

Instruction Manual

E2M28 and E2M30 Rotary Vacuum Pumps



Description	Item Number
E2M28, 100/200 V, 50 Hz or 100-105/200-210 V, 60 Hz, single-phase	A373-15-904
E2M28, 115/230 V, 60 Hz, single-phase	A373-15-981
E2M28, 200-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase	A373-15-903
E2M28, 200-220/380-415 V, 50 Hz, or 200-230/460 V, 60 Hz, three-phase	A373-30-940
E2M28, 200-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase (Amphenol)	A373-16-903
E2M28, 110/200-240 V, 50 Hz, or 115-120/200-230 V, 60 Hz, single-phase	A373-17-984
E2M28FF, 110/220-240 V, 50 Hz, or 115/200-230 V, 60 Hz, single-phase, (Fomblin) filled	A373-25-984
E2M28-FF, 220/240 V, 50 Hz, or 230/240 V, 60 Hz, single-phase	A373-25-903
E2M28-FF, 200-220/380-415 V, 50 Hz, or 200-230/460 V, 60 Hz, three-phase	A373-41-940
E2M30, 100/200 V, 50 Hz or 100-105/200-210 V, 60 Hz, single-phase	A374-15-904
E2M30, 115/230 V, 60 Hz, single-phase	A374-15-981
E2M30, 200-240 V, 50 Hz, or 230-240 V, 60 Hz, single-phase	A374-15-903

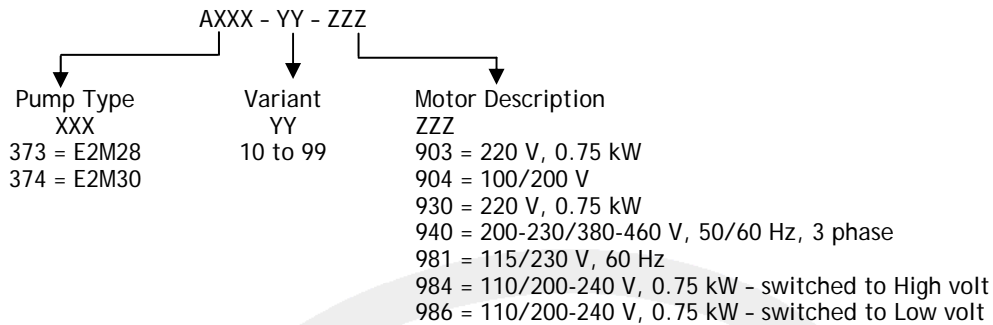




Declaration of Conformity

We, Edwards,
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)



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

- | | |
|-------------------------|---|
| EN ISO 12100-2: 2003 | Safety of Machinery. Basic Concepts, General Principles for Design. Technical Principals |
| + A1: 2009 | |
| EN1012-2:1996, A1: 2009 | Compressors and Vacuum Pumps. Safety Requirements. Vacuum Pumps |
| EN61010-1: 2001 * | Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. General Requirements |
| EN13463-1: 2009 | Non-electrical equipment for use in potentially explosive atmospheres. Basic method and requirements |
| EN13463-5: 2003 | Non-electrical equipment for use in potentially explosive atmospheres. Protection by constructional safety 'c' |
| EN60034-1: 2004 | 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 |
- * 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 |
| 94/9/EC | ATEX Directive on use in Potentially Explosive Atmospheres |



II 3 G c IIB T4 Internal atmospheres only - Tech File Ref: MPTR 0271

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



 Peter Meares, Technical Support Manager - Industrial & Chemical

9 December 2009

 Date and Place

This product has been manufactured under a quality system registered to ISO9001

Contents

Section	Page
1	Introduction 1
1.1	Scope and definitions 1
1.2	ATEX directive implications 2
1.3	Description 4
1.4	Gas-ballast 4
2	Technical data 5
2.1	Operating and storage conditions 5
2.2	Performance 5
2.3	Mechanical data 6
2.4	Lubrication data 6
2.5	Electrical data 7
3	Installation 9
3.1	Safety 9
3.2	System design 9
3.3	Unpack and inspect 10
3.4	Locate the pump 10
3.5	Fill the pump with oil 11
3.6	Electrical installation: single-phase motors 11
3.6.1	Introduction 11
3.6.2	Standard single-phase motors 12
3.6.3	Amphenol version single-phase motors 12
3.6.4	110/200-240 V 50 Hz or 115-120/200-230 V 60 Hz single-phase motors 12
3.7	Electrical installation: three-phase motors 16
3.7.1	Connect the electrical supply to the motor 16
3.7.2	Check the direction of rotation 17
3.8	Connect the pump inlet 17
3.9	Connect the pump outlet 18
3.10	Gas-ballast inlet connection 18
3.11	Leak test the system 18
4	Operation 19
4.1	ATEX directive implications 19
4.1.1	Introduction 19
4.1.2	Flammable/pyrophoric materials 19
4.1.3	Gas purges 20
4.2	Gas-ballast control 20
4.3	Start-up 21
4.4	To achieve ultimate vacuum 21
4.5	To pump condensable vapours 22
4.6	To decontaminate the oil 22
4.7	Unattended operation 22
4.8	Shut-down 22
5	Maintenance 23
5.1	Safety information 23
5.2	Maintenance plan 23
5.3	Check the oil-level 24
5.4	Replace the oil 24

5.5	Inspect and clean the inlet-filter	25
5.6	Clean the gas-ballast filter	26
5.7	Clean the motor fan-cover and enclosure	26
5.8	Clean and overhaul the pump	26
5.9	Replace the run capacitor and test the motor	27
5.10	Fit new blades	27
5.11	Fault finding	27
5.11.1	Introduction	27
5.11.2	The pump has failed to start	27
5.11.3	The pump fail to achieve specified performance (failure to reach ultimate vacuum)	28
5.11.4	The pump is noisy	28
5.11.5	The pump surface temperature is above 100°C	28
5.11.6	The vacuum is not maintained after the pump is switched off	29
5.11.7	The pumping speed is poor	29
5.11.8	There is an external oil leak	29
6	Storage and disposal	31
6.1	Storage	31
6.2	Disposal	31
7	Service, spares and accessories	33
7.1	Introduction	33
7.2	Service	33
7.3	Spares	33
7.4	Capacitor selection table	34
7.5	Accessories	35
7.5.1	Introduction	35
7.5.2	Inlet catchpot	35
7.5.3	Inlet dust filter	35
7.5.4	Inlet desiccant trap	35
7.5.5	Inlet chemical trap	35
7.5.6	Outlet mist filter	35
7.5.7	Solenoid operated pipeline valve	37
7.5.8	Foreline trap	37
7.5.9	Vibration isolators	37
7.5.10	Oil drain extension	37
7.5.11	Pump inlet adaptor	37
7.5.12	Flexible bellows	37
7.5.13	Pump outlet adaptor	37
7.5.14	Gas ballast banjo/elbow assembly	37
7.5.15	Gas ballast valve	37
8	PFPE-prepared EM pumps	39
8.1	Introduction	39
8.2	Installation	39
8.3	Operation	39
8.4	Maintenance	39

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

Illustrations

Figure	Page
1 The E2M28/E2M30 pump	3
2 Dimensions (mm)	8
3 Electrical supply connection: single-phase motors: 220-240 V 50 Hz and 230-240 V 60 Hz	13
4 Electrical supply connection: single-phase motors: 100 V 50 Hz, 100-105 V 60 Hz and 115 V 60 Hz	13
5 Electrical supply connection, single-phase motors: 200 V 50 Hz, 200-210 V 60 Hz and 230 V 60 Hz	14
6 Electrical supply connection, single-phase motors with Amphenol connector: 220-240 V 50 Hz and 230-240 V 60 Hz	15
7 Motor voltage selection: single-phase motors, 110/200-240 V 50 Hz and 115-120/200-240 V 60 Hz	16
8 Remove/replace the inlet filter	25
9 Remove/replace the gas-ballast filter	26
10 Accessories	36

Tables

Table	Page
1 Operating and storage conditions	5
2 Performance data	5
3 Mechanical data	6
4 Lubrication data	6
5 Electrical data: three-phase motors	7
6 Electrical data: single-phase motors	7
7 Checklist of items	10
8 Motor connection details	11
9 Maintenance plan	24
10 Spares item numbers	33
11 Capacitor kits	34
12 Capacitor kit selection table	34
13 Accessory item numbers	35

Associated publications

Publication title	Publication number
Vacuum pump and vacuum system safety	P300-20-000
Vibration isolators	A248-01-880
EMF3, EMF10 and EMF20 oil mist filters	A462-26-880

This page has been intentionally left blank.

1 Introduction

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards E2M28 and E2M30 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 labels are on the pump:



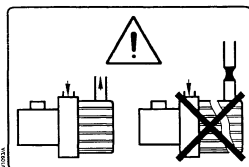
Warning - refer to accompanying documentation.



Warning - risk of electric shock.



Warning - hot surfaces.



Warning - do not block the pump outlet.

1.2 ATEX directive implications



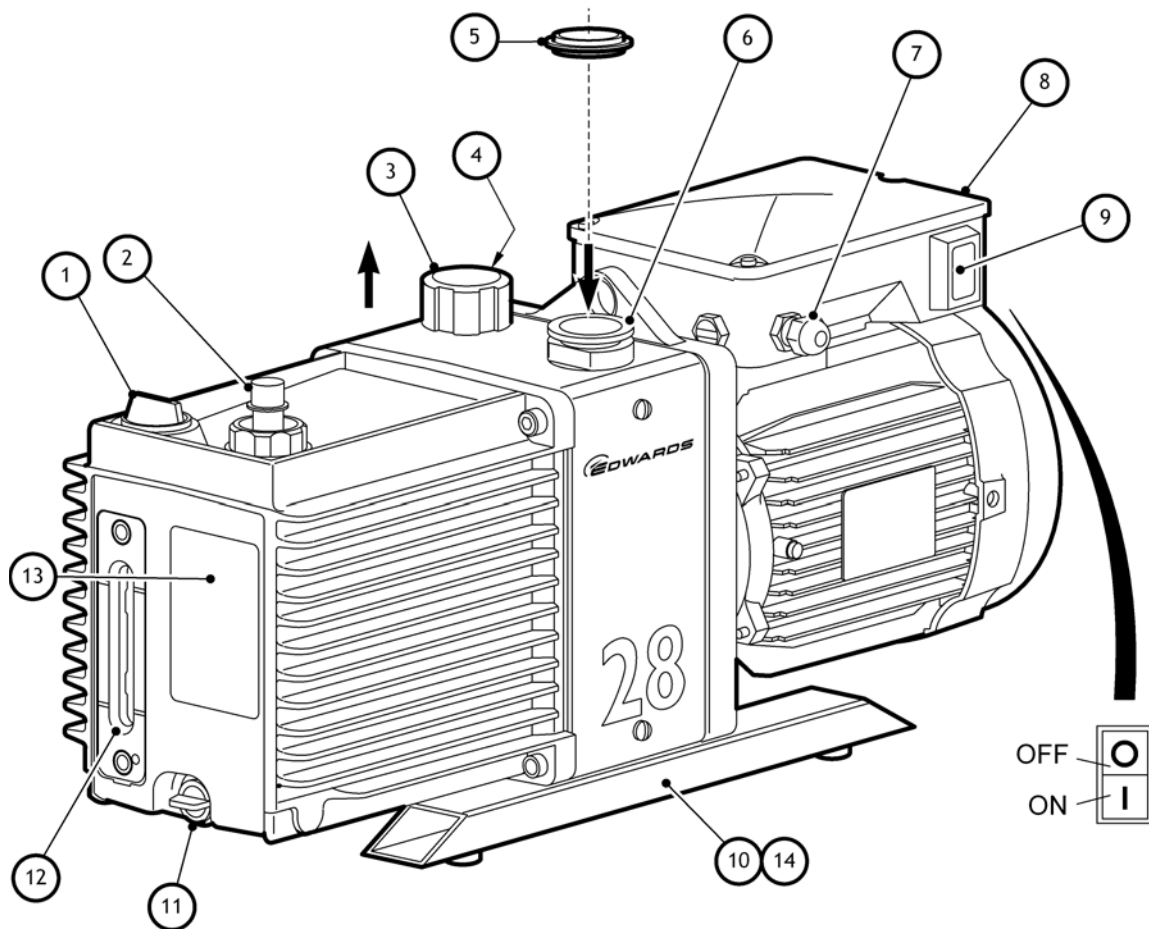
- This equipment is designed to meet the requirements of Group II Category 3 equipment in accordance with Directive 94/9/EC of the European Parliament and the Council of 23rd March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use 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 you must:
 - 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 your nearest Edwards company.

Figure 1 - The E2M28/E2M30 pump



dcs/8832/050

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

Notes: 1. A pump with a single-phase motor is shown in this figure.

2. The motor shown in this figure is not representative of the motor used on the E2M28 (Amphenol) pump with Item Number A373-17-984. On this pump, items 7 and 9 are transposed, with Item 7 being an IEC60320 16-20 Amp socket.

1.3 Description

The Edwards E2M28 and E2M30 pumps are shown in [Figure 1](#). Refer to [Figure 1](#) for item numbers in brackets in the following descriptions.

The E2M28 and E2M30 pumps are two-stage, direct drive, sliding vane pumps. 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](#).

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 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 7.5](#).

1.4 Gas-ballast

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

Air (or another gas) can be introduced into the low vacuum stage through the gas-ballast control. The gas-ballast control is a multi-turn valve which you can adjust, as required, between closed and fully open.

2 Technical data

2.1 Operating and storage conditions

Note: To comply with 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	Reference 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)
Vibration severity†	Class 1C

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

† Measured at the inlet port to ISO 2372 (1974)

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

Maximum displacement	E2M28	E2M30
50 Hz electrical supply	32.2 m ³ h ⁻¹	19 cfm
60 Hz electrical supply	38.9 m ³ h ⁻¹	23 cfm
Maximum pumping speed - Pneurop		
50 Hz electrical supply	27.5 m ³ h ⁻¹	16.2 cfm
60 Hz electrical supply	33.0 m ³ h ⁻¹	19.4 cfm
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)	1 x 10 ⁻⁴ mbar 1 x 10 ⁻² Pa	7 x 10 ⁻⁵ torr
without gas-ballast (total pressure)	1 x 10 ⁻³ mbar 1 x 10 ⁻¹ Pa	7 x 10 ⁻⁴ torr
with full gas-ballast (partial pressure)	2 x 10 ⁻¹ mbar 2 x 10 ¹ Pa	1.5 x 10 ⁻¹ torr
Maximum water vapour inlet pressure	30 mbar 3 x 10 ³ Pa	22.5 torr

Table 2 - Performance data (continued)

Maximum displacement	E2M28	E2M30
Maximum water vapour pumping rate	0.7 kg h ⁻¹	0.7 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

Parameter	Reference Data
Approximate pump mass	44 kg
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: A Edwards Material Safety Data Sheet for the oils specified below is available on request.

Table 4 - Lubrication data

Hydrocarbon pumps:	
Recommended oil*	Ultragrade 19
Maximum oil capacity	1.32 litres
PFPE - prepared EM pumps:	
Recommended oil*	Krytox 1506 or Fomblin 06/6
Maximum oil capacity	1.32 litres

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

2.5 Electrical data

Refer to [Table 5](#) and [6](#). For motor current information please refer to the motor rating plate. 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.

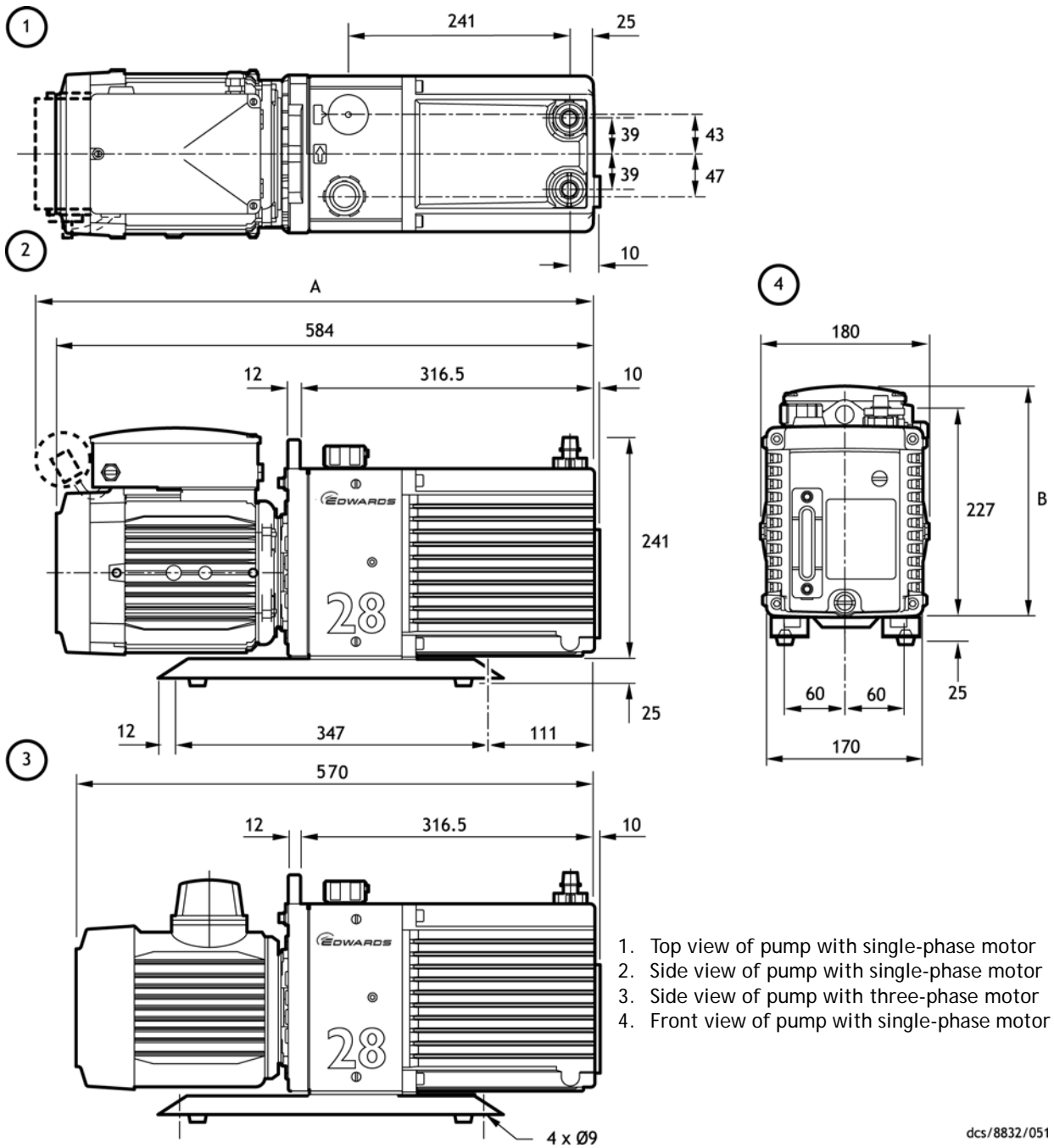
Table 5 - Electrical data: three-phase motors

Pump Item Number	Voltage (V)	Frequency (Hz)
A373-30-940, A373-41-940	200-220	50
	380-415	50
	200-230	60
	460	60
Motor output rating (continuous)		
50 Hz operation		0.75 kW
60 Hz operation		0.90 kW

Table 6 - Electrical data: single-phase motors

Pump Item Number	Voltage (V)	Frequency (Hz)
A373-15-903, A373-16-903, A374-15-903	220-240	50
	230-240	60
A373-15-981, A374-15-981	115	60
	230	60
A373-15-904, A374-15-904	100	50
	100-105	60
	200	50
	200-210	60
A373-17-984, A373-25-984	110	50
	115-120	60
	200-240	50
	200-230	60
Motor output rating (continuous)		
50 Hz operation		0.75 kW
60 Hz operation		0.90 kW

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

Pump Item Number	Dimension (mm)	
	A	B
Single-phase motors		
A373-15-903, A373-16-903, A374-15-903	-	251
A373-15-981, A374-15-981	598	251
A373-15-904, A374-15-904	598	251
A373-17-984, A373-25-984	-	251
Three-phase motors		
A373-30-940, A373-41-940	-	217

dcs/8832/051

3 Installation

3.1 Safety



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.



WARNING

You must not use the E2M28 or E2M30 pump to pump hazardous substances.



WARNING

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

- A suitably trained and supervised technician must install the pump.
- 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.
- Safely route any electrical supply cables so that they cannot accidentally trip people.
- You must ensure that the E2M28 or E2M30 pump is suitable for your application. If you have any doubts as to the suitability of the pump for your 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 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 (refer to Section 7.5.15).

3.3 Unpack and inspect

1. 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.
2. Check that your package contains the items listed in Table 7. 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 6.1.

Table 7 - Checklist of items

Quantity	Description	Check (✓)
1	E2M28 or E2M30 rotary vacuum pump	<input type="checkbox"/>
(1)	Fitting pack containing the following:	
1	NW25 centring-ring	<input type="checkbox"/>
1	O-ring for centring-ring	<input type="checkbox"/>
1	Receptacle connectors*	<input type="checkbox"/>

* Various sizes: supplied with single-phase motors except for pumps with Item Numbers A373-16-903, A373-17-984 and A373-25-984.

3.4 Locate the pump



WARNING

Use suitable lifting equipment to move the pump. If you do not, you can injure yourself or damage 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 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 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 your 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 your electrical supply voltage and frequency. If you do not, you can damage the motor.

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 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.

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 on the motor rating plate. The fuse ratings must be calculated by a qualified electrician. The supplier of your thermal over-current protection device may specify fuse ratings to ensure correct operation of the over-current protection device. Ensure that the fuse you use is suitable for the starting currents given on the motor rating plate.

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 your 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
A373-16-903	(all)	50/60	6
A373-15-903, A374-15-903	(all)	50/60	3
A373-15-981, A374-15-981	115	60	4
	230	60	5
A373-15-904, A374-15-904	100	50	4
	100-105	60	4
	200	50	5
	200-210	60	5
A373-17-984, A373-25-984	(all)	50/60	7

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.
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 your cable wires:
 - Use the red connectors for wire sizes 0.75 to 1.5 mm².
 - Use the blue connectors for wire sizes 1.5 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 Figure 3 to 5. You must 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. 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 you select 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 your 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 you select 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.

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

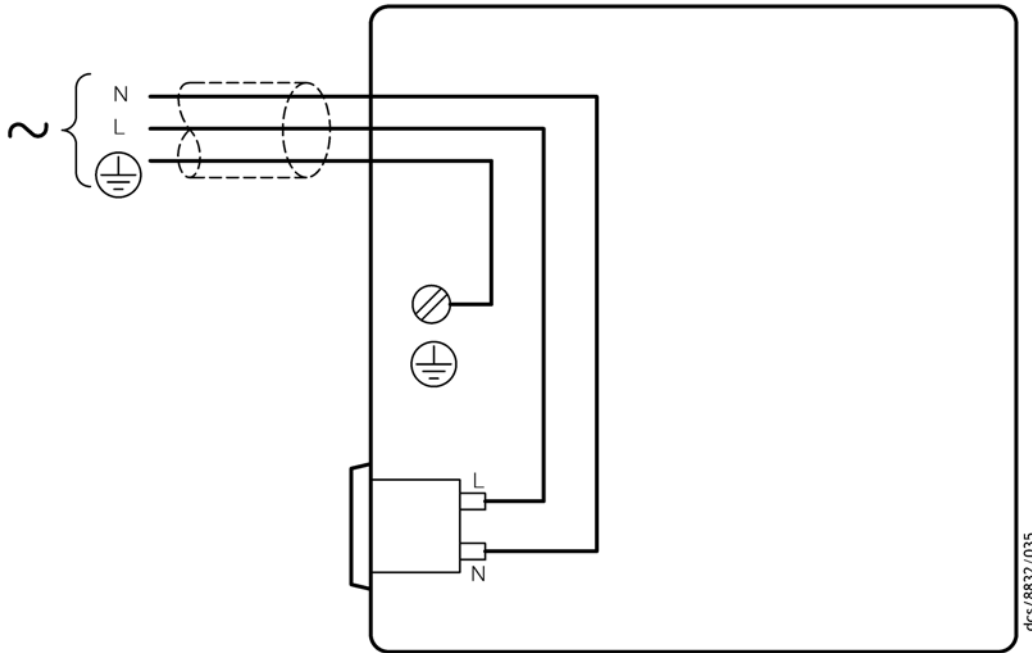
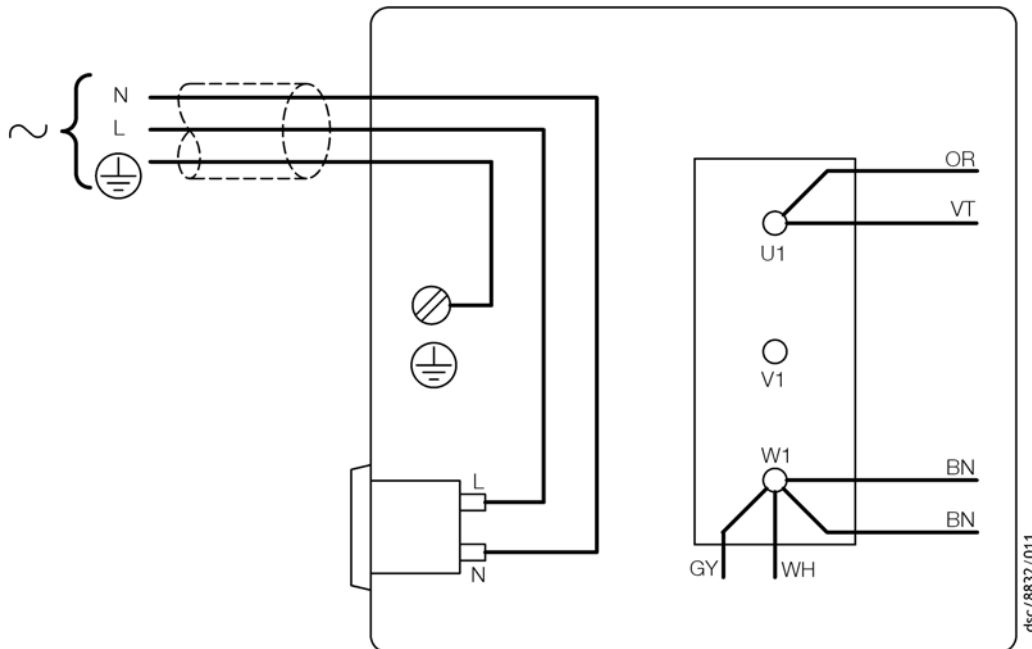


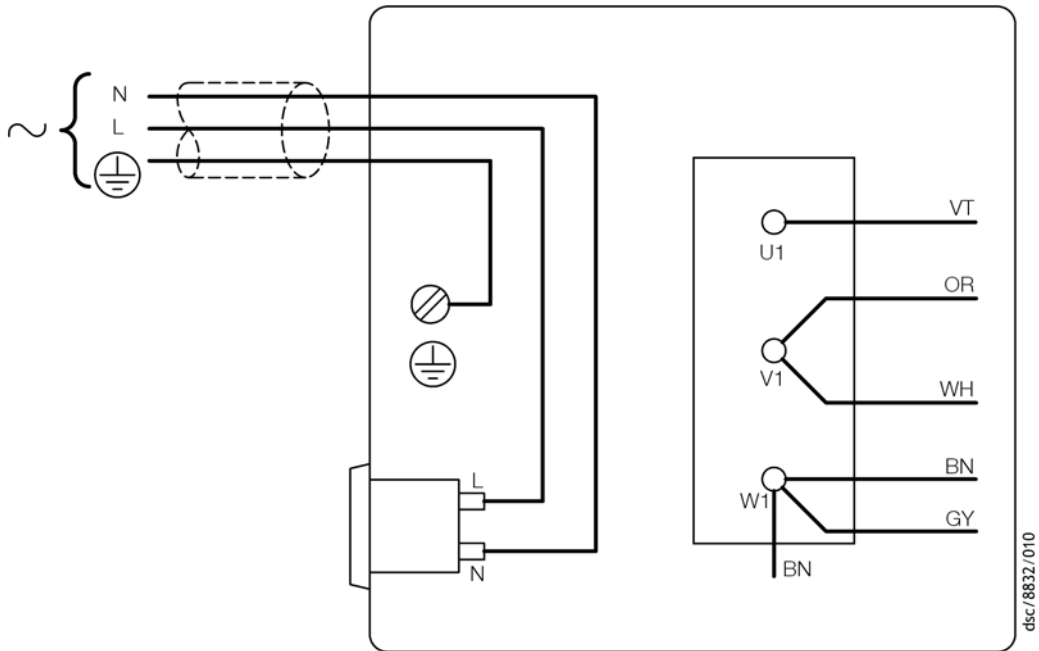
Figure 4 - Electrical supply connection: single-phase motors: 100 V 50 Hz, 100-105 V 60 Hz and 115 V 60 Hz



Wire colour codes:

BN	Brown	VT	Violet
GY	Grey	WH	White
OR	Orange		

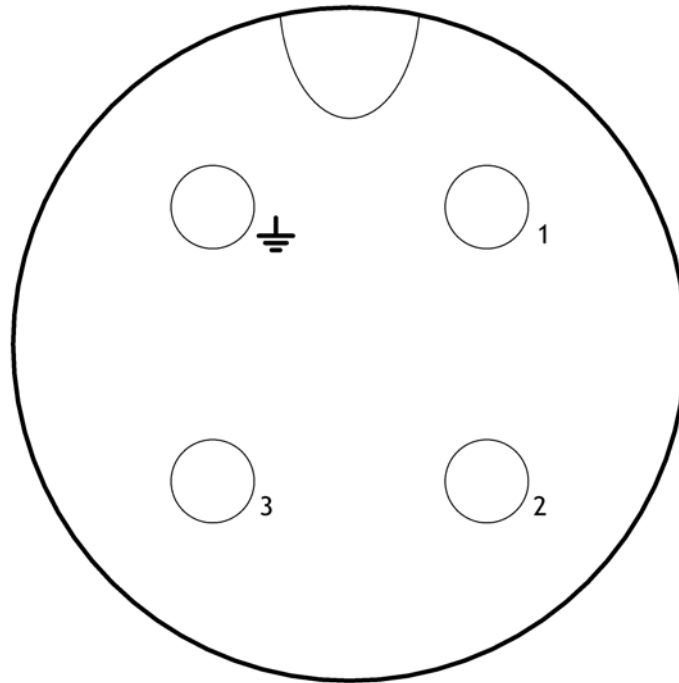
Figure 5 - Electrical supply connection, single-phase motors: 200 V 50 Hz, 200-210 V 60 Hz and 230 V 60 Hz



Wire colour codes:

BN	Brown	VT	Violet
GY	Grey	WH	White
OR	Orange		

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

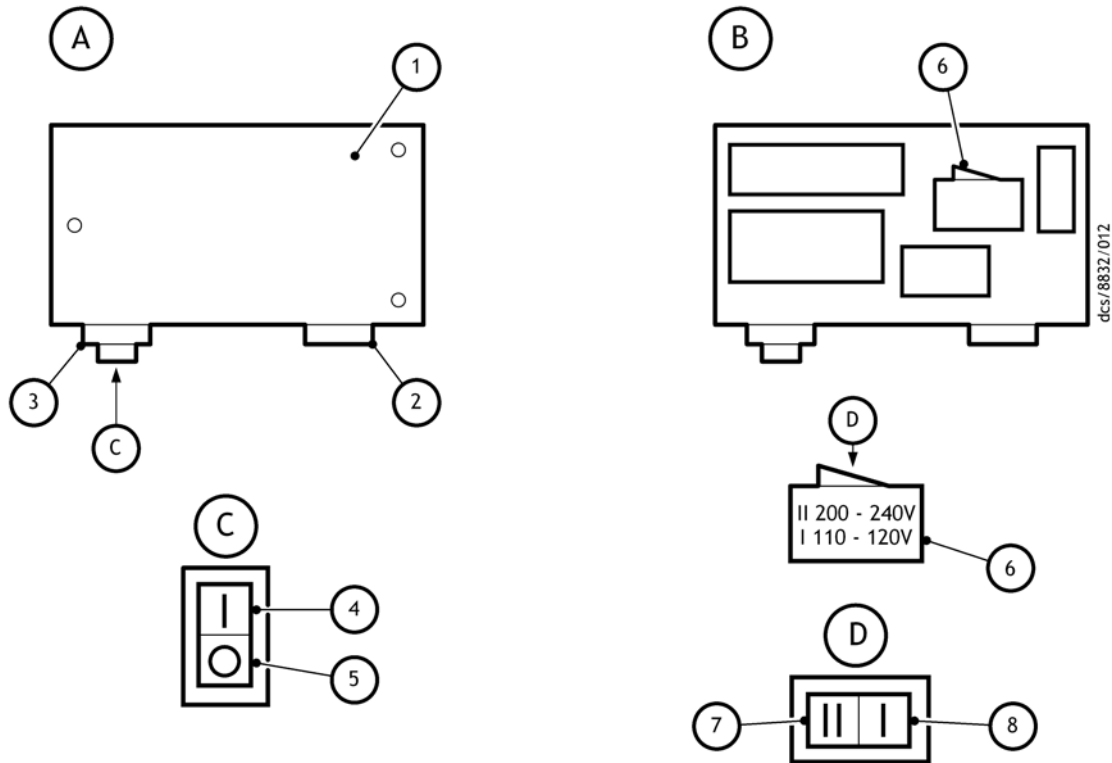


dcs/8832/042

Pin codes:

- 1. Live
- 2. Neutral
- 3. Not used
- ⏏ Earth (ground)

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. On/off 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 your 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 your electrical supply voltage and frequency. If you do not, you can 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.

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 on the motor rating plate. The fuse ratings must be calculated by a qualified electrician. The supplier of your thermal over-current protection device may specify fuse ratings to ensure correct operation of the over-current protection device. Ensure that the fuse you use is suitable for the starting currents given on the motor rating plate.

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. 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.
3. For motor wiring information refer to the wiring diagram supplied in the motor terminal box. You can configure the dual voltage motors to operate with either the high range or low range electrical supply.
4. Pass the electrical supply cable through the cable-gland and connect to the appropriate terminals. You must tighten the earth (ground) terminal connection to a torque of 2.13 to 2.87 Nm.
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 motor rotates in the correct direction. If it does not, the pump and your vacuum system can become pressurized when you operate the pump.

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 wiring diagram supplied in the motor terminal box.
 - Refit the cover to the terminal-box.

3.8 Connect the pump inlet

Take note of the following information when you connect the pump to your vacuum system. Refer to [Section 7.5](#) 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 inlet 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.

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, refer to [Section 7.5.11](#).

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, 1.5×10^5 Pa) at full pump throughput.

We recommend that you fit an oil mist filter to the pump outlet in the following circumstances:

- 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.
- If you frequently pump down from atmospheric pressure.

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

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

- 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 7.5.13](#)) and then connect to the NW25 flange.

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:

1. Remove the filters (as described in [Section 5.6](#)).
2. 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



WARNING

Do not expose any part of your body to vacuum. If you do, you may be injured.

Note: If your pump is PFPE-prepared, please 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

You must 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 you must:

- 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.

4.1.3 Gas purges



WARNING

If you use 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

You must 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 you calculate 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, you should 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, you must stop the flow of flammable gases or vapours into the pump.

Note: We recommend that you obtain and read the *Vacuum Pump and Vacuum System Safety manual* (publication number P300-20-000), available from Edwards or your 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 six turns anti-clockwise to open it fully. Use the gas-ballast control open:

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

When you operate 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.

4.3 Start-up



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 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. If you want to achieve ultimate vacuum, to pump condensable vapours or to 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 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, 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:

- 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.

4.5 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 you have pumped condensable vapours, you can (if necessary) decontaminate the oil; 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, 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.

4.8 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 7.5.15).*

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 4.6 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.

5 Maintenance

5.1 Safety information



WARNING

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

CAUTION

Never use hydrocarbon lubricants in a PFPE-prepared pump.

Note: If your 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 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 oil will be contaminated with the process chemicals that have been pumped during operation. Ensure that the pump is decontaminated before maintenance and that you take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred.
- Leak-test the system after maintenance work is complete if you have connected or disconnected 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 your 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, 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 7.3.

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

Table 9 - Maintenance plan

Operation	Frequency	Refer to Section
Check the oil level	As required; at least monthly	5.3
Replace the oil	3 to 6 months depending on application	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 and replace the blades as necessary	3 to 4 years depending on application	5.8
Replace the run capacitor	Every 4 years	5.9
Test the motor condition	Every 4 years	5.9
Fit new blades	Every 30000 hours of operation	5.10

5.3 Check the oil-level

- Notes:**
1. 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.
 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 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:
 - 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.

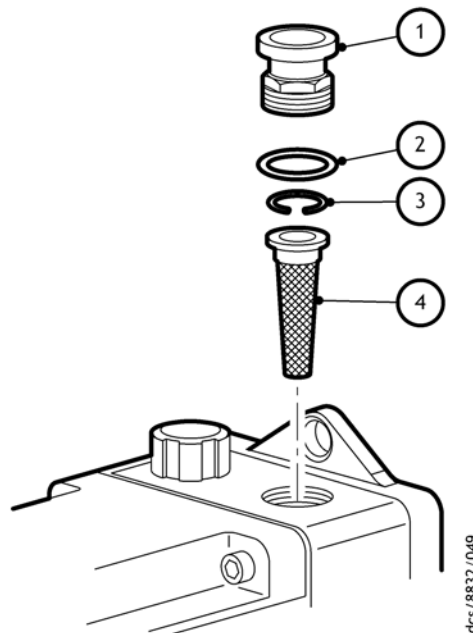
- Repeat this step until the oil reservoir is clean.
6. Refit the oil drain-plug, remove the block and reconnect the pump to your vacuum system.
 7. Fill a suitable container with clean oil and pour the oil into the filler hole until the oil-level reaches the MAX level mark on the bezel of the oil sight-glass (12).
 8. Allow a few minutes for the oil to drain into the pump. If necessary, add more oil. Refit the oil filler-plug.

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

Figure 8 - Remove/replace the inlet filter



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

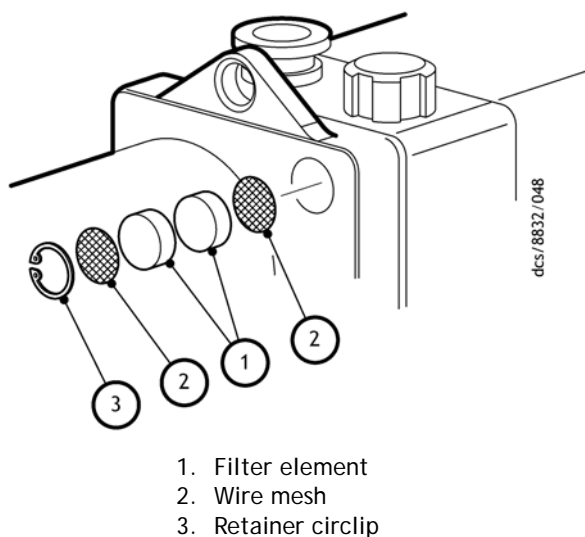
5.6 Clean the gas-ballast filter

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

Figure 9 - Remove/replace the gas-ballast filter



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).

5.9 Replace the run capacitor and test the motor



WARNING

Change the run capacitor as per the maintenance plan.

Replace the run capacitor as described in the instructions supplied with the capacitor kit. Refer to [Table 11](#), [Section 7.3](#).

Test the earth (ground) 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 (ground) continuity is less than 0.1 Ω .
- Insulation resistance is greater than 10 M Ω .

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

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 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.

5.11.2 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.

5.11.3 The pump fail 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).

5.11.4 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.

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.

This page has been intentionally left blank.

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 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 4.8](#).
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.

Note: When required, prepare and install the pump as described in [Section 3](#). If the pump has been stored for more than a year, you must clean and overhaul the pump before you install 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.

This page has been intentionally left blank.

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 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 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.

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

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

7.3 Spares

The maintenance kits listed in [Table 10](#) 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.

Table 10 - Spares item numbers

Spare	Item Number
Clean and Overhaul Kit (Hydrocarbon)	A373-01-131
Clean and Overhaul Kit (PFPE filled)	A373-01-136
Blade Kit	A373-01-135
Ultragrade 19 Oil (4 litres)	H110-25-013
Fomblin Grade 06/6 Oil	H113-01-016

Table 11 - Capacitor kits

Motor Part Number	Capacitance	Colour	Item Number
A07110028	20µF	White	A50591813
A07110032	80µF	Silver	A50591800
A07110033	80µF	Silver	A50591800
A07110036	20µF	White	A50591813
A07110037	20µF	White	A50591813
A07110039	30µF	White	A50591814
A07110040	80µF	Silver	A50591800

7.4 Capacitor selection table

The following table can be used to select the correct capacitor kit if motor and/or pump part numbers are known.

Table 12 - Capacitor kit selection table

Pump Type	Pump Part Number	Motor Part number	Capacitor Kit
E2M28	A37315903	A07110028	A50591813
	A37315904	A07110033	A50591800
	A37315981	A07110032	A50591800
	A37316903	A07110036	A50591813
	A37317984	A07110039	A50591814
	A37319903	A07110037	A50591813
	A37324904	A07110040	A50591800
	A37324930	A07110028	A50591813
	A37325903	A07110028	A50591813
	A37325984	A07110039	A50591814
E2M30	A37415903	A07110028	A50591813
	A37415904	A07110033	A50591800
	A37415981	A07110032	A50591800
	A37435903	A07110028	A50591813
	N04091000	A07110028	A50591813

7.5 Accessories

7.5.1 Introduction

A range of accessories is available for the E2M28 and E2M30 pumps, as shown in Figure 10.

The accessories are briefly described in the following sections. Refer to Table 13 for the Item Numbers of these accessories.

Table 13 - 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
EMF30 Outlet Mist Filter	A462-33-000
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	C105-11-670
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

7.5.2 Inlet catchpot

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

7.5.3 Inlet dust filter

The Inlet Dust Filter protects the pump against abrasive dust.

7.5.4 Inlet desiccant trap

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

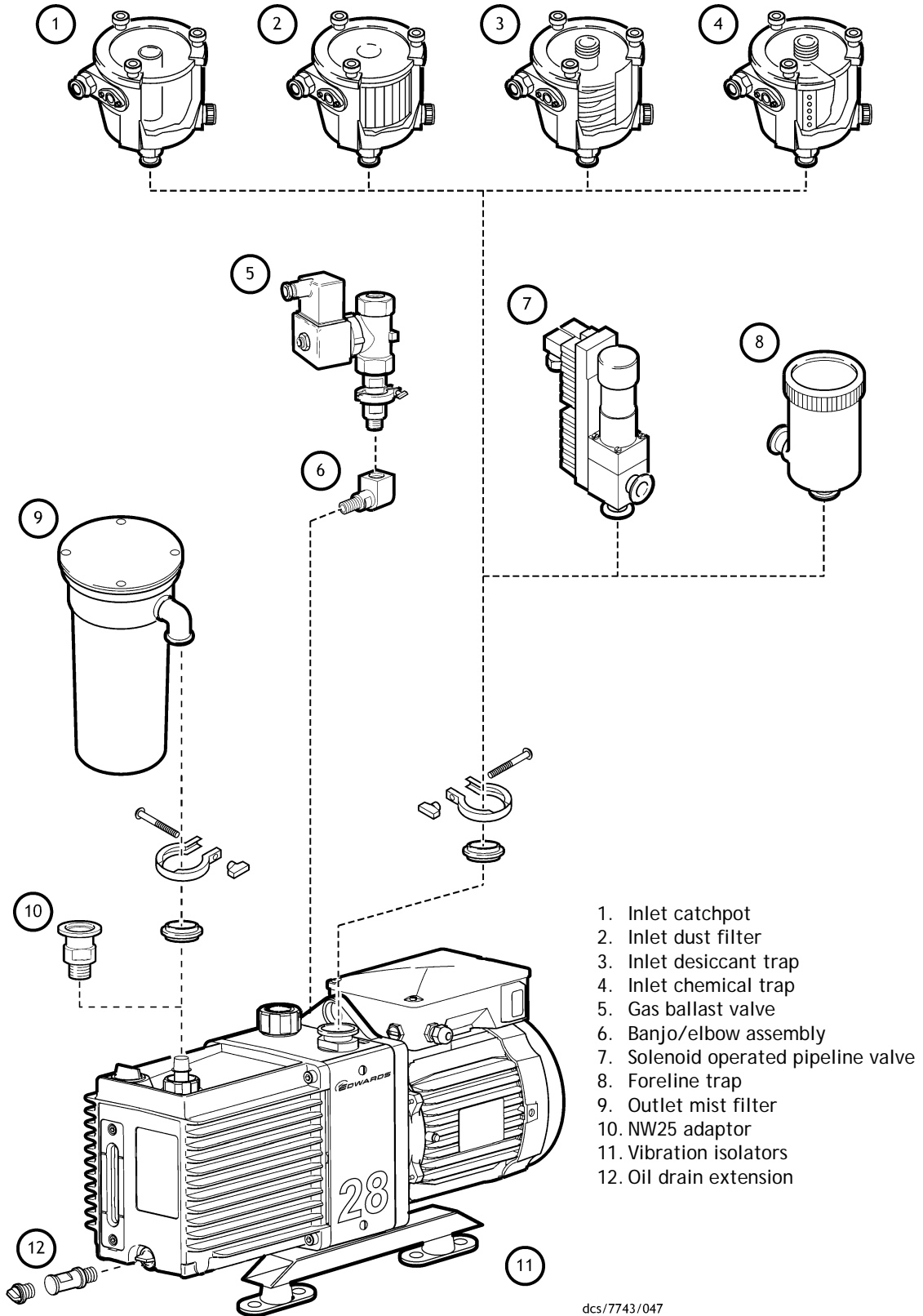
7.5.5 Inlet chemical trap

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

7.5.6 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.

Figure 10 - 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

dcs/7743/047

7.5.7 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.

7.5.8 Foreline trap

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

7.5.9 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.

7.5.10 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.

7.5.11 Pump inlet adaptor

This is an 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.

7.5.12 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.

7.5.13 Pump outlet adaptor

This is a 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 NW25 pump inlet.

7.5.14 Gas ballast banjo/elbow assembly

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

7.5.15 Gas ballast valve

Use this to control the gas-ballast remotely. You will also need the Gas Ballast Banjo/Elbow Assembly (refer to [Section 7.5.14](#)) when you fit this accessory.

This page has been intentionally left blank.

8 PFPE-prepared EM pumps

8.1 Introduction

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

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

We recommend that you refer to Edwards publication P300-20-000 (Vacuum pump and Vacuum System Safety) before you install and use 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](#).

8.3 Operation

WARNING



PFPE-prepared EM pumps are suitable for pumping high concentrations of oxygen, but we recommend that you do not use a PFPE-prepared EM pump for the pumping of hazardous materials.

Operation of a PFPE-prepared EM pump is as specified in [Section 4](#).

8.4 Maintenance

WARNING



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

- Take additional care if you suspect that the pump or 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 when heated to 260 °C and above. The pump may have overheated if misused, malfunctioned or if it was in a fire. Material Safety Data Sheets for PFPE oils used in the pump are available on request: contact your supplier or Edwards.

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

- If you fill your PFPE-prepared EM pump with Fomblin oil, we recommend that you regularly check for oil leaks, particularly around the shaft seals.
- If you detect an oil leak, contact your supplier or Edwards for advice.

This page has been intentionally left blank.