

INSTRUCTION MANUAL

High Performance Vacuum Pumps

Models
VLP80, VLP120,
VLP200, VLP285

Savant

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INSTRUCTION MANUAL

High Performance Vacuum Pumps

Models
VLP200, VLP250,
VLP300, VLP350



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1 INTRODUCTION

1.1 Scope and Definitions

This manual provides installation, operation and maintenance instructions for the Rotary Vane Pumps. The pump must be used in accordance with this user manual. Read this manual before installing and operating the pump.

Important safety information is highlighted as WARNINGS and CAUTIONS. The use of WARNINGS and CAUTIONS are defined below.

WARNING

Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION

Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.

The units used throughout this manual conform to the SI international system of units of measurement.

In accordance with the recommendations of IEC1010, the following warning symbols are on the pump:



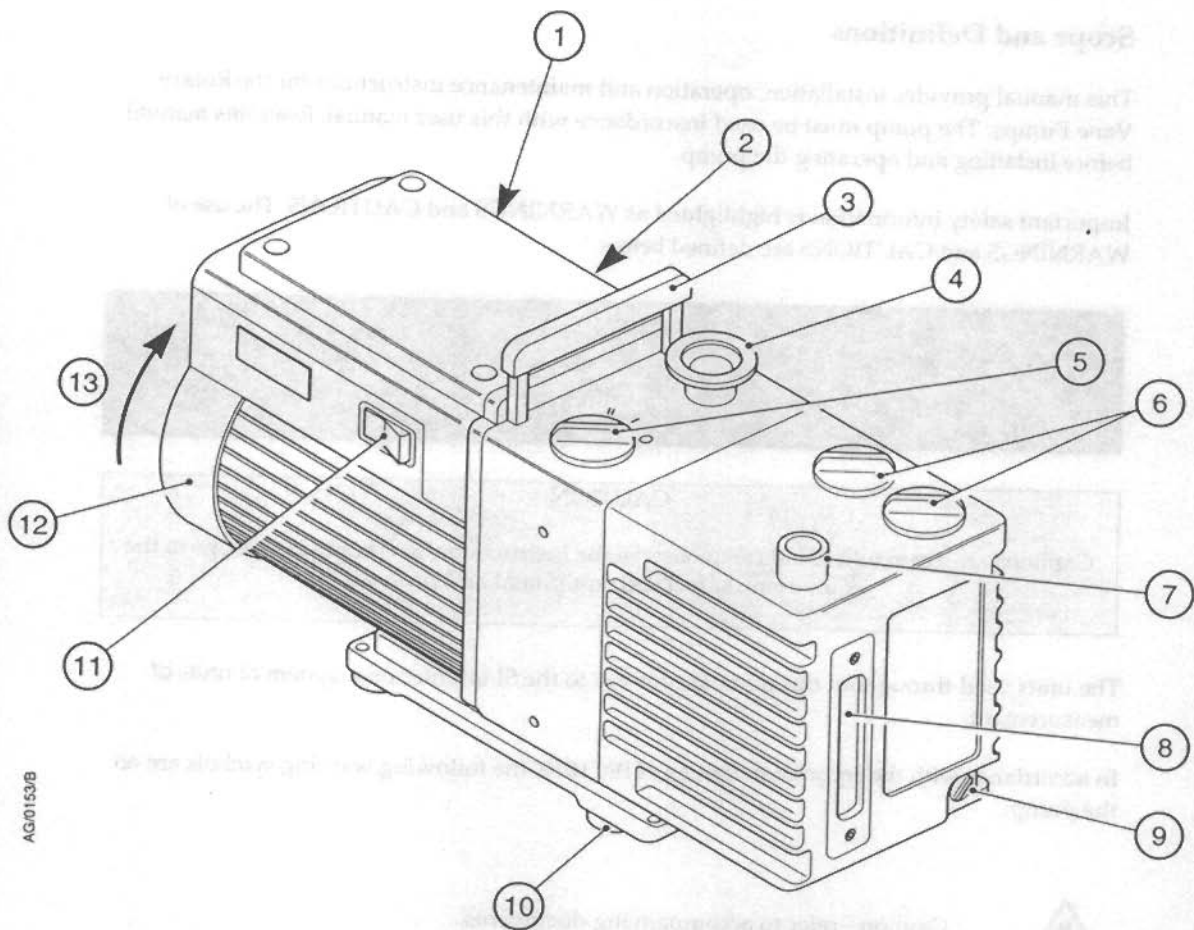
Caution - refer to accompanying documents.



Caution - risk of electric shock.



Caution - hot surface.



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- | | | |
|---|--------------------------|-----------------------------------|
| 1. Electrical inlet-connector | 4. NW25 inlet-port | 10. Rubber feet (4 off) |
| 2. Voltage indicator | 5. Gas-ballast control | 11. On/off switch |
| 3. Lifting handle (lifting bracket on VLP200 & 285 pumps) | 6. Oil filler-plug | 12. Motor fan-cover |
| | 7. 1/2" NPTF | 13. Correct direction of rotation |
| | 8. Oil-level sight-glass | |
| | 9. Oil drain-plug | |

Figure 1 - The Pump

1.2 Description

The pump is shown in Figure 1. Refer to Figure 1 for item numbers in brackets in the following descriptions. The pumps are two-stage, oil-sealed, sliding-vane vacuum pumps. The pump has NW25 inlet (4), ½" NPTF outlet ports (7) and a gas-ballast control (5). When the pump is switched off, an inlet-valve seals the inlet and prevents the suck-back of air and oil into the vacuum system.

The VLP80 & 120 pumps have a retractable lifting handle (3). The VLP200 & 285 pumps are fitted with a lifting bracket for use with suitable lifting equipment.

An oil-pump delivers pressurized oil to the vacuum pumping mechanism in the pump. You can inspect the level and condition of the oil in the oil-box through a sight-glass (8). Two oil filler-plugs (6) and an oil drain-plug (9) are provided on the oil-box.

The pump mechanism is driven directly by a single-phase electric motor through a flexible motor-coupling. The motor is totally enclosed and is cooled by the motor cooling-fan which directs air along the motor fins. The pumps are cooled by an additional fan attached to the motor-coupling.

The motors are fitted with an on/off switch (11) and a thermal overload device. When the motor is too hot, the thermal overload device switches the pump off. The thermal overload device has an automatic reset; when the motor cools down, the device resets and (unless you have incorporated suitable control equipment which must be manually reset: see Section 3.6.2), the motor will restart.

The pump is mounted on a base plate on rubber feet (10).

1.3 Controls

The pump has a three position gas-ballast control (5).

1.3.1 Gas-ballast Control

To pump high vapor loads a gas-ballast is delivered into the pump to prevent condensation of the vapor carried by the pumped gases.

Air can be introduced to the low vacuum stage through the gas-ballast valve. Alternatively, an inert gas such as nitrogen can be supplied through a suitable external valve.

The gas-ballast control has three positions:

- Closed (position '0')
- Low flow (position 'I')
- High flow (position 'II').

1.4 Construction

The pump-shafts and rotors are made of high-grade cast-iron. The pump-body and oil-box are made from cast-aluminum. All surfaces of the pump which are exposed to the pumped gases are free from copper, zinc and cadmium.

Other materials of construction include fluorocarbon elastomer, nitrile, silicon, chemically-resistant polymers, nickel and stainless steel.

2 TECHNICAL DATA

2.1 Operating and Storage Conditions

Ambient temperature range (operation)	55 to 105 °F (12 to 40 °C)
Normal surface temperature of the pump-body at ultimate vacuum (operation), ambient temperature of 20 °C	112 to 158 °F (50 to 70 °C)
Maximum humidity (operation)	90% RH
Ambient temperature range (storage)	-22 to 158 °F (-30 to 70 °C)

2.2 Performance

2.2.1 Specification

		VLP80	VLP120	VLP200	VLP285
Maximum Displacement L/m (cfm)	60 Hz	76 (2.7 cfm)	116 (4.1 cfm)	195 (6.9 cfm)	283 (10.0 cfm)
	50 Hz	62 (2.2 cfm)	96 (3.4 cfm)	161 (5.7 cfm)	238 (8.4 cfm)
Gas Ballast	0 (Torr)	1.5×10^{-3}	1.5×10^{-3}	1.5×10^{-3}	1.5×10^{-3}
	I (Torr)	2.3×10^2	2.3×10^2	2.3×10^2	2.3×10^2
	II (Torr)	9.0×10^2	7.5×10^2	4.5×10^2	4.5×10^2
Oil Capacity		0.7	0.7	0.75	1.0
Dimensions	Inches	16.9x6.2x8.8	16.9x6.2x8.8	18.5x6.2x10.5*	19.3x6.2x10.5*
	Millimetres	429x158x225	429x158x225	471x158x261*	489x158x261*
Weight (Without Oil)	lbs	47.6	47.4	57.3	58.0
	kg	21.6	21.5	26.0	26.3
Motor Power	120 V, 60 Hz (Watts)	300	300	550	550
	Start-Up Current (Amps)	31.5	31.5	34.0	34.0
	Fuse Rating, (Amps)	20	20	25	25
	230 V, 50 Hz (Watts)	250	250	450	450
	Start-Up Current (Amps)	15.6	15.6	18.0	18.0
	Fuse Ratings, (Amps)	10	10	13	13
Noise (At 50 Hz) (dBA)		48	48	48	48
Vacuum Inlet Fitting, OD (in/mm)		0.5/12.7	0.5/12.7	0.5/12.7	0.5/12.7

Table 1 - Specifications

* Includes height of lifting bracket

All ValuPumps™ come filled with vacuum pump oil, and are shipped complete with Oil Mist Eliminator (OME 190), Mist Filter (MF190), and Oil Drain Kit (DK100). Pumps conform to standards IEC1010, IP44, CSA, CE; manufactured under an ISO9001 certified quality system.

2.2.2 Performance Characteristics

The position of the gas-ballast control defines the performance characteristics of the pump. These performance characteristics are listed fully in Table 2.

		VLP80	VLP120	VLP200	VLP285
Parameters	Units	1-phase	1-phase	1-phase	1-phase
Gas-ballast control closed (position '0')					
Ultimate total pressure	Torr	$1,5 \times 10^{-3}$	$1,5 \times 10^{-3}$	$1,5 \times 10^{-3}$	$1,5 \times 10^{-3}$
Gas-ballast control low flow (position 'I')					
Ultimate total pressure	Torr	$2,25 \times 10^{-2}$	$2,25 \times 10^{-2}$	$2,25 \times 10^{-2}$	$2,25 \times 10^{-2}$
Gas-ballast flow	l.min^{-1}	5	5	5	5
Maximum water vapor pumping rate	g.h^{-1}	60	60	60	60
Maximum water vapor inlet pressure	Torr	20	12	7,5	5,25
Gas-ballast control high flow (position 'II')					
Ultimate total pressure	Torr	$0,9 \times 10^{-1}$	$0,75 \times 10^{-1}$	$4,5 \times 10^{-2}$	$4,5 \times 10^{-2}$
Gas-ballast flow	l.min^{-1}	14	14	16	16
Maximum water vapor pumping rate	g.h^{-1}	220	220	220	290
Maximum water vapor inlet pressure	Torr	60	37.5	28.5	24

Table 2 - Technical Data (High Vacuum Mode)

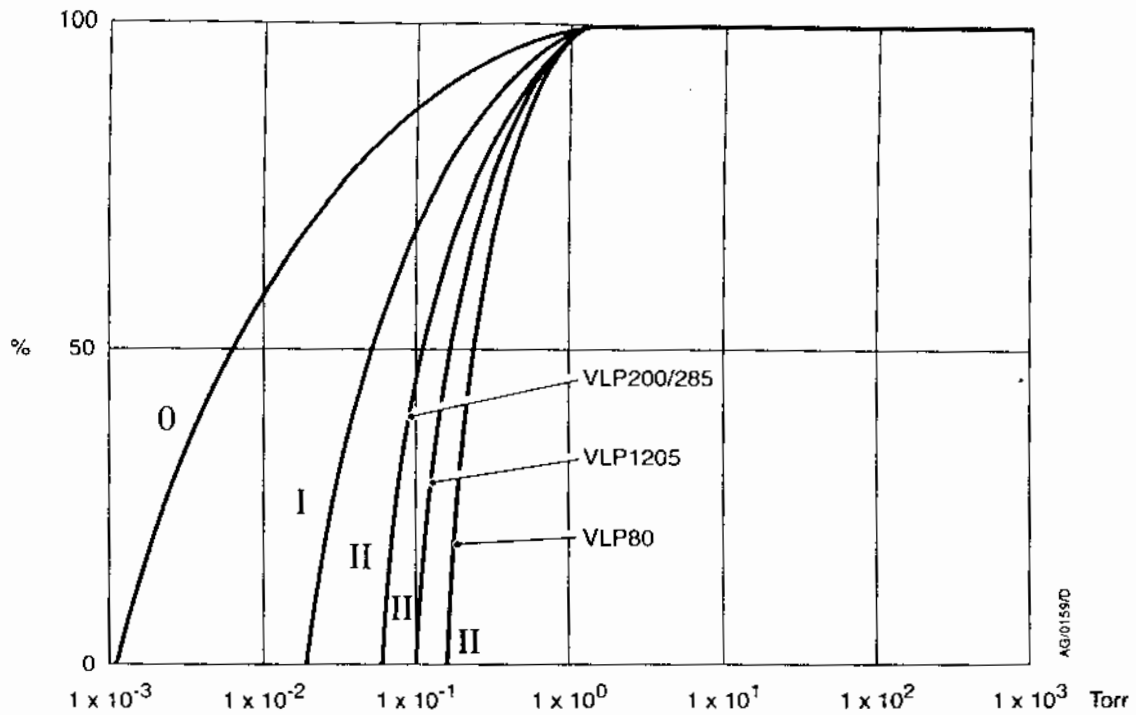


Figure 2 - Performance Characteristics in High Vacuum Mode
(Pumping Speed Against Inlet Pressure)

2.3 Mechanical Data

2.3.1 General

Overall dimensions	See Figure 3
Degree of protection (IEC 34-5: 1981)	IP44
Maximum tilt angle	10°
Motor rotational speed (50 Hz supply)	1470 r.min ⁻¹
Motor rotational speed (60 Hz supply)	1760 r.min ⁻¹

	VLP80	VLP120	VLP200	VLP285
Maximum mass, without oil lbs (kg)	47.5 (21.6)	47.5 (21.5)	57.2 (26.0)	57.8 (26.3)

2.3.2 Noise and Vibration Data

Sound pressure, measured at ultimate vacuum 1 metre from the end of the pump to ISO 11201, High Vacuum mode ♦, 50 Hz operation	1-phase 48 dB (A)
Vibration severity: measured at the inlet port to ISO 2372 (1974)	Class 1C

2.4

Electrical Data

Note: We recommend that you use fuses of the maximum ratings specified in Table 5. You must not use fuses of a higher rating.

The dual-voltage, dual-frequency motor is designed for a single-phase electrical supply and is suitable for 50 Hz or 60 Hz operation. The motor can be manually switched between nominal supply voltages of 110-120 V and 220-240 V (refer to Section 3.6.1).

When you start a cold pump, the motor will draw the start-up current shown in Table 5 for up to several seconds, so you must use a slow-blow fuse to prevent unnecessary fuse failure during pump start-up. Within five minutes, as the oil in the pump warms up, the current drawn will slowly reduce to the full load current specified in Table 5.

Pump	Nominal supply (V)	Frequency (Hz)	Power (W)	Full load current (A)	Start-up current	Maximum fuse rating (A)
VLP80 and VLP120	220-240	50	250	2.4	15.6	13
	230-240	60	300	2.2	15.2	13
	110	50	250	4.6	29.4	20
	115-120	60	300	4.4	31.5	20
VLP200 and VLP285	220-240	50	450	4.0	18.0	13
	230-240	60	550	3.6	18.0	13
	110	50	450	7.8	34.0	25
	115-120	60	550	7.2	34.0	25

Table 3 - Electrical Data

2.5

Lubrication Data

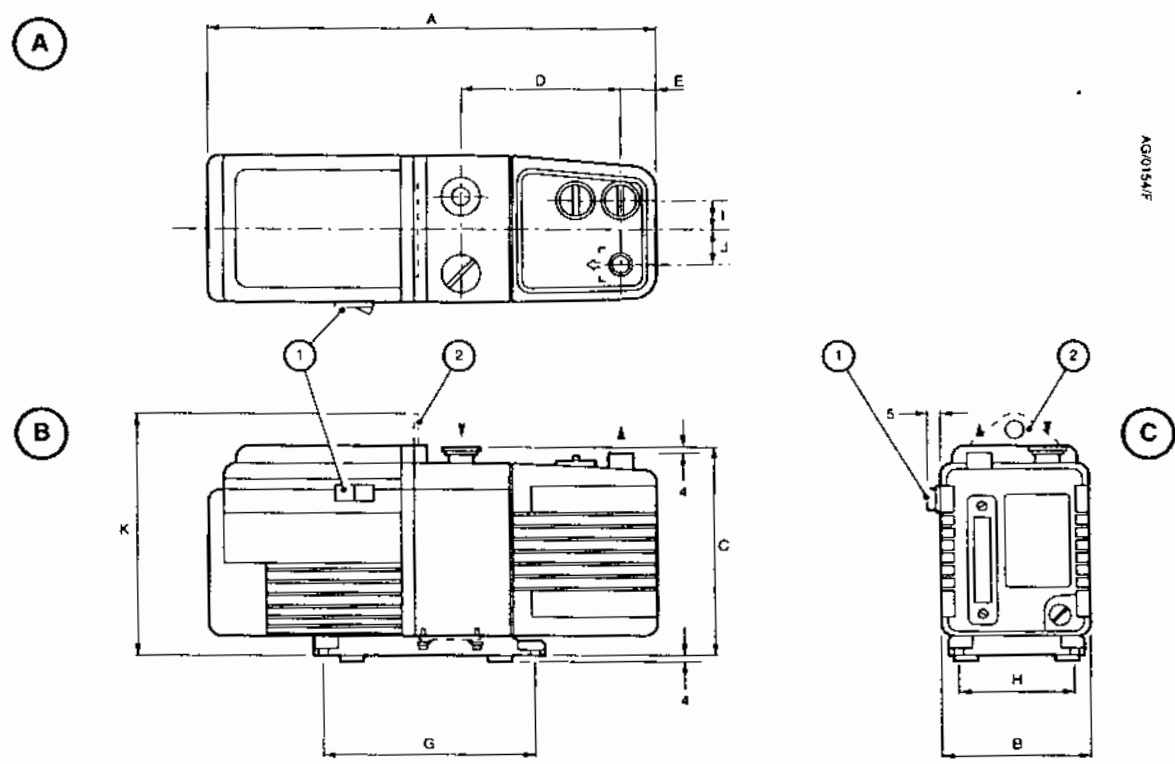
Note: Health and Safety Data sheets for rotary pump oils are available on request.

Recommended oil* in hydrocarbon prepared pumps:

Oil capacity (liters)	VLP80	VLP120	VLP200	VLP285
Maximum	0.70	0.70	0.75	1.00
Minimum	0.42	0.42	0.45	0.65

- * To operate the pump when the ambient temperature is outside the limits specified in Section 2.1, or to optimise the pump performance when you pump condensable vapors, you may need to use a different oil.

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- 1. On/off switch
- 2. Lifting bracket (VLP200 and VLP285 pumps only)

- A Top view
- B Side view
- C Front view

Pump	A	B	C	D	E	F	G	H	I	J	K
VLP80	430	158	225	127	29	78	230	120	37	32	-
VLP120	430	158	225	127	29	78	230	120	37	32	-
VLP200	470	158	225	161	35	78	230	120	37	32	261
VLP285	490	158	225	181	35	78	230	120	37	32	261

Figure 3 - Dimensions: mm

3 INSTALLATION

3.1 Safety

WARNING

The hydrocarbon prepared pump is not recommended for pumping hazardous substances.

You must ensure that the pump is suitable for your application. If you have any doubt as to the suitability of the pump for your application, refer to the guidelines on vacuum pump and vacuum system safety.

The installation of your pump must be performed by a suitably trained and supervised technician. Obey the safety instructions listed below when you install the pump, especially when you connect the pump into an existing system. Details of specific safety precautions are given at the appropriate point in the instructions.

- Wear the appropriate safety-clothing when you come into contact with contaminated components.
- Vent and purge your vacuum system before you start installation work.
- Ensure that the installation technician is familiar with the safety procedures which relate to the pump-oil and the products handled by the pumping system. Take suitable precautions to avoid the inhalation of oil mist and excessive skin contact with pump-oil, as prolonged exposure can be harmful.
- Disconnect the other components in the pumping system from the electrical supply so that they cannot be operated accidentally.

3.2 System Design Considerations

Consider the following points when you design your pumping system:

- Use a suitable valve to isolate the pump from your vacuum system if you need to allow the pump to warm up before you pump condensable vapors, or to provide additional system protection when the pump is switched off.
- Avoid high levels of heat input to the pump from the process gases, otherwise the pump may overheat and seize, and cause the motor thermal overload device to open.
- If you use the pump in a high ambient temperature and have a high gas throughput, the temperature of the pump-body may exceed 70 °C and you must fit suitable guards to prevent contact with hot surfaces.
- Make sure that the exhaust pipeline cannot become blocked. If you have an exhaust-isolation valve, make sure that you cannot operate the pump with the valve closed.
- Provide for a purge of inert gas when you shut down the pumping system, to dilute dangerous gases to safe concentrations.

3.3 Unpack and Inspect

Remove all packing materials, remove the pump from its packing-box, remove the protective covers from the inlet and outlet-ports and inspect the pump. If the pump is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the pump together with your order number and your supplier's invoice number. Retain all the packing materials for inspection. Do not use the pump if it is damaged.

If the pump is not to be used immediately, replace the protective covers. Store the pump in suitable conditions, as described in Section 6.1.

3.4 Locate the Pump

WARNING

Use suitable lifting equipment to move the pump.
The mass of the pump is approximately 58 lbs (26 kg).

The VLP80 and VLP120 pumps have a lifting handle which you can use to move the pump by hand. If you wish to use mechanical lifting equipment, do not attach the equipment to the handle; for stability, use slings around the motor and the pump-body.

Do not lift the VLP200 and VLP285 pumps by hand; attach your mechanical lifting equipment to the lifting bracket on the pump. You do not need to use slings to move the pumps.

Provide a firm, level platform for the pump. Locate the pump so that the oil-level sight-glass is visible and the oil filler-plug, oil drain-plug, mode selector and gas-ballast control are accessible.

If your pump will be located inside an enclosure, make sure that there is adequate ventilation at both ends of the pump, so that the ambient temperature around the pump does not exceed 40 °C. There must be a minimum space of 25 mm between the pump and the enclosure walls.

3.5 Fill the Pump with Oil

WARNING

If you use a hydrocarbon prepared pump, you must not use the pump to process oxygen in concentrations greater than 25 % in volume. If you do, there is a risk of fire or explosion in the oil-box of the pump.

The pump is delivered prefilled with oil, but if necessary the pump can be refilled using the following method. Refer to Section 2 for the recommended oil. Refer to Figure 1 for the item numbers in brackets.

1. Remove one of the oil filler-plugs (6)
2. Pour oil into the pump until the oil-level just reaches the MAX mark on the bezel at the top of the sight-glass (8). If the oil-level goes above the MAX mark, remove the drain-plug (9) and drain the excess oil from the pump.
3. After a few minutes, recheck the oil-level. If the oil-level is now below the MAX mark, pour more oil into the pump.
4. Refit the oil filler-plug. Tighten the plug firmly by hand. Do not overtighten.

3.6 Electrical Installation

3.6.1 Check and Configure the Motor

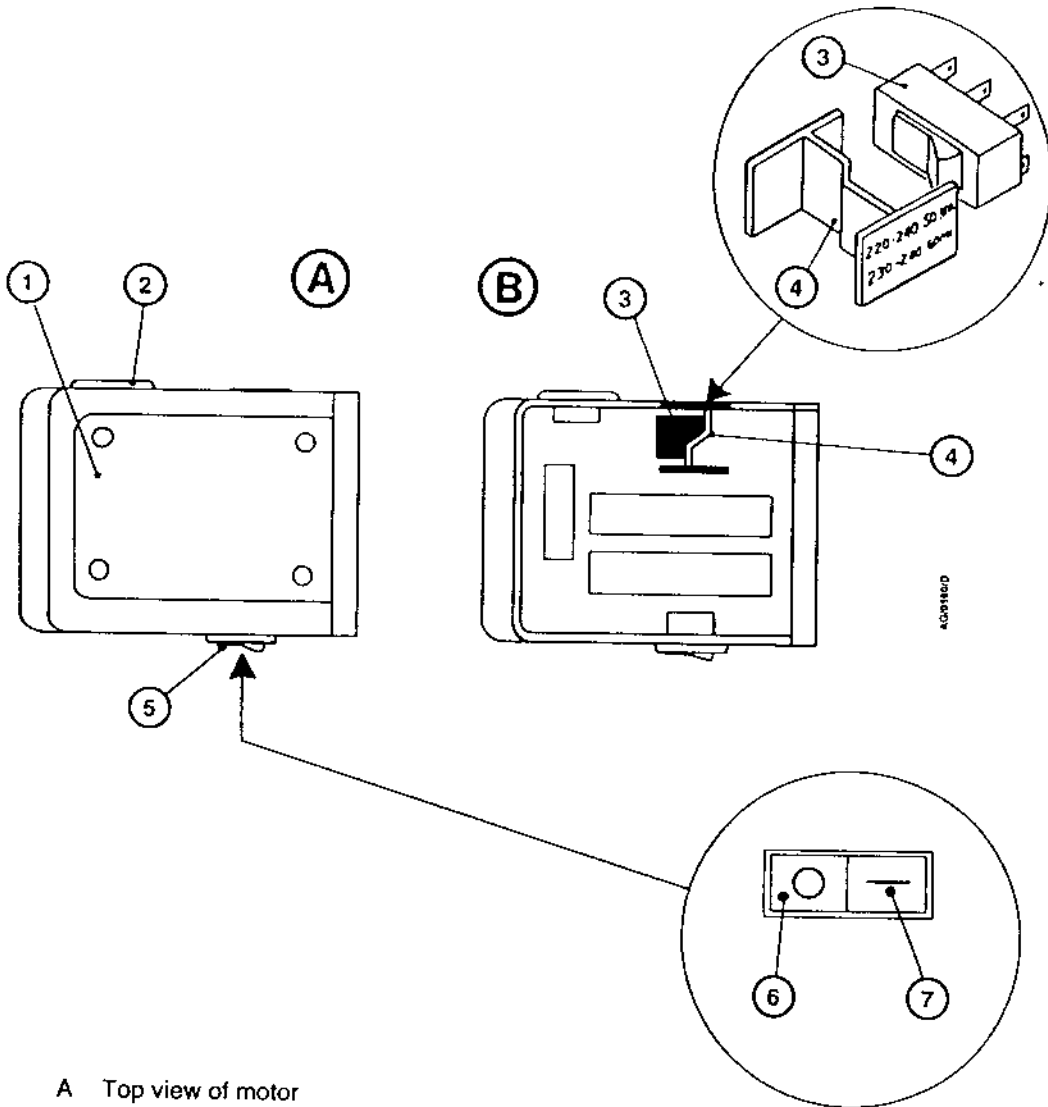
CAUTION

Ensure that the motor is correctly configured for your electrical supply. If you operate the pump when the motor is not correctly configured for the electrical supply, you will damage the motor.

Refer to Figure 4 for the item numbers in brackets.

Ensure that the voltage shown on the voltage indicator (4) in the motor-cover corresponds with your electrical supply voltage. If it does not, you must change the *configuration of the pump-motor* to match your electrical supply voltage; use the procedure below.

1. Disconnect the motor from the electrical supply.
2. Undo the four screws, remove the cover-plate (1) and lift out the voltage indicator (4).
3. Press molding the voltage selector switch (3) to select the alternative position.
4. Turn the voltage indicator molding over so that the outer panel shows the required voltage. Refit the molding.
5. Refit the cover-plate and secure it with the four screws.



A Top view of motor
 B Internal view of top of motor

- 1. Cover-plate
- 2. Electrical inlet-connector
- 3. Voltage selector switch
- 4. Voltage indicator
- 5. On/off switch
- 6. Position 'O' (off)
- 7. Position 'I' (on)

Figure 4 - Motor Voltage Configuration

3.6.2 Connect the Pump to your Electrical Supply

WARNING

Ensure that the electrical installation of the pump conforms with your local and national safety requirements. It must be connected to a suitably fused and protected electrical supply and a suitable earth point.

Notes: To prevent automatic restart of the pump-motor if the electrical supply is restored after an electrical supply failure, connect the pump to the electrical supply through suitable control equipment which must be reset manually after an electrical supply failure.

Make the electrical connections to the pump-motor with an IEC 320 cable socket (cold condition type) that satisfies your local electrical standards.

To maintain compliance with CSA standards, you must only use CSA/UL certified electrical supply cables and connectors. Cables must be SJT rated (minimum) and must incorporate an earth conductor. The conductors in the cable must be a minimum of 18 AWG.

If your pump was supplied with an electrical supply cable, the cable will be fitted with a moulded IEC connector at one end. The other end of the cable may be fitted with a plug suitable for your local electrical supply. A cable without a plug will contain wires color coded as follows:

Green and yellow	earth
Blue	neutral
Brown	live

1. Ensure that the on/off switch on the motor (Figure 4, item 5) is in the off position.
2. Insert the moulded IEC connector at the end of the cable into the electrical inlet-connector on the motor (Figure 4, item 2).
3. Connect the plug (if fitted) at the other end of the cable to your electrical supply. If a plug is not fitted, connect the wires in the cable to the correct terminals of your electrical supply.

3.6.3 Check the Direction of Rotation

CAUTION

Ensure that the pump-motor rotates in the correct direction. If it does not, the pump and your vacuum system can become pressurized. Do not connect the pump to the vacuum system whilst carrying out the tests detailed below.

Refer to Figure 1 for the item numbers in brackets.

1. Watch the motor cooling-fan through the motor fan-cover (13).
2. Use the on/off switch (12) to switch-on the electrical supply to the motor for a few seconds.
3. Check that the motor cooling-fan rotates in the correct direction (14) shown by the arrow on the motor fan-cover. If the direction of rotation is incorrect, switch off the electrical supply immediately and contact the factory for advice.

3.7 Inlet and Outlet Connections

WARNING

The pump is supplied with an exhaust mist eliminator. Alternately, connect the exhaust to a suitable treatment plant to prevent the discharge of dangerous gases and vapors to the surrounding atmosphere. Use a catchpot to prevent the drainage of contaminated condensate back into the pump.

Before you connect the pump to your vacuum system, fit the centring-ring and inlet-filter (supplied with the pump) to the pump inlet-port (see Figure 5).

Take note of the following information when you connect the pump to your vacuum system.

- For optimum pumping speeds, the pipeline connected to the pump-inlet should have an internal diameter of 25 mm or larger.
- Support the vacuum pipelines to prevent loading of the coupling-joints.
- If necessary, incorporate flexible bellows in your system pipelines to reduce the transmission of vibration and to prevent loading of coupling-joints. If you use flexible bellows, you must ensure that you use bellows which have a maximum pressure rating which is greater than the highest pressure that can be generated in your system. We recommend that you use flexible bellows.
- Use a suitable inlet trap if you pump condensable vapors or if you use the pump for very dusty applications.
- Use a suitable valve to isolate the pump from your vacuum system if you need to pump condensable vapors or maintain vacuum when the pump is switched off.
- Ensure that sealing surfaces are clean and scratch-free.

In any of the following circumstances, we recommend that you fit an oil mist filter to the pump outlet:

- If you use the pump with the gas ballast control open (in position 'I' or position 'II').
- If you operate the pump with an inlet pressure greater than 7.5 mTorr (10 mbar) for extended periods.
- If you frequently pump down from atmospheric pressure.

The oil mist filter will trap the oil exhausted from the pump.

3.8 Leak-test the System

Leak-test the system and seal any leaks found after you have installed the pump, to prevent leakage of substances out of the system and leakage of air into the system.



4 OPERATION

4.1 How to Use the Pump Controls

You can use the gas-ballast control (Figure 1, item 5) to optimise the performance of the pump for your application. The performance characteristics of the pump with the different control settings are shown in Tables 1 and 2. You can change the position of the gas-ballast control when the pump is off or when the pump is operating.

4.1.1 Gas-ballast Control

Use the gas-ballast control to change the amount of air (or inert gas) introduced into the low vacuum stage of the pump (refer to Section 1.3.2). Use of gas-ballast will prevent the condensation of vapors in the pump; the condensates would contaminate the oil. You can turn the gas-ballast control to select one of three positions, as follows:

To select gas-ballast closed, turn the control to position '0'. Use this setting:

- to achieve ultimate vacuum;
- to pump dry gases.

To select low flow gas-ballast, turn the control to position 'I'. Use this setting:

- to pump low concentrations of condensable vapors;
- to decontaminate the oil.

To select high flow gas-ballast, turn the control to position 'II'. Use this setting:

- to pump high concentrations of condensable vapors.

When you use either low flow or high flow gas-ballast, there will be an increased rate of oil loss from the pump. Where possible, we recommend that you select low flow gas-ballast (position 'I') rather than high flow gas-ballast (position 'II') to minimize the loss of oil.

WARNING

Ensure that your system design does not allow the exhaust pipeline to be blocked.

If the oil is contaminated, or if the pump temperature is below 12 °C, or if the electrical supply voltage is more than 10% below the lowest voltage specified on the voltage indicator (Figure 4, item 4), the pump may operate at a reduced speed for a few minutes. If the pump continues to operate at reduced speed, the motor thermal overload device will open and stop the pump. When the motor has cooled, the thermal overload device will reset automatically and the pump will restart.

1. Check that the pump oil-level is between the MAX and MIN marks on the bezel of the oil-level sight-glass; if it is not, refer to Section 5.3.
2. Turn the gas-ballast control to position 'I' or 'II', as required (refer to Section 4.1.1).
3. Switch on the electrical supply to the pump; turn the on/off switch to ON.
4. If you want to achieve ultimate vacuum, to pump condensable vapors or to decontaminate the pump oil, refer to the procedures in Sections 4.3, 4.4 and 4.5 respectively. Otherwise, open the vacuum system isolation-valve.

4.3

To Achieve Ultimate Vacuum

If the pump does not achieve the performance specified in Section 2, make sure that this is not due to your system design before you contact your supplier for advice. In particular, the vapor pressure of all materials used in your vacuum system (including pump oil, see below) must be much lower than the specified ultimate vacuum of the pump. Refer to Section 5.12.2 for a list of possible causes for failure to achieve the specified performance; note however that the most common causes are:

- Your pressure measurement technique or gage head is unsuitable or the gage head is faulty.
- You have used an oil other than the recommended oil, and the vapor pressure of the oil is higher than the specified ultimate vacuum of the pump.

Use the following procedure to achieve ultimate vacuum:

1. Isolate the pump from your vacuum system.
2. Set the gas-ballast control to low flow (position 'I') and operate the pump for at least 1 hour (or overnight) to thoroughly purge the oil of contaminants.
3. Close the gas-ballast control (that is, set it to position '0').
4. Open the vacuum system isolation-valve and pump down to ultimate vacuum.

4.4 To Pump Condensable Vapors

Use gas-ballast (gas-ballast control in position 'I' or 'II') when there is a high proportion of condensable vapors in the process gases.

1. Close the vacuum system isolation-valve.
2. Turn the gas-ballast control to high flow (position 'II') and operate the pump for 30 minutes to warm the oil; this will help to prevent vapor condensation in the pump.
3. Set the gas-ballast control to the position required for your application (refer to Section 4.1.2 and the data in Tables 1 and 2).
4. Open the vacuum system isolation-valve.

After you have pumped condensable vapors, you can (if necessary) decontaminate the oil: use the procedure in Section 4.5.

4.5 To Decontaminate the Oil

The oil in the pump should be clear; if the oil is cloudy or discolored, it is contaminated with process vapors.

1. Look at the condition of the oil in the oil-level sight-glass (Figure 1, item 8). If the oil is cloudy or discolored, continue with the procedure at Step 2 below.
2. Close the vacuum system isolation-valve.
3. Set the gas-ballast control to low flow (position 'I').
4. Operate the pump until the oil is clear.

4.6 Unattended Operation

The pump is designed for unattended operation under the normal operating conditions specified in Section 2. However, we recommend that you check the pump at regular intervals of not more than 14 days, or more frequently if you pump high volumes of gas or vapor.

The motor is protected by an overload device which isolates the pump from the electrical supply when critical temperature or current levels are exceeded. The overload device resets automatically when the motor has cooled. When you check the pump, make sure that the pump is not going through a repetitive cycle of thermal overload failures and automatic resets. If necessary, reduce the thermal load from the pumped gases, to prevent overheating of the pump.

Shut-Down

We recommend, as described in the procedure below, that you decontaminate the oil before you shut down the pump; this will prevent damage to the pump by the contaminants in the oil.

1. Refer to Section 4.5 and decontaminate the oil, as required.
2. Close the vacuum system isolation-valve (if not already closed).
3. Close gas-ballast (that is, set the gas-ballast control to position '0').
4. Use the on/off switch to switch off the pump.
5. Switch off the electrical supply to the pump.

5 MAINTENANCE

5.1 Safety Information

WARNING

Obey the safety instructions given below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.

- Ensure that maintenance is done by a suitably trained and supervised technician. Obey your local and national safety requirements.
- Ensure that the maintenance technician is familiar with the safety procedures which relate to the pump-oil and the products processed by the pumping system.
- Check that all the required parts are available and of the correct type before you start work.
- Isolate the pump and other components from the electrical supply so that they cannot be operated accidentally.
- Allow the pump to cool (so that it is at a safe temperature for skin contact) before you start maintenance work. Make sure the pump is switched off in case the thermal overload device restarts the pump.
- Do not reuse 'O' rings and seals if they are damaged.
- After maintenance is completed, recheck the direction of pump rotation if the electrical supply has been disconnected.
- The pump and the pump-oil will be contaminated with the process chemicals that have been pumped during operation. Ensure that the pump is decontaminated before maintenance and that you take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred.
- Do not touch or inhale the thermal breakdown products of fluorinated materials which may be present if the pump has been heated to 310 °C and above. Fluorinated materials are safe in normal use but can decompose into very dangerous substances (which may include hydrofluoric acid) if they are heated to 310 °C and above. The pump may have overheated if it was misused or if it was in a fire. Health and Safety Data sheets for fluorinated materials used in the pump are available on request: contact your supplier.

5.2 Maintenance Plan

The plan shown in Table 6 details the routine maintenance operations necessary to maintain pumps in normal use. Instructions for each operation are given in the section shown.

Operation	Frequency	Refer to Section
Check the oil-level	Monthly	5.3
Replace the oil	Every 3000 hours	5.4
Inspect and clean the inlet-filter	Yearly	5.5
Inspect and clean the gas-ballast control	Yearly	5.6
Clean the oil-level sight-glass	Yearly	5.7
Clean the motor fan-cover and enclosure	Yearly	5.8
Clean and overhaul the pump	Every 15000 hours	5.9
Fit new blades	Every 30000 hours	5.10
Test the motor condition	Every 15000 hours	5.11

Table 4 - Maintenance Plan

More frequent maintenance may be required if the pump is used to pump corrosive or abrasive gases and vapors, such as solvents, organic substances and acids; in these circumstances, we recommend that you replace the pump seals every year.

If necessary, adjust the maintenance plan according to your experience.

5.3 Check the Oil-level

Note: If required, you can check the oil-level while the pump is operating, however you must switch off the pump and isolate the pump and other components in the pumping system from the electrical supply before you pour oil into the pump.

Refer to Figure 1 for the items in brackets.

1. Check that the oil-level in the sight-glass (8) is between the MAX and MIN level marks on the bezel of the sight-glass.
2. If the oil-level is near to or below the MIN level mark, remove one of the filler-plugs (6) and pour more oil into the reservoir until the oil reaches the MAX level mark. If the oil-level goes above the MAX mark, remove the drain-plug (9) and drain the excess oil from the pump. Refit the filler-plug.
3. If the oil is contaminated, drain and refill the pump with clean oil as described in Section 5.4.

5.4 Replace the Oil

1. Refer to Figure 1. Operate the pump for approximately ten minutes to warm the oil, then switch off the pump (this lowers the viscosity of the oil and enables it to be drained from the pump more easily).
2. Isolate the pump from your electrical supply and disconnect it from your vacuum system.
3. Remove one of the oil filler-plugs (6).
4. Place a suitable block under the pump-motor to tilt the pump and place a suitable container under the drain-plug (9). Remove the drain-plug and allow the oil to drain into the container.
5. If the oil drained from the pump is contaminated, pour clean oil into the filler-hole and allow it to drain out of the pump. Repeat this step until the oil reservoir in the pump has been thoroughly cleaned.
6. Refit the drain-plug, remove the block and reconnect the pump to your vacuum system.
7. Fill a suitable container with clean oil and pour the oil into the filler hole until the oil-level reaches the MAX level mark on the bezel of the sight-glass (8).
8. Allow a few minutes for the oil to drain into the pump. If necessary, add more oil. Refit the filler-plug.

5.5 Inspect and Clean the Inlet-filter

1. Refer to Figure 5. Disconnect your vacuum system from the pump inlet-port (3) and remove the centring-ring and filter assembly (1) and the 'O' ring (2). Inspect the centring-ring and the 'O' ring. If they are clean, continue at Step 5. If they are not clean, continue at Step 2.
2. Remove the 'O' ring (2) from the centring-ring and filter assembly (1). Do not allow the 'O' ring to come into contact with the cleaning solution.
3. Wash the centring-ring and filter assembly in a suitable cleaning solution and allow it to dry.
4. If necessary, wipe the 'O' ring with a clean, dry, lint-free cloth.
5. Refit the centring-ring and filter assembly and the 'O' ring to the inlet-port. Refit your vacuum system to the pump inlet-port.

1. Centring-ring and filter assembly
2. 'O' ring
3. Inlet-port

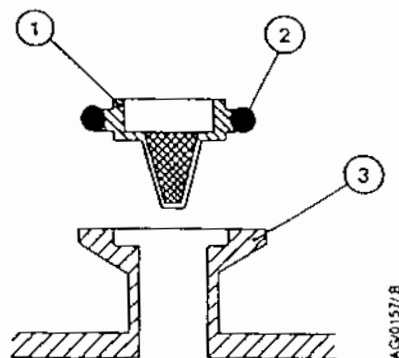


Figure 5 - Inlet-filter Assembly

5.6 Inspect and Clean the Gas-ballast Control

Note: The gas-ballast filter element (Figure 6, item 7) is retained in its seating with adhesive; do not try to remove it.

1. Refer to Figure 6. Turn the gas-ballast control (1) to the high flow position (position 'II').
2. Push the control down against the compression spring (6) as far as it will go, then turn the control anticlockwise slightly to release the bayonet-lugs (5) and remove the control.
3. If necessary, wipe the control with a clean, dry, lint-free cloth and check that the air-hole (3) is not blocked.
4. Refit the control into the gas-ballast inlet and ensure that the compression spring locates correctly between the bayonet-lugs.
5. Push the control down as far as it will go and then turn the control clockwise slightly until the bayonet-lugs engage correctly.
6. Reset the gas-ballast control to the required position.

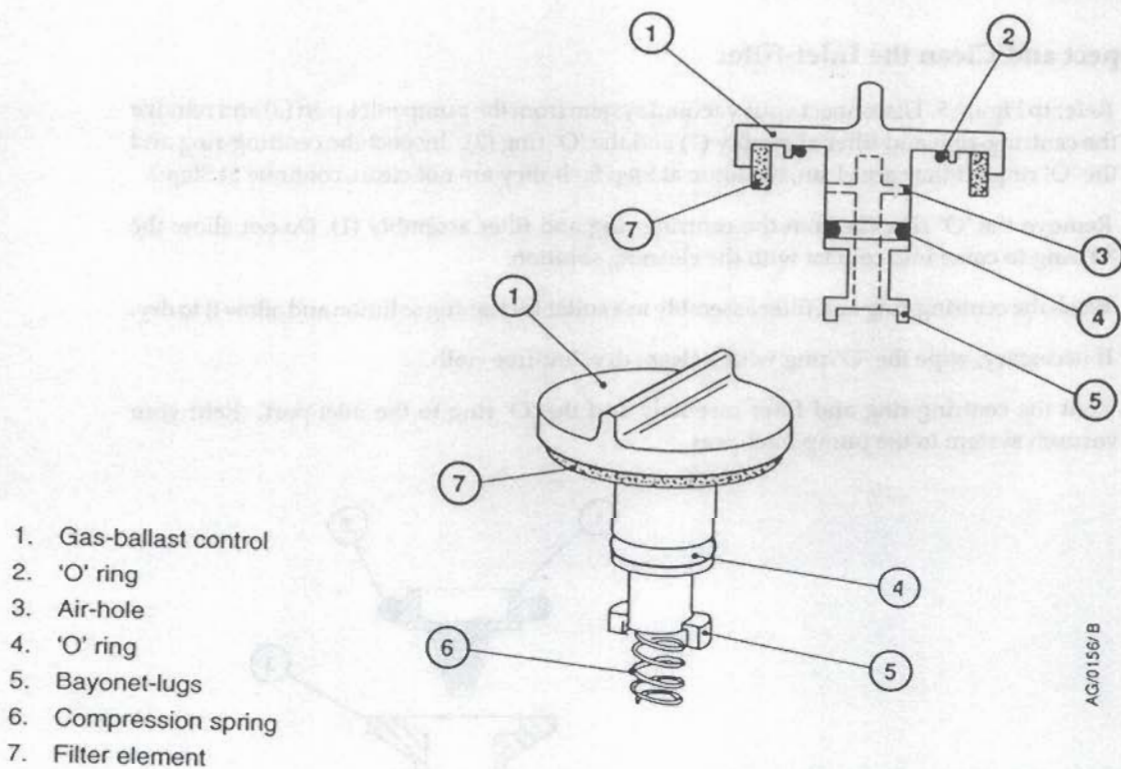


Figure 6 - Gas-ballast Control Assembly

5.7 Clean the Oil-level Sight-glass

Refer to Figure 7 for the item numbers in brackets.

1. Drain the oil as described in Section 5.4.
2. Undo the two screws (1) and remove the bezel (2), the sight-glass (3) and the 'O' ring (4) from the oil-box (5).
3. Clean the screws, bezel and sight-glass with a suitable cleaning solution.
4. Wipe the 'O' ring with a clean, dry, lint-free cloth.
5. Wipe the sight-glass recess in the oil-box with the cloth.
6. Refit the 'O' ring, sight-glass and bezel and secure with the two screws.
7. Refill the pump with oil as described in Section 5.4.
8. Check that the sight-glass does not leak.

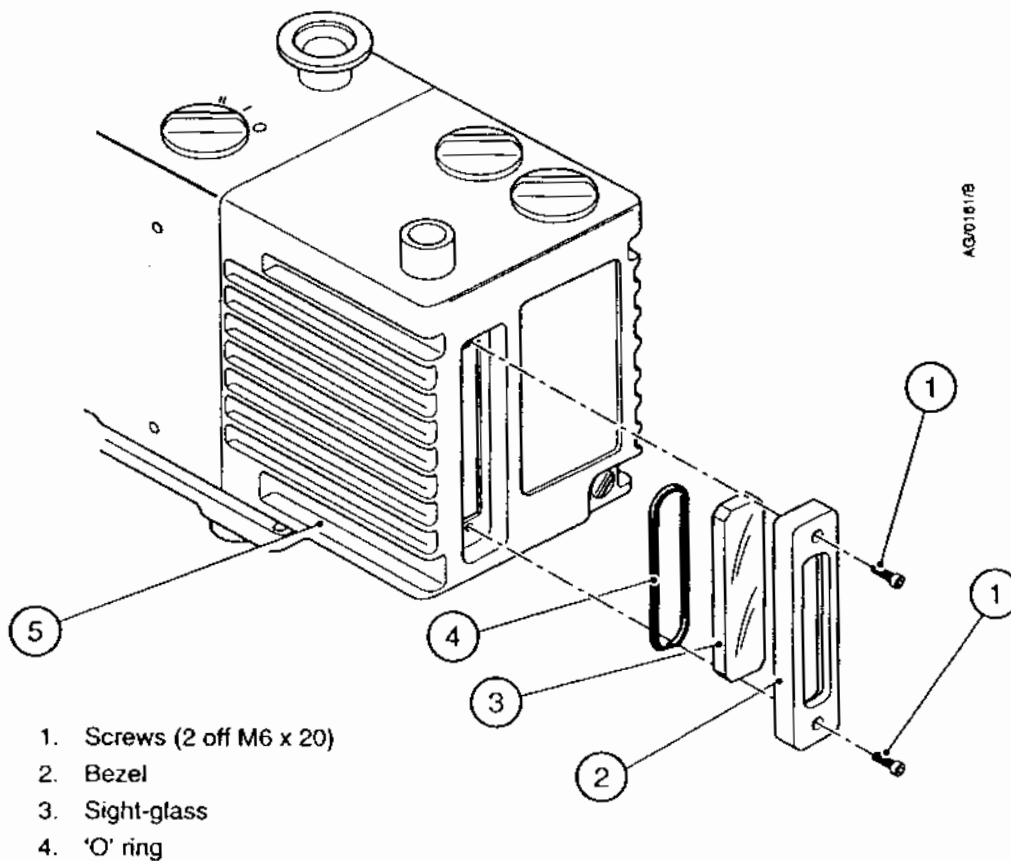


Figure 7 - Sight-glass Assembly

5.8 Clean the Motor Fan-cover and Enclosure

If the motor fan-cover and enclosure are not kept clean, the air-flow over the motor can be restricted and the pump may overheat.

1. Switch off the pump and disconnect it from the electrical supply.
2. Use a dry cloth and a soft brush to remove dirt and deposits from the fan-cover and enclosure.

5.9 Clean and Overhaul the Pump

Clean and overhaul the pump as described in the instructions supplied with the clean and overhaul kit (see Section 7).

5.10 Fit NW Blades

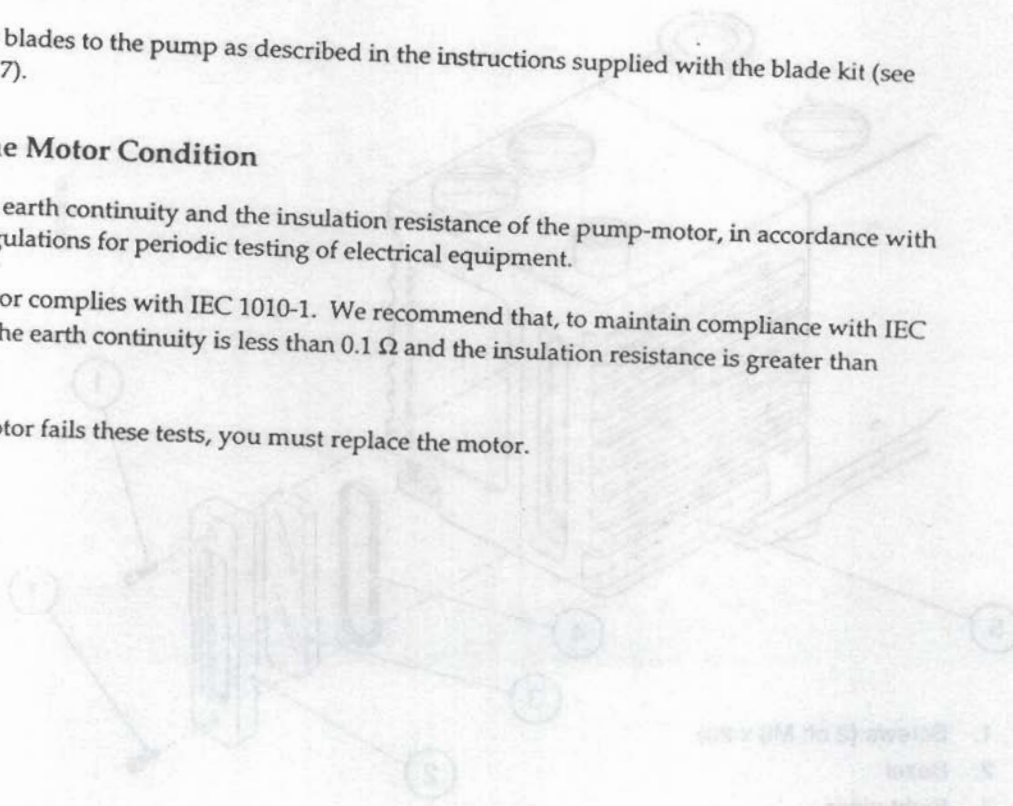
Fit new blades to the pump as described in the instructions supplied with the blade kit (see Section 7).

5.11 Test the Motor Condition

Test the earth continuity and the insulation resistance of the pump-motor, in accordance with local regulations for periodic testing of electrical equipment.

The motor complies with IEC 1010-1. We recommend that, to maintain compliance with IEC 1010-1, the earth continuity is less than 0.1Ω and the insulation resistance is greater than $10 M\Omega$.

If the motor fails these tests, you must replace the motor.



5.12 Fault-finding

A list of fault conditions and their possible causes is provided here to assist you in fault-finding.

5.12.1 The Pump has Failed to Start

- The electrical supply fuse has blown.
- The electrical supply voltage does not match that of the motor.
- The outlet pipeline or the outlet-filter (if fitted) is blocked.
- The oil temperature is below 12 °C.
- The oil is too viscous.
- The oil is contaminated.
- The pump has seized after long storage.
- The pump has been left to stand after contaminants have been pumped and has seized.
- The motor is faulty.

5.12.2 The Pump has Failed to Achieve the Specified Performance (has failed to reach ultimate vacuum)

- Your pressure measurement technique or gage head is unsuitable or gives an incorrect indication of pressure. For example, a contaminated Pirani gage can indicate a pressure which is several times higher than the actual pressure in the system.
- You have filled the pump with the wrong type of oil.
- There is a leak in your vacuum system.
- The gas-ballast control is set incorrectly.
- The oil-level is below minimum level.
- The oil is contaminated.
- Your vacuum fittings are dirty or damaged.
- The inlet-filter is blocked.
- The pump has not warmed up.

5.12.3 The pump is Noisy

- The motor fan-cover is damaged.
- The motor bearings are worn.
- The oil is contaminated with solid particles.

5.12.4 The Pump Surface Temperature is Above 100 °C

Note: If the inlet pressure is continuously higher than 100 mbar, the surface temperature of the pump can reach 115 °C when the ambient temperature is 40 °C.

- The ambient temperature is too high.
- The cooling-air supply is insufficient or is too hot.
- The electrical supply voltage is too high.
- The outlet-filter or the outlet pipeline is blocked.
- The oil-level is below minimum level.
- You have filled the pump with the wrong type of oil.
- The oil is contaminated.
- The process gas is too hot or the throughput is too high.

5.12.5 The Vacuum is not Fully Maintained after the Pump is Switched Off

- The gas-ballast control is open (that is, in position 'I' or 'II').
- The inlet valve-pad is damaged.
- The inlet valve has not closed.

5.12.6 The Pumping Speed is Poor

- The connecting pipelines are too small in diameter.
- The connecting pipelines are too long.
- The inlet-filter is blocked.

5.12.7 There is an External Oil Leak

- The outer shaft-seal is worn or damaged.
- The oil-box gaskets have deteriorated.
- There is an oil leak from the gas-ballast control.
- There is an oil leak from the drain-plug.
- There is an oil leak from the sight-glass.

6 STORAGE AND DISPOSAL

6.1 Storage



Note: If you will store a new pump in conditions of high humidity, remove the pump from its cardboard packaging box; dispose of the box (refer to Section 6.2).

Use the following procedure to store the pump:

1. Shut-down the pump as described in Section 4.
2. Disconnect the pump from the electrical supply.
3. Purge your vacuum system and the pump with dry nitrogen and disconnect the pump from your vacuum system.
4. Replace the oil as described in Section 5.4.
5. Place and secure protective covers over the inlet and outlet-ports.
6. Store the pump in cool, dry conditions until required for use. When required, prepare and install the pump as described in Section 3. If the pump has been stored for more than a year, before you install the pump you must clean and overhaul it as described in the instructions supplied with the clean and overhaul kit.

6.2 Disposal

Dispose of the pump and any components removed from it safely in accordance with all local and national safety and environmental requirements.

Particular care must be taken with components and waste oil which have been contaminated with dangerous process substances.

Do not incinerate fluoroelastomer seals and 'O' rings.

7 MAINTENANCE KITS

7.1 Description

Three kits provided for the maintenance of the pumps are described as follows:

Clean and Overhaul Kit - to replace the springs, seals and elastomer components in the pump.

Blade Kit and Clean and Overhaul Kits - to replace the blade in the pump.

Inlet Valve Kit - to replace the inlet valve assembly in the pump.

7.2 Unpack and Inspect

Check that your kit contains the components listed in Table 5, 6 or 7 as appropriate. Note that the Clean and Overhaul Kit components are packed in three separate bags, labelled bag 1, 2 and 3; the contents of the bags are shown in Table 7.

If the kit is not to be used immediately, replace the protective covers and repack the components of the kit in the packing materials. Store the kit in cool, dry conditions until required for use.

Qty	Description	Figure 9 reference	Check (✓)
1	Oil-pump blade	115	<input type="checkbox"/>
2	H. V blade	116	<input type="checkbox"/>
3	L. V blade	117	<input type="checkbox"/>

Table 5 - Checklist of Blade Kit Components

Qty	Description	Figure 8 and 10 reference	Check (✓)
1	Inlet-valve assembly (assembled); this comprises of the following components (shown in Figure 10):	202	<input type="checkbox"/>
	Valve cover	202-1	
	Piston	202-2	
	Valve pad	202-3	
	Brush	202-4	
	'U' seal	202-5	
	'O' ring: 49.5 x 3.0, nitrile	202-6	
	'O' ring: 7.6 x 2.4, viton	202-7	
	'O' ring: 32.5 x 3.0, nitrile	202-8	
1	Spring (inlet-valve)	213	<input type="checkbox"/>
1	Printed gasket (top-plate)	216	<input type="checkbox"/>

Table 6 - Checklist of Inlet-Valve Kit Components

Bag Label	Qty	Description	Figure 8-10 reference	Check (✓)
Bag 1	1	Shaft-seal spacer	C	<input type="checkbox"/>
	1	Air Bleed Assembly	201	<input type="checkbox"/>
	1	Reed valve	111	<input type="checkbox"/>
	1	Oldham coupling (L.V. Oil pump)	119	<input type="checkbox"/>
	1	Printed gasket (seal carrier)	120	<input type="checkbox"/>
	1	Shaft-seal (inner)	123	<input type="checkbox"/>
	1	Shaft-seal (outer)	124	<input type="checkbox"/>
	1	Gas ballast check-valve	210	<input type="checkbox"/>
	2	Spring (dump valve and gas ballast check-valve)	211	<input type="checkbox"/>
	1	Printed gasket (cartridge)	215	<input type="checkbox"/>
	1	Dump valve	217	<input type="checkbox"/>
	1	Oil pressure valve	209	<input type="checkbox"/>
	1	'O'ring: 57.6 x 2.4 (cartridge/adaptor)	219	<input type="checkbox"/>
	1	Coupling element	411	<input type="checkbox"/>

Bag Label	Qty	Description	Figure 8-10 reference	Check (✓)
Bag 2	1	Inlet valve 'U' seal	202-5	<input type="checkbox"/>
	1	'O' ring: 49.5 x 3.0, nitrile (inlet valve)	202-5	<input type="checkbox"/>
	1	'O' ring: 7.6 x 2.4, (inlet valve)	202-5	<input type="checkbox"/>
	1	'O' ring: 32.5 x 3.0, nitrile (inlet valve)	202-5	<input type="checkbox"/>
	1	Spring (inlet valve)	213	<input type="checkbox"/>
	1	Printed Gasket (top plate)	216	<input type="checkbox"/>
Bag 3	1	'O' ring: 42.5 x 3.0, nitrile (inlet connection)*	005	<input type="checkbox"/>
	1	'O' ring: 14.6 x 2.4, nitrile (gas ballast control)	203-3	<input type="checkbox"/>
	1	'O' ring: 9.6 x 2.4 (mode selector)	204-3	<input type="checkbox"/>
	1	Spring (gas ballast control)	212	<input type="checkbox"/>
	2	'O' rings: 21.5 x 3.0, nitrile (gas ballast insert and mode selector)	220	<input type="checkbox"/>
	1	Exhaust diaphragm	301-3	<input type="checkbox"/>
	1	Printed gasket (oil-box)	314	<input type="checkbox"/>
	3	'O' rings: 28.2 x 3.53, nitrile (oil filler-plugs and Exhaust-flange)	319	<input type="checkbox"/>
	1	'O' ring: 28.2 x 3.53, nitrile (sight glass)	321	<input type="checkbox"/>
	1	'O' ring: 15.6 x 2.4, nitrile (oil drain plug)	323	<input type="checkbox"/>
1	'O' ring: 21.5 x 3.0, nitrile (gas ballast control)	203-4	<input type="checkbox"/>	
1	Shoulder washer	222	<input type="checkbox"/>	

* If required.

Table 7 - Checklist of Clean and Overhaul Kit Components

7.3 How to Use the Clean and Overhaul Kit

Refer to Figures 8 to 10 which show exploded views of the pump and use the following procedure to install the components of the kit. Where necessary, refer to the pump instruction manual.

1. Switch off the pump, disconnect it from the electrical supply and allow the pump to cool.
2. Drain the oil from the pump. Undo and remove the bolts (327) which secure the oil-box (310) and remove the oil-box from the pump. Remove any debris from the inside of the oil-box, then clean all surfaces of the oil-box with a suitable cleaning solution.
3. Dismantle the pump; we recommend that you do not remove the shaft-seal sleeve (109) from the H.V. rotor (102). Use a suitable cleaning solution to clean all of the surfaces of the components that you will reuse.
4. If the pump has a detachable stainless steel inlet flange (instead of the integral top-plate (208), remove the inlet flange and replace the 'O' ring (005) with the 'O' ring supplied.
5. Press the outer shaft-seal (124) out of the seal carrier (110). Press through the three 3 mm diameter holes (located around the bearing bore) in the outer surface of the H.V. stator (101) to remove the inner shaft-seal (123).
6. Inspect the shaft-seal sleeve (109) for signs of wear. If the shaft-seal sleeve is worn, place the shaft-seal spacer (C) in the seal carrier (110) before you fit the replacement outer shaft-seal.
7. Use the components supplied in the Clean and Overhaul Kit to replace the corresponding components in the pump. Ensure that the components are clean before you fit them; before you fit elastomer components, wipe them with a clean lint-free cloth and lightly lubricate them with the oil which you use in your pump.
8. Remove and inspect the restrictor (226). If necessary, use a suitable cleaning solution to clean the restrictor orifice.
9. Remove and inspect the filter (if fitted) from the air bleed assembly (201). If necessary, use a suitable cleaning solution to clean the orifice and the filter.
10. Reassemble the pump. When you refit the side panels (408, 412), ensure that you do not over-tighten the securing screws. If the side panels are damaged, you must replace them before you operate the pump.
11. Use the oil-box printed gasket (314) supplied in the kit and refit the oil-box (310) to the pump. Fill the pump with the correct quantity of new oil,
12. Fit an oil mist filter to the pump-outlet and connect the outlet of the oil mist filter to a suitable exhaust-extraction system.
13. Connect the pump to the electrical supply, then look at the oil-level in the sight-glass and switch on the pump; check that the oil-level drops by 3 to 5 mm when you switch on the pump. If the oil-level does not drop, refer to the pump instruction manual.
14. Refer to the pump instruction manual for normal operation of the pump.
15. Dispose of the old components and used oil safely in accordance with all local and national safety and environmental requirements.

7.4 How to Use the Blades Kit

Refer to Figures 8 to 10 which show exploded views of the pump and use the following procedure to install the components of the kit. Where necessary, refer to the pump instruction manual.

1. Dismantle the pump, clean the pump components and replace the pump components with the components supplied in the Clean and Overhaul Kit as described in Steps 1 to 9 of Section 7.3.
2. Dismantle the cartridge (Figure 9): ensure that you take note of the orientation of the blades (116, 117) in the cartridge.
3. Use a suitable cleaning solution to clean all the surfaces of the components in the Blade Kit and the surfaces of the dismantled cartridge which you will reuse.
4. Replace the H.V. and L.V. blades in the cartridge (116, 117) with the new blades supplied in the Blade Kit; ensure that you fit the blades in the correct orientation (as noted in Step 2).
5. Replace the oil-pump blade (115) with the new blade supplied in the Blade Kit and reassemble the cartridge.
6. Reassemble and commission the pump as described in Steps 11 to 14 of Section 7.3.
7. Dispose of the old components and used oil safely in accordance with all local and national safety and environmental requirements.

7.5 How to Use the Inlet-Valve Kit

Refer to Figures 8 to 10 which show exploded views of the pump and use the following procedure to install the components of the kit. Where necessary, refer to the pump instruction manual.

1. Switch off the pump, disconnect it from the electrical supply and allow the pump to cool.
2. Remove the side panels (408, 412). Remove the top-cover from the motor and loosen the motor securing bolts (421).
3. Undo and remove the four screws which secure the top-plate (208). Remove the top-plate and the top-plate printed gasket (216).
4. Use a suitable tool to firmly grip the rim of the valve cover (202-1), pull out the inlet-valve assembly (A) and remove the spring (213).
5. Fit the new spring and inlet-valve assembly supplied in the kit.
6. Fit the new top-plate printed gasket (216) supplied in the kit, then fit the top-plate (208) and secure it with the four screws removed in Step 3.
7. Tighten the motor bolts (421) and refit the top-cover on the motor. On all pumps, refit the side panels (408, 412).
8. Dispose of the old components safely in accordance with all local and national safety and environmental requirements.

- A Oil pressure/dump valve assembly
- B Cartridge
- F Gas ballast check valve assembly
- D Motor starting relay
- E Motor top cover

- 202 Inlet valve assembly; see Figure 10
- 208 Top-plate
- 226 Restrictor
- 310 Oil-box
- 327 Bolt

- 408 Side panel
- 412 Side panel
- 421 Bolt
- * Included in the clean and overhaul kit; see table 3
- † Included in the Blade Kit;
- ◆ Included in the Inlet Valve Kit;
- Included for reference only; see key →

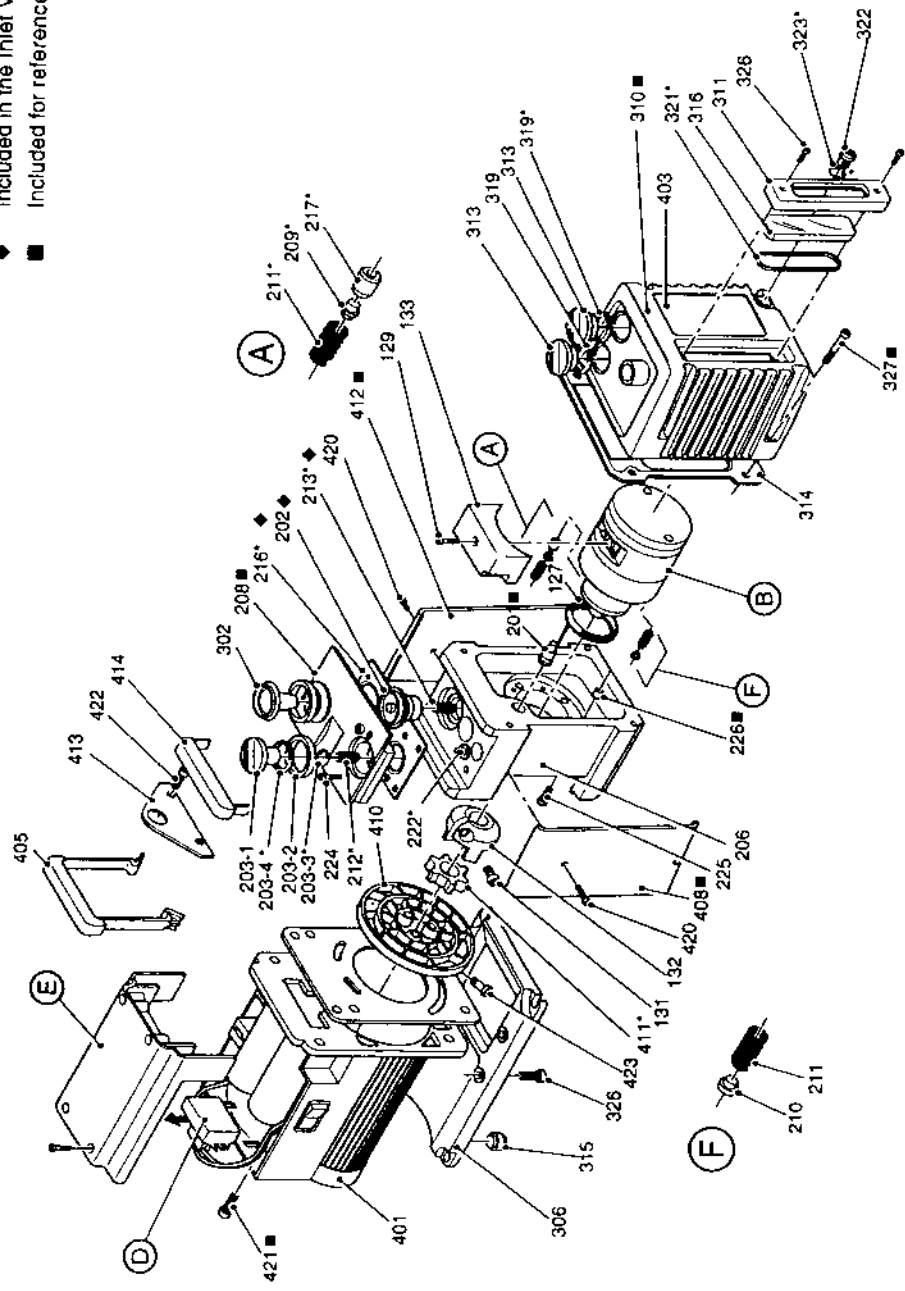
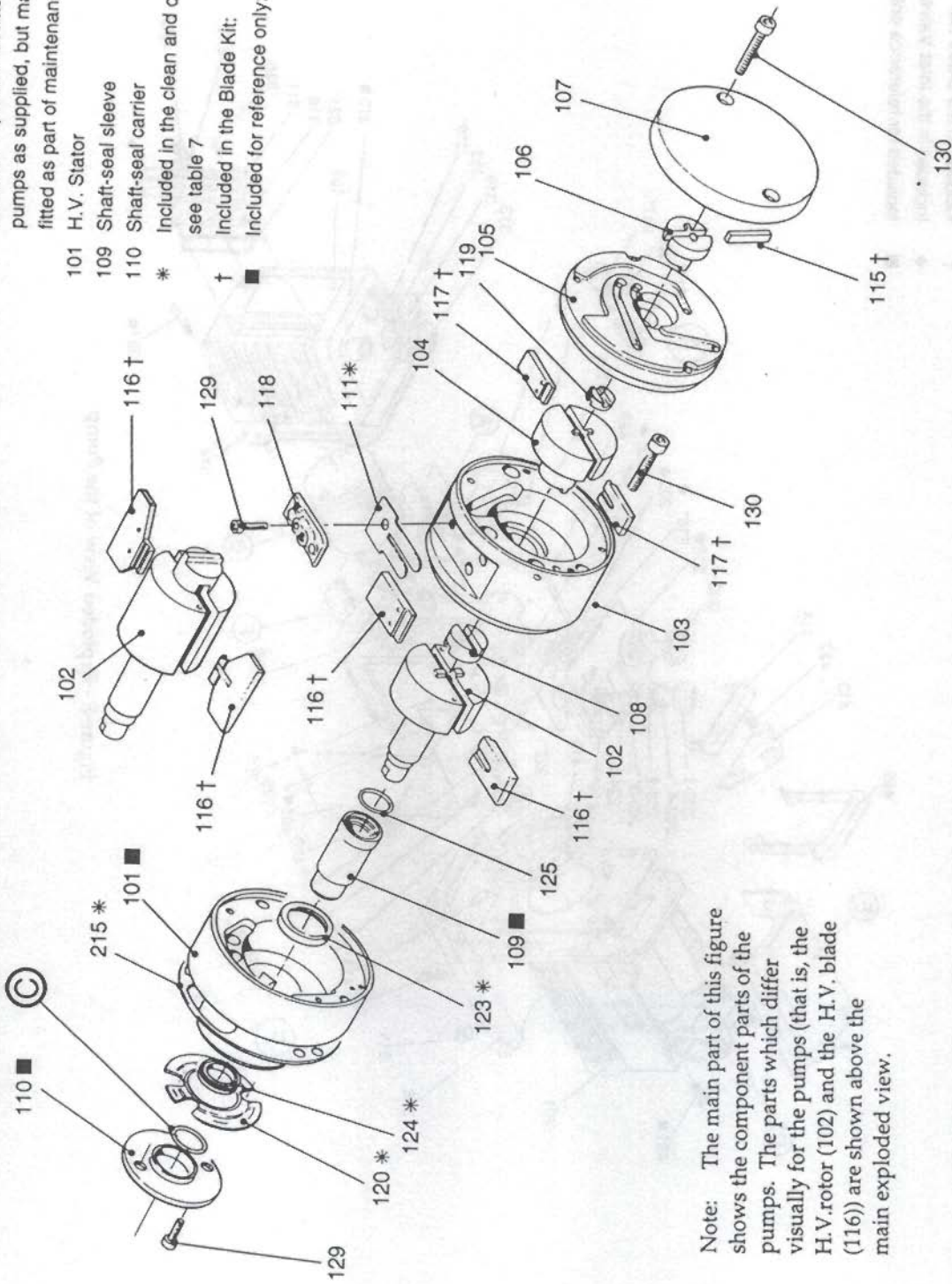


Figure 8 - Exploded View of the Pump

- C Shaft-seal spacer: not fitted to pumps as supplied, but may be fitted as part of maintenance
- 101 H.V. Stator
- 109 Shaft-seal sleeve
- 110 Shaft-seal carrier
- * Included in the clean and overhaul kit: see table 7
- † Included in the Blade Kit:
- Included for reference only: see key →



Note: The main part of this figure shows the component parts of the pumps. The parts which differ visually for the pumps (that is, the H.V. rotor (102) and the H.V. blade (116)) are shown above the main exploded view.

Figure 9 - Exploded View of the Cartridge

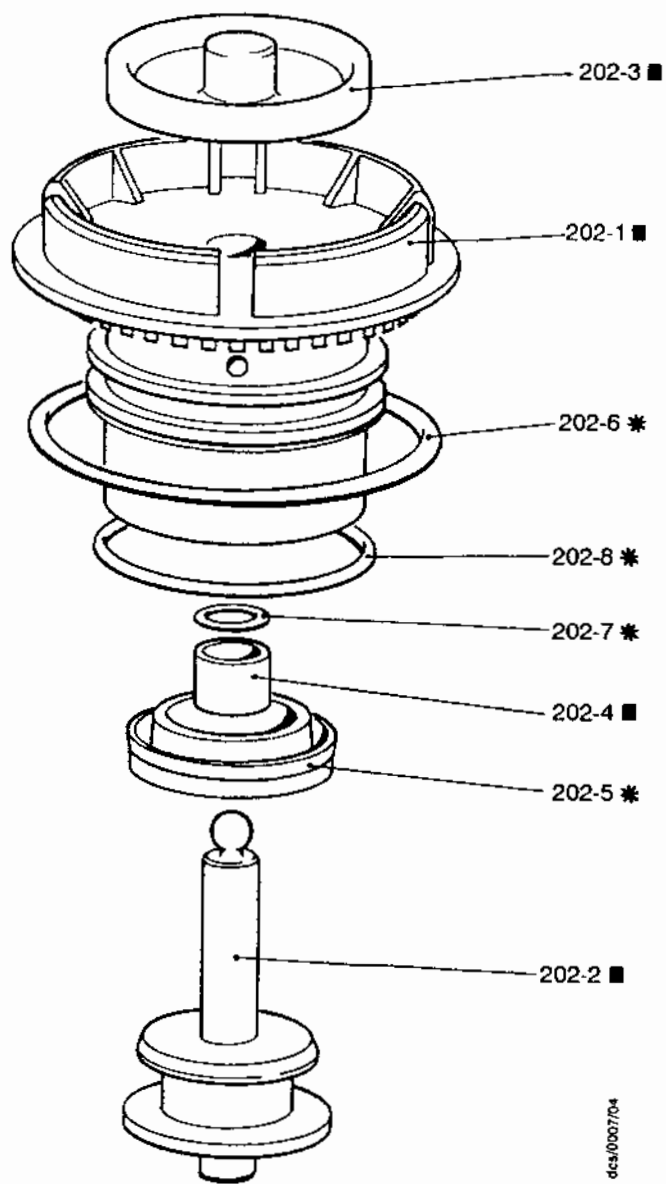


Figure 10 - Exploded View of the Inlet-valve Assembly

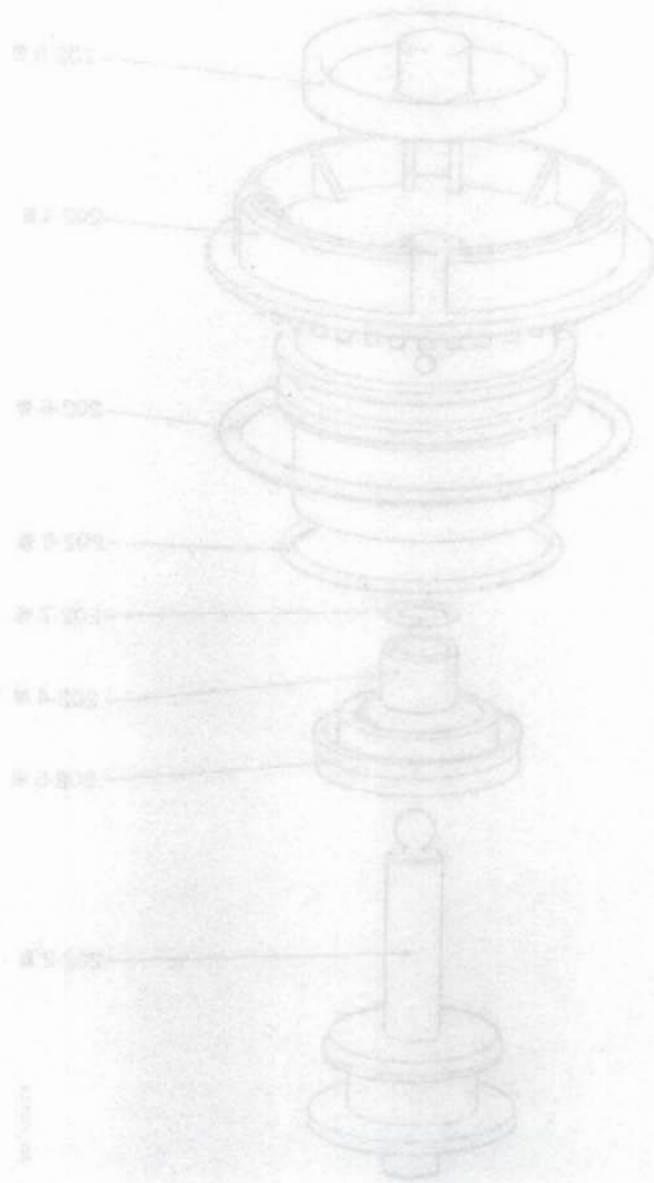


Figure 10 - Exploded View of the Valve Assembly

