Instruction Manual

EH Mechanical Booster Pumps

EDWARDS

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CONTENTS

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Illustrations

Tables

Associated publications

Publication title	Publication Number
Vacuum pump and vacuum system safety	P300-20-000

1 INTRODUCTION

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards EH250, EH500A, EH1200, EH2600 and EH4200 Mechanical Booster Pumps. The Item Numbers for the products are listed in Section 2.7. You must use your pump as specified in this manual.

Read this manual before you install and operate your 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.

1.2 Description

1.2.1 General

Edwards EH Mechanical Booster Pumps are compact and have high pumping speeds. You must use the EH Mechanical Booster Pump with a suitable backing pump. The EH Mechanical Booster Pumps can operate with a maximum continuous inlet pressure of 1000 mbar. Low system pressures can be achieved by using two or more mechanical booster pumps in series.

The pump coupling-cover is connected to the pump outlet and forms an integral part of the vacuum system. The connecting lines have a filter which removes debris and so prevents contamination of the lubricating oil and bearings. For an even cleaner system, the coupling-cover and bearings can be evacuated by connection to the pump-inlet or to an external vacuum pump.

Two versions of the EH pumps are available. The standard versions use mineral oil, such as Edwards No. 16. Versions for use with PFPE (perfluoropolyether) oils are also available for vacuum systems in which oxygen or other reactive or corrosive gases are pumped. All pumps have ISO inlet-flange and outlet-flange connections.

1.2.2 Construction

The EH pumps are positive displacement Roots vacuum pumps. The pump mechanism is driven by a three-phase electric motor through a hydrokinetic fluid-coupling.

The EH250 and EH500A pumps are air-cooled. The EH1200, EH2600 and EH4200 pumps are water-cooled. The motor is air-cooled on all pump models.

The pump shafts and rotors are made of high-grade, corrosion-resistant, cast-iron. The internal and external shaft-seals are made of polytetrafluoroethylene (PTFE) or fluoroelastomer.

The pump-bearings, gears and seals are lubricated by oil fed from reservoirs in the coupling-cover. A series of seals stops the oil from reaching the vacuum side of the pump. The coupling-cover is evacuated. You can inspect the oil-levels through sight-glasses which are fitted to the coupling-cover. Oil-filler, oil-drainage and external evacuation connections are provided on the cover.

The timing gears on the EH1200, EH2600 and EH4200 pumps are lubricated by oil inside the gear-cover. An oil-filler connection is provided and you can inspect the oil-level through a sight-glass fitted to the gear-cover.

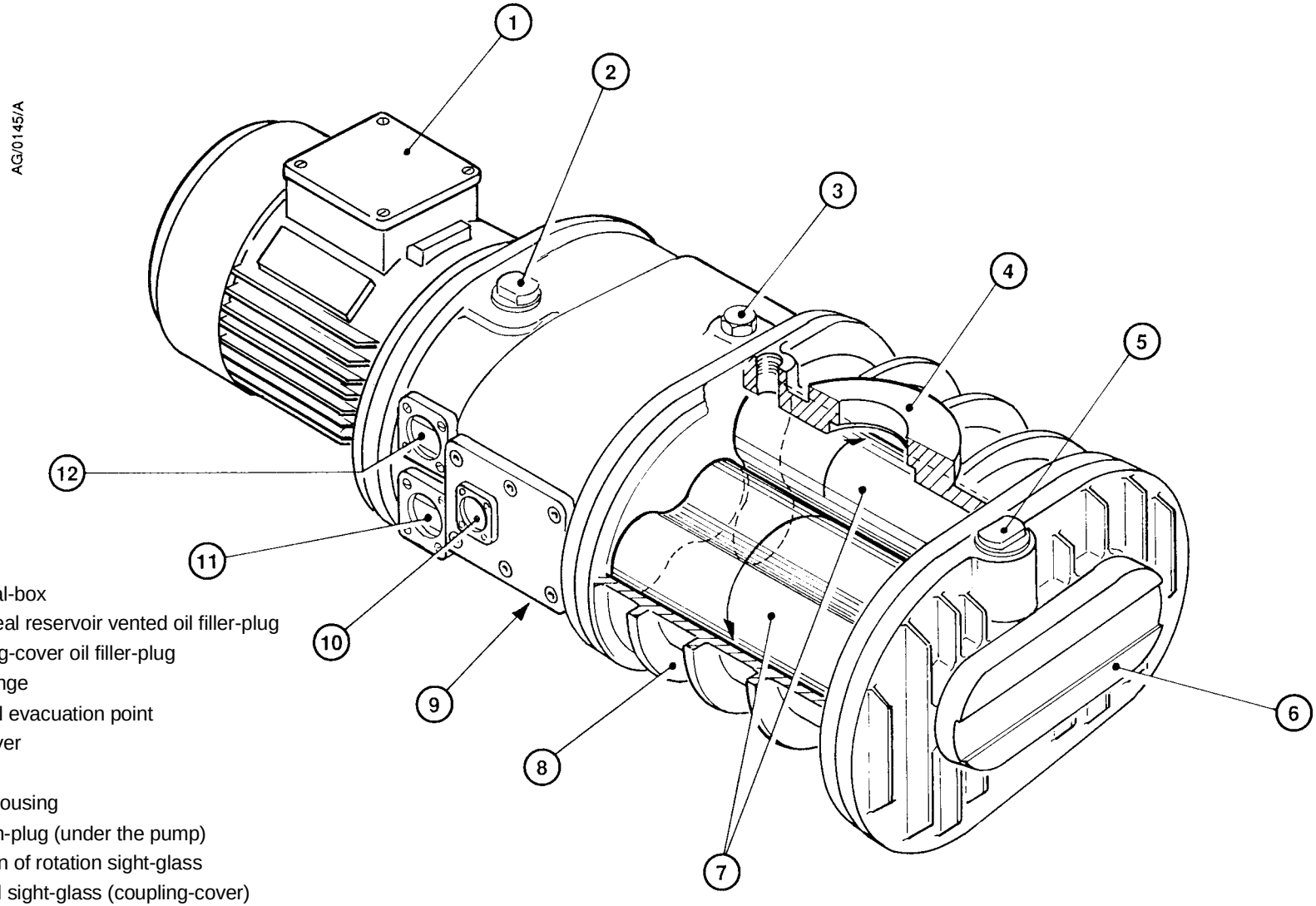
1.2.3 Principle of operation

The EH Mechanical Booster Pump is shown in Figures 1 and 2. The motor-shaft drives one of the rotors through the fluid-coupling. The 1:1 gears inside the coupling-cover drive the second rotor in the opposite direction inside the stator housing. A small, accurately gauged, clearance is maintained between the rotors and between each rotor and the stator wall. This clearance allows the pump to operate at high speed without mechanical wear and without the need for lubrication inside the swept volume.

1.2.4 Hydrokinetic fluid-coupling

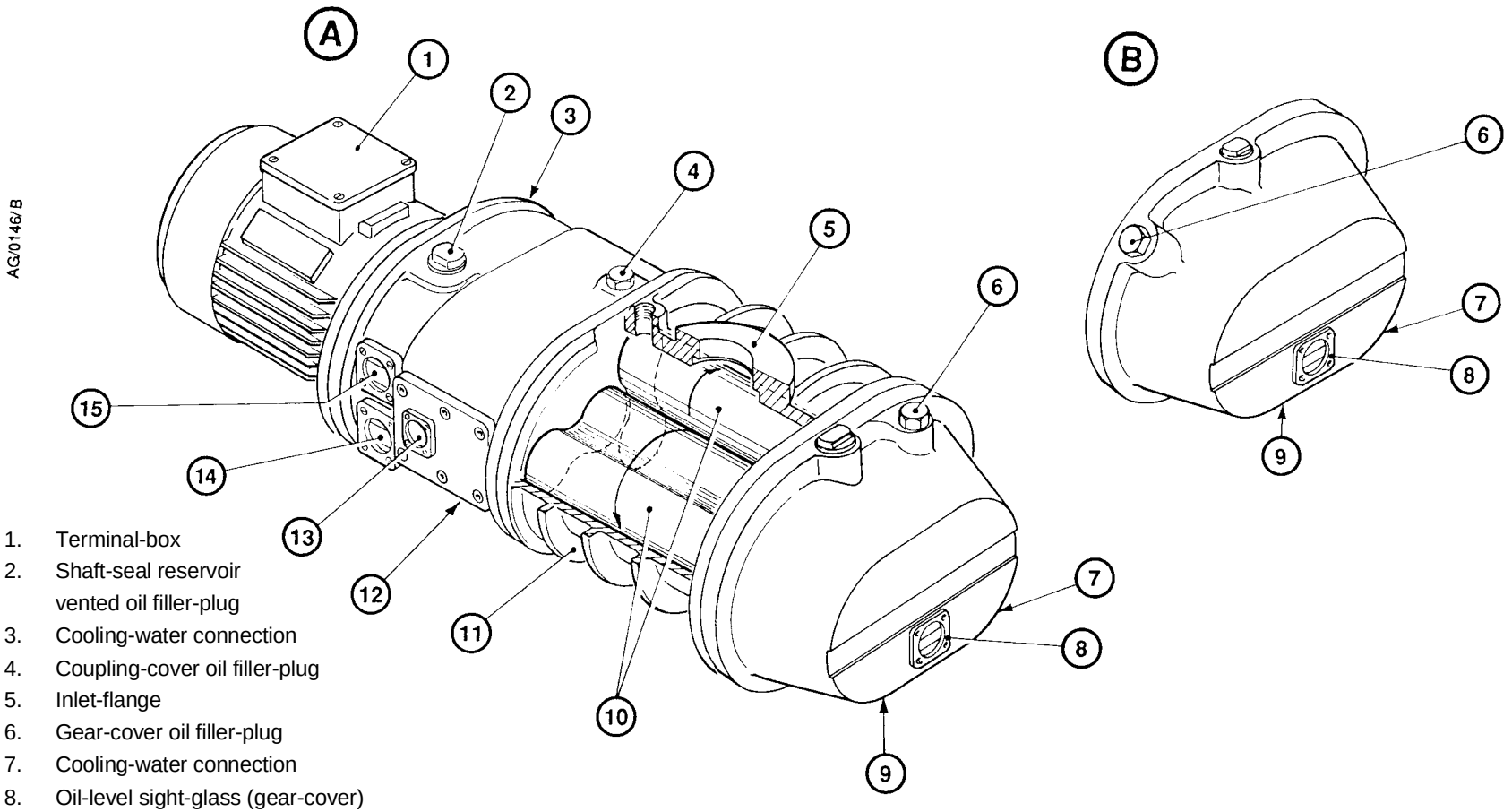
The hydrokinetic fluid-coupling connects the electric-motor shaft to the rotor. This system is configured so that when the gas-load is high the rotational speed of the rotors is reduced. As the gas-load decreases, the rotors accelerate to full speed. This allows continuous operation of the pump over the vacuum range without the risk of overloading the motor and removes the need for bypass-valves and associated pipelines.

The fluid-coupling is viscosity sensitive. The two versions of the pump (for mineral and PFPE oils) have fluid-coupling drives which are specifically designed for the type of oil used in the pump.



1. Terminal-box
2. Shaft-seal reservoir vented oil filler-plug
3. Coupling-cover oil filler-plug
4. Inlet-flange
5. External evacuation point
6. End-cover
7. Rotors
8. Stator housing
9. Oil drain-plug (under the pump)
10. Direction of rotation sight-glass
11. Oil-level sight-glass (coupling-cover)
12. Oil-level sight-glass (shaft-seal reservoir)

Figure 1 - EH250 / 500A Mechanical Booster Pumps (part cut-away)



1. Terminal-box
2. Shaft-seal reservoir vented oil filler-plug
3. Cooling-water connection
4. Coupling-cover oil filler-plug
5. Inlet-flange
6. Gear-cover oil filler-plug
7. Cooling-water connection
8. Oil-level sight-glass (gear-cover)
9. Gear-cover oil drain-plug (under the pump)
10. Rotors
11. Stator housing
12. Coupling-cover oil drain-plug (under the pump)
13. Direction of rotation sight-glass
14. Oil-level sight-glass (coupling-cover)
15. Oil-level sight-glass (shaft-seal reservoir)

A EH2600 & EH4200 pumps
B EH1200 pump (detail)

Figure 2 - EH1200 / 2600 / 4200 Mechanical Booster Pumps (part cut-away)

2 TECHNICAL DATA

2.1 General

Overall dimensions	See Figures 3 to 6
Mass	
EH250	61 kg
EH500A	74 kg
EH1200	149 kg
EH2600	308 kg
EH4200	400 kg
Ambient operating temperature range	5 to 40 ^{o}C (see Note 1 below)
Storage temperature range	-10 to 80 ^{o}C
Maximum operating humidity	90% RH
Protection degree (as defined by IEC 529)	IP44
Recommended cooling-water flow (with inlet temperature of 20 ^{o}C)	
EH1200	120 lh^{-1} (see Note 2 below)
EH2600	250 lh^{-1}
EH4200	250 lh^{-1}
Recommended cooling-water supply pressure	2 to 6 bar gauge (3 to 7 bar absolute, 3×10^5 to 7×10^5 Pa)
Recommended oil type	
Standard pumps	Ultragrade 20 (see Note 3 below)
PFPE pumps	Fomblin YVAC 16/6 (see Note 3 below)
Recommended grease type (for use with EH250/EH500A pumps)	Fomblin RT15 (see Note 3 below)
Oil capacity	See Table 1 below

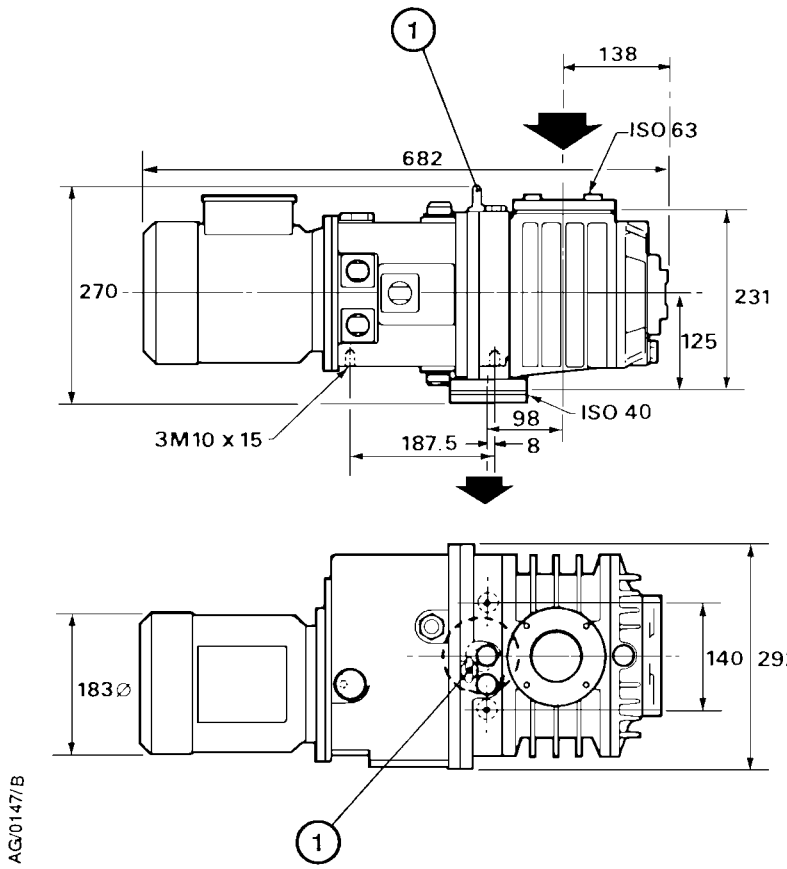
	EH250	EH500A	EH1200	EH2600	EH4200
Gear-cover	-	-	1.25	3.5	3.5
Coupling-cover	1.5	1.5	2.4	6.5	6.5
Shaft-seal reservoir	0.125	0.125	0.125	1.5	1.5

Table 1 - Lubrication capacities (litres)

Note 1: For operation outside this temperature range contact Edwards for advice. Between -30 ^{o}C and 5 ^{o}C, special precautions must be taken.

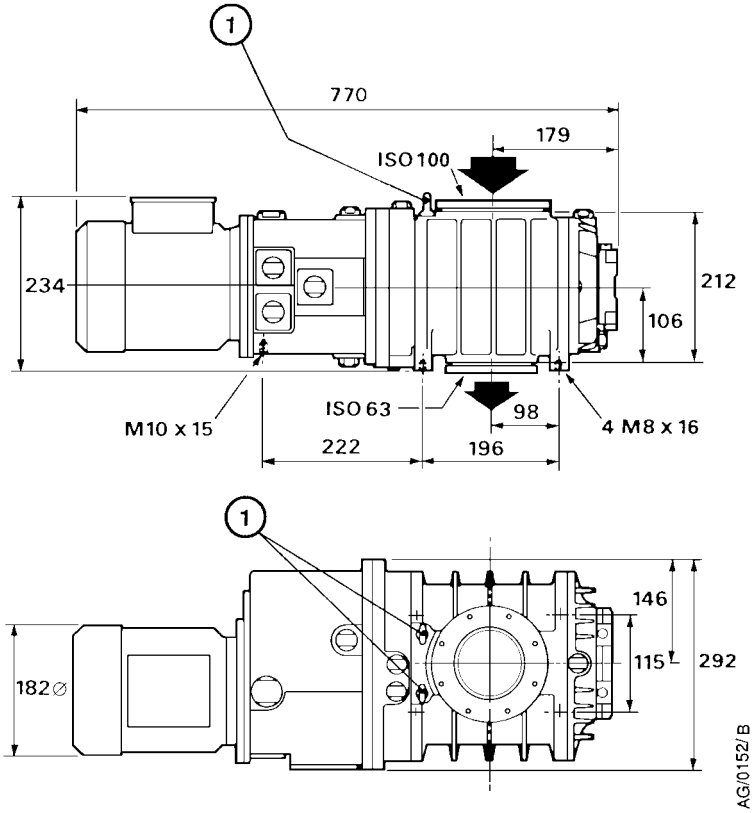
Note 2: You can operate the EH1200 continuously without cooling-water if the inlet pressure is kept below 5 mbar (5×10^2 Pa) and the pumpdown time is no longer than 10 minutes.

Note 3: Edwards Health and Safety Data sheets for the above oils and grease are available on request.



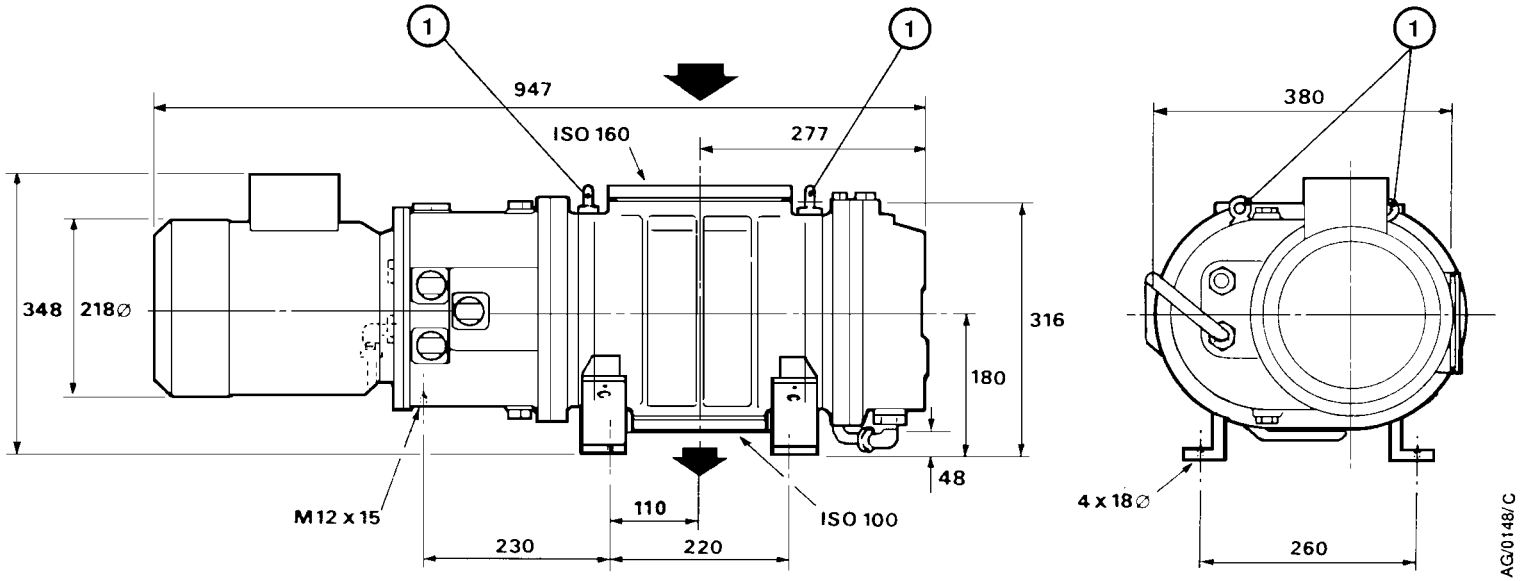
1. Lifting point

Figure 3 - EH250 dimensions (mm)



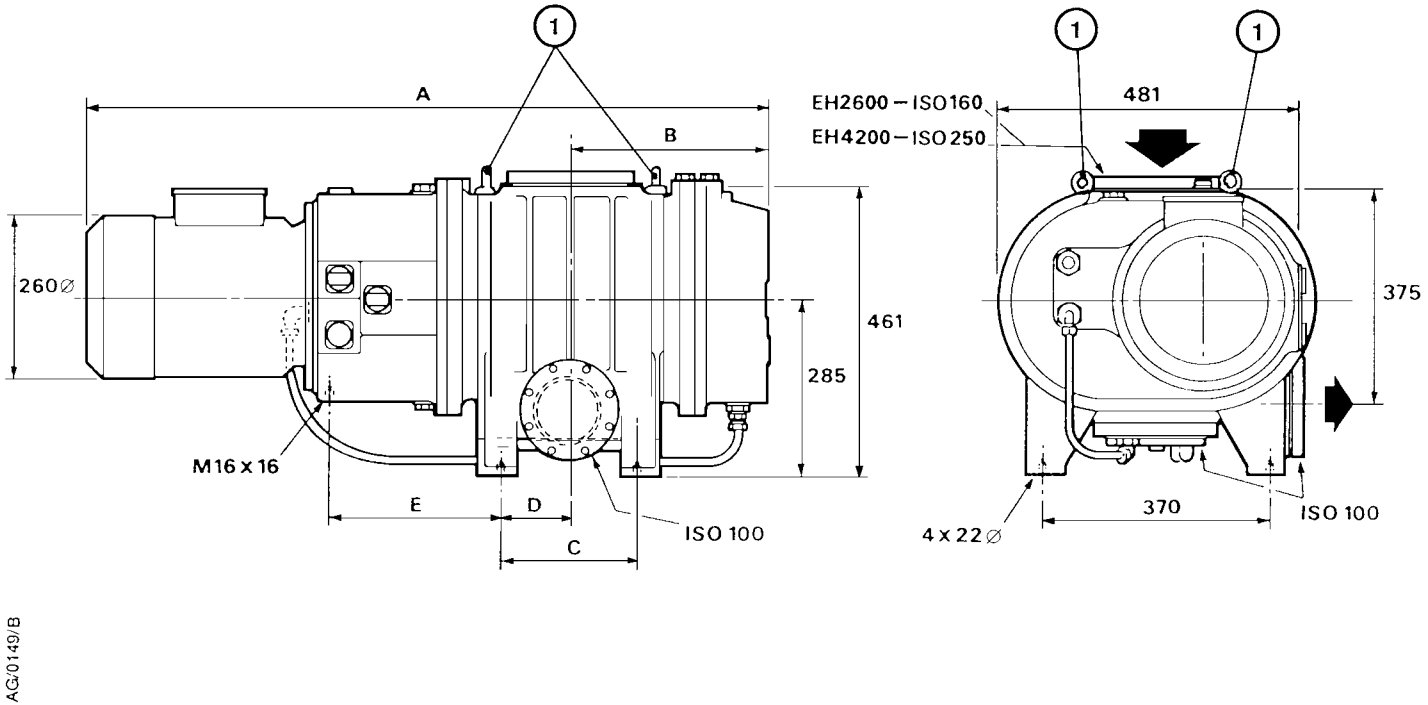
1. Lifting point

Figure 4 - EH500A dimensions (mm)



1. Lifting point

Figure 5 - EH1200 dimensions (mm)



1. Lifting point

	A	B	C	D	E
EH2600	1093	312	220	110	275
EH4200	1273	402	370	185	290

Figure 6 - EH2600/4200 dimensions (mm)

2.2 Performance

Rotational speed (50 Hz supply)	0 to 2900 $r.min^{-1}$
Rotational speed (60 Hz supply)	0 to 3500 $r.min^{-1}$
Total pressure (single-stage backing pump, with gas-ballast)	2×10^{-2} mbar absolute (2 Pa)
Ultimate pressure (single-stage backing pump without gas-ballast, permanent gases)	2×10^{-3} mbar absolute (2×10^{-1} Pa)
Total pressure (two-stage backing pump with gas-ballast)	1×10^{-3} mbar absolute (1×10^{-1} Pa)
Maximum outlet pressure (see Section 1.2.4)	1000 mbar absolute (1×10^{5} Pa)

Pressure differential across pump
(determined by the hydrokinetic drive)

Pump	50 Hz		60 Hz	
EH250	0 to 180 mbar	0 to 1.8×10^{4} Pa	0 to 150 mbar	0 to 1.5×10^{4} Pa
EH500A	0 to 110 mbar	0 to 1.1×10^{4} Pa	0 to 90 mbar	0 to 0.9×10^{4} Pa
EH1200	0 to 90 mbar	0 to 0.9×10^{4} Pa	0 to 75 mbar	0 to 0.75×10^{4} Pa
EH2600	0 to 80 mbar	0 to 0.8×10^{4} Pa	0 to 67 mbar	0 to 0.67×10^{4} Pa
EH4200	0 to 60 mbar	0 to 0.6×10^{4} Pa	0 to 50 mbar	0 to 0.5×10^{4} Pa

2.3 Recommended backing pumps

Because of the flexibility of the hydrokinetic drive, there is a wide range of backing pumps which are suitable for use with the EH Mechanical Booster pumps. Select the backing pump which suits your process from the following list:

Pump	Recommended backing pumps
EH250	Edwards QDP40 / 80, E1M40 / 80 or E2M40 / 80
EH500A	Edwards QDP40 / 80, DP180, E1M40 / 80 or E2M40 / 80
EH1200	Edwards QDP80, DP180, E2M80 / 175 / 275
EH2600	Edwards DP180, E2M175 or E2M275
EH4200	Edwards DP180, ES7500 or E2M275

2.4 Connections

2.4.1 Vacuum connections

	Inlet	Outlet
EH250	ISO63	ISO40
EH500A	ISO100	ISO63
EH1200	ISO160	ISO100
EH2600	ISO160	ISO100
EH4200	ISO250	ISO100

2.4.2 Cooling-water connections

Inlet connection	$^{3}/_{8}$ inch BSP male
Outlet connection	$^{3}/_{8}$ inch BSP male

2.5 Electrical data

Note: The motors of EH250 and EH500A pumps are supplied configured for 'low voltage' operation (240 V and lower), the motors of EH1200, EH2600 and EH4200 pumps are supplied configured for 'high voltage' operation (380 V and higher): refer to Section 3.6.

Number of phases	3
Supply voltage	220-240 V / 380-415 V at 50 Hz 208-230 V / 460 V at 60 Hz
Voltage tolerance	±6%
Full load current ratings	See Table 2

Supply voltage & frequency →		208 V 60 Hz	220 V 50 Hz	230 V 60 Hz	240 V 50 Hz	380 V 50 Hz	415 V 50 Hz	460 V 60 Hz
EH250 & EH500A	Full load (A)	6.1	6.3	5.5	5.8	3.7	3.4	2.8
	Rating (kW)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
EH1200	Full load (A)	11.9	11.1	10.7	10.2	6.4	5.9	5.4
	Rating (kW)	3	3	3	3	3	3	3
EH2600 & EH4200	Full load (A)	20.9	19.8	18.9	18.2	11.5	10.5	9.5
	Rating (kW)	7.5	7.5	7.5	7.5	7.5	7.5	7.5

Table 2 - Full load current ratings

2.6 Noise and vibration data

Continuous A-weighted sound pressure level measured
at 1 metre from a major surface of the pump

EH250	72 dB (A)
EH500A	72 dB (A)
EH1200	76 to 77 dB (A)
EH2600	85 dB (A) (80 dB (A) with muffled fan)
EH4200	85 dB (A) (80 dB (A) with muffled fan)

Vibration

BS 4675	Class 1B grade

2.7 Product Item Numbers

Product Item Numbers for the different versions of the EH pumps are shown in Table 3.

	220-240 V / 380-415 V 3-phase, 50 Hz		208-230 V / 460 V 3-phase, 60 Hz	
	Standard	PFPE	Standard	PFPE
EH250	A301-51-935	A301-53-935	A301-52-936	A301-54-936
EH500A	A302-71-935	A302-73-935	A302-72-936	A302-74-936
EH1200	A305-90-935	A305-92-935	A305-91-936	A305-93-936
EH2600	A307-51-935	A307-53-935	A307-52-936	A307-54-936
EH4200	A309-51-935	A309-53-935	A309-52-936	A309-54-936

Table 3 - Product Item Numbers

3 INSTALLATION

3.1 Safety

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.

- A suitably trained and supervised technician must install your EH pump.
- Ensure that the installation technician is familiar with the safety procedures which relate to the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components. Dismantle and clean contaminated components inside a fume-cupboard.
- Consult Edwards publication P300-20-000 (Vacuum pump and vacuum system safety) before you install and use the pump to process hazardous materials.
- Vent and purge the pumping system before you start installation work.
- Check that all the required components are available and of the correct type before you start work.
- Provide adequate access to all pump servicing points and oil-level sight-glasses.
- Disconnect the other components in the pumping system from the electrical supply so that they cannot be operated accidentally
- Do not reuse 'O' rings and Co-Seals
- Leak-test the system after installation work is complete to prevent leakage of hazardous substances out of the system and leakage of air into the system.

3.2 System requirements

Consider the following points when you design your pumping system:

- You must use a suitable backing pump: refer to Section 2.
- The mechanical booster pump must be mounted on a firm, level surface.
- Vacuum pipelines must be adequately supported to stop the transmission of stress to pipeline joints.
- If necessary, incorporate flexible pipelines in your system pipelines to reduce the transmission of vibration and to prevent loading of the coupling joints. If you use flexible pipelines, you must ensure that you use flexible pipelines which have a maximum pressure rating which is greater than the highest pressure that can be generated in your system.
- You must be able to isolate the pump-inlet and exhaust from the atmosphere and from your vacuum system if you will use or produce corrosive chemicals in the pump.
- Limit the maximum continuous gas heat-input to less than 200 W.

- Ensure that your design incorporates all appropriate safety precautions if toxic, inflammable or explosive gases or particulates will be pumped.
- You must be able to purge with an inert gas when you shut down the pumping system to dilute dangerous gases to safe concentrations. Consult Edwards or your supplier if you are in doubt.

If the pump is to be fitted in a new system, ensure that all preliminary pipelines have been installed and that a suitable base for the pump has been prepared before you start installation. Check that the following services and facilities are available for connection to the pump:

- Cooling-water supply and return
- Electrical supply
- Exhaust-extraction system.

Ensure that debris does not get into the pump when you install it. If the pump is to replace a pump in an existing system, purge the existing pump with nitrogen for 15 minutes before you disconnect it.

3.3 Unpack and inspect

Use the following procedure to unpack and inspect the pump:

1. Place the pallet in a convenient position with a fork lift truck or a pallet truck.
2. Remove all packing materials.
3. Use suitable lifting-gear attached to the lifting-eyes provided on the pump to remove the pump from its pallet. Do not try to lift the pump by hand (see Section 2 for the mass of your pump).
4. Remove all protective covers and inspect the pump. If the pump is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the pump together with your order number and your supplier's invoice number. Retain all packing materials for inspection. Do not use the pump if it is damaged.
5. If the pump is not to be used immediately, refit the protective covers. Store the pump in suitable conditions as described in Section 6.1.

3.4 Fill the pump with oil

> CAUTION
>
> Ensure that the oil-levels in the pump are correct. If an oil-level is incorrect, pump performance may be affected and the pump may be damaged.

3.4.1 Coupling-cover

We recommend that the coupling-cover oil-level is maintained at the recommended oil-level shown in Figure 7, item 5; if the oil-level is above or below the recommended oil-level, the performance of the pump may be affected. Do not allow the coupling-cover oil-level to fall below the bottom of the reflector plate (Figure 7, item 4) or the pump may be damaged.

1. Remove the coupling-cover oil filler-plug (Figure 1, item 3).
2. Refer to Figure 7. Fill the coupling-cover with PFPE oil until the oil-level reaches the recommended oil-level (5) at the top of the reflector plate (4) in the oil-level sight-glass (3).
3. Refit the coupling-cover oil filler-plug.

3.4.2 Shaft-seal reservoir

> WARNING
>
> Ensure that the correct vented filler-plug is refitted in the shaft-seal reservoir. If you use a non-vented plug, the reservoir will be pressurised and the oil sight-glass may fracture.

Note: Some early model pumps are fitted with an all-metal vented filler-plug (that is, there is no plastic insert in the filler-plug). On these pumps, the shaft-seal sight-glass should be full. If it is not, the oil-level is too low and you must fill the reservoir to the bottom thread of the vented filler-plug.

We recommend that you fill the shaft-seal reservoir so that the oil-level is at the recommended oil-level, shown in Figure 7, item 2. You can operate the pump as long as the oil-level is above the bottom of the reflector plate. Do not allow the shaft-seal oil-level to fall below the bottom of the reflector plate or the pump may be damaged. You must use the same oil you used to fill the coupling-cover.

1. Remove the shaft-seal reservoir vented oil filler-plug (Figure 1, item 2).
2. Refer to Figure 7. Fill the shaft-seal reservoir with oil until the oil-level is at the recommended oil-level (2) at the top of the reflector plate (6).
3. Refit the vented oil filler-plug.

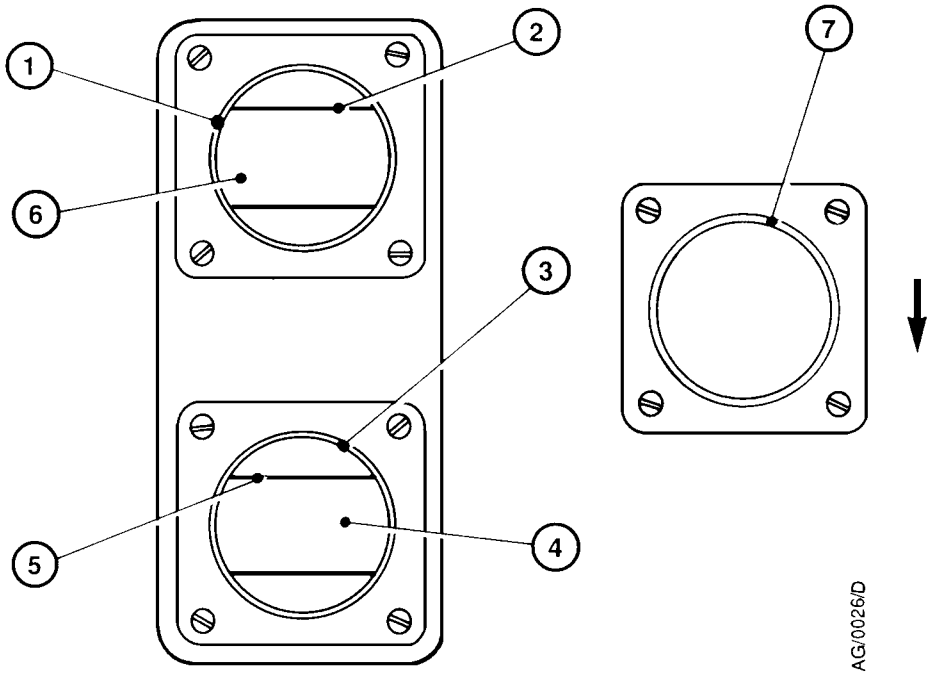
3.4.3 Gear-cover (EH1200, EH2600 and EH4200 pumps only)

Use the following procedure to fill the gear-cover on EH1200, EH2600 and EH4200 pumps. You must fill the gear-cover with the same oil you used to fill the coupling-cover and shaft-seal reservoir.

1. Remove the oil filler-plug on the top of the gear-cover (Figure 2, item 6).

2. Fill the gear-cover with oil until the oil-level is at the middle of the reflector plate in the gear-cover oil-level sight-glass (Figure 2, item 8).

3. Refit the oil filler-plug.



1. Shaft-seal reservoir sight-glass
2. Shaft-seal reservoir recommended oil-level
3. Coupling-cover sight-glass
4. Coupling-cover reflector plate
5. Coupling-cover recommended oil-level
6. Shaft-seal reflector plate
7. Direction of rotation sight-glass (the arrow shows the correct direction of rotation)

Figure 7 - Sight-glasses

3.5 Cooling-water connections (EH1200, EH2600 and EH4200 pumps only)

Note: You can operate the EH1200 continuously without cooling-water if the inlet pressure is kept below 5 mbar (5×10^2 Pa) and the pumpdown time is no longer than 10 minutes.

Connect the cooling-water supply and return lines to the $^3/_8$ inch BSP connectors. One connector is on the rear of the coupling-cover, the other connector is on the underside of the gear-cover. You can connect the supply and return lines to either of the connectors; the direction of cooling-water flow is not important.

Refer to Section 2 for the minimum cooling-water flow rate required. Do not allow the cooling-water supply pressure to go above the maximum pressure stated in Section 2.

3.6 Electrical connections

> WARNING
>
> The pump must be connected to an electrical earth.

3.6.1 Electrical supply configuration

The motors of the EH250 and EH500A pumps are supplied configured for 'low-voltage' operation (240 V and lower).

The motors of the EH1200, EH2600 and EH4200 pumps are supplied configured for 'high-voltage' operation (380 V and higher).

Refer to Table 4 before you connect the electrical supply to the pump motor (as described in Section 3.6.2). Table 4 tells you which figure you must refer to for the electrical connections for your pump and your electrical supply.

Electrical supply voltage and frequency	Refer to Figure	
	EH250/500A	EH1200/2600/4200
208 V, 60 Hz	10	12
220 V, 50 Hz	8	8
230 V, 60 Hz	10	12
240 V, 50 Hz	8	8
380 V, 50 Hz	9	9
415 V, 50 Hz	9	9
460 V, 60 Hz	11	11

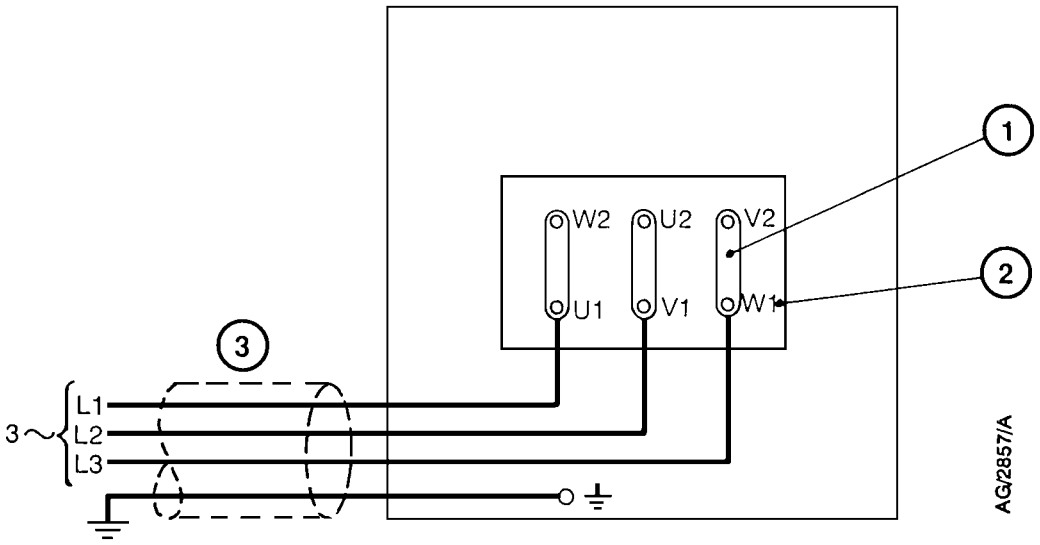
Table 4 - Electrical supply connection configurations

3.6.2 Motor connections

> CAUTION
>
> The motor must be correctly configured and you must make the correct electrical connections for your electrical supply. If you do not, you can damage the motor.

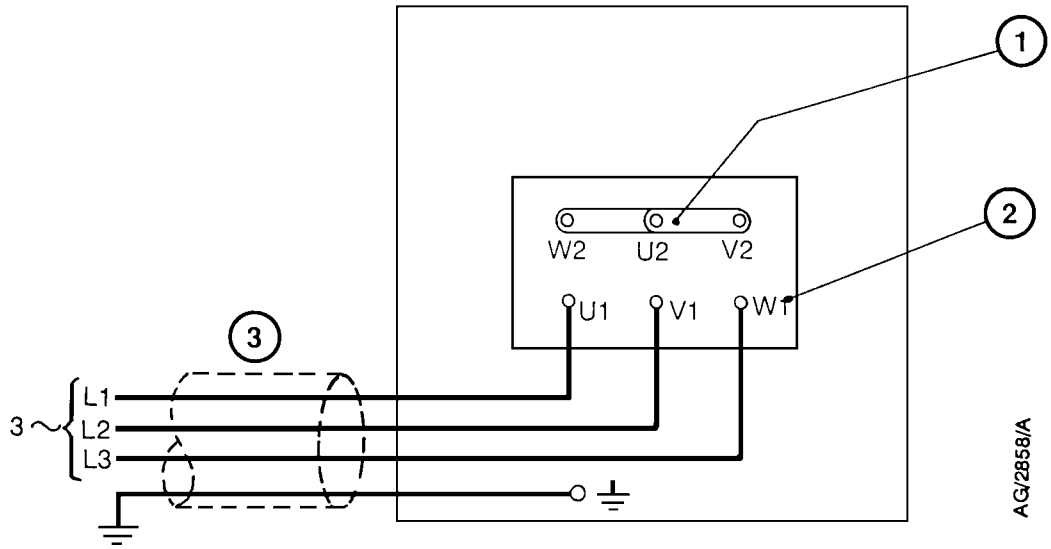
Connect the motor to the electrical supply as described below. Connect the supply through a contactor which has overload-protection or use a controller which incorporates a contactor. You must use a contactor which has a manual reset control. If you do not, the pump could automatically restart after an electrical overload or an electrical supply failure.

1. Remove the motor terminal-box cover (Figures 1 and 2, item 1).
2. Check your electrical supply voltage and frequency. If necessary, configure the motor to operate with your supply voltage (see Section 3.6.1).
3. Remove the plug from the cable-entry hole that you will use for the electrical supply cable. Choose the most suitable hole for your application.
4. Fit a suitable 20 mm cable-gland to the hole. If your cable is too large to fit through a 20 mm cable-gland, fit a 20 mm male to 25 mm female thread-adaptor to the cable-entry hole, and fit a 25 mm cable-gland to the adaptor. The cable-gland (and adaptor, if fitted) must provide a protective seal to IP44 (or higher), as defined by IEC 529.
5. Pass the electrical supply cable through the cable-gland.
6. Connect the wires of the cable to the appropriate terminals, as shown in Figures 8 to 12 (refer to Table 4).
7. Tighten the cable-gland and refit the terminal-box cover.



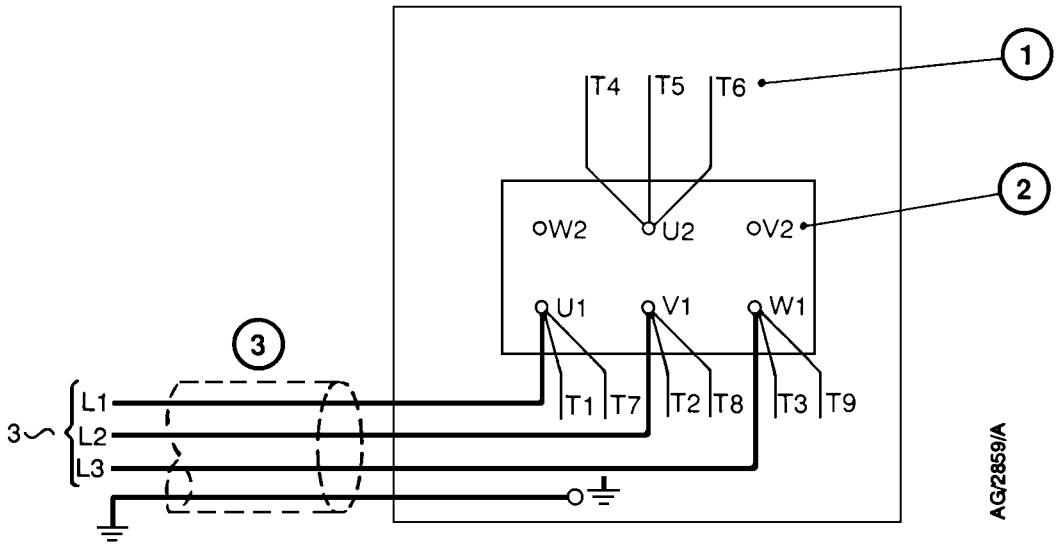
1. Links
2. Terminal markings
3. To electrical supply

Figure 8 - Electrical supply connection: EH250 / 500A / 1200 / 2600 / 4200: 220 to 240 V, 50 Hz



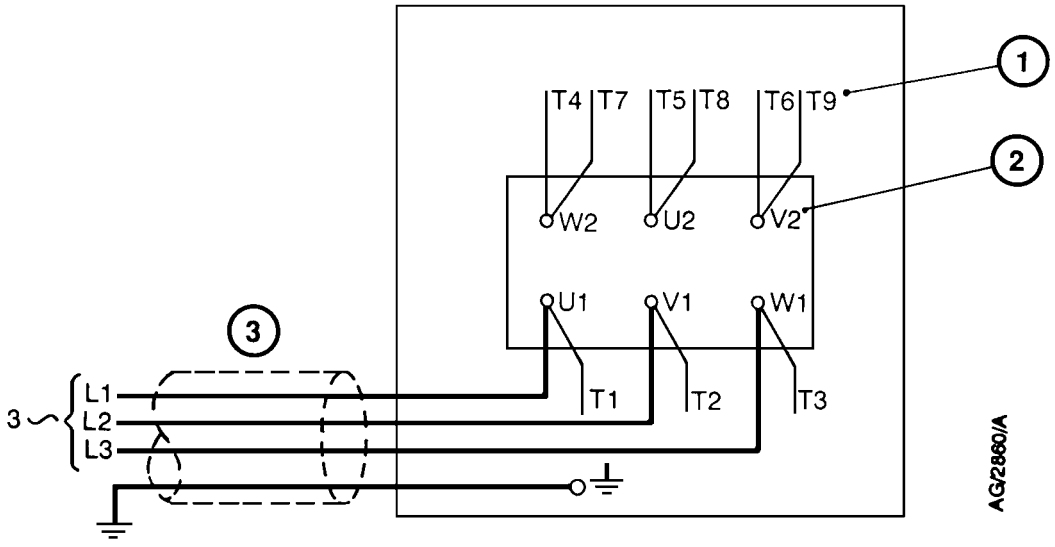
1. Links
2. Terminal markings
3. To electrical supply

Figure 9 - Electrical supply connection: EH250 / 500A / 1200 / 2600 / 4200: 380 to 415 V, 50 Hz



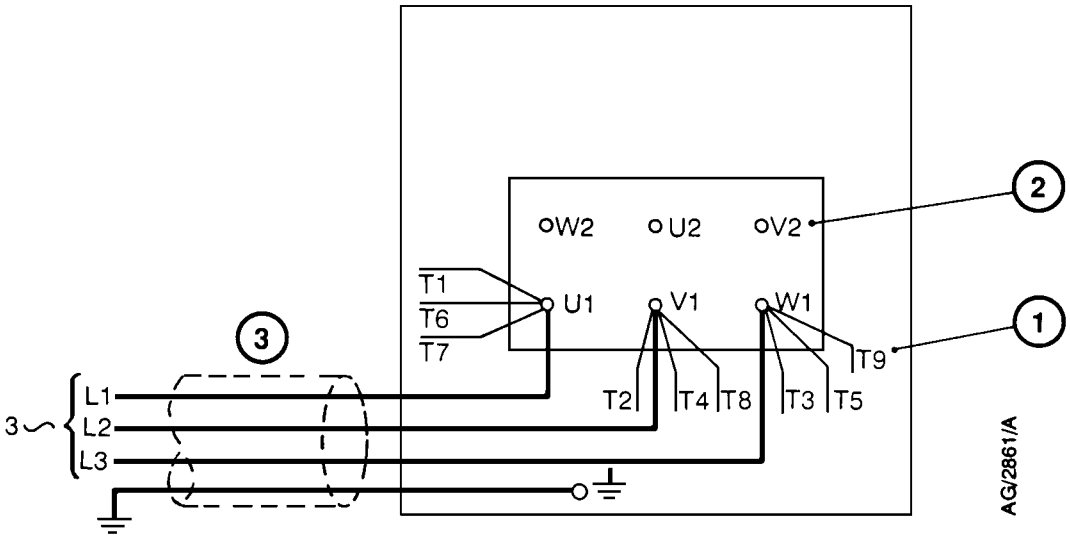
1. Motor wire markings
2. Terminal markings
3. To electrical supply

Figure 10 - Electrical supply connection: EH250 / 500A: 208 to 230 V, 60 Hz



1. Motor wire markings
2. Terminal markings
3. To electrical supply

Figure 11 - Electrical supply connection: EH250 / 500A / 1200 / 2600 / 4200: 460 V, 60 Hz



1. Motor wire markings
2. Terminal markings
3. To electrical supply

Figure 12 - Electrical supply connection: EH1200 / 2600 / 4200: 208 to 230 V, 60 Hz

3.7 Check the pump rotation

WARNING

Blank the inlet or connect the pump to the vacuum system before you check the direction of pump rotation. If you do not, there is danger of objects being trapped in the rotating rotors.

It is possible for the three-phase electrical supply to the motor to be phased incorrectly. If the supply is phased incorrectly, the rotors will rotate slowly in the reverse direction or remain stationary. Look through the direction of rotation sight-glass in the coupling-cover (Figure 1, item 10 and Figure 2, item 13) to check the direction of rotation of the motor-coupling. An enlarged view of the sight-glass is shown in Figure 7. The correct direction of rotation is indicated by an arrow. Check the direction of rotation as described below.

1. Check that the pump is connected to the vacuum system or that the inlet is blanked off.
2. Connect the backing pump and switch the backing pump on.
3. Watch the motor-coupling in the sight-glass (Figure 7, item 7) and switch on the EH pump for two or three seconds.
4. Check that the direction of rotation of the coupling is the same as that indicated by the rotation arrow on the motor and shown in Figure 7.
5. If the direction of rotation of the coupling is incorrect, switch off the backing pump and isolate the EH pump from the electrical supply. Reverse any two of the phase-wires in the motor terminal-box.
6. Repeat the check to ensure that the direction of rotation is now correct.

3.8 Connect the pump-inlet and outlet

Pump-inlet and outlet connections are made with standard ISO flanges, Edwards trapped 'O' rings and (on the EH250 pump only) an Edwards Co-Seal.

The EH2600 and EH4200 pumps have two alternative outlet positions :

- on the underside of the pump
- at the side of the pump.

As supplied, these pumps are configured to use the outlet at the side of the pump and the flange on the underside of the pump is blanked off. If you do not wish to use the side outlet, remove the blanking-plate from the outlet on the underside of the pump and refit the blanking-plate over the side outlet-flange.

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

- Move the pump to the required location and ensure that it is level and secure.
- For optimum pumping speeds, ensure that the pipeline connected to the pump-inlet is as short as possible and has a bore size not less than the inlet port diameter.
- Use a flexible connection in the pipeline from the vacuum system to the pump to reduce vibration and stress in the system pipelines (see Section 3.2).
- On very dusty applications, use a low-impedance inlet-filter to minimise abrasion in the pump.

3.9 External evacuation of coupling-cover (optional)

The coupling-cover may be evacuated using an external pump. A description of the connections required is beyond the scope of this manual. Contact your supplier or your nearest Edwards company for advice if you wish to use this facility.

4 OPERATION

4.1 Operational safety

WARNING

Do not touch any part of the pump when it is switched on. Surfaces of the pump are very hot, especially at high inlet pressures, and can cause injury to people and damage to equipment.

If you operate the EH250 or EH500A pump in an area of poor ventilation, the temperature of the coupling-cover can reach 100 ^{o}C and above. Take all necessary precautions to avoid accidental contact with the coupling-cover; if necessary, use a pump enclosure or fit a guard to the pump.

If you operate the EH1200 pump with the inlet pressure higher than 4 mbar for a long period, the stator and the coupling-cover will reach very high temperatures. Take all necessary precautions to avoid accidental contact with the stator and the coupling-cover; if necessary, use a pump enclosure or fit a guard to the pump.

4.2 Start-up procedure

4.2.1 Pre-start checks

1. Check that the pump oil-levels are correct (see Section 3.4).
2. Check that the pump is correctly installed, especially after initial installation and maintenance.

4.2.2 Start-up

Start-up the pump as described in the procedure below. This procedure assumes that the pump and the vacuum system are at atmospheric pressure.

1. On EH1200, EH2600 and EH4200 pumps only : switch on the cooling-water supply and check that there is an adequate flow of cooling-water at the correct pressure (see Section 2.1).
2. Close all valves to atmospheric pressure and ensure that all other openings are closed.
3. Switch on the backing pump and open the backing valve (if fitted).
4. Switch on the mechanical booster pump.
5. Slowly open the pump-inlet isolation-valve (if fitted).
6. Allow the pump to run for approximately fifteen minutes to achieve normal operating temperature.
7. Check the water connections for leaks.

4.3 Shut-down

1. Close the pump-inlet isolation-valve (if fitted).
2. Switch off the mechanical booster pump.
3. Open the backing pump air-admittance valve (if fitted) and switch off the backing pump.
4. On EH1200, EH2600 and EH4200 pumps only : turn off the cooling-water supply.

5 MAINTENANCE

5.1 Safety

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.

- A suitably trained and supervised technician must maintain the pump.
- Dismantle the pump in a clean workshop environment, with the correct tools and safety facilities available.
- Ensure that the maintenance technician is familiar with the safety procedures which relate to the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components. Dismantle and clean contaminated components inside a fume-cupboard.
- Allow the pump to cool to a safe temperature before you start maintenance work.
- Vent and purge the pumping system with nitrogen before you start maintenance work.
- Check that all the required parts are available and of the correct type before starting work.
- Isolate the pump and other components from the electrical supply so that they cannot be operated accidentally.
- Re-check the pump rotation direction if the electrical supply has been disconnected.
- Do not reuse 'O' rings and Co-Seals.
- Dispose of components and waste oil safely (see Section 6.2).
- Take care to protect sealing-faces from damage.
- Do not touch or inhale the thermal breakdown products of fluorinated materials which may be present if the pump has been overheated to 260 ^{o}C and above. These breakdown products are very dangerous. Fluorinated materials in the pump may include oils, greases and seals. The pump may have overheated if it was misused, if it malfunctioned or if it was in a fire. Edwards Health and Safety Data sheets for fluorinated materials used in the pump are available on request: contact your supplier or Edwards.
- Leak-test your system after installation and maintenance to prevent leakage of dangerous substances out of the system and leakage of air into the system.

The pump will be contaminated with the process chemicals that have been pumped. Ensure that you take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred.

5.2 Maintenance plan

Table 5 details the maintenance operations necessary to maintain EH pumps 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 pump corrosive or abrasive gases and vapours. If necessary, adjust the maintenance plan according to your experience.

Operation	Frequency	Refer to Section
Check the oil-levels	3 monthly	5.3
Inspect the pump connections	Monthly	5.4
Change the pump oil	As required	5.5
Lubricate the rear bearing (EH250/500A pumps only)	12 monthly	5.6

Table 5 - Maintenance plan

5.3 Check the oil-levels

CAUTION

Ensure that the oil-levels in the pump are correct. If an oil-level is incorrect, pump performance may be affected and the pump may be damaged.

Note: If there is a loss of oil from the shaft-seal reservoir, the shaft-seal may have failed. You cannot replace the shaft-seal. Contact your supplier or an Edwards Service Centre for advice.
If you have an early model pump, refer to the note in Section 3.4.2.

Use the following procedure to check the oil-levels in the sight-glasses. Refer to Figures 1 and 2 for the location of the filler-plugs and sight-glasses. During normal operation, the coupling-cover sight-glass (Figure 7, item 3) may appear empty or show a froth because the oil is in circulation around the coupling.

1. Refer to Figure 7. Check the shaft-seal oil-level. If the oil-level is below the bottom of the reflector plate (6), refer to Section 3.4 and refill the shaft-seal reservoir.

2. Check the coupling-cover oil-level. If the oil-level is below the top of the reflector plate, refer to Section 3.4 and refill the coupling-cover oil reservoir.

3. On EH1200, EH2600 and EH4200 pumps only, check the gear-cover oil-level. If the oil-level is below the middle of the reflector plate, refer to Section 3.4 and refill the gear-cover.

5.4 Inspect the pump connections

1. Check that the cooling-water connections are secure.
2. Inspect the cooling-water pipelines and connections for corrosion, leaks and damage.
3. Check that the electrical connections are secure.
4. Check the electrical supply cables for damage.
5. Inspect all the vacuum pipelines for corrosion and damage. Check that all the vacuum connections are secure.

5.5 Change the pump oil

> CAUTION
>
> Ensure that the oil-levels in the pump are correct. If an oil-level is incorrect, pump performance may be affected and the pump may be damaged.

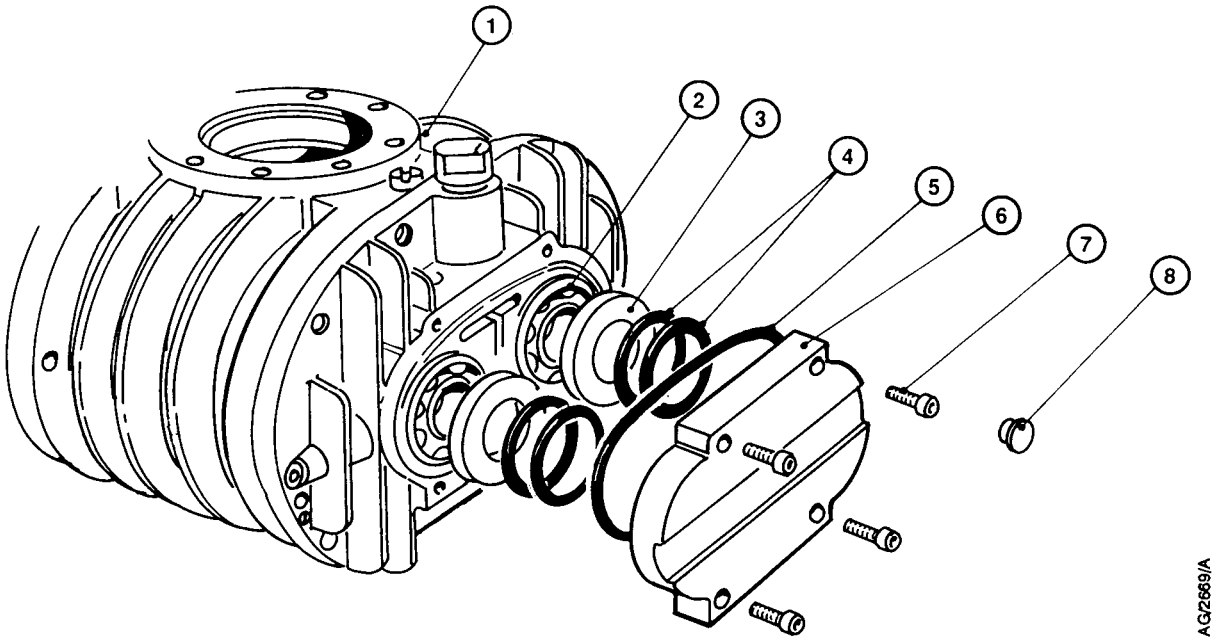
Replace the pump oil as described below. Refer to Figures 1 and 2 for the location of the oil-filler and drain-plugs.

1. Switch off the pump and allow it to cool.
2. Remove the coupling-cover oil filler-plug.
3. Remove the coupling-cover oil drain-plug from the underside of the coupling-cover and allow the oil to drain into a suitable container.
4. Remove the shaft-seal vented oil filler-plug. Use a suitable pump to suck the oil out of the shaft-seal reservoir.
5. Refit the coupling-cover oil drain-plug.
6. Refer to Section 3.4 and fill the coupling-cover and shaft-seal reservoir with oil.
7. Refit the coupling-cover oil filler-plug and the shaft-seal reservoir oil filler-plug.
8. On EH1200, EH2600 and EH4200 pumps only:
   - Remove the oil filler-plug on the gear-cover.
   - Remove the oil drain-plug from the underside of the gear-cover and allow the oil to drain into a suitable container.
   - Refit the oil drain-plug and refer to Section 3.4 to refill the gear-cover with oil.
   - Refit the oil filler-plug.

5.6 Lubricate the rear-bearing (EH250 and EH500A pumps only)

Use the procedure below to replace the grease in the rear-bearing.

1. Switch off the pump and isolate it from the electrical supply. Vent the pump to atmospheric pressure.
2. Refer to Figure 13. Remove the four plastic cover-caps (8) from the bearing end-cover (6).
3. Undo and remove the socket-head screws (7) located under the four plastic cover-caps.
4. Remove the end-cover (6) and 'O' ring (5). Dispose of the 'O' ring safely.
5. Note the exact location of the shims (4) and spacers (3) inside the end-cover (6). Clean off all visible grease from the end-cover taking care not to misplace or damage the shims and spacers.
6. Use a soft, clean, lint free cloth or a plastic or wooden spatula to remove all visible grease from both bearings (2).
7. Fill the visible side of each bearing (2) with clean grease, then lightly force the grease into the bearing.
8. Refill the visible side of each bearing (2) with clean grease.
9. Apply a light wipe of high-vacuum grease to the new 'O' ring (5) and fit into the groove in the end cover (6).
10. Check that the shims (4) and spacers (3) are correctly located in the end-cover (6).
11. Refit the end-cover (6) and secure it with the four socket-head screws (7). Tighten the screws evenly and refit the plastic cover-caps (8).
12. Leak test the system and seal any leaks found.



1. Pump-body
2. Bearing
3. Spacer
4. Shims
5. 'O' ring
6. End-cover
7. Socket-head screw
8. Cover-cap

Figure 13 - Lubricate the rear bearing (EH250/500A pumps only)

6 STORAGE AND DISPOSAL

6.1 Storage

CAUTION

Observe the storage temperature limits stated in Section 2. Storage below -30 ^{o}C will permanently damage the pump seals and lubricants.

Use the procedure below to store the pump.

1. Shut-down the pump as described in Section 4.
2. Isolate the pump from the electrical supply and disconnect it from the vacuum system.
3. Clean the pump and change the oil as described in Section 5.
4. Place protective covers over the inlet and outlet-flanges.
5. Store the pump in cool, dry conditions until required for use. When required, prepare and install the pump as described in Section 3.

6.2 Disposal

Dispose of the pump and any components 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.

7 SPARES AND ACCESSORIES

7.1 Introduction

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

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

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

7.2 Spares

The spare parts listed below are available for the EH Mechanical Booster Pump:

Product	**Item Number**
RT15 Fomblin grease (100 gm)	H113-50-003
End-cover 'O' ring	H021-22-091
Ultragrade 20 oil (1 l)	H110-24-015
Ultragrade 20 oil (4 l)	H110-24-013
Krytox 1514 fluid (1 kg)	H113-08-018
Krytox 1514 fluid (5 kg)	H113-08-020