

Instructions

E1M18 and E2M18 Rotary Vacuum Pumps

Description

E1M18, 100 /200 V, 50 Hz, or 100-105/200-210 V, 60 Hz, single-phase
E1M18, 115/230 V, 60 Hz, single phase
E1M18, 220 V, 50/60 Hz, single phase
E1M18, 220-240 V, 50 Hz, single-phase
E1M18, 220-240 V, 50 Hz, or 230-240 V, 60 Hz single phase
E1M18, 200-230/ 380-460 V, 50/60 Hz, three-phase
E2M18, 100 /200 V, 50 Hz, or 100-105/200-210 V, 60 Hz, single-phase
E2M18, 115/230 V, 60 Hz, single phase
E2M18, 220 V, 50/60 Hz, single phase
E2M18, 220-240 V, 50 Hz, single-phase
E2M18, 220-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase
E1M18 200-230/380-460 V, 50/60 Hz, three phase

Item Number

A343-15-904
A343-15-981
A343-15-920
A343-15-912
A343-15-903
A343-10-940
A363-15-904
A363-15-981
A363-15-920
A363-15-912
A363-15-903
A363-10-940



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Associated publications

Publication title	Publication number
Vacuum Pump and Vacuum System Safety	P300-20-000

1 INTRODUCTION

1.1 Scope of this manual

This manual provides installation, operation and maintenance instructions for the Edwards E1M18 and E2M18 rotary vacuum pumps. You must use the pump as specified in this manual. Read this manual before you install and operate the pump.

Important safety information is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is 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.

The following warning symbols are on the pump:



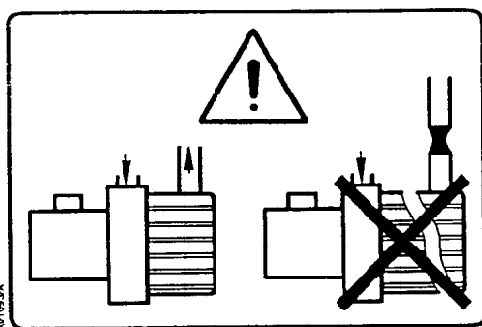
Caution - refer to accompanying documents.



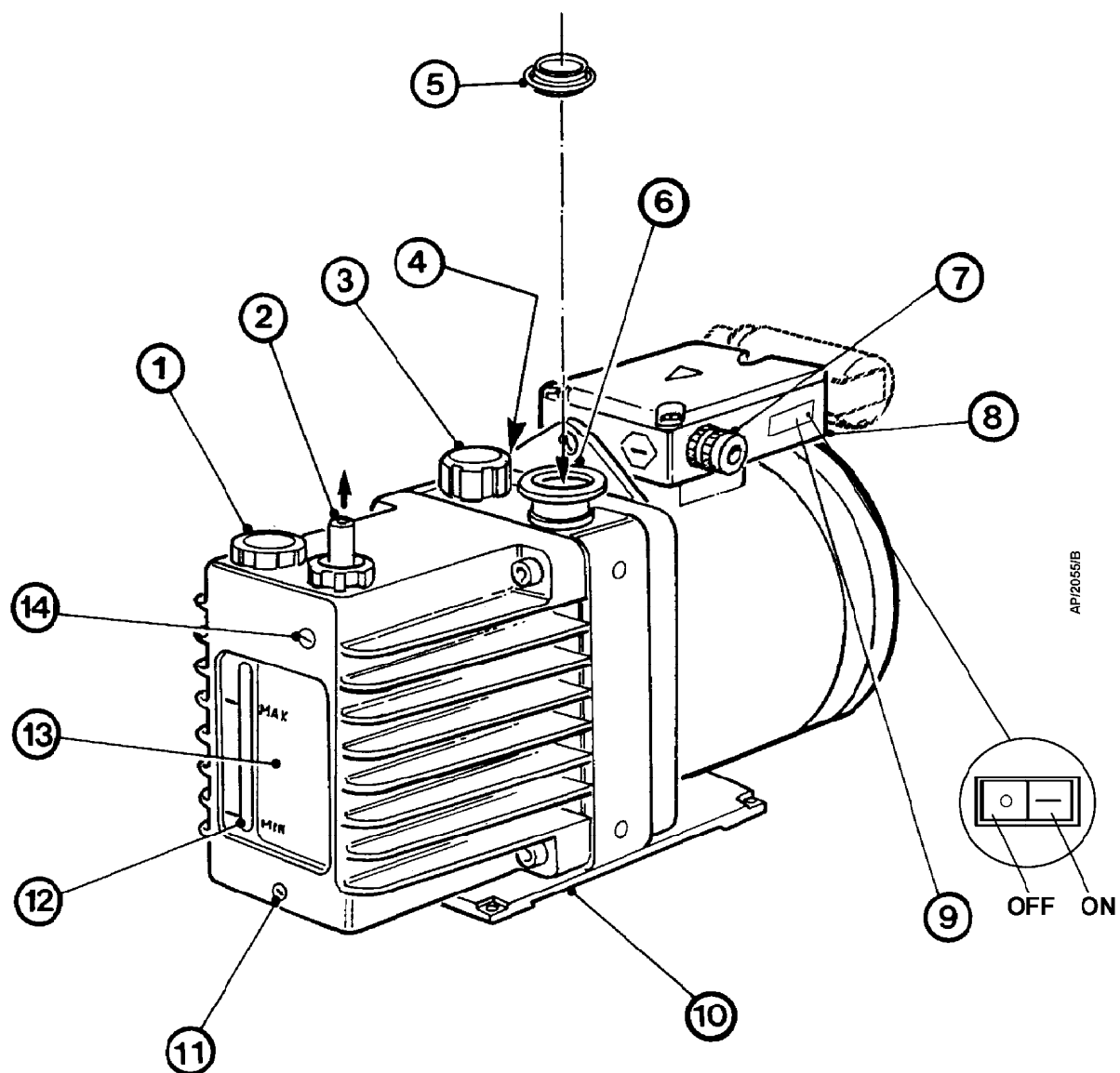
Caution - risk of electric shock.



Caution - hot surface.



Caution - do not block the pump outlet.



- | | |
|---|--|
| 1. Oil filler-plug | 9. On/Off switch (on single-phase motors only) |
| 2. Outlet nozzle | 10. Baseplate |
| 3. Gas-ballast control | 11. Oil drain-plug (gravity drain) |
| 4. Gas ballast inlet | 12. Oil sight-glass |
| 5. NW25 centring ring and 'O' ring (supplied) | 13. Pump identification label |
| 6. NW25 inlet-port (adaptor flange) | 14. Oil drain-plug (pressure drain) |
| 7. Cable gland | |
| 8. Motor terminal box | |

Figure 1 - The E1M18 or E2M18 pump (single-phase motor shown)

1.2 Description

The Edwards E1M18 and E2M18 pumps are shown in Figure 1. Refer to Figure 1 for item numbers in brackets in the following descriptions.

The E1M18 and E2M18 pumps are two-stage, direct drive, sliding vane pumps. The pumps are oil-sealed and designed for reliable, long-term operation in both laboratory and industrial environments. The pumps are free-standing units. The drive is provided through a flexible coupling by a single-phase or three-phase (four pole) motor.

The motors are totally enclosed and are cooled by the motor-cooling fan which directs air along the motor fins.

The single-phase motors have a thermal overload device. When the motor is too hot, the thermal overload device switches off the pump. The thermal overload device has an automatic reset; when the motor cools down, the device resets and the motor will restart. The single-phase motors have an on/off switch.

An oil pressure system lubricates the pump shaft bearing surfaces and rotor sealing faces. The pump has an oil distribution valve which prevents discharge of oil to the pump interior (suckback) after the pump stops. The pumping chambers are air-tight, so this arrangement prevents air suckback unless the gas-ballast valve is open. For protection in this case, refer to Section 1.3.

You can inspect the level and condition of oil in the oil box reservoir through the oil sight-glass (12). An oil filler-plug (1) is fitted to the top of the oil box. The pump has two oil drain-plugs (11 and 14) to allow either gravity oil drain or pressure oil drain.

The pump has inlet-port (6), outlet nozzle (2) and gas-ballast control (3). The pump is mounted on an aluminium alloy baseplate (10) on rubber pads. Details of suitable vibration isolators and other recommended accessories are given in Section 7.

1.3 Gas-ballast

When you use the pump with high vapour throughputs, you should use the gas-ballast facility to prevent condensation of the vapours inside the pump.

The condensates will contaminate the oil, will cause performance to deteriorate and may cause corrosion of the pump mechanism. Air (or an inert gas) is introduced to the pump mechanism through the gas-ballast control (Figure 1, item 3).

The gas-ballast control is a multi-turn valve. From closed, the first two turns of the gas-ballast control provide an additional oil-feed to the pump mechanism, but do not introduce gas-ballast into the pump. The additional oil-feed improves the lubrication and sealing of the pump mechanism. After the first two turns of the gas-ballast control, the gas-ballast flow into the pump increases from zero, until the valve is fully open.

2 TECHNICAL DATA

2.1 Operating and storage conditions

Ambient temperature range (operation)	13 to 40 °C
Normal surface temperature of the pump-body at ultimate vacuum (operation) ambient temperature of 20 °C	45 to 65 °C
Maximum humidity (operation)	90% RH
Ambient temperature range (storage)	-30 to 70 °C

2.2 Performance

Note: Where total pressures are shown in the technical data tables, measurements were taken using an untrapped total pressure capacitance diaphragm gauge on a header, as specified by Pneurop standards.

	E1M18	E2M18
Maximum displacement		
50 Hz electrical supply	20.5 m ³ h ⁻¹	20.5 m ³ h ⁻¹
60 Hz electrical supply	25.0 m ³ h ⁻¹	25.0 m ³ h ⁻¹
Maximum speed - Pneurop		
50 Hz electrical supply	17.0 m ³ h ⁻¹	17.0 m ³ h ⁻¹
60 Hz electrical supply	20.4 m ³ h ⁻¹	20.4 m ³ h ⁻¹
Motor rotational speed		
50 Hz electrical supply	1440 r min ⁻¹	1440 r min ⁻¹
60 Hz electrical supply	1720 r min ⁻¹	1720 r min ⁻¹
Ultimate vacuum		
without gas-ballast (partial pressure)	2 x 10 ⁻² mbar (2 Pa)	1 x 10 ⁻⁴ mbar (1 x 10 ⁻² Pa)
without gas-ballast (total pressure)	3 x 10 ⁻² mbar (3 Pa)	1 x 10 ⁻³ mbar (1 x 10 ⁻¹ Pa)
with full gas-ballast (partial pressure)	6.5 x 10 ⁻¹ mbar (6.5 x 10 ¹ Pa)	5 x 10 ⁻³ mbar (5 x 10 ⁻¹ Pa)
Maximum water vapour inlet pressure	50 mbar (5 x 10 ³ Pa)	20 mbar (2 x 10 ³ Pa)
Maximum water vapour pumping rate	0.65 kgh ⁻¹	0.3 kgh ⁻¹
Maximum permitted outlet pressure (at full pump throughput)	0.5 bar gauge, 1.5 bar absolute, 1.5 x 10 ⁵ Pa	0.5 bar gauge, 1.5 bar absolute, 1.5 x 10 ⁵ Pa

2.3 Mechanical data

2.3.1 General

	E1M18	E2M18
Mass (approximate)	32kg	36 kg
Dimensions	See Figure 2	See Figure 2
Degree of protection (IEC34-5:1981)		
Single-phase motors	IP44	IP44
Three-phase motors	IP54	IP54
Pump inlet-port	NW25 (flange can be removed from 1 inch BSP threaded hole).	
Pump outlet port	15 mm external diameter nozzle (nozzle can be removed from 3/4 inch BSP threaded hole).	
Noise level at 1 metre	57 dB(A)@ 50 Hz	57 dB(A)@ 50 Hz

2.4 Electrical data: single-phase motors

The electrical data for single-phase motors is given in Table 1. The motor start-up current is drawn for less than one second, so you must use slow-blow fuses to prevent unnecessary fuse failure when the pump starts. Fuses should be to EN60269 Section 2.2. For conformance with CSA standards only CSA certified fuses are to be used. If you use the pump at temperatures lower than 13 °C, the start-up current will be drawn for longer; this may cause the motor thermal overload device to open.

Motor output rating (continuous)	
50 Hz	0.55 kW or 0.65 kW
60 Hz	0.75 kW

2.5 Electrical data: three-phase motors

The electrical data for three-phase motors is given in Table 2. The motor start-up current is drawn for less than one second, so you must use slow-blow fuses to prevent unnecessary fuse failure when the pump starts. Fuses should be to EN60269 Section 2.2. For conformance with CSA standards only CSA certified fuses are to be used.

Motor output rating (continuous)	
50 Hz	0.65 kW
60 Hz	0.75 kW

2.6 Lubrication data

Note: An Edwards Health and Safety Data Sheet for the following oil is available on request.

Recommended oil*	Ultragrade 19
Maximum oil capacity	1.4 litre 1.05 litre

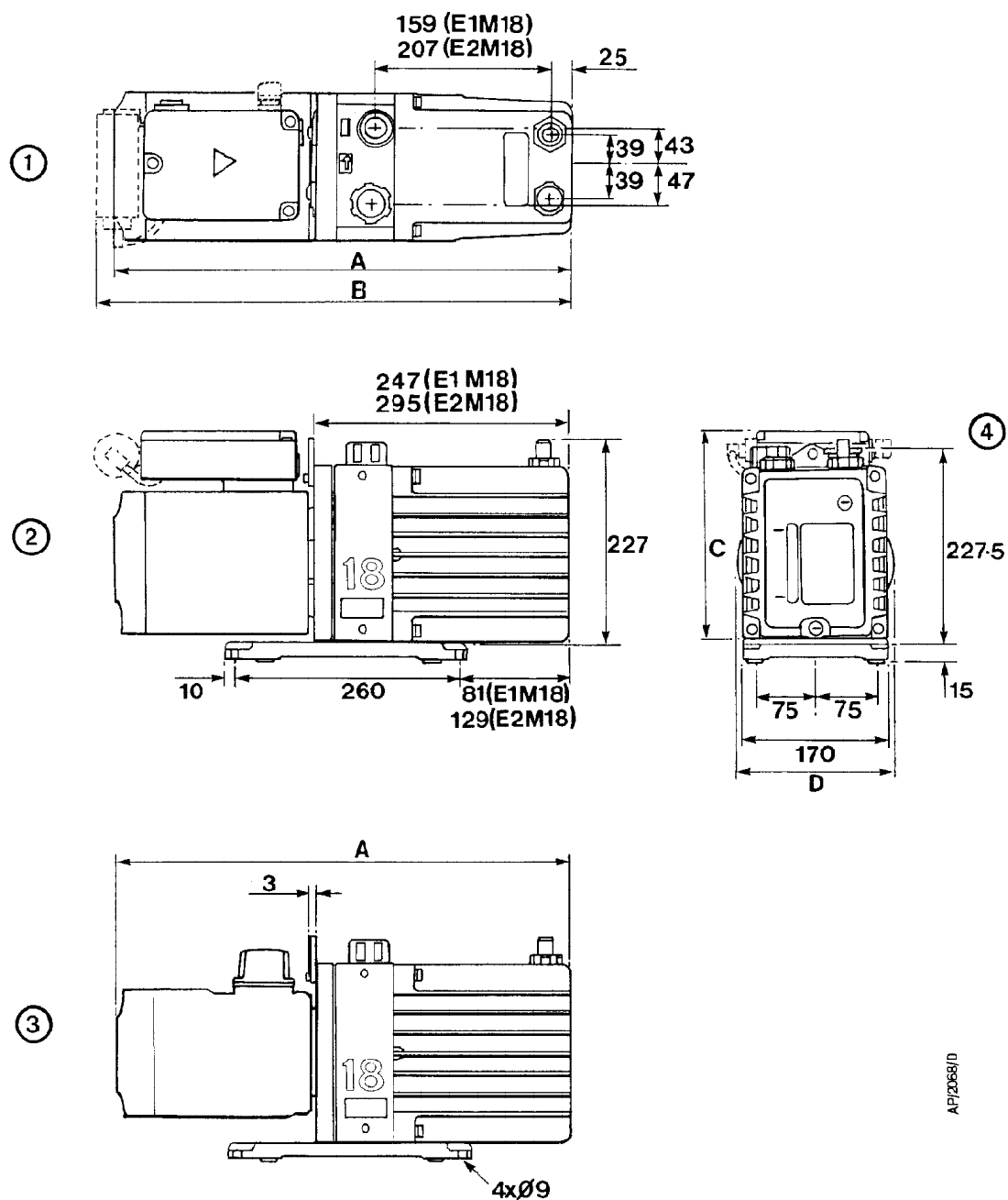
*To operate the pump when the ambient temperature is outside the range specified in Section 2.1, or to optimise the pump performance when you process condensable vapours, you may need a different oil.

Item Number	Voltage (V)	Frequency (Hz)	Full load current (A)	Start current (A)	Maximum fuse rating (A)	Electrical supply connection Figure	Motor electrical circuit Figure	Dimensions in Figure 2 (mm)			
								A	B	C	D
A343-15-912 or A363-15-912	220-240	50	5.0	25	13	3	11	471	-	239	162
								519	-	239	162
A343-15-920 or A363-15-920	220 220	50 60	5.5 5.0	35 35	15 15	3 3	11 11	471	-	239	162
								519	-	230	162
A343-15-981 or A363-15-981	115 230	60 60	11.0 5.5	70 35	40 20	4 5	12 12	471	515	239	162
								519	563	239	162
A343-15-904 or A363-15-904	100 100-105 200 200-210	50 60 50 60	12.0 11.0 6.0 5.5	88 88 44 44	30 30 15 15	4 4 5 5	12 12 12 12	471	515	239	162
								471	515	239	162
								519	563	239	162
								519	563	239	162
A363-15-903	220-240 230-240	50 60	4.8 5.0	33 33	20 20	3 3	11 11	549	-	251	180

Table 1 - Electrical data (single-phase motors)

Item Number	Voltage (V)	Frequency (Hz)	Full load current (A)	Start current (A)	Maximum fuse rating (A)	Electrical supply connection Figure	Dimensions in Figure 2 (mm)	
							A	D
A343-10-940	200-220	50	3.3	16.1	10	6	471	162
	380-415	50	1.9	10.2	6	7		
	200-230	60	2.3	15.9	10	6		
	460	60	1.8	10.6	6	7		
A363-10-940	200-220	50	3.3	16.1	10	6	519	162
	380-415	50	1.9	10.2	6	7		
	200-230	60	3.4	15.9	10	6		
	460	60	1.8	10.6	6	7		

Table 2 - Electrical data (three-phase motors)
Fuses should be to EN60269 Section 2.2. For conformance with CSA standards only CSA certified fuses are to be used.



AP/2068/D

- 1 Top view of pump with single-phase motor
- 2 Side view of pump with single-phase motor
- 3 Side view of pump with three-phase motor
- 4 Front view of pump with single-phase motor

Figure 2 - Dimensions (mm)

3 INSTALLATION

3.1 Safety

WARNING

The E1M18 and E2M18 pump are not recommended for pumping hazardous substances.

WARNING

If you use a hydrocarbon oil in this 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

You must ensure that the E1M18 or E2M18 pump is suitable for your application, If you have any doubts as to the suitability of the E1M18 or E2M18 pump for your application, refer to the Edwards guidelines on vacuum pump and vacuum system safety (see the Associated Publication at the end of the contents list at the front of this manual).

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.

- The installation of your E1M18 or E2M18 pump must be performed by a suitably trained and supervised technician.
- 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 processed 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

Consider the following points when you design your pumping system:

- Use a suitable inlet-valve to isolate the pump from your vacuum system if you need to allow the pump to warm up before you pump condensable vapours or if you need to maintain vacuum 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 outlet-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. A suitable gas-ballast control valve for introduction of purge gas into the pump is available as an accessory (see Section 7.3.5).

3.3 Unpack and inspect

Remove all packing materials and protective covers and check 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 packing materials for inspection. Do not use the pump if it is damaged.

Check that your package contains the items listed in Table 3. If any of these items are missing, notify your supplier within 3 days.

If the pump is not to be used immediately, replace the protective covers. Store the pump in suitable conditions, as described in Section 6.

Qty	Description	Check (3)
1	E1M18 or E2M18 rotary vacuum pump	q
	Fitting pack containing the following:	
1	NW25 centring ring	q
1	'O' ring for NW25 centring ring	q
6	Receptacle connectors, various sizes (supplied with single-phase motors)	q

Table 3 - Check list

3.4 Locate the pump

WARNING

Use suitable lifting equipment to move the E1M18 or E2M18 pump.
The mass of the E1M18 and E2M18 pumps is approximately 36 kg.

The pump can be either free-standing on its baseplate, or fixed by bolts through the four fixing holes in the baseplate, or used with vibration isolators. For the location of fixing holes in the baseplate, refer to Figure 2. 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-plugs 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

Fill the pump with oil as described below. Refer to Figure 1 for the item numbers in brackets.

1. Remove the oil filler-plug (1).
2. Pour oil into the pump until the oil-level just reaches the MAX mark on the bezel at the top of the oil sight-glass (12). If the oil-level goes above the MAX mark, remove the oil drain-plug (11) 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: single-phase motors

WARNING

Ensure that the electrical installation of the E1M18 or E2M18 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.

CAUTION

If your pump-motor can be used with more than one voltage range, you must ensure that the motor is configured for your electrical supply voltage and frequency. If you do not, you may damage the motor.

Note: The pump will restart automatically when the electrical supply is restored after an interruption and when the pump cools after it has overheated. If you do not want the pump to restart automatically, use electrical control equipment which must be reset manually.

Ensure that your electrical supply voltage corresponds with the voltage specified on the motor data plate. Table 1 gives the figure reference of the correct electrical supply connection diagram, and details the recommended fuse rating.

The diameter of the outer sheath of the electrical supply cable must be within the range 7 mm to 10.5 mm. The cable must conform in size and colour coding with your local and national electrical installation regulations. The temperature rating of the cable must be 70°C or greater.

1. Remove the cover from the motor terminal box (Figure 1, item 8).
2. Remove the cable-gland from the inside of the terminal-box and fit the cable-gland to the cable leadthrough hole in the side of the terminal-box.
3. Pass the electrical supply cable through the gland.
4. Remove the receptacle connectors from the fitting pack.
5. Fit a ring connector to your earth wire.
6. Select the correct size of receptacle connectors for your cable wires: use the red connectors for wire sizes 0.75 mm² to 1.5 mm² or the blue connectors for wire sizes 1.5 mm² to 2.5 mm².
7. Attach the appropriate connector to the live and neutral wires.
8. Connect the electrical supply cable to the appropriate terminals as shown in Figures 3 to 5.
9. Tighten the dome shaped nut on the cable-gland until the outer sheath of the cable is firmly gripped. Do not overtighten.
10. Check that the cable connections are correct, then refit the cover on the motor terminal-box.

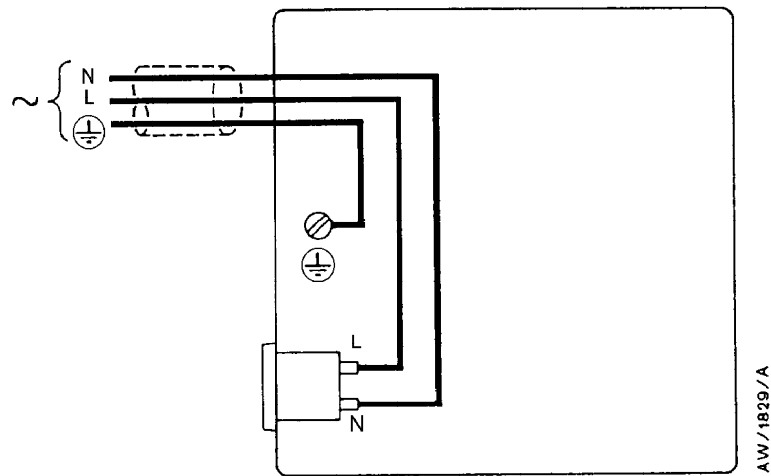


Figure 3 - Electrical supply onnection, single-phase motors, 220-240 V 50 Hz,
or 220 V 50/60 Hz, or 230-240 V 60 Hz

Wire colour codes:

BN Brown
OR Orange
VT Violet
GY Grey

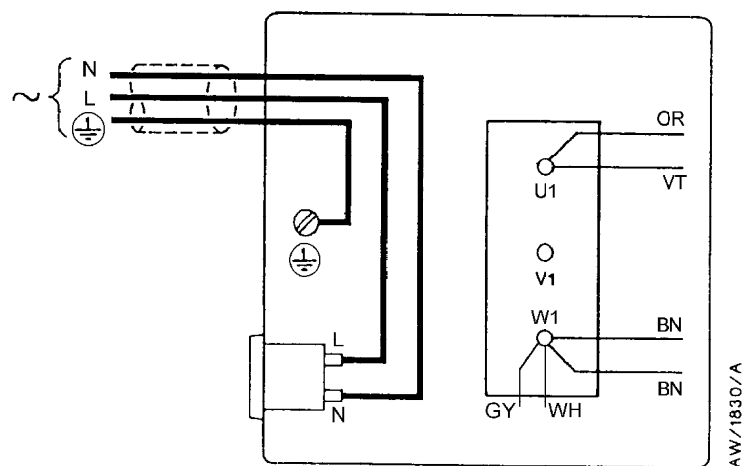


Figure 4 - Electrical supply connection, single-phase motors, 100 V 50 Hz,
or 100-105 V 60 Hz, or 115 V 60 Hz

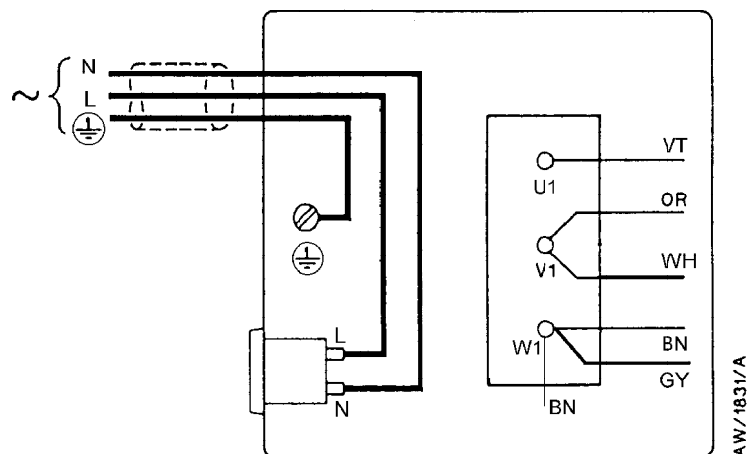


Figure 5 - Electrical supply connection, single-phase motors, 200 V 50 Hz, 200-210 V 60 Hz, or 230 V 60 Hz

3.7 Electrical installation: three-phase motors

3.7.1 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.

CAUTION

If your pump-motor can be used with more than one voltage range, you must ensure that the motor is configured for your electrical supply voltage and frequency. If you do not, you may damage the motor.

Note: The pump will restart automatically when the electrical supply is restored after an interruption. If you do not want the pump to restart automatically, use electrical control equipment which must be reset manually.

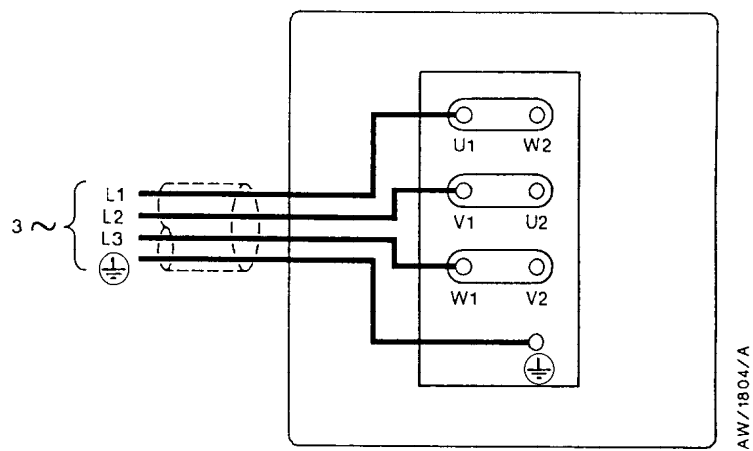


Figure 6 - Electrical supply connection, three-phase motors, 200-220 V 50 Hz, or 200-230 V 60 Hz

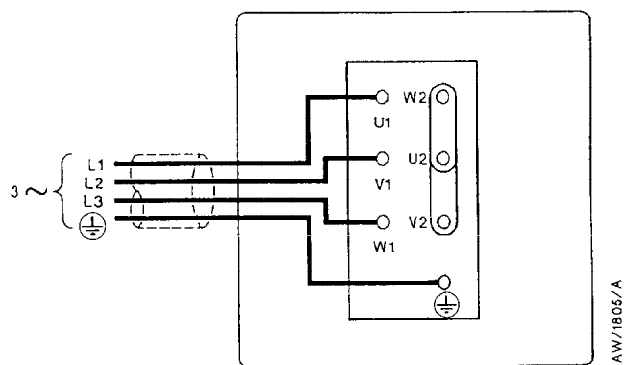


Figure 7 - Electrical supply connection, three-phase motors, 380-415 V 50 Hz, or 460 V 60 Hz

We recommend that you connect the electrical supply to the motor through a starter or circuit breaker which has thermal over-current protection which can be adjusted to suit the full load current ratings shown in Table 2. The fuse ratings in Table 2 are provided for guidance only. The supplier of your thermal over-current protection device may specify different values to ensure correct operation of the fuse and the over-current protection device. Ensure that the fuse you use is suitable for the starting currents given in Table 2. Table 2 also gives the figure reference of the correct electrical supply connection diagram for your motor.

The diameter of the outer sheath of the electrical cable must be in the range 10-14 mm. The cable must conform in size and colour coding with your local and national electrical installation regulations.

1. Remove the cover from the motor terminal-box.
2. Remove the cable-gland from the inside of the terminal-box and fit the cable-gland to the cable leadthrough hole in the side of the terminal-box.
3. Refer to the electrical supply connection diagram for your pump, (Figure 6 or 7). Make sure that the metal links are connected as shown; if they are not, move the links to the position shown.
4. Pass the electrical supply cable through the cable-gland and connect to the appropriate terminals, as shown in Figures 6 and 7.
5. Tighten the cable gland until the outer sheath of the cable is firmly gripped. Do not overtighten.
6. Ensure that the gasket seal for the terminal box cover is correctly positioned, then refit the cover to the terminal-box and secure with the screws.

3.7.2 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 pressurised.

1. Watch the motor cooling-fan through the motor fan-cover.
2. Switch-on the electrical supply to the motor for a few seconds.

3. Check that the motor cooling-fan rotates in the correct direction shown by the arrow on the motor mounting plate. If the direction of rotation is incorrect:
 - Switch off the electrical supply immediately.
 - Isolate the pump from the electrical supply.
 - Remove the terminal-box cover and swap wires L1 and L3: see Figures 6 and 7.
 - Refit the cover to the terminal-box.

3.8 Inlet connection

Connect your vacuum system to the inlet-port (Figure 1, item 6). To make this connection, you can:

- Connect to the NW25 flange supplied: use the NW25 centring ring and 'O' ring supplied.
- Remove the NW25 flange and connect to the 1 inch BSP threaded hole.
- Use an NW25 to 28 mm bore tube adaptor available as an optional accessory, see Section 7.

Take note of the following information when you connect the pump to your vacuum system. Refer to Section 7 for details of the accessories mentioned below.

- For optimum pumping speeds, ensure that the pipeline connected to the inlet-port is as short as possible and has an internal diameter not less than the inlet-port diameter.
- 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 Edwards flexible bellows.
- Use a suitable catchpot if you pump condensable vapours or if you use the pump for very dusty applications.
- Ensure that sealing surfaces are clean and scratch-free.

3.9 Outlet connection

WARNING

Connect the pump outlet to a suitable treatment plant to prevent the discharge of dangerous gases and vapours to the surrounding atmosphere. Use a catchpot to prevent the drainage of contaminated condensate back into the pump.

To connect the pump to your outlet accessories or to your exhaust treatment plant, you can:

- Connect 10 mm internal diameter vacuum hose or 12 mm internal diameter plastic hose to the outlet nozzle (Figure 1, item 2).
- Remove the outlet nozzle and connect to the 3/4 inch BSP threaded hole.
- Remove the outlet nozzle and replace it with an NW25 flange adaptor (available as an optional accessory, see Section 7) and then connect to the NW25 flange.

Take note of the following information before you connect to the pump outlet:

- The exhaust system must be configured so that the maximum pressure at the pump outlet does not exceed 0.5 bar gauge (1.5 bar absolute, 1.5×10^5 Pa) at full pump throughput.
- In 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
 - if you operate the pump with an inlet pressure greater than 10 mbar for extended periods or
 - if you frequently pump down from atmospheric pressure.
 - The mist filter will trap the oil exhausted from the pump: you can re-use the oil if it is not contaminated.

3.10 Gas ballast inlet connection

The position of the gas ballast inlet is shown in Figure 1 (item 4). The gas ballast inlet has several filters (shown in Figure 9) to trap any dust and debris if you use air as the gas ballast supply.

If you want to use a different gas for the gas ballast supply, or if you want to connect a valve to the gas ballast inlet, remove the filters (as described in Section 5.6) and connect your gas supply or valve to the 1/4 inch BSP threaded hole.

3.11 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 Gas-ballast control

Use the gas-ballast control (Figure 1, item 3) to change the flow of gas-ballast into the low vacuum stage of the pump, and to provide an additional oil-feed to the pump mechanism.

Use the gas-ballast control closed:

- to achieve ultimate vacuum
- to pump dry gases.

Turn the gas-ballast control by up to two turns anti-clockwise to introduce an additional oil-feed to the pump mechanism. We recommend that you do this when you pump high throughputs of dry gases.

Turn the gas-ballast control from two to six turns anti-clockwise to increase the gas-ballast flow from zero. When you use gas-ballast, there will be an increased rate of oil loss from the pump. Use gas-ballast:

- to pump high concentrations of condensable vapour
- to decontaminate the oil.

4.2 Start-up procedure

WARNING

Do not block the pump outlet or allow the outlet pressure to rise above 1.5 bar absolute.
If you do, the oil box may fracture: this may cause injury to people nearby.

If the oil is contaminated, or if the pump temperature is below 13 °C, or if the electrical supply voltage is more than 10% below the lowest voltage specified for the pump, the pump may operate at a reduced speed for a few minutes. On single-phase pumps, 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 the required position (refer to Section 4.1).
3. Switch on the electrical supply to the pump.

4. Check that the oil-level in the sight-glass drops slightly (3 to 5mm) after start-up. This shows that the pump has primed with oil.
5. If the pump fails to prime, operate the pump with the inlet open to atmosphere for approximately 30 seconds. Then isolate the inlet and check that the oil-level drops 3-5 mm.
6. If you want to achieve ultimate vacuum, to pump condensable vapours 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 or Edwards for advice. In particular, the vapour 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 5.11.2 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 gauge head is unsuitable or the gauge head is faulty.
- You have used an oil other than the recommended oil, and the vapour 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. Turn the gas-ballast control fully anti-clockwise (fully open) and operate the pump for at least 1 hour (or overnight) to thoroughly purge the oil of contaminants.
3. Close the gas-ballast control.
4. Open the vacuum system isolation-valve and pump down to ultimate vacuum.

4.4 To pump condensable vapours

Use gas-ballast (open the gas-ballast control) when there is a high proportion of condensable vapours in the process gases.

1. Close the vacuum system isolation-valve.
2. Turn the gas-ballast control anti-clockwise to fully open and operate the pump for 30 minutes to warm the oil; this will help to prevent vapour condensation in the pump.
3. Open the vacuum system isolation-valve and continue to operate the pump with the gas-ballast control open.

After you have pumped condensable vapours, 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 discoloured, it is contaminated with process vapours.

1. Look at the condition of the oil in the oil sight-glass (Figure 1, item 12). If the oil is cloudy or discoloured, continue with the procedure at Step 2 below.
2. Close the vacuum system isolation-valve.
3. Turn the gas-ballast control fully anti-clockwise.
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 a regular interval of not more than 14 days; check the pump more frequently if you pump high volumes of gas or if you operate the pump with the gas-ballast control open.

Single-phase motors are cooled by internal fans. These motors have a thermal overload device. When the motor is too hot, the thermal overload device switches off the pump. The thermal overload device has an automatic reset; when the motor cools down, the device resets and the motor will restart. 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.

4.7 Shut-down

Note: If the gas-ballast control is open and the pump is switched off for any reason, the pump drive shaft may rotate in the reverse direction, causing a system pressure rise. To prevent this, use a gas-ballast control valve (refer to Section 7.3.5).

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, turn the gas-ballast control clockwise).
4. Switch off the electrical supply to the pump.

5 MAINTENANCE

5.1 Safety information

WARNING

Obey the safety instruction 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.
- Allow the pump to cool to a safe temperature before you start maintenance work.
- Isolate the pump and other components in the pumping system from the electrical supply so that they can not be operated accidentally.
- After maintenance is completed, recheck the pump rotation direction if the electrical supply has been disconnected.
- Do not reuse 'O' rings and seals if they are damaged.
- The pump and its fluid 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 260 °C and above. These breakdown products are very dangerous. Fluorinated materials in the pump may include oils, greases and seals. The pump may have overheated if it was misused, if it malfunctioned or if it was in a fire. Edwards Health and Safety Data sheets for fluorinated materials used in the pump are available on request: contact your supplier or Edwards.
- Leak-test the system after maintenance work is complete if you have connected or disconnected any vacuum or exhaust joints; seal any leaks found.

5.2 Maintenance plan

The plan shown in Table 4 details the routine maintenance operations necessary to maintain the pump in normal use. Instructions for each operation are given in the section shown.

More frequent maintenance may be required if the pump is used to process corrosive or abrasive gases and vapours; in these circumstances, we recommend that you replace the pump seals every year. If necessary, adjust the maintenance plan according to your experience.

When you maintain the pump, use Edwards spares and maintenance kits; these contain all of the components necessary to complete maintenance operations successfully. The Item Numbers of the spares and kits are given in Section 7.

Examine the condition of any external accessories, filters or traps (if fitted). Refer to the instructions supplied with these accessories for maintenance procedure.

Operation	Frequency	Refer to Section
Check the oil-level	As required, at least monthly	5.3
Replace the oil	3000 operation hours	5.4
Inspect and clean the inlet-filter	Every oil change	5.5
Clean or replace the gas-ballast filters	Yearly	5.6
Clean the motor fan-cover	Yearly	5.7
Clean and overhaul the pump	15000 operation hours	5.8
Fit new blades	30000 operation hours	5.9
Test the motor condition	15000 operation hours	5.10

Table 4 - Maintenance plan

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 oil sight-glass (12) 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 the oil filler-plug (1) 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 oil drain-plug (11) and drain the excess oil from the pump. Refit the oil 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

Refer to Figure 1 for the items in brackets. You can drain the oil from the pump by the gravity drain method or the pressure drain method.

The pressure drain method is the fastest method, but requires you to operate the pump: we recommend that you use an oil drain extension tube (available as an optional accessory, see Section 7).

5.4.1 Gravity drain method

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 allows the oil 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 the oil filler-plug (1).
4. Place a suitable block under the pump-motor to tilt the pump and place a suitable container under the oil drain-plug (gravity drain) (11). Remove the oil drain-plug and allow the oil to drain into the container.
5. If the oil is dirty or contaminated, pour clean oil into the pump and allow it to drain out of the pump. Repeat this step until the oil reservoir is clean.
6. Refit the oil 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 oil sight-glass (12).
8. Allow a few minutes for the oil to drain into the pump. If necessary, add more oil. Refit the oil filler-plug.

5.4.2 Pressure drain method

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 allows the oil to be drained from the pump more easily).
2. Isolate the pump from your vacuum system.
3. Remove the oil drain-plug (pressure drain) (14) .
4. Screw the oil drain extension accessory (or another suitable tube) into the 1/8 inch BSP threaded hole. Connect a flexible hose from the tube to a suitable container to collect the drained oil.
5. Switch on the pump and fully open the gas-ballast control (3). Partially restrict the pump outlet while the oil drains from the pump (this causes a positive pressure in the oil box and forces the oil out through the pressure drain tube).
6. As soon as the oil has drained, remove the partial restriction from the pump outlet. Switch off the pump.

7. If the oil is dirty or contaminated, remove the oil filler-plug (1) and pour clean oil into the pump. Replace the oil filler-plug and drain the oil from the pump. Repeat this step until the oil reservoir is clean.
8. Remove the drain hose and extension tube. Replace the oil drain-plug.
9. Fill a suitable container with clean oil, remove the oil filler-plug (1) and pour the oil into the filler hole until the oil-level reaches the MAX level mark on the bezel of the oil sight-glass (12).
10. Allow a few minutes for the oil to drain into the pump. If necessary, add more oil. Refit the oil filler-plug.

5.5 Inspect and clean the inlet-filter

Refer to Figure 8.

1. Unscrew the inlet adaptor (1) and remove the 'O' ring (2), circlip (3) and inlet-filter (4).
2. Wash the filter in a suitable cleaning solution. Allow the filter to dry.
3. Replace items (4), (3), (2), and (1).

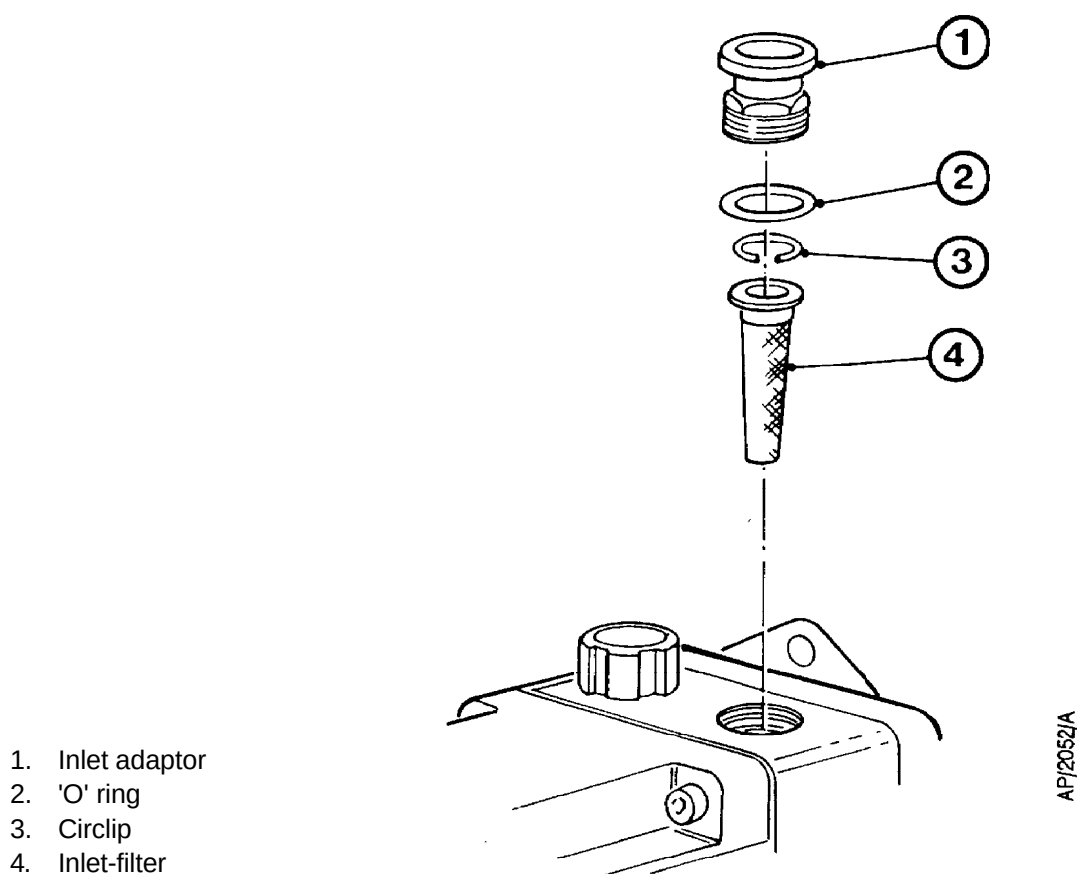


Figure 8 - Inlet-filter removal and replacement

5.6 Clean the gas-ballast filter

Note: You may have removed the gas ballast filter to connect a gas supply or valve to the gas ballast inlet.

Refer to Figure 9.

1. Remove the retainer circlip (3).
2. Remove the protective wire mesh (2) and filter elements (1).
3. Wash the wire mesh and filter in a suitable cleaning solution. Allow the wire mesh and filter to dry before replacing them in the pump.
4. Replace the wire mesh (2) and filter element (1) in the adaptor plate housing and retain with the retainer circlip (3).

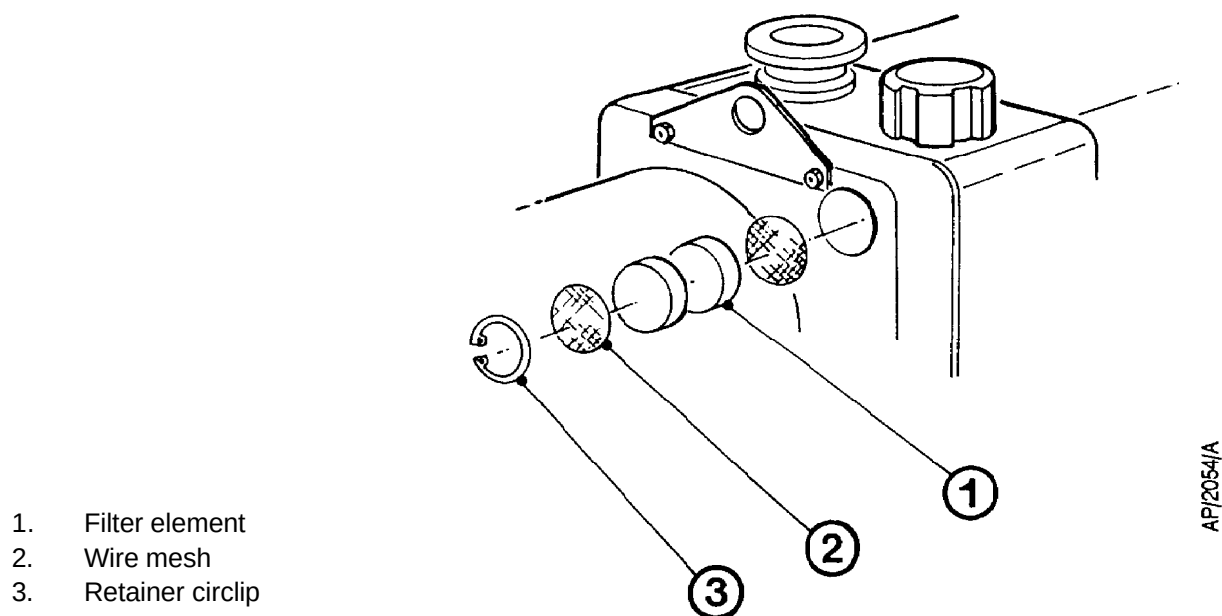


Figure 9 - Gas-ballast filter removal and replacement

5.7 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.

5.8 Clean and overhaul the pump

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

5.9 Fit new blades

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

5.10 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. We recommend that, the earth continuity is less than $0.1\ \Omega$ and the insulation resistance is greater than $10\ \text{M}\Omega$. If the motor fails these tests, you must replace the motor.

5.11 Fault finding

A list of fault conditions and their possible causes is provided here to assist you in basic fault-finding. If you are unable to rectify a fault when you use this guide, call your supplier or your nearest Edwards Service Centre for advice.

5.11.1 The pump has failed to start

- The electrical supply fuse has blown.
- The motor is incorrectly wired.
- The operating voltage does not match that of the motor.
- The exhaust filter or exhaust line is blocked.
- The oil temperature is below $13\ ^\circ\text{C}$.
- The oil is too viscous.
- The oil is contaminated.
- The pump is seized after long storage, or has been left to stand after pumping contaminants.
- The motor is faulty.

5.11.2 The pump failed to achieve specified performance (Failure to reach ultimate vacuum)

- Your measuring technique or gauge is unsuitable.
- There is a leak in the external vacuum system.
- The gas-ballast control is open.
- The oil-level is too low.
- You have filled the pump with the wrong type of oil.
- The oil is contaminated.
- The pump has not primed.
- The vacuum fittings are dirty.
- The inlet-filter is blocked.
- The pump has not warmed up.
- The motor shaft rotates in the wrong direction - three-phase motors only.

5.11.3 The pump is noisy

- The motor fan-cover is damaged.
- The coupling and fan assembly are poorly adjusted.
- The motor coupling is loose.
- The motor bearings are worn.
- The oil is contaminated with solid particles.
- One of the pump blades is sticking.

5.11.4 The pump surface temperature is above 100 °C.

- The ambient temperature is too high.
- The cooling-air supply is insufficient or is too hot.
- The cooling-air supply is blocked.
- The electrical supply voltage is too high.
- The exhaust filter or exhaust line is blocked.
- The oil-level is too low.
- The pump is filled with the wrong type of oil.
- The oil is contaminated.
- The process gas is too hot, or the throughput is too high.

5.11.5 The vacuum is not maintained after the pump is switched off

- The gas-ballast control is open.
- 'O' ring(s) are damaged or missing.
- The shaft seals have deteriorated.

5.11.6 The pumping speed is poor

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

5.11.7 There is an external oil leak

- The oil pump shaft seal is worn or damaged.
- The oil box gasket has deteriorated.
- There is an oil leak from gas-ballast control.
- There is an oil leak from the drain-plug.

6 STORAGE AND DISPOSAL

6.1 Storage

CAUTION

Observe the storage temperature limits stated in Section 2. Storage below -30 °C will permanently damage the pump seals.

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 4.7.
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, the oil and any components removed from the pump in a safe manner in accordance with all local and national safety and environmental requirements.

Particular care must be taken with the following:

- Components which have come into contact with the pump fluid.
- Components which have been contaminated with dangerous process substances.

Do not incinerate fluoroelastomer seals and 'O' rings.

7 SPARES AND ACCESSORIES

7.1 Introduction

Edwards products, spares and accessories are available from Edwards companies in Belgium, Brazil, Canada, France, Germany, Hong Kong, Italy, Japan, Korea, Switzerland, United Kingdom, U.S.A and a worldwide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive Edwards training courses.

Order spare parts and accessories from your nearest Edwards company or distributor. When you order, state for each part required:

- Model and Item Number of your equipment
- Serial number
- Item Number and description of part.

7.2 Spares

The following maintenance kits contain all of the parts you will need to maintain your pump. The maintenance kits also include instructions for the use of the kits. Use the Clean and Overhaul Kit for routine maintenance operations. Use the Blade Kit together with the Clean and Overhaul Kit when you must renew the blade assembly in the rotary pump.

Maintenance kit	Item Number
E1M18 and E2M18 Clean and Overhaul Kit	A363-01-131
E1M18 Blade Kit	A343-01-041
E2M18 Blade Kit	A363-01-020
Ultragrade 19 oil, 4 litres	H110-25-020

7.3 Accessories

A range of accessories is available for the E1M18 and E2M18 pumps; refer to Figure 7.

7.3.1 Inlet catchpot

The inlet catchpot traps any liquid droplets and prevents their entry into the pump.

Product	Item Number
IT020K Inlet catchpot	A441-10-000

7.3.2 Inlet dust filter

The inlet dust filter protects the pump against abrasive dust.

Product	Item Number
ITF20K Inlet dust filter	A442-15-000

7.3.3 Inlet desiccant trap

Use a desiccant trap when you pump limited quantities of water vapour at high pumping speeds to a low vapour pressure.

Product	Item Number
ITD20K Inlet desiccant trap	A445-10-000

7.3.4 Inlet chemical trap

The inlet chemical trap protects the pump against chemically active gases.

Product	Item Number
ITC20K Inlet chemical trap	A444-10-000

7.3.5 Foreline trap

Use a foreline trap on a clean pumping system to prevent back-migration of rotary pump oil vapour into your vacuum system.

Product	Item Number
FL20K Foreline trap	A133-05-000

7.3.6 Solenoid operated pipeline valve

Fit the pipeline valve between your vacuum system and the pump inlet to provide additional system protection when the pump is switched off.

Product	Electrical supply	Item Number
PV25EK Valve	200 / 240 V, single-phase, 50 / 60 Hz	C413-01-000.
	110 / 127 V, single-phase, 50 / 60 Hz	C413-03-000

7.3.7 Outlet mist filter

The outlet mist filter separates and traps oil droplets in the pump outlet to prevent oil mist discharge.

Product	Item Number
EMF20 Outlet mist filter	A462-29-000

7.3.8 Oil drain extension

Fit the oil drain extension between the oil drain port on the pump and the oil drain-plug to make the drainage of oil from the pump easier.

Product	Item Number
ODP20 Oil drain extension	A500-02-000

7.3.9 Vibration isolators

The vibration isolators reduce transmission vibration and noise when the pump is floor or frame mounted and to help to reduce strain when the mounting area is uneven.

Product	Item Number
Vibration isolators (pack of four)	A248-01-412

7.3.10 Pump inlet adaptor

NW25 to 28 mm bore tube adaptor, supplied with connection hardware. Attach this adaptor to the NW25 pump-inlet to connect 28 mm bore plastic or rubber tube.

Product	Item Number
Pump inlet adaptor	C105-20-201

7.3.11 Flexible bellows

Use flexible bellows to connect the pump-inlet to your vacuum system. We recommend that you use bellows when you use vibration isolators.

Product	Item Number
Flexible bellows	C105-11-670

7.3.12 Pump outlet adaptor

3/4 inch BSP to NW25 adaptor. Use this adaptor when you remove the hose adaptor supplied fitted to the pump outlet, to adapt the 3/4 inch BSP thread to a NW25 flange.

Product	Item Number
Pump outlet adaptor	C105-01-414

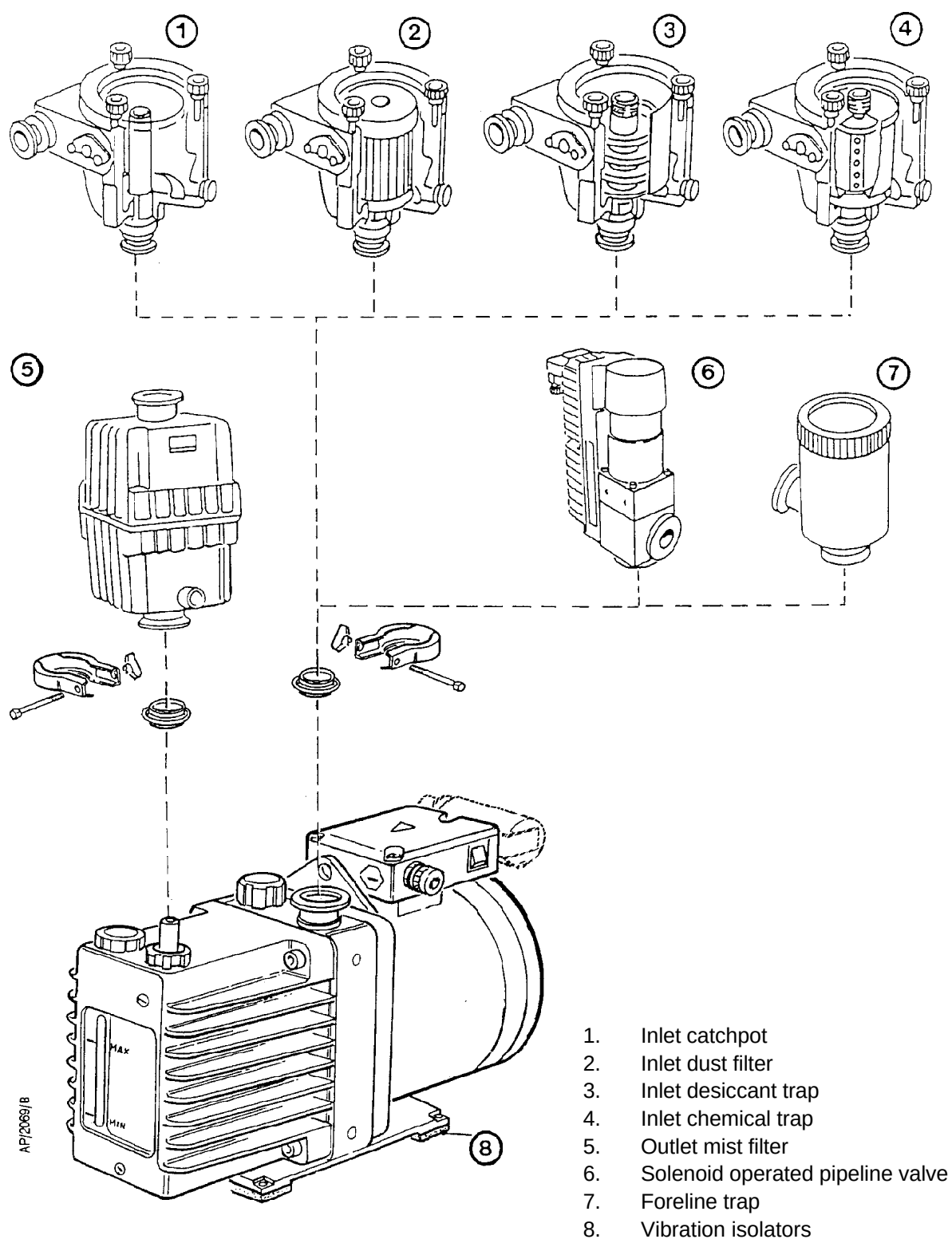


Figure 10 - Accessories

Return of BOC Edwards Equipment - Procedure (Form HS1)

Introduction

Before you return your equipment you must warn your supplier if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must complete the Declaration (HS2) on the next page and send it to your supplier before you dispatch the equipment. If you do not, your supplier will assume that the equipment is dangerous and he will refuse to accept it. If the Declaration is not completed correctly, there may be a delay in processing your equipment.

Guidelines

Take note of the following guidelines:

- Your equipment is '**uncontaminated**' if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is '**contaminated**' if it has been used with any dangerous substances.
- If your equipment has been used with radioactive substances, you must decontaminate it before you return it to your supplier. You must send independent proof of decontamination (for example a certificate of analysis) to your supplier with the Declaration (HS2). Phone your supplier for advice.
- We recommend that contaminated equipment is transported in vehicles where the driver does not share the same air space as the equipment.

PROCEDURE

Use the following procedure:

1. Contact your supplier and obtain a Return Authorisation Number for your equipment.
2. Turn to the next page(s), photocopy and then complete the Declaration (HS2).
3. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories which will be returned to your supplier. Drain all fluids and lubricants from the equipment and its accessories.
4. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.
6. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20" x 35"); contact your supplier if you cannot meet this requirement.
8. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
9. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.
10. Fax or post a copy of the Declaration (HS2) to your supplier. The Declaration must arrive before the equipment.
11. Give a copy of the Declaration to the carrier. You must tell the carrier if the equipment is contaminated.
12. Seal the original Declaration in a suitable envelope; attach the envelope securely to the outside of the equipment package. **WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.**

Return of BOC Edwards Equipment - Declaration (Form HS2)

Return Authorisation Number:

You must:

- Know about all of the substances which have been used and produced in the equipment before you complete this Declaration
- Read the Procedure (HS1) on the previous page before you attempt to complete this Declaration
- Contact your supplier to obtain a Return Authorisation Number and to obtain advice if you have any questions
- Send this form to your supplier before you return your equipment

SECTION 1 : EQUIPMENT

Equipment model _____

Serial Number _____

Has the equipment been used, tested or operated?

yes **0** Go to Section 2 no **0** Go to Section 4

FOR SEMICONDUCTOR APPLICATIONS ONLY:

Tool Reference Number

Process

Failure Date

Serial Number of Replacement Equipment

SECTION 2 : SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Are any of the substances used or produced in the equipment

- Radioactive yes 0 no 0
- Biologically active yes 0 no 0
- Dangerous to human health and safety? yes 0 no 0

If you have answered 'no' to all of these questions, go to Section 4.

Your supplier will not accept delivery of any equipment that is contaminated with radioactive substances, unless you:

- Decontaminate the equipment
- Provide proof of decontamination

YOU MUST CONTACT YOUR SUPPLIER FOR
ADVICE BEFORE YOU RETURN SUCH EQUIPMENT

SECTION 3 : LIST OF SUBSTANCES IN CONTACT WITH THE EQUIPMENT

Substance name	Chemical symbol	Precautions required (for example, use protective gloves, etc.)	Action required after spillage or human contact
1			
2			
3			
4			
5			
6			

SECTION 4 : RETURN INFORMATION

Reason for return and symptoms of malfunction: _____

If you have a warranty claim:

- who did you buy the equipment from ? _____
- give the supplier's invoice number _____

SECTION 5 : DECLARATION

Print your name: _____ Print your job title: _____

Print your organisation: _____

Print your address: _____

Telephone number: _____ Date of equipment delivery: _____

I have made reasonable enquiry and I have supplied accurate information in this Declaration. I have not withheld any information. I have followed the Return of BOC Edwards Equipment Procedure (HS1) on the previous page.

Signed: _____ Date _____

Addresses

EUROPE

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