A343-10-880
Issue R Original

Instruction Manual

E1M18 and E2M18 Rotary Vacuum Pumps

Description	Item Number
E1M18, 100/200 V, 50 Hz or 100-105/200-210 V, 60 Hz, single-phase	A343-15-904
E1M18, 115/230 V, 60 Hz, single-phase	A343-15-981
E1M18, 220 V, 50/60 Hz, single-phase	A343-15-920
E1M18, 220-240 V, 50 Hz, single-phase	A343-15-912
E1M18, 220-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase	A343-15-903
E1M18, 200-230/380-460 V, 50/60 Hz, three-phase	A343-10-940
E1M18, 220-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase (Amphenol)	A343-16-903
E1M18, 110/200-240 V, 50 Hz, or 115-120/200-230 V, 60 Hz, single-phase	A343-17-984
E1M18, 110/200-240 V, 50 Hz, or 115-120/200-230 V, 60 Hz, single-phase, fomblin filled	A343-25-984
E2M18, 100/200 V, 50 Hz or 100-105/200-210 V, 60 Hz, single-phase	A363-15-904
E2M18, 115/230 V, 60 Hz, single-phase	A363-15-981
E2M18, 220 V, 50/60 Hz, single-phase	A363-15-920
E2M18, 220-240 V, 50 Hz, single-phase	A363-15-912
E2M18, 220-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase	A363-15-903
E2M18, 200-230/380-460 V, 50/60 Hz, three-phase	A363-10-940
E2M18, 110/200-240 V, 50 Hz, or 115-120/200-230 V, 60 Hz, single-phase	A363-17-984
E2M18-FF, 200-230/380-460 V, 50/60 Hz, three-phase	A363-21-940
E2M18-FF, 100/200 V, 50/60 Hz, single-phase	A363-25-904
E2M18, 220-240 V, 50 Hz, single-phase	A363-25-912
E2M18, 110/200-240 V, 50 Hz, or 115-120/200-230 V, 60 Hz, single-phase, fomblin filled	A363-25-984

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Declaration of Conformity

We, Edwards Limited,
Crawley Business Quarter,
Manor Royal,
Crawley,
West Sussex, RH10 9LW, UK

declare under our sole responsibility, as manufacturer and person within the EU authorised to assemble the technical file, that the product(s)

E1M18 and E2M18 Rotary Vacuum Pumps

AXXX – YY – ZZZ

Pump Type	Variant	Motor Description
XXX	YY	ZZZ
343 = E1M18	10 to 99	903 = 220 V, 0.75 kW
363 = E2M18		904 = 100/200 V
		912 = 220 V, 0.55 kW
		920 = 220 V, 50/60 Hz
		930 = 220 V, 0.75 kW
		940 = 200-230/380-460 V, 50/60 Hz, 3 phase
		981 = 115/230 V, 60 Hz
		984 = 110/200-240 V, 0.75 kW – switched to High volt
		986 = 110/200-240 V, 0.75 kW – switched to Low volt

to which this declaration relates is in conformity with the following standard(s) or other normative document(s)

EN61010-1:2010*	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. General Requirements
EN60034-1: 2010	Rotating electrical machines. Rating and performance
C22.2 No77: 1995#	Motors with inherent overheating protection
C22.2 No100: 2004	Motors and Generators
C22.2 61010-1-04: 2004	Safety requirements for electrical equipment for measurement, Control and laboratory use – Part 1: General requirements
UL61010A: 2002 #	Safety requirements for electrical equipment for measurement, Control and laboratory use – Part 1: General requirements
UL1004: 1994	Electric Motors
EN50581: 2012	Technical Documentation for the Assessment of Electrical and Electronic Products with respect to the Restriction of Hazardous Substances
** 1-phase pumps only.*	*The pumps comply with EN 61010-1 when installed in accordance with the instruction manual supplied with the pumps.*
# 1-phase pumps only.	*Canadian Standards Authority and Underwriters Laboratory.*

and fulfils all the relevant provisions of

2006/42/EC	Machinery Directive
2006/95/EC	Low Voltage Directive
2004/108/EC	Electromagnetic Compatibility (EMC) Directive
2011/65/EU**	Restriction of Certain Hazardous Substances (RoHS) Directive

*** i.e. The product(s) contain less than - 0.1wt% for hexavalent chromium, lead, mercury, PBB and PBDE; 0.01wt% for cadmium - in homogeneous materials (subject to the exemptions allowed by the Directive). The RoHS Directive does not legally apply to industrial vacuum equipment until July 2019 (July 2017 for instruments).*

Note: This declaration covers all product serial numbers from the date this Declaration was signed onwards.

Peter Meares
GV Technical Support Manager

11.10.2013, Burgess Hill
Date and Place

This product has been manufactured under a quality system certified to ISO9001:2008

P200-00-600 Issue G

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For return of equipment, complete the HS Forms at the end of this manual.

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Associated publications

Publication title	Publication number
Vacuum pump and vacuum system safety	P400-40-100
Vibration isolators	A248-01-880
EMF3, EMF10 and EMF20 oil mist filters	A462-26-880

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1 Introduction

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards E1M18 and E2M18 rotary vacuum pumps. The pump must be used as specified in this manual.

Read this manual before installing and operating the pump. Important safety information is highlighted as WARNING and CAUTION instructions; these instructions must be obeyed. 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.

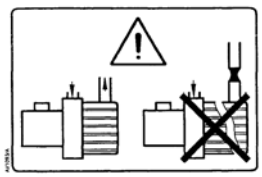
The units used throughout this manual conform to the SI international system of units of measurement.

The following warning labels are on the pump:

Warning - refer to accompanying documentation.

Warning - risk of electric shock.

Warning - hot surfaces.



Warning - do not block the pump outlet.

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1.2 ATEX directive implications

- This equipment is designed to meet the requirements of Group II Category 3 equipment in accordance with Directive 94/9/EC of the European Parliament and the Council of 23rd March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. (The ATEX Directive)

  The ATEX Category 3 applies in respect of potential ignition sources internal to the equipment. An ATEX Category has not been assigned in respect of potential ignition sources on the outside of the equipment as the equipment has not been designed for use where there is an external potentially explosive atmosphere. There is no potential source of ignition within the pump during normal operation but there may be potential sources of ignition under conditions of predictable and rare malfunction as defined in the Directive.

  Accordingly, although the pump is designed to pump flammable materials and mixtures, operating procedures should ensure that under all normal and reasonably predictable conditions, these materials and mixtures are not within explosive limits. Category 3 is considered appropriate for the avoidance of ignition in the case of a rare malfunction which allows flammable materials or mixtures to pass through the pump while within their explosive limits.

- When flammable or pyrophoric materials are present within the equipment:
  - Do not allow air to enter the equipment.
  - Ensure that the system is leak tight.
- For further information, please contact Edwards: refer to the Addresses page at the end of this manual for details of the nearest Edwards company.

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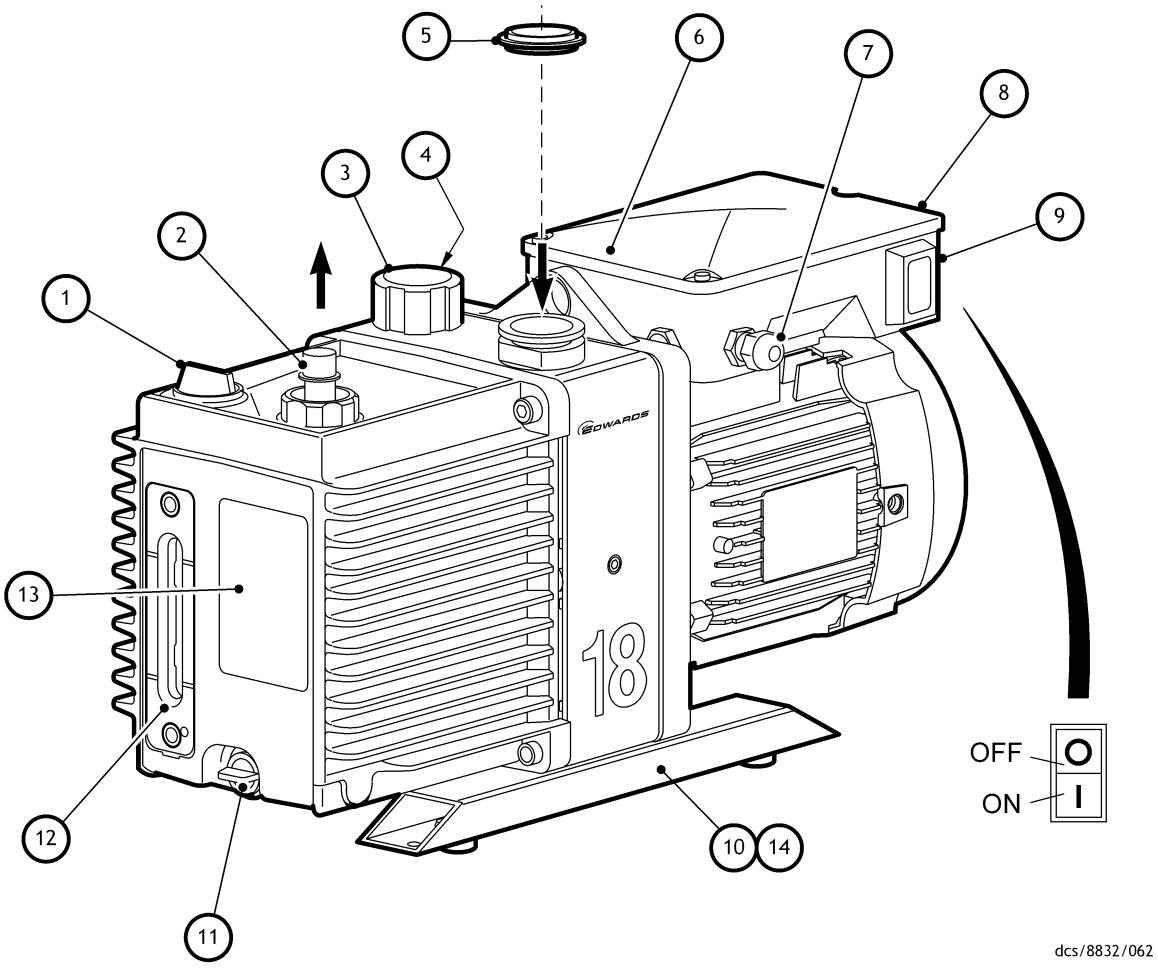
Figure 1 - The E1M18/E2M18 pump



1. Oil filler
2. Outlet nozzle
3. Gas-ballast control
4. Gas-ballast inlet
5. Centring-ring and O-ring (supplied)
6. Inlet-port (adaptor flange)
7. Cable-gland/Amphenol connector position
8. Motor terminal box
9. On/Off switch
10. Box section skids
11. Oil drain-plug (gravity drain)
12. Oil sight-glass
13. Pump identification label
14. Oil drip tray

Note: *A pump with a single-phase motor is shown in this figure. The motor shown in this figure is not representative of the motor used on the E1/E2M18 pumps with Item Numbers A343-17-984 and A363-17-984. On these pumps, items 7 and 9 are transposed, with Item 7 being an IEC60320 16-20 Amp socket.*

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1.3 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 direct drive, sliding vane pumps. The E1M18 is a single-stage pump and the E2M18 is a two-stage pump. The pump is oil-sealed and designed for reliable, long-term operation in both laboratory and industrial environments. The pump is a free-standing unit. 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 1.4.

The level and condition of oil in the oil box reservoir can be inspected through the oil sight-glass (12). An oil filler-plug (1) is fitted to the top of the oil box. The pump has an oil drain-plug (11) to allow gravity oil drain.

The pump has an inlet-port (6), outlet nozzle (2) and gas-ballast control (3). The pump is mounted on two mild steel box section skids (10) on rubber pads. Details of suitable vibration isolators and other recommended accessories are given in Section 7.4.

1.4 Gas-ballast

When using the pump with high vapour throughputs, the gas-ballast facility should be used 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) can be introduced into the pump mechanism through the gas-ballast control (Figure 1, item 3).

The gas-ballast control is a multi-turn valve:

- From the closed position, 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.
- With further turns of the gas-ballast control, the gas-ballast flow into the pump increases from zero flow, until the valve is fully open.

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2 Technical data

2.1 Operating and storage conditions

Note: *To comply with EN 61010 and CSA standards, the pump must be installed and used indoors and within the operating conditions specified in Table 1 below.*

Table 1 - Operating and storage conditions

Parameter	Data
Ambient temperature range (operation)	13 to 40°C
Ambient temperature range (storage)	-30 to 70°C
Normal surface temperature of the pump-body *	45 to 65°C
Maximum humidity (operation)	90 % RH
Maximum altitude (operation)	2000 m
Pollution degree	2
Installation category	II
Noise level at 1 metre	57 dB(A) (at 50 Hz)

* *At ultimate vacuum, with ambient temperature of 20°C.*

2.2 Performance

Note: *Where total pressures are shown in Table 2 below, measurements were taken using an untrapped total pressure capacitance diaphragm gauge on a header, as specified by Pneurop standards.*

Table 2 - Performance data

Parameter	Data	
	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 pumping 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)	2×10^{-2} mbar 2 Pa	1×10^{-4} mbar 1×10^{-2} Pa
without gas-ballast (total pressure)	3×10^{-2} mbar 3 Pa	1×10^{-3} mbar 1×10^{-1} Pa
with full gas-ballast (partial pressure)	6.5×10^{-1} mbar 6.5×10^{1} Pa	5×10^{-3} mbar 5×10^{-1} Pa
Maximum water vapour inlet pressure	50 mbar 5×10^{3} Pa	20 mbar 2×10^{3} Pa

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Table 2 - Performance data (continued)

Parameter	Data	
	E1M18	E2M18
Maximum water vapour pumping rate	0.65 kg h^{-1}	0.3 kg h^{-1}
Maximum permitted outlet pressure (for full pump throughout)	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

Table 3 - Mechanical data

Approximate pump mass	38 kg (E1M18), 41 kg (E2M18)
Dimensions	Refer to Figure 2
Degree of protection	
Single-phase motors	IP44
Three-phase motors	IP54
Pump inlet port	NW25 (the flange can be removed from the 1 inch BSP threaded hole)
Pump outlet port	15 mm external diameter nozzle (the nozzle can be removed from the 3/4 inch BSP threaded hole)

2.4 Lubrication data

Note: *Edwards Material Safety Data Sheets for the oils specified below are available upon request.*

Table 4 - Lubrication data

Hydrocarbon pumps:	
Recommended oil*	Ultragrade 19
Maximum oil capacity	
E1M18	1.4 litres
E2M18	1.05 litres
PFPE-prepared EM pumps:	
Recommended oil	Krytox 1506 or Fomblin 06/6
Maximum oil capacity	
E1M18	1.4 litres
E2M18	1.05 litres

* *To operate the pump when the ambient temperature is outside the range specified in Section 2.1 or to optimise pump performance when processing condensible vapours, a different oil may be required.*

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2.5 Electrical data

Refer to Table 5 and 6. The motor start-up current is drawn for less than one second, so slow-blow fuses must be used 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 using 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.

Table 5 - Electrical data: three-phase motors

Pump Item Number	Voltage (V)	Frequency (Hz)	Full load current (A)	Start current (A)	Maximum fuse rating (A)
A343-10-940	200-220	50	3.3	16.1	10
	380-415	50	1.9	10.2	6
	200-230	60	2.3	15.9	10
	460	60	1.6	10.6	6
A363-10-940	200-220	50	3.3	16.1	10
	380-415	50	1.9	10.2	6
	200-230	60	3.4	15.9	10
	460	60	1.6	10.6	6
Motor output rating (continuous)					
50 Hz operation		0.65 kW			
60 Hz operation		0.75 kW			

Table 6 - Electrical data: single-phase motors

Pump Item Number	Voltage (V)	Frequency (Hz)	Full load current (A)	Start current (A)	Maximum fuse rating (A)
A363-15-903, A343-16-903, A343-15-903	220-240 230-240	50 60	4.6 5.0	33 33	15 15
A343-15-981, A363-15-981	115 230	60 60	11.0 5.5	70 35	40 20
A343-15-904, 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
A343-17-984, A363-17-984, A343-25-984, A363-25-984	110 115-120 200-240 200-230	50 60 50 60	11.0 10.0 5.5 5.0	42 38 32 31	30 25 15 15
A343-15-912, A363-15-912	220-240	50	5.0	25	13
A343-15-920, A363-15-920	220 220	50 60	5.5 5.0	35 35	15 15
Motor output rating (continuous)					
50 Hz operation		0.55 kW or 0.65 kW			
60 Hz operation		0.75 kW			

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Figure 2 - Dimensions (mm): key

Pump Item Number	Hz	Dimensions (mm)			
Single-phase motors		A	B	C	D
A343-15-912	50	518	-	241	162
A363-15-912	50	520			
A343-15-920, A363-15-920	50	474	-	241	162
	60	520	-	241	162
A343-15-981	60	474	518	241	162
A363-15-981	60	520	564	241	162
A343-15-904	50/60	474	518	241	162
A363-15-904	50/60	520	564	241	162
A363-15-903, A363-17-984	50/60	550	-	251	183
A343-16-903, A343-15-903, A343-17-984	50/60	504	-	251	183
A343-17-984, A363-17-984	50/60	504	-	251	183
Three-phase motors					
A343-10-940	50/60	474			162
A363-10-940	50/60	520			162

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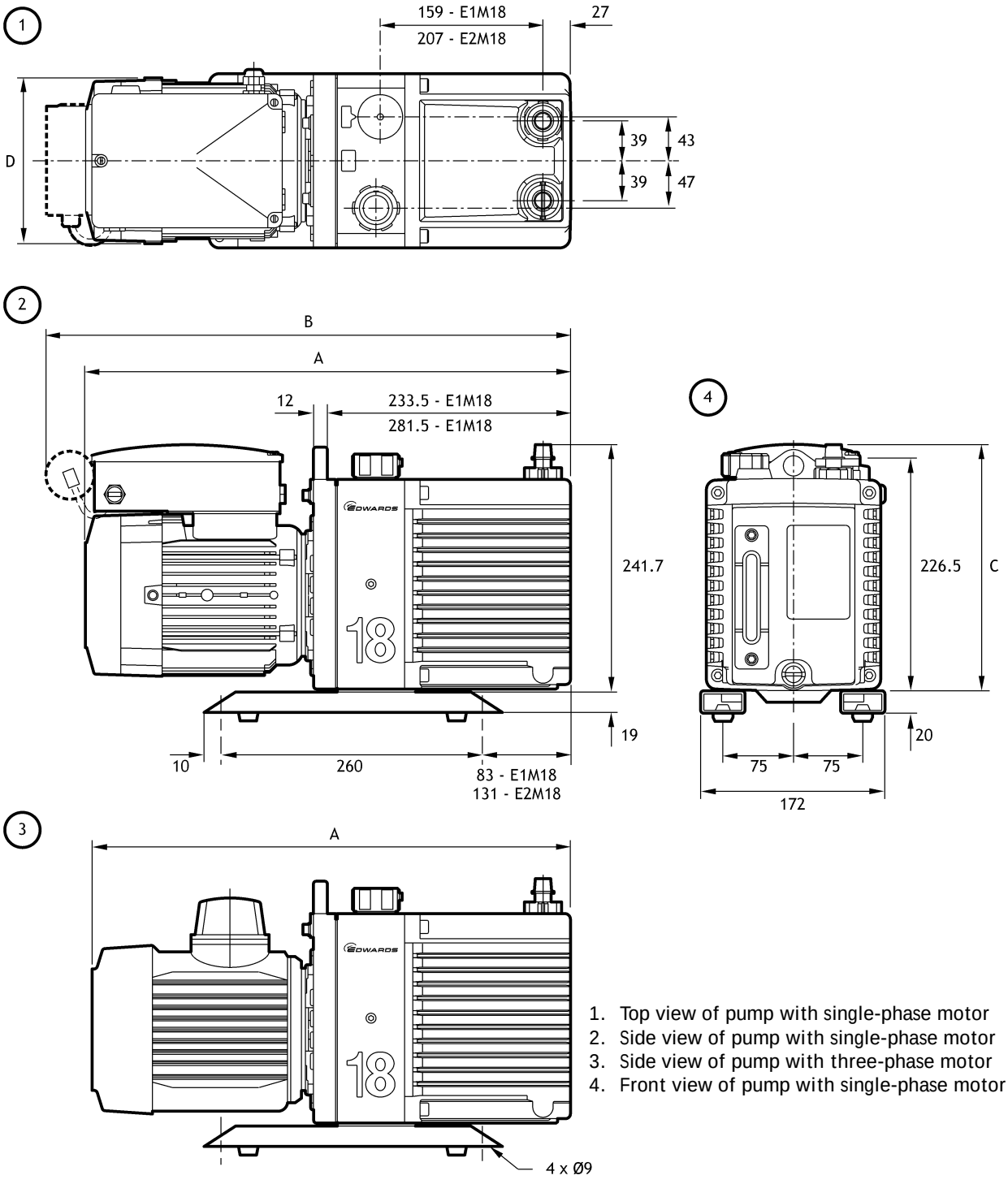
Figure 2 - Dimensions (mm)



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

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3 Installation

3.1 Safety

WARNING

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

WARNING

Do not use the E1M18 or E2M18 pump to pump hazardous substances.

WARNING

Obey the safety instructions listed below and take note of appropriate precautions. Failure to do so can cause injury to people and damage to equipment.

Prevent any part of the human body from coming into contact with the vacuum.

- A suitably trained and supervised technician must install the pump.
- Wear the appropriate safety-clothing when in contact with contaminated components.
- Vent and purge the vacuum system before installation work is started.
- Ensure that the installation technician is familiar with the safety procedures that 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.
- Safely route any electrical supply cables so that they cannot accidentally trip people.
- Ensure that the E1M18 or E2M18 pump is suitable for the application. If in doubt as to the suitability of the pump for the application, refer to the Edwards guidelines on vacuum pump and vacuum system safety (refer to the Associated Publication at the end of the contents list at the front of this manual).

3.2 System design

Consider the following points when designing the pumping system:

- Use a suitable inlet-valve to isolate the pump from the vacuum system if the pump needs to warm up before condensable vapours are pumped, or if the vacuum needs to be maintained 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 the pump is used in a high ambient temperature and has a high gas throughput, the temperature of the pump-body may exceed 70°C. Suitable guards must be fitted to prevent contact with hot surfaces.
- Make sure that the exhaust pipeline cannot become blocked. If an outlet-isolation valve is fitted, make sure the pump cannot be operated with the valve closed.
- Provide for a purge of inert gas when the pumping system is shut down, 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 (refer to Section 7.4.15).

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3.3 Unpack and inspect

1. Remove all packing materials and protective covers and check the pump. If the pump is damaged, notify the supplier and the carrier in writing within three days; state the Item Number of the pump together with the order number and the supplier's invoice number. Retain all packing materials for inspection. Do not use the pump if it is damaged.
2. Check that the package contains the items listed in Table 7. If any of these items are missing, notify the 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 6.1.

Table 7 - Checklist of items

Quantity	Description	Check (✓)
1	E1M18 or E2M18 rotary vacuum pump	❒
(1)	Fitting pack containing the following:	
1	NW25 centring-ring	❒
1	O-ring for centring-ring	❒
1	Receptacle connectors*	❒

* *Various sizes: supplied with single-phase motors except for pumps with Item Numbers A343-16-903, A343-17-984, A363-17-984, A343-25-984 and A363-25-984.*

3.4 Locate the pump

WARNING

Use suitable lifting equipment to move the pump. Failure to do so can result in injury to people or damage to the pump. Refer to Section 2.3 for the mass of the pump.

The pump can be either free-standing on its box section skids, or be fixed by bolts through the four fixing holes in the box section skids, or be used with vibration isolators. For the locations of the fixing holes in the box section skids, 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 the 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.

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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 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 pump conforms with the local and national safety requirements. It must be connected to a suitably fused and protected electrical supply and a suitable earth (ground) point.

CAUTION

Ensure that the motor is correctly configured for the electrical supply voltage and frequency. If not, damage to the motor can occur.

3.6.1 Introduction

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 the pump is not required to restart automatically, use electrical control equipment which must be reset manually.*

Ensure that the electrical supply voltage corresponds with the voltage specified on the motor data plate.

Table 5 gives the recommended fuse rating and Table 8 specifies the Figure which identifies the correct electrical supply connection details.

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

Table 8 - Motor connection details

Pump Item Number	Voltage (V)	Frequency (Hz)	Connection details: refer to Figure
A343-15-912, A363-15-912, A343-15-920, A363-15-920, A363-15-903, A343-15-903	(all)	50/60	3
A343-15-981, A363-15-981	115 230	60 60	4 5
A343-15-904, A363-15-904	100 100-105 200 200-210	50 60 50 60	4 4 5 5
A343-16-903	(all)	50/60	6
A343-17-984, A363-17-984, A343-17-984, A363-17-984	(all)	50/60	7

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3.6.2 Standard single-phase motors

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. Using a tool this should be tightened to a torque of 3.75 Nm.
3. Pass the electrical supply cable through the gland.
4. Remove the receptacle connectors from the fitting pack.
5. Fit a ring connector to the earth (ground) wire.
6. Select the correct size of receptacle connectors for the cable wires:
   - Use the red connectors for wire sizes 0.75 to 1.5 mm^2.
   - Use the blue connectors for wire sizes 1. 5 to 2.5 mm^2.
7. Attach the appropriate connector to the live and neutral wires.
8. Connect the electrical supply cable to the appropriate terminals as shown in Figure 3 to 5. Tighten the earth (ground) terminal connection to a torque of 2.13 to 2.87 Nm.
9. Tighten the dome shaped nut on the cable-gland until the outer sheath of the cable is firmly gripped. Using a tool this should be tightened to a torque of 2.5 Nm, do not overtighten.
10. Check that the cable connections are correct, then refit the cover on the motor terminal-box.

3.6.3 Amphenol version single-phase motors

When selecting the mating half of the amphenol connector, please ensure that it is compatible.

For conformance with CSA standards, only CSA certified connectors are to be used; the protective earth (ground) connection is required to make first and break last with respect to the other connections.

Connect the electrical supply cable to the appropriate pins as shown in Figure 6.

3.6.4 110/200-240 V 50 Hz or 115-120/200-230 V 60 Hz single-phase motors

The motor is designed for a single-phase electrical supply and is suitable for 50 Hz and 60 Hz operation. The motor can be manually switched between nominal supply voltages of 110-120 V and 200-240 V.

Use the following procedure to check that the voltage selector switch is correctly positioned for the electrical supply voltage:

1. Refer to Figure 7. Undo the three screws securing the terminal box cover (1) and remove the cover.
2. Check the position of the voltage selector switch (6). If the switch is in the correct position, continue at Step 3. If the voltage selector switch (6) is in the wrong position, press the switch to select the alternative position.
3. Refit the terminal box cover and secure with the three screws.

When selecting the mating half of the connector, please ensure that it is compatible (IEC60320 C19 female). For compliance with CSA standards, only CSA certified connectors are to be used.

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Figure 3 - Electrical supply connection: single-phase motors: 220-240 V 50 Hz and 230-240 V 60 Hz

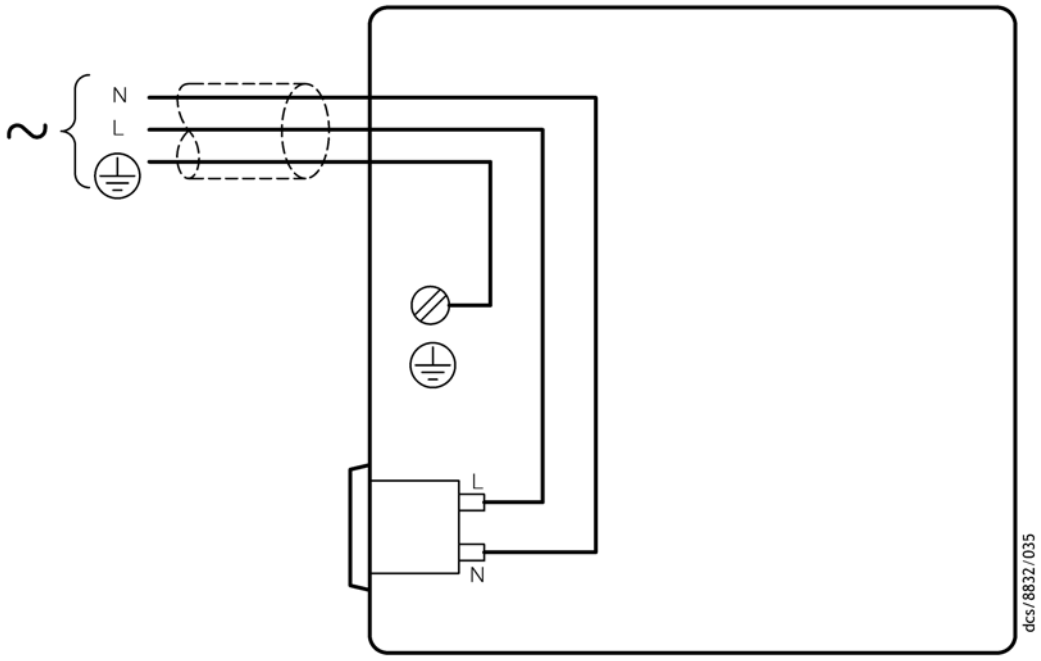
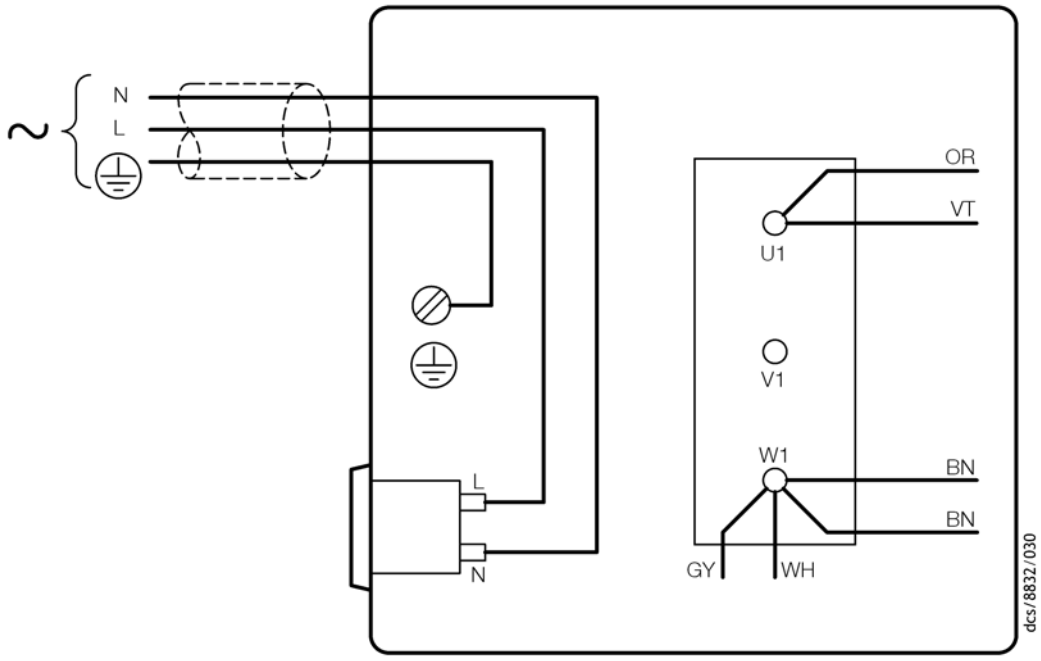


Figure 4 - Electrical supply connection: single-phase motors: 100 V 50 Hz, 100-105 V 60 Hz and 115 V 60 Hz



Wire colour codes:

BN	Brown	VT	Violet
GY	Grey	WH	White
OR	Orange		

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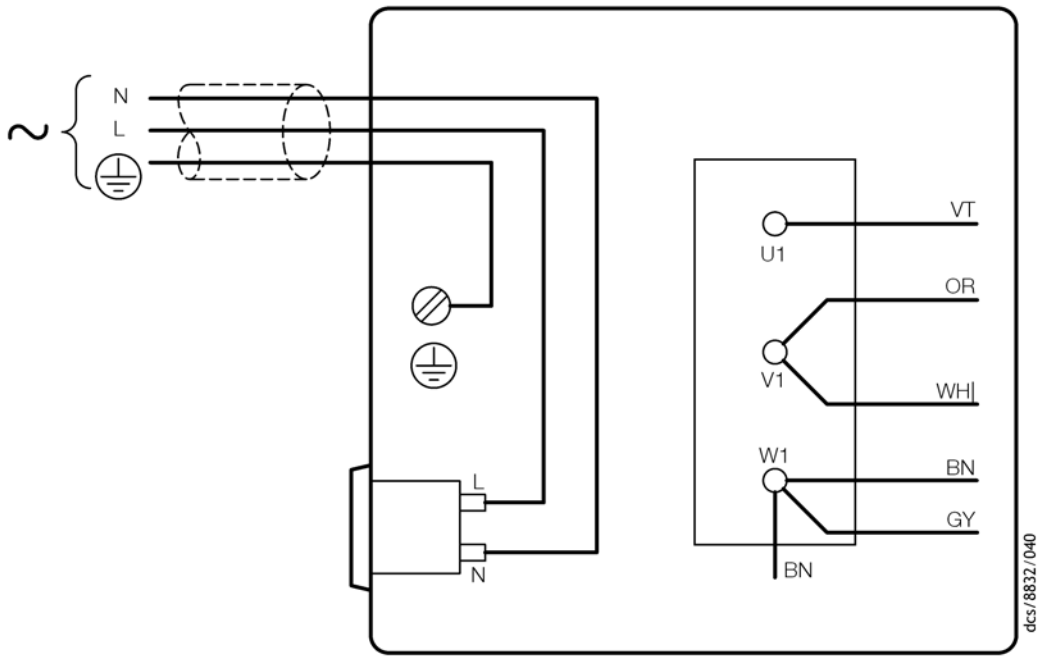
Figure 5 - Electrical supply connection, single-phase motors: 200 V 50 Hz, 200-210 V 60 Hz and 230 V 60 Hz



Wire colour codes:

BN	Brown	VT	Violet
GY	Grey	WH	White
OR	Orange		

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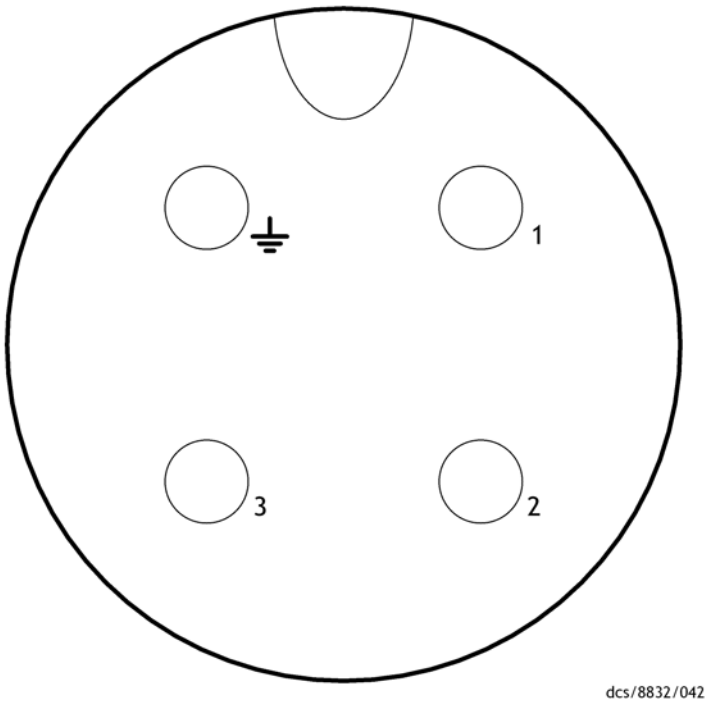
Figure 6 - Electrical supply connection, single-phase motors with Amphenol connector: 220-240 V 50 Hz and 230-240 V 60 Hz



Pin codes:

1	Live
2	Neutral
3	Not used
⏚	Earth (ground)

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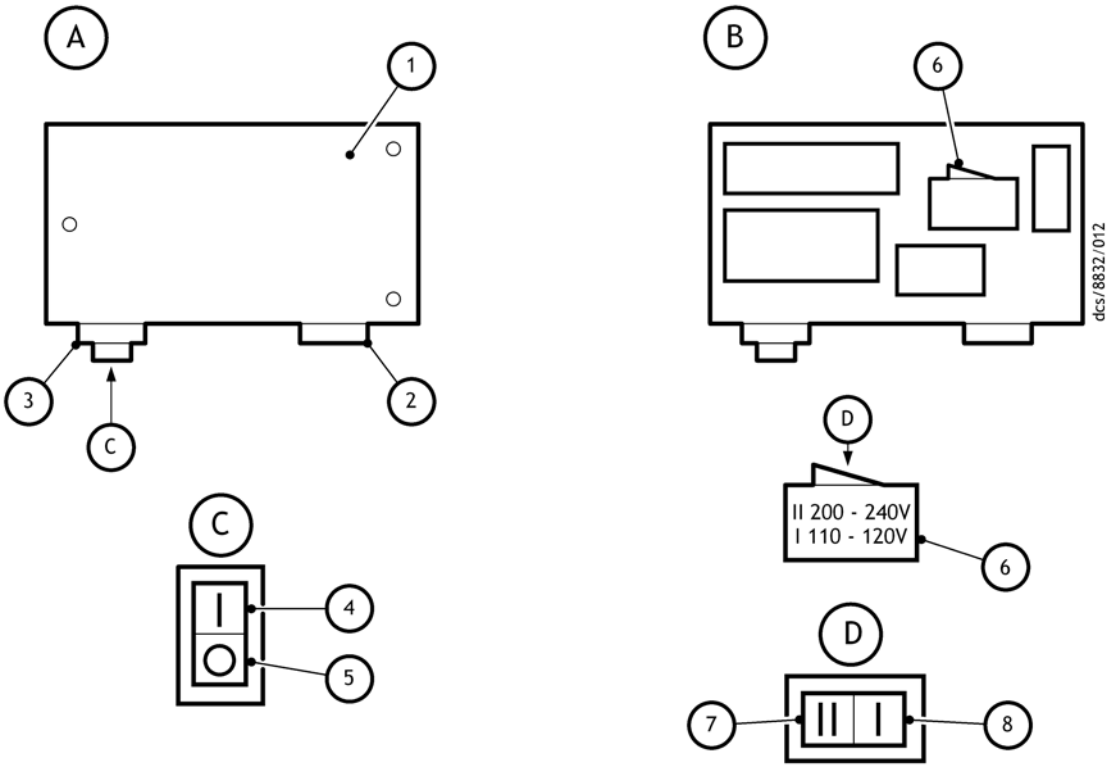
Figure 7 - Motor voltage selection: single-phase motors, 110/200-240 V 50 Hz and 115-120/200-240 V 60 Hz



A. Top view of motor
B. Internal view of top of motor
C. Voltage selector switch

1. Terminal box cover
2. Electrical inlet socket
3. On/Off switch
4. Position 'I' (on)
5. Position 'O' (off)
6. Voltage selector switch
7. Position 'II' (high voltage setting 200 – 240 V)
8. Position 'I' (low voltage setting 110 – 120 V)

3.7 Electrical installation: three-phase motors

3.7.1 Connect the electrical supply to the motor

WARNING

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

CAUTION

Ensure that the motor is correctly configured for the electrical supply voltage and frequency. If not, damage to the motor can occur.

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

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Edwards 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 5. The fuse ratings in Table 5 are provided for guidance only. The supplier of the thermal overcurrent protection device may specify different values to ensure correct operation of the fuse and the overcurrent protection device. Ensure that the fuse used is suitable for the starting currents given in Table 5. Refer to Figure 8 or 9 as appropriate for the correct electrical supply connection diagram for the 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 the 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.
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. Using a tool this should be tightened to a torque of 3.75 Nm.
3. Refer to the electrical supply connection diagram for the pump, (Figure 8 or 9). Make sure that the metal links are connected as shown; if they are not, move the links to the positions shown.
4. Pass the electrical supply cable through the cable-gland and connect to the appropriate terminals, as shown in Figure 8 and 9. Tighten the earth (ground) terminal connection to a torque of 2.13 to 2.87 Nm.
5. Tighten the dome shaped nut on the cable gland until the outer sheath of the cable is firmly gripped. Using a tool this should be tightened to a torque of 2.5 Nm, 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 motor rotates in the correct direction. If it does not, the pump and the vacuum system can become pressurized when the pump is in operation.

1. With the pump inlet still unconnected, watch the motor cooling-fan through the motor fan-cover, switch-on the electrical supply to the motor for a few seconds, then switch off the electrical supply again.
2. 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: refer to Figure 8 and 9.
   - Refit the cover to the terminal-box.

3.8 Connect the pump inlet

Take note of the following information when connecting the pump to the vacuum system. Refer to Section 7.4 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.

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- If necessary, incorporate flexible bellows in the system pipelines to reduce the transmission of vibration and to prevent loading of coupling-joints. If you using flexible bellows, ensure that bellows are used which have a maximum pressure rating which is greater than the highest pressure that can be generated in the system. It is recommended that Edwards flexible bellows are used.
- Use a suitable inlet catchpot if pumping condensible vapours or if using the pump for very dusty applications.
- Ensure that sealing surfaces are clean and scratch-free.

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

- 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, refer to Section 7.4.11.

Figure 8 - Electrical supply connection, three-phase motors: 200-220 V 50 Hz and 200-230 V 60 Hz

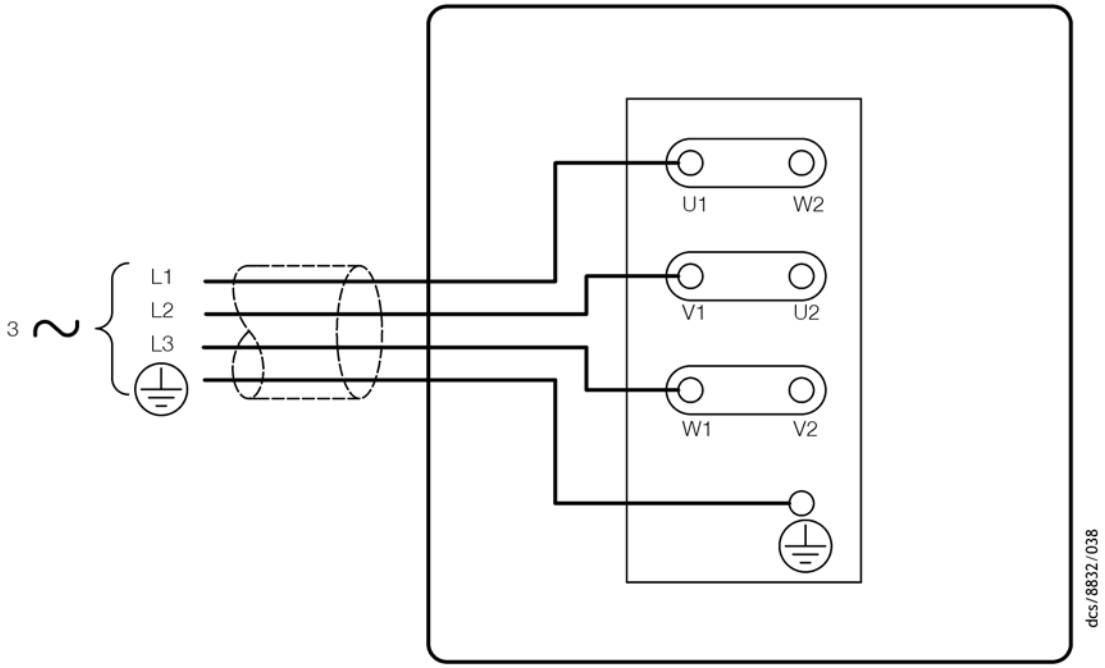

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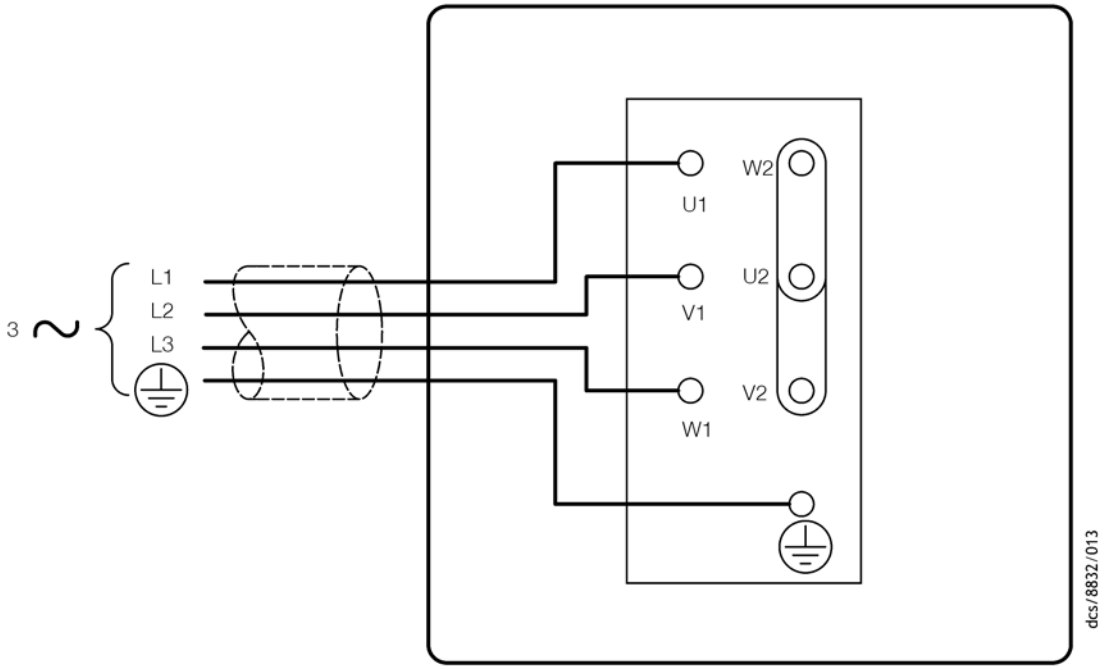
Figure 9 - Electrical supply connection, three-phase motors: 380-415 V 50 Hz and 460 V 60 Hz



3.9 Connect the pump outlet

WARNING

Connect the pump outlet to a suitable treatment plant to prevent the discharge of dangerous gases and vapours to the surrounding atmosphere.

WARNING

Use a catchpot to prevent the drainage of contaminated condensate back into the pump.

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 x 10^5 Pa) at full pump throughput.

Edwards recommend fitting an oil mist filter to the pump outlet in the following circumstances:

- When using the pump with the gas-ballast control open.
- When operating the pump with an inlet pressure greater than 10 mbar for extended periods.
- When frequently pumping down from atmospheric pressure.

The mist filter will trap the oil exhausted from the pump: the oil can be reused if it is not contaminated.

To connect the pump to the outlet accessories or to the exhaust treatment plant:

- Connect 15 mm internal diameter vacuum or 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, refer to Section 7.4.13) and then connect to the NW25 flange.

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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 11) to trap any dust and debris if air is used as the gas-ballast supply.

If using a different gas for the gas-ballast supply or to connect a valve to the gas-ballast inlet:

1. Remove the filters (as described in Section 5.6).
2. Connect the 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 installation of the pump to prevent leakage of substances out of the system and leakage of air into the system.

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4 Operation

WARNING

Do not expose any part of the body to vacuum. Failure to obey this warning could result in injury.

Note: *If the pump is PFPE-prepared, refer to Section 8.*

4.1 ATEX directive implications

4.1.1 Introduction

This equipment is designed to meet the requirements of Group II Category 3 equipment in accordance with Directive 94/9/EC of the European Parliament and the Council of 23rd March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres. (The ATEX Directive)

The ATEX Category 3 applies in respect of potential ignition sources internal to the equipment. An ATEX Category has not been assigned in respect of potential ignition sources on the outside of the equipment as the equipment has not been designed for use where there is an external potentially explosive atmosphere.

There is no potential source of ignition within the pump during normal operation but there may be potential sources of ignition under conditions of predictable and rare malfunction as defined in the Directive. Accordingly, although the pump is designed to pump flammable materials and mixtures, operating procedures should ensure that under all normal and reasonably predictable conditions, these materials and mixtures are not within explosive limits. Category 3 is considered appropriate for the avoidance of ignition in the case of a rare malfunction which allows flammable materials or mixtures to pass through the pump whilst within their explosive limits.

4.1.2 Flammable/pyrophoric materials

WARNING

Obey the instructions and take note of the precautions given below to ensure that pumped gases do not enter their flammable ranges.

When flammable or pyrophoric materials are present within the equipment:

- Do not allow air to enter the equipment.
- Ensure that the system is leak tight.
- Use an inert gas purge (for example, a nitrogen purge) to dilute any flammable gases or vapours entering the pump inlet, and/or use an inert gas purge to reduce the concentration of flammable gases or vapours in the pump and in the exhaust pipeline to less than one quarter of the gases' published lower explosive limits (LEL).
- Use an inert gas purge into the pump gas ballast connection to prevent the condensation of flammable vapours within the pump mechanism and exhaust pipeline.

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4.1.3 Gas purges

WARNING

If using inert gas purges to dilute dangerous gases to a safe level, ensure that the pump is shut down if an inert gas supply fails.

WARNING

Obey the instructions and take note of the precautions given below to ensure that pumped gases do not enter their flammable ranges.

Switch on the inert gas purge to remove air from the pump and the exhaust pipeline before the process starts. Switch off the purge flow at the end of the process only after any remaining flammable gases or vapours have been purged from the pump and exhaust pipeline.

If liquids that produce flammable vapours could be present in the pump foreline, then the inert gas purge to the pump should be left on all the time this liquid is present. Flammable liquids could be present in the foreline as a result of condensation or may be carried over from the process.

When calculating the flow rate of inert gas required for dilution, consider the maximum flow rate for the flammable gases/vapours that could occur. For example, if a mass flow controller is used to supply flammable gases to the process, assume a flow rate for flammable gases that could arise if the mass flow controller is fully open.

Continually measure the inert gas purge flow rate: if the flow rate falls below that required, stop the flow of flammable gases or vapours into the pump.

Note: *Edwards recommend obtaining and reading the Vacuum Pump and Vacuum System Safety manual (publication number P400-40-100), available from Edwards or the supplier.*

4.2 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. Edwards recommend doing this when pumping high throughputs of dry gases.

Turn the gas-ballast control from two to six turns anti-clockwise to increase the gas-ballast from zero flow. Use gas-ballast flow:

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

When operating the pump with the gas-ballast control open there will be an increased rate of oil loss from the pump. Ideally, a mist filter and oil return kit should be used on clean applications.

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4.3 Start-up

WARNING

Do not block the pump outlet or allow the outlet pressure to rise above 1.5 bar absolute. The oil box may fracture and 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 4.2).
3. Switch on the electrical supply to the pump.
4. Check that the oil-level in the sight-glass drops slightly (by 3 to 5 mm) 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 by 3 to 5 mm.
6. To achieve ultimate vacuum, pump condensable vapours or decontaminate the pump oil, refer to the procedures in Section 4.4, 4.5 and 4.6 respectively. Otherwise, open the vacuum system isolation-valve.

4.4 To achieve ultimate vacuum

If the pump does not achieve the performance specified in Section 2.2, make sure that this is not due to the system design before you contact the supplier or Edwards for advice, In particular, the vapour pressure of all materials used in the vacuum system (including pump oil, refer to below) must be much lower than the specified ultimate vacuum of the pump.

Refer to Section 5.11.3 for a list of possible causes for failure to achieve the specified performance; note however that the most common causes are:

- Pressure measurement technique or gauge head is unsuitable or the gauge head is faulty.
- Use of 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 the 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.

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4.5 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 pumping condensible vapours, decontaminate the oil (if necessary); use the procedure in Section 4.6.

4.6 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.

4.7 Unattended operation

The pump is designed for unattended operation under the normal operating conditions specified in Section 2.1. However, Edwards recommend checking the pump at a regular interval of not more than 14 days; check the pump more frequently if pumping high volumes of gas or if operating 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 checking 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.

4.8 Shut-down

Note: *If the gas-ballast control is open and the motor 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 7.4.15).*

Edwards recommend, as described in the procedure below, decontaminating the oil before shutting down the pump; this will prevent damage to the pump by the contaminates in the oil.

1. Refer to Section 4.6 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.

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5 Maintenance

5.1 Safety information

WARNING

Obey the safety instructions given below and take note of appropriate precautions. Failure to do so can cause injury to people and damage to equipment.

CAUTION

Never use hydrocarbon lubricants in a PFPE-prepared pump.

Note: *If the pump is PFPE-prepared, refer to Section 8.*

- A suitably trained and supervised technician must maintain the pump.
- 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 starting 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 oil will be contaminated with the process chemicals that have been pumped during operation. Ensure that the pump is decontaminated before maintenance and that adequate precautions are taken to protect people from the effects of dangerous substances if contamination has occurred.
- Leak-test the system after maintenance work is complete if connecting or disconnecting any vacuum or exhaust joints; seal any leaks found.
- 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 Material Safety Data sheets for fluorinated materials used in the pump are available on request: contact the supplier or Edwards.

5.2 Maintenance plan

The plan shown in Table 9 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, Edwards recommend replacing the pump seals every year. If necessary, adjust the maintenance plan according to experience.

When carrying out maintenance on 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 7.3.

Examine the condition of any external accessories, filters or traps (if fitted) when carrying out maintenance on the pump. Refer to the instructions supplied with these accessories for the necessary maintenance procedures.

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Table 9 - Maintenance plan

Operation	Frequency	Refer to Section
Check the oil level	As required; at least monthly	5.3
Replace the oil	Every 3000 hours of operation	5.4
Inspect and clean the inlet filter	Every oil change	5.5
Clean or replace the gas-ballast filter	Yearly	5.6
Clean the motor fan-cover and enclosure	Yearly	5.7
Clean and overhaul the pump	Every 15000 hours of operation	5.8
Replace the run capacitor	Every 4 years	5.9
Test the motor condition	Every 15000 hours of operation	5.9
Fit new blades	Every 30000 hours of operation	5.10

5.3 Check the oil-level

Notes: *1. If required, it is possible to check the oil-level while the pump is operating, however the pump must be switched off. Isolate the pump and other components in the pumping system from the electrical supply before pouring oil into the pump.*

2. Do not mix hydrocarbon lubricants with PFPE or vice versa. If the oil is mixed, drain and refill with clean oil as described in Section 5.4.

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 oil 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 drain-plug. 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.

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 the electrical supply and disconnect it from the 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:
   - Refit the oil drain-plug and pour clean oil into the pump.
   - Reconnect the pump to the electrical supply and operate the pump for about 5 to 10 minutes.
   - Disconnect the pump from the electrical supply, remove the oil drain-plug and allow the oil 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 the vacuum system.

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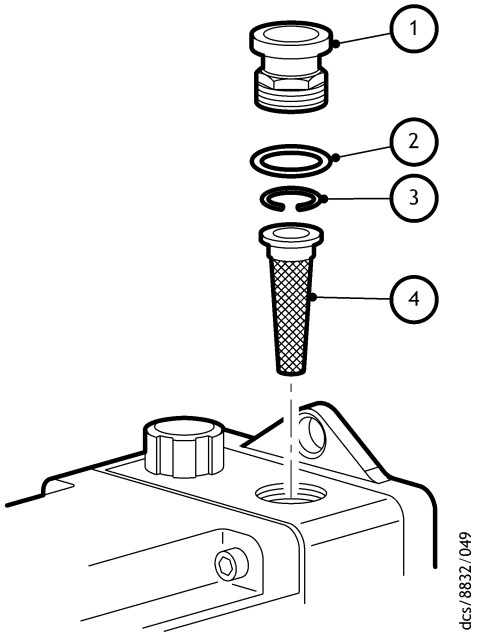
7. Fill a suitable container with clean oil and pour the oil into the filler hole until the oil-level reaches the MAX level mark on the bezel of the oil sight-glass (12).
8. Allow a few minutes for the oil to drain into the pump. If necessary, add more oil. Refit the oil filler-plug.

5.5 Inspect and clean the inlet-filter

Refer to Figure 10.

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. Refit the inlet-filter (4), circlip (3), O-ring (2) and inlet adaptor (1).

Figure 10 - Remove/replace the inlet filter



1. Inlet adaptor
2. O-ring
3. Circlip
4. Inlet-filter

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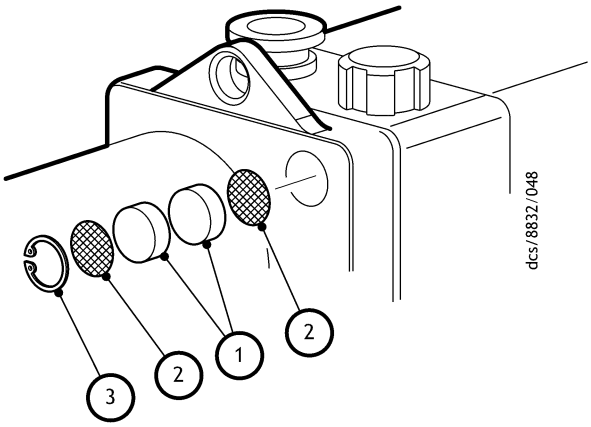
5.6 Clean the gas-ballast filter

Note: *The gas-ballast filter may have been removed to connect a gas supply or valve to the gas-ballast inlet.*

Refer to Figure 11.

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. Refit the wire mesh (2) and filter element (1) in the adaptor plate housing and retain with the retainer circlip (3).

Figure 11 - Remove/replace the gas-ballast filter



1. Filter element
2. Wire mesh
3. Retainer circlip

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 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 instructions supplied with the clean and overhaul kit (refer to Section 7.3).

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5.9 Replace the run capacitor and test the motor

Replace the run capacitor as described in the instructions supplied with the capacitor kit.

Test the earth (ground) continuity and the insulation resistance of the pump-motor, in accordance with local regulations for periodic testing of electrical equipment. Edwards recommend that:

- The earth (ground) continuity is less than 0.1 Ω.
- Insulation resistance is greater than 10 MΩ.

If the motor fails these tests, the motor must be replaced.

5.10 Fit new blades

Fit new blades to the pump as described in the instructions supplied with the blade kit (refer to Section 7.3).

5.11 Fault finding

5.11.1 Introduction

A list of fault conditions and their possible causes is provided in the following sections to assist in basic fault-finding. If unable to rectify a fault when using this guide, call the supplier or nearest Edwards Service Centre for advice.

5.11.2 The pump has failed to start

- The electrical supply fuse has failed.
- 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°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.

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5.11.3 The pump fail to achieve specified performance (failure to reach ultimate vacuum)

- The 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.
- The pump has been filled 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.

5.11.4 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.

5.11.5 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.

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5.11.6 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.

5.11.7 The pumping speed is poor

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

5.11.8 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.

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6 Storage and disposal

6.1 Storage

CAUTION

Observe the storage temperature limits stated in Section 2.1. Storage below these limits will permanently damage the pump seals.

Note: *If storing 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 4.8.
2. Disconnect the pump from the electrical supply.
3. Purge the vacuum system and the pump with dry nitrogen and disconnect the pump from the 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, clean and overhaul the pump before installing 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 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.

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7 Service, spares and accessories

7.1 Introduction

Edwards products, spares and accessories are available from Edwards companies in Belgium, Brazil, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, United Kingdom, U.S.A and a world-wide network of distributors. The majority of these centres employ Service Engineers who have undergone comprehensive Edwards training courses.

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

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

7.2 Service

Edwards products are supported by a world-wide network of Edwards Service Centres. Each Service Centre offers a wide range of options including: equipment decontamination; service exchange; repair; rebuild and testing to factory specifications. Equipment which has been serviced, repaired or rebuilt is returned with a full warranty.

The local Service Centre can also provide Edwards engineers to support on-site maintenance, service or repair of the equipment.

For more information about service options, contact the nearest Service Centre or other Edwards company.

7.3 Spares

The maintenance kits listed in Table 10 contain all of the parts required to maintain the 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 renewing the blade assembly in the rotary pump.

Table 10 - Spares item numbers

Spare	Item Number
Clean and Overhaul kit (Hydrocarbon filled)	A363-01-131
Clean and Overhaul kit (PFPE filled)	A363-01-136
E1M18 Blade kit	A343-01-041
E2M18 Blade kit	A363-01-020
Ultragrade 19 Oil (4 litres)	H110-25-013
Fomblin Grade 06/6-500 ml	H113-01-016
Capacitor kit for pump part number A343-15-903	A505-91-813
Capacitor kit for pump part number A343-16-903	A505-91-813
Capacitor kit for pump part number A363-15-903	A505-91-813
Capacitor kit for pump part number A343-15-904	A505-91-800
Capacitor kit for pump part number A363-15-904	A505-91-800
Capacitor kit for pump part number A363-25-904	A505-91-800

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Table 10 - Spares item numbers (continued)

Spare	Item Number
Capacitor kit for pump part number A343-15-912	A505-91-811
Capacitor kit for pump part number A363-15-912	A505-91-811
Capacitor kit for pump part number A363-25-912	A505-91-811
Capacitor kit for pump part number A343-15-920	A505-91-812
Capacitor kit for pump part number A363-15-920	A505-91-812
Capacitor kit for pump part number A343-15-981	A505-91-800
Capacitor kit for pump part number A363-15-981	A505-91-800
Capacitor kit for pump part number A343-17-984	A505-91-814
Capacitor kit for pump part number A343-25-984	A505-91-814
Capacitor kit for pump part number A363-17-984	A505-91-814
Capacitor kit for pump part number A363-25-984	A505-91-814

7.4 Accessories

7.4.1 Introduction

A range of accessories is available for the E1M18 and E2M18 pumps, as shown in Figure 12.

The accessories are briefly described in the following sections. Refer to Table 11 for the Item Numbers of these accessories.

Table 11 - Accessory item numbers

Accessory	Item Number
ITO20K Inlet Catchpot	A441-10-000
ITF20K Inlet Dust Filter	A442-15-000
ITD20K Inlet Desiccant Trap	A445-10-000
ITC20K Inlet Chemical Trap	A444-10-000
EMF20 Outlet Mist Filter	A462-29-000
PV25EK Valve: 200/240 V, 1-phase, 50/60 Hz	C413-01-000
PV25EK Valve: 110/127 V, 1-phase, 50/60 Hz	C413-03-000
FL20K Foreline Trap	A133-05-000
Vibration Isolators (pack of four)	A248-01-412
ODE 1/4 Oil Drain Extension	A505-03-000
Pump Inlet Adaptor	C105-20-201
Flexible Bellows	C105-14-670
Pump Outlet Adaptor	C105-01-414
Gas Ballast Banjo Elbow Assembly	A500-06-003
Gas Ballast Valve: 110 V, 50/60 Hz	A500-06-984
Gas Ballast Valve: 240 V, 50/60 Hz	A500-06-930

7.4.2 Inlet catchpot

The Inlet Catchpot traps any liquid droplets and prevents their entry into the pump.

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7.4.3 Inlet dust filter

The Inlet Dust Filter protects the pump against abrasive dust.

7.4.4 Inlet desiccant trap

Use a Desiccant Trap when pumping limited quantities of water vapour at high pumping speeds to a low vapour pressure.

7.4.5 Inlet chemical trap

The Inlet Chemical Trap protects the pump against chemically active gases.

7.4.6 Outlet mist filter

The Outlet Mist Filter separates and traps oil droplets in the pump outlet to prevent oil mist discharge. The Mist Filter is supplied with an adaptor to connect it to the pump outlet.

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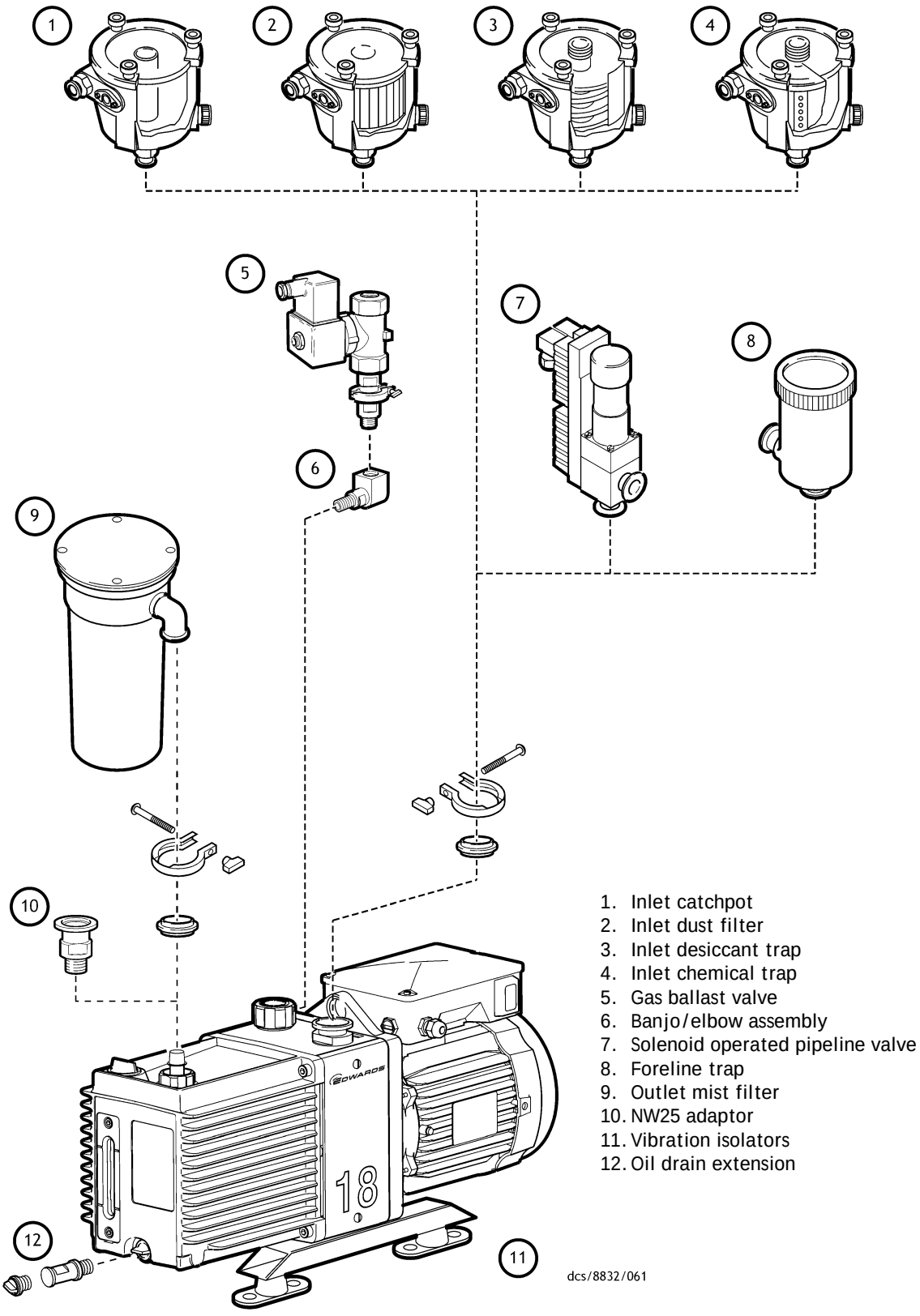
Figure 12 - Accessories



1. Inlet catchpot
2. Inlet dust filter
3. Inlet desiccant trap
4. Inlet chemical trap
5. Gas ballast valve
6. Banjo/elbow assembly
7. Solenoid operated pipeline valve
8. Foreline trap
9. Outlet mist filter
10. NW25 adaptor
11. Vibration isolators
12. Oil drain extension

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7.4.7 Solenoid operated pipeline valve

Fit the Pipeline Valve between the vacuum system and the pump inlet to provide additional system protection when the pump is switched off.

7.4.8 Foreline trap

Use a Foreline Trap on a clean pumping system to prevent back-migration of rotary pump oil vapour into the vacuum system.

7.4.9 Vibration isolators

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

7.4.10 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.

7.4.11 Pump inlet adaptor

This is a 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.

7.4.12 Flexible bellows

Use Flexible Bellows to connect the pump-inlet to the vacuum system. Edwards recommend the use of bellows when using Vibration Isolators.

7.4.13 Pump outlet adaptor

This is a 3/4 inch BSP to NW25 adaptor. Use this adaptor when removing the hose adaptor supplied fitted to the pump outlet to adapt the 3/4 inch BSP thread to NW25 pump inlet.

7.4.14 Gas ballast banjo/elbow assembly

Use this 3/4 inch BSP assembly when a remote ballast supply or gas ballast valve is fitted.

7.4.15 Gas ballast valve

Use this to control the gas-ballast remotely. The Gas Ballast Banjo/Elbow Assembly will also be required (refer to Section 7.4.14) when fitting this accessory.

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8 PFPE-prepared EM pumps

8.1 Summary

If a PFPE-prepared EM pump has been ordered, the pump will be supplied prepared for use with Edwards PFPE mechanical pump oils, such as Fomblin YVAC 06/6 and Krytox 1506.

PFPE-prepared EM pumps are suitable for pumping high concentrations of oxygen.

Edwards recommend referring to publication P400-40-100 (Vacuum pump and Vacuum System Safety) before installing and using a PFPE-prepared EM pump.

8.2 Installation

CAUTION

Never use hydrocarbon lubricants in a PFPE-prepared pump.

Installation of a PFPE-prepared EM pump is as specified in Section 3, but take note of the caution above.

8.3 Operation

WARNING

PFPE-prepared EM pumps are suitable for pumping high concentrations of oxygen, but Edwards recommend that a PFPE-prepared EM pump is not used for the pumping of hazardous materials.

Operation of a PFPE-prepared EM pump is as specified in Section 4, but take note of the warning above.

8.4 Maintenance

WARNING

Obey the safety instructions given below and take note of appropriate precautions. Failure to do so can cause injury to people.

- Take additional care if it is suspected that the pump (and hence the PFPE oil) has overheated.
- Do not touch or inhale the thermal breakdown products of PFPE oil, which may be present, if the pump has been heated to 260°C and above. PFPE oils are safe in normal use but can decompose into very dangerous substances if they are heated to 260°C and above. The pump may have overheated if it was misused, if it malfunctioned or if it was in a fire. Safety Data Sheets for PFPE oils used in the pump are available on request: contact the supplier or Edwards.

Fomblin oil has different properties from other pump oils, therefore:

- When filling the PFPE-prepared EM pump with Fomblin oil, Edwards recommend regular checks for oil leaks, particularly around the shaft seals.
- If an oil leak is detected, contact the supplier or Edwards for advice.

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