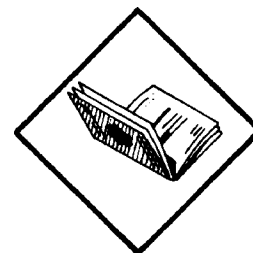


# Operating Instructions



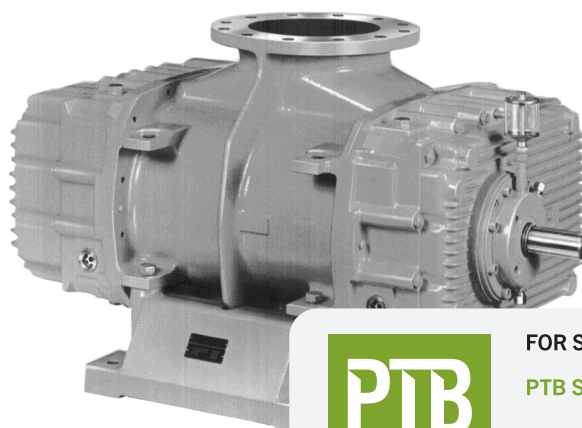
for  
High-Vacuum Rotary Piston Blower HV

with sizes: GMa/GLa 10.0, 10.1, 10.2, 11.3, 11.4,  
12.5, 12.6, 13.f7, 13.8  
GMb/GLb 14.9, 15.10, 15.11, 16.12, 16.f13,  
16.13, 17.15, 18.17, 19.19, 20.21

Roots Principle

EN

Instructions for the transportation,  
storage, installation, commissioning,  
maintenance and cleaning



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## 1. Safety information



### 1.1 General

The Positive Displacement Blowers are constructed according to the latest technical standards; the requirements of the German regulations for accident prevention VBG 16 are fulfilled.

Nevertheless, operating risks resulting from improper handling, inappropriate use or operation by untrained personnel cannot be excluded.

These may result in injuries, as well as damage to the machines and production work.

In the user's plant, anyone involved in the operation, maintenance and repair of the machines must have read and understood the operating/maintenance manual, and in particular this safety information.

The machines must only be handled and operated by trained and authorized personnel.

Responsibility for the operation of the machines must be clearly defined in order to avoid uncertainties of competence.

All work performed on the machines, including repairs, oil changes, maintenance etc. are to be carried out during machine shutdown, with the electrical power supply to the compressor shut-off and locked out.



### 1.2 Recommendations - operator safety

- Working methods reducing the safe operation of the machine must be avoided.
- The user is responsible for ensuring that no unauthorized persons are in any way involved with the machine.
- Operating personnel have the obligation of advising their superior of any changes occurring to the machine and which reduce the safety of its operation.
- The user is responsible for ensuring that the machines are operated when in proper working condition only.
- Management must inform operating personnel of the need to wear safety clothing, safety glasses, and hearing protection.
- By means of appropriate procedures and controls, the user must guarantee cleanliness in the work place and ease of access to and around the machines.
- Under absolutely no circumstances may safety devices be removed or disabled.
- Work on electrical components must be carried out by authorized persons only.
- While carrying out machine verification tasks, and in particular when opening the acoustic hood, the use of hearing protection is compulsory.
- The discharge piping may reach a temperature of up to 150 °C and must not be touched.
- Piping must not be disassembled prior to having been depressurized and purged with a neutral gas.
- Pressurized lube and instrumentation lines must not be opened, i.e. connections must not be tightened. There is risk of injury, for example resulting from escaping oil.
- Machines conveying oxygen must remain free of grease and oil in the vicinity of the conveyed medium. There is risk of fire and explosion.
- Extreme caution must be exercised in the case of internal combustion engine driven machines, given the risk of poisoning resulting from exhaust gases. The machine rooms must be sufficiently ventilated.
- In the case of machines operating in nuclear power plants, specific instructions apply. There is risk of radiation.
- Cleaning operations involving the use of sprays or cleansing agents must be carried out in accordance with the relevant guidelines. There is risk of poisoning resulting from inhalation, and burns resulting from contact with caustic substances.
- Safety devices, for example safety relief valves, coupling guards, belt guards, contact thermometers, and contact switches, must not be removed or modified.
- Conversions and modifications not authorized by the manufacturer are not allowed for reasons of safety.



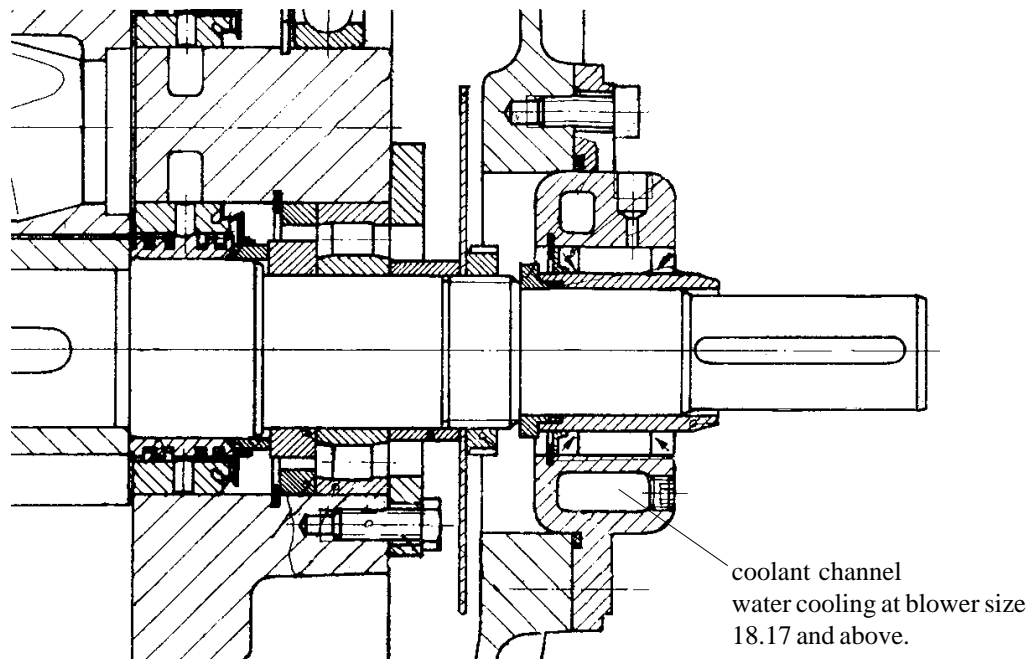
### 1.3 Spare parts and accessories

We expressly draw your attention to the fact that replacement parts and accessories not supplied by us are neither tested nor approved by us. The integration or installation, as well as the use of such products can, under certain circumstances, alter the original design characteristics of the equipment. We exempt ourselves from any liability for damages resulting from the use of parts and accessories not supplied by us.

## 2. General

These rotary piston blowers (Roots principle), used in vacuum operation, are distinguished by the letter "G". The subsequent letters "L" or "M" indicate the direction of flow.

The numbers, e.g. "14.9", indicate the model size. The letters "HV" following mean "high vacuum" and the letter "m" following means "with auxiliary inlet".

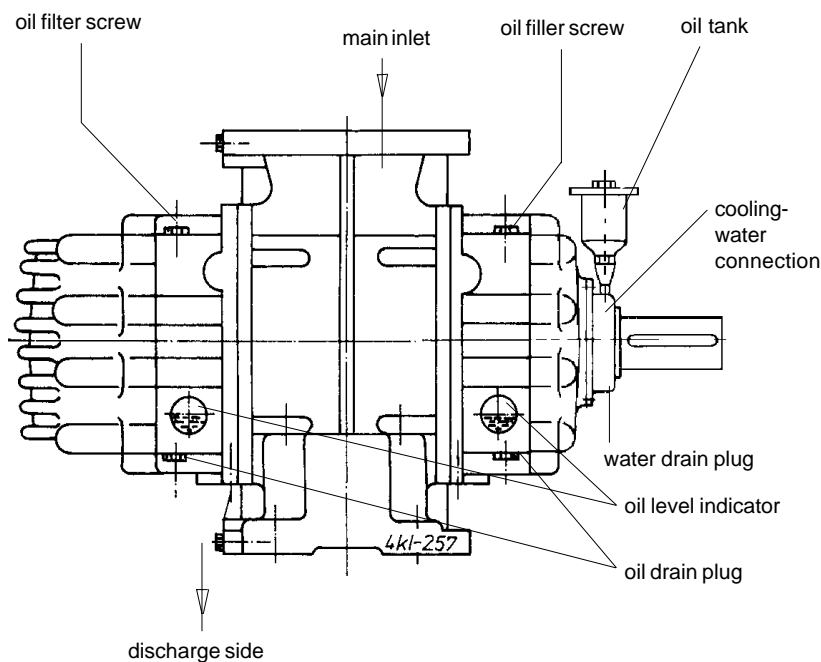


The radial sealing rings run on a hardened and ground shaft protection sleeve. The oil chamber ensures that the radial sealing rings are vacuum-tight and have a long service life.

The level of sealing oil can be checked visually through the transparent oil tank. Oil must be always be present. (see: Lubrication)

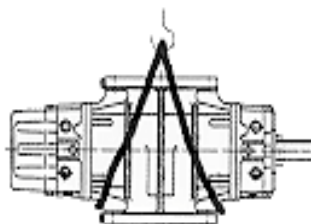
Concerning the blower types HV 18.17 to 20.21 the sealing ring casings at the driving shaft are to be provided with cooling water. The connections are designed in G 1/4". All other blowers do not need a water cooling.

External machined parts are coated with rust preventing varnish, and the inlet and outlet flanges are fitted with plastic caps to prevent the entry of dirt and water spray.



### 3. Notes on transportation

- 3.1 The unit must be protected against jolts and impact during transportation.
- 3.2 When lifting the unit by crane, do not use the free ends of the shaft nor the cast eyes on the side plates or the top of the housing: use instead a suitable hemp or wire rope sling placed around the side plates.
- 3.3 When the unit arrives at its destination, check that it is undamaged and that the delivery is complete.



### 4. Storage

If the units have to be stored before use, a dry, well protected space should be provided. If necessary, the rust preventing varnish coating on the machined surfaces should be renewed, using a rust preventing oil. If the unit has to be stored for a longer period and there is insufficient protection from dampness, the smooth faces of the flanges and the interior chambers of the blower must be coated with a conservation oil to prevent corrosion.

**Protective oils:**

External	Oil chambers	Conveying chamber
TECREX 39 (MOBIL OIL)	ESSOLUB MZ 20 W/20	Ballistol-oil
RUST BAN 324 (ESSO)	SHELL Ensis Motor Del 20	(biodegradable, no ground
V-Produkt 9703 (SHELL)	MOBIL Mobilarma 523 or 524	water contamination)
	AVIA Avilub MK 2000	

or other equivalent products offered by mineral oil manufacturers.

**Cleaning agent:** e.g. Certrex 62 from Mobil or Varsol from Esso.

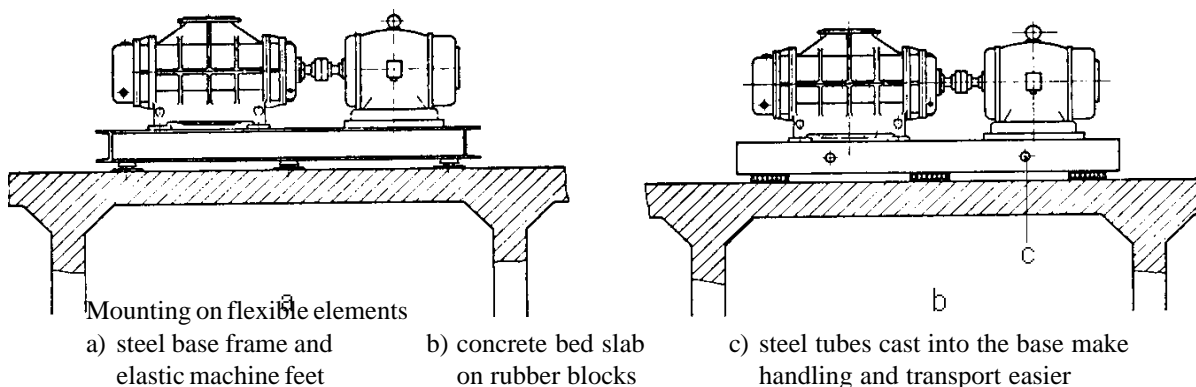
### 5.1 Preparation

Before transporting the unit to the prepared base, all surfaces which will come into contact with the base should be cleaned of oil and grease to ensure proper contact.

Leave the plastic caps on the flange until the pipework is ready to be finally connected.

### 5.2 Type of foundation

Rotary piston blowers should be mounted on a flat, vibration-free foundation. The dimensions for the foundations should be taken from our drawings. If the unit is to be located on a steel structure or a deck which is capable of vibrating, then we recommend that it be mounted on elastic machine feet which absorb transmitted noise; in this case, the blower and its drive motor are mounted on a single common steel base frame, a cast concrete bed slab, laid on rubber blocks, is also suitable.

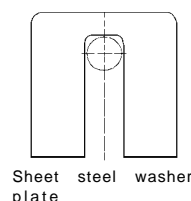


### 5.3 Preparing the foundation

The surface of the foundation should be roughened and then cleaned. Blow out the anchoring holes.

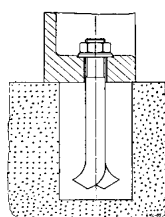
### 5.4 Alignment

Place the blower unit onto the foundation, and adjust it until it is accurately level, using steel shim plates (no wedges !). Use a machinist's level on machined surfaces or on the drive shaft.



The maximum permitted deviation from true horizontal is 0,2 mm per meter length. The steel shim plates should be pushed in under the base frame so that it completely covers them; they are then also grouted in, with the anchoring bolts. If the blower and the drive motor are not mounted on the same base, then the blower should be mounted higher, to enable the subsequent alignment to be carried out properly.

### 5.5 Anchoring bolts



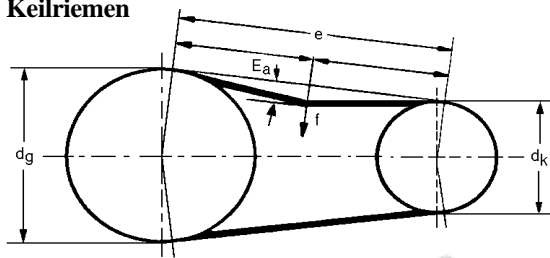
After levelling has been completed, the anchoring bolts should be grouted in, and once the grout has set and hardened, tightened. It should be possible to turn the blower easily by hand: If, there is any resistance then this indicates either that the base plate or the housing is distorted, or there is dirt in the cylinder. In cases where the blower will be subject to wide temperature variations, only the feet on the drive side should be rigidly fixed to the foundation: the rear feet should be held by means of spacer bushes in such a way that a slight movement parallel to the shaft is possible, to allow for thermal expansion of the housing.

### 5.6 Couplings and pulleys

The shaft journals should be thoroughly cleaned of rust-preventing varnish or oil before fitting the pulleys or the couplings. A suitable jig must be used for fitting the pulleys or couplings; the jig is centred in the centering hole on the end of the shaft. Fitting (and later removal if necessary) are made easier by first coating the end of the shaft with molybdenum disulphide (e.g. Molykote).

Only couplings that have been machined on all sides and balanced according to VDI 2060 quality grade Q 6.3.

### 5.7 Keilriemen



e = Achsabstand  
 E = Eindrücktiefe je 100 mm Achsabstand  
 Ea = Eindrücktiefe der Trums  
 f = Prüfkraft  

$$Ea = \frac{E \cdot e}{100} \quad (1)$$



Profil	Prüfkraft f je Keilriemen (daN) od. (kp)	Durchmesser dk (mm)	Eindrücktiefe E(mm) je 100 mm Achsabstand
SPZ/3V	2,5	≥ 56 - 71	2,45
XPZ/3VX		> 71 - 90	2,20
		> 90 - 125	2,05
	> 125	1,90	
SPA	5,0	≥ 71 - 100	3,20
XPA		> 100 - 140	2,75
		> 140 - 200	2,55
		> 200	2,45
SPB / 5V	7,5	≥ 112 - 160	3,00
XPB/5VX		> 160 - 224	2,55
		> 224 - 355	2,22
		> 355	2,10
SPC	12,5	≥ 180 - 250	2,20
		> 250 - 355	2,05
		> 355 - 560	1,90
		> 560	1,70

1. Consult the table to find the test force "f" appropriate to the type of belt used.
2. Find the smallest-diameter pulley in the system, and use this to find the deflection "E" from the table.
3. Calculate the deflection "Ea" from the actual shaft centre distance "e" using formula (1).
4. Apply the test force "f" to the belt exactly midway between the two shafts (whose centre distance is "e") and exactly at right angles to its original (undeflected) path.  
 Then tighten the belt until the deflection equals the correct calculated deflection "Ea".

Belt tension example: belt profile SPZ; dk = 100 mm; e = 380 mm; f = 2.5 daN; Ea = 5.5 mm

The belts should be retightened after they have run for about 30 minutes.

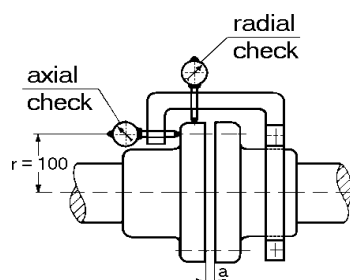
### 5.8 Final adjustment

For the final adjustment, the shaft of the blower should be taken as the fixed reference point. The drive motor, which was deliberately mounted slightly lower than the blower, should now be raised by means of steel shims, until the shafts marry up. Each shim must be of at least the same area as the foot which it supports.

The gap between the two halves of the coupling must be precisely as stated in the specification.

If special couplings are used, follow the fitting instructions accurately.

The coupling must be tested for true running using dial gauges. If the two halves of the coupling have identical flange diameters, this check can also be carried out using a straight edge and a feeler gauge.



When using dial gauges for the alignment, proceed as shown in the diagram.

A jig is fixed to one half of the coupling, and is used to hold two dial gauges which bear onto the other half of the coupling, as shown.

Then turn both shafts simultaneously and note the maximum deflections from true running.

### Tolerances for rotation of couplings

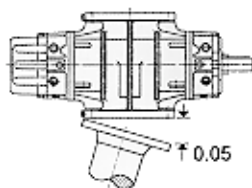
Radial: max. 0.05 mm shaft misalignment (i.e. 0.1 mm total on a full revolution)

Axial: max. 0.05 mm shaft misalignment over a complete revolution; if possible the misalignment should be kept lower than 0.03 mm at a distance  $r = 100$  mm from the middle of the shaft (for distances other than this, calculate the corresponding tolerance in linear proportion).

## 5.9 Pipelines

When installing the vacuum pipes, take particular care that the pairs of flanges are accurately parallel to one another (if necessary, use a feeler gauge to check), as otherwise they will be under strain and may distort when connected.

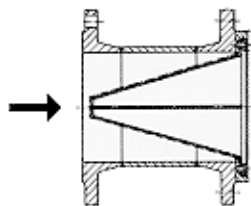
The seal rings should be lightly greased with vacuum grease before being inserted. The weight of the piping and of any silencers etc. must be supported on separate brackets, and not carried by the flange. Once the flange bolts have been tightened, turn the blower over by hand and check that it turns easily. If any resistance is felt, then check that the blower has been mounted correctly without any mechanical strain or distortion. To do this, undo the flange connections and if necessary also the foundation anchoring bolts. Check the inside chambers of the blower for dirt.



### Note:

Experience has shown, that, when starting up the blower for the first time, it is advisable to fit a strainer of 0.3 mm mesh size to the inlet side of the blower for the initial running-in period. The strainer should be of conical form, with the tip of the cone pointing AGAINST the direction of flow. The fine-mesh strainer should be supported on a perforated metal sheet.

If the strainer is still clean after the first 200 hours operation, it can be removed.



## 6. Initial start-up

### 6.1 Test run of drive motor

Uncouple the blower, and check that the motor alone runs smoothly and in the correct direction. If any electrically-operated instruments are provided (e.g. thermometer, manometer with electrical contacts), these must be checked for correct functioning.

### 6.2 Test run of blower

On the test run, watch for the following points: smooth running of blower and coupling, temperature of housing, shaft seals, long run-down when switched off, still turns easily by hand after test run, maximum pressure difference not exceeded.

**Important: Guards for the coupling or for the belts must be fitted. Danger of accidents.**



## 7. Maintenance

### 7.1 General

If run under normal operating conditions, a rotary piston blower needs scarcely any maintenance. The rotary pistons do not touch metal at any point and thus do not need any lubricant.

Maintenance is restricted to the oil system and the instrumentation.

### 7.2 Standard seals

The compression chamber is sealed from the bearing housings with a piston ring labyrinth seal.

The drive shaft is sealed with two radial lip seals.

### 7.3 Heatable vacuum blowers wHV

To prevent deposits in the compression chamber, blowers of model GMa 12.5 to 13f7 have double walled cylinders and model GMb 14.9 to 17.15 double walled side plates to allow the injection of a heating medium.

Allowable heating mediums are oil, steam or water. However to prevent damage to the bearings maximum temperature of 110 °C must not be exceeded.

Max. pressure of heating medium: 2.0 bar (g).

## 8. Lubrication

### 8.1 General

Vacuum blowers are normally splash lubricated. In case of increased speed operation of vacuum blowers is admissible with an installed oil guiding device (wheel side) only. For reasons of space the installation of such an oil guiding device is possible in blowers sizes 14...20 only. Admissible application limits can be taken from the sheets 4TG-3381 and 4TG-3382. The correct oil level has to be checked at regular intervals. For this purpose the blower has to be switched off. Wait a few minutes until the oil has run down from the walls and the oil level is static.

The oil has to be filled up as follows:

GMa 10-13 centre of sight glasses

GLa 10-13 upper edge of reflector

GLb 14-17 upper edge of hole

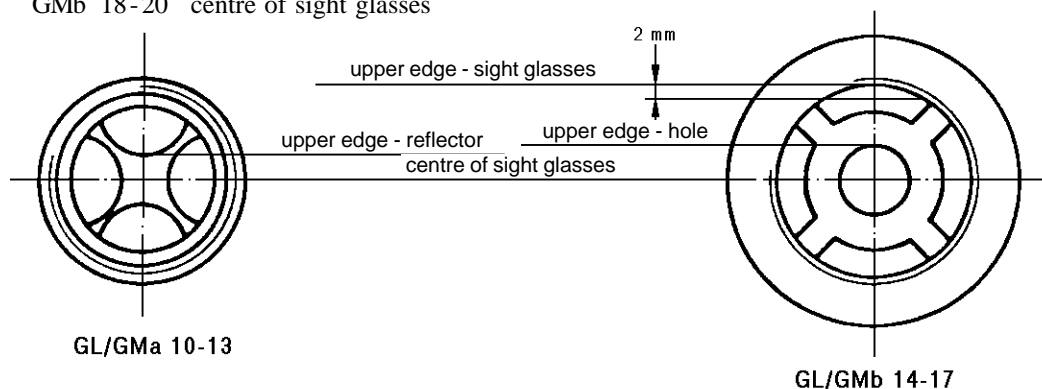
GLb 14-16 (with oil feed device) 2 mm below upper edge of sight glasses

GMb 14-17 (without oil feed device) centre of sight glasses

GMb 14-17 (with oil feed device) drive side - centre of sight glasses

gear side - upper edge of hole

GMb 18-20 centre of sight glasses



**Note:** Through the oil filling opening it can be checked whether an oil feed device is installed.

## 8.2 Oil lubrication qualities

Instructions for lube oils upon operating of standard positive displacement machines

Commercial full-synthetic high-performance light motor oil

API oil specification SH / CF or higher.

Viscosity classes DIN 51 511 0W - 40 / 5W - 40 / 10W - 40

Kinematic viscosity of at least 13 mm<sup>2</sup>/s at 100°C.

Special requirements:

Oxidation stability at oil temperatures up to 110°C.

Special recommendations:

In case of change-over from mineral to synthetic oil, an oil exchange is to be effected within an operation period of 24 h.

It is not necessary to clean the oil chambers separately.

Concerning the following oil brands, good practical experiences are available:

Oil brand	Name	SAE - viscosity class	Pour-point
Aral	Aral High Tronic	5W - 40	-60°C
Esso	Ultron	5W - 40	-54°C
Mobil	Mobil 1	0W - 40	-55°C
Shell	Helix Diesel Ultra	5W - 30	-55°C

Other oils brands may also be applied, provided the specification is observed.

**Before the test run the bearing and gear covers are to be filled with the conservation oil ESSOLUB MZ 20W-20.**

**After the mechanical test run the lube- and conservation oil is to be drained.**

**The blower is delivered without lubricant filling.**



**Prior to commissioning fill up oil**

## 8.3 Oil filling - transparent reservoir

In order to avoid a dry-running of the seal rings of the driving shaft during commissioning on delivery of the blower stage the seal ring housing is filled with ARAL Motanol HV100.



**Adjust oil level to center of transparent reservoir**

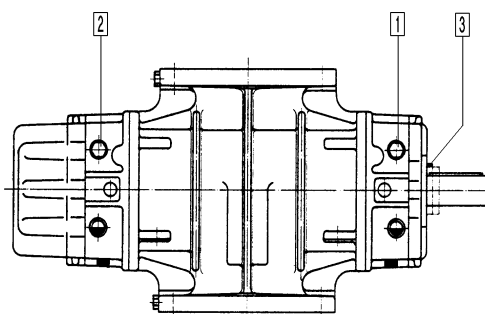
For supplies of blowers with transparent reservoirs (oiler) of code No. 117502 (applicable until May 1998) a deventilation of the sealing chamber can be achieved as follows: a hose, Ø 4 mm, is lead into the sealing chamber through the transparent reservoir. By means of oil feeder pump in oil, until the reservoir is approx. half-full. It must be guaranteed, that the sealing chamber is deventilated.

**8.4 Oil fillings** (total, for drive and gear side together)

Type	approx. litres		
GLa 10.0	10.1	102	0,7
GMa 10.1	10.1	102	0,9
GLa 11.3	11.4		0,8
GMa 11.3	11.4		1,1
GLa 12.5	12.6		1,1
GMa 12.5	12.6		1,5
GLa 13.f7	13.8		2,1
GMa 13.f7	13.8		2,5
GLb 14.9			3,5
GMb 14.9			7,0
GLb 15.10	15.11		5,4
GMb 15.10	15.11		12,0
GLb 16.12	16.f13	16.13	7,6
GMb 16.12	16.f13	16.13	11,0
GMb 17.15			18,5
GMb 18.17			22,0
GMb 19.19			35,0
GMb 20.21			140,0



**8.5 Oil change**



Machine part	Lubricating point	Type of lubrication	Lubricant symbol acc. DIN 51502	Lubricating qty. oil		Change of lubricant acc. to	
				litres		first	further*
driving side	1	splash lubrication	Motor oil 5W-40	see list	-	200	4000
wheel side	2	splash lubrication	Motor oil 5W-40	see list	-	200	4000

\* all year at the latest

## 9. Cleaning of the blower

As the rotors operate without contact with one another, the clearances between rotors and housing allow the conveyance of dust laden media to a limited extent. Thus deposits in the blower can occur.

When removing the piping the conveying chamber can be checked and cleaned. Adhesive and sticking deposits can be removed either with a scraper or an appropriate solvent on their nature.

After every thorough cleaning the lubricating oil is to be changed.



## 10. Change of flow direction (GMa 10.0 - GMb 16.13)

In case it is necessary to change an already dispatched machine from GM to GL the following steps have to be carried out:

- 1) Extract oil
- 2) Relocate feet, drive shaft is now at the bottom
- 3) Exchange oil sight glasses and filler/drain
- 4) Remove seal ring housing
- 5) Lengthen pipe between seal ring housing and oil reservoir
- 6) Mount seal ring housing with oil reservoir vertical
- 7) Fill up oil in accordance with the operating instruction

## 11. Watercooled seal ring housing

Water quantities at 1 bar (g) and $\Delta t = 10\text{ }^{\circ}\text{C}$			
blower type		water quantity	
GMb/GLb	17	40 l/h	
	18	40 l/h	
	19	50 l/h	
	20	50 l/h	

The max. admissible water pressure amounts to 1 bar (g).



**Aerzener Maschinenfabrik  
GmbH**

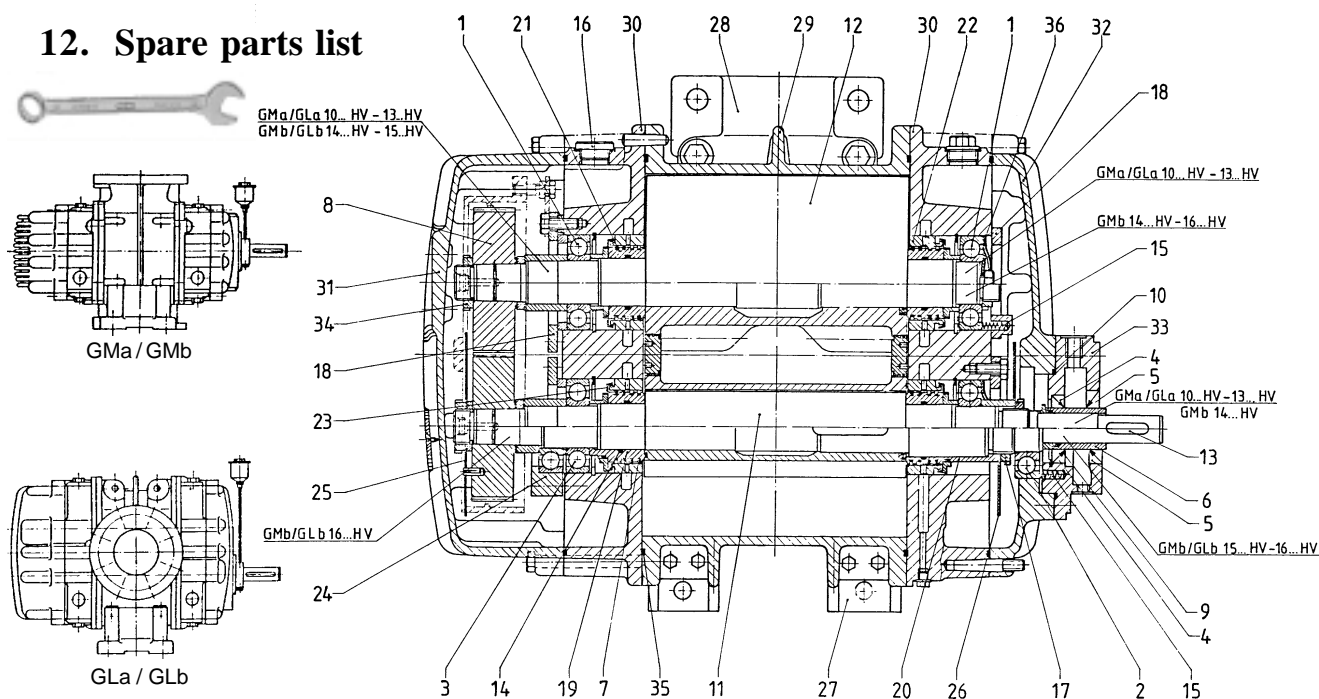
Reherweg 28  
D-31855 Aerzen

Postfach 11 63  
D-31849 Aerzen

Tel.: 05154/810, Telex: 92847 amd, Fax: 05154/81191



## 12. Spare parts list



item	denomination	GMa / GLa 10...-13... HV	GMb / GLb 14...HV GMb 17...HV	GMb / GLb 15...HV	GMb / GLb 16...HV
1	single-row ball bearing	4	4	3	-
2	single-row ball bearing	-	-	1	1
3	single-row ball bearing	-	-	-	5
4	radial shaft seal ring	1	1	1	1
5	radial shaft seal ring	1	1	1	1
6	shaft sleeve	1	1	1	1
7	piston ring	16	16	16	16
8	pair of gear wheels	1	1	1	1
9	O-ring	1	1	1	1
10	O-ring	1	1	1	1
11	rotary piston with driving shaft	1	1	1	1
12	rotary piston with secondary shaft	1	1	1	1
13	fitting key	1	1	1	1
14	O-ring	4	4	4	5
15	adjusting key	-	6	8	16
16	oil level indicator	4	4	4	4
17	shaft nut	-	-	1	1
18	bearing cover	4	4	3	1
19	ring retainer	-	-	-	3
20	ring retainer	-	-	1	1
21	ring retainer	4	4	3	-
22	sealing bush	4	4	4	4
23	oil splasher	4	4	4	4
24	bearing cover	-	-	-	2
25	oil thrower	1	1	1	1
26	oil thrower	1	1	1	1
27	foot	-	-	-	4
28	foot	2	2	2	-
29	cylinder	1	1	1	1
30	side plate	2	2	2	2
31	gear case	1	1	1	1
32	housing cover	1	1	1	1
33	seal ring housing	1	1	1	1
34	shaft nut	2	4	2	2
35	O-ring	4	4	4	4
36	bearing fixing washer	2	-	-	-



normal speed					4TG - 3381				higher speed with oil feed device			
blower GMa Gmb	pressure diff. $\Delta p$ max (mbar)	speed n max (U/min)	motor P max (kW)	theor. intake $S_{th}$ (m <sup>3</sup> /h)	pressure diff. $\Delta p$ max (mbar)	speed n max (U/min)	motor P max (kW)	theor. intake $S_{th}$ (m <sup>3</sup> /h)	pressure diff. $\Delta p$ max (mbar)	speed n max (U/min)	motor P max (kW)	theor. intake $S_{th}$ (m <sup>3</sup> /h)
GMa 10.0 (a)	200	3000 / 3600	3,0	180 / 220								
GMa 10.1	200	3000 / 3600	3,0	250 / 300								
GMa 10.2(b)	160	3000 / 3600	3,0	370 / 450								
GMa 11.3	200	3000 / 3600	5,5	500 / 600								
GMa 11.4(b)	160	3000 / 3600	5,5	750 / 900								
GMa 12.5	200	3000 / 3600	11	1000 / 1200								
GMa 12.6(b)	160	3000 / 3600	11	1430 / 1700								
GMa 13f7	200	3000 / 3600	15	2000 / 2400								
GMa 13.8(b)	160	3000 / 3600	15	2900 / 3450								
*GMa/b 14.9	200	1500 / 1800	18,5	1950 / 2350	100	3000 / 3600	18,5	3900 / 4700				
*GMa/b 15.10	265	1500 / 1800	30	2800 / 3300	100 / 53	3000 / 3600	30 / 15	5600 / 6700				
*GMa/b 15.11	200	1500 / 1800	30	3750 / 4500	100 / 53	3000 / 3600	30 / 18,5	7500 / 9000				
*GMa/b 16.12	265	1500	45	5400	100	1800	45	6500				
Gmb 16f13	180	1500	45	8150	100	1800	45	9800				
*GMa/b 16.13	160	1500	45	9750	100	1800	45	11 700				
*GMa 17.15	200	1000	75	10 700	100	1200 / 1500	75	13 000 / 16 000				
Gmb 17.15	133	1000	45	10 700	100	1200 / 1500	75	13 000 / 16 000				
*GMa/b 18.17	200	900	132	19 500								
GMa 19.19	180	750	160	30 000								
GMa 20.21	85	600	160	61 000								

**Direct coupled speeds**

- 1) Splash lubrication
- 2) The pressure difference  $\Delta p$  max. can only be run with higher intake pressures due to the thermal load.  
For thermal limit values please refer to the corresponding curve diagram.
- 3) Regarding speeds n smaller than n max. the max. power rating P max. must be reduced to P" max. acc. to the following conversion formula:  $P''_{max} = P_{max} \cdot n / n_{max}$   
The power of the motor must be less or equal P" max.  
Example: P max = 5,5 kW ; P" max = 5,0 kW ; i.e. 5,5 kW is not allowed ; 4,0 kW is admissible - refer to motor catalogue.
- 4) (a) \*GMa/b 15.10 and \*GMa/b 15.11 at speed greater than 3000 1/min P max = 15 kW res. 18,5 kW.
- 5) Types with \*): GMa - type only spare blowers.

normal speed						4TG - 3382					higher speed with oil feed device				
GMa Gmb	press.diff. $\Delta p$ max (mbar)	speed n max (U/min)	motor P max (kW)	blower pulley d min (mm)	theor. intake $S_{th}$ (m <sup>3</sup> /h)	press.diff. $\Delta p$ max (mbar)	speed n max (U/min)	motor P max (kW)	blower pulley d min (mm)	theor. intake $S_{th}$ (m <sup>3</sup> /h)	press.diff. $\Delta p$ max (mbar)	speed n max (U/min)	motor P max (kW)	blower pulley d min (mm)	theor. intake $S_{th}$ (m <sup>3</sup> /h)
GMa 10.0(a)	53	4000	1,5	140	240										
GMa 10.1	53	4000	1,5	140	330										
GMa 10.2(b)	53	4000	1,5	140	500										
GMa 11.3	80	3600	2,2	160	600										
GMa 11.4(b)	53	3600	2,2	160	900										
GMa 12.5	80	3600	4	180	1200										
GMa 12.6(b)	53	3600	4	180	1700										
GMa 13f7	53	3600	5,5	180	2400										
GMa 13.8(b)	53	3600	5,5	180	3450										
*GMa/b 14.9	53	1800	7,5	355	2350	40	3600	11	180	4700					
*GMa/b 15.10	80	1500 / 1800	11	400 / 355	2800 / 3300	80	3000	15	224	5600					
*GMa/b 15.11	53	1500 / 1800	11	400 / 355	3750 / 4500	53	3000	15	224	7500					
*GMa 16.12	80	1500	18,5	400	5400	80	2000	30	315	7250					
Gmb 16.12	120	1500	22	400	5400	100 / 80	2000 / 2350	30	315 / 280	7250 / 8500					
Gmb 16f13	80	1500	22	400	8150	100 / 60	2000 / 2350	30	315 / 280	10 800 / 12800					
*GMa 16.13	53	1500	18,5	400	9750	53	2000	30	315	13 000					
Gmb 16.13	65	1500	22	400	9750	65 / 53	2000 / 2350	30	315 / 280	13 000 / 15 250					
*GMa 17.15	53	1000	30	560	10 700	53	1500	37	450	16 000					
Gmb 17.15	65	1000	30	560	10 700	65	1500	37	450	16 000					

**V-belt-drive**

- 1) Splash lubrication
- 2) The pressure difference  $\Delta p$  max can only be run with higher intake pressures due to the thermal load.  
For thermal limit values please refer to the corresponding curve diagram.
- 3) In case of belt speed of 25 to 40 m/s the belt pulleys must be balanced dynamically.
- 4) Regarding speeds n smaller than n max. and deviations from the min. admissible to P" max. acc. to the following conversion formula:  $P''_{max} = P_{max} \cdot n / n_{max} \cdot d / d_{min}$   
The power of the motor must be less or equal P" max.  
Example : P max = 5,5 kW ; P" max = 5,0 kW ; i.e. 5,5 kW is admissible ; 4,0 kW is admissible - refer to motor catalogue.
- 5) Upon selection of the pulley diameter d the belt speed must not exceed V max. = 40 m/s.  
Check :  $V = d \cdot \pi \cdot n / 60000$  (m/s) < 40 m/s ; d (mm) ; n (U/min)  
e.g. possible diameters d (mm) = 140; 150; 160; 180; 200; 224; 250; 280; 300; 315; 355; 400; 450; 500; 560; 630.
- 6) Types with \*): GMa - type only spare blowers.