Kinney Vacuum Division

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KVAC-5
KVAC-10
KVAC-15
KVAC-21

Rotary Vane Pumps

Instruction Manual

Revision 1
July-1998

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Warranty

Products manufactured by Seller are under warranty against defects in materials and workmanship for twelve (12) months from date of shipment there of to Customer, and Seller's liability under valid warranty claims is limited, at the option of Seller, to repair, replacement, or refund of an equitable portion of the purchase price of the Product. Items expendable in normal use are not covered by this warranty. All warranty replacement or repair of parts shall be limited to equipment malfunctions which, in the sole opinion of Seller, are due or traceable to defects in original materials or workmanship. All obligations of Seller under this warranty shall cease in the event of abuse, accident, alteration, misuse, or neglect of the equipment. In warranty repaired or replacement parts are warranted only for the remaining unexpired portion of the original warranty period applicable to the repaired or replaced parts. After expiration of the applicable warranty period, Customer shall be charged at the then current prices for parts, labor, and transportation.

Reasonable care must be used to avoid hazards. Seller expressly disclaims responsibility for loss or damage caused by the use of its Products other than in accordance with proper operating procedures.

When products are used with toxic chemicals, or in an atmosphere that is dangerous to the health of humans, or is environmentally unsafe, it will be the responsibility of the Customer to have the product cleaned by an independent agency skilled and approved in handling and cleaning contaminated materials before the product will be accepted by Kinney Vacuum Division for repair and/or replacement.

Except as stated herein, Seller makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except as stated herein, Seller shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise. Statements made by any person, including representatives of Seller, which are inconsistent or in conflict with the terms of this warranty shall not be binding upon Seller unless reduced to writing and approved by an officer of Seller.

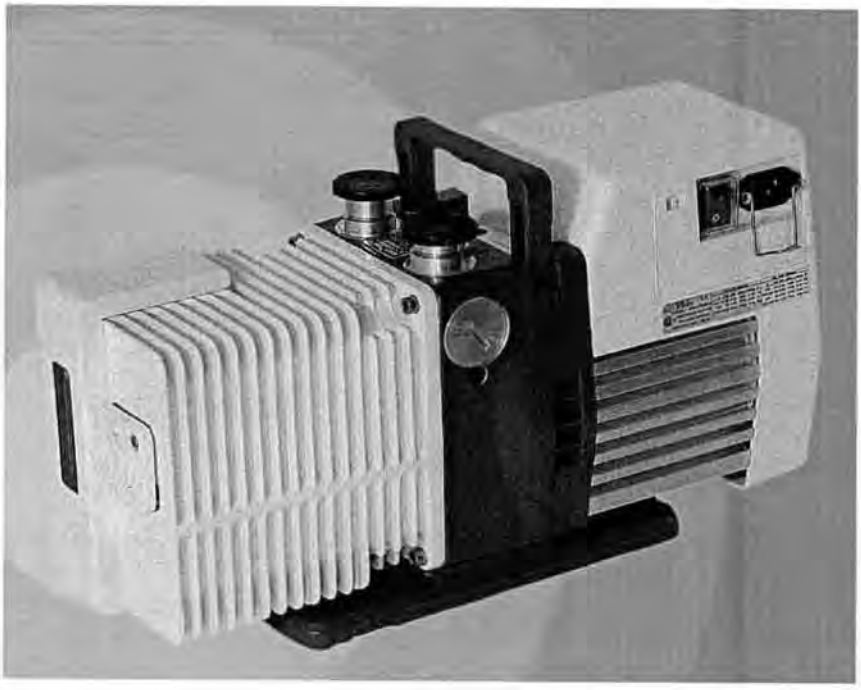
Warranty Replacement and Adjustment

All claims under warranty must be made promptly after occurrence of circumstances giving rise thereto, and must be received within the applicable warranty period by Seller or its authorized representative. Such claims should include the Product serial number, the date of shipment, and a full description of the circumstances giving rise to the claim. Before any Products are returned for repair and/or adjustment, written authorization from Seller or its authorized representative for the return and instructions as to how and where these Products should be returned must be obtained. Any Product returned to Seller for examination shall be prepaid via the means of transportation indicated as acceptable by Seller. Seller reserves the right to reject any warranty claim not promptly reported and any warranty claim on any item that has been altered or has been returned by non-acceptable means of transportation. When any Product is returned for examination and inspection, or for any other reason, Customer shall be responsible for all damage resulting from improper packing or handling, and for loss in transit, notwithstanding any defect or non-conformity in the Product, in all cases, Seller has the sole responsibility for determining the cause and nature of failure, and Seller's determination with regard thereto shall be final.

If it is found that Seller's Product has been returned without cause and is still serviceable, Customer will be notified and the Product returned at its expense; in addition, a charge for testing and examination may be made on Products so returned.

Welcome

KVAC Series pumps



When you purchase a Kinney KVAC series rotary vane pump, you purchase the extensive knowledge of the people who make up Kinney Vacuum.
These are the same people who provide you with the technical support on your most complex and demanding applications.

APPLICATIONS:

• RESEARCH AND DEVELOPMENT
Physics and chemistry laboratories, etc.

• INDUSTRY
Foods (freeze-drying), Pharmaceuticals,
Electronic tube manufacture,
Metallurgy, Drying systems,
Refrigeration systems, Chemical industry, etc.

• INSTRUMENTATION
Mass SPECTROMETRY, Centrifuges,
Electronic microscopes, Leak detection systems, etc.

We suggest that you read this manual, particularly the chapter on installation and start-up, before you start to use this pump so that you can obtain optimum levels of performance and complete satisfaction from this equipment.

Features

KVAC-5, KVAC-10, KVAC-15, KVAC-21

Series 5 through 21 pump models with the following main characteristics:

- A **direct drive motor** makes them very compact.

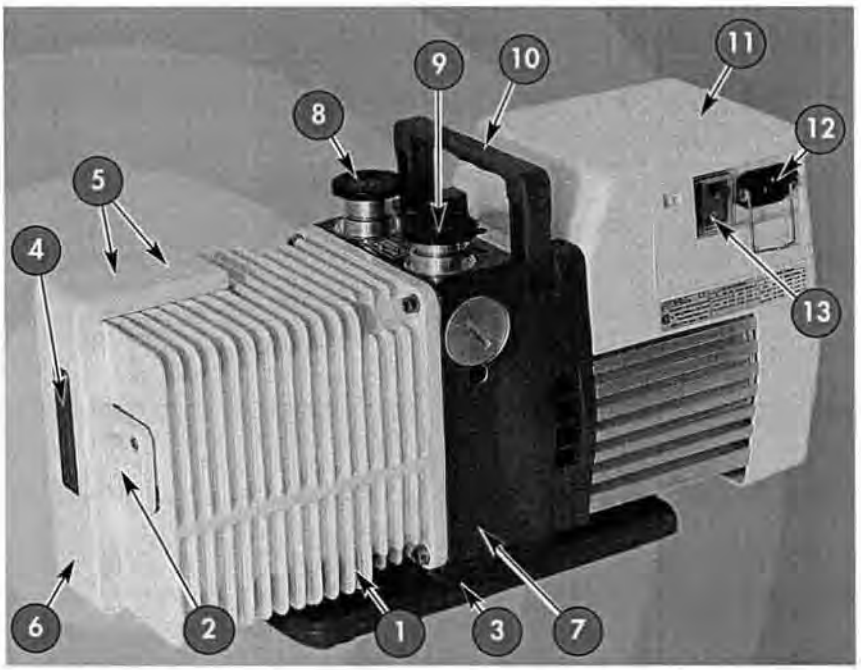
- An electrically insulated **fold-away handle** is used for easy carrying.

- An **anti-suckback system** ensures the tightness of the pump during accidental or voluntary shutdowns.

- A **gas ballast** enables the pumping of condensable vapors.

- The universal three-phase or single-phase **motor** can be disassembled **independently** of the rest of the pump, without needing to drain the oil case.

- On the oil case, a **vertical sight glass** can be used to inspect the oil level easily when filling the tank and during the operation of the pump.



1. Oil case
2. Gas ballast control
3. Base
4. Oil level sight glass
5. Filling plugs
6. Draining plug
7. Frame
8. Inlet end fitting
9. Exhaust end fitting
10. Fold-away handle
11. Electric motor
12. IEC electric socket
13. ON/OFF switch

The inlet and exhaust end fittings are PNEUROP ISO-KF standardized. They are fitted vertically on the pump at delivery but can be positioned on the horizontal openings if required by operating conditions. They can also be used to connect many of our accessories.

The main replacement parts are interchangeable: This enables easier disassembly-assembly operations and replacement without changing the pump's performance.

Various accessories can be used to adapt the pump to meet the requirements of your application.

The molded aluminum pump frame supports the pumping module and the motor. All the parts of the pumping module in contact with gases are free of zinc, copper and cadmium.
The other construction materials include cast iron, aluminum alloy, stainless steel, fluorocarbons (FPM), nitril (NBR) and chemically resistant polymers.

Safety instructions

Safety instructions concerning the installation and operation of pumping systems

⚠ **Before switching on the equipment, the user must read the manual and observe the safety instructions listed in the booklet of declarations of compliance supplied with the unit.**

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Unpacking

When you receive the equipment, unpack it carefully. Do not discard the packaging until you have ensured that the pump has not been damaged during transport. Otherwise, take the necessary measures with the transporting company and, if necessary, notify KINNEY.

For all handling, only use the devices provided for this purpose (lifting rings, handle, etc.).

The pump is not supplied filled with oil. The oil is contained in separate bottles. Similarly, it is recommended to drain the pump before redispatching the equipment.

Storage

• If the pump is to be stored, we guarantee the reliability of our equipment without particular storage precautions for up to 3 months (ambient temperature between 41°F and 149°F or 5°C and 65°C).

• For storage periods of over 3 months, we recommend to fill the pump with oil during storage. For this, fill the pump and run it at ultimate vacuum (inlet orifice blocked) for approximately 1 hour in order to lubricate all the parts of the functional block (see page 23).
Then, stop the pump and store it with the inlet and exhaust orifices sealed: clamping ring, centering ring, plug, etc.
The shaft should be rotated by hand or by starting the pump every six months following this storage procedure.

• After 6 months storage without oil, factors such as temperature, degree of humidity, salt air, etc. may cause the deterioration of the pump components, particularly the hardening of O-rings and the "sticking" of lip seals on shafts and the gumming of oil. In this state, a pump may have operational problems, particularly oil leaks. Before any start-up (new pump as well as used), the pump must be disassembled (***see page 36***), and all the seals changed.

Note 1:
The seal kits must be stored with caution. Keep them away from heat and light (sunlight and ultraviolet light) in order to prevent the elastomers from hardening.

Installation and start-up

- The machines must be connected to an electrical installation in compliance with any local electrical codes that apply.

- It is important to isolate the machine from the power source before any intervention on the equipment (for maintenance purposes).

- When switching off the power of equipment containing capacitors loaded with over 60 VDC or 25 VAC, take precautions when accessing the connector pins (single-phase motors, equipment with mains filter, frequency converter, monitor, etc.).

- Rotary vane pumps use lubricants, it is recommended to request information from the manufacturer on the safety data sheets concerning the product used.

- Our pumps are designed to prevent any thermal risk for user safety. However, specific operating conditions may generate temperatures which may justify particular attention on the part of the user (outer surfaces > 158°F or 70°C).

Purges for pumping condensable, corrosive, and hazardous gases

Purges

The use of vane pumps may result in pumping gases or vapors which are flammable or that could contaminate the oil. In this case, these products must be diluted using purges supplied with dry gases, such as nitrogen to avoid undesirable reactions.
For this purpose, a filtered dry nitrogen supply or other inert gas with the same characteristics is required:
- condensation point < 72°F (22°C),
- dust < 1µm,
- minimum relative pressure 1 bar.

Oil case purges

The purge dilutes pumped gases with a neutral gas:
it makes it possible to limit corrosion in the oil case, condensation and accumulation of gases in dead spaces of the pump.

Connect the nitrogen supply to one of the unused filling plugs on the oil case (BSPP 1/8 Gas connection).
Set the nitrogen pressure to approximately 1.2 PSIG (0.1 relative bar) (flow 50 to 300 SCCM) and the flow rate so as to satisfy the dilution conditions.
Caution: do not generate an excess pressure > 14 PSIG (1 relative bar).

Use of purge with gas ballast

A neutral gas supply can also be connected via the gas ballast (BSPP 1/8 Gas connection).

Oxygen pumping

In certain applications, mixtures containing oxygen at different concentrations, or even pure oxygen, are used.

Oils of mineral origin are combustible. Exposure to pure oxygen at high temperatures may cause them to self-ignite. In addition, they are highly oxidized during pumping and quickly lose their lubricating properties. Mineral oils must not be used for oxygen levels of over 21 % in pumped gases. In this case, perfluorinated synthetic oils must be used, see list on ***page 18.***

The pump must be completely disassembled and all traces oil mineral oil removed. Flushing the oil case is not adequate.

In addition, it is strongly recommended not to use fluids such as tri-aryl-phosphate-ester which are know to cause accidents.

Any accumulation of oxygen in the installation should be avoided and the oxygen or combustible mixture should be diluted with a neutral gas at the exhaust: the gas flow rate should be 4 times the oxygen flow rate.

Certain combustible or explosive gases require a higher degree of dilution. Our Customer Services can advise you to help you solve problems of this kind.

Operating principle

Oil

Its function

Oil has several important functions in the pump:
- It lubricates mechanical components (bearings, seals, rotor, vanes, etc.).
- It makes moving parts relatively tight by limiting internal leakage.
- It carries away the heat produced by the compressed gases.

Choosing the right oil

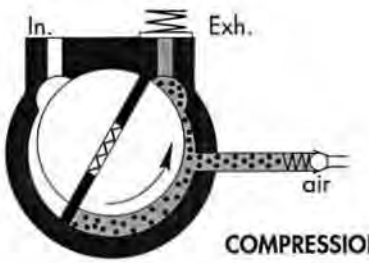
Not all oils produce the same ultimate pressure in a given pump.
Ultimate pressure depends on the saturated vapor pressure of the oil, its viscosity and its ability to dissolve gases.
Good pumping conditions are related to the type of oil used.
The choice depends on:
- Expected pump performance.
- Chemical aggression and corrosion of pumped gases.
- Accessories used.
- Desired maintenance intervals and total operating cost.

Lubrication and anti-noise device

The pump is equipped with a **lubrication** system which provides the oil flow rate required in the vacuum pump. In addition this system also ensures the gassing of the lubrication oil and therefore **the low noise level** of the pump.

Gas ballast

When condensable vapors are being pumped, gas is compressed beyond its saturated vapor pressure in the "compression" phase and can condense, impairing pump performance.



COMPRESSION

The gas ballast can be used to inject a certain quantity of air (neutral or dry gas) into the last stage of the pump during the "compression" phase so that the partial pressure of the pumped gas is less than its saturated vapor pressure at the temperature of the pump.
Condensation is therefore impossible if this limit is not reached.
The maximum admissible vapor pressure is obtained at pump inlet for this value.

At the end of "compression", the pressure in the exhaust chamber is greater than atmospheric pressure. An anti-suckback device (valve + spring) prevents the gases and oil from being discharged to the outside via the inlet.

The saturated vapor pressure of a body is higher when the system is hot than when it is cold; therefore, the pump must reach operating temperature before pumping condensable vapors.

- Using the gas ballast increases the ultimate pressure of the pump as well as the temperature.
- The gas ballast control, located at the front of the oil case cannot be used to set the gas injection flow rate.
- When the gas ballast control is open, the pump is not tight when stopped. To guarantee this tightness, install an automatic gas ballast.

Operating principle of the rotary vane pump

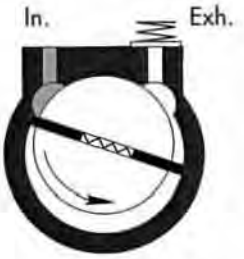
Rotary vane pump principle

This is a volumetric pump, with a functional part composed of:

- A hollow cylindrical stator with inlet and exhaust valves.
- A rotor mounted eccentrically inside the stator for pumping.
- Two vanes sliding in the rotor, forced against the stator by centrifugal force and springs.

The pumping cycle is given below for each stage:

Inlet



As the vane passes in front of the inlet orifice, an increasing space is formed into which the gas from the chamber to be evacuated expands. When the second vane passes, the space is closed.

Transfer

The gas trapped in the space between the two vanes is transferred to the exhaust orifice as the rotor rotates.

Compression

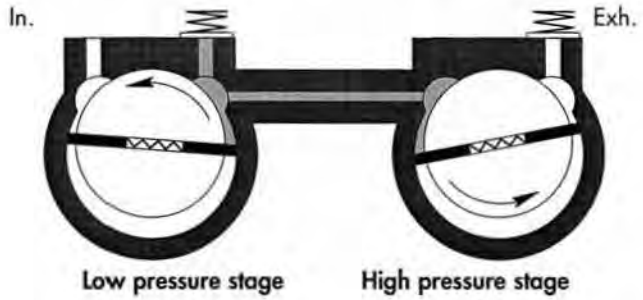
The space communicates with the exhaust, which is fitted with a valve: the gas is compressed until the safety valve is opened.

Exhaust

The gas is expelled into the oil casing when the pressure is sufficient to open the valve.

Two-stage rotary vane pump

To improve the backing pressure and flow rate at low pressure, two stages are connected in series. The second is similar to the first both structurally and operationally. The gases pulled in by the first (low pressure) stage are transferred to the second (high pressure) stage and discharged through the high pressure (HP) valve.



Application

Two stage rotary vane pumps are the best choice for application requiring an ultimate vacuum as low as 10^{-3} Torr (1.33×10^{-3} mbar).
Note : when operating a two stage vane pump continuously, greater than half an hour, above 1.0 Torr, the unit should be equipped with an oil mist eliminator and oil return system (Contact KINNEY).

Note: Two stage Rotary Vane Pumps are recommended for continuous operation below 10 Torr (10 mbar) only.

Regeneration of pump oil

In a pump stored with the same oil for a long time, condensed vapors may contaminate the oil bath and affect performance. This is also the case after pumping vapors and when the oil appears cloudy or discolored through the sight glass.

- Run the pump, shutting it off from the system at the inlet by a valve or a plug.
- Open the gas ballast and allow the pump to operate for 1/2 hour to 1 hour, or longer if the oil remains cloudy. This operation accelerates the temperature rise of the pump while eliminating residual vapors present in the oil bath.

Pumping condensable vapors

To pump with condensable products, it is necessary to operate with a hot pump. For this, shut off the pump from the system and allow it to operate for 1/2 hour with the gas ballast open or 1 hour (if possible) with the gas ballast closed. When the oil bath is hot, the condensation of vapors in the pump is reduced or prevented.

Choice of pump and system

The pump's capacity to eliminate condensable vapors is related to their type, the pump temperature and the quantity of air introduced by the gas ballast. Thus, for high vapor levels in a system, the single-stage pump is more suitable. However, when not pumping vapors, its ultimate pressure is higher.
Care should be taken to limit the inlet pressure of the pump to its maximum admissible pressure with the pumped product. This is obtained by reading the pump characteristic table for water vapor.
The use of cold traps or condensers are recommended when large quantities of vapors are to be extracted. Excessively intense or prolonged pumping may cause the products fixed on the trap to be evaporated a second time.

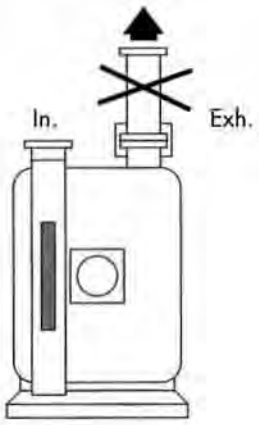
Choice of oil

Choose an oil which facilitates the separation of pumped products which may be condensed in the oil bath (anti-emulsion oil for water-based compounds, etc.) (***see page 18***). Kinney recommends Kinney Super X oil.

Assembly

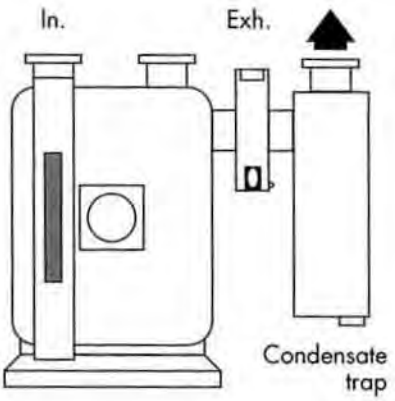
The condensation of vapors at the pump exhaust is reduced if:
- the pump and oil temperature are high;
- the pressure at the exhaust is as low as possible (removal of the oil mist eliminator...);
- the condensates are collected separately from the oil bath and do not block the exhaust duct.

For this:
- avoid using any vertical ducting promoting the condensation of products and the return of these products to the pump.
- use a condensate collector;



Assembly (continued)

- we do not recommend an oil mist eliminator when pumping condensable vapors: if it is essential, do not connect it directly to the pump exhaust but place it outside the condensation zone.
- remove the stop valve from the pump exhaust;
- if possible, connect the exhaust to a mechanical device creating a negative pressure from 0.75 to 1.5 Torr.



Vapor pumping procedure

- Valve off the pump from the system and increase the pump temperature, 30 minutes with gas ballast (***see page 23***).
- Start pumping and check the oil level:
  - the level drops, oil is being lost;
  - the level rises, condensates have been added to the oil.
- After pumping, regenerate the oil using gas ballast if it is cloudy or discolored.
  - if the level is too high, change the oil and regenerate.
- Change the oil as soon as inlet pressure characteristics drop and are not improved by regeneration.

Presentation of the product range

A wide range

Specific solutions adapted to various applications

Kinney oil seal rotary vane pumps are used in all vacuum technology applications.

They can be used on their own to achieve a maximum vacuum of 10^{-3} Torr (10^{-3} mbar), or in pumping assemblies, e.g. at the exhaust of a diffusion pump or turbomolecular pump.

KVAC series

Standard pumps for several purposes (non-corrosive applications).
Manufacture of light bulbs, production of TV tubes, manufacture of electronic tubes, metallurgy, centrifuges, R&D, laboratories, etc.

Two-stage pumps

Characteristics	Unit	KVAC-5		KVAC-10		KVAC-15		KVAC-21	
Frequency	Hz	50	60	50	60	50	60	50	60
Number of stages		2		2		2		2	
Rotation speed	rpm	1500	1800	1500	1800	1500	1800	1500	1800
Nominal flow rate	m3/h	**5.4**	**6.5**	**9.7**	**11.6**	**15**	**18**	**20.7**	**24.8**
	cfm		3.8		6.8		10.6		14.6
Flow rate Pneurop method	m3/h	**4.8**	**5.7**	**8.5**	**10.2**	**12.5**	**15**	**16.5**	**20**
	cfm		3.4		6		8.8		11.8
Partial ultimate pressure* with Kinney Super X type oil	Torr/mbar /Pa	**$7.5.10^{-5}$ / 1.10^{-4}** 1.10^{-2}							
Ultimate pressure with gas ballast closed	Torr/mbar /Pa	**$1.5.10^{-3}$ / 2.10^{-3}** 2.10^{-1}							
Ultimate pressure with gas ballast open	Torr/mbar /Pa	**$1.5.10^{-2}$ / 2.10^{-2}** 2							
Oil capacity	l	0.83		0.950		0.950		0.98	
Weight (pump + motor)**	kg (lbs)	25 (55)		26 (57)		27 (59.5)		28 (62)	
Maximum water vapor pumping capacity (Ballast flow rate 1.1 m^3/h)	mbar	**35**	**25**	**20**	**15**	**12**	**10**	**7**	**7**
	Pa	35.10^2	25.10^2	2.10^3	15.10^2	12.10^2	1.10^3	7.10^2	7.10^2
Water vapor pumping capacity	g/h	120	110	125	100	110	100	90	90
Inlet and exhaust end fittings	ISO-KF	DN 25							

* Partial ultimate pressure measured according to Pneurop 6602 specifications. It may vary if other oils are used ***(See page 18).***
** These values are for pumps equipped with universal single-phase motors.

Note: The pressure measurements were made with a capacitive diaphragm pressure gauge measuring a total pressure in the absence of a cold trap. Measurements using a Pirani type gauge can give different pressure values.

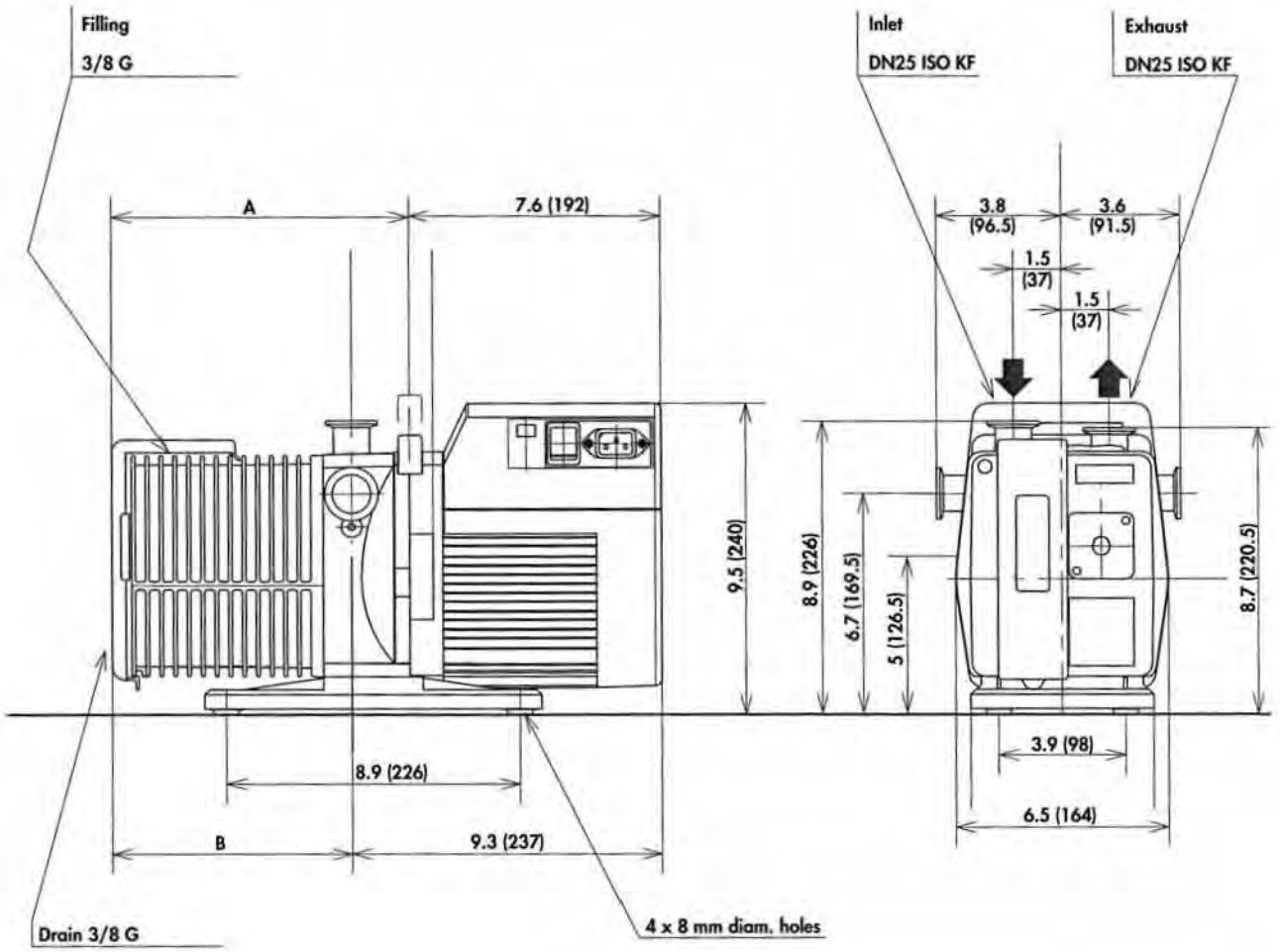
Table of recommended oils

Recommended oils In the vane pumps, we recommend to use only the KINNEY oil in the table below:

OIL	APPLICATION	Total ultimate pressure* (mbar)	Viscosity SUS @	Vapor Pressure mmHG	Flash point
KINNEY Super X	Mineral oil distilled under vacuum - Pumping non-corrosive products - Low viscosity	≤ **3.10^{-3}**	100°F/315 130°F/140 210°F/53.3	**< .001**	450°F

These values are given as a rough guide only. They may vary according to the type of pump and the pumping conditions.

Dimensions



Dim.	Pump type			
inch/(mm)	5	10	15	21
A	9 (229)	9.8 (249)	10.6 (270)	11.5 (292)
B	7 (183)	8 (204)	8.9 (225)	9.7 (246)

Filling with oil

Use **KINNEY Super X** oil.

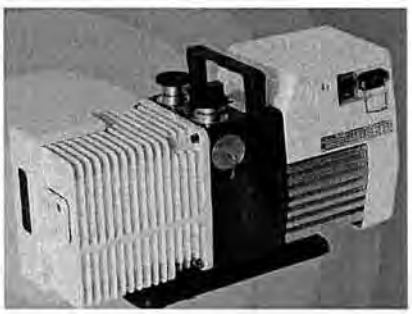
At delivery, there is some oil in the functional block.

Our pumps are tested in the factory with Kinney oil: it is recommended to use the same oil during operation.

⚠ **In all cases, follow the recommendations of the pump specifier for the choice of oil to be used.**

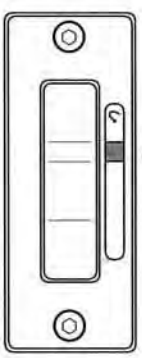
Checking the oil level

To use the pump in optimum conditions, the oil level must be observed and checked regularly. This level is checked with the pump switched off, hot and on a horizontal plane.



Note: Optimum pump performance and service life are obtained when the oil level is between the maximum level and the minimum level.

Oil level sight glass for "KVAC" series pumps



Preliminary precautions

• The performance and operating safety of this product can only be guaranteed if it is operated according to normal conditions of use.
• The vacuum pump is also a compressor: incorrect operation may be dangerous. Study the user manual before starting up the pump.
• The pumps are designed to prevent any thermal risk for user safety. However, specific operating conditions may generate temperatures which may justify particular attention on the part of the user > 70°C).
• Product tightness is guaranteed for normal operating conditions when the product leaves the factory. It is the user's responsibility to maintain the level of tightness particularly when pumping dangerous products.
• All electrical must be performed by a qualified electrician and must comply with national and local codes.

Be sure to fill the pump with oil ***(see page 21)*****.**

Operating temperature

- **At start-up**, before switching on the motor, check that the oil bath temperature is greater than 53°F (12°C).

- **The ambient operating temperature** for the pump must be between 53°F (12°C) and 113°F (45°C).

- Under these conditions, **the stabilized pump temperature** (at the front of the oil case) will be between 140°F and 158°F (60°C and 70°C) (depending on operating conditions).

Special case - Synthetic oils
Synthetic oils are much more viscous when cold than mineral oils.
Do not start up the pump at ambient temperatures below 59°F (15°C).
For the same reason and to facilitate lubrication of the pump, pour a few drops of oil (1 to 2 cm^3) through the inlet orifice before starting.

Before starting-up the pump

Check that the exhaust orifice is not blocked.

In certain cases, when the pump is started up in cold ambient conditions, or with slightly contaminated oil, the current after start-up may remain high until the oil in the pump is heated up. These conditions are sufficient for the internal thermal protection to be activated, making start-up impossible ***(see pages 25 & 26)***.

Start-up

• When using a three phase motor, **check the direction of rotation of the motor** (see electrical connections ***start-up chap. page 24***).

• **Check the oil level (*See page 21*).**

• **Start-up the pump.**

• **Allow the pump to run for one hour at ultimate vacuum:**
During this operation, make sure that the oil circuit is operating.
Remove one of the oil fill plugs to listen to the pump.

At start-up, the oil enters the lubrication circuit of the vacuum pump.
As a result, noises will be heard (first irregularly, then regularly) which will reduce as the oil heats up. These noises will no longer be heard when the fill plug has been replaced.

Under normal temperature conditions, the oil circuit should start less than 1 minute after start-up (this time may vary with the type of oil and its degree of contamination).

• **Use the gas ballast if necessary:**
- to decontaminate the pump's oil;
- to accelerate heating. It is normal for the oil level to change (as can be seen through the oil sight glass) when the pump is hot, due to expansion of the oil, starting of the oil circuit and the operating conditions of the pump (inlet pressure). If necessary, stop the pump and adjust the oil level between the "max" and "min" levels on the sight glass.

In the event of a malfunction, refer to the "Troubleshooting and corrective actions" table (***page 30***).

Electrical Connections

⚠ The machines must be connected to an electrical installation in compliance with any local electrical codes that apply.

• Our products are designed to meet current regulations. **Any modification on the part of the user** are liable to cause non-compliance with regulations or even affect the EMC (Electromagnetic compatibility) performance and safety of the product. Kinney cannot be held responsible for consequences resulting from such an intervention.
• Before any maintenance intervention on a product performed by a maintenance operator who has not been trained on safety regulations (EMC, electrical safety, chemical pollution, etc.), isolate the product from its various energy sources (electricity, compressed air, etc.).
• **As a general rule, it is recommended to protect the motor for 120% of its nominal current (see *page 25*).**
• Check that the electrical wiring and the voltage selector position of the motor correspond to the line voltage, before starting up the pump.
• Ensure that the electrical installation conforms with your local safety requirements. It must include the appropriate fuse and reliable earth ground.

Three-phase version

Electrical motor is in accordance with major international standards (UL, CSA, CE) and offers two voltage ranges:
- Law voltage: 170 V to 254 V 50Hz - 170 V to 300 V 60Hz,
- High voltage: 342 V to 460 V 50Hz - 342 V to 520 V 60Hz.

All three phase motors (protection level IP 43. TEFC type) must be protected by a customer supplied starter consisting of a suitably rated contactor and thermal overload.

Furthermore, they are equipped with a dry contact (NC) thermal protection which is available in the terminal box.

Wire the motor according to the line voltage. The connections to be made are shown on a diagram inside the terminal box or on its lid.
Check the direction of rotation of the motor (direction of arrow located on the motor cover). For this:
- Remove the protective caps on the inlet and exhaust orifices.
- Vent the pump to atmospheric pressure.
- Switch on the pump for no longer than 2 to 3 seconds, with your hand on the inlet orifice if suction is felt, the wiring is correct.
Otherwise, invert 2 consecutive phases.
The earth terminal must be connected correctly.

Single-phase version

Electrical motor is in accordance with major international standards (UL, CSA, CE) and offers two voltage ranges:
- Low voltage: 90 V to 132 V 50/60Hz,
- High voltage: 180 V to 254 V 50/60Hz.

**Note: single-phase motors (protection level IP 43 - TEFC type) have a thermal circuit interrupter with an automatic starting device: when the internal motor temperature reaches a value over the preset limit value, the motor stops.
However, when the motor is cooled, it will start up again automatically.**

Before connecting to the mains, check the position of the voltage selector:
High Voltage (HV) or Low Voltage (LV) **(see table page 26)**.
The plug is equipped with a ground pin which must be connected.
The motor rotation direction is set at the factory.

External motor protection, electrical protection

Characteristics, connection, protection

The information below is given as a recommendation.
The user must comply with the electrical standards or recommendations (IEC, VDE, UL, CSA, etc.) applicable in the country in which the pump is used.
The use of electrical protection for the pump motor makes it possible to protect:
- The motor: in the event of excess voltage or rotor blocking, the resulting excess current may destroy the coil and possibly the start-up system (for a single-phase motor).
- The pump: in the event of a lubrication fault (contaminated oil, presence of particles), increased resistance will draw excessive motor current.

Differential thermal circuit-breakers should be used, in which the mechanism contains an instantaneous disconnection controlled by a bi-metal blade.

Never protect a three-phase motor with fuses not equipped with a differential system: if three phase motors are powered on 2 phases without a differential system, the motor could burn.

• single-phase motor:
The table on the following page gives the characteristics at start-up (for temperatures ≥ 59°F) and in permanent operation.
In this table, you will find, for each pump, a standard fuse or motor-associated value.

• three-phase motor:
The table on the following page gives, for each pump, the electrical characteristics in permanent operation and the proposed circuit breaker.

Single-phase motors

Specific internal protection

Single-phase motors have a thermal circuit switch with automatic starting device (CSA standard): when the internal motor temperature reaches a value over the preset limit value, the motor stops. However, when the motor is cooled, it will start-up again automatically.

Voltage range change

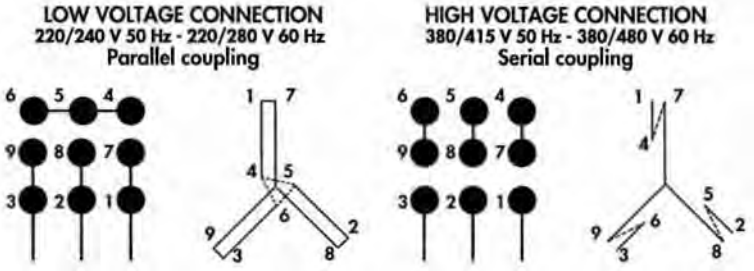
The voltage range can be read beside the motor switch: the dual frequency single-phase motor can be configured for low voltage (LV) or high voltage (HV).
To change this type of connection, proceed as follows:
- make sure that the motor is not switched on, and the power cord is removed,
- unfasten the 4 attachment screws on the motor upper cover and remove it,
- remove the voltage selector cover marked with the voltage, press on the voltage selector (position II).
- invert the position of the voltage selector cover in order to show the other voltage at the outside of the motor cover: "HV" for high voltages, or "LV" for low voltages. Check to be sure that the voltage selector has fully latched the rocket switch when the voltage selector cover is replaced.
- install the upper cover and refasten the 4 screws.
- secure the upper cover as follows:
  - Center it on the front motor flange,
  - Install the connector between the relay and condenser,
  - Close the upper cover,
  - Install and tighten the 4 screws, starting installing the screws on the pump handle side first.

Three-phase motors

Electrical connections

The pumps are equipped with 9 wire terminal box motors, the wiring diagram of the terminals is given as a rough guide only. In the event of doubt, only the plate in the terminal box should be used as a reference.

Terminal box (9 wires)



Summary tables of various types of motors

The characteristics and ratings of fuses and circuit breaker associated with standard KINNEY pump motors, 5 to 21 m^3/h, single-phase or three-phase.

Single-phase motor

	Current at Ultimate Pressure (A)		*Start-up current (A)		Proposed Fuse protection (A)	
Voltage/Frequency	50 Hz	60 Hz	50 Hz	60 Hz	Standard	Type aM**
100V 50/60Hz	5.0	3.5	30.0	34.0	20/20	8/6
115V 60Hz		4.0		35.0	20	6
200V 50/60Hz	2.5	2.0	14.0	19.0	10/16	4/4
220V 60Hz		2.0		20.0	16	4
230V 50Hz	3.5		8.0		10	4

* Temperature = 12°C = 59°F
** aM : Motor-associated type fuse

Three-phase motor

	*Start-up current (A)		Proposed Circuit Breaker protection (A)	
Voltage/Frequency	50 Hz	60 Hz	50Hz	60Hz
Low voltage				
200V 50/60Hz	3.1	2.8	4	3.5
220V 50/60Hz	3.5	3.1	4.5	4
240V 50Hz	4.0		5	
280V 60Hz		3.7		4.5
High voltage				
380V 50Hz	1.5		2	
415V 50Hz	1.6		2	
480V 60Hz		1.6		2

* Temperature = 12°C = 59°F

Mechanical Connections

For a given application, pump performance, vacuum characteristics, temperature and reliability depend on the following:
- assembly conditions, accessories filter.
- the oil used.
- mechanical connections: pipes, etc.
- maintenance frequency and quality.

For the assembly of the vacuum circuit, provide the accessories required for maintenance: valves, purges, etc.

Mounting on a frame

The pump can be mounted on a frame using the 4 attachment holes on the base and the shock mounts supplied.

Note: Special shock mounts, effective against the pump's own vibrations, can also be used but they do not ensure correct attachment during the transfer of equipment. In this case, the pump should be clamped onto its support.

Ventilation

The pump and the motor are each equipped with a ventilation system. During pump installation, the pump should be placed in ventilated place. Provide a minimum gap of 25 mm around the pump.

The vents on the pump and the motor should be checked regularly to ensure that they are not blocked.

KINNEY pumps are designed for operation at an ambient temperature between 53°F and 113°F (12 and 45°C).

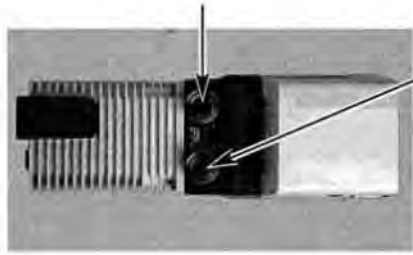
Inlet and exhaust fitting

Remove the protective caps on the inlet and exhaust orifices; these components prevent foreign bodies from entering the pump during transport and storage.
It is dangerous to leave them on the pump during operation.

The pump inlet and exhaust orifices are equipped with DN 25 ISO-KF end fittings which can be used to fit various line components made of stainless steel, plastic, etc. (see catalog).

Inlet

Make sure that the parts or chambers connected to the pump inlet withstand a negative pressure of 1 bar relative to atmospheric pressure.



Also make sure that the maximum excess pressure does not exceed 1 bar relative to atmospheric pressure (for security).

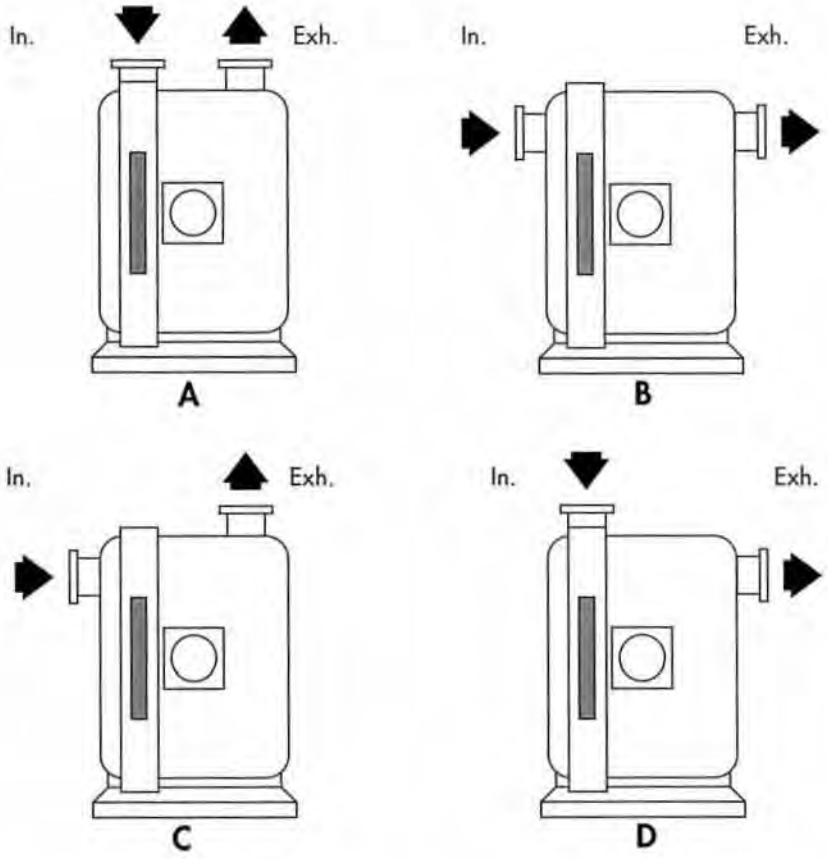
Exhaust

It is recommended to connect the pump exhaust to a smoke evacuation duct.

- If the pump exhaust orifice is connected to an extraction duct or an oil mist eliminator, the exhaust stop valve fitted in the pump exhaust orifice must be removed.
- At the pump exhaust, the evacuation circuit must be such that the resulting excess pressure in the tank is as low as possible: for correct pump operation the max. exhaust pressure recommended should be 1.125 Torr (1.5 bar) absolute pressure.

Changing position of inlet and exhaust fittings

Depending on the types of accessories used and the pumping conditions, these orifices can be fitted vertically on the pump or horizontally as shown on the diagram below.
Note: The pump is supplied in configuration A.



Disassembling the fittings

4 Unfasten the attachment screw from the end fitting to be removed.

30 Unfasten the end fitting and remove it from its housing along with the O-ring.
In the case of the inlet end fitting, also remove the inlet filter.

Horizontal reassembly

4 Remove the attachment screw from the lateral cap and using a wide screwdriver, remove the cap.
- Position the end fitting in the corresponding lateral orifice taking care to fit the O-ring. Attach the end fitting with the screw.
In the case of the inlet end fitting, fit the filter at the bottom of the orifice.
- Close unused orifices with plugs and fasten the screws.

Maintenance

General precautions

For normal operation, the maintenance of KINNEY KVAC series pumps only require regular oil changes.

⚠ Before any draining or maintenance operation, check the pumping conditions of the installation: potential toxicity, corrosion or radioacitivity of pumped gases.

Depending on the case, we recommend:

- **to purge the pumping installation with dry nitrogen before interventions;**
- **wear gloves, protective goggles and, if necessary, a breathing apparatus;**
- **ventilate the premises well and disassemble the equipment under a suction hood;**
- **not to dispose of used oils and residues using the standard system and, if necessary, to have them destroyed by a specialized company.**

⚠ After a complete maintenance operation, it is recommended to perform a helium leak tightness test.

Troubleshooting and corrective actions

Incidents	Causes	Corrective actions
The pump is not running	• Incorrect motor power supply.	Check the power supply.
	• Temperature too low.	Reheat the pump and its oil.
	• Gumming of seals after prolonged storage.	1 - Disassemble the motor and try to run the fan manually. 2 - Disassemble, clean the pump, replace seals, reassemble.
	• Oil contaminated after pumping.	Drain, flush and refill with clean oil.
	• Motor coupling damaged.	Replace by disassembling the motor.
	• Pump seized, due to a stopping after pumping in difficult conditions (no draining or flushing).	Disassemble, clean, hone the scratched metal parts (replace them if necessary) and reassemble.
The pump does not start	• Oil cold.	Warm pump.
	• Insufficient oil in the oil case.	Fill up to the level.
	• Oil contaminated.	Drain, flush and refill with clean oil.
	• Oil pump inlet partially blocked.	Drain, and clean the oil pump inlet duct.
	• Lubrication holes blocked.	Disassemble and clean.
	• Vane or spinner-cam (KVAC models) damaged.	Replace them.
	• Incorrect anti-suckback system assembly.	Repeat the assembly and the setting.
The vacuum pump does not produce a vacuum	**Ultimate pressure obtained: a few mbar**	
	• Direction of motor rotation incorrect (three phase).	Rewire.
	• Insufficient motor power.	Check the power supply.
	• Intake filter blocked.	Clean it.
	• Insufficient oil in the oil case.	Add oil.
	• Oil cold, oil pump inlet blocked.	Warm, disassemble, clean.
	• Oil contaminated.	Drain, flush and start again with clean oil.
	• Oil pump inlet partially blocked.	Drain and clean the oil pump inlet duct.
	• One of the LP safety valves is damaged.	Replace.
	• Part forgotten in reassembly.	Repeat the reassembly.

Incidents	Causes	Corrective actions
The vacuum pump does not produce a vacuum (continued)	**Ultimate pressure obtained: a few 10^{-2} Torr (10^{-2} mbar)**	
	• Gas ballast adjustment button open.	Close.
	• O-ring pinched.	Replace.
	• One of the seals is damaged.	Replace.
	• One of the HP safety valves is damaged.	Replace.
	• Lubrication holes blocked.	Disassemble and clean.
	• Incorrect anti-suckback assembly.	Repeat the assembly and setting.
	• Part forgotten in reassembly.	Repeat the reassembly.
	Accessories	
	• At the pump exhaust, the installation produces an exhaust pressure of 1,125 Torr (1.5 bar).	Check the installation.
	• Oil mist eliminator cartridge clogged.	Replace.
Noisy pump	• Oil level too high.	Drain and fill with a new oil.
	• Oil contaminated (presence of particles).	Drain, flush and refill with clean oil.
	• Pump not prepared for the oil used.	Check the pump configuration or the type of oil.
	• Incorrect motor power supply.	Check the power supply.
	• Motor bearings damaged.	Replace the motor after inspection.
	• Motor coupling incorrectly set or damaged.	Check the setting.
	• Incorrect fan assembly.	Check the assembly.
	• Incorrect anti-suckback device assembly	Repeat the assembly.
	• Vanes damaged or stuck.	Replace.
Pump too hot	• Ambient temperature too high.	
	• Pump placed in a poorly ventilated place or vents blocked.	Check the installation.
	• Operation at high pressure P > 22 Torr (30 mbar).	Check for system leaks.
	• Excess pressure at exhaust.	Check the exhaust line.
	• Motor in over-voltage or Motor in short-circuit.	Check the voltage, replace the motor.
	• Oil contaminated.	Drain, flush and refill with clean oil.
	• Pump not prepared for the oil used or oil unsuitable.	Check pump configuration or type of oil.

Incidents	Causes	Corrective actions
Considerable oil losses.	• Oil level too high.	Drain and fill with new oil.
	• Operation at high pressure.	Use an HP type oil mist eliminator with oil recovery.
	• Gas ballast open: 1 - accidentally, 2 - pumping of condensable vapors.	1 - Close. 2 - Use a condensate collector.
	• Leak at oil case seal or at front seal.	Check the assembly and replace the seals if necessary.
Poor pump tightness when switched off.	• Gas ballast open.	Close.
	• Safety valve damaged.	Replace.
	• Incorrect anti-suckback assembly.	Repeat the assembly.
	• O-ring pinched.	Replace.
	• Seals damaged.	Replace.
	• Oil contaminated.	Drain, flush and refill with clean oil.
Oil in base.	• Oil case and frame cleaned poorly during reassembly.	Remove the base and clean.
	• Oil case seal pinched.	Disassemble the oil case, clean the faces and refit a new seal.
	• Front seal damaged or felt saturated.	Replace.

Maintenance frequency

An incorrect ultimate vacuum or a reduction in pumping speed are signs that the oil has deteriorated.

The periodic inspection of the state of the oil is performed by comparison with a sample of new oil in order to check the level of contamination or deterioration of the lubricant.

The frequency at which oil is renewed is adapted to the type of operation:

- if the oil is cloudy, this indicates that condensables have been absorbed during pumping. The oil can be regenerated using the gas ballast (***see page 12***).
- a thickening of the oil, together with a blackish colour and a "burnt" smell indicate that the oil has deteriorated.

Drain the pump and flush it.

Normally, **for a pump operating continuously at a pressure lower than 0.75 Torr (1 mbar) with a clean gas (dry air), the oil should be changed every 6 months. This value is given as a guide only**. It may be extended to 1 year if the ultimate vacuum required is sufficient (for primary vacuum pumps).

Similarly, **if the pump is stopped frequently for long periods, the oil should be changed at intervals of 6 months to a maximum of 1 year** (oil may become sticky).

Note: Every pumping operation is different. This oil must therefore be changed at intervals adapted to each specific application. The use of certain accessories (***see page 20***) can reduce the frequency of these maintenance operations.

Draining

⚠ The draining operation places the contaminated pumping circuit in communication with the outside atmosphere. Take all necessary steps to ensure personal safety.

The pump must be drained when hot and after the oil case has been vented to atmospheric pressure. For this:

- switch off the pump;
- isolate the pump or disconnect from the installation;
- tilt the pump;
- unscrew the draining plug on the side of the oil case and the filling plug on the top of the oil case. When all the oil has drained, replace the two plugs temporarily and run the pump for about 10 seconds leaving the intake open. Take care with the oil mist which may appear at the exhaust. This operation removes the oil from the functional block;
- drain this oil by removing the draining plug;
- replace the draining plug and fill with fresh oil to the appropriate maximum level of the oil case oil sight glass through the filling orifice (***see page 21***).

Flushing

The draining operation can be followed by a flushing operation if the oil is particularly dirty. This operation requires a volume of oil equal to the capacity of the pump.

After draining the oil case (**see page 33**), replace the draining plug. Remove the intake filter, clean it and replace it. Run the pump at atmospheric pressure, pour the flushing oil **very slowly** through the inlet orifice. Take care with oil mist which may develop at the exhaust. Stop the pump and drain the flushing oil via the draining plug. Replace the plug and fill with fresh oil (**see page 21**).

5 to 21 m^3/h series pumps are tested in the factory with KINNEY Super X oil unless specified otherwise in the order. When the pump is delivered, a certain quantity of oil remains in the functional block.

Replacement of front seal

In the event of an external oil leak on the pump, it is necessary to change the shaft seal on the motor side.
You will need:
- a front seal replacement kit (***see page 42***),
- a screwdriver,
- a 3, 4 and 5 mm Allen wrench.

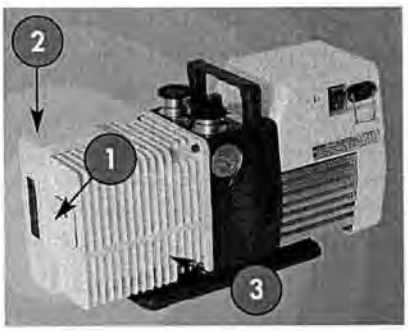
• Stop the pump and disconnect the power cord motor.
• Disconnect the pump from the installation to which it is connected.
• If possible, position the pump vertically, with the motor at the top, resting on the front side of the oil case; in this position, it is not necessary to drain the oil case. Otherwise, disassemble the pump in the horizontal position, resting it on its base, after it has been drained.
• Disconnect the motor by unscrewing the 4 fastening screws, simultaneously and alternately.
• Remove the motor vertically.
• Unscrew the fan fastening screw. Remove the fan, the key and the support washer.
• With a screwdriver, remove the shaft sleeve and its O-ring.
• Unscrew the two seal-holder fastening screws and remove the seal-holder.
• Remove the seal from the seal-holder as described on ***page 39*** and discard it.
• Clean the metal parts. Inspect the wearing side of the shaft sleeve: after cleaning, the sleeve may show a perfectly normal trace of rubbing (caused by polishing). Should the sleeve show any signs of indentation or grooves, it must be replaced.
• Preferably use new parts from the seal kit or set of seals.
• Reassemble the lip seal in its housing as described on ***page 39***.
• Reinsert the new O-ring on the seal-holder.
• Insert the shaft sleeve inside the seal-holder.
• Engage the reassembled seal-holder on its axis and screw onto the frame.
• Insert the O-ring in the shaft sleeve. Position the support washer. Then, install the key, reassemble the fan and the motor in the reverse order of disassembly.
• Immediately order a replacement maintenance set or kit (***see page 42***).

Disassembling the pump

Disassembling the motor block

3 Remove the motor cover.

5 Remove the motor attachment screws.



Disassembling the fan

4 Remove the fan fastening screw and the support washer.
Remove the key.

Replacing the front seal

See page 35.

Disassembling the gas ballast (1)

2.5 Remove the gas ballast cover (2 screws), the adjustment button, the spring and the sleeve.
Remove the tank feed-through (2 screws) and its seal.

Disassembling the oil sight glass (2)

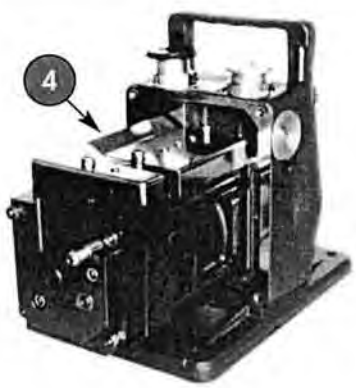
3 Remove the sight glass cover.
Remove the plate, the sight glass and the O-ring.

Removing the oil case (3)

5 Remove the oil case and its O-ring after removing the 4 fastening screws.

Disassembling the exhaust valve cover (4)

5 Remove the cover(s), the exhaust valves and their springs.



Disassembling the KVAC pump oil system

The oil system is set in the factory, it must be reset in the event of disassembly (see reassembly). However, the rear flange **(5)** can be disassembled without modifying the setting.
Remove the spinner-cam **(6)** by removing the circlip.
Do not disassemble the nozzle to clean it. During the reassembly, check that it is not blocked by sending a jet of compressed air through it.

Disassembling the rear flange

Remove the 4 nuts (and washers). Release the flange in the axis.

Disassembling the HP stator and the rotor

Remove the stator by sliding it along the rotor.

Release the rotor and the vanes.

Disassembling the intermediate flange

Insert two screwdrivers in the notches and release the flange in the axis.

Disassembling the LP stator and the rotor

Remove the LP stator.
Remove the rotor and the vanes equipped with the springs.

Cleaning components

Cleaning metal components

Solvents are required to clean components.

Standard precautions should be taken in compliance with the manufacturer's instructions.

After use in mineral or synthetic oil, clean the metal components with a mineral products based solvent such as **AXAREL**(1) , **CARECLEAN**(2), **PREMACLEAN**(3), **NAPHTEOL**(4). Proceed as follows:
- Clean when cold or hot (max. 45°C) by dipping or using a cloth
- Vacuum dry in a ventilated oven
- **The component must be cleaned a second time with alcohol**.

After use in (perfluorinate) synthetic oil, clean the metal components in a solvent such as **GALDEN S 90™**(5) and proceed as follows:
- Clean when cold by dipping or using a cloth
- Dry the components in the air or with compressed air

After use in (non-perfluorinate) synthetic or mineral oil, clean the metal components with a solvent such as alcohol and proceed as follows:
- Clean when cold by dipping or using a cloth
- Dry the components in the air
- Industrial washing solutions can also be used. The cleaning operation should be followed by vacuum drying.

Cleaning the oil level sight glass

KVAC series pumps

When cleaning this plastic sight glass, avoid contact with alcohol or alcohol-based washing solutions. Clean the component with a solvent, but do not steep it, and rinse it immediately.

(1) DUPONT DE NEMOURS registered trademark
(2) CASTROL registered trademark
(3) DOW registered trademark
(4) Nippon Chemical registered trademark
(5) MONTEDISON registered trademark

Replacement of shaft seals

Specific tools
- Specific assembly mandrel.
- A support plate (or washer).

Recommended tools
- A flat screwdriver.

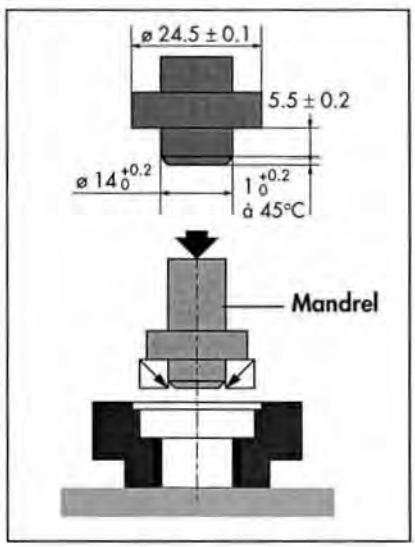
Extracting a shaft seal from its housing

With the flange flat, the seal is extracted using a screwdriver, resting on the plate (or washer) so as not to damage the seal housing.

Assembling the shaft seal

The seal housing and the seal lip are lubricated with the lubricant used in the pump.
The flange is resting on a flat surface.

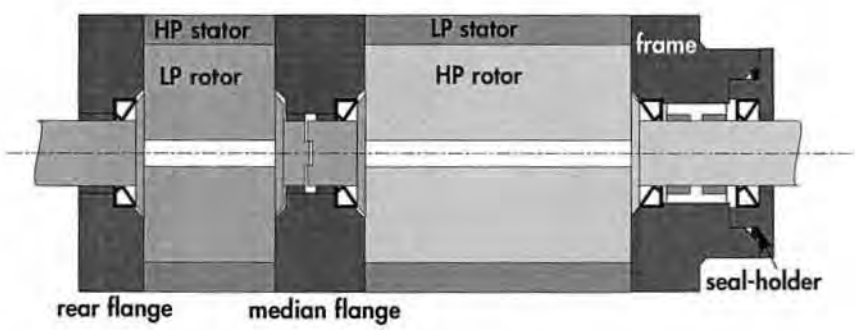
According to the direction of assembly specific to each pump, the seal is fitted on the assembly mandrel.



Using a press or a hammer, the seal is inserted in its housing.

Direction of assembly of shaft seals

They are fitted using the assembly mandrel according to the direction of assembly below:



Reassembling the pump

Component preparation

- Rest the frame on a flat surface in order to raise the pump.
- All surfaces in contact are coated with oil.
- Observe a **nominal clamping torque of 0.8 mdaN (5.8 ftlbs) for the reassembly of the functional block.**

The functional block is reassembled in the reverse order of disassembly.

Reassembling the median flange

On the median flange, check that the lubrication hole is not blocked.

New vanes are assembled on **the rotors**, with the rounded edges facing outwards.

Reassembling the exhaust valve cover

Pour a small quantity of oil beforehand around the exhaust valve holes.
Position the exhaust valves, the springs and the exhaust valve covers.

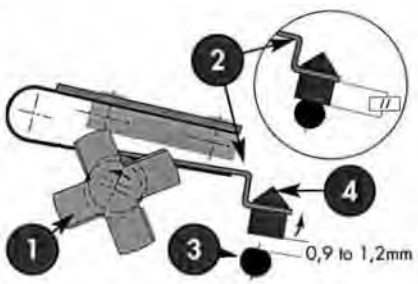
Setting the oil system

KVAC series pump

Offset the spinner-cam **(1)** by pressing on the blades.

Turn the shaft up to the maximum displacement of the lever **(2)**.

The distance between the seat **(3)** and the stop valve **(4)** must be 0.9 to 1.2mm (6.42 to 8.6 ft lbs) :
it is set by adjusting the orientation of the lever.



The stop valve face must be perpendicular to the axis of the oil inlet hole; when free, the stop valve should rest on its seat: check the parallelism of the lever in relation to the bearing face of the stop valve seat.
Orient the seat to obtain the correct setting.

Reassembling the oil case

Fit the oil case on the frame. Fasten the attachments after making sure that the seal is positioned in its seal groove (clamping torque 0.8 mdaN (5.8 ft lbs)).

Reassembling the gas ballast

Position the oil case feed-through equipped with the seal in its housing by centering it on the gas ballast tube. Assemble using the screws.
Equip the adjustment knob with the sleeve and the spring.
Position the assembly in the cover and secure on the oil case feed-through.

Reassembling the oil level sight glass

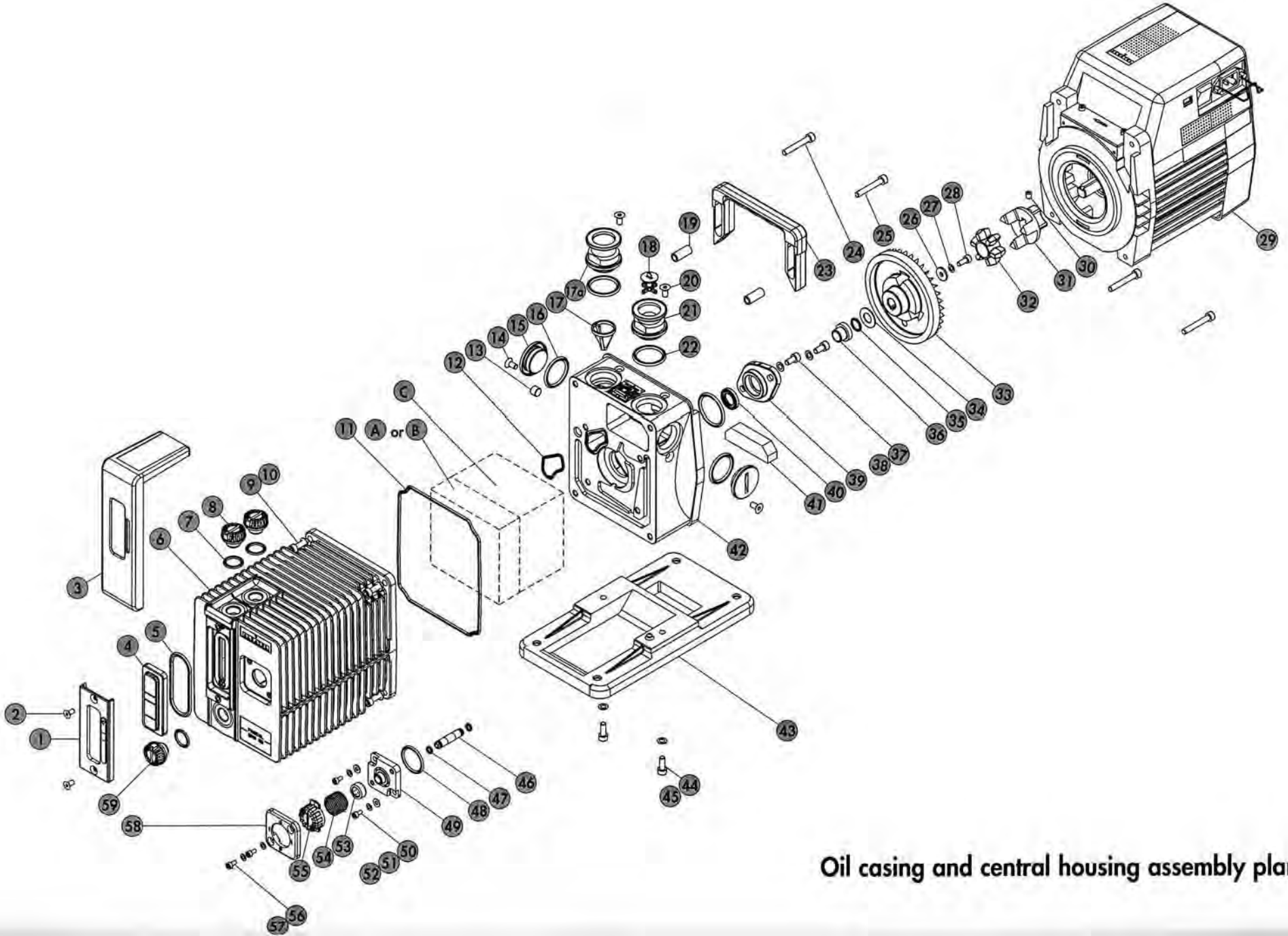
Replace the O-ring (included in the seal kit).
Fit the sight glass and assemble with screws (clamping torque 0.3 mdaN (2.14 ft lbs)).

Reassembling the seal-holder

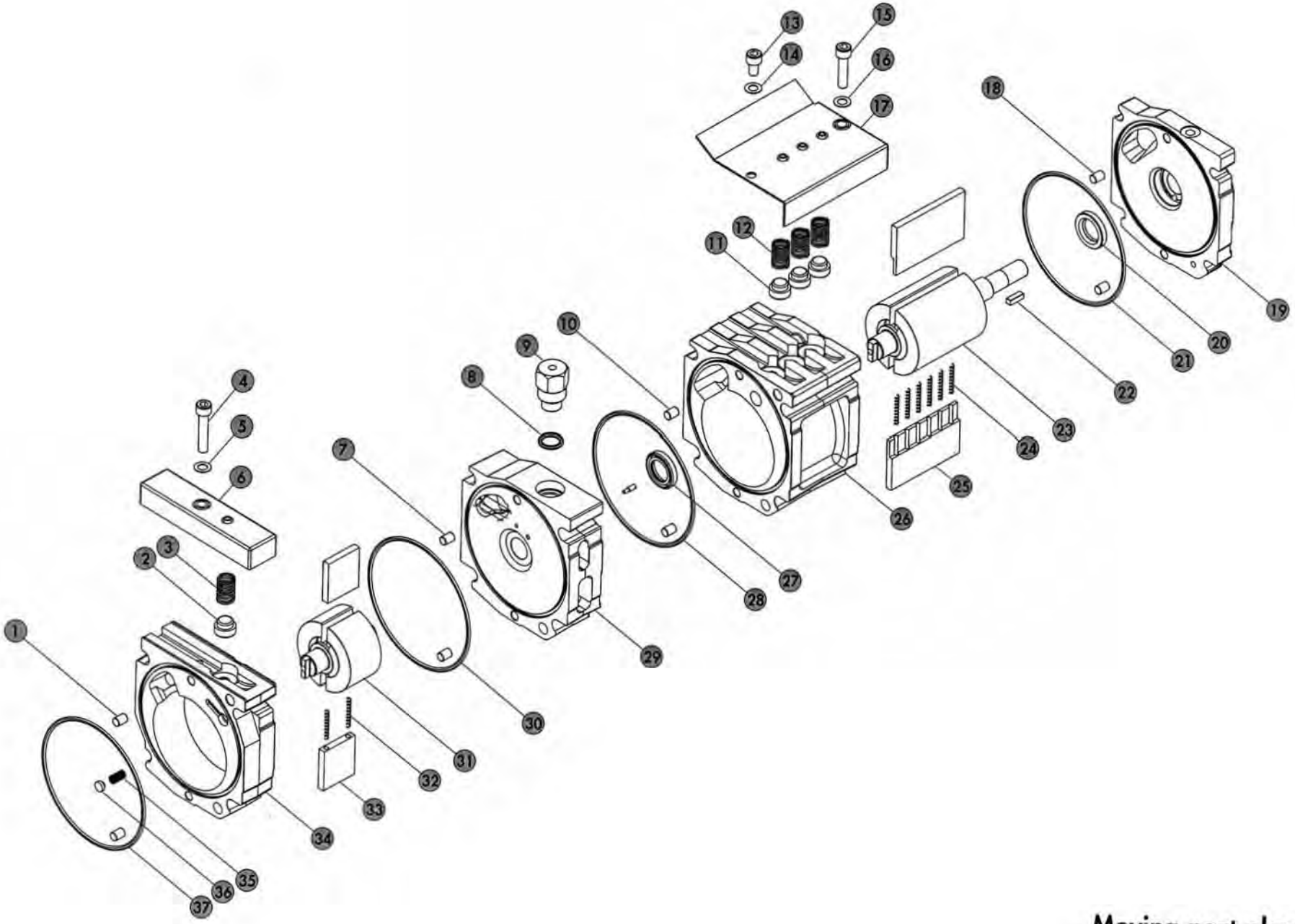
See page 35.
Fit the fan 1/2 sleeve.

Reassembling the motor side components

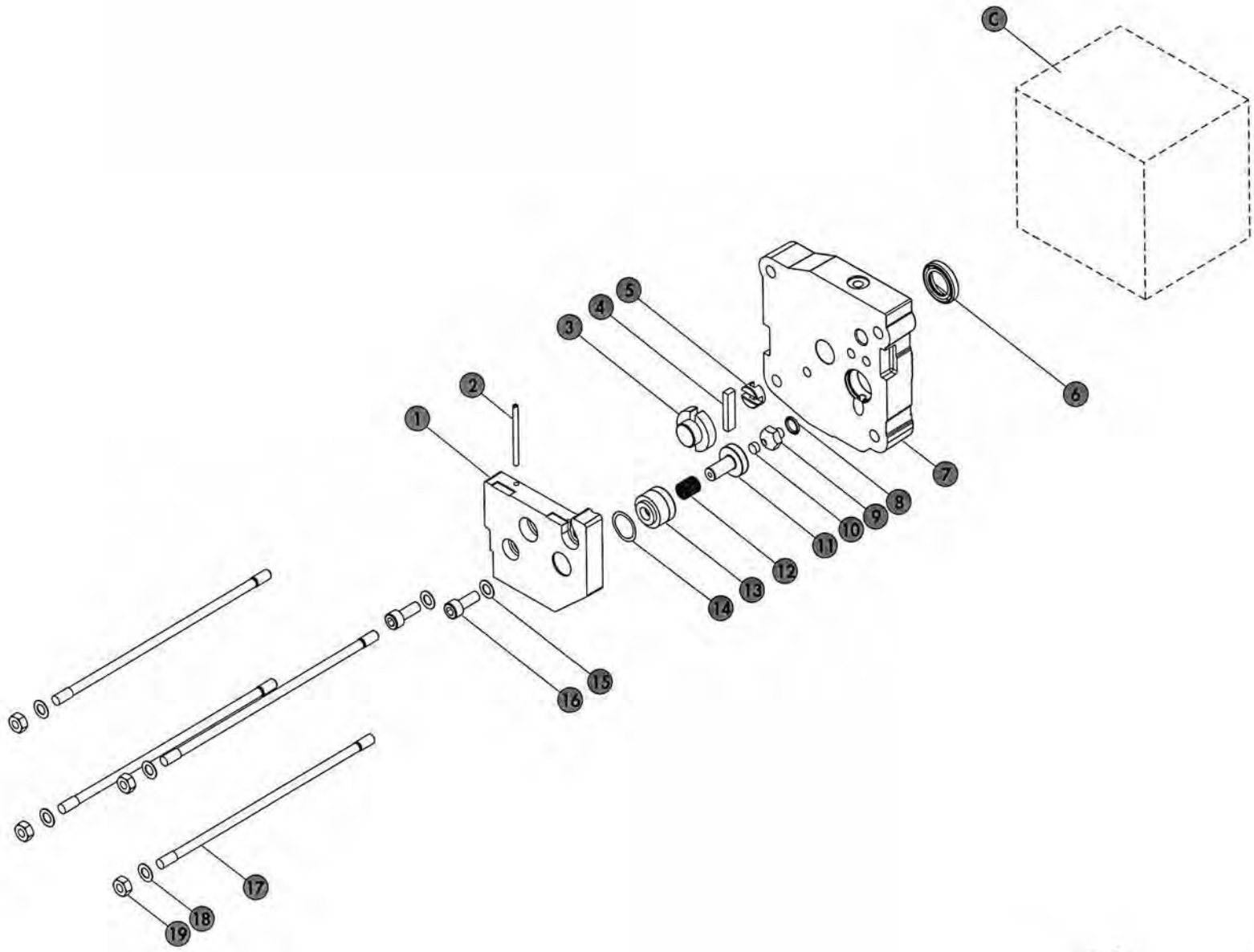
Fit the drive key on the motor shaft.
Install the motor coupling sleeve down to the stop on the motor shaft.
Fit the motor on the frame and install the 4 mounting bolts (clamping torque 1 mdaN (7.14 ft lbs)).



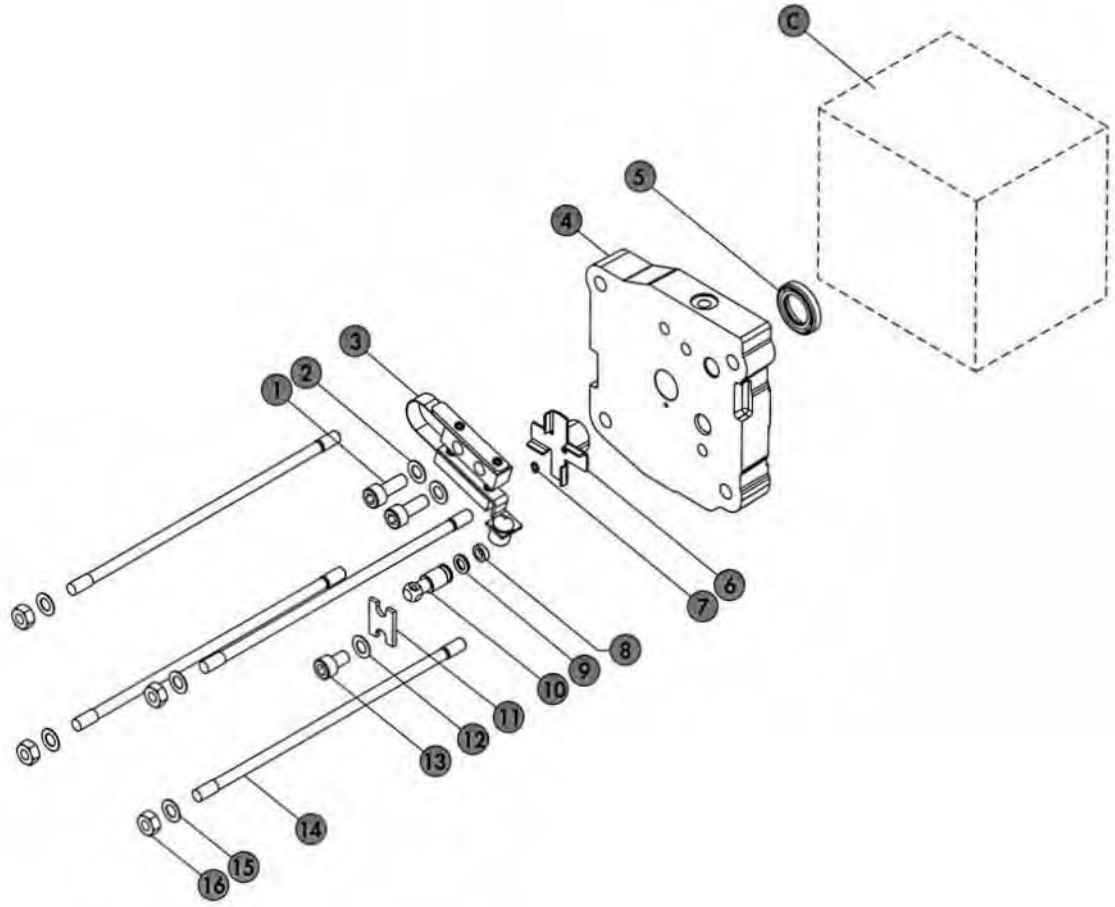
Oil casing and central housing assembly plan



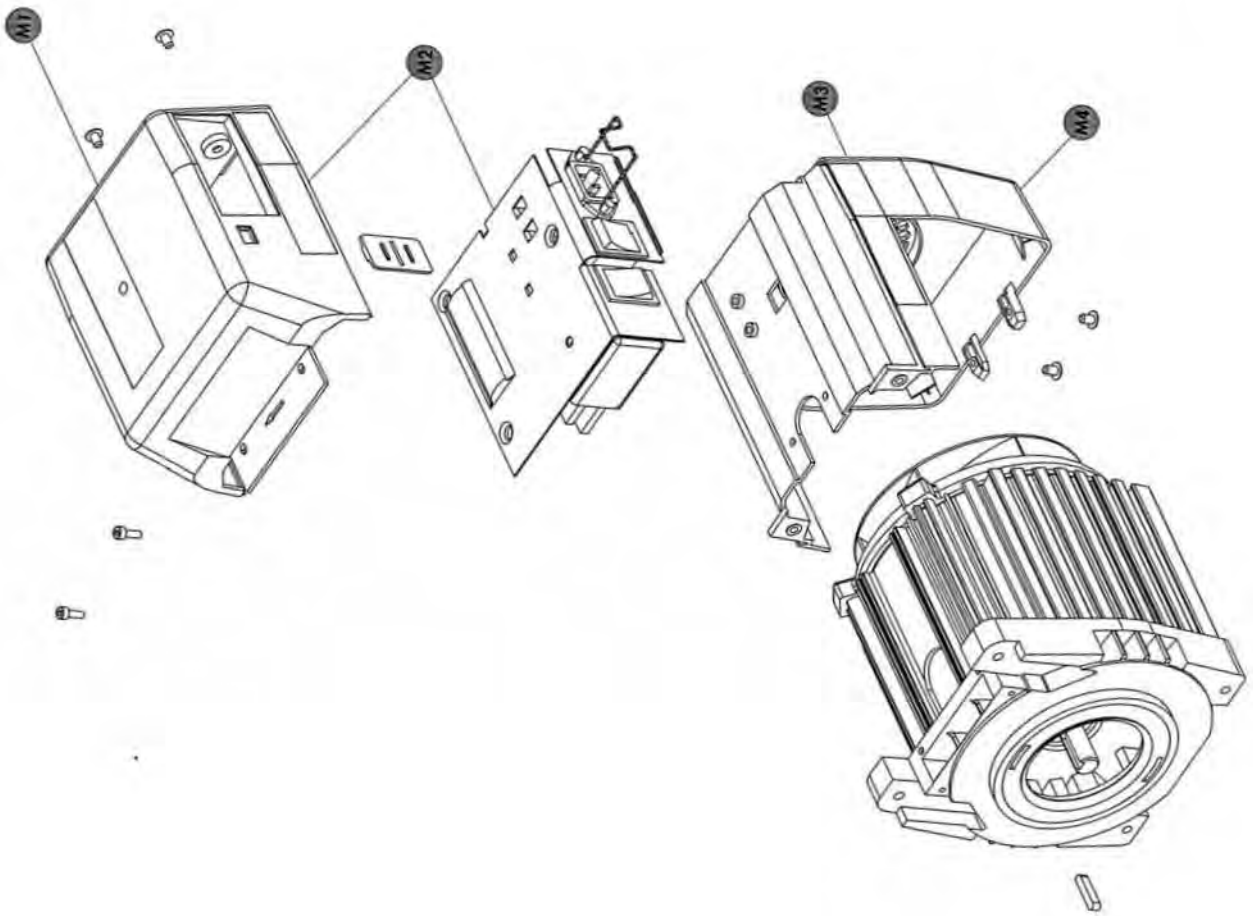
Moving part plan (C)

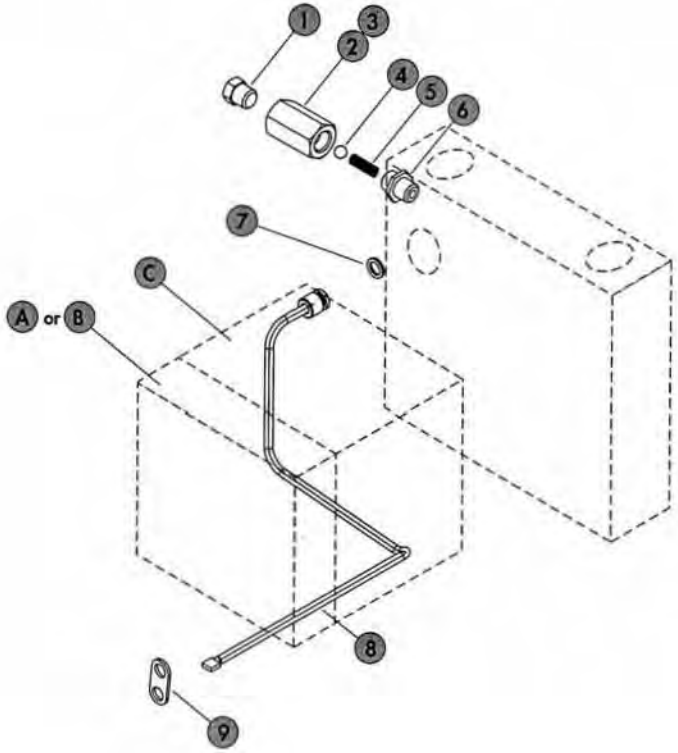


Oil pump system plan (A)



Oil system plan (B)


M1
M2
M3
M4



Bubbler system plan