TWIN LOBE - TRI LOBE BLOWER

&

VACUUM PUMP

INSTALLATION OPERATION & MAINTENANCE MANUAL

INDEX

CONTENTS **PAGE NO.**

MESSAGE

Dear Kay Customer,

Thank you for choosing a Kay Positive Displacement Rotary Twin or Tri Lobe Blower & Vacuum Pump (Root Blower). We believe that you have bought the best.

Kay International Ltd. has ISO 9001:2008 certified for Marketing & Sales, Development & Production of Twin or Tri Lobe Blower & Vacuum Pump (Root Blower). Each component of the Kay blower under goes stringent quality control checks to ensure an international standard end product.

This installation, Operation & Maintenance Manual contains information about your new equipment, its operation & service requirements. Please take few minutes to read it carefully.

If, for any reason, any of our products do not meet your performance expectations, we would like to hear from you. At Kay we believe that our sales force is you, our customer, & we want you to be satisfied.

We appreciate your purchase of a Kay product & look forward to providing you prompt after sales service & catering to your future equipment needs.

Yours truly,

K.L.Arora
Chairman cum Managing Director

INTRODUCTION

Kay Rotary Twin or Tri Lobe Blower & Vacuum Pump (Root Blower) are designed, manufactured & provided maintenance according to ISO 9001:2008. KAY is dedicated to quality, through excellence of their people and performance of their production equipment.

Each component that goes into a KAY Blower undergoes stringent quality control before finally being fitted. Also, all the rotating parts are dynamically balanced for smooth running and lower bearing loads.

All manufactured KAY Blowers are tested on test benches according to BS:1571, Part-II, where the load applied is the same as in actual service conditions (required by client). Each Blower duly painted and packed in wooden boxes is ready for shipment to required destination.

SECTION – 1

1.1 GENERAL

Although Kay Blowers are sturdy CNC–engineered machines which are quality controlled to prevent manufacturing defects, there are several relatively simple but basic installation and maintenance procedures that must be observed to ensure optimum performance. As there is no guesswork in the manufacture of these highly advanced units, there must be none in preparing them to get the job done in the field. It is the purpose of this manual to help you properly install, maintain and service your Kay blower. Follow the instructions carefully and you will be rewarded with yours of trouble-free operation. Some principles of correct installation and maintenance are identical or similar for all series of Kay Blowers. In such cases instructions for all models are treated compositely in various subsections.

Some of the data is particular only to the specific series described in the cover of this manual. Hence, it is important that no section be overlooked when preparing to install your blower.

The manual is prepared in sections covering: Operation, Installation, Maintenance and Trouble shooting before delivery the blowers are subjected to a run test in our factory. The test record may be sent on request. The oil casings are drained after the test.

The blowers are delivered WITHOUT OIL.

Each blower is provided with a name plate showing the machine type and the serial number. Any unauthorized modification of the machine or any failure to observe the installation or operation requirements specified in this instruction manual shall be the sole responsibility of the client and shall cancel any guarantee rights.

1.2 TYPE OF BLOWER

Air Cooled Blower :- The body of this type of Blower is cooled by atmospheric air. The Blower body is provided with fins around it. Heat produced in body is carried to fins and from here it is taken away by atmospheric air. These types of Blower are suitable for operation up to the pressure of 7000 MMWG.

Water Cooled Blower :- This type of Blower is provided with water cooling arrangement. The Blower body is manufactured with water jackets around it. The fresh water is circulated with the heat produce in body is carried away with water. These types of Blower are suitable for operation of above 7000 MMWG Pressure.

Gas Pump :- Kay Gas Pump are designed for providing trouble free operation with hazardous as well as No-Hazardous gases. These pumps have special sealing arrangement with stuffing box. As per specific requirements, the Kay Gas Pumps can be provided with Mechanical Seals in addition to the stuffing box sealing arrangements.

Vacuum Pump :- Kay Vacuum Pump has a special configuration with three working port i.e. Suction, Discharge and Injection port. So in one equipment three silencers are provided, i.e. one for each working port and on the opposite end of suction a specially designed manifold is provided to mount both discharge and injection silencer.

1.3 OPERATING CHARACTERISTICS

Read the appropriate working instructions BEFORE running the machine.

The rotary lobe blower is a positive displacement type unit, whose volumetric capacity is determined by the size of the unit, the operating speed, the differential pressure and the atmospheric conditions. It employs two bi-lobe or two tri-lobe impellers mounted on parallel shafts and rotating in opposite directions within a cylinder and closed at the ends by side plates. As the impellers rotate, air is drawn into one side of the cylinder and forced out the opposite side against the existing pressure. Therefore, the pressure developed depends on the resistance of the discharge system.

Effective sealing of the blower inlet area from the discharge area is accomplished by use of very small internal clearances. The resulting absence of contacts between moving parts eliminates the need for any internal lubrication. Clearances between the impellers during rotation are maintained by a pair of accurately machined timing gears mounted on the two shafts extended outside the air chamber.

No attempt should ever be made to control capacity by means of a throttle valve in the inlet or discharge piping. This will not only increase the power load on the drive, but can also overload and seriously damage the blower. Likewise, if a possibility exists that flow to the blower inlet may be cut off during normal operation of a process, then an adequate vacuum relief valve or protection switch must be installed near the blower. A pressure type relief valve in the discharge line near the blower is also mandatory for protection against cut-off or blocking in this line.

When a belt drive is employed, blower speed can usually be adjusted to obtain desired capacity by changing the diameter of one or both sheaves. In a direct coupled arrangement, a variable speed motor or transmission is required, or excess air may be blown off through a manually or controlled unloading valve and silencer. If returned to the blower inlet, air must go through a cooled by-pass arrangement.

Before making any changes in blower capacity, or operating conditions, contact the nearest Kay Sales Office for specific information applying to your particular blower. In all cases, operating conditions must be maintained within the approved range or pressures, temperatures and speed. Also, the blower must not be used to handle air containing liquids or solids, since serious damage to the rotating parts will result.

1.4 DIRECTION OF ROTATION

1.4.1 TWIN LOBE BLOWER

'KAY' Rotary Twin Lobe Blowers follows the well established principle of the Roots Blowers. KAY's units covered in this manual represent the basic type rotary lobe arrangement and the proprietary design. Operation is both simple and effective.

The shape of the impellers (Fig. 1.2) such that a small accurately gauged clearance is maintained at all times between the impellers and casing (Fig. 1.3). As they rotate, air is drawn into the space between the impellers and the casing, where it is trapped as the tip of the impellers passes the edge of the inlet opening (Fig. 1.1)

Twin impellers mounted on parallel shafts and rotating in opposite directions within a body closed at the ends by side plates. As the impellers rotate, the opposite tip of the impellers passes the edge of the outlet opening and the trapped air is pushed through the outlet into the air line. This action is repeated twice for each revolution of the impeller, or four times for each revolution of the drive shaft. The volume of air displaced by one revolution of the drive shaft for each size of compressor has been calculated, and the amount of air moved at any given speed and pressure is known. This makes it simple to select the speed at which the compressor should operate to supply the required volume of air.

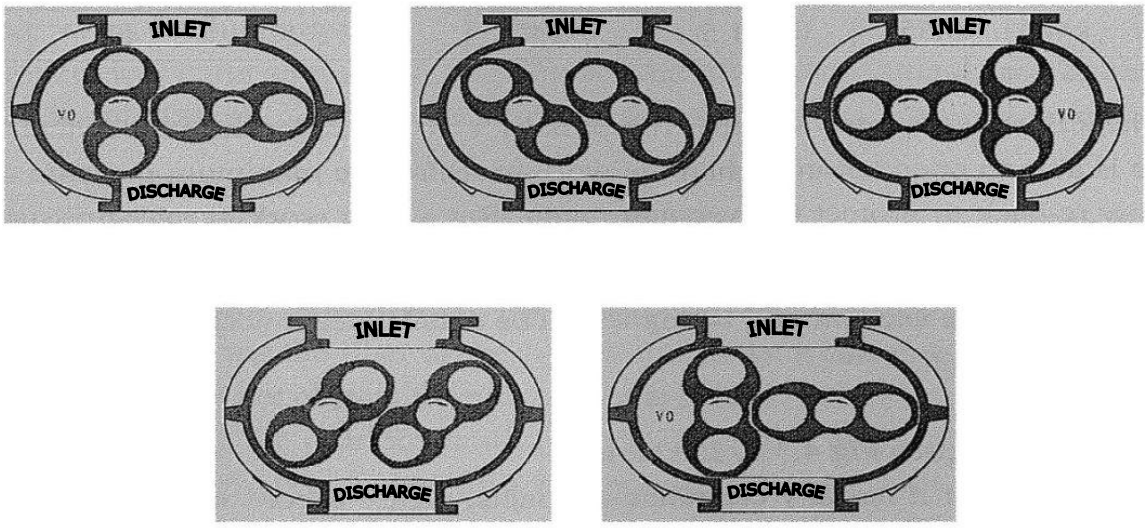


Fig. 1.1

Fig. 1.2

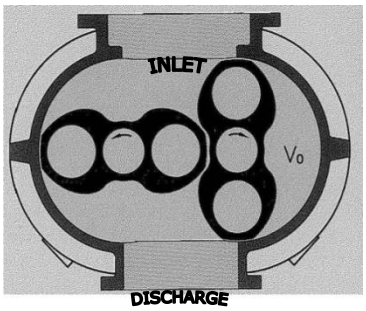


Fig. 1.3

1.4.2 TRI LOBE BLOWER

The shape of the impellers (Fig. 2.2) such that a small accurately gauged clearance is maintained at all times between the impellers and casing (Fig. 2.3). As they rotate, air is drawn into the space between the impellers and the casing, where it is trapped as the tip of the impellers passes the edge of the inlet opening (Fig. 2.1). Tri impellers mounted on parallel shafts and rotating in opposite directions within a body closed at the ends by side plates just like Twin Lobe Blower. But in this action it is repeated trice for each revolution of the impeller, or six times for each revolution of the drive shaft.

Normally direction of rotation of compressor is anticlockwise when facing the drive end.

- Blower Type V – Suction LH, Discharge RH (when facing drive end)(Fig. 2.4)
- Blower Type H – Suction above, Discharge below (Fig. 2.4)
- When operating clockwise the case will be reverse as described above. (Fig. 2.4)

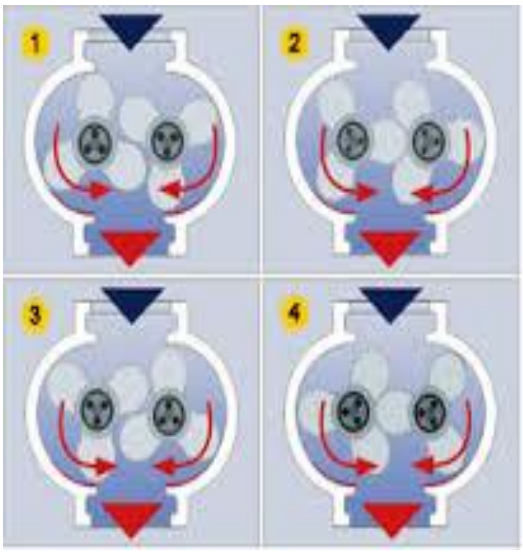


Fig. 2.1

Fig. 2.2

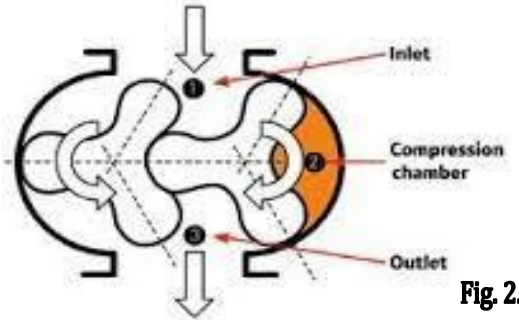


Fig. 2.3

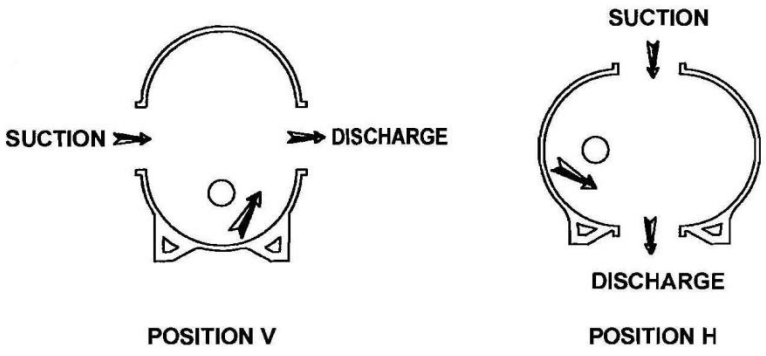


Fig. 2.4

1.4.3 VACUUM PUMP

Normally the direction of rotation is anticlockwise with top suction and bottom discharge + injection when viewed from drive end. Simultaneously with vertical mode of mounting the direction of rotation will remain same with horizontal flow direction.

In case of any specific requirement of direction of rotation the configuration may be changed to suit the customer requirement. (See Fig. 2.5)

Note :- This machine is not designed to rotate in the reverse direction in any of the specified configuration indicated above.

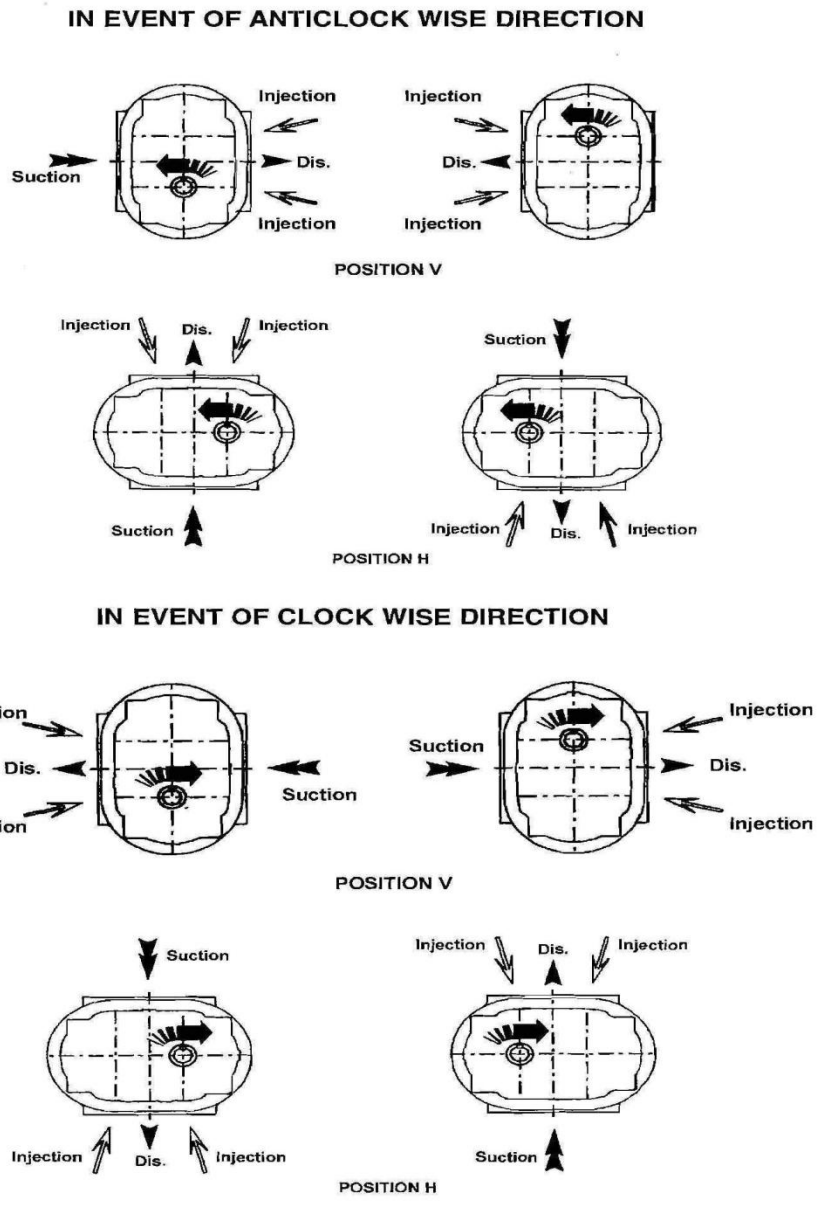


Fig. 2.5

1.5 BLOWER ACCESSORIES

1.5.1 TWIN LOBE BLOWER

I. Suction Filter :- The filter safeguards the Blower against dust and foreign particles. The dust if allowed to enter in side the Blower will get deposited on casing inner wall and on lobes. This will cause to decrease the clearances and lead to seizure of the rotating lobes. Also when any foreign object Is sucked inside it will damage the machine. It is therefore very-very essential to use the filter in the system.

II. Suction & Discharge Silencer :- The silencer is basically used to muffle the noise created by machine. For this purpose one silencer is fitted at suction end and another is on delivery end. Both silencers are so designed that they reduce the noise level created inside the Blower to prescribed limit i.e. Measured as 90 dBA at 1 meter distance from rear of the Blower.

III. Pressure Gauge :- Pressure gauge is an instrument to measure the pressure delivered by Blower at discharges end.

IV. Safety Valve :- The safety valve is a device which is fitted in down line of the Blower. It is to safe guard the system from any abnormal rise of the pressure. This happens because of any kind of blockage in the down line the pressure will rise tremendously because the Blower is positive displacement type. The excessive pressure may cause the pipeline to burst or lead to machine failure. Therefore, the safety valve is a critical item as it safe guards the system from any undesirable higher pressure.

The valve is adjusted to get operated when the pressure rises beyond the safe limit. The excess pressure is released to atmosphere or back to the suction line. The upper limits of pressure are set with the help of dead weight type safety valve or adjust of spindle screw in spring type safety valve.

V. Non-Return Valve (NRV) :- The equipment permits the flow of Air/Gas in one direction only. When fitted in down line it will allow the flow from Blower to discharge point, but isolate the Blower side at the time of shut down.

1.5.2 TRI LOBE BLOWER

I CHECK VALVE :- Check valve is essentially required in discharge side for pressure application and in suction side for vacuum application.

II RELIEF VALVE (SAFETY VALVE) :- Essentially required

- For pressure application – Mount the valve on the discharge side before the check valve.
- For vacuum application – Mount the valve on the suction side after the check valve.
- The relief valve (safety valve) is delivered in pre-set condition as loose piece; valve setting may be adjusted if required when starting machine operation. The relief valve (safety valve) is a safety device, so it should be periodically checked for its correct functioning.

III SILENCER :- It is recommended to install suction silencer or a discharge silencer. The silencers should be mounted as close as possible to Blower.

Utility of Silencer

- To reduce Noise Level
- To absorb temperature inside so that heat effect cannot be transferred outside.

IV FILTER :- When air is sucked from atmosphere, it is recommended to mount suction filter on the upstream end of the suction line.

For all other cases mount suction filter exactly as per recommendation of manufacturer or refer the manufacturer General arrangement and foundation plan drawing. No suction filter required if the compressor s used for vacuum application.

V INSTRUMENT TAPPING POINT :- For monitoring vacuum at suction nozzle and pressure at discharge nozzle of machine, threaded nozzle at suction and discharge are provided for instrument mounting or a separate pipe line may be provided for mounting all monitoring instruments as well as safety device (such as safety relief valve).

VI FLEXIBLE RUBBER BELLOW :- It can be provided by manufacturer as and when required by the customer. It has following advantages.

- Absorb any vibration due to solid born sound transmission
- Compensate slight mis-alignment up to tolerance recommended by manufacturer.
- Should not be fitted directly to the machine flange but after the silencer.
- In no case it should be used to compensate any excessive or insufficient length of the piping.

VII OIL CIRCUIT MONITORING :- Blower is provided with splash lubrication with the help of gear on drive side and oil flinger on Non-drive side.

For monitoring Oil Level or Oil Circulation an indicator is provided to give indication of level and functioning of oil circulation on both sides of blower.

1.5.3 VACUUM PUMP

I RELIEF VALVE :- It is installed on suction side & a very essential safety device for the equipment. It must be checked for its functioning periodically.

II SILENCER :- This Vacuum Pump has a special configuration with three working port i.e. Suction, Discharge and Injection port, It means one for each working port and one the opposite end of suction a specially designed manifold is provided to mount both discharge and injection silencer. So, for one equipment three silencers are provided.

III FILTER AT INJECTION LINE :- In a dusty environment, the air injection system must be fitted with filter. Caution will be taken that head loss across the filter must be as low as possible.

IV INSTRUMENT TAPPING POINT :- For monitoring vacuum at suction nozzle and pressure at discharge nozzle of machine, threaded nozzle at suction and discharge are provided for instrument mounting or a separate pipe line may be provided for mounting all monitoring instruments as well as safety device (such as safety relief valve).

V MANIFOLD ASSEMBLY :- It is a specially designed adaptor fitted to body to isolate discharge and injection port and has flanged connection to mount discharge silencer and injection silencer.

The surface of manifold facing to body counter connection side has special connection plate.

VI FLEXIBLE RUBBER BELLOW :- It can be provided by manufacturer as and when required by the customer. It has following advantages.

- Absorb any vibration due to solid born sound transmission
- Compensate slight mis-alignment up to tolerance recommended by manufacturer.
- Should not be fitted directly to the machine flange but after the silencer.
- In no case it should be used to compensate any excessive or insufficient length of the piping.

VII OIL CIRCUIT MONITORING :- Blower is provided with splash lubrication with the help of gear on drive side and oil flinger on Non-drive side. For monitoring Oil Level or Oil Circulation an indicator is provided to give indication of level and functioning of oil circulation on both sides of blower.

SECTION – 2

2.1 INSTALLATION

2.1.1 INSTALLATION OF FOUNDATION

Place the Blower on a concrete or equally substantial level foundation with the feet supported evenly on the base frame. The perfect level can be acquired by inserting the appropriate metallic shims between the base frame and Blower legs, this will prevent distortion of the casing when tightening down. The foundation bolts should be grouted in the allowed to set before the Blower is tightened down.

If the Blower is mounted on a base plate together with the motor, ensure that the Blower casing is not distorted when the foundation bolts are tightened. There should be even tightening (even torque) of all mounting points.

If the Blower is direct coupled to the prime mover, the flexible coupling must be accurately aligned with an even gap between the faces. The axis of the coupling must be lined up exactly in both horizontal and vertical directions. When the drive to Blower is to be given though:-

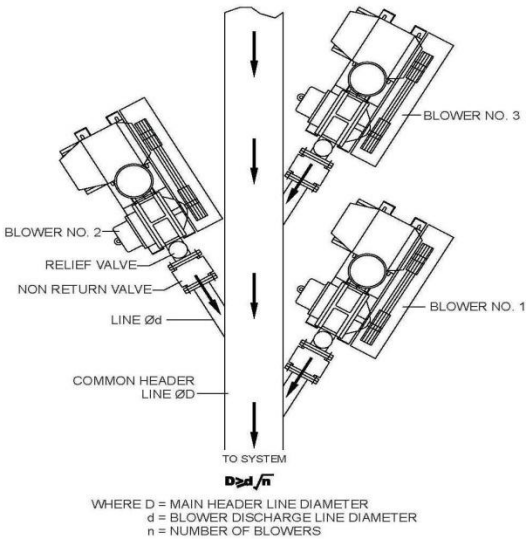
a) The Blower and motor must be horizontal and the axis of Blower pulley shaft and electric motor shaft should be exactly in parallel line.

b) The belt pulleys are always to be on the shaft in such a way that the belt pulls is near to the machine.

c) V-belts are tightened in such a way that v-belts are able to pressed by hand at mid of distance between two pulleys. Too much tightening of belt will be overloading the motor and torque load on the drive shaft of Blower. Too loose belts will cause the slippage of v-belts over pulleys. This will in-turn and damage the belts.

NOTE :-

- If the pulley or coupling is not of the taper bush type, it must be pressed onto the shaft to avoid damage to the locating bearing. Under no circumstances should a hammer be used to fit the coupling or pulley. The pulley should be fitted as close as possible to the drive shaft bearing cover.
- Never insert shims between blower and base plate to correct any leveling defects. Maximum Horizontal Deviation : 0.2 mm/m.
  When installing the blower unit, never use the integral cast lugs on the blower side plates and casing.



2.1.2. MULTIPLE BLOWER INSTALLATIONS

When two or more blowers are connected to a system through the common header, don't connect the discharge line to header by T-joint. It should be long bend radius type to avoid Air Trapping & back pressure result in low line losses & consequently blower saving, Refer to proposed layouts as shown below.

INSTALLATION OF BLOWER WITH ELASTIC SUPPORT

Under the base plate legs an elastic support (i.e. Anti-Vibration Pad) is provided which should be fitted to base plate using bolts and nuts. Lower the compressor unit on foundation, taking care that the holes of Anti-Vibration Pad, Base Frame mounting hole coincide with the foundation bolt.

The elastic supports (Anti-Vibration Pad) must well set. The elastic supports are not for any compensation of unevenness of foundation. Any major unevenness in foundation will reduce vibration absorption capacity of Anti-Vibration Pad. In case of unevenness insert solid block between base and the concrete.

2.1.3 PIPE WORK

It is essential that pipe connection should match up to the Blower flanges without strain and that the pipe work is adequately supported. Otherwise the Blower casing might be distorted. This could cause contact between the impellers and the casing with the result that the Blower will eventually seize. All pipe lines should be thoroughly cleaned internally before being connected to the Blower inlet & outlet. Also, the blower must be inspected for any loose foreign object inside the body before giving pipe connections to blower.

Caution :- Size reduction of the pipe in suction & delivery line and direction change by putting the sharp bend should be avoided & it should be long radius type bend. In case of unavoidable circumstances it should be done after proper calculation. This will avoid any back pressure to the Blower and shall give you're the trouble free operation. Do not give immediate bend just after NRV. This may restrict the movement of the NRV for its full range of operation.

2.1.4 DRIVE PREPARATION

Drive Shaft end is coated with protective layer of anticorrosive element, which should be removed before installation of the coupling or pulley. Use only adequate tools for pulley/Coupling fitment and withdrawal.

To make the mounting easy and to avoid any scratch mark on the shaft use lubricant on the shaft before mounting.

CAUTION :- Never mount the Coupling / Pulley with hammer blow.

2.1.4.1 DIRECT DRIVE THROUGH COUPLING

For datum axis, consider the compressor shaft axis, the motor shall be placed at the correct level and alignment should be done by inserting shims below motor leg. Size of shims should be as per leg dimension preferably larger then leg area.

The space between both coupling halves must be in line with the recommendation of manufacturer and also the alignment tolerance and fitment procedure must be exactly as per recommendation of manufacturer.

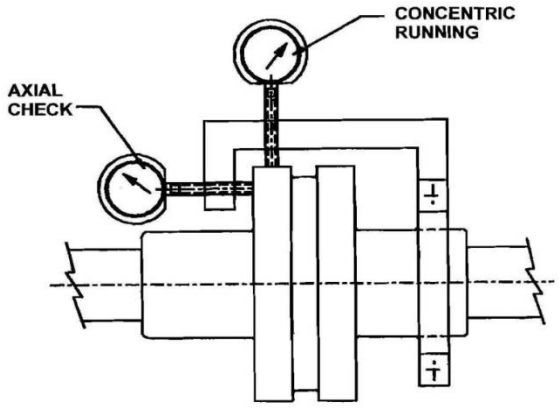
Alignment inspection must be done for coupling, as it is a major factor for drive mounting as per appropriate inspection procedure as recommended or suggested. One most common method of inspection is by dial indicator.

When using the dial indicator method, the shaft coupling alignment shall be checked as follows :-

- Check the face run out of coupling
- Check the lateral and longitudinal run out of coupling.

COUPLING ALIGHMNET TOLERENCE :-

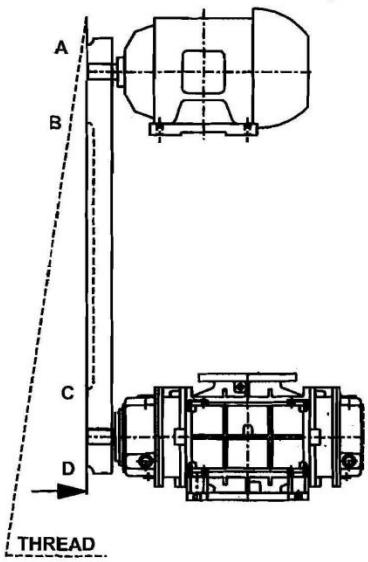
For radial alignment max 0.05 mm
For axial alignment max 0.05 mm



CHECKING THE ALIGNMENT OF COUPLING

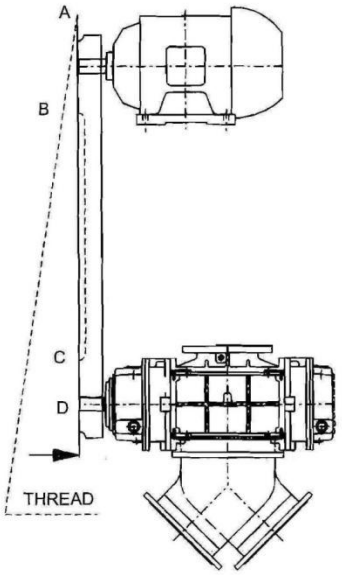
2.1.4.2.1 BELT DRIVE (TWIN LOBE)

The pulley alignment shall be carried out by using an appropriate media such as (thread or a rule). The shaft parallelism is confirmed when the thread or a rule is in contact with the pulley at points A, B, C & D.



CHECKING THE MOTOR PULLEY& BLOWER PULLEY ALIGNMENT

2.1.4.2.2 BELT DRIVE (TRI LOBE & VACUUM APPLICATION)



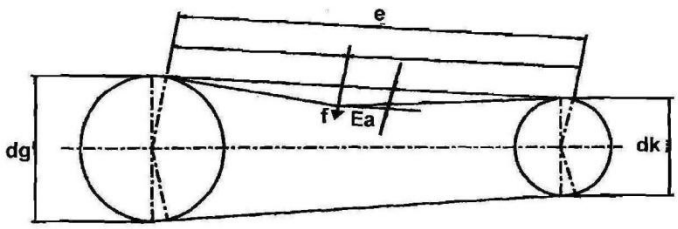
CHECKING THE MOTOR PULELY & VACUUM PUMP PULLEY ALIGNMENT

2.1.5 BELT TENSIONING

The recommended belt tension is tabulated and the tension given should be strictly as per recommended.

BELT SECTION	TEST FORCE "f" PER BELT-(kp)	DIAMETER – (mm) "dk"	DEFLECTION FOR EACH 100mm OF CENTER DISTANCE 'E'– (mm)
SPZ-3V	2.5	>63-71 >71-90 >90-125 >125	2.00 1.75 1.45 1.30
SPA	5.0	>90-100 >100-140 >140-200 >200	2.75 2.30 2.10 2.00
SPB/5V	7.5	>140-160 >160-224 >224-355 >355	2.00 1.55 1.20 1.10
SPC	12.5	>224-250 >250-355 >355-560 >560	2.10 1.60 1.60 1.55

There is also a procedure for checking belt tension. (Using testing device)



BELT TENSIONING

Press the belt at the mid of both shaft. The total deflection should not be less than

$$Ea. = \frac{E \cdot e}{100}$$

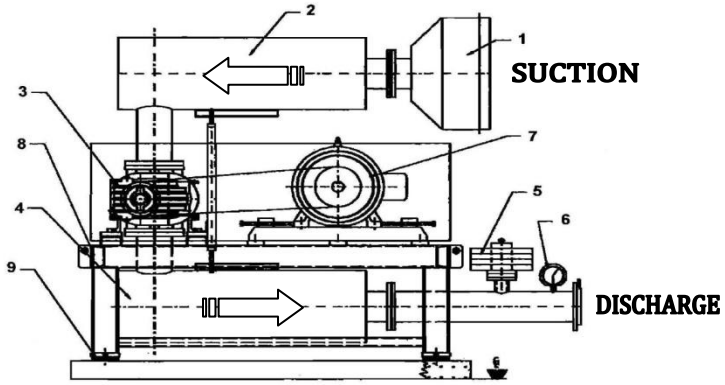
E = recommended deflection for each 100mm of center distance
E = Center distance
Ea = Tension the belt till its total calculated deflection E reached
F = Test Force

First check of belt tension should be carried out after 30 min. and then second check after 24 hrs. of continuous running. Tighten the belt if required.

SECTION – 3

3.1 PUTTING INTO OPERATION

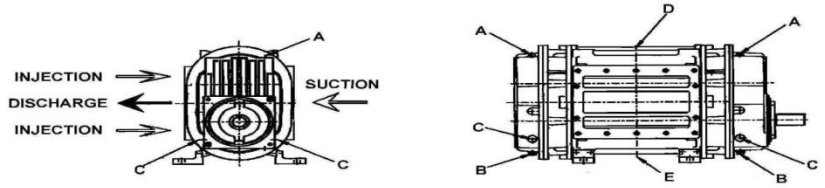
3.1.1 TWIN LOBE BLOWER



(GENERAL ARRANGEMENT DRAWING)

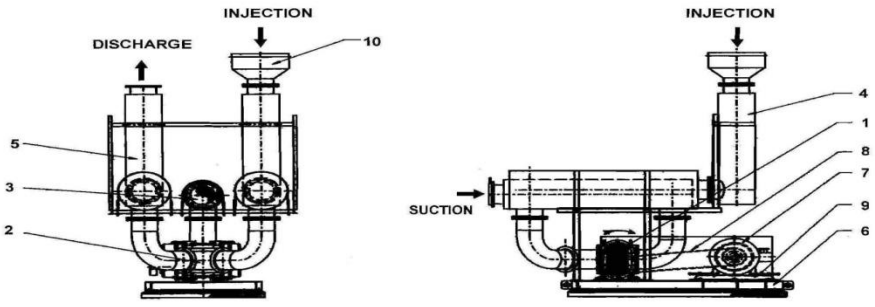
S. No.	PARTS NAME	S. No.	PARTS NAME
1	SUCTION FILTER	6	PRESSURE GAUGE
2	SUCTION SILENCER	7	MOTOR
3	COMPRESSOR	8	BASE FRAME
4	DISCHARGE SILENCER	9	ANTI-VIBRATION PAD
5	SAFETY RELIEF VALVE		

3.1.2 TRI LOBE BLOWER



A- OIL FILLING PLUG
B- OIL DRAIN PLUG
C. OIL LEVEL INDICATOR
D. PLUG FOR CLEANING THE COMPRESSION CHAMBER AND ROTORS
E. CASING DRAIN PLUG

SKETCH OF 3HVP(V) VACUUM PUMP



GENERAL ARRANGEMENT DRAWING

S. No.	PARTS NAME	S. No.	PARTS NAME
1	VACUUM PUMP	6	BASE FRAME
2	MANIFOLD	7	MOTOR
3	SUCTION SILENCER	8	V-BELT
4	INJECTION SILENCER	9	SLIDE RAIL
5	DISCHARGE SILENCER	10	FILTER

3.1.3 CHECK LIST AFTER INSTALLATION OF THE BLOWER

1. Check the fixation of the Blower on the base frame.
2. The Blower must run freely by hand.
3. Check for all connections are done;

   a) Connection to the process

   b) Water feed pipe (if the Blower is water cooled and inlet pressure should be 0.5 kg./cm^2 but not more than 1.5 kg./cm^2). Check water circulation as per flow mark on water pipe line. Inlet

   c) Electrical connection to electrical box of the motor.

4. Check the data (RPM, Frequency, Voltage) shown on the name plate of electric motor (before putting v-belts/coupling)
5. Check the motor shaft/motor pulley rotation as marked.
6. Check the alignment and tension of belts.
7. Water and electricity supply, available.
8. Availability of recommended oil on site.
9. Check the fitment of safety valve, pressure gauge and NRV in the system.
10. Check the NRV is fitted incorrect direction and has free operation.
11. Check the supplied weight plates placed on safety valve ad small bolt fitted on top of safety valve cap.
12. Check the inlet and outlet pipes are well supported to avoid any stress on Blower flanges.

3.1.4 INITIAL STARTING

- Check that the pipings exert no strain on the machine flange, both on suction and discharge side.
- Check the tightness of oil indicator.
- Check the entire Gasket sealing at suction and discharge flange as well as rubber sealing at oil indicator, breather plug & drain plug.
- Fill the oil casing up to Red Marked level in the oil indicator.
- Check the free movement of blower shaft before & after mounting of drive (i.e. coupling or pulleys).
- Check the supply voltage for motor and then direction of rotation as per construction of machine and its recommended direction of rotation.
- Check the belt tension and alignment or the coupling alignment.
- Check the functioning of check valve and it's opening before putting it into operation.

As far as possible try to mount check valve in Horizontal position.

CAUTION :- Never operate machine in close position of valve in either suction or discharge line.

3.1.5 SUBSEQUENT STARTING

- Check the oil level
- Make sure that on the discharge line in case of blower operation in compression or on suction line when operating in vacuum no valve is closed.
- Set the safety valve if any mounted on suction or discharge line progressively, to obtain the selected Vacuum or Pressure.

3.1.6 Startup Check List

The following procedure is recommended when a Blower is to be started up for the first time or when a machine is put to work again after major repairs which have necessitated its removal from its foundation.

1. Inspect the interior of the Blower and all piping lead to and run from it to ensure that all foreign matter has been removed.
2. Check for level and alignment of drive. Check belt tension. Incorrect alignment and/or tension can cause excessive wear on bearings, V-belts or coupling bushes.
3. Check for correct lubrication (Refer Section-5 for specified lubricant). It is essential that the oil level in the gear case should be up to the red dot mark at the center of oil indicator when the Blower is not in operation.

Note :- Too much oil will cause over heating excessive noise and oil leakage through breather plug in the gear case. Too little oil will result in the rapid failure of the gears/bearings due to their running dry.

4. Pump the recommended grease with grease gun through the gas nipple on both drive and driven shaft bearings until fresh grease appears from the grease drain plug.
5. Rotate the impellers by hand to ensure that there are no tight spots.
6. 'Flick' the motor two or three times by putting the starter in and out quickly to check the direction of rotation, and also to ensure that the impellers turn freely.
7. Start the Blower and run for at least fifteen minutes under no load conditions. During this period keep checking at various points on the Blower casing and the bearing housing for signs of heating. The Blower should remain cool throughout this period.
8. Apply the pressure load gradually over a period of say, thirty minutes to one hour. Whilst under full load, keep the machine under observation.
9. Frequent checking should be carried out for any abnormality during the first day in service.

Note :- In the event of suspected faulty operation, shut down the Blower immediately and investigate for possible causes. If this is not done, serious damage may result in a very short time.

SECTION – 4

4.1 PREVENTIVE MAINTENANCE

Preventive maintenance of blower is to be done to avoid any kind of breakdown in the machine. If the routine check up is done timely then the damage which is likely to happen in future can be eliminated.

Routine check up and servicing is to be carried out under this heading are given below :-

1. Weekly or 100 Hrs. of operation (whichever is earlier) :-

	Checks	**Observation**	**Action**
A	Oil Level	Below red mark level on sight glass	Fill up the gear chamber with specified oil grade up to red mark. (Refer the oil grade table in Section-5)
B	V-Belt Condition	If Belts are wearing out	Change the full set of belts. **Note :-** In any case change the full set of belts with new set i.e., All the belts on pulley to be replaced wi new belts.
C	Tightness of V-belts	Belts are over heating	Alignment to be done. **Note :-** This may also be due to over loading of Blower (Refer Section-2)
D	Oil Leakage	Yes	Refer Section -6, Para 6.1.7
E	Discharge Pressure	Above limit	Refer Section -6, Para 6.1.2
F	Smooth running of	Any obstruction or abnormal sound	Refer Section -6, Para 6.1.1
G	Current drawn by motor	More than the limit	Refer Section -6, Para 6.1.5
H	In case the environment is dusty check the filter element	Dirty	Clean the filter element Cleaning Procedure :- Clean the filter element with the help of dry compressed air

2. 1000 Hrs. of operation :-

	Checks	**Observation**	**Action**
A	Functioning of Safety Valve. **Note:-** The functioning of safety valve can be checked by throttling the stop valve of discharge. **Caution :-** Never close the stop valve completely when the Blower is running.	Not Operating	Dead Weight Type Safety Valve:- Remove the head bolts and lift the cover of safety valve clean male and female part with kerosene/diesel and dry the inner surface. Put the parts back into position and place the bolt. Spring Loaded Type Safety Valve:- Adjust the spindle screw.
B	Check the filter element	Dirty	Clean the element
C	Check the tightness of belt	Loose	Proper adjustment to be done or change the set of belts.

3. Oil- Change :- Ref. Section -5 (Lubrication)

Caution:- In case of any problem (which needs to dismantle the Blower) gears removal is not advisable. This is because re-fitment of gears need gear time adjustment which can be done by a qualified man (i.e., Our qualified service engineer). Incorrect setting of gear timing will damage the complete machine when run.

4.2 REMOVING PROTECTIVE MATERIALS

The Drive shaft is protected with rust inhibitor that can be removed with any standard solvent and don't use filler and scrubbers. Alternatively the blower pulley is factory fitted on the shaft and it requires no cleaning. Blower inlet and outlet are temporarily capped to keep out dirt and other contaminants during shipment. These covers must be removed before start-up. Keep them intact during the period of storage.

Kay Blowers are internally and externally treated to protect against normal atmospheric corrosion. Prior to installation remove covers from blower inlet and discharge openings and inspect internals. If the cleaning is required, clean the internals thoroughly using any commercial solvent (e.g. Kerosene & Diesel). Continue this procedure until the unit is visibly clean. Check the drive shaft by rotating manually to ensure the impellers turn freely at all points. No internal adjustment is generally required.

Warning :- Rotating components will cause severe injury in case of personal contact-keep hands away from blower inlet and discharge ports.

SECTION – 5

5.1 LUBRICATION

5.1.1 OIL

The timings gears are housed in a gear case containing oil. The oil used should be suitable for the minimum ambient temperature (cold starting) and for the highest oil temperature reached on maximum load.

Fill the gear case with the appropriate of oil until it reaches the correct level i.e., Red mark shown on the oil level indicator in the gear case. This must be done when the blower is not in operation. The first fill gear oil after 240 hours of working, after that refill the oil in every 1440 hours of working or depending upon the condition of the oil. The oil level should be checked daily.

Note :- A good grade of industrial type non-detergent, anti-foaming oil should be used when the average of blower inlet and discharge temperature is 125°F (52°C) or lower. Oil should be changed after the first 100 hours of operation. After initial oil change, normal oil change periods under these conditions may be considered as 2000 operating hours. At higher temperatures these oils may turn black and leave carbon deposits. For average temperatures above 125°F (52°C) it is recommended that oil with an efficient oxidation inhibitor be used, and that change interval be reduced. Suggested oil change periods for the higher operating temperatures are as follows:

Average Temp. °F (C°)	**Operating Hrs.**
Below 150 (65)	1000
151-160 (66-71)	500

Recommended Gear Oil :- For Indian operating conditions SP-320 of Indian Oil.

Also lubricating oils which fulfills the following properties may also be used as an alternative :

a)	Kinematic Viscosity, cST, at 40^0 c	:	320-350
b)	Viscosity Index, Min	:	90
c)	Flash Point, (COC), ^{0} C	:	232
d)	Pour Point, ^{0} C	:	-9
e)	Color (ASTM)	:	8.0
f)	Oil must have been passed for Rust test		

Following brands of oil can be used worldwide for Kay Compressor:-

SUPPLIERS	**OIL TYPE**	**SUPPLIERS**	**OIL TYPE**
MOBILOIL	Mobilgear630	B.P.	Energol 220xP
Castrol	Alpha Sp220	Cofran	Mecanep 220
Solea	Reductelf SP200	Esso	Spartan EP 220
Fina	Giran 220	Fuchs	Renep Compound 106
Q8	Goya 220	IGOL	Dynam SP220
Labo	Prexol 220	Shell	Omala 220
Taxaco	Meropa ISO 220	Total	Carter EP 220

3.1.2 GREASE

The Bearing at the timing gears end are splash lubricated by the gears whilst those at the drive end are grease lubricated. Open the grease drain plug. Pump the grease with grease gun through the greasing nipple until the fresh grease comes out from drain plug. Now fit the grease drain plug back to its position. Grease to each drive end bearing every 250 working hours. Please note that greasing is not required for the compressors having both side oil lubrication chambers.

Recommended Grease :- AP-3 (Castrol)

Note :- Overfilling must be avoided as this will cause the gears to run hot, resulting in damage.

SECTION – 6

6.1 TROUBLE SHOOTING

6.1.1 Abnormal Sound :-

S. No.	Observation	Action
1.	Loose flange at inlet/outlet of Blower.	Tighten the joints
2.	Improper opening of non return valve	Correct the valve position as per flow direction
3.	Low level of gear oil	Fill the oil to correct (red mark) level.
4.	Higher of gear oil	Adjust the specified R.P.M. of the blower
5.	Filter choking	Clean/change the filter

➲ If you don't find above then call our nearest Sales Office.

6.1.2 Over Heating of Blower :-

S. No.	Observation	Action
1.	The filter is dirty and choked	Clean/change the filter.
2.	Discharge pressure too high : a) Direction/operation of NRV not proper OR b) Operation of gate valve not proper OR c) Operation of safety valve not proper	✸ Correct the valve position as per flow Direction or change the NRV ✸ Rectify/change the gate valve/delivery gate ✸ Clean the male & female parts of Safety valve or change the valve
3.	Oil level too low/high or oil chamber is dry	Fill the oil chamber to correct level.
4.	Viscosity of oil is high.	Fill the specified grade of oil.
5.	Bearings at pulley side are dry	Grease the bearings or fill correct oil (for both side oil lubricating Blower).
6.	Deposits on the lobes/inner walls of casing. (For checking this open the inlet/outlet flange of the blower)	Clean the blower with Kerosene/Diesel.

➲ If you don't find above then call our nearest Sales Office.

6.1.3 Low Volume at Delivery End :-

S. No.	Observation	Action
1.	Bypass valve is open	Close/adjust the bypass valve.
2.	Leakage in down line/delivery line	Stop the leakage.
3.	Filter is dirty & choked	Clean/change the filter.
4.	RPM of Blower is too low	Correct the RPM of blower to specified limit
5.	Belts are loose	Tighten the belts.

➲ If you don't find above then call our nearest Sales Office.

6.1.4 Low Pressure at Delivery End :-

S. No.	Observation	Action
1.	Filter is dirty/choked	Clean/change the filter
2.	Bypass valve is opened	Close/adjust the bypass valve
3.	Leakage in down line/delivery line	Stop the leakage
4.	Low RPM of Blower	Correct the RPM
5.	Belts are loose	Tighten the belts

➲ If you don't find above then call our nearest Sales Office.

6.1.5 Excess Power Consumption :-

S. No.	Observation	Action
1.	Filter is dirty/chocked	Clean/change the filter
2.	Pressure at delivery is high a) Safety valve is faulty b) NRV is not functioning	Correct the safety valve Change the NRV
3.	Deposits on the lobes/inner wall of casing. (for checking this open the inlet/outlet flange of the Blower	Clean the blower with Kerosene/Diesel.

➲ If you don't find above then call our nearest Sales Office.

6.1.6 Seizure (Blower Jamming)

S. No.	Observation	Action
1.	Deposits on the lobes or inner wall of the casing	Clean the blower with Kerosene/Diesel.
2.	Electric Motor is faulty (To check this remove the belts, isolate the Blower from motor and run the motor.)	Change the motor.

➲ If you don't find above then call our nearest Sales Office.

6.1.7 Oil Leakage :-

S. No.	Observation	Action
1.	Oil leaks from the breather plug Cause : Oil level too high.	Fill the oil to marked level.
2.	Oil leaks through the drain plug Cause : a) Loose fitting of plug b) Rubber seal damaged	Tight the plug properly Change the seal
3.	Oil leakage from vent hole of the blower in gear and pulley side.	Call our nearest Sales Office
4.	Oil leakage in delivery line	Call our nearest Sales Office

➲ If you don't find above then call our nearest Sales Office.

SECTION – 7

7.1 EQUIPMENT CHECK

On uncrating, check the packing slip carefully to be sure all the parts have been received. All accessories are listed as separate items on the packing slip, and small important accessories such as relief valves, can be overlooked or lost. After every item on the packing slip has been checked off, unpack carefully. Register a claim with the carrier for lost or damaged equipment.

Warning :- Customers are cautioned to provide adequate protection, warning and safety equipment necessary to protect personnel against hazards involved in installation and operation of this equipment in the system or facility.

7.2 TRANSPORT AND STORAGE

Before packing and shipment of the blower, all external machined parts are coated with a rust preventive film and the nozzles are closed with protective caps to avoid any introduction of foreign matter or water.

When receiving the machine, it must be checked for any damages due to transport. Before any handling, all contact surfaces must be protected with wood places and appropriate slings or cables should be used. All base plates have four lifting lugs. The blower, when alone, may be handled with slings under the side plates or under the cylinder (blower body) on both sides of the flanges. Never use the integral cast lugs of side plates and gear castings.

The Blower and accessories should be stored in a dry, heated and suitably protected place. The rust preventive coating or oil shall be renewed or changed, if necessary.

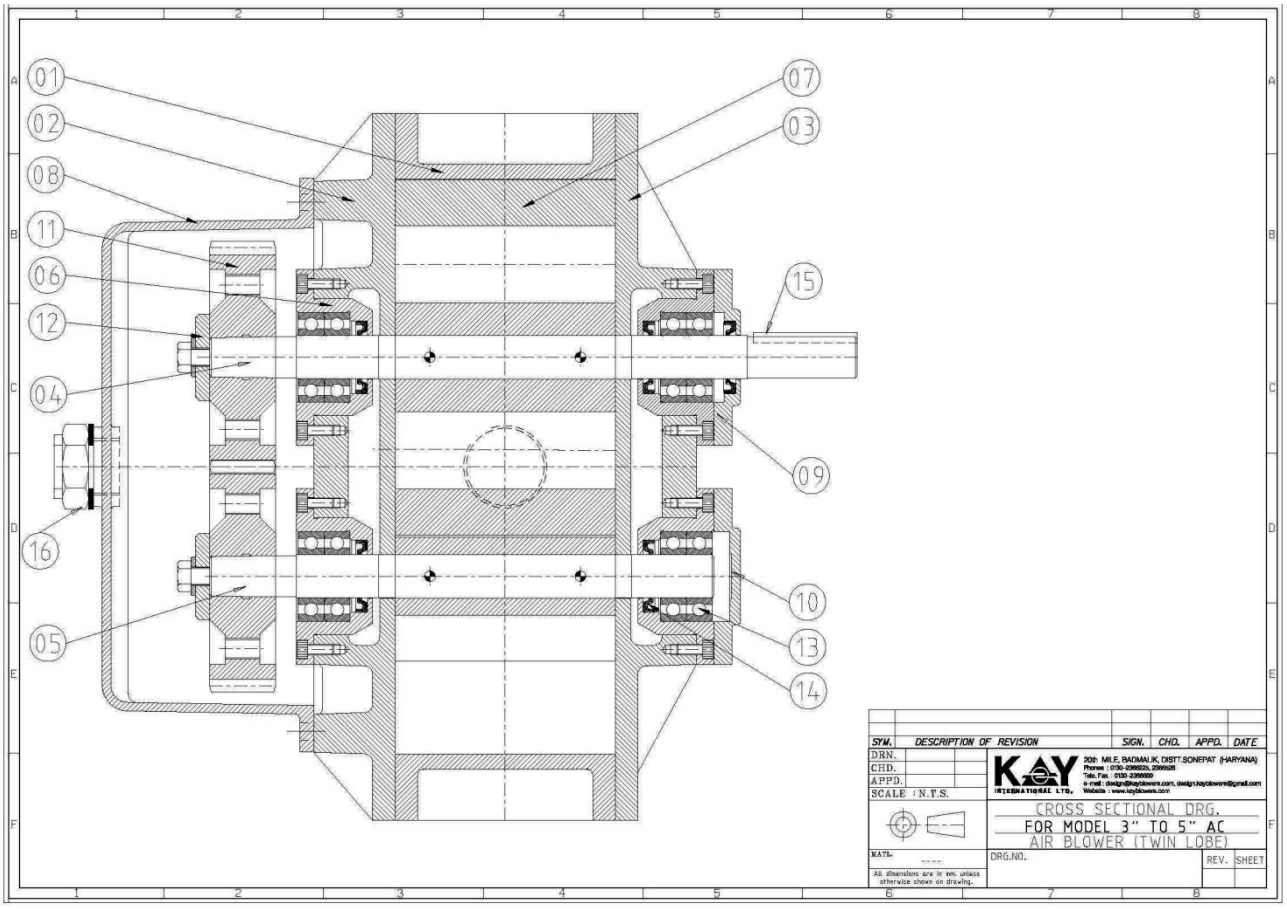
During storage, it is essential to prevent the machine from being subjected to vibration produced by the operation of nearby machines and propagated via the bearing surfaces. Vibrations applied for long periods could damage the machine and motor bearings.

For a long storage time
- Loosen any transmission belts.
- Fill the castings with rust preventive oil up to sight glass, and rotate the shaft a few revolutions
- Spray rust preventive oil in the compression chamber
- Rotate the shaft three or four revolution every two weeks to avoid any damaging of the bearing.
- It is also recommended to place a bag of silica gel or another gyroscopic substance inside the inlet opening and inside the outlet opening, immediately replace the respective cover.

At the end of the storage time, the compression chamber should be cleaned using a solvent (Alcohol, White Spirit). The casting must be drained.

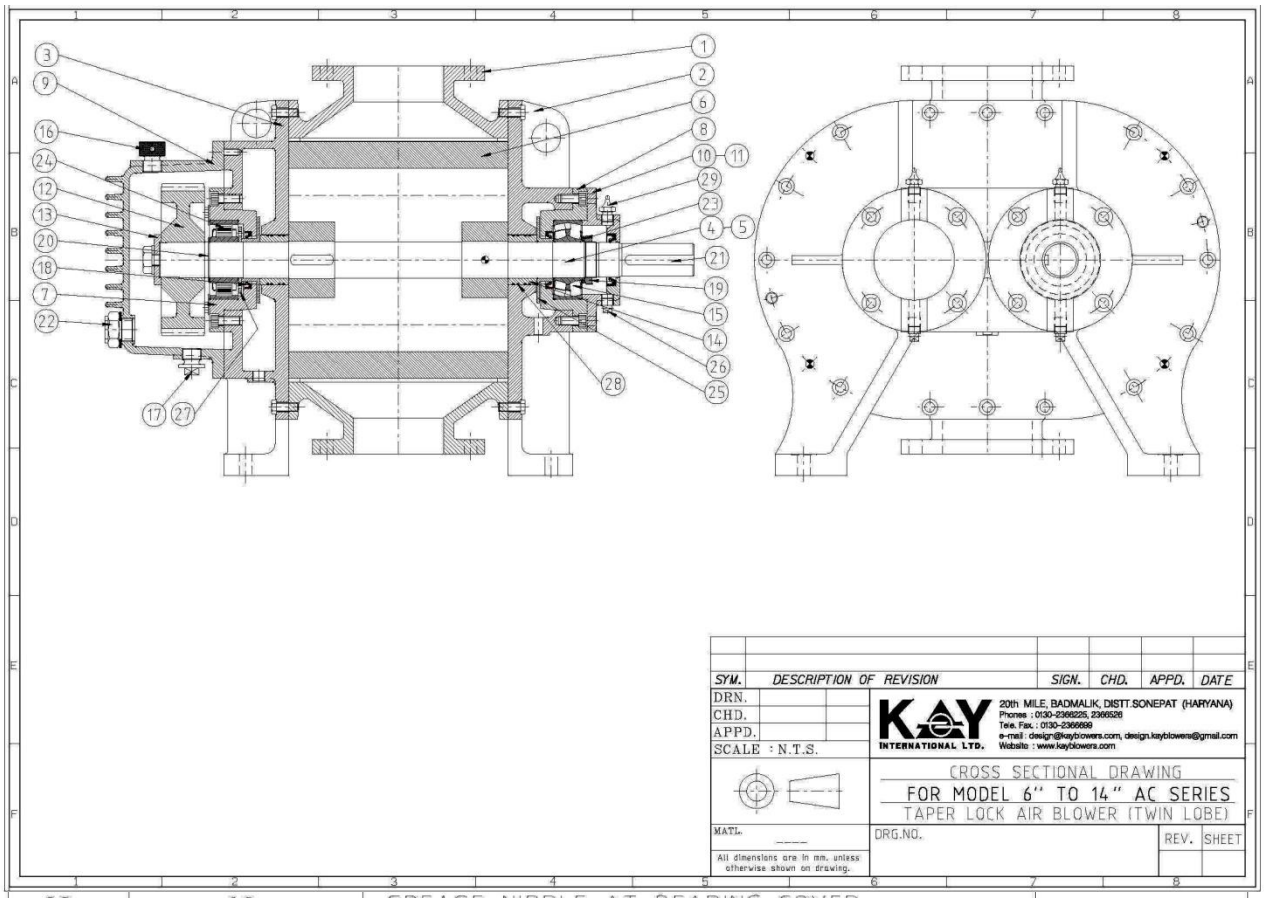
SECTION – 8

8.1 AIR BLOWER (TWIN LOBE) 3" TO 5" SERIES



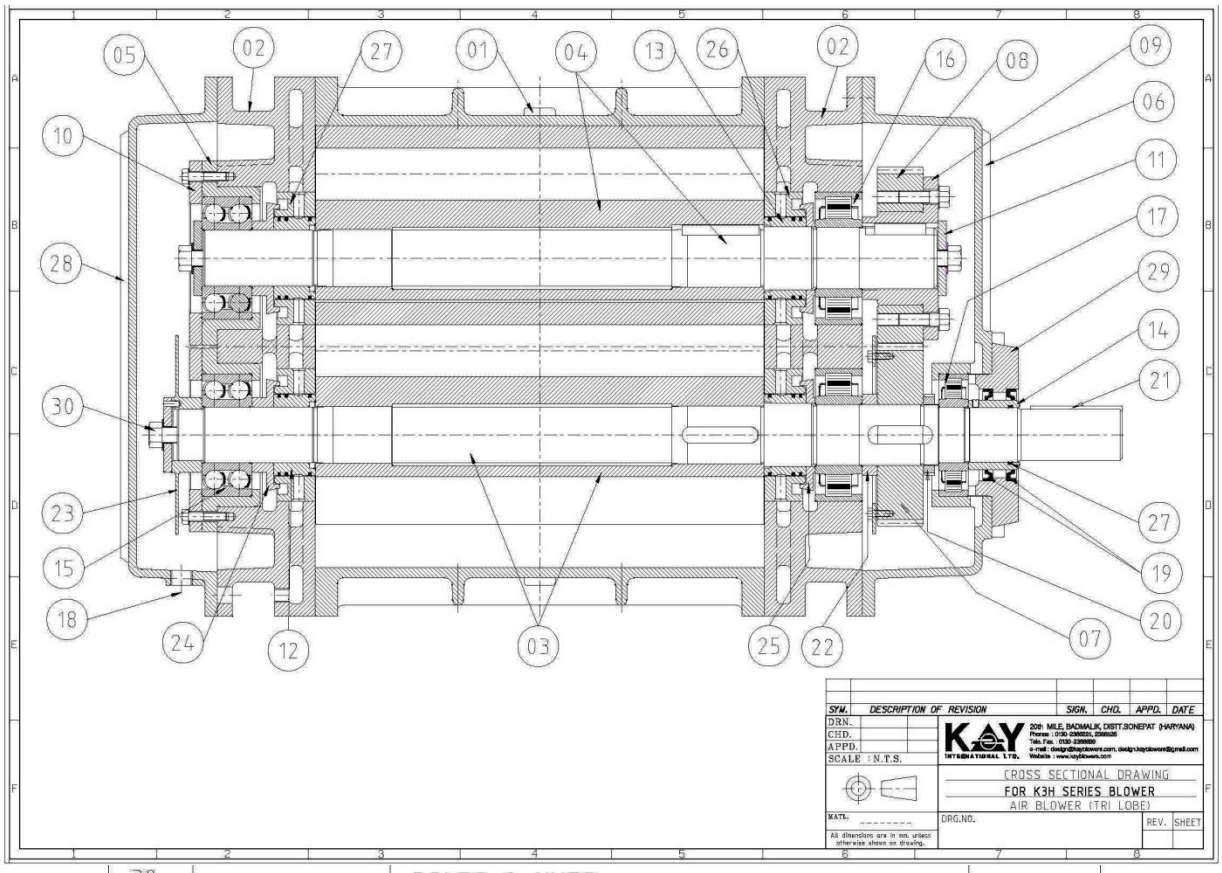
S.NO.	QTY. IN NOS.	DESCRIPTION	REMARKS
01	01	CASING	
02	01	GEAR SIDE PLATE	
03	01	PULLEY SIDE PLATE	
04	01	DRIVE SHAFT	
05	01	DRIVEN SHAFT	
06	04	BEARING HOUSING	
07	02	IMPELLER	
08	01	GEAR COVER	
09	01	BEARING COVER DRIVE SHAFT	
10	01	BEARING COVER DRIVEN SHAFT	
11	02	SPUR GEAR (TAPER BORE)	
12	02	THRUST PLATE	
13	08	DEEP GROOVE BALL BEARING	
14	05	LIP OIL SEAL	
15	01	KEY FOR PULLEY	
16	01	OIL LEVEL INDICATOR	
--	03	DRAIN PLUG	
--	02	GREASE NIPPLE	
--	01	BREATHER PLUG	

8.2 AIR BLOWER (TWIN LOBE) 6" TO 14" SERIES



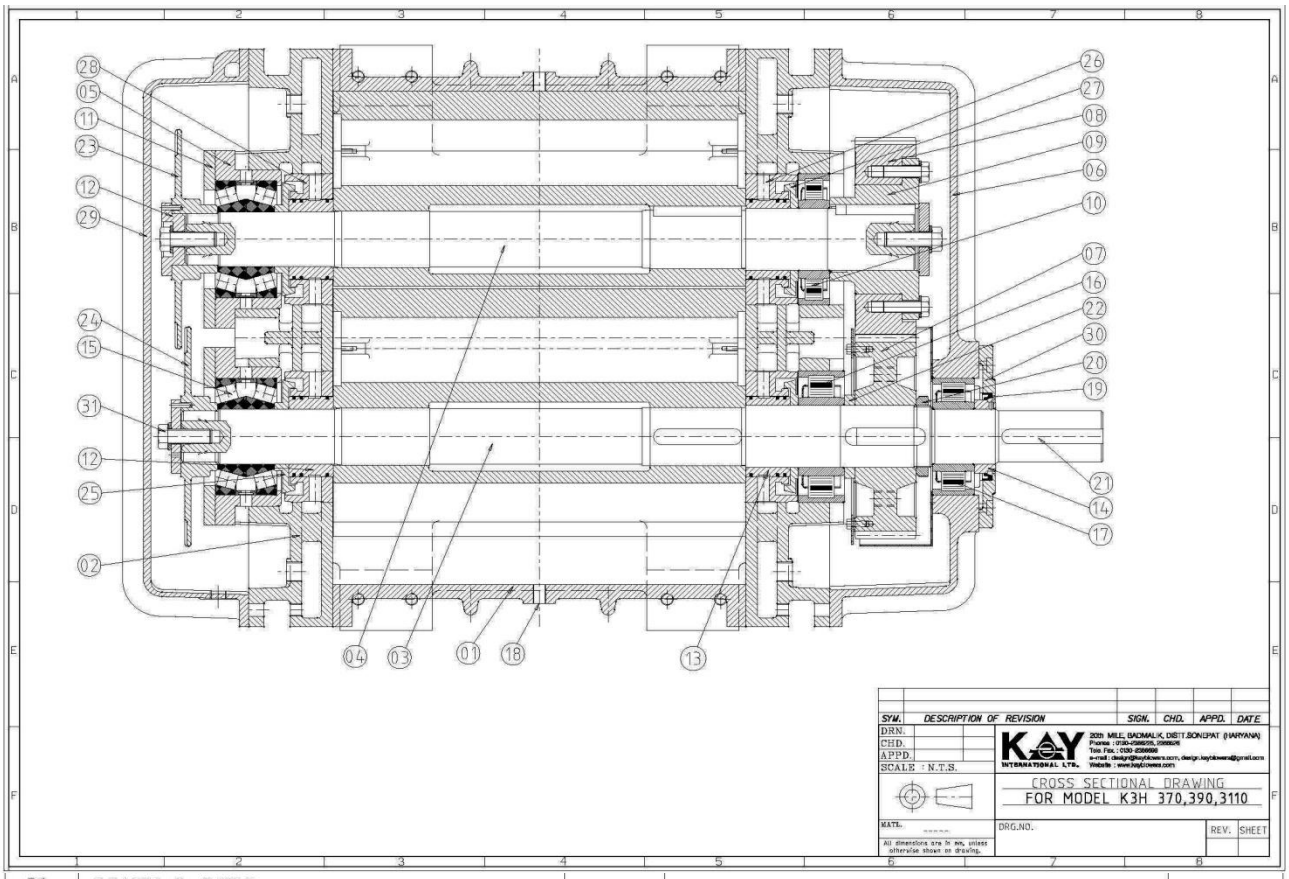
SR.NO.	QTY. IN NOS.	DESCRIPTION	REMARKS
29	02	GREASE NIPPLE AT BEARING COVER	
28	16	PISTON RING	
27	02	BEARING PULLER DISC AT GEAR SIDE	
26	02	DRAIN PLUG AT BEARING COVER	
25	04	OIL SECURING DISC	
24	02	BEARING ON NON-DRIVE SIDE	
23	04	SPACER	
22	01	OIL LEVEL INDICATOR	
21	01	KEY FOR PULLEY	
20	02	EXTERNAL CIRCLIP	
19	02	CHECK NUT AT DRIVE & DRIVEN SHAFT	
18	05	OIL SEAL	
17	01	DRAIN PLUG AT GEAR COVER	
16	01	BREATHER PLUG	
15	02	BEARING ON DRIVE SIDE	
14	04	PISTON RING BUSH	
13	02	THRUST PLATE	
12	02	HELICAL GEAR (TAPER BORE TYPE)	
11	01	BEARING COVER AT DRIVEN SHAFT	
10	01	BEARING COVER AT DRIVE SHAFT	
09	01	GEAR COVER	
08	02	BEARING HOUSING (P.S.)	
07	02	BEARING HOUSING (G.S.)	
06	02	IMPELLER	
05	01	DRIVEN SHAFT (T.B. TYPE)	
04	01	DRIVE SHAFT (T.B. TYPE)	
03	01	GEAR SIDE PLATE	
02	01	PULLEY SIDE PLATE	
01	01	CASING	

8.3 AIR BLOWER (TRI LOBE) K3H SERIES (303, 306, 309, 322, 342)



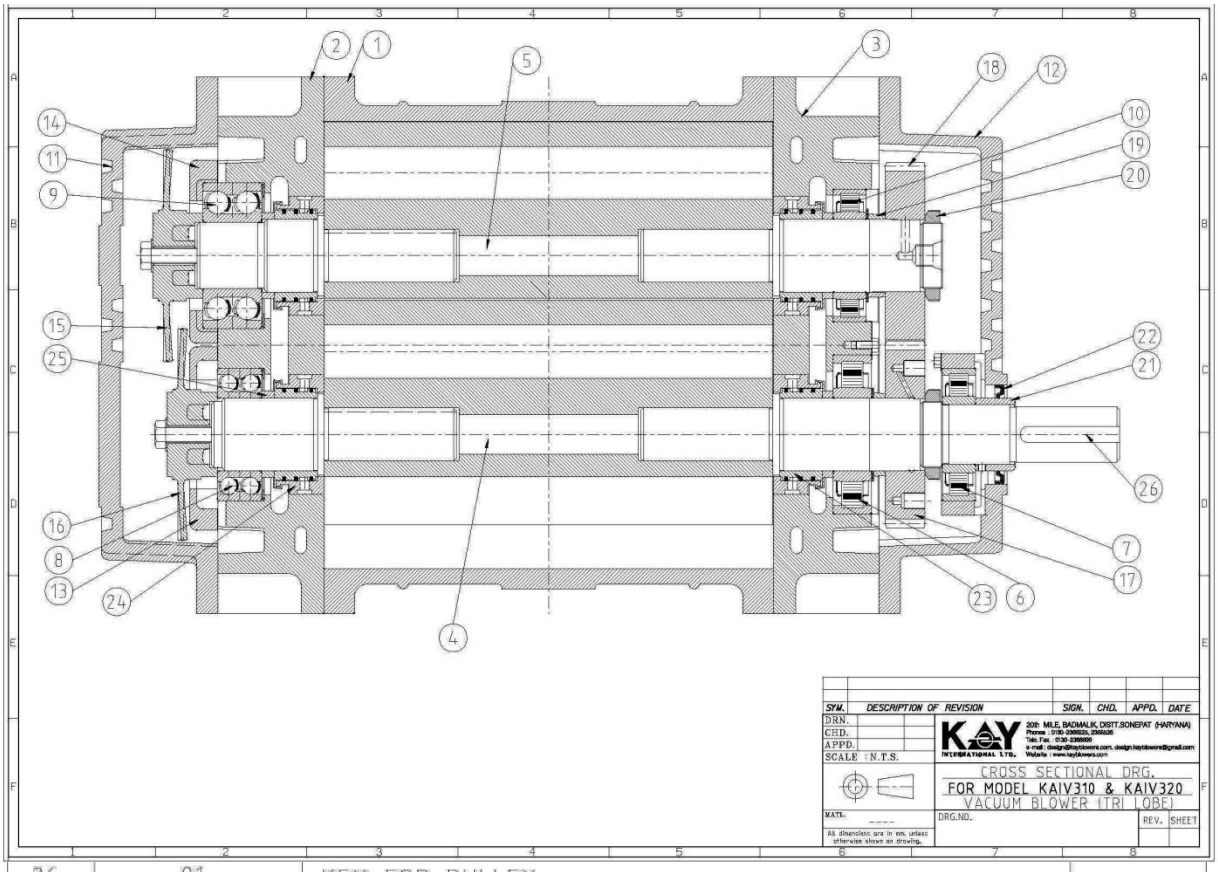
S. NO.	QTY. IN NOS.	DESCRIPTION	REMARKS
30.	--	BOLTS & NUTS	
29.	01	OIL SEAL HOUSING	
28.	01	OIL COVER FOR NON DRIVE END	
27.	02	SIDE PLATE BUSH AT NON DRIVE END	
26.	02	SIDE PLATE BUSH AT DRIVE END	
25.	02	OIL PREVENTING DISC AT DRIVE END	
24.	02	OIL PREVENTING DISC AT NON DRIVE END	
23.	01	OIL FLINGER FOR DRIVE SHAFT	
22.	01	SPACER INFRONT OF DRIVER GEAR	
21.	01	KEY FOR PULLEY	
20.	01	CHUCK NUT	
19.	02	OIL SEAL	
18.	14	DRAIN PLUG	
17.	01	CYLINDRICAL ROLLER BEARING	SKF
16.	02	CYLINDRICAL ROLLER BEARING	SKF
15.	02	DOUBLE ROW ANGULAR CONTACT BALL BEARING	SKF
14.	01	OIL SEAL BUSH	
13.	02 SETS	PISTON RING BUSH WITH PISTON RING AT DRIVE END	
12.	02 SETS	PISTON RING BUSH WITH PISTON RING AT NON DRIVE END	
11.	03	THRUST PLATES	
10.	02	BEARING COVER AT NON DRIVE END	
09.	01	HUB FOR DRIVEN GEAR	
08.	01	HELICAL GEAR FOR DRIVEN SHAFT	
07.	01	HELICAL GEAR FOR DRIVE SHAFT	
06.	01	OIL COVER FOR DRIVE END	
05.	02	BEARING HOUSING AT NON DRIVE END	
04.	01	DRIVEN SHAFT FITTED WITH LOBE	
03.	01	DRIVE SHAFT FITTED WITH LOBE	
02.	02	SIDE PLATES	
01.	01	CASING	

8.4 AIR BLOWER (TRI LOBE) K3H SERIES (370, 390, 3110)



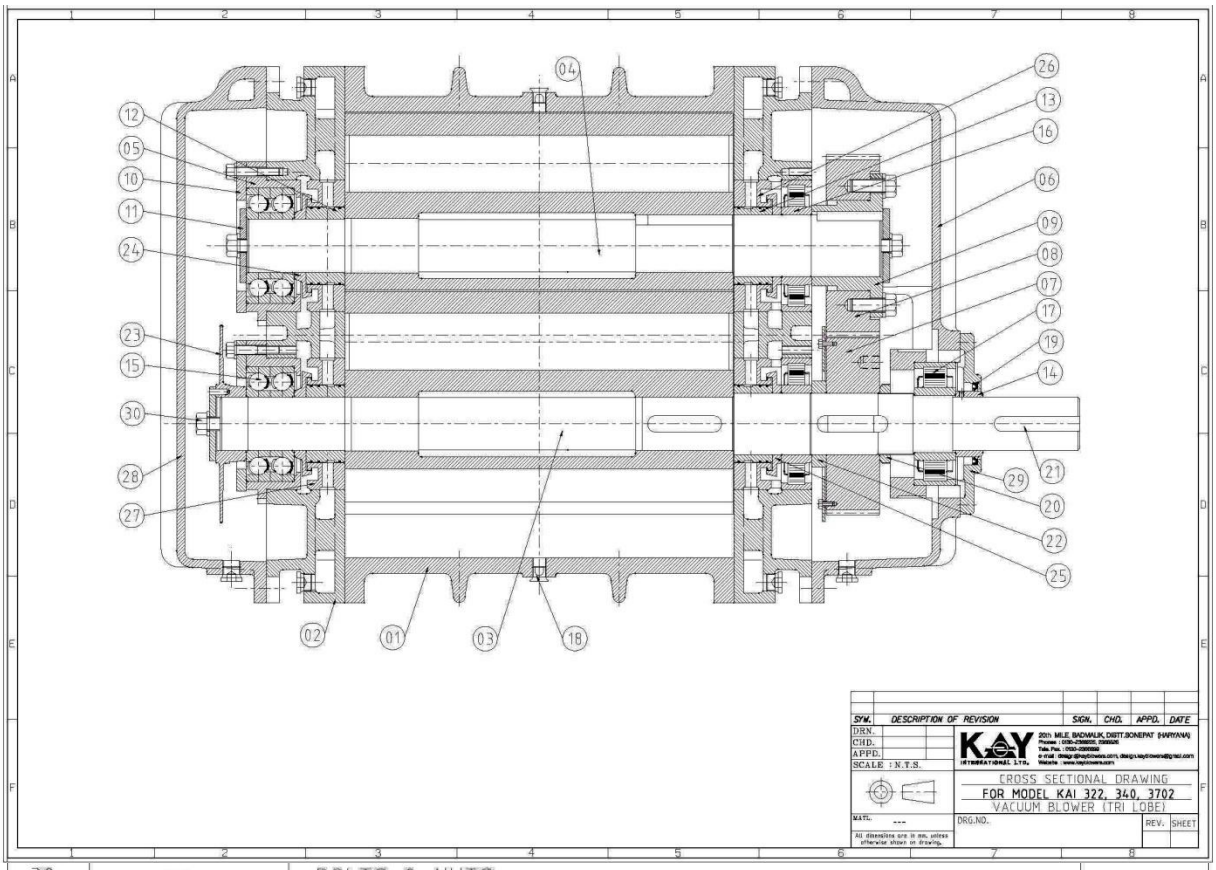
S. NO.	DESCRIPTION	QTY.	MATERIAL/REF.	REMARKS
31.	BOLTS & NUTS	--	--	
30.	OIL SEAL HOUSING	01	C.I., IS: 210	
29.	OIL COVER FOR NON DRIVE END	01	C.I., IS: 210	
28.	SIDE PLATE BUSH AT NON DRIVE END	02	C.I., IS: 210	
27.	OIL PREVENTING DISC AT DRIVE END	02	M.S., IS: 2062	
26.	SIDE PLATE BUSH AT DRIVE END	02	C.I., IS: 210	
25.	OIL PREVENTING DISC AT NON DRIVE END	02	M.S., IS: 2062	
24.	OIL FLINGER FOR DRIVE SHAFT	01	AL. ALLOY	
23.	OIL FLINGER FOR DRIVEN SHAFT	01	AL. ALLOY	
22.	SPACER INFRONT OF DRIVER GEAR	01	M.S., IS: 2062	
21.	KEY FOR PULLEY	01	EN-24, BS: 970/817 M40	
20.	CHUCK NUT	01	M.S., IS: 6731	
19.	OIL SEAL	01	IS: 5129	
18.	DRAIN PLUG	06	M.S., IS: 2062	
17.	CYLINDRICAL ROLLER BEARING AT DRIVE SHAFT END	01	STD.	SKF
16.	CYLINDRICAL ROLLER BEARING AT DRIVE SHAFT AT DRIVE END	01	STD.	SKF
15.	TAPER ROLLER BEARING	04	STD.	SKF
14.	OIL SEAL BUSH	01	STD.	
13.	PISTON RING BUSH WITH PISTON RING	04 SETS	STD.	
12.	THRUST PLATES	03	M.S., IS: 2062	
11.	BEARING COVER AT NON DRIVE END	02	STD.	
10.	CYLINDRICAL ROLLER BEARING AT DRIVEN SHAT AT DRIVE END	01	STD.	SKF
09.	HUB FOR DRIVEN GEAR	01	STD.	
08.	HELICAL GEAR FOR DRIVEN SHAFT	01	EN-353, BS: 970/815 M17	
07.	HELICAL GEAR FOR DRIVE SHAFT	01	EN-353, BS: 970/815 M17	
06.	OIL COVER FOR DRIVE END	01	C.I., IS: 210	
05.	BEARING HOUSING AT NON DRIVE END	02	STD.	
04.	DRIVEN SHAFT FITTED WITH LOBE	01	C.I. FG.-260, IS:210; EN-24, BS: 970/817 M40	
03.	DRIVE SHAFT FITTED WITH LOBE	01	C.I. FG.-260, IS:210; EN-24, BS: 970/817 M40	
02.	SIDE PLATES	02	C.I. FG.-260, IS:210	
01.	CASING	01	C.I. FG.-260, IS:210	

8.5 VACUUM BLOWER (TRI LOBE) KAIV SERIES (MODEL KAIV 310 & 320)



S. NO.	QTY. IN NOS.	DESCRIPTION	REMARKS
26.	01	KEY FOR PULLEY	
25.	04	OIL PREVENTING DISC	
24.	04	SIDE PLATE BUSH	
23.	04 SET	PISTON RING BUSH WITH PISTON RING	
22.	01	OIL SEAL	
21.	01	OIL SEAL BUSH	
20.	02	CHUCK NUT	
19.	02	SPACER	
18.	01	SPUR GEAR AT DRIVEN SHAFT	
17.	01	SPUR GEAR AT DRIVE SHAFT	
16.	01	OIL FLINGER FOR DRIVE SHAFT	
15.	01	OIL FLINGER FOR DRIVEN SHAFT	
14.	01	BEARING COVER AT NON DRIVE SHAFT	
13.	01	BEARING COVER AT DRIVE SHAFT	
12.	01	OIL COVER AT DRIVE END	
11.	01	OIL COVER AT NON DRIVE END	
10.	01	ROLLER BEARING AT DRIVEN SHAFT FOR DRIVE END	
09.	01	BALL BEARING AT DRIVEN SHAFT FOR NON DRIVE END	
08.	01	BALL BEARING AT DRIVE SHAFT FOR NON DRIVE END	
07.	01	ROLLER BEARING FOR DRIVE END OIL COVER	
06.	01	ROLLER BEARING AT DRIVE SHAFT FOR DRIVE END	
05.	01	DRIVEN SHAFT FITTED WITH LOBE	
04.	01	DRIVE SHAFT FITTED WITH LOBE	
03.	01	DRIVE END SIDE PLATE	
02.	01	NON DRIVE END SIDE PLATE	
01.	01	CASING	

8.6 VACUUM BLOWER (TRI LOBE) KAIV SERIES (MODEL KAIV 322, 340 & 3702)



S. NO.	QTY. IN NOS.	DESCRIPTION	REMARKS
30.	---	BOLTS & NUTS	
29.	01	OIL SEAL HOUSING	
28.	01	OIL COVER FOR NON DRIVE END	
27.	02	SIDE PLATE BUSH AT NON DRIVE END	
26.	02	SIDE PLATE BUSH AT DRIVE END	
25.	02	OIL PREVENTING DISC AT DRIVE END	
24.	02	OIL PREVENTING DISC AT NON DRIVE END	
23.	01	OIL FLINGER FOR DRIVE SHAFT	
22.	01	SPACER INFRONT OF DRIVER GEAR	
21.	01	KEY FOR PULLEY	
20.	01	CHUCK NUT	
19.	01	OIL SEAL	
18.	14	DRAIN PLUG	
17.	01	CYLINDRICAL ROLLER BEARING	
16.	02	CYLINDRICAL ROLLER BEARING	
15.	02	DOUBLE ROW ANGULAR CONTACT BALL BEARING	
14.	01	OIL SEAL BUSH	
13.	02 SETS	PISTON RING BUSH WITH PISTON RING AT DRIVE END	
12.	02 SETS	PISTON RING BUSH WITH PISTON RING AT NON DRIVE END	
11.	03	THRUST PLATES	
10.	02	BEARING COVER AT NON DRIVE END	
09.	01	HUB FOR DRIVEN GEAR	
08.	01	HELICAL GEAR FOR DRIVEN SHAFT	
07.	01	HELICAL GEAR FOR DRIVE SHAFT	
06.	01	OIL COVER FOR DRIVE END	
05.	02	BEARING HOUSING AT NON DRIVE END	
04.	01	DRIVEN SHAFT FITTED WITH LOBE	
03.	01	DRIVE SHAFT FITTED WITH LOBE	
02.	02	SIDE PLATES	
01.	01	CASING	