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NO. V049 - PL - 133

PROJECT CORRESPONDENCE

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LIGO Project MS-51-33

ATTENTION:

The following documents are attached:

EDWARDS HIGH VACUUM PUMP MANUALS;
STPH 2000 C TURBO MOLECULAR PUMP
QDP DRYSTAR VACUUM PUMPS
EH MECHANICAL BOOSTER PUMPS
EDP 200 CHEMICAL DRY VACUUM PUMPS
EXT TURBO MOLECULAR PUMPS
EXH TURBO MOLECULAR PUMP CONTROLLERS

Comments:

Signed By: J Motter

cc: LIGO File

A705-52-880
Issue B

Instruction Manual

Drystar® EDP200 and EDP300 Chemical Dry Vacuum Pumps

Description	*Item Number*
Drystar EDP200, 460 V, 60 Hz, standard	*A705-52-908*
Drystar EDP200, 460 V, 60 Hz, explosion-proof	*A705-54-908*
Drystar EDP300, 460 V, 60 Hz, standard	*A707-52-908*
Drystar EDP300, 460 V, 60 Hz, explosion-proof	*A707-54-908*

T960202
LIGO-~~P960010~~-00-V

EDWARDS

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1993

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DBW 5532-95

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EDWARDS STAFF:

If you change this manual, you must also change A705-51-880.

1 INTRODUCTION

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards Drystar EDP200 and EDP300 pumps. You must use the pumps 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 or process.

The following IEC warning labels appear on the pump:

Caution - refer to accompanying documentation.

Caution - risk of electric shock.

Caution - hot surface.

1.2 Description

Refer to Figure 1 in the following Sections.

1.2.1 The EDP200 and EDP300 pumps

The EDP200 and EDP300 are rugged, reliable dry pumps designed specifically for use in the chemical and pharmaceutical processing industries. The pump is mounted vertically in a frame (6); this configuration ensures that liquids in the process gases easily drain through the pump.

The pump is a three-stage, positive displacement rotary pump in which pairs of intermeshing rotors (mounted on common shafts) are held in correct phase relation by a pair of timing-gears. The timing-gears and the adjacent double-row angular contact ball bearings are oil lubricated.

1.2.2 Gas system

The purge pipeline (16) delivers a nitrogen purge to the shaft-seals. This nitrogen purge: ensures that the shaft-seals are maintained at a positive pressure during pump operation; prevents the entry of corrosive or toxic process vapours into the pump gearbox; prevents contamination of the process gases by pump oil; prevents damage to the shaft-seals by debris.

Accessory kits are available to provide final stage gas ballast and inlet purge facilities on the pump: refer to Section 7.

1.2.3 Temperature control system

The pump has an indirect cooling system. Coolant circulates around the pump-body by natural convection; the coolant then passes through a secondary circuit in the heat exchanger (19). In the heat exchanger, heat is extracted from the coolant by cooling-water which circulates through a primary circuit in the heat exchanger. The pump-body has a coolant overflow pipe (18). As the temperature of the pump-body increases and the coolant expands, excess coolant may be forced out of this pipe.

In operation, the pump is maintained at a constant temperature by a TCV (thermostatic control-valve, 7) which controls the supply of cooling-water to the heat exchanger. The pump-motor (12) is air-cooled.

The cooling-water supply passes through a filter (Figure 7, item 10) and then through a pipeline to the heat exchanger (19). A flow indicator (Figure 7, item 11) in the cooling-water return pipeline shows when there is a flow of cooling-water through the heat exchanger.

An adjustable thermal snap-switch (25) is fitted to the pump-body. The output of the thermal snap-switch will go open circuit when the temperature of the pump-body is too high. Use the thermal snap-switch output to shut down the pump if the pump is too hot.

1.2.4 Pressure relief valve

The pump has a pressure relief valve (23) fitted in a pipe between the pump-outlet and the last stage of the pump. The valve is normally held closed by spring pressure, but opens depending on the pump-inlet pressure, as follows:

- At pump-inlet pressures of 300 torr and above on the EDP200, and at pump-inlet pressures of 188 torr and above on the EDP300, the interstage pressure forces the valve open against the spring action. This allows process gases to pass directly from the second stage into the pump-outlet, without compression in the third stage of the pump.
- At pump-inlet pressures below those specified above, the interstage pressure is low and the valve is held closed by the spring. Process gases pass through all stages of the pump; that is the process gases are compressed in the third stage before they pass into the pump-outlet.

The pressure relief valve allows the pump to provide a constant pumping speed from atmospheric pressure down to 7.5 torr and also prevents excessive electrical power consumption by the pump-motor when the pump starts.

1.2.5 Torque limiter operation

The pump-motor (12) drives the pump rotors through a torque limiter. When the torque required to turn the pump rotors is excessive (for example, if the pump is accidentally flooded with process liquids), the torque limiter automatically decouples the pump-motor from the pump and the pump-motor no longer drives the pump rotors. This prevents damage to the pumping mechanism and to the pump-motor.

When the torque limiter decouples, the pump-motor will continue to operate, however there will be a significant fall in the electrical current consumed by the pump-motor. You can monitor this current to determine when the torque limiter has decoupled the pump-motor from the pump.

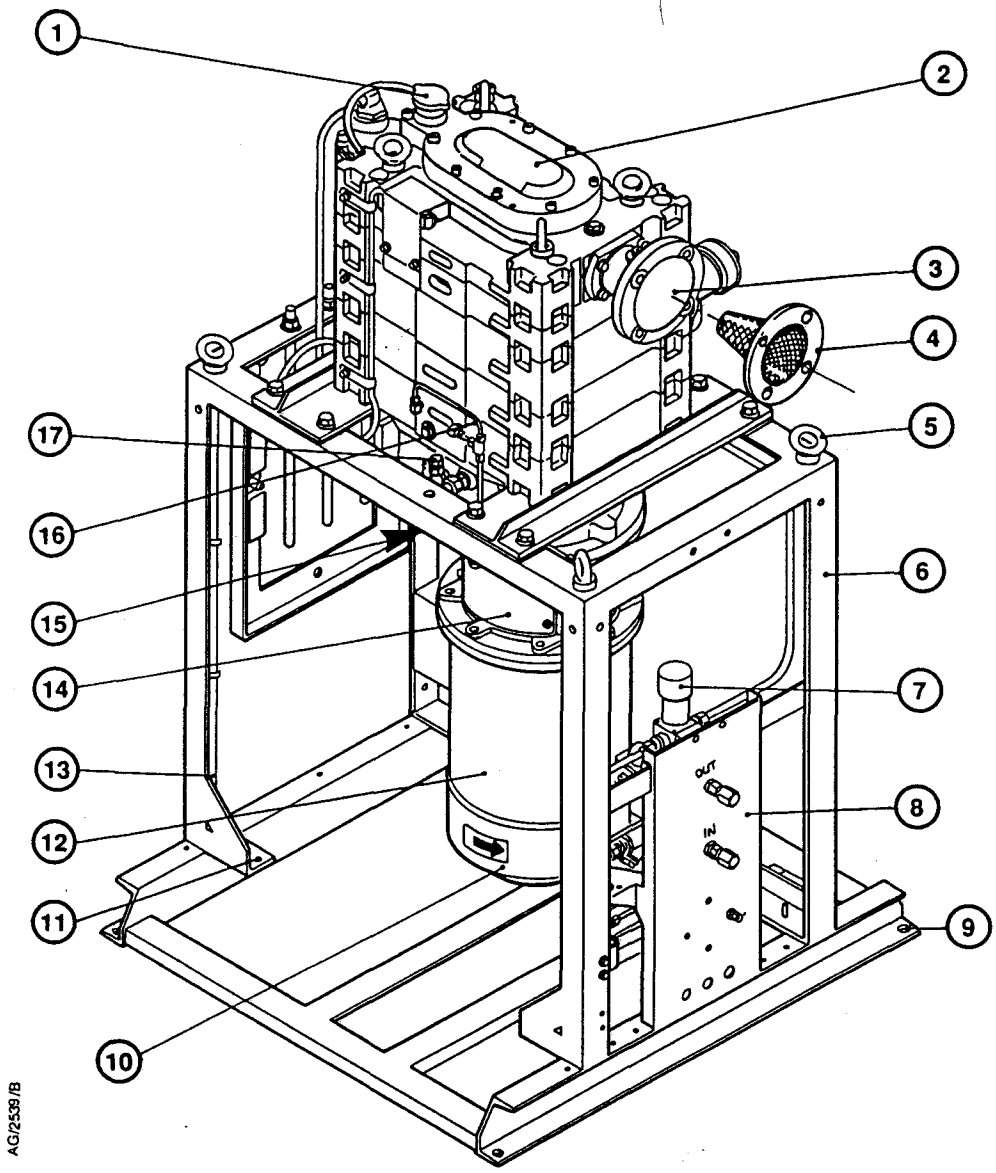
The torque limiter is enclosed in the coupling housing which has two removable coupling covers (14). You can remove these covers to recouple the pump-motor to the pump (refer to Section 4.3).

1.2.6 Pump frame

The pump is vertically mounted in a robust frame (6). The frame has lifting-bolts (5) and lower cross-members (11) which can be used to move the pump with a fork-lift truck.

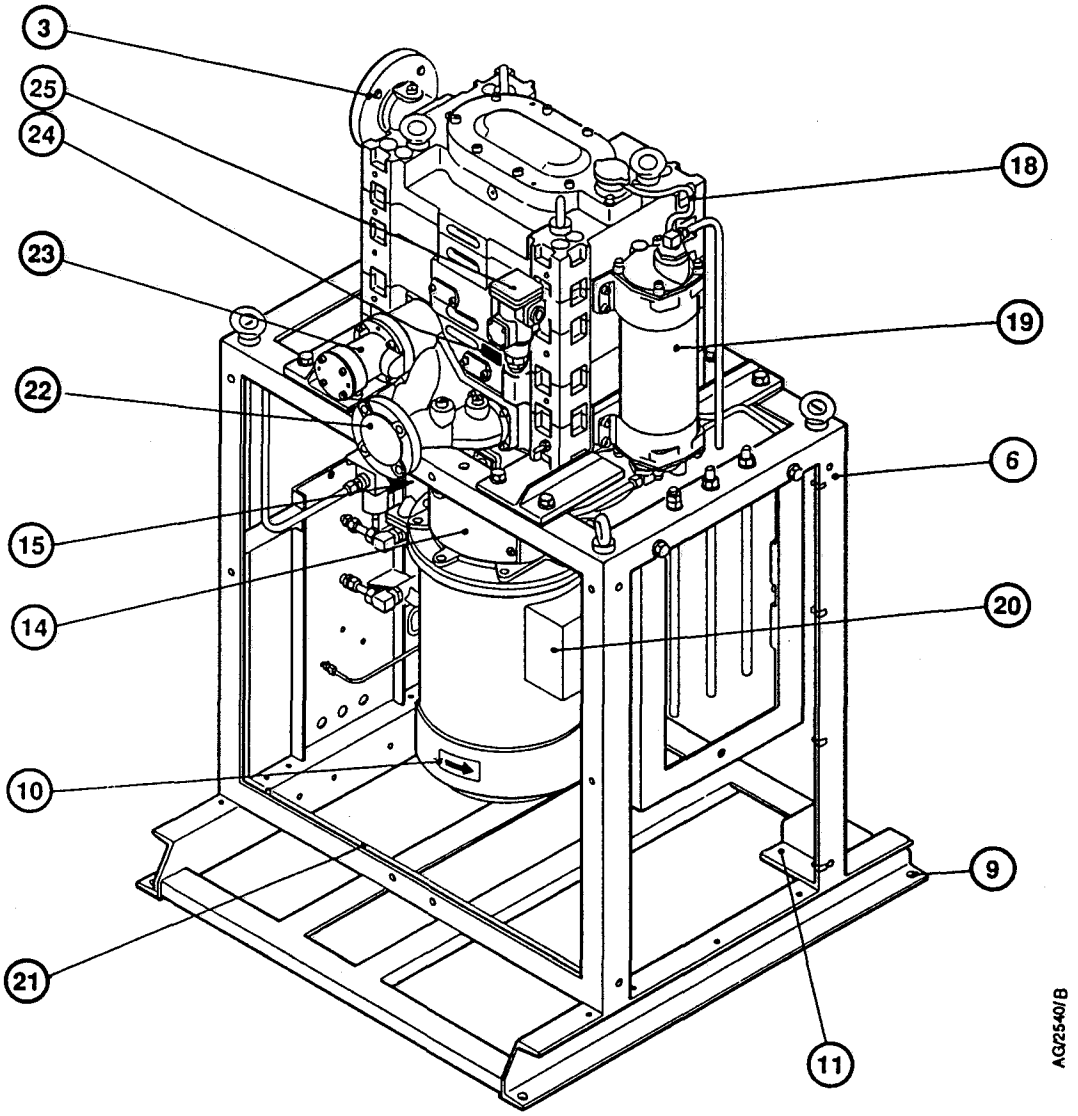
The cooling-water and gas purge connections are on a services panel (8) on the frame. The TCV (7) is fitted to the rear of the services panel.

Fixing holes (9) in the frame can be used to secure the pump frame in its operating position.



1. Coolant filler cap
2. Bearing cover
3. Pump-inlet
4. Inlet filter (in pump-inlet)
5. Lifting bolt
6. Frame
7. TCV (thermostatic control-valve)
8. Services panel
9. Fixing hole
10. Direction of rotation arrow
11. Frame lower cross member
12. Pump-motor

Figure 1 - The EDP200/EDP300 pump: sheet 1



13. End of coolant overflow pipe
14. Coupling cover
15. Oil-level sight-glass (behind frame)
16. Shaft-seals purge pipeline
17. Oil filler-plug
18. Coolant overflow pipe
19. Heat exchanger
20. Pump-motor terminal-box
21. Frame lower cross members
22. Pump-outlet
23. Pressure relief valve
24. Temperature measurement point
25. Thermal snap-switch

Figure 1 - The EDP200/EDP300 pump: sheet 2

1.2.7 Explosion-proof and standard versions of the pump

European certification

The pump is available in both explosion-proof and standard versions. The explosion-proof pumps have been certified for safe use in Zone 1 and Zone 2 hazardous areas and (when fitted with the correct pump-inlet and pump-outlet flame arrestors) are permitted to pump gases and vapours allocated to Group IIA and IIB as classified by BS 5345 Part 2: 1990. Certification was carried out on the basis of BS 5501 Part 5 (EN50018).

If all of the following conditions apply, all surfaces of the pump will be below 275 °F at all times:

- Ambient temperature ≤ 77 °F.
- Pump outlet pressure ≤ 2.2 psig.
- Cooling-water supply temperature ≤ 68 °F.
- Cooling-water flow ≥ 158 US gallons.h^{-1}.

If any of the above conditions do not apply, under certain operating conditions, even though the main body of the pump will remain below 275 °F, parts of the exhaust manifold may exceed this temperature.

If the cooling-water supply does not meet the requirements of Section 2.3, or if there is reduced cooling-water flow through the pump (due, for example, to a blockage), the maximum surface temperature of the pump body will not exceed 392 °F.

US equivalents for pump certification

The approximate US equivalents for the above European certifications are as follows:

European area classification	Approximate US equivalent
Zone 1	Division 1
Zone 2	Division 2

European gas grouping	Approximate US equivalent
IIA (ammonia, propane)	Class I, Group D: methane
IIB (ethylene)	Class I, Group C: ethylene

The explosion-proof pump-motors are appropriately rated as Division I, Class I C and D, Class II F and G.

Both explosion-proof and standard versions of the pump are fitted with a thermal snap-switch rated to Division I Class I C and D.

1.3 Accessories

A number of accessories are available for the EDP200 and EDP300 pumps; use these to configure the pump for specific applications. These accessories are listed in Section 7.

2 TECHNICAL DATA

2.1 General

	EDP200	EDP300
Dimensions	See Figure 2	See Figure 2
Mass	1820 lb	1980 lb
Pump-motor rating	20 h.p.	30 h.p
Full load and no load current ratings	See Table 1	See Table 1
Typical pump rotation speed	3580 rev.min^{-1}	3580 rev.min^{-1}
Warm-up time (to a pump body temperature of 131 °F)	45 minutes	45 minutes
Pump-inlet connection	3 inch ANSI 150 lbf raised face flange	
Pump-outlet connection	2 inch ANSI 150 lbf raised face flange	
Recommended pump-inlet and pump-outlet seals	PTFE envelope gaskets: 'KLINGER' milled type with a 1.5 mm full-face insert	
Ambient operating temperature range †	40 to 105 °F	40 to 105 °F
Maximum ambient operating humidity	90% RH	90% RH
Maximum outlet pressure †	2.2 psig	2.2 psig
Typical continuous A-weighted sound pressure level (tested in accordance with Pneurop PN8NTC2)	82 dB(A)	82 dB(A)

2.2 Performance data

Maximum pumping speed	177 cfm	250 cfm
Displacement (swept volume)	223 cfm	350 cfm
Ultimate vacuum	0.15 torr	0.15 torr

Pump electrical supply		Pump type	EDP200		EDP300	
Voltage (V)	Frequency (Hz)		Full load current (A)	No load* current (A)	Full load current (A)	No load* current (A)
460	60	Standard	23.1	5.3	34.2	7.3
460	60	Explosion-proof	23.6	5.3	35.1	7.3

* With pump-motor decoupled from the pump

Table 1 - Full load and no load current ratings

† Refer to Section 1.2.7

2.3 Services

Electrical supply	See front cover
Voltage tolerance	± 6%
Cooling-water supply	
Supply temperature range †	40 to 95 °F
Maximum supply pressure	145 psig
Minimum required pressure differential across supply and return	30 psig
Typical heat removed from pump	17100 $btu.h^{-1}$
EDP200 maximum water consumption * †	
at pump operating temperature of 113 °F	127 US $gallons.h^{-1}$
at pump operating temperature of 149 °F	32 US $gallons.h^{-1}$
EDP300 maximum water consumption * †	
at pump operating temperature of 131 °C	160 US $gallons.h^{-1}$
at pump operating temperature of 149 °F	48 US $gallons.h^{-1}$
Fittings type	$^1/_2$ inch NPT female
Shaft-seals purge nitrogen supply	
Supply pressure	29 to 147 psig
Regulated pressure to shaft seals	5 to 7 psig
Fittings type	$^1/_4$ inch compression

2.4 Temperature control system

Water-cooling system	
Type	Indirect water-to-coolant heat exchanger
Coolant capacity	
EDP200	4.2 US gallons
EDP300	4.6 US gallons
Coolant type	See Section 2.5
TCV (thermostatic control-valve)	
Operating temperature range	50 to 175 °F
Maximum sensor temperature	265 °F
Thermal snap-switch	
Opening temperature range	120 to 212 °F adjustable
Contact rating	
Maximum voltage	240 V
Maximum current (inductive load)	5 A
Maximum current (resistive load)	12 A

* With a cooling-water supply temperature of 68 °F and an ambient temperature of 68 °F.
† Refer to Section 1.2.7

1. Pump-inlet: 3 inch ANSI 150 lbf raised face flange
2. Pump-outlet: 2 inch ANSI 150 lbf raised face flange
3. Fixing hole: Ø0.7 inch (4 off)
4. Cooling-water outlet connection: $^1/_2$ inch NPT female
4. Cooling-water inlet connection: $^1/_2$ inch NPT female
5. Nitrogen supply inlet connection: $^1/_4$ inch compression

	EDP200	EDP300
A	$64^3/_4$	$66^1/_4$
B	$59^1/_2$	61

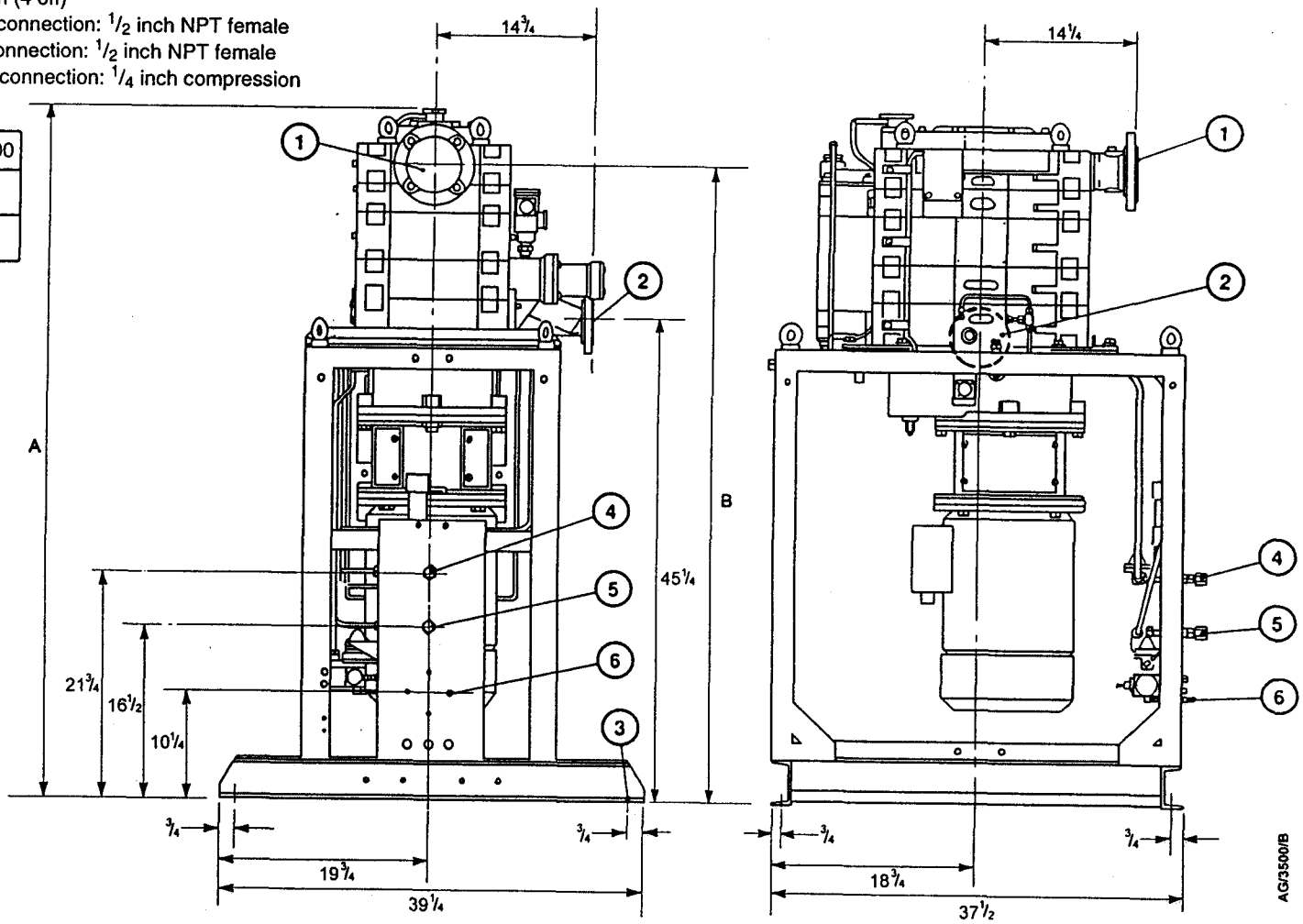


Figure 2 - Dimensions (inches)

2.5 Coolant type

The pump is supplied filled with Edwards coolant which is both an antifreeze and a corrosion inhibitor. Spare Edwards coolant is available: refer to Section 7.2.

If you will use another coolant type to replenish lost coolant:

- It must prevent the formation of visible oxide sludge and scale deposits.
- It must provide frost protection down to a temperature of 7 °F, when mixed in accordance with the manufacturer's recommendations.
- It must be compatible with the materials of construction of the cooling-jacket; that is: SG iron, copper, brass and fluoroelastomer (Viton) seals.
- It must comply with the requirements of BS 6580-1992 and BS 5117.
- It must be based on monopropylene glycol or ethylene glycol fluid.
- It must not contain amines.

The coolants shown in Table 2 may be suitable for use in the EDP200 and EDP300 pumps. All of these coolants are amine free, automotive grade, ethylene glycol antifreezes and must be diluted to between 35% to 50% by volume with water to provide the required cooling protection. However, we recommend that you use Edwards coolant; Edwards cannot guarantee that other types of coolant will provide the best corrosion protection for the pump.

Manufacturer	Product
BP (Chemicals)	NAPGEL C2230 (Universal)
Texaco Lubricants	Texaco Engine Coolant ETX 6024
Castrol	Castrol Antifreeze

Table 2 - Possible alternative coolants

2.6 Lubrication system

Note: Edwards Health and Safety Data sheets for some of the oils and greases referenced below are available on request.

Gearbox	
Oil capacity	
Minimum	0.96 US gallons
Maximum	1.15 US gallons
Recommended oil type	Hydrocarbon
ISO viscosity grade	150
Recommended oil (supplied)	Shell Tellus 150
Other suitable oils	Inland 87, BP Energol RC150, Texaco Rando HD150, Mobil DTE Extra Heavy
High vacuum bearings	
Grease type	Perfluoropolyether
Recommended grease	Fomblin RT15

2.7 Area classification in accordance with Article 500, National Electrical Code

Explosion-proof pumps	
Hazardous Area	Division 1 and Division 2
Gas Group	Class I, Group C and D
Temperature classification	T3 (200 °C/392 °F)
Standard pumps	
Safe Area designation only	

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 EDP200 or EDP300 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.
- Vent and purge the process system before you start installation work.
- Check that all the required components are available and of the correct type before you start work.
- Disconnect the other components in the process system from the electrical supply so that they cannot be operated accidentally.
- Do not reuse 'O' rings if they are damaged.

3.2 Unpack and inspect

> WARNING
>
> Use suitable lifting-equipment to move the pump. Refer to Section 2 for the mass of the pump.

Use the following procedure to unpack and inspect the pump.

1. Use a fork-lift truck or a pallet truck to place the pallet in a convenient position.
2. Remove the polythene bag which covers the pump, then remove the packing material from around the pump.
3. Remove small items (such as the torque limiter reset tool and the steel rod) packed with the pump.
4. Inspect the equipment. If the pump or any of the other items 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. Check that you have received the items listed in Table 3. If any of these items is missing, notify your supplier in writing within three days.

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

Qty	Description	Check (✓)
1	EDP200 or EDP300 pump	❑
1	Torque limiter reset tool	❑
1	Steel rod	❑
1	Fittings kit	❑

Table 3 - Unpacking checklist

3.3 Locate the pump

WARNING

Use suitable lifting-equipment to move the pump. Refer to Section 2 for the mass of the pump.

WARNING

When you move or install the pump, the baseframe of the pump must be no more than 10° from horizontal. If it is, it may topple.

Notes: If you will operate the pump in an environment with an ambient temperature of 32 °F or lower, contact your supplier or Edwards for advice.

Ensure that the cooling-air flow around the pump-motor is not restricted.

Use suitable lifting-equipment to move the pump; use one of the following methods:

- Use the four lifting bolts on the frame (Figure 1, item 5).
- Use a fork-lift or pallet truck through the frame lower cross members (Figure 1, items 11 and 21).

Locate the pump on a firm, level surface. Ensure that the surface is clean and free from debris and contamination (such as oil). Use suitable bolts through the four fixing holes (Figure 1, item 9) to secure the pump in position.

3.4 Check coolant level

Note: Edwards coolant is available as a spare: refer to Section 7.2.

1. Refer to Figure 3, detail A. Press down the coolant filler-cap (1), turn it anticlockwise and remove it from the pump.
2. Remove any dirt or water-scale from the seal of the filler-cap (1) and from the filler-tube (4).
3. Refer to detail B. Check the level of coolant (6); if it is more than approximately 1 inch below the bottom of the filler-neck (5), continue at Step 4, otherwise continue at Step 7.
4. Remove the cap from a new container of coolant. Place a clean funnel into the container and fill the container with clean water.
5. Replace the cap on the container, then shake the container to fully mix the water and coolant.
6. Remove the cap and pour the coolant mix into the pump through the filler-tube (4) until the coolant level (6) is approximately 1 inch below the bottom of the filler-neck (5). If necessary repeat Steps 4 to 6 to mix and add more coolant.
7. Refit the coolant filler-cap (1); press it down and turn it clockwise to secure it to the pump.

3.5 Check the gearbox oil-level

The pump is supplied filled with oil. Before you operate the pump, check that the gearbox oil-level is correct. Refer to Figure 1 for the locations of the two oil-level sight-glasses on the pump. The oil-level must be between the MIN and MAX marks on the bezel of either of the two oil-level sight-glasses (see Figure 10, detail A). If necessary, pour more oil into the gearbox: refer to Section 5.3.

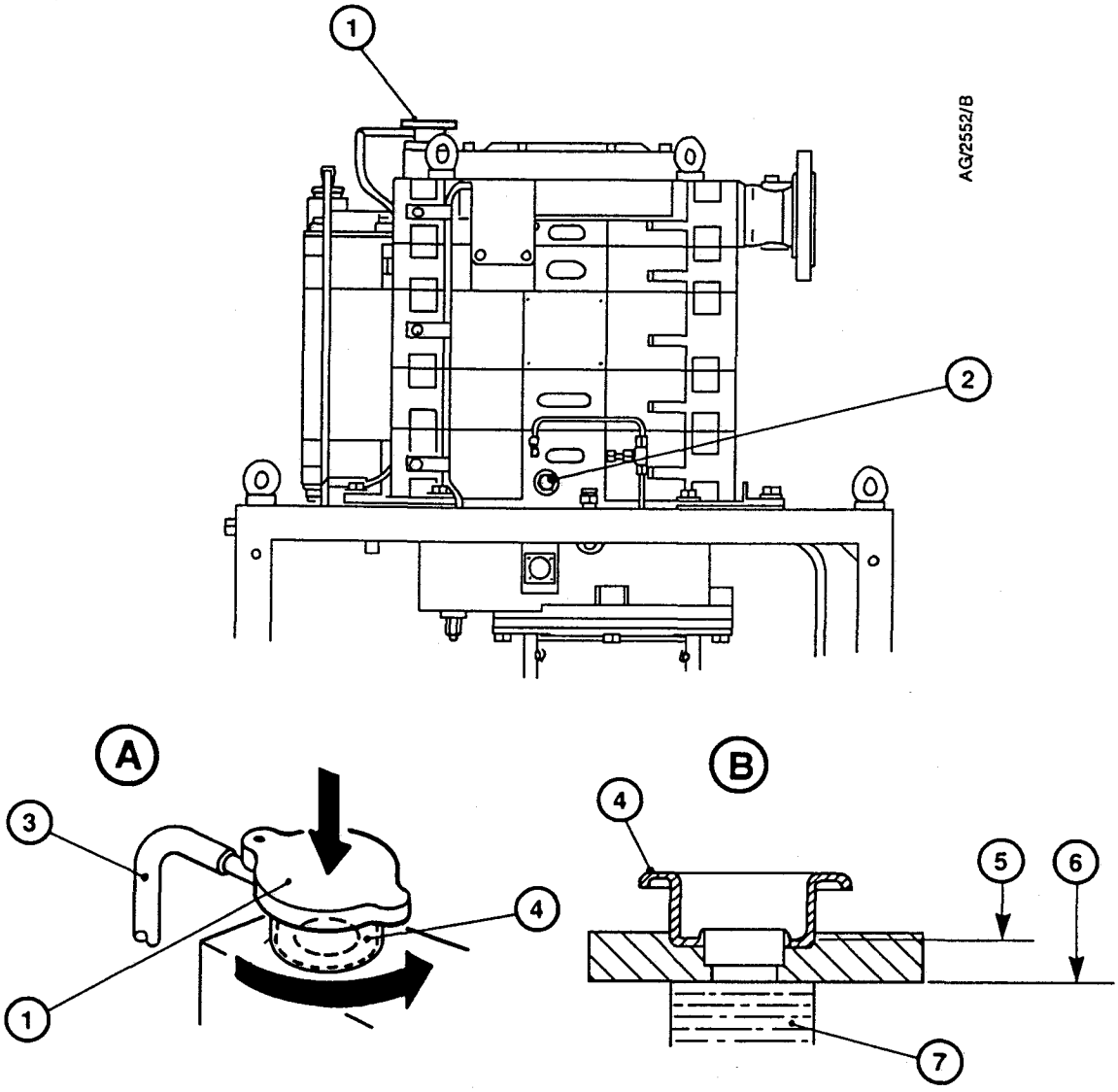
3.6 Electrical connections

3.6.1 Introduction

Make the electrical connections to the pump as described in the following sections. Figure 4 shows a schematic diagram of the recommended electrical circuits for correct operation and shut-down of the pump (and closure of an optional pump-inlet isolation-valve) when the thermal snap-switch opens.

If you connect the electrical supply to the pump through a suitable current monitor, you will be able to determine when the torque limiter has decoupled the pump-motor from the pump (see Section 1.2.5). We recommend that you configure the low current setting on your current monitor to switch off the pump-motor at a current consumption of 12.0 A; this current level indicates that the torque limiter has decoupled the pump-motor from the pump. If you do not configure your current monitor to automatically switch off the pump-motor, note that you should not continue to operate the pump for more than 8 hours if the torque limiter has decoupled the pump-motor from the pump: refer to Section 4.

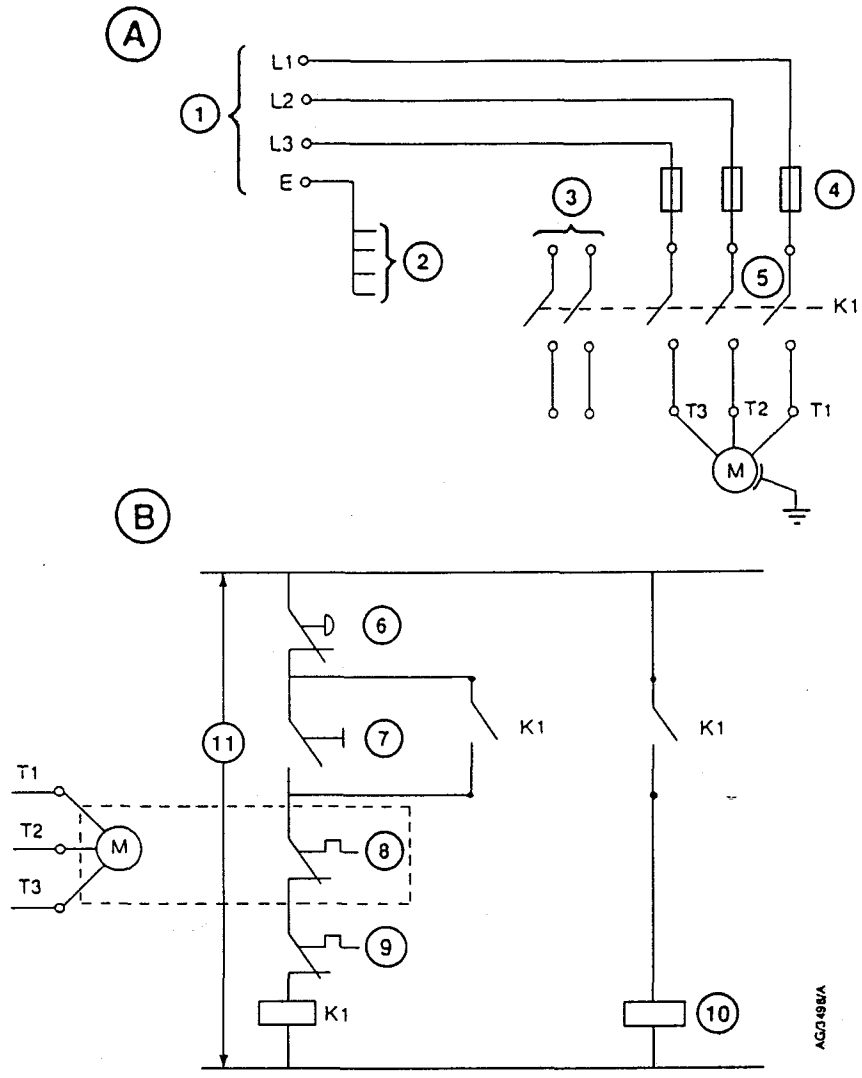
Earth studs are available on the pump (refer to Figure 4). If required, you can connect suitable earthing strips to these earth studs to provide additional earthing protection.



A Remove the coolant filler-cap
B Cross section of filler tube

1. Coolant filler-cap
2. Coolant drain-plug
3. Coolant overflow pipe
4. Filler-tube
5. Bottom of the filler-neck
6. Recommended coolant level
7. Coolant

Figure 3 - Fill the pump with coolant



A Pump-motor connections
B Control circuit

1. To your electrical supply
2. Earth points
3. Auxiliary contacts (2 off, normally closed)
4. Fuse or circuit breaker
5. Control voltage
6. STOP control
7. START control
8. Motor thermostats
9. Thermal snap-switch (on pump)
10. Inlet-valve control solenoid (optional)
11. Control voltage

Earth points	
Location	**Size**
Thermal snap-switch	M4 tapped hole
Pump motor	-
Pump casing	M8 stud
Frame	M8 stud

Figure 4 - Schematic diagram of the recommended electrical connections

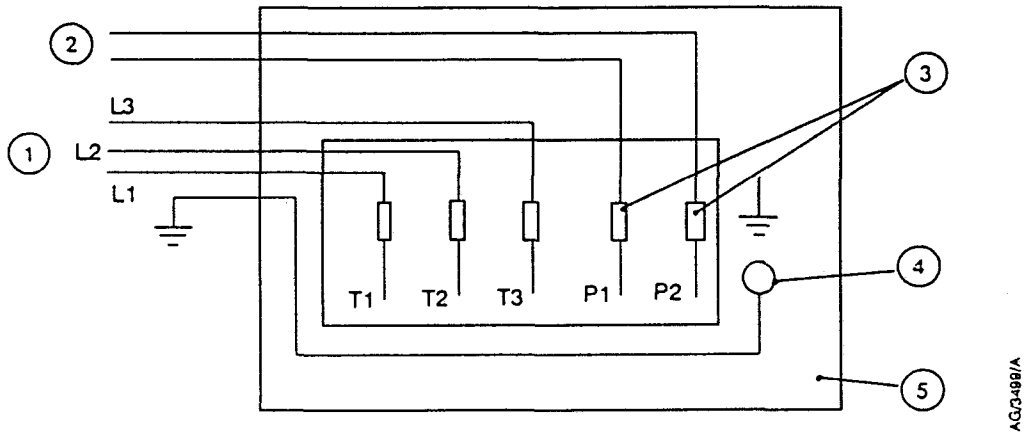
3.6.2 Connect the electrical supply to the pump-motor

> WARNING
>
> On explosion-proof pumps, you must use a suitable cable gland to connect the electrical supply to the pump-motor. If you do not, the installation will not be explosion-proof.

Note: You must make the wiring connections to the pump-motor in accordance with the National Electrical Code and with approved local and site practices.

Connect your electrical supply to the pump-motor through a suitable contactor. The contactor must incorporate a circuit-breaker which meets the full load current ratings specified in Table 1. Use a suitably rated six-core cable (three phase wires, earth wire and two control wires) to connect the electrical supply and your control equipment to the pump-motor as described below.

1. Remove the cover from the pump-motor terminal-box (Figure 1, item 20).
2. Remove the plug from one of the electrical supply cable entry holes on the terminal-box.
3. Fit a suitable cable-gland and nut to the entry hole, then pass the cable through the cable-gland.
4. Refer to Figure 5. Connect the three phase wires (L1, L2, L3) of the cable to the leads marked T1, T2 and T3. Connect the earth wire to the earth terminal (4).
5. Connect the two control wires of the cable to the thermostat leads marked P1 and P2.
6. Connect the wires in the other end of the cable to your electrical supply and to your control equipment (see Figure 4).
7. Tighten the cable-gland nut strain-relief screws and refit the terminal-box cover.



1. To your electrical supply
2. To your control circuit
3. Cable wires to leads connections
4. Earth terminal
5. Terminal-box

Figure 5 - Connect the electrical supply to the pump-motor

3.6.3 Connect the thermal snap-switch

WARNING

You must connect the thermal snap-switch so that the pump stops when the thermal snap-switch opens. If you do not, there may be a risk of fire or explosion.

WARNING

Incorporate a manual reset device in your control equipment. If you do not (and a fault which causes the thermal snap-switch to open is not corrected), the pump will automatically switch on again when it cools down. If you have started maintenance or fault finding on the pump, there will then be a risk of fire or explosion and injury to people.

WARNING

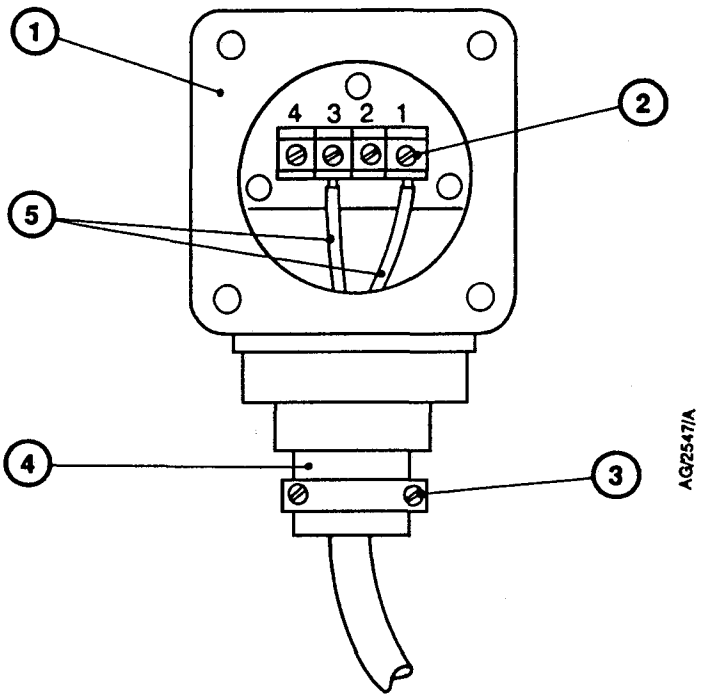
On explosion-proof pumps, you must use a suitable $^1/_2$ inch NPT cable-gland to connect to the thermal snap-switch. If you do not, the installation will not be explosion-proof.

You must connect the thermal snap-switch to the electrical-overload control-loop of your contactor, so that the contactor will automatically switch off the pump if it is too hot: refer to Figure 4.

The thermal snap-switch will reset (that is, close again) when the pump cools down to a preset temperature (see Section 2). We therefore recommend that your control equipment incorporates a manual reset device so that the pump does not automatically switch on again when it cools down.

Use the following procedure to connect to the thermal snap-switch. If you connect to the thermal snap-switch as described below, the output from the thermal snap-switch will be normally closed and will open when the pump is too hot.

1. Remove the four bolts which secure the cover to the top of the thermal snap-switch (Figure 1, item 25), then remove the cover.
2. Pass a suitably rated two-core cable through the cable-gland.
3. Refer to Figure 6. Connect one wire of the cable to terminal 1 on the terminal block (2). Connect the other wire of the cable to terminal 3.
4. Connect the wires at other end of the cable to the electrical-overload control-loop of your contactor.
5. Use the four bolts to refit the cover to the thermal snap-switch.



1. Thermal snap-switch (with cover removed)
2. Terminal block
3. Strain-relief screws (not supplied)
4. Cable gland (not supplied)
5. Wires

Figure 6 - Connect the thermal snap-switch

3.7 Check the direction of pump rotation

WARNING

You must ensure that the direction of rotation of the pump is correct before you operate the pump. If you do not, and the pump direction of rotation is incorrect, the inlet pipeline will be pressurised and may be damaged and there will be a risk of injury to people or explosion or fire.

WARNING

Refit the coupling cover before you operate the pump. If you do not, there will be a danger of injury or death from the rotating mechanisms of the pump.

1. Refer to Figure 1. Remove the push-on blanking-caps fitted to the pump-inlet (3) and pump-outlet (22).
2. Remove the four bolts which secure the coupling cover (14) to the coupling housing (on the opposite side of the pump from the pump-outlet) and remove the coupling cover.
3. Refer to Figure 9. Watch the torque limiter plates (2, 3, 6) and switch on the pump for one or two seconds, then switch the pump off.
4. If the torque limiter plates do not rotate in the correct direction (shown by an arrow on the pump-motor, Figure 1, item 10), the direction of rotation is incorrect. If the direction of rotation is incorrect:
   - Isolate the pump from the electrical supply.
   - Reverse any two of the electrical supply phase-wires in the pump-motor terminal-box: refer to Section 3.6.2.
   - Repeat Steps 3 and 4 to ensure that the direction of rotation is now correct.
5. Refit the coupling cover (Figure 1, item 14) and secure with the four bolts.

3.8 Connect the cooling-water supply

Refer to Figure 7 and connect the cooling-water supply as described below. If you need to connect more than one EDP200 or EDP300 pump to the water supply, you must connect them in parallel and not in series.

1. Remove the water inlet and outlet connectors from the fittings kit and fit them onto your cooling-water supply and return pipes.
2. Remove the red blanking caps from the cooling-water inlet and outlet compression connections (5, 3) on the services panel.
3. Fit the pipe fitting (6) on your cooling-water supply pipe to the water inlet compression connection (5) on the water services panel, then tighten the connection.
4. Fit the pipe fitting (4) on your cooling-water return pipe to the water outlet compression connection (3) on the services panel, then tighten the connection.

3.9 Connect the shaft-seals purge nitrogen supply

> WARNING
>
> Your nitrogen supply pressure must comply with the requirements of Section 2.3. If it does not, the shaft-seals purge pipelines may become over-pressurised and may explode.

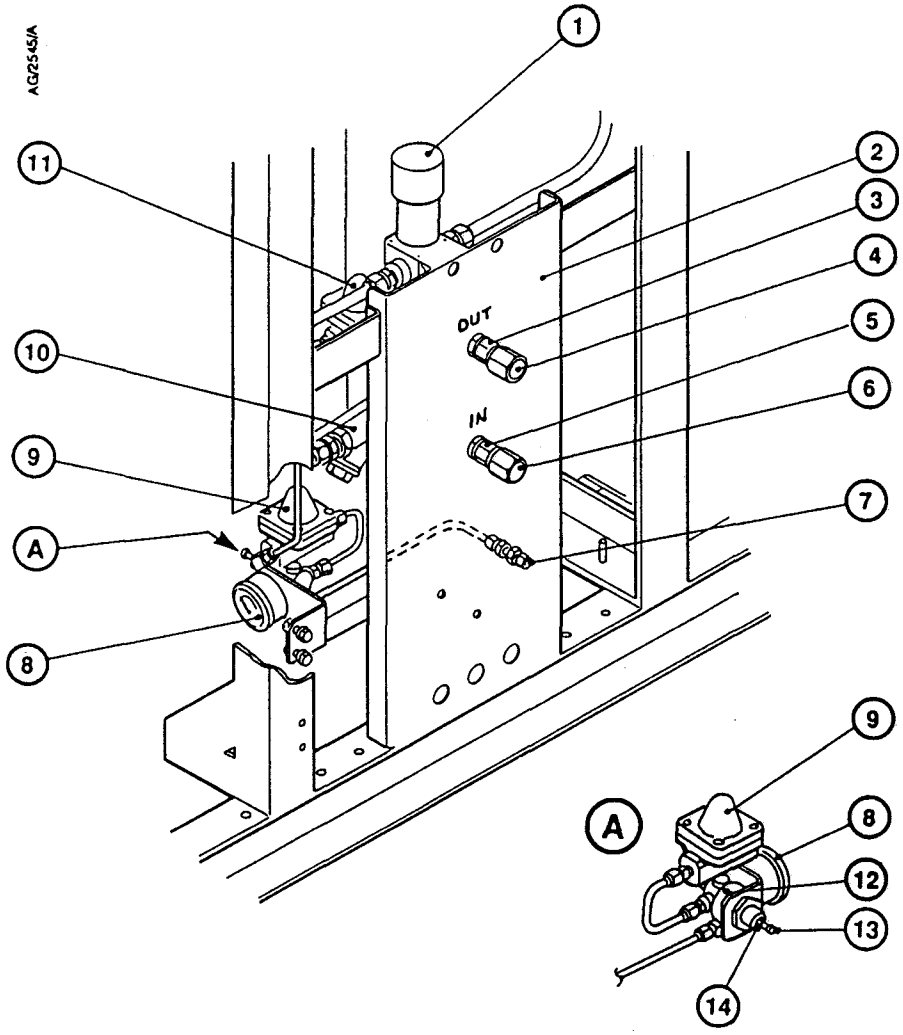
Use a rigid metal (such as stainless steel) pipeline with an outside diameter of $^1/_4$ inch for your nitrogen supply. If you will fit an acoustic enclosure, ensure that the pipeline will not obstruct the enclosure.

We recommend that you install an automatically operated isolation-valve in your nitrogen supply configured so that:

- The shaft-seals purge nitrogen supply is on whenever the pump is on.
- The shaft-seals purge nitrogen supply is off whenever the pump is off.

Refer to Figure 7 and use the following procedure to connect your shaft-seals purge nitrogen supply.

1. Remove the mating connector from the fittings kit and fit it onto your nitrogen supply pipeline.
2. Remove the red blanking cap from the nitrogen inlet (7) on the services panel and fit the connector on your nitrogen supply pipeline to the nitrogen inlet connector (7).



1. TCV
2. Services panel
3. Compression fitting
4. Water outlet connector
5. Compression fitting
6. Water inlet connector
7. Nitrogen inlet connector
8. Nitrogen pressure gauge
9. Nitrogen flow indicator
10. Cooling-water filter
11. Cooling-water flow indicator
12. Nitrogen pressure regulator
13. Adjuster
14. Locknut

Figure 7 - Services panel

3.10 Connect the pump-inlet and pump-outlet

WARNING

Take all necessary safety precautions when you pump toxic, flammable or explosive gases. If you do not, there will be a danger of injury or death to people.

WARNING

Ensure that your system can provide adequate gas ballast and/or inlet purge to dilute toxic gases to safe limits. If you do not, there will be a risk of emission of dangerous gases.

WARNING

If you will pump flammable and explosive gases, fit flame arrestors and ensure that your system can provide adequate gas ballast and/or inlet purge to dilute to the gases to safe levels. If you do not, there may be a danger of fire or explosion.

WARNING

Fit Edwards flame arrestors if you will pump Class I Groups C and D gases. If you do not, there may be a risk of flame propagation along the inlet and exhaust pipelines.

3.10.1 Connect the pump to your process system

Note: Flame arrestors suitable for use with the pump are available as accessories: refer to Section 7.

When you connect the pump to the process system:

- Support process pipelines to stop the transmission of stress to pipeline joints.
- You must be able to isolate the pump from the atmosphere and from your process system if you have pumped or produced dangerous chemicals.
- To get the best pumping speed, ensure that the pipeline which connects the process system to the pump is as short as possible and has an internal diameter not less than the pump-inlet.
- Use a flexible connection in the pipeline from the process system to the pump to reduce vibration and stress in the system pipelines.

Use the following procedure to connect the pump-inlet to your process system. Do not allow debris to get into the pump during installation. Refer to Figure 1.

1. The pump-inlet has an inlet filter:
   - If you install the pump in a new process system, leave the filter (4) in the pump-inlet (3) to prevent the entry of weld particles or other debris into the pump. You will remove the filter in Section 5.4.
   - If you install the pump in an existing process system which you are sure does not contain any debris which could damage the pump, remove the filter (4) from the pump-inlet (3).
2. Use four suitable bolts to connect the pump-inlet to your process system. Use a suitable PTFE gasket to seal the connection. We recommend that you use the gasket type specified in Section 2.1.

3.10.2 Connect the pump-outlet

WARNING
Pipe the exhaust to a suitable treatment plant to prevent the discharge of dangerous gases or vapours to the surrounding atmosphere.

WARNING
Incorporate safety devices to prevent operation of the pump when the exhaust pipeline is restricted or blocked. If you do not, the exhaust pipeline may become over-pressurised and may burst.

CAUTION
Install an outlet catchpot to prevent the drainage of condensate back into the pump. If you do not, condensate which drains back into the pump may damage it or cause it to seize.

Note: Flame arrestors suitable for use with the pump are available as accessories: refer to Section 7.

Use four suitable bolts to connect the pump-outlet to your exhaust system. Use a suitable PTFE gasket to seal the connection. We recommend that you use the gasket type specified in Section 2.1.

Your exhaust pipeline system must be designed so that the pressure in the pipeline during pump operation is less than 2.2 psig. If the pressure in the pipeline is higher than this pressure, the pump will operate at a high temperature and may trip because of excessive electrical current consumption. Incorporate flexible bellows in the exhaust pipeline 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.

3.11 Leak test the installation

WARNING
Leak-test the system after installation and maintenance and seal any leaks found to prevent the leakage of dangerous substances out of the system and leakage of air into the system.

Leak-test the system after installation and seal any leaks found. Substances which leak from the system may be dangerous to people and there may be a danger of explosion if air leaks into the system.

The leak rate of the pump is tested to be less than 2×10^{-6} atm.ft^3.min^{-1} when supplied. The required leak rate for your system will depend on your safety and process requirements.

3.12 Commission the pump

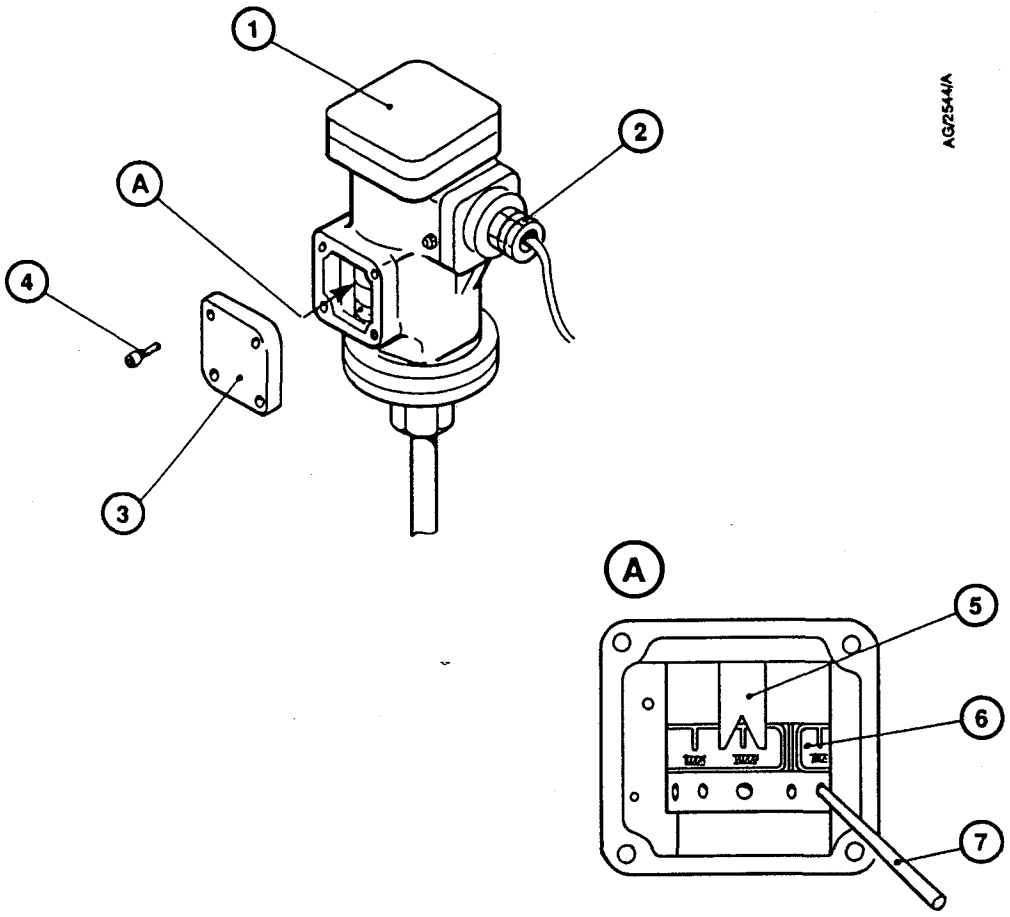
3.12.1 Adjust the thermal snap-switch (if required)

Refer to Figure 1. As supplied, the TCV is adjusted so that the pump operating temperature reaches 149 °F measured at the temperature measurement position (24). The thermal snap-switch is adjusted to open at 149 °F. Because there is a large temperature gradient between the pump-body and the thermal snap-switch, the thermal snap-switch will not open until the pump-body temperature reaches, typically, 185 °F. This configuration prevents nuisance tripping, but provides protection against operation of the pump when it is too hot.

When you adjust the TCV to change the pump operating temperature, we recommend that you adjust the thermal snap-switch to open at the same temperature (in the operating temperature range 122 to 194 °F).

If you want to change the operating temperature of the pump (see Section 3.12.3) or if you want to change the temperature at which the thermal snap-switch opens, use the following procedure. Refer to Figure 8.

1. Remove the four bolts (4) which secure the cover (3) on the thermal snap-switch, then remove the cover.
2. Turn over the cover (3) and remove the metal dowel (7) from its storage position in the back of the cover.
3. Push one end of the dowel into one of the holes on the adjuster (6), then turn the adjuster until the required operating temperature (shown on the adjuster scale) is indicated by the arrow (5).
4. Remove the dowel (7) from the adjuster and place the dowel in its storage position in the back of the cover (3).
5. Use the four bolts (4) to refit the cover (3) to the thermal snap-switch.



1. Thermal snap-switch
2. Cable gland (not supplied): to fit $^1/_2$ inch NPT electrical entry
3. Cover
4. Bolt
5. Arrow
6. Adjuster
7. Metal dowel

Figure 8 - Adjust the thermal snap-switch

3.12.2 Commissioning procedure

> WARNING
>
> Do not adjust the TCV to a lower setting (that is, turn the adjuster knob anticlockwise) when the pump is hot. This will increase the flow of cooling-water which may damage the pump because of the differential contraction of the pump rotor and case.

1. Isolate the pump from your process system.
2. Turn on the cooling-water supply, the shaft-seals purge nitrogen supply and your exhaust-extraction system.
3. Check that there are no leaks in the water, nitrogen system, and exhaust-extraction system connections. Seal any leaks found.
4. Refer to Figure 7. Turn the adjuster knob on the TCV (1) to the '0' position. Check that the ball in the cooling-water flow indicator (11) moves; this indicates that there is a flow of cooling-water through the cooling-water flow indicator.
5. Adjust the TCV to the required pump operating temperature:
   - For an EDP200 pump operating temperature of 149 °F, turn the adjuster knob to the '4' position; this is the setting of the TCV when the pump is supplied.
   - For an EDP300 pump operating temperature of 149 °F, turn the adjuster knob to the '$3^1/_2$' position; this is the setting of the TCV when the pump is supplied.
   - For a different pump operating temperature, refer to Section 3.12.3.
6. Switch on the pump.
7. Check that the pressure shown on the shaft-seals purge nitrogen pressure gauge (8) is between 0.34 and 0.48 bar (5 to 7 psig). If you need to adjust the pressure:
   - Loosen the locknut (14) on the rear of the pressure regulator (12).
   - Turn the adjuster (13) until the required pressure is shown on the pressure gauge.
8. Leave the pump to operate for approximately 60 minutes to allow the pump operating temperature to stabilise.
9. Check that the pump operating temperature is correct. If necessary, adjust the TCV to change the pump operating temperature (refer to Section 3.12.3) and adjust the thermal snap-switch for this new operating temperature (refer to Section 3.12.1).
10. Turn off the pump and the cooling-water and shaft-seals nitrogen purge supplies.

3.12.3 Adjust the TCV (thermostatic control-valve)

WARNING

Do not adjust the TCV to a lower setting (that is, turn the adjuster knob anticlockwise) when the pump is hot. This will increase the flow of cooling-water which may damage the pump because of the differential contraction of the pump rotor and case.

Note: As supplied, the TCV is adjusted for a pump operating temperature of 149 °F (measured at the point shown in Figure 1, item 24). If you adjust the TCV for a different pump operating temperature, you must also adjust the thermal snap-switch: refer to Section 3.12.1.

The minimum pump operating temperatures stated below are with a cooling-water flow of 3.2 US gallons.h^{-1} and with a cooling-water supply temperature of 68 °F.

The TCV regulates the flow of water through the water cooling system to maintain the pump at the required operating temperature and is adjustable between 0 (minimum) and 5 (maximum). These TCV settings correspond to pump operating temperatures of:

- Approximately 104 °F (minimum) and approximately 194 °F (maximum) on the EDP200.
- Approximately 131 °F (minimum) and approximately 194 °F (maximum) on the EDP300.

If you need to adjust the TCV to suit your operating conditions, turn the adjuster knob on the TCV (Figure 7, item 1) clockwise or anticlockwise to the position corresponding to your required pump operating temperature. Note that it takes approximately 60 minutes for the pump to stabilise at its final operating temperature.

4 OPERATION

WARNING

During operation, parts of the pump can become very hot. Under abnormal conditions, the temperature of the pump-body can reach 300 °F. Ensure that you do not touch the pump.

WARNING

Do not operate the pump with a coupling cover removed or with the pump-inlet or pump-outlet open to atmosphere. If you do, there will be a danger of injury or death from the rotating mechanisms or from hot exhaust gases.

WARNING

If the pump is located in a Division 1 hazardous area, do not let the pump-motor operate for more than 8 hours if the pump-motor has decoupled from the pump. If you do, the torque limiter may get very hot and there may be a risk of fire or explosion.

The following procedures assume that you have a pump-inlet isolation-valve fitted to your pump.

4.1 Start the pump

CAUTION

Allow the pump to warm up and use full gas inlet purge and gas ballast (if fitted) before you pump condensable vapours. If you do not, the vapours may condense in the pump and corrode or damage the pump.

Use the procedure below to start the pump.

1. Check the gearbox oil-level in the sight-glass on the side of the pump: refer to Section 3.5.
2. Turn on your cooling-water supply, shaft-seals purge nitrogen supply and exhaust-extraction system (if fitted).
3. Check that the pressure of the shaft-seals nitrogen purge supply is correct and adjust if necessary: refer to Section 3.12.2.
4. Switch on the pump.

4.2 Shut down the pump

> CAUTION
>
> Purge the pump before you shut it down. If you do not, process vapours may condense in the pump and corrode or damage it.

Note: If the pump will be shut down for a long time in an environment where the temperature is close to freezing, we recommend that you drain the cooling-water from the pump to prevent damage to the pump: refer to Section 6.1.

1. Isolate the pump-inlet from the process gases.
2. Purge the pump of contaminants. Use one of the following methods:
   - Operate the pump at or close to atmospheric pressure for at least 15 minutes.
   - Operate the pump with full inlet purge (if fitted) for at least 15 minutes.
   - Operate the pump with full gas ballast (if fitted) for at least 15 minutes.
3. Switch off the pump.
4. When the pump has cooled down, turn off the cooling-water supply and the shaft-seals purge nitrogen supply.

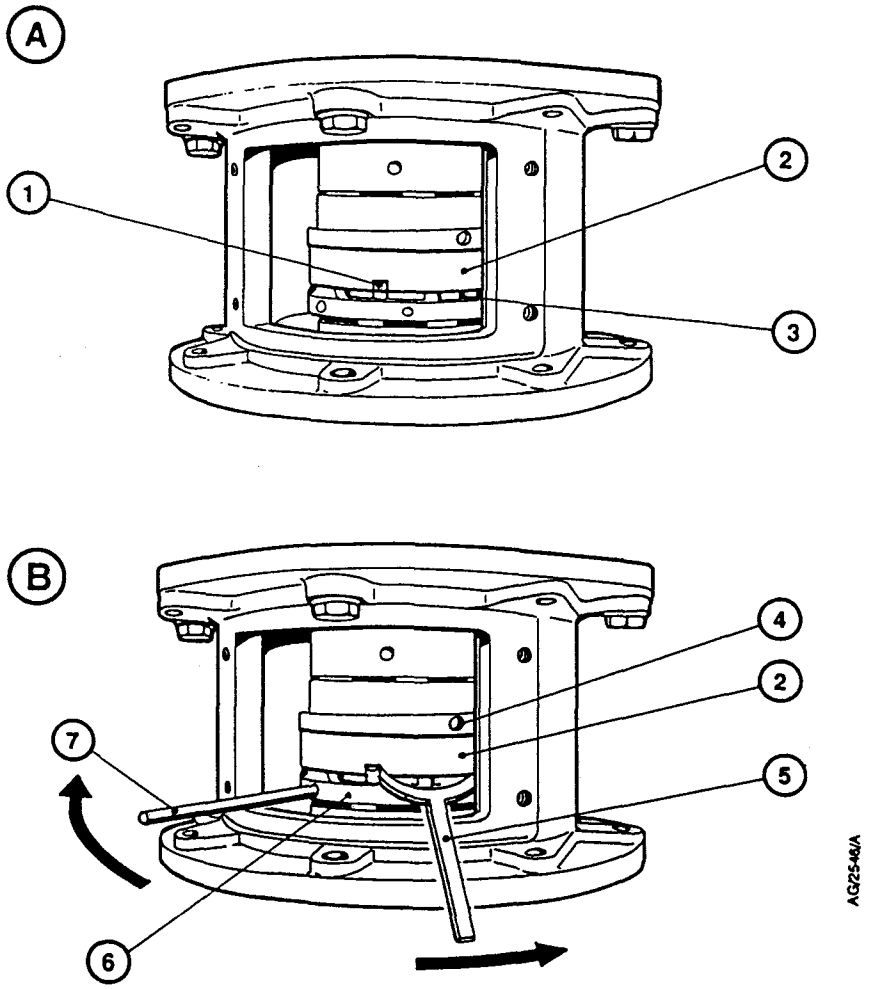
4.3 Recouple the pump-motor to the pump

> WARNING
>
> Switch off the pump and isolate the pump from the electrical supply before you recouple the pump-motor to the pump. Refit the coupling cover before you switch on the pump again. If you do not, there will be a danger of injury or death from the rotating coupling mechanism.

Note: If the torque limiter continually decouples the pump-motor from the pump, refer to Section 5.15.

Use the following procedure to recouple the pump-motor to the pump when the torque limiter has decoupled the pump-motor from the pump (see Section 1.2.5).

1. Switch off the pump and isolate the pump from the electrical supply.
2. Undo and remove the four M8 bolts which secure one of the coupling covers (Figure 1, item 14), then remove the coupling cover.
3. Refer to Figure 9. Turn the drive plate (2) so that a notch (1) in the plate aligns with a notch on the cage plate (3).
4. Place the steel rod (7) in one of the holes in the thrust plate (6).



A Align the drive and cage plates

B Use the tools to reset the torque limiter and recouple the pump-motor to the pump

1. Notches
2. Drive plate
3. Cage plate
4. Hole in coupling adaptor
5. Reset tool
6. Thrust plate
7. Steel rod

Figure 9 - Recouple the pump-motor to the pump

5. Place the torque limiter reset tool (5) in the notches (1) in the drive plate (2) and cage plate (3).

6. Turn the torque limiter reset tool to the right while you turn the steel rod to the left, until the torque limiter recouples. You will hear a click when the pump-motor recouples to the pump.

7. Remove the steel rod and torque limiter reset tool (7, 5), then use the four bolts to refit the coupling cover (Figure 1, item 14). Tighten the bolts to a torque between 2.2 and 3.6 lbf.ft.

8. Ensure that the cause of the decoupling has been rectified (for example, if the pump has been flooded, ensure that the liquids have drained from the pump), then switch on the pump.

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.
- Ensure that the maintenance technician is familiar with the safety procedures which relate to the synthetic oils and greases used and the products pumped. Wear the appropriate safety-clothing when you come into contact with contaminated components, grease and pump oil. Dismantle and clean contaminated components inside a fume-cupboard.
- Use suitable lifting equipment and wear safety shoes when you replace the pump-motor.
- Allow the pump to cool to a safe temperature before you start maintenance work.
- Isolate the pump and other components in the process system from the electrical supply so that they can not be operated accidentally.
- Recheck the pump rotation direction if the electrical supply has been disconnected.
- Do not reuse 'O' rings or gaskets if they are damaged.
- 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 overheated to 500 °F and above. These breakdown products are very dangerous. 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 the fluorinated materials used in the pump are available on request: contact your supplier or Edwards.
- Leak-test the system after installation work is complete and seal any leaks found to prevent leakage of dangerous substances out of the system and leakage of air into the system: refer to Section 3.11.

5.2 Maintenance plan

The plan in Table 4 details the maintenance operations we recommend to maintain the pump in normal operation. Instructions for each operation are given in the section shown. In practice, the frequency of maintenance is dependent on your process. In clean processes, you may be able to decrease the frequency of maintenance operations; in harsh processes you may have to increase the frequency of maintenance operations. Adjust the maintenance plan according to your experience.

When you maintain the pump, use Edwards maintenance and service kits. These contain all of the necessary seals, lubricating grease and other components necessary to complete maintenance operations successfully. The Item Numbers of these kits are given in Section 7.2.

Operation	Frequency	Refer to Section
Check the gearbox oil level and fill the gearbox with oil (if necessary)	Weekly	5.3
Remove the inlet filter	After 1 month of operation	5.4
Inspect the pipelines and connections	3 monthly	5.5
Inspect the pressure relief valve and replace the valve spring and valve pad 'O' ring (if necessary)	Yearly or when necessary	5.6
Change the gearbox oil and clean the oil-level sight-glasses #	Yearly or when contaminated, whichever occurs first *	5.7
Relubricate the high vacuum bearings #	When necessary ▼	5.8
Check the coolant level and refill if necessary	Yearly	5.9
Flush the pump with cleaning solution	When necessary	5.10
Clean the cooling-water system #	Yearly or when necessary	5.11
Overhaul the pump ▲	3 Yearly	5.12
Replace the pressure relief valve	When necessary	5.13
Replace the pump-motor and drive coupling bushes Δ	When necessary	5.14

* If the gearbox oil is contaminated (indicated by a change in colour of the oil, for example, water contamination will turn the oil a white colour), you must change the oil. You may be able to remove the contaminants from the oil by filtration.

\# You must have a Routine Maintenance Kit to do these maintenance operations.

Δ You must have a new pump-motor and a Motor Fitment Kit to do this maintenance operation.

▲ You must have a Pump Module Service Kit to overhaul the pump.

▼ The frequency of maintenance depends on the operating temperature of the pump: see Section 5.8

Table 4 - Maintenance plan

5.3 Check the gearbox oil-level and fill the gearbox with oil (if necessary)

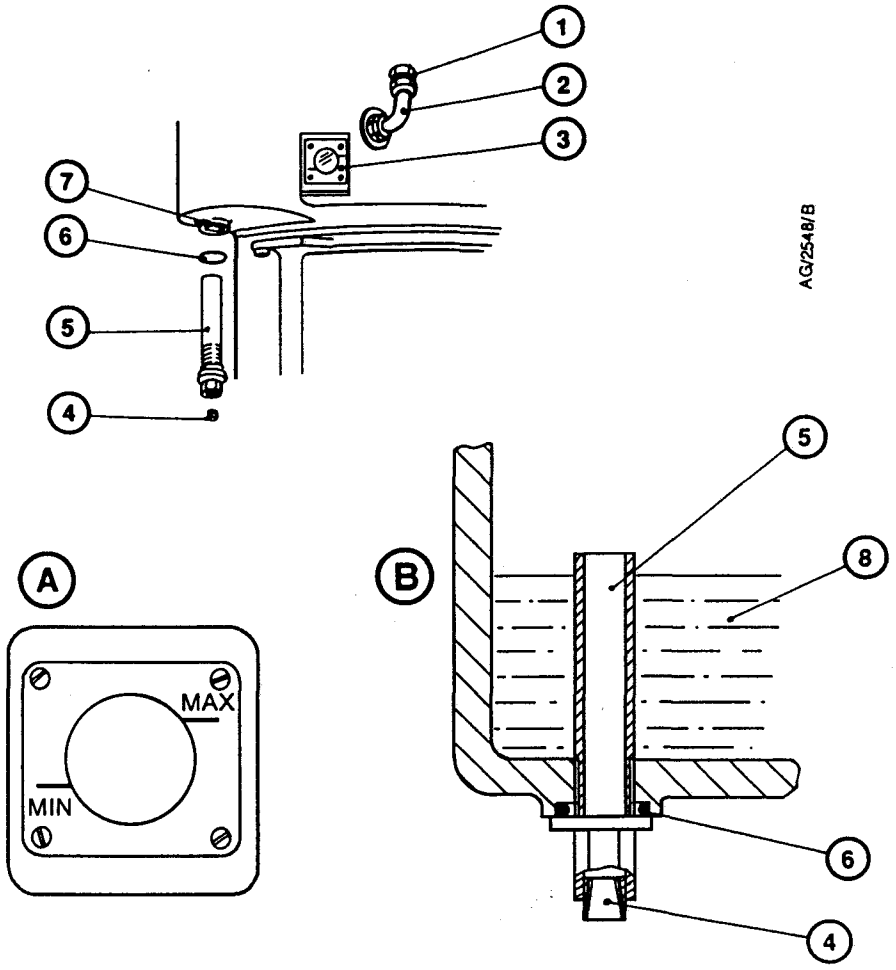
Figure 1 shows the locations of the two oil-level sight-glasses on the pump. Refer to Figure 10, detail A and check that the pump gearbox oil-level is at the MAX mark on the bezel of either of the two oil-level sight-glasses. If the oil-level is below the MAX mark:

1. Remove the oil filler-plug (1), fit a suitable funnel to the filler elbow (2), then pour oil through the funnel into the pump gearbox until the oil-level is at the MAX mark on the bezel of the oil-level sight-glass (see detail A).

2. If you overfill the gearbox: place a suitable container under the vent tube (5); unscrew the vent tube and lower it slightly until the oil just starts to drain from the gearbox; when the oil level reaches the MAX mark on the sight-glass (3), refit and tighten the vent tube (5).

3. Refit the filler-plug to the filler elbow (2).

If you need to pour oil into the gearbox frequently, or if there is a sudden loss of a large amount of oil, this may indicate that the pump has a fault. In these circumstances, we recommend that you shut down the pump as soon as possible and contact your supplier or Edwards for advice.



A Oil-level sight-glass
B Cross section view of the gearbox

1. Oil filler-plug
2. Filler elbow
3. Oil-level sight-glass
4. 1/4 BSP drain-plug
5. Vent tube
6. Bonded rubber seal
7. Oil drain-port
8. Oil in gearbox

Figure 10 - Oil-level sight-glass and oil filling and draining connections

5.4 Remove the inlet filter

If you left the inlet filter in the pump-inlet when you installed the pump (refer to Section 3.10.1), you must remove the inlet filter after the pump has been in operation for one month. If you do not, the performance of the pump will be impaired. Use the following procedure.

1. Disconnect the pump-inlet from your process system.
2. Refer to Figure 1. Remove the inlet filter (4) from the pump-inlet (3).
3. Reconnect the pump-inlet to your process system: refer to Section 3.10.1.

5.5 Inspect the pipelines and connections

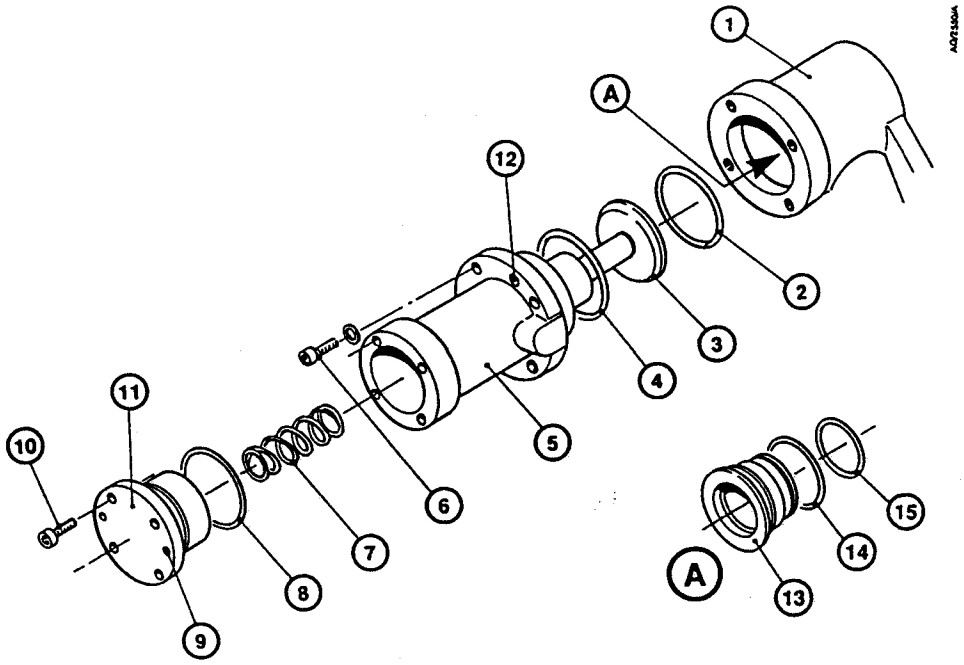
1. Inspect all cooling-water pipelines and connections; check that they are not corroded or damaged. Replace any of the pipelines and connections that are corroded or damaged. Check that all cooling-water connections are secure. Tighten any connections that are loose.
2. Inspect all nitrogen supply pipelines and connections; check that they are not corroded or damaged. Replace any pipelines and connections that are corroded or damaged. Check that all nitrogen supply connections are secure. Tighten any connections that are loose.
3. Inspect all electrical cables; check that they are not damaged and have not overheated. Replace any cables that are damaged or have overheated. Check that all electrical connections are secure. Tighten any connections that are loose.
4. Inspect all process and exhaust pipelines; check that they are not corroded or damaged. Replace any pipelines that are corroded or damaged. Check that all process and exhaust connections are secure. Tighten any connections that are loose.

5.6 Inspect the pressure relief valve and replace the valve spring and valve pad 'O' ring (if necessary)

If you think that the pressure relief valve does not operate correctly, use the following procedure to inspect it. Refer to Figure 11.

1. Remove the four M8 bolts (10) which secure the valve cap (11). Place two of the bolts into the jacking holes (9) in the valve cap and tighten the bolts to remove the valve cap and spring (7) from the valve body (5). Remove the bolts from the jacking holes.
2. Remove the four M8 bolts (6) which secure the valve body (5) to the exhaust manifold (1).
3. Fit two of the bolts (6) into the jacking holes (12) and tighten the bolts to remove the valve body (5) from the exhaust manifold (1).
4. Use a suitable safe light source to inspect the valve seat (13) in the exhaust manifold (1). If the valve seat is damaged, you must replace the complete pressure relief valve: refer to Section 5.13. If the valve seat does not need to be replaced, continue at Step 5.

5. Inspect the spring (7), the inside of the valve body (5), the valve pad and piston (3) and the valve pad 'O' ring (2):
   - If the valve body or valve pad and piston are damaged or corroded, you must replace the pressure relief valve: refer to Section 5.13.
   - If the valve spring is broken or damaged, you must replace it: continue at Step 6.
   - If the valve pad 'O' ring is damaged, you must replace it: continue at Step 6.
6. Clean the inside of the exhaust manifold (1) to remove any deposits; if necessary, use a suitable cleaning solution. If you use a cleaning solution, ensure that all of the solution is removed before you fit the new pressure relief valve seat.
7. If required, fit the new valve pad 'O' ring (2) and the new valve body 'O' ring (4).
8. Use the four bolts (6) to refit the valve body (5) to the exhaust manifold (1).
9. If required, fit the new spring (7), then use the four bolts (10) to refit the valve cap (11) and new 'O' ring (8) to the valve body (5).



1.	Exhaust manifold	6.	Bolt (4 off)	11.	Valve cap
2.	Valve pad 'O' ring	7.	Spring	12.	Jacking hole
3.	Valve pad and piston	8.	'O' ring	13.	Valve seat
4.	'O' ring	9.	Jacking hole	14.	'O' ring
5.	Valve body	10.	Bolt (4 off)	15.	'O' ring

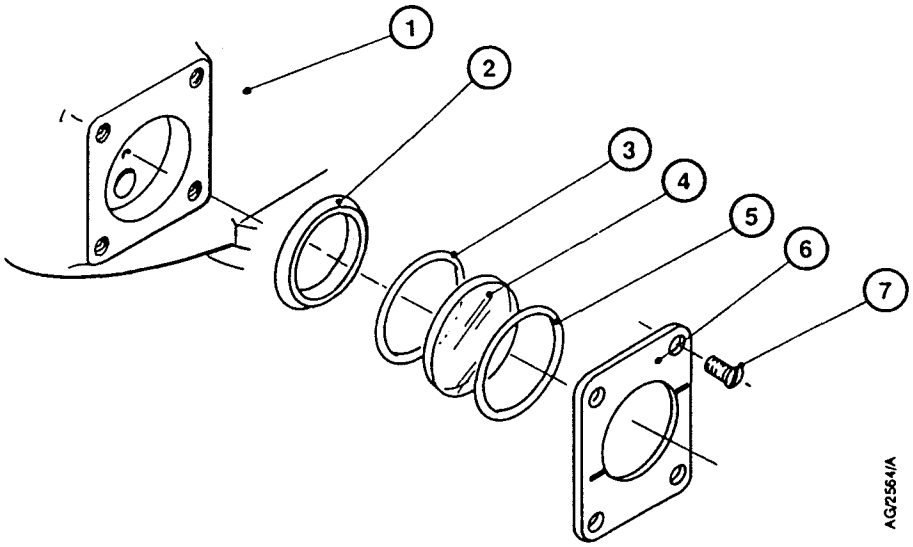
Figure 11 - Exploded view of the pressure relief valve

5.7 Change the gearbox oil and clean the oil-level sight-glasses

> WARNING
>
> Ensure that you do not come into contact with the used pump oil. The gearbox oil may be hot (up to 194 °F) and can cause injury.

There are two oil-level sight-glass on the pump (Figure 1, items 15). You must clean both sight-glasses when you change the gearbox oil.

1. Refer to Figure 10. Remove the oil filler-plug (1).
2. Place a suitable container under the oil drain-plug (4); the container must have a capacity of at least 0.96 US gallons for the EDP200 and at least 1.15 US gallons for the EDP300.
3. Unscrew the gearbox vent-tube (5) and the bonded rubber seal (6) and allow the oil to drain from the gearbox. Dispose of the bonded rubber seal.
4. Refer to Figure 12. Undo and remove the four M5 screws (7) from the sight-glass bezel (6) on one of the oil-level sight-glasses.
5. Remove the bezel (6), 'O' ring (5), sight-glass (4),'O' ring (3) and compression ring (2). Dispose of the 'O' rings.
6. Clean all of the sight-glass components and the sight-glass recess in the gearbox (1) with a soft lint-free cloth. If necessary, use a suitable cleaning solution; if you use a cleaning solution, ensure that all of the solution is removed before you reassemble the sight-glass.
7. Refit the compression ring (2) in the sight-glass recess in the gearbox (1).
8. Fit two new 'O' rings (3, 5) and the sight-glass (4), then fit the bezel (6) and secure with the four M5 screws (7).
9. Repeat Steps 4 to 8 to clean the other oil-level sight-glass.
10. Refer to Figure 10. Place a suitable funnel in the filler elbow (2).
11. If the oil drained from the pump is very discoloured, flush the gearbox with new or clean oil two or three times, until the oil which drains from the gearbox is clean.
12. Refer to Figure 10. Wipe clean the gearbox vent tube (5), then fit a new bonded rubber seal (6) and the gearbox vent tube (5).
13. Fit the drain-plug (4) to the vent tube (5).
14. Fill the gearbox through the funnel, with the correct grade and quantity of oil. Allow the oil to drain into the gearbox and then check the level on the oil sight-glass (refer to Section 5.3).
15. Remove the funnel from the filler elbow (2) and refit the oil filler-plug (1) to the filler elbow.
16. Dispose of the used oil safely: refer to Section 6.2.



1. Gearbox
2. Compression ring
3. 'O' ring
4. Sight-glass
5. 'O' ring
6. Bezel
7. Screw (4 off)

Figure 12 - Exploded view of an oil-level sight-glass

5.8 Relubricate the rotor bearings

> WARNING
>
> Allow the pump to cool down and release the pressure in the cooling jacket before you remove the bearing cover. If you do not, hot coolant may be ejected from the cooling jacket and may cause injury.

Note: If you use the pump on a harsh application, we recommend that an Edwards service engineer removes and cleans the bearing assembly before it is relubricated: contact your supplier or Edwards to arrange this.

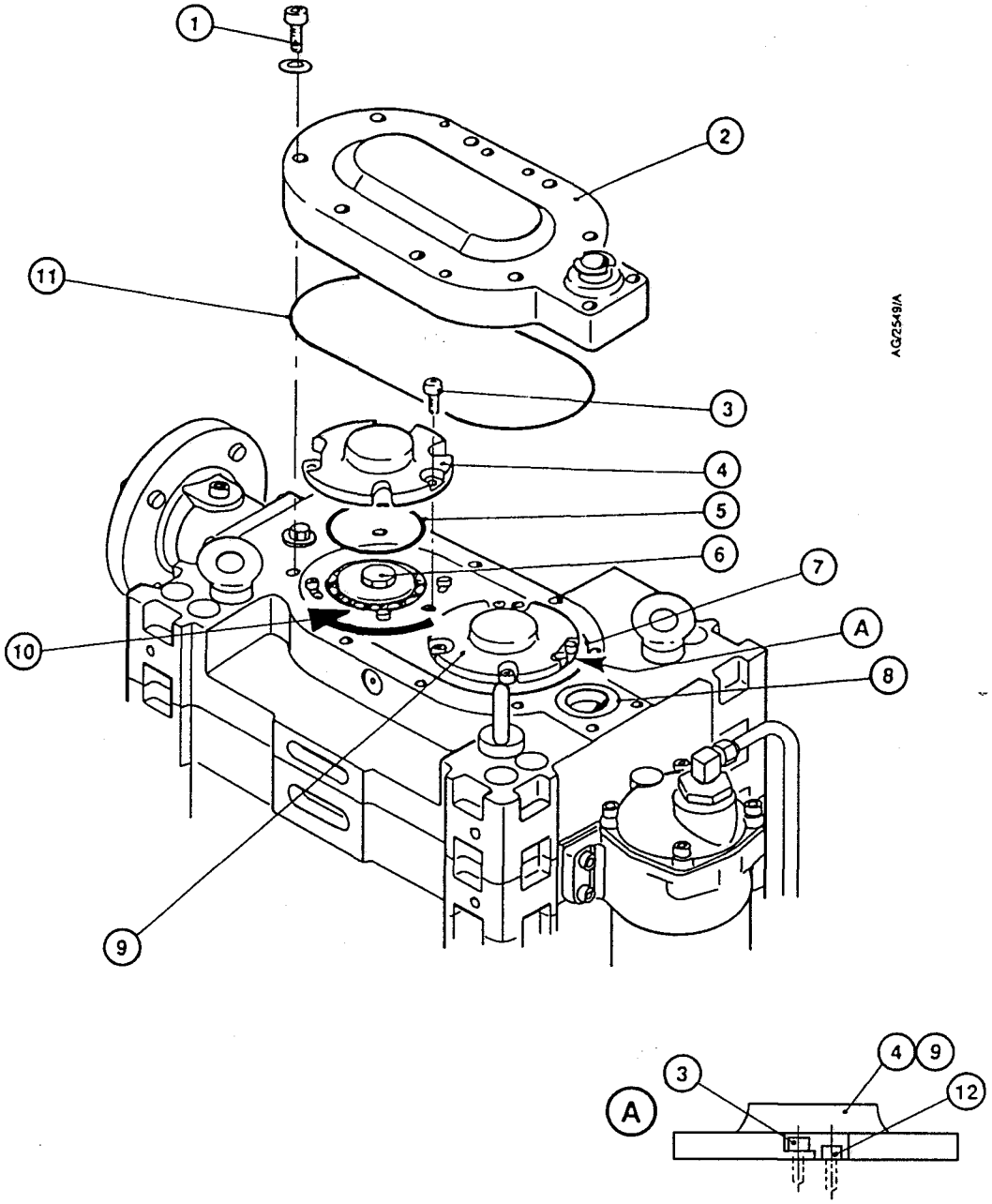
The frequency of relubrication of the rotor bearings depends on the operating temperature of the pump. Table 5 shows the recommended frequencies.

Pump operating temperature (^{o}F)	Relubrication frequency
up to 158	Every 8800 hours (1 year)
158 to 185	Every 4400 hours (6 months)
185 to 194	Every 2200 hours (3 months)

Table 5 - Recommended frequencies for rotor bearing relubrication

Relubricate the rotor bearings as described below.

1. Refer to Figure 3. Wear thermal protective gloves and push down the coolant filler cap (1) and turn it anticlockwise by a $^{1}/_{4}$ of a turn (as shown in detail A) to release the pressure in the cooling jacket.
2. Refer to Figure 13. Remove the ten M10 bolts and spring-washers (1) which secure the bearing cover (2) to the high vacuum head-plate.
3. Remove the bearing cover (2), the bearing cover 'O' ring (11) and the cooling-jacket 'O' ring (8). Discard the 'O' rings.
4. Remove the three M8 bearing cap retaining bolts (3) which secure the bearing cap (4) on the drive rotor shaft; ensure that you do not accidentally remove one or more of the bearing carrier bolts (12, see detail A), which are next to the bearing cap retaining bolts. Remove the bearing cap (4) and the bearing cap 'O' ring (5).
5. Repeat Step 4 to remove the bearing cap (9) and bearing cap 'O' ring on the driven rotor shaft.
6. Use a clean lint-free cloth to remove as much old grease as possible from the inside face of the bearing caps (4, 9) and from the top of the bearings. Do not use your fingers for this operation.
7. Inspect the bearings for obvious signs of wear or the presence of debris. If the bearings are worn, contact your supplier or Edwards for advice.



1. Bolt and spring washer
2. Bearing cover
3. Bearing cap retaining bolt
4. Bearing cap (drive shaft)
5. Bearing cap 'O' ring
6. Drive rotor shaft
7. Bearing cover 'O' ring groove
8. Cooling-jacket 'O' ring
9. Bearing cap (driven shaft)
10. Correct direction of rotation
11. Bearing cover 'O' ring
12. Bearing carrier bolt

Figure 13 - Relubricate the rotor bearings

8. If the bearings are in a satisfactory condition, use a suitable syringe to force approximately 1.8 oz of new Fomblin RT15 grease into the bearings so that a smooth layer of grease covers the case and bearings. Do not put too much grease in the bearings or the pump will run hot.
9. Use a 24 mm A/F spanner to turn the drive rotor shaft (6) in the correct direction (10) three or four complete revolutions.
10. Press any grease forced out of the bearings back into the bearings.
11. Refit the bearing cap (4) with a new bearing cap 'O' ring (5) on the drive rotor shaft. Apply a suitable thread sealant (for example, Loctite Screwlok 242 or equivalent) to each of the three bearing cap retaining bolts (3) and refit the bolts to secure the bearing cap.
12. Repeat Step 11 to refit the bearing cap (9) on the driven rotor shaft.
13. Apply a light wipe of vacuum grease to the new bearing cover 'O' ring (11) and the water jacket 'O' ring (8), then place them in position on the high-vacuum head-plate.
14. Refit the bearing cover (2) to the high vacuum head-plate and secure with the ten bolts and spring washers (1).
15. Refer to Figure 3. Turn the coolant filler cap (1) clockwise to tighten it.
16. Dispose of the old grease safely: refer to Section 6.2.

5.9 Check the coolant level and refill if necessary

WARNING

Allow the pump to cool down and release the pressure in the cooling-jacket before you remove the coolant filler-cap. If you do not, hot coolant may be expelled from the pump and may cause injury.

5.9.1 Refill the pump with Edwards coolant

Note: To refill the pump with Edwards coolant, you will require new coolant, available as a spare: refer to Section 7.

1. Refer to Figure 3. Wear thermal protective gloves and push down the coolant filler-cap (1) and turn it anticlockwise by a $^1/_4$ of a turn to release the pressure in the cooling-jacket: see detail A.
2. Turn the coolant filler-cap (1) anticlockwise and remove it from the pump.
3. Remove any dirt or water-scale from the seal of the filler-cap (1) and from the filler-tube (4).
4. Look at the level of coolant (6) in the cooling-jacket. If the coolant level is more than approximately 1 inch below the filler-neck (5, see detail B), continue at Step 5 below, otherwise continue at Step 8.
5. Remove the cap from the new coolant container. Place a clean funnel into the container and fill the container with clean water.

6. Replace the cap on the container, then shake the container to fully mix the water and coolant.
7. Remove the cap and pour the coolant mix into the pump through the filler tube (4) until the coolant level is approximately 1 inch below the filler-neck (see detail B). If necessary, repeat Steps 5 to 7 to mix and add more coolant.
8. Refit the coolant filler-cap (1).

5.9.2 Fill the pump with a different coolant

Note: You will require a Routine Maintenance Kit (see Section 7) to drain and refill the pump with a different coolant.

If you will refill the pump with a different coolant, refer to Figure 3 and use the following procedure. The coolant you use must comply with the requirements of Section 2.5.

1. Refer to Figure 3. Wear thermal protective gloves and push down the coolant filler-cap (1) and turn it anticlockwise by a $^1/_4$ of a turn to release the pressure in the cooling-jacket: see detail A.
2. Turn the coolant filler-cap (1) anticlockwise and remove it from the pump.
3. Remove any dirt or water-scale from the seal of the filler-cap (1) and from the filler-tube (4).
4. If required, place a suitable container under the coolant drain-plug (2), then remove the drain-plug and $^1/_2$ BSP rubber bonded seal from the pump and allow the coolant to drain from the cooling jacket.
5. Flush the cooling-jacket with clean water (through the filler tube) to remove any sludge or debris from the cooling-jacket.
6. Fit the new bonded seal and refit the coolant drain-plug (2) to the pump.
7. Mix the coolant with water as recommended by the coolant manufacturer.
8. Fill the pump with new coolant through the filler tube (4), until the coolant level is approximately 1 inch below the filler-neck (see detail B).
9. Refit the coolant filler-cap (1)

5.9.3 Check for coolant leaks

Check the pump for obvious signs of a coolant leak (for example, a small stream of coolant at one of the joints on the pump-body). If there are signs of a coolant leak, contact your supplier or Edwards for advice.

5.10 Flush the pump with cleaning solution

5.10.1 Introduction

Choose a cleaning solution suitable for the process substances pumped. Note that to completely flood all the unblocked cavities in the pump, you will require approximately 2.25 US gallons of cleaning solution for the EDP200 pump, and approximately 2.5 US gallons of cleaning solution for the EDP300 pump. Use the following procedure to flush the pump with cleaning solution.

1. Switch on the shaft-seals purge gas supply. If you do not, you will contaminate the lip seals in the pump when you flush it with cleaning solution.
2. Flush the pump: if you want to remove deposits from a pump which has been operating correctly, use the procedure in Section 5.10.2; if the pump has seized, use the procedure in Section 5.10.3.

5.10.2 Flush a pump which has been operating

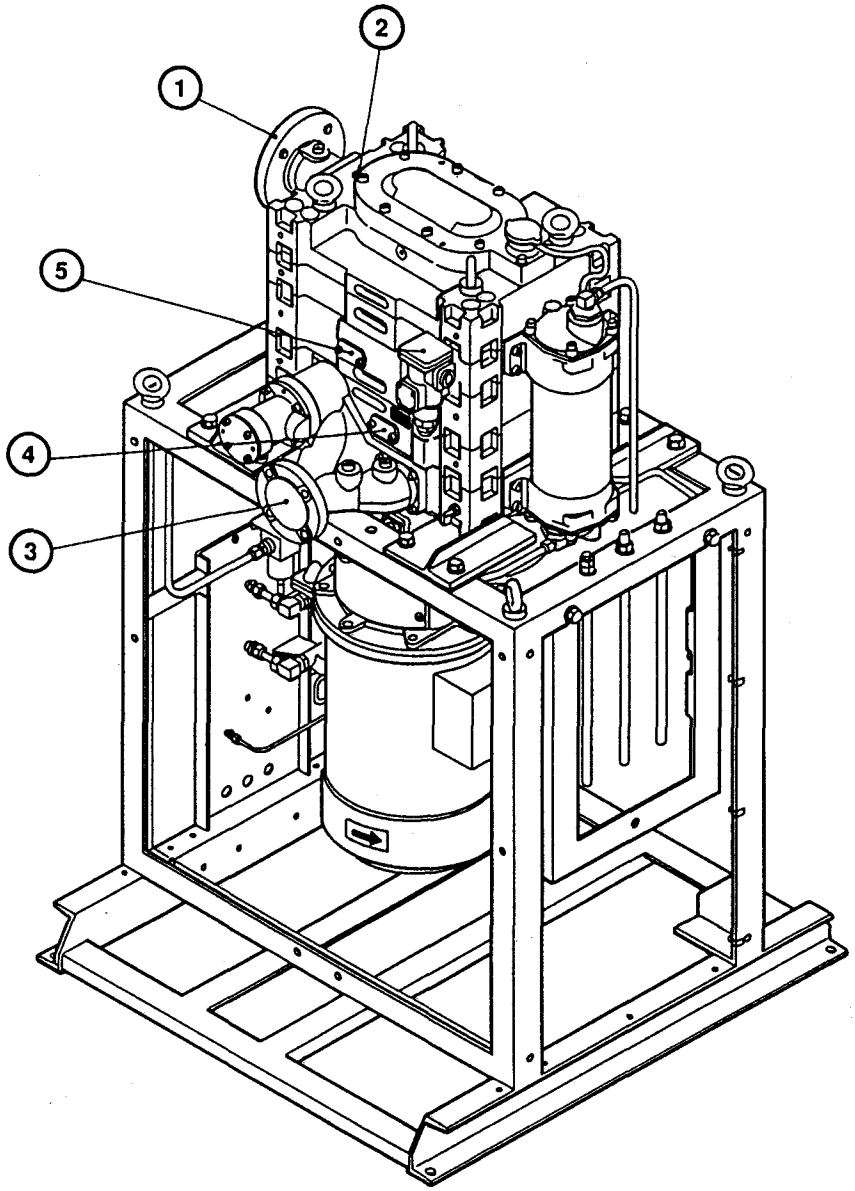
Note: If the torque limiter has decoupled the pump-motor from the pump, do not recouple the pump-motor to the pump until you have finished this procedure. If you leave the pump-motor decoupled from the pump, it will be easier to turn the pump by hand.

1. Refer to Figure 1. Remove the four bolts which secure one of the coupling covers (14) and remove the coupling cover.
2. Disconnect the exhaust pipeline from the pump-outlet (22) and place a suitable container under the pump-outlet.
3. If you have a pump-inlet isolation-valve in your system, close the valve. If you do not have a pump-inlet isolation-valve, disconnect the pump-inlet (3) from your process system and fit a blanking-flange over the pump-inlet.
4. Refer to Figure 14. Remove the two M8 bolts which secure the cover (4) on the gas ballast purge port, use a suitable tool to inject the cleaning solution into the port until the cleaning solution comes out of the port, then refit the cover.
5. Remove the two M8 bolts which secure the cover (5) on the middle stage purge port, use a suitable tool to inject the cleaning solution into the port until the cleaning solution comes out of the port, then refit the cover.
6. Remove the plug from the inlet flush port (2), use a suitable tool to inject the cleaning solution into the port until the cleaning solution comes out of the port, then refit the plug.
7. Refer to Figure 9. Fit the steel rod (7) supplied into the hole (4) in the coupling adaptor and turn the pump clockwise through three or four complete revolutions.
8. Repeat Steps 4 to 7 above as necessary, until the pump rotates freely.
9. If you have a pump-inlet isolation-valve, open the valve, otherwise, remove the blanking-flange from the pump-inlet and reconnect the pump-inlet to your process system.

10. Refer to Figure 1. Use the four bolts to refit the coupling cover (14) to the pump. Tighten the bolts to a torque between 2.2 and 3.6 lbf.ft.

11. Refit the pump-outlet (22) to your exhaust pipeline. If necessary, recouple the pump-motor to the pump: refer to Section 4.3.

12. Dispose of the deposits removed from the pump.



1. Pump inlet-flange
2. Inlet flush port
3. Pump outlet-flange
4. Gas ballast purge port
5. Middle stage purge port

Figure 14 - Flush the pump

5.10.3 Flush a seized pump

Note: If the torque limiter has decoupled the pump-motor from the pump, do not recouple the pump-motor to the pump until you have finished this procedure. If you leave the pump-motor decoupled from the pump, it will be easier to turn the pump by hand.

1. Refer to Figure 1. Remove the four bolts which secure one of the coupling covers (14) and remove the coupling cover.
2. If you have a pump-inlet isolation-valve in your system, close the valve. If you do not have a pump-inlet isolation-valve, disconnect the pump-inlet (3) from your process system and fit a blanking-flange over the pump-inlet.
3. Refer to Figure 14. Remove the plug from the inlet flush port (2).
4. Disconnect the pump-outlet (3) from your exhaust pipeline and fit a blanking-cap to the pump-outlet.
5. Slowly pour a suitable cleaning solution into the inlet flush port (2). Wait for several minutes to allow the cleaning solution to drain into the pump.
6. Repeat Step 5 until you can pour no more cleaning solution into the pump (the EDP200 pump has a capacity of approximately 2.25 US gallons and the EDP300 pump has a capacity of approximately 2.5 US gallons), then leave the pump for at least one hour for the cleaning solvent to fully react with the deposits in the pump.
7. Refer to Figure 9. Fit the steel rod (7) into the hole (4) in the coupling adaptor and try to turn the pump clockwise:
   - If you cannot turn the pump, continue at Step 8 (to leave the pump for longer).
   - If you can turn the pump, continue at Step 9.
8. Place a suitable container under the pump-outlet (Figure 14, item 3) and remove the blanking-flange.
9. Use the steel rod to turn the pump clockwise through three or four complete revolutions. If the pump seizes, this is probably because of a hydraulic lock in the pump:
   - Wait for a few seconds for the cleaning solution to drain through the pump, or
   - Remove one or more of the purge port covers (Figure 14, items 4 and 5) to allow the cleaning solution to drain out of the purge port(s), then refit the cover(s) to the purge port(s).
10. If necessary, repeat Steps 5 to 9 to flush the pump again.
11. Remove the blanking-flange from the pump-inlet (Figure 14, item 1) and reconnect the pump-inlet to your process system (refer to Section 3.10.1) or open the pump-inlet isolation-valve.
12. Reconnect the pump-outlet to your exhaust pipeline: refer to Section 3.10.2.
13. If necessary, recouple the pump-motor to the pump: refer to Section 4.3.
14. Dispose of the used cleaning solution and deposits removed.

5.11 Clean the cooling system

5.11.1 Drain the coolant from the cooling system

> WARNING
>
> Allow the pump to cool down and release the pressure in the cooling-jacket before you remove the coolant filler cap. If you do not, hot coolant may be ejected from the cooling jacket and may cause injury.

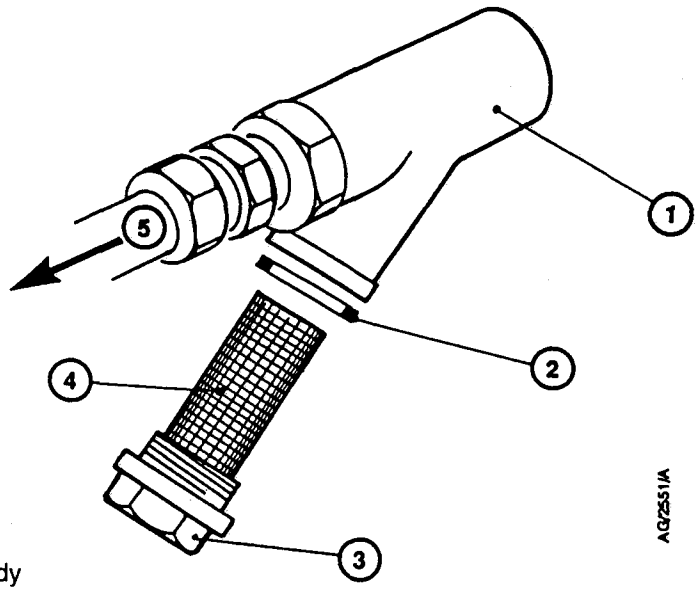
Clean the cooling system every year or when you think that the efficiency of the cooling system is reduced because of deposits or other contamination in the heat exchanger or cooling-water pipelines.

1. Refer to Figure 1. Ensure your cooling-water supply is switched off, then turn the adjuster knob on the TCV (7) to the '0' setting.
2. Refer to Figure 3. Push down the coolant filler-cap (1) and turn it anticlockwise by a $^1/_4$ of a turn to release the pressure in the cooling-jacket: see detail A.
3. Turn the coolant filler-cap (1) anticlockwise and remove it from the pump.
4. Refer to Figure 7. Place a suitable container under the cooling-water connections (3, 5) on the services panel, then remove the connectors (4, 6) on your cooling-water supply and return pipelines from the connections on the services panel and allow the cooling-water to drain from the pump.
5. Drain the coolant from the pump: refer to Steps 4 and 5 of Section 5.9.2.
6. Refer to Figure 17. Place a suitable container under the drain-plug (7), then remove the drain-plug (7) and allow the cooling-water to drain from the heat exchanger.

5.11.2 Clean the cooling-water filter

The location of the water filter is shown in Figure 7, item 10.

1. Refer to Figure 15. Undo the hex head nut (3) and remove the filter element (4) and the gasket (2) from the cooling-water filter-body (1).
2. Empty the deposits from the filter element (4); if required, you can use a compressed air supply to blow the deposits from the filter element.
3. Fit the new gasket (2) and the cleaned filter element (4) to the cooling-water filter-body (1).



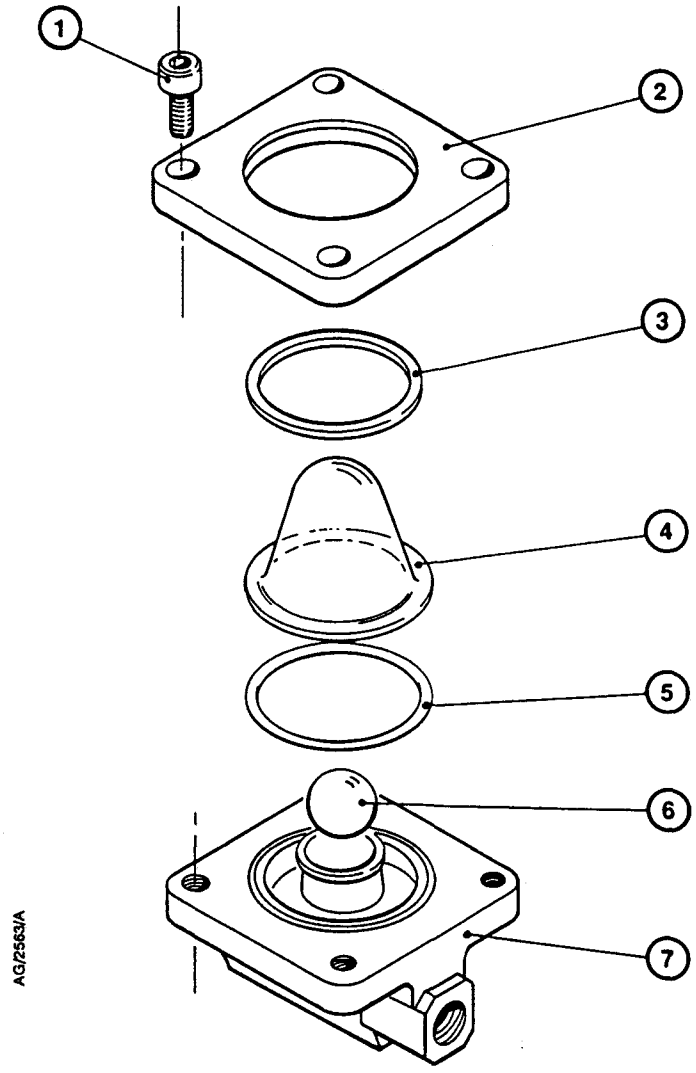
1. Water filter body
2. Gasket
3. Hex head nut
4. Filter element
5. Direction of cooling-water flow

Figure 15 - Clean the cooling-water filter

5.11.3 Clean the cooling-water flow indicator

The location of the cooling-water flow indicator is shown in Figure 7, item 11.

1. Refer to Figure 16. Remove the four bolts (1).
2. Remove the bezel (2), gasket (3), dome (4), 'O' ring (5) and ball (6) from the body of the cooling-water flow indicator.
3. Dispose of the 'O' ring and the gasket (3).
4. Clean the ball (6), the inside of the dome (4) and the inside of the body (7) to remove any deposits; if necessary, use a suitable cleaning solution.
5. Use the new 'O' ring and refit the ball (6), 'O' ring (5), dome (4), gasket (3) and bezel (2) to the body (7) of the cooling-water flow indicator.
6. Use the four bolts (1) to secure the bezel to the body (7) of the cooling-water flow indicator.



1. Bolt
2. Bezel
3. Gasket
4. Dome
5. 'O' ring
6. Ball
7. Body

Figure 16 - Clean the cooling-water flow indicator

5.11.4 Clean the heat exchanger

Refer to Figure 17 and use the following procedure to clean the heat exchanger.

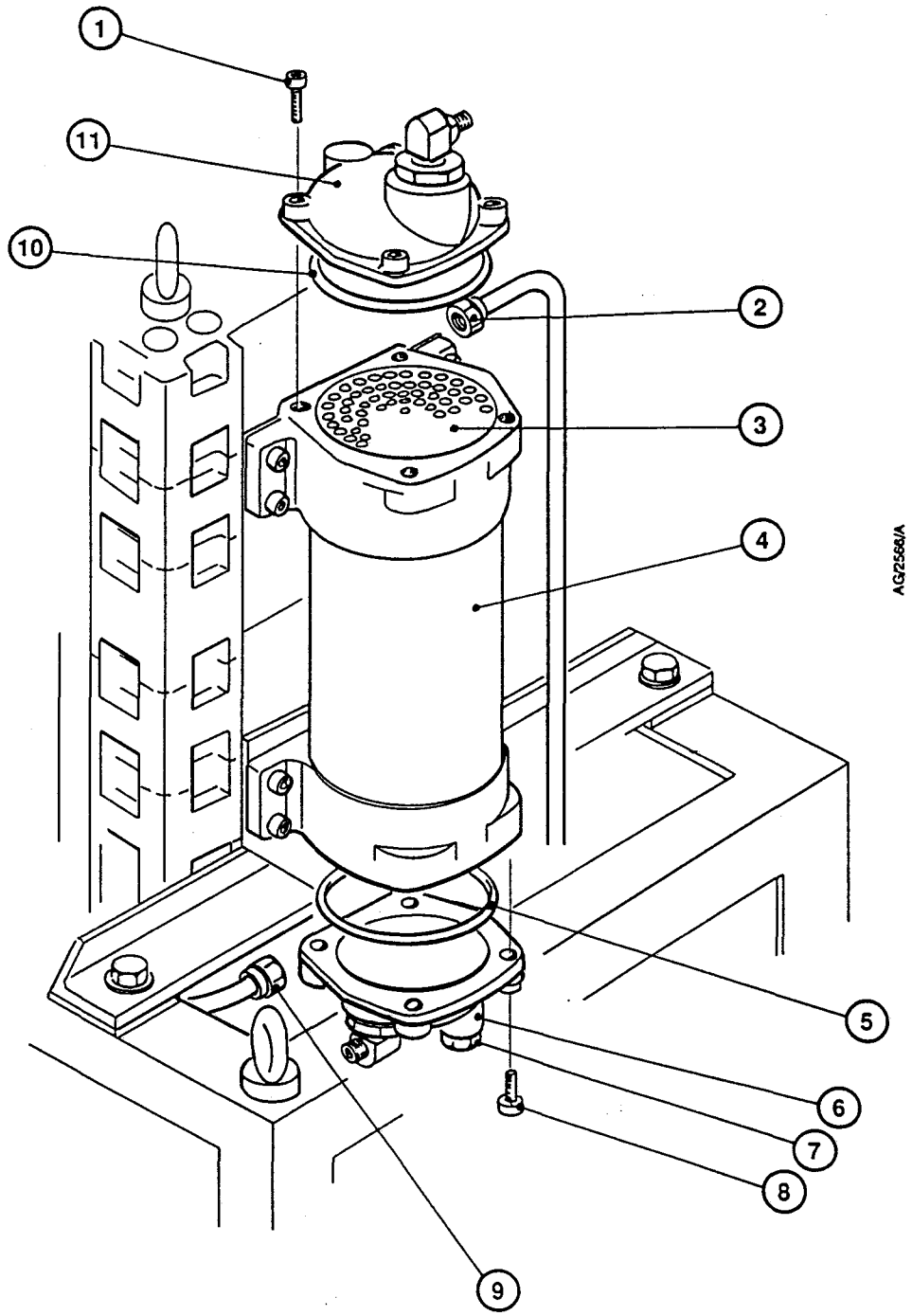
1. Undo the fitting nuts (2, 9) of the cooling-water connectors to disconnect the cooling-water pipes from the top and bottom end-caps of the heat exchanger.
2. Remove the four M8 bolts (1) which secure the top end-cap (11) to the heat exchanger and remove the end-cap and the 'O' ring (10).
3. Remove the four M8 bolts (8) which secure the bottom end-cap (6) to the heat exchanger and remove the end-cap and the 'O' ring (5).
4. Use a pipe cleaner which will pass through a 16 inch length of 0.2 inch diameter tube to clean and remove any scale from each tube in the tube stack (3).
5. Clean the 'O' ring sealing faces of the top and bottom end-caps (11, 6) and the top and bottom of the heat exchanger.
6. Fit the new 'O' ring (5) and then use the four M8 bolts (8) to refit the bottom end-cap (6) to the heat exchanger.
7. Fit the new 'O' ring (10) and then use the four M8 bolts (1) to refit the top end-cap (11) to the heat exchanger.
8. Reconnect the fitting nuts (2, 9) of the cooling-water connectors to the top and bottom end-caps (11, 6).

5.11.5 Prepare the pump for operation

1. Refer to Figure 3. Use one of the new rubber bonded seals to refit the coolant drain-plug (2), then refill the pump with coolant: refer to Steps 6 to 9 of Section 5.9.2.
2. Refer to Figure 17. Refit the drain-plug (7) to the bottom end cap (6) of the heat exchanger.
3. Refer to Figure 7. Refit the fittings (4, 6) on your cooling-water supply and return pipelines to the connections (3, 5) on the services panel.

5.12 Overhaul the pump

We recommend that the pump is given a major overhaul every three years. Such an overhaul is outside the scope of this manual and should be done by qualified Edwards service personnel: contact your supplier or Edwards.



1. Bolt
2. Cooling-water connector
3. Tube stack
4. Heat exchanger
5. 'O' ring
6. Bottom end cap
7. Drain-plug
8. Bolt
9. Cooling-water connector
10. 'O' ring
11. Top end cap

Figure 17 - Clean the heat exchanger

5.13 Replace the pressure relief valve

You must replace the pressure relief valve if it is damaged. To replace the valve, you will require the Pressure Relief Valve Replacement Kit (refer to Section 7). Refer to Figure 11.

1. Undo and remove the four M8 bolts (6) which secure the valve body (5) to the exhaust manifold (1).
2. Place two of the bolts in the jacking holes (12) and tighten the bolts to remove the valve body (5) from the exhaust manifold.
3. Use the valve seat removal tool supplied in the Kit to remove the valve seat (13) and the 'O' rings (14, 15) from the exhaust manifold (1).
4. Clean the inside of the exhaust manifold to remove any deposits; if necessary, use a suitable cleaning solution. If you use a cleaning solution, ensure that all of the solution is removed before you fit the new pressure relief valve seat.
5. Lightly lubricate the 'O' rings (14, 15) with Fomblin RT15 or another suitable grease, then fit the new valve seat (13) and the 'O' rings (14, 15) to the exhaust manifold (1).
6. Fit the new pressure relief valve to the exhaust manifold and secure with the four M8 bolts (6).

5.14 Replace the pump-motor and the drive coupling bushes

Use the procedures in the following sections to replace the drive coupling bushes with the new bushes supplied in the Motor Fitment Kit and to replace the pump-motor with a new pump-motor (supplied separately).

5.14.1 Lower the pump-motor and coupling housing

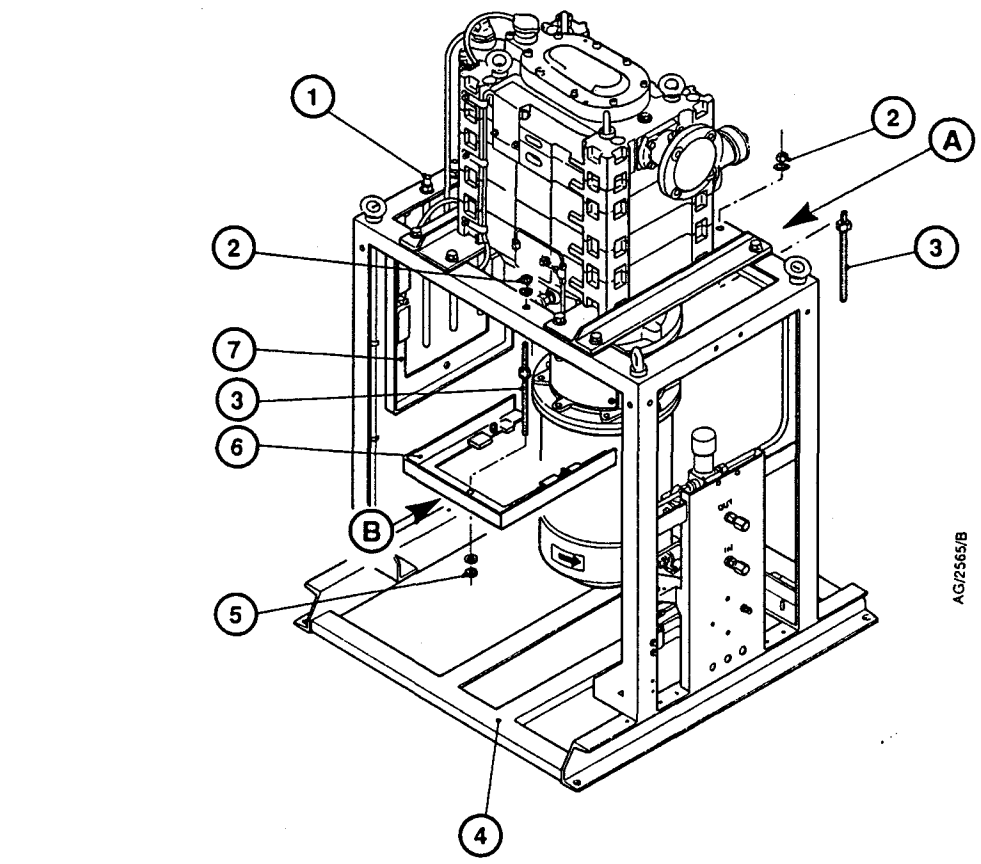
> WARNING
>
> Ensure that the pump-motor and coupling housing assembly does not fall over when you move it. If it falls over, it can cause injury to people. The mass of the pump-motor and coupling housing assembly is 420 lb on the EDP200 and 505 lb on the EDP300.

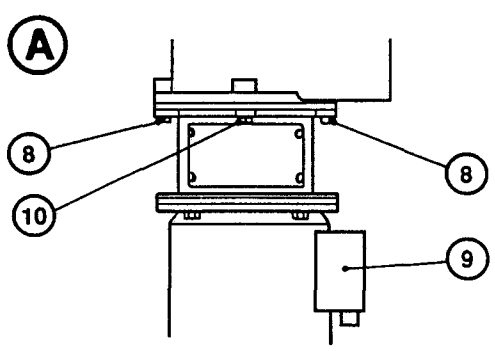
1. Refer to Figure 18. Undo and remove the three nuts and washers from the tops of the studs (1) and remove the studs and the motor change frame (7) from the pump frame (4).
2. Refer to detail A. Remove the two M16 fixing bolts (8) which secure the coupling housing to the gearbox; one bolt is located next to the oil drain port and the other bolt is on the opposite side of the pump. Do not remove the other two bolts (10), as these secure the pump-motor and coupling housing assembly to the pump.
3. Refer to Figure 19. Loosen the four M16 bolts (9) which secure the coupling housing (12) to the pump-motor (8). Do not over-loosen or remove the bolts, as they secure the pump-motor in place.

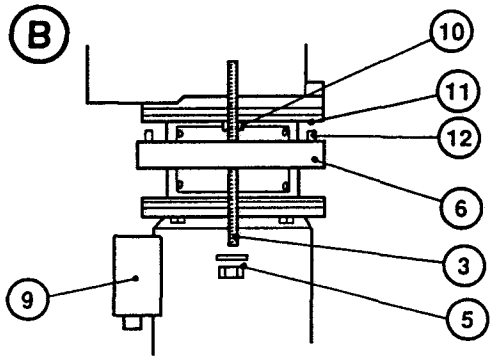
4. Refer to Figure 18. Pass the three studs (3) through the holes in the pump frame (4); there are three holes in the pump frame, as follows:
   - Two on the main cross-member, either side of the exhaust manifold.
   - One on the main cross-member on the opposite side of the pump, near the oil filler elbow (as shown in Figure 18).
5. Secure the tops of the three studs to the cross-members of the pump frame (4). Use a nut and washer above and below the cross members and ensure that the nuts are tight, so that the studs cannot turn and become detached from the cross-members. The studs should now hang down from the pump frame.
6. Position the motor change frame (6) so that the two locating pins (12, detail B) are upwards.
7. From the oil filler elbow side of the pump, slide the motor change frame between the top and bottom flanges of the coupling housing, as shown in detail B.
8. Refer to detail B. Move the motor change frame (6) up over the studs until the two locating pins (12) fit into the holes (11) from which the two fixing bolts were removed.
9. Hold the motor change frame (6) in place, then fit a washer and nut (5) to the bottom of each stud (3) and spin the nuts upwards until the motor change frame is held tightly in place against the top flange of the coupling housing.
10. Remove the remaining two coupling housing M16 fixing bolts (10). The mass of the pump-motor and coupling housing assembly is now supported by the motor change frame (6).
11. Keep the top of the pump-motor level throughout and undo the three lower nuts (5) on the studs to lower the pump-motor and coupling housing assembly until the pump-motor rests on the two cross-members at the bottom of the pump frame (4). While you undo the three nuts, continually check that the top nuts are tight and that the studs are firmly secured to the pump frame.
12. Ensure that the pump-motor rests securely on the pump frame and remove the motor change frame (6), then remove the three studs (3) from the pump-frame.
13. Carefully slide the pump-motor and coupling housing assembly out of the pump frame, then use suitable lifting equipment to lower the pump-motor and coupling housing assembly so that it rests on the floor in an upright orientation (that is, with the top flange of the coupling housing at the top).

5.14.2 Remove the coupling housing from the pump-motor

1. Refer to Figure 19. Remove the four M16 bolts (9) which secure the pump-motor (8) to the coupling housing (12).
2. Take note of the orientation of the coupling housing on the pump-motor (so that you can refit it later in the same orientation), then lift the coupling housing from the pump-motor.

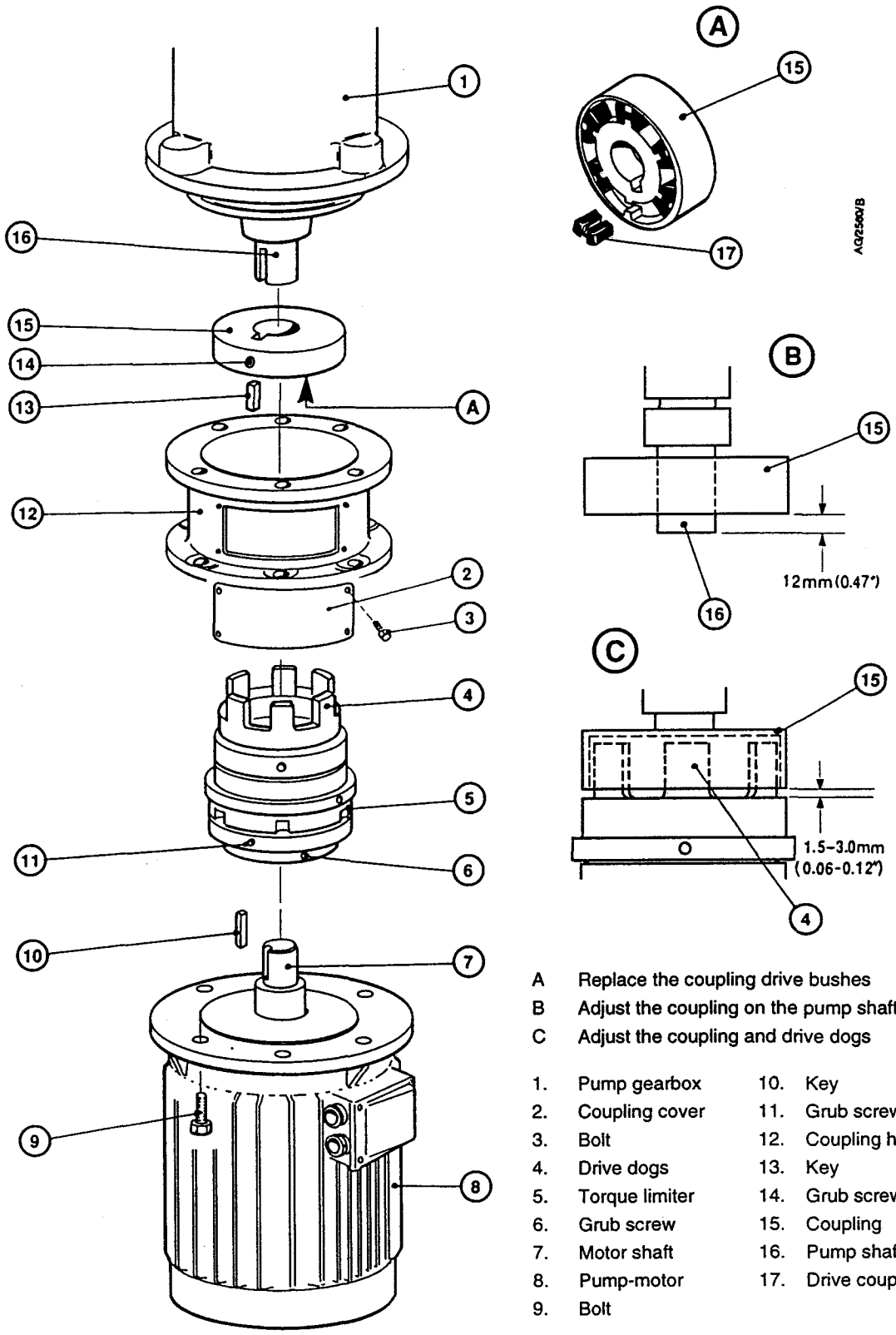






1. Stud (on pump frame)
2. Nut and washer
3. Stud (removed from pump frame)
4. Pump frame
5. Nut and washer
6. Motor change frame (removed from pump frame)
7. Motor change frame (on pump frame)
8. Bolt
9. Pump-motor terminal-box
10. Bolt
11. Bolt hole
12. Locating pin

Figure 18 - Lower the pump-motor and coupling housing assembly



A Replace the coupling drive bushes
B Adjust the coupling on the pump shaft
C Adjust the coupling and drive dogs

1. Pump gearbox
2. Coupling cover
3. Bolt
4. Drive dogs
5. Torque limiter
6. Grub screw
7. Motor shaft
8. Pump-motor
9. Bolt
10. Key
11. Grub screw
12. Coupling housing
13. Key
14. Grub screw
15. Coupling
16. Pump shaft
17. Drive coupling bush

Figure 19 - Exploded view of the pump-motor, torque limiter and coupling housing

5.14.3 Replace the drive coupling bushes

1. Refer to Figure 19. Undo and remove the two grub screws (14) in the coupling (15).
2. Slide the coupling (15) off the pump shaft (16) and remove the key (13) from the pump shaft. Dispose of the key.
3. Refer to detail A. Pull the drive coupling bushes (17) out of the coupling (15). Dispose of the bushes.
4. Fit the new drive coupling bushes (17) into the coupling (15).
5. Apply a suitable thread sealant (such as Loctite 242 Nutlock) to the new grub screws (14) and screw the grub screws into the coupling (15).
6. Fit the new key (13) into the pump shaft (16).
7. Refer to detail B. Slide the coupling (15) onto the pump shaft (16) and position it so that the bottom face of the coupling (15) is 12 mm above the end of the pump shaft.
8. Fully tighten the two grub screws (14) to secure the coupling (15) and key (13) in place.

5.14.4 Remove the torque limiter and fit to the new pump-motor

1. Refer to Figure 19. Undo and remove the two grub screws (11) and the two grub screws (6) on the torque limiter (5).
2. Use a suitable puller tool to remove the torque limiter (5) from the motor shaft (7).
3. Remove the key (10) from the shaft and dispose of the key.
4. Dispose of the key supplied with the new pump-motor.
5. Inspect the motor shaft (7) of the new pump-motor (8). The motor shaft must be free of burrs and dirt. If necessary, clean or refinish the motor shaft.
6. Inspect the motor shaft bore of the torque limiter (5). The bore must be free of burrs and dirt. If necessary, clean or refinish the bore.
7. Fit the new key (10, supplied in the Motor Fitment Kit) into the motor shaft (7).
8. Fit the torque limiter (5) onto the motor shaft (7) and push it fully down until the lower face of the torque limiter is against the shoulder on the motor shaft.
9. Apply a suitable thread sealant (such as Loctite 242 Nutlock) to the new grub screws (11 and 6), then screw the grub screws into the correct screw holes in the torque limiter (5). Fully tighten the grub screws to secure the torque limiter (5) to the motor shaft (7).

5.14.5 Fit the coupling housing to the new pump-motor

> CAUTION
>
> Ensure that the pump-motor flange and the bottom flange of the coupling housing are clean and free of burrs. *If you do not,* the pump-motor and coupling housing may be misaligned and you may damage the pump-motor, the pump or the torque limiter when you operate the pump.

1. Refer to Figure 19. Inspect the bottom flange of the coupling housing (12) and the flange of the pump-motor (8). The flanges must be free of burrs and dirt. If necessary, clean or refinish the flanges.
2. Fit the coupling housing (12) onto the flange of the pump-motor (8). Ensure that the coupling housing is orientated correctly (as noted in Section 5.14.2): one of the coupling covers (2) must be at 90° to the terminal-box on the pump-motor (see Figure 18, details A and B).
3. Refer to Figure 19. Fit the four M16 bolts (9) and tighten the bolts to secure the coupling housing (12) to the pump-motor (8); note that you will fully tighten the bolts in Section 5.14.6.

5.14.6 Refit the pump-motor and coupling housing to the pump

> WARNING
>
> Ensure that the pump-motor and coupling housing assembly does not fall over when you move it. If it falls over, it can cause injury to people. The mass of the pump-motor and coupling housing assembly is 420 lb on the EDP200 and 505 lb on the EDP300.

> CAUTION
>
> Ensure that the bottom flange of the pump gearbox and the top flange of the coupling housing are clean and free of burrs. If you do not, the pump gearbox and coupling housing may be misaligned and you may damage the pump-motor, the pump or the torque limiter when you operate the pump.

1. Refer to Figure 19. Undo and remove the four bolts (3) which secure each of the two coupling covers (2) and remove the coupling covers from the coupling housing (12).
2. Inspect the top flange of the coupling housing (12) and the bottom flange of the pump gearbox (1). The flanges must be free of burrs and dirt. If necessary, clean or refinish the flanges.
3. Refer to Figure 18. Use suitable lifting equipment to lift the pump-motor and coupling housing onto the bottom of the pump frame (4). Carefully slide the pump-motor and coupling housing assembly so that it is directly under the pump and so that the pump-motor terminal-box (9) is directly below the gearbox oil drain-plug.

4. Refit the three studs (3) to the pump frame (4) and secure with the nuts and washers (2).

5. Fit the motor change frame (6) so that the studs (3) go through the holes in the motor change frame. Slide the motor change frame up the studs until the two locating pins (12) fit in the bolt holes (11) in the top flange of the coupling housing.

6. Hold the motor change frame (6) in place, fit a washer and nut (5) to the bottom of each stud (3) and tighten the nuts up the studs until the motor change frame (6) is secured against the top flange of the coupling housing.

7. Ensure that the top flange of the coupling housing is level at all times and alternately and evenly tighten the three nuts (5) to start to raise the motor change frame (6) and the pump-motor and coupling housing assembly.

8. Refer to Figure 19. Look through the access hole in the coupling housing (12) and continue to raise the motor change frame and the pump-motor and coupling housing assembly until the drive dogs (4) are almost engaged in the coupling (15).

9. Turn the torque limiter (5) until the drive dogs (4) align with the gaps between the drive coupling bushes (17) in the coupling (15).

10. Refer to Figure 18. Fully tighten the three lower nuts (5) on the studs (3) to raise the pump-motor and coupling housing assembly until the top flange of the coupling housing locates against the bottom flange of the pump gearbox.

11. Use the two M16 bolts (10) to secure the coupling housing and pump-motor assembly to the pump gearbox.

12. Refer to Figure 19, detail C. Check the gap between the bottom face of the coupling (15) and the inner faces of the drive dogs (4). If the gap is correct, continue at Step 14.

13. If the gap is not correct:

    - Check that the bottom flange of the coupling housing (12) is correctly located against the top flange of the pump-motor: refer to Section 5.14.5.

    - Check that the top flange of the coupling housing (12) is correctly located against the bottom flange of the pump gearbox (1): refer to Steps 1 to 11 and to the WARNING at the start of this section.

    - Check that the torque limiter (5) is fully located on the motor shaft (7), so that the lower face of the torque limiter is against the shoulder on the motor shaft: refer to Section 5.14.4.

    - If the coupling housing and the torque limiter are correctly fitted, loosen the two grub screws (14) on the coupling (15) and adjust the position of the coupling, then tighten the two grub screws (14) again. Continue at Step 12 to check the gap is now set correctly.

14. Refer to Figure 18. Undo and remove the three nuts and washers (5) from the studs (3) and remove the motor change frame (6) from the studs. Undo and remove the three nuts and washer (2) and remove the three studs (3) from the pump frame (4).

15. Fit the remaining two M16 fixing bolts (8) to fully secure the coupling housing and pump-motor assembly to the pump.

16. Ensure that all of the M16 fixing bolts (Figure 18, items 8 and 10, and Figure 19, item 9) are tightened to a torque between 94.4 and 97.4 lbf.ft.

17. Secure the three studs (1) and the motor change frame (7) to the side of the pump frame.

18. Refer to Figure 19. Use the four bolts (3) to secure each coupling cover (2) to the coupling housing. Tighten the bolts to a torque between 2.2 and 3.6 lbf.ft.

5.15 Fault finding

Symptom	Check	Action
The pump-motor starts but the pump does not operate.	Has the torque limiter decoupled the pump-motor from the pump ?	Recouple the pump-motor to the pump: refer to Section 4.3.
The pump suddenly stops or the torque limiter continually decouples the pump-motor from the pump when reset. The pump-motor may be tripping due to excessive electrical current consumption.	Is there a hydraulic lock in the pump ?	Switch off and drain the fluid from the pump. If necessary, turn the pump by hand (refer to Step 7 of Section 5.10.3), then recouple the pump-motor to the pump (refer to Section 4.3).
	Has the pump seized due to deposits ?	Switch off and then flush the pump (refer to Section 5.10), then recouple the pump-motor to the pump (refer to Section 4.3).
The pump stops but the torque limiter does not decouple the pump-motor from the pump.	Has the thermal snap-switch operated to stop the pump because the pump is operating at too high a temperature ?	Check that the thermal snap-switch is correctly set for the required operating temperature. If necessary, adjust the thermal snap-switch (refer to Section 3.12.1).
		Check that the TCV is set to the required operating temperature. If necessary, adjust the TCV (refer to Section 3.12.3).
		Check that the coolant level in the pump is correct. If necessary, add coolant (refer to Section 5.9).
		Check that there is a flow of cooling-water through the heat exchanger: look at the cooling-water flow indicator. If your cooling-water supply is on and is at the correct pressure, the water filter or the heat exchanger may be blocked: clean the cooling system (refer to Section 5.11).
	Has the pump seized because the thermal snap-switch is faulty ?	Check the temperature at which the thermal snap-switch operates. If the temperature of the pump-body is > 68 °F above the thermal snap-switch setting, the thermal snap-switch is faulty and you must replace it: contact your supplier or Edwards for advice.

Table 6 - Fault finding

Symptom	Check	Action
The pump operates at too high a temperature or the pump temperature is unstable. The coolant filler-cap continuously opens to release pressure in the cooling-jacket.	Does the thermal snap-switch not operate at the required temperature ? Has the TCV been set correctly ? Has the TCV failed ?	Check the operation of the thermal snap-switch as described above. Before you restart the pump, check the coolant level (refer to Section 5.9). Adjust the TCV to a lower temperature setting (refer to Section 3.12.3). Adjust the TCV to a lower temperature setting. If the cooling-water supply is on and is at the correct pressure, but there is no flow indicated in the cooling-water flow indicator, the TCV may have failed: contact your supplier or Edwards for advice.
The pump continues to operate at a high temperature which may result in seizure.	Is the pressure relief valve stuck in the open position ?	Inspect the pressure relief valve and clean it or replace it if necessary (refer to Sections 5.6 and 5.13).
The pump only achieves an ultimate pump-inlet pressure of 22.5 to 37.5 torr.	Is the pressure relief valve stuck in the open position ?	See above.
The pump-motor trips out due to excessive electrical current consumption when the EDP200 pump is operating with pump-inlet pressure in the range 337 to 750 torr, or when the EDP300 pump is operating with pump-inlet pressure in the range 187 to 750 torr.	Is the pressure relief valve stuck in the closed position ?	Inspect and clean the valve (refer to Section 5.6). If the valve spring is broken, you must replace it: refer to Section 5.6. If necessary, replace the valve (refer to Section 5.13).
The gearbox and oil are contaminated with the process substances pumped.	Has the shaft-seal purge failed ? Has the shaft-seal purge failed ? (continued) Have the seals in the pump failed ?	Check that there is a flow of nitrogen purge to the shaft-seals (look at the nitrogen flow indicator); if necessary adjust the pressure regulator (refer to Section 3.12.2). Change the gearbox oil before you restart the pump (refer to Section 5.7). If you cannot adjust the pressure regulator to the required pressure, there is no flow; check your nitrogen supply pressure and rectify as necessary. Change the gearbox oil before you restart the pump (refer to Section 5.7). The seals must be replaced. Contact your supplier or Edwards for advice.
The gearbox is noisy.	Is the oil level low ?	Check the oil level and fill as necessary (refer to Section 5.3).

Table 6 - Fault finding (continued)

Symptom	Check	Action
The pump does not operate.	Is the pump-motor faulty ?	Make all the other appropriate checks in this table. If there is no other apparent cause for failure of the pump to operate, check the pump-motor and if necessary replace it (refer to Section 5.14).

Table 6 - Fault finding (continued)

6 STORAGE AND DISPOSAL

6.1 Storage

Note: If you will store the pump in an environment with an ambient temperature below 7 °F, you must also drain the oil and coolant from the pump: use the procedures in Sections 5.7 and 5.11.1, then refit all of the drain-plugs to the pump before you store it.

Store the pump as follows:

1. Ensure that the pump has been shut down as described in Section 4.2, then disconnect the pump from the electrical supply.
2. Place a suitable container under the cooling-water connections on the services panel (Figure 7, items 3 and 5), then remove your cooling-water supply and return hoses from the connections and allow the cooling-water to drain from the pump.
3. Drain the cooling-water from the heat exchanger as described in Section 5.11.1. Refit the drain-plug.
4. Disconnect the shaft-seals purge nitrogen supply and disconnect the pump process and exhaust connections.
5. Fit blanking-plates to the pump-inlet and pump-outlet. Place protective covers over the pump services connection points.
6. Store the pump in clean dry conditions until required.
7. When required for use, prepare and install the pump as described in Section 3 of this manual.

6.2 Disposal

Dispose of the pump, cleaning solution, deposits removed from the pump, used pump oil, coolant, grease and any components safely in accordance with all local and national safety and environmental requirements.

Particular care must be taken with the following:

- Fluoroelastomers which may have decomposed as the result of being subjected to high temperatures
- Components and 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, please state for each part required:

- Model and Item Number of your equipment
- Serial number (if any)
- Item Number and description of the part.

7.2 Spares

Note: You will need eight containers of coolant to completely refill a EDP200 pump with coolant and you will need nine containers of coolant to completely refill a EDP300 pump with coolant.

Spare	Item Number
Shell Tellus oil (1.3 US gallons)	H110-21-005
Container of coolant (0.24 US gallons as supplied, 0.53 US gallons when diluted)	H128-10-002
Routine Maintenance Kit	A705-01-825
Pressure Relief Valve Replacement Kit	A705-01-816
Motor Fitment Kit	A705-01-805
Pump Module Service Kit	A705-01-815

7.3 Accessories

7.3.1 Exhaust silencer

The exhaust silencer fits on the pump-outlet and attenuates the pressure pulses in the pump exhaust gases and reduces pump-induced resonance in your exhaust extraction system.

Accessory	Item Number
Exhaust Silencer: mild steel	
EDP200	A505-13-000
EDP300	A505-21-000
Exhaust Silencer: stainless steel	
EDP200	A505-14-000
EDP300	A505-22-000

7.3.2 Gas ballast kit

When fitted, this kit provides a nitrogen gas ballast facility on the pump.

Accessory	Item Number
Gas ballast kit (standard pump)	A600-41-041
Gas ballast kit (explosion-proof pump)	A600-41-042

7.3.3 Inlet purge kit

When fitted, this kit provides an inlet purge facility on the pump.

Accessory	Item Number
Inlet purge kit (standard pump)	A600-41-046
Inlet purge kit (explosion-proof pump)	A600-41-047

7.3.4 Acoustic enclosure

When fitted, the acoustic enclosure reduces noise from the pump. If you have a pump with flame arrestors, you will only require the Acoustic enclosure. If you have a pump without flame arrestors, you will require the Acoustic enclosure and the Acoustic cover kit.

Accessory	Item Number
Acoustic enclosure	A600-41-020
Acoustic cover kit	A600-41-021

7.3.5 Other accessories

A number of other accessories suitable for use with the EDP200 and EDP300 pumps are available. These include pump-inlet and pump-outlet flame arrestors and inlet and outlet condensers.

For further details on these accessories, contact your supplier or Edwards.

Return of Edwards Equipment - Procedure (Form HS1)

Introduction

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

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

Guidelines

Take note of the following guidelines:

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

PROCEDURE

Use the following procedure:

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

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