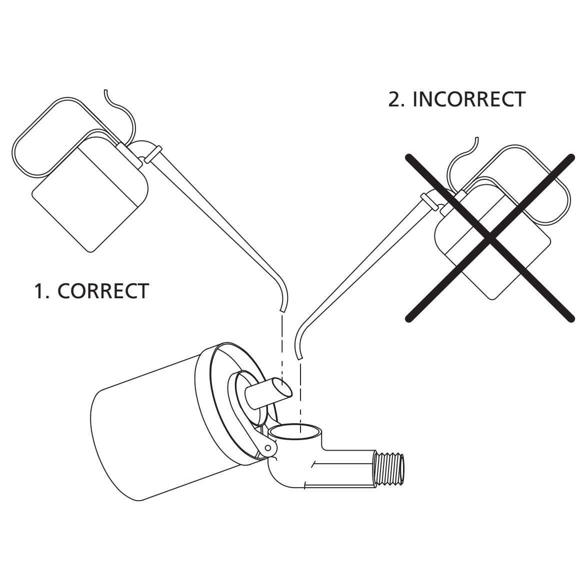


Fig. 12.4.

The quantities of oil required for filling, depending on the machine model, are shown in table 12.5 below.

CAPACITY OF OIL-LUBRICATED MACHINES

MODEL	LITER PER HOUSING	LITER PER OILER	TOTAL OF LITER PER MACHINE
77	0.67	0.11	1.56
151	0.67 or 1.67	0.11	1.56 or 3.56
251 / 400 / 500	1.91	0.11	4.04
600 / 700	5.11	0.11	10.44

Table 12.5 - Oil required for filling

12.3.1 Replacement of transmission belts

The replacement of transmission belts is a non-routine maintenance operation which is necessary only a few times in the life of the machine if the following conditions are maintained during its operation:

- tension at minimum possible value so as not to allow any slipping in any conditions of operation;

- perfect alignment of pulleys.

Of course frequent start-ups, especially if direct and under load, and operation beyond the maximum admissible power absorption limit substantially reduce the service life of a set of belts.

It is also important to avoid any form of overheating of the belts and to keep them well ventilated.

It is recommended that belt tension be checked regularly and corrected where necessary, ensuring that pulley alignment is observed.

This check shall be particularly frequent during the machine's initial hours of operation.

To replace the belts, the protective guard has to be removed and the motor/machine center distances reduced using the motor fixing screws and those provided or its positioning.

The position of the machine in relation to the baseplate, on the other hand, must not be changed in any way.

It is very important that, during operation, every belt transmits its part of the power so that all the belts contribute to power transmission.

Otherwise, all the power is transmitted by only some of the belts which then wear prematurely as they are overloaded.

Only when these belts start to slip are the others involved in power transmission, but these too are overloaded and likewise wear prematurely.

To avoid this, the pulleys must be well aligned and it is essential above all that all the belts are equal.

For this reason, the belts are grouped in sets directly by the manufacturer, on the basis of strict measurements.

It is therefore not advisable to replace only one or a few of the belts; instead the replacement of the whole set of belts forming the transmission is recommended.

When the belts are bought, it is preferable to order a set comprising a given number of belts rather than a given number of belts.

When the belts are replaced, it is worthwhile assessing whether the operation is necessary due to normal wear or whether the operation has become necessary prematurely for other reasons.

In this case, it is an opportune moment to identify and eliminate the causes in order to extend the life of the new set.

12.4.1 Replacement of bearings

The need to replace a bearing can be due to unexpected breakage or if breakage in the near future is thought probable.

To prevent the first of the above two possibilities occurring, we suggest that the information in item 12.1.1 be implemented.

In the case of unexpected breakage, the repair operation can involve far more than a simple replacement of the bearing and in some cases can even involve the replacement of the shaft, if not the general overhaul of the unit, due to the impeller assembly rubbing on the intermediate parts separating the individual impellers.

In particular, the total lack of lubrication, due for example to an excessive quantity of grease as described in item 12.2.1, can cause the internal ring of the bearing to weld on to the shaft, which then needs to be replaced.

Where, on the other hand, a bearing is replaced because its noise level and/or vibration level has increased on the housing, indicating that it may break in the near future, the operation can be carried out much more simply and rapidly.

In the case of the coupling end bearing, the pulley or coupling must be removed.

Pulleys with friction connectors can be removed and refitted quite easily without the use of extractors. It is, however, advisable to mark their position with regard to the shaft before removing them.

For traditional pulleys and for half couplings, on the other hand, an extractor must be used. Where possible, threaded holes are provided in the hub of the pulley or the half coupling so that hydraulic jacks can be used.

Traditional pulleys and couplings can be heated in an oil bath for ease of refitting.

Machines with direct transmission are sometimes fitted with a coupling with a spacer which allows the coupling end bearing to be replaced without disturbing the alignment.

For oil-lubricated bearings, the housing must be drained before it is removed.

With the housing cover removed, dismantle the various components (lock nut, spacers, discs etc.) until the bearing inner ring is released.

It is important to note the dismantling sequence of all the components to be sure of refitting them in the same position and in the same direction.

Then remove all the screws fixing the housing to the head and, using the two threaded holes provided on the housing connection flange and screws of a suitable length, the bearing is removed using the housing itself as an extractor.

Important :
The bearing extracted in this way cannot be re-used as the rolling bodies and tracks have been stressed.

Before continuing, all the components to be refitted must be carefully cleaned and inspected.

This is an opportune moment to inspect and, if necessary, replace the sealing rings on the shaft as they are accessible with the housing removed.

The housing can then be refitted with all the fixing screws thoroughly tightened.

The new bearing shall be removed from its packaging at the latest possible moment to avoid any extraneous matter entering it.

It is generally protected by a corrosion-proofing film applied directly by the works and must therefore be washed absolutely clean in solvent (mineral or oil resin without acids) and then dried.

Obviously, pre-lubricated bearings with shields must not be washed and it is sufficient to remove the protective film from the internal and external rings.

Before fitting the new bearing, it is a good idea to oil lightly the seats on the shaft and in the housing, to improve their glide.

In the installation phase, pressure must never be applied to one ring to make the other one slide, as this will certainly damage the rolling bodies and the tracks.

The force necessary to overcome friction generated at the same time at the internal and the external rings, must be applied at the same time to the two rings by means of a very thick ring which has an external diameter slightly less than the diameter of the external ring and an internal diameter slightly greater than that of the internal ring.

The force via the ring can be applied using a hydraulic cylinder appropriately connected or by hitting with a lead mallet.

Under no circumstances are the rings, cage or rolling bodies to be hit directly.

It is essential to check that the internal ring of the bearing is tightly fitted before the other components are fitted.

It is worthwhile noting that the outlet end bearing is left axially free to absorb the thermal expansion difference between the shaft and the body of the machine and therefore its external ring can slide axially in the housing within certain limits and does not come into contact with the housing end cover.

The inlet end bearing, on the other hand, is connected axially and defines the position of the whole rotor with regard to the body of the machine.

Its internal ring is clearly tightly fitted to the shaft and the position of the external ring is defined on the one hand by the housing support and on the other by the housing cover. A ring with a calibrated spacer is sometimes fitted between the housing cover and the bearing external ring.

When the inlet end bearing is replaced, it may be found that the shaft slides axially, returning, however, to its original position once the operation is completed.

It is possible to check that the bearing replacement operation has been carried out correctly by checking that the rotor of the unit rotates freely manually and is restrained axially in both directions.

Refer to items 12.2.1, 12.2.2, 12.5.1 and 12.5.2 with regard to the lubrication, pulley and coupling alignment and belt tensioning operations which need to be carried out before the unit is restarted.

When the unit is brought into operation, it is essential to check that the level of vibrations on the housing and the bearing temperature, measured on the external ring via the appropriate hole, lie within normal values.

12.5.1 Alignment and tension of transmission belts

The alignment of the pulleys and the correct tension of the belts enable the useful life of the bearings and the belts themselves to be utilized to the maximum.

Non-alignment causes asymmetric wear of the belt and does not allow the belts in the set to be uniformly loaded.

Generally, it is not worthwhile carrying out regular checks on the alignment as this does not change during operation.

On the other hand, alignment must always be carried out when the belts are tensioned and whenever they are adjusted.

The external faces of the 2 pulleys must be on the same vertical plane when aligning and this is generally carried out by placing an iron bar as shown in Fig. 12.6.

The face of the machine pulley is taken as a reference and the bar is placed on this, checking contact at points C and D.

The motor is then moved, keeping the 4 fixing screws only slightly slackened and adjusting screws 1, 2, 3 and 4 until contact at points A and B is also made.

Any axial movements can be made by means of small knocks with a lead or plastic mallet, if the motor size so allows, or by means of screws provided for this purpose.

Of course, the operations of pulley alignment and belt tensioning affect each other.

A good practical way of streamlining these operations is as follows:

- carry out a rapid and approximate alignment with the belts slack and tighten screws 1, 2, 3 and 4 manually;

make a preliminary and approximate tensioning of the belts taking care, however, to turn the above-mentioned screws equally (for example, if screws 4 and 2 are slackened by a complete turn, turn screws 1 and 3 a complete revolution too);

complete alignment with the necessary precision;

complete belt tensioning to the final value, always taking care to ensure that the 4 screws are rotated by the same amount (as, in the final phase, parts of a revolution can be required, it is advisable to mark the head);

before fully tightening the motor anchoring screws, check the alignment once more which, given the method followed, may require just a small final correction by an axial shift of the motor.
This correction does not affect the tensioning obtained.

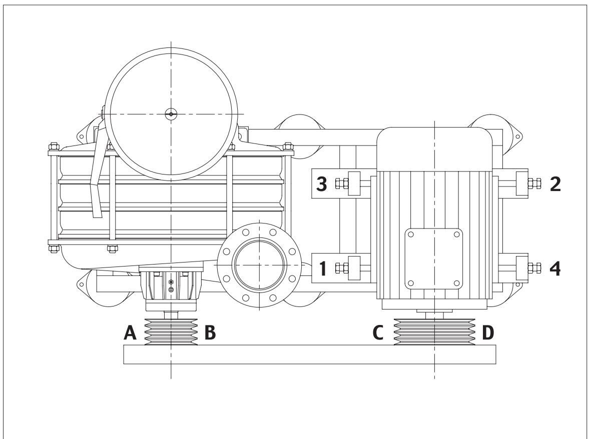


Fig. 12.6

Shims are only rarely needed under the motor feet to correct parallelism defects on the horizontal plane of the axes of the motor and machine.

Excessive belt tension results in an unnecessary increase in the load on the bearings and the bending moment on the shaft.

In extreme cases, it can even cause the shaft to break due to fatigue.

Inadequate tension on the belts causes them to slip, overheat and wear prematurely.

In extreme cases, overheating can cause irreversible damage to the pulleys as well.

Tensioning of the trapezoidal belts which are fitted on a CONTINENTAL machine is generally carried out correctly, rapidly and easily by any expert maintenance personnel.

However, in view of the range of belts on the market and their different characteristics, it is a good idea to have specific data so that belt tension can be definitely set correctly.

To determine analytically, with adequate approximation, the data required for correct tensioning, the following data needs to be taken from the machine served:

- D = diameter of pulley mounted on drive shaft, in mm (if possible, use the original diameter);

- d = diameter of pulley mounted on machine shaft, in mm (if possible, use the original diameter);

- I = approximate center distance between the two pulleys, in mm;

- N = motor power in kW;

- n = speed of rotation of motor in rpm;

- c = number of belts comprising the transmission;

- section of belts used.

Using table 12.7 below, the coefficients M and Y can be determined, depending on the belt section.

Belt Section	M	Y	Belt Section	M	Y
A	0.0090	1.3	SPC	0.0320	4.1
B	0.0140	1.9	SPZ	0.0066	1.5
C	0.0260	3.0	XPA	0.0104	2.0
D	0.0520	6.3	XPB	0.0130	2.6
Z	0.0050	0.9	XPZ	0.0060	1.5
AX	0.0080	1.3	3V	0.0066	1.5
BX	0.0130	1.9	5V	0.0170	2.6
CX	0.0230	3.0	8V	0.0460	6.0
SPA	0.0120	2.0	3VX	0.0060	1.5
SPB	0.0170	2.6	5VX	0.0130	2.6

Table 12.7 - Coefficients M and Y

The following are then calculated:

$$V = \frac{0.052 \times n \times D}{1,000}$$ (velocity of belt in m/s)

$$f = \frac{I}{100}$$ (deflection in mm)

$$A = \frac{D - d}{I}$$ (function of contact arc)

With value A thus obtained, G is found from the following sequence:

where A = --> 0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70
G = --> 1.00 0.99 0.97 0.96 0.94 0.93 0.91 0.89
where A = --> 0.80 0.90 1.00 1.10 1.20 1.30 1.40 1.50
G = --> 0.87 0.85 0.82 0.80 0.77 0.73 0.70 0.65

Naturally any intermediate values need to be interpolated.

The following can now be calculated :

$$T = \frac{45 \times (2.5 - G) \times N}{G \times c \times V} + M \times V2 \quad \text{(static tension in kg)}$$

$$Fmin = \frac{T + Y}{25} \qquad Fmax = \frac{1.5\,T + Y}{25}$$

Fmin and Fmax are the values between which force F must lie, which applied to the center of the section, to a single belt, is perpendicular to it as shown in Fig. 12.8 and is able to produce a deflection equal to f mm.

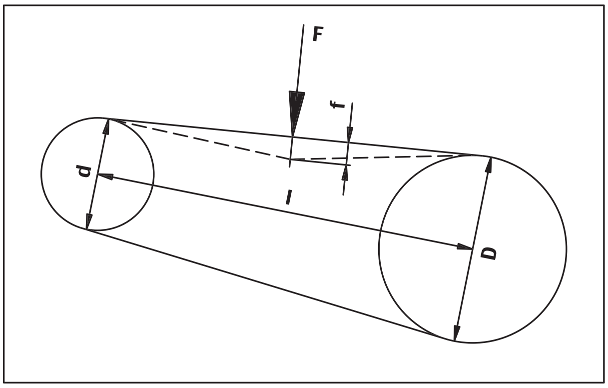


Fig. 12.8

If the belts are new, Fmi n and Fmax need to be increased by 30% to take account of the rapid fall in tension occurring during the running-in period.

Tensioning is checked after the first 4 hours of operation and corrected to the nominal Fmi n and Fmax values calculated above. The checks are repeated until they are found to be stable.

12.5.2 Alignment of transmission coupling

The correct alignment of the transmission coupling allows the machine to operate at minimum vibration levels and enables the useful life of the bearings to be utilized to the maximum.

Before carrying out this operation, it is essential to read the following items:

3.3.1 Direct drive using a coupling
3.3.3 Pulley/belt drive with countershaft
3.3.5 Drive using a gearbox.

Alignment is carried out as follows:

* place the axes of the two shafts coupled on the same vertical plane or on two parallel vertical planes, with a specified distance between them;

* place the axes of the two shafts coupled on the same horizontal plane or on two parallel horizontal planes, with a specified distance between them;

* keep a specified distance between the ends of the two coupled shafts or better between the two faces of the half couplings.

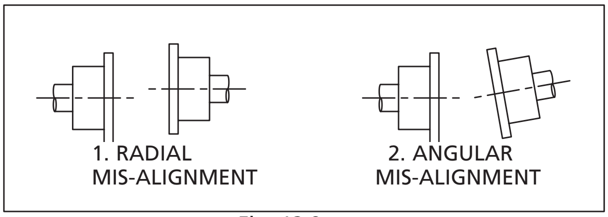


Fig. 12.9

Radial mis-alignment and angular mis-alignment are shown in Fig. 12.9. Naturally, these can be present at the same time.

Due to thermal expansion and other causes such as, for example, the lubricating oil film in the plain bearings, radial thrusts by the gears etc., the position of the two shafts coupled with the machine in normal operation can be very different from their position when the machine is off and cold.

Therefore when aligning cold, radial mis-alignment values can be prescribed calculated so as to obtain perfect alignment when the machine is running in normal operation.

If no specific instructions are given, the shafts must be aligned cold so as to obtain the minimum possible value of radial and angular mis-alignment. The distance between the faces of the half couplings can be taken from the machine drawing.

Maximum admissible mis-alignment when hot can vary depending on the type of coupling; however, if no specific instructions are given, the following tolerances must be used:

- distance between the half coupling faces: +/- 0.10 mm - radial mis-alignment (T.I.R.): _ 0.10 mm - angular mis-alignment: 0.50°.
The distance between the half coupling faces where there is a spacer can be measured by means of a caliper or an internal micrometer or otherwise by a thickness gauge.

Radial mis-alignment can be assessed by means of a set square or a straight bar which is sufficiently rigid and long, but it is preferable to use a gauge fitted as shown in Fig. 12.11 A. The T.I.R. reading (Total Indicator Reading) given by the gauge for a 180° rotation represents double the actual misalignment.
With reference to Fig. 12.10, half of the reading for a 180° rotation from O to 180° provides the height difference between the shaft axes. Half the reading for a 180° rotation from 90° to 270° provides the distance between the two vertical planes on which the shaft axes are placed.

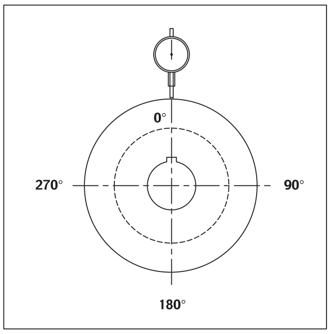


Fig. 12.10

Angular mis-alignment can be assessed by means of a caliper, internal micrometer or a thickness gauge, but it is preferable to use a gauge fitted as shown in Fig. 12.11 B. The ratio between the T.I.R. reading (Total Indicator Reading) provided by the gauge for a 180° rotation and the diameter of the circle described by the rotation of the tracer point axis represents the tangent of the misalignment angle.

With reference to Fig. 12.10, from the reading for a 180° rotation from 0° to 180°, the angular mis-alignment is determined by the height of the couplings. From the reading for a 180° rotation from 90° to 270°, the angular mis-alignment is determined by the transversal position of the couplings.
Machines and/or motors are moved laterally by means of appropriate adjustment screws provided in the works. A lead mallet may be needed for smaller machines without adjustment screws.
Machines and/or motors are moved vertically by using shims placed under the feet as required. When adjusting the height of machines and/or motors with shims, the following precautions are recommended:

* ensure that the feet, their bearing surfaces and every individual shim used are as clean as possible;

* ensure that all the anchoring screws have been tightened before taking the readings;

* ensure that all the feet are completely in contact with the shims and that the tightening of the anchoring screws does not produce any deformation to the base-plate and/or the machine or motor.

A good practical method for alignment is as follows:

1. study the machine, the height and position of which needs to be considered fixed with regard to the base-plate;

2. check that its anchoring screws are centred in the holes, i.e. that it is possible to move it in all directions;

3. completely tighten the anchoring screws;

4. check that the height of the shaft is greater than or equal to the minimum required, correcting with shims if necessary;

5. place a gauge with a magnetic base on the base-plate and a tracer point on the machine feet close to one of the anchoring screws and set it to zero;

6. slacken the anchoring screws and check that the gauge does not indicate movements of more than 0.005 mm (any movement greater than the given value requires the insertion of corrective shims);

7. repeat the operation for all the anchoring points to the base-plate;

8. slacken the anchoring screws of the other machine;

9. measure the distance between the faces of the two half couplings and move the machine in an axial direction until the prescribed value is reached;

10. tighten the anchoring screws;
11. while rotating the two half couplings at the same time measure the radial mis-alignment and:

- move the machine transversally until the prescribed value is obtained (T.I.R. 90° - 270); - shim all the machine feet until the prescribed value is obtained (T.I.R. 0 - 180);

12. while rotating the two half couplings at the same time measure the angular mis-alignment and:
- move the machine transversally until the prescribed value is obtained (T.I.R. 90° - 270);
- shim two of the feet of the machine until it comes within the prescribed tolerance (T.I.R. O - 180°)

Operations 11 and 12 affect each other reciprocally and therefore must be repeated alternately until the correct result is obtained.

13. repeat on this machine the operations described in items 5, 6 and 7.

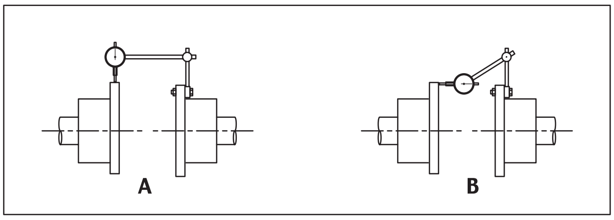


Fig. 12.11

13.0.0 ANOMALIES: CAUSES AND REMEDIES

The performance of CONTINENTAL turbo blowers and turbo exhausters remains absolutely unchanged over time. The efficiency, noise level and operating temperatures remain at their initial values indefinitely.

However, it is possible that anomalies may occur for various reasons of ageing.

13.1.1 Reduced performance

This can occur in the form of a reduction in the volume and therefore in the differential pressure through the machine.

Causes and remedies:

- Inlet filter dirty. Replace filter elements.

- Valves up and down line from the machine not correctly adjusted.
  Check and correct.

- Pipework obstructed up and/or down line from the machine.
  Check and correct.

- Direction of rotation reversed following maintenance operations on the motor and electrical equipment.
  Check and correct

- Speed of rotation lower than nominal.
  This is possible only in the presence of turbines, internal combustion motors, hydraulic motors and electric motors with a frequency variator.
  Check and correct

- Partial blocking (fouling) of the cavities of the impellers and/or diffusers due to the presence in the fluid processed of components which produce deposits. It may be necessary to carry out a general overhaul of the machine.

In every case, original performances can always be fully restored.

13.2.1 Change in noise level

In no case can the sound pressure level exceed the values found in the new machine.
However, changes in the sound produced by the machine can provide information about possible irregular operating conditions.

- Reduction in capacity of fluid processed.
  Increase capacity.

13.3.1 Excessive outlet or discharge temperature

For standard machines, outlet or discharge temperatures above the values given in table 13.1 are considered excessive.
The limits applicable to machines for high temperature operation are clearly higher and are specified separately.

OUTLET / DISCHARGE TEMPERATURE

MODEL Grease lubrication	Temp in°C	in°F	MODEL Oil lubrication	Temp in°C	in°F
2	100	*212*	77	125	*257*
8	135	*275*	151	125	*257*
20	135	*275*	251	125	*257*
31	135	*275*	400	125	*257*
51	135	*275*	600 / 700	135	*275*

Tab.13.1

13.4.1 Excessive bearing temperature
The temperature of the bearings measured on the external ring is considered excessive when it is above 110°C.

Causes and remedies:
- Raised outlet/discharge temperature.
  Check and correct

- Excess lubricant.
  Check and correct

13.5.1 Excessive power absorption

Power absorption is always directly proportional to the mass capacity of the fluid processed; therefore any power absorption increase indicates an increase in capacity.
An increase in pressure drop, at inlet or outlet, translates, on the other hand, in a reduction in capacity and thus in reduced power absorption.

Causes and remedies:
- Valves up and/or down line from the machine not correctly adjusted.
Check and correct

- Change in inlet conditions.
Reduce capacity.

- Valves up line and down line from machine completely open (starting problem).
Check and correct

- Presence of liquid inside the machine (starting problem).
Open the drainage plugs on all diffusers and the outlet or discharge head.

13.6.1 High vibration level

Vertical, horizontal and axial vibration values measured on the bearing housings can be assessed by using the graph shown in Fig. 13.2.

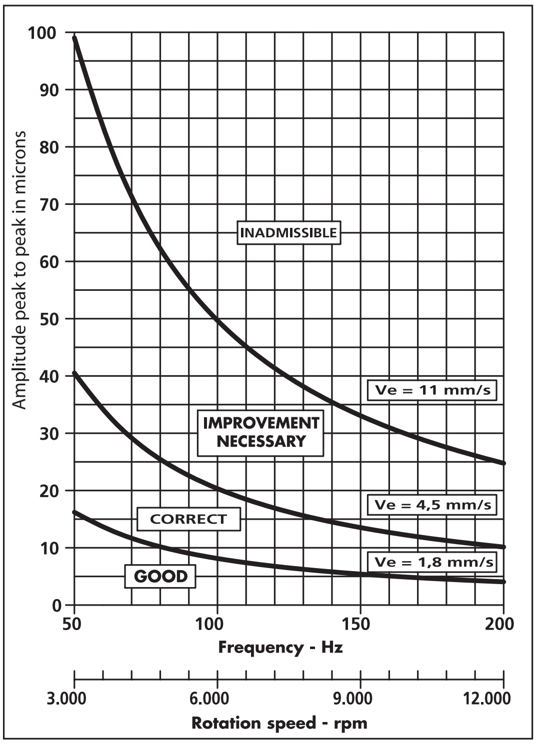


Fig. 13.2

The areas in the graph are defined by the curves of the three effective reference velocities (R.M.S.). Naturally, the amplitude values vary depending on the speed of rotation of the machine.

Causes and remedies:

Deterioration in ball bearings.
Replace bearings.

Mis-alignment following maintenance operations. *Check and correct alignment.*

Imperfect contact between the feet of the machine and/or the motor and/or the base-plate following maintenance operations.

Check and correct the contact of the feet of the machine and/or motor with the base-plate.

Imperfect contact between the base-plate and its supports on the foundation following maintenance operations.

Check and correct the contact of the base-plate with supporting shock-absorbing blocks.

Belt defective following maintenance operations.
Identify the defective belt using a stroboscopic

Rotor imbalance due to excessive tension of belts following maintenance operations.
Check and correct

Rotor imbalance due to deposits on the impellers (fouling).
A general machine overhaul may be necessary.

Rotor imbalance due to corrosion of impellers.
General overhaul required.

Rotor imbalance due to breakage of impellers.
General overhaul required.

Transmission via the foundations following the startup of machinery in adjacent zones.
Check and improve isolation.

Causes and origins can always be identified by vibration analysis, using appropriate equipment.

14.0.0 SPARE PARTS

Thanks to the extreme simplicity of their design, CONTINENTAL turbo blowers and turbo exhausters can operate for extremely long periods before spare parts are needed. However, it is a good idea to keep a stock of the recommended set of spare parts for keeping the machine in operation.

14.1.1 Recommended set

The following list is with reference to standard machines.

Spare parts for any particular components and/or

fittings must be provided in addition:

- bearing end cover gasket
- bearing lock nut
- bearing lock washer
- bearing
- bearing housing gasket (if present)
- carbon ring housing gasket (if present)
- carbon ring (if present)
- oil feeder (if present)
- set of transmission belts (if present).

14.2.1 Consumables

These are restricted to:

- filter cartridges (if present)
- lubricant.

14.3.1 Ordering

The reference number of the spare parts can be found on the section drawing of the machine and the attached components list.

When ordering, it is advisable to give the serial number of the machine, found on the plate fixed to the machine itself, or any other reference to help identify it.

All spare parts can be ordered from:

CONTINENTAL INDUSTRIE S.A.S
Route de Baneins
01990 Saint Trivier sur Moignans

TEL.: ++33 (0) 4 74 55 88 77
FAX: ++33 (0) 4 74 55 86 04
email : export@continental-industrie.com

However, repairs and/or overhauls of CONTINENTAL turbo blowers and turbo exhausters can also be carried out by a maintenance service or workshop specializing in rotating machines found throughout the country, provided that they have sufficiently expert personnel and the necessary tooling.

15.0.0. ASSISTANCE

Requests for technical assistance should be adressed to :

CONTINENTAL INDUSTRIE S.A.S
Route de Baneins
01990 Saint Trivier sur Moignans

TEL.: ++33 (0) 4 74 55 88 77
FAX: ++33 (0) 4 74 55 86 04
email : export@continental-industrie.com

15.1.1 On-site repairs

All running repairs, i.e those not requiring the replacement of impellers, the shaft or stator parts (heads and/or diffusers), can be conveniently carried out on site by maintenance service personnel or external workshop personnel.

Naturally, it is also possible to request the on-site services of specialized CONTINENTAL personnel able to react within 48 hours of a request.

Services are provided on the basis of tariffs current on the date of the intervention and shall be requested by means of a regular written order.

15.2.1 Repairs in our workshops

If the repair requires the replacement of impellers, the shaft or stator parts (heads and/or diffusers), the machine needs to be completely stripped and the dynamic rebalancing of the rotor needs to be carried out.

Where the maintenance service or the external workshops available are not able to carry out the operation, it may be appropriate to send the machine to our workshop for an overhaul; this will be carried out on the basis of acceptance by the client of an estimate given for this work.

When under repair, the machine is completely dismantled, all the parts are cleaned, checked and replaced where necessary, the rotor is rebalanced dynamically and the repaired machine undergoes mechanical tests and is repainted.

Overhauled machines are covered by guarantee for 6 months.

GB MANUAL
REV 102007-2GB

CONTINENTAL INDUSTRIE

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