



SERVICE OF VACUUM PUMP SYSTEMS
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A705-52-880 Issue L Original

Instruction Manual

Drystar® EDP60, EDP120, EDP200 and EDP300 Chemical Dry Vacuum Pumps

<i>Description</i>	<i>Item Number</i>
<i>Drystar EDP60, 460 V, 60 Hz, standard</i>	<i>A701-52-908</i>
<i>Drystar EDP60, 460 V, 60 Hz, explosion-proof</i>	<i>A701-54-908</i>
<i>Drystar EDP120, 460 V, 60 Hz, standard</i>	<i>A703-52-908</i>
<i>Drystar EDP120, 460 V, 60 Hz, explosion-proof</i>	<i>A703-54-908</i>
<i>Drystar EDP200, 460 V, 60 Hz, standard</i>	<i>A705-52-908</i>
<i>Drystar EDP200, 460 V, 60 Hz, explosion-proof</i>	<i>A705-54-908</i>
<i>Drystar EDP300, 460 V, 60 Hz, standard</i>	<i>A707-52-908</i>
<i>Drystar EDP300, 460 V, 60 Hz, explosion-proof</i>	<i>A707-54-908</i>

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Drystar chemical dry vacuum pumps

1. Scope of Amendment

This amendment corrects the information given in Table 7 of each of the above manuals.

2. Correction

	DP80	DP160 *	DP250	DP400
Maximum water consumption ‡				
Pump operating temperature 55°C	540 l/h	600 l/h	600 l/h	720 l/h
Pump operating temperature 65°C	120 l/h	180 l/h	120 l/h	240 l/h
Pump operating temperature 90°C	12 l/h	51 l/h	42 l/h	120 l/h

	DPS80	DPS160 *	DPS250	DPS400
Maximum water consumption ‡				
Pump operating temperature 55°C	540 l/h	600 l/h	600 l/h	720 l/h
Pump operating temperature 65°C	120 l/h	180 l/h	120 l/h	240 l/h
Pump operating temperature 90°C	12 l/h	51 l/h	42 l/h	120 l/h

	EDP60	EDP120	EDP200	EDP300
Maximum water consumption †				
Pump operating temperature 131°F	158.5 gal/h	158.5 gal/h	158.5 gal/h	190 gal/h
Pump operating temperature 149°F	79 gal/h	47.5 gal/h	63.5 gal/h	63.5 gal/h
Pump operating temperature 194°F	8 gal/h	13.5 gal/h	14 gal/h	32 gal/h

	EDPS60	EDPS120	EDPS200	EDPS300
Maximum water consumption †				
Pump operating temperature 131°F	158.5 gal/h	158.5 gal/h	158.5 gal/h	190 gal/h
Pump operating temperature 149°F	79 gal/h	47.5 gal/h	63.5 gal/h	63.5 gal/h
Pump operating temperature 194°F	8 gal/h	13.5 gal/h	14 gal/h	32 gal/h

* Both 1150mbar and 1300mbar pumps.

‡ With a cooling-water supply temperature of 20°C and an ambient temperature of 20°C.

† With a cooling-water supply temperature of 68°C and an ambient temperature of 68°C.

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BOC EDWARDS STAFF

If you change this manual, you may also have to change A705-51-880.


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1 INTRODUCTION

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the BOC Edwards Drystar EDP60, EDP120, EDP200 and EDP300 Chemical Dry Vacuum Pumps. You must use the Drystar pumps as specified in this manual.

Read this manual before you install and operate your pump. Important safety information is highlighted as **WARNING** and **CAUTION** instructions; you must obey these instructions. The use of **WARNINGS** and **CAUTIONS** is defined below.

	<p style="text-align: center;">WARNING</p> <p>Warnings are given where failure to observe the instruction could result in injury or death to people.</p>
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<p style="text-align: center;">CAUTION</p> <p>Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.</p>

The following IEC warning labels appear on the pump:



Warning - refer to accompanying documentation.



Warning - risk of electric shock.



Warning - hot surfaces.

1.2 The EDP pumps

Refer to Figure 1. The Drystar pumps are rugged, reliable dry vacuum 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.

1.3 Shaft-seals purge

Refer to Figure 1. The purge pipeline (17) 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 7.4.

1.4 Temperature control system

Refer to Figure 1. 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 (21). 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 (19). 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.

(Continued on page 2)

The cooling-water supply passes through a filter (Figure 6, item 10) and then through a pipeline to the heat exchanger (21). A flow indicator (Figure 6, 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 (18) 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.

1.5 Pressure relief valve (EDP200 and EDP300 only)

Refer to Figure 1. The EDP200 and EDP300 pumps have a pressure relief valve (26) fitted in a pipe between the pump-outlet and the last stage of the pump. The valve is normally held closed by its own weight, 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. 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. 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.

1.6 Drive operation

Note: *The torque limiter only provides protection for the pumping mechanism.*

1.6.1 Introduction

The EDP200 and EDP300 pumps have a torque limiter. The basic EDP60 and EDP120 pumps have a drive coupling, however you can order these pumps to be supplied with a torque limiter fitted (refer to Section 1.10). Refer to Section 1.6.2 for a description of the drive coupling operation, and refer to Section 1.6.3 for a description of the torque limiter operation.

1.6.2 Drive coupling operation

The basic EDP60 and EDP120 pumps have a flexible drive coupling which transmits the drive from the pump-motor to the pump rotors.

Refer to Figure 20. A coupling hub (16) is fitted to the pump shaft (17) and a drive hub (5) is fitted to the motor shaft (7). Flexible drive coupling bushes (18) fit in the coupling hub and engage in the drive dogs (4) on the drive hub.

1.6.3 Torque limiter operation

CAUTION

If you continue to operate the pump-motor when the torque limiter has tripped and the pump-motor is decoupled from the pump, you may cause excessive wear to the torque limiter.

Refer to Figure 1. 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 trips. When the torque limiter trips, it decouples the pump-motor from the pump, and the pump-motor no longer drives the pump rotors. This prevents damage to the pumping mechanism.

When the torque limiter trips, the pump-motor will continue to operate, however there will be a significant fall in the electrical current consumed by the pump-motor. We recommend that:

- Your control equipment should monitor the current consumed by the pump-motor, in order to determine when the torque limiter has tripped.
- When the torque limiter has tripped, your control equipment should switch off the pump-motor; operation in the decoupled state may cause excessive wear to the torque limiter.

The torque limiter is enclosed in the coupling housing which has two removable coupling cover guards (14). You can remove these covers to reset the torque limiter and recouple the pump-motor to the pump (refer to Section 4.4).

The coupling hub and flexible drive coupling bushes used in the torque limiter (see Figure 19) are identical to those used in the EDP60 and EDP120 drive coupling.

1.7 Pump frame

Refer to Figure 1. The pump is vertically mounted in a robust frame (6), which has lifting-bolts (5). The frame on EDP200 and EDP300 pumps has 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.

1.8 Explosion-proof and standard versions of the pump

European certification

The pumps are 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:

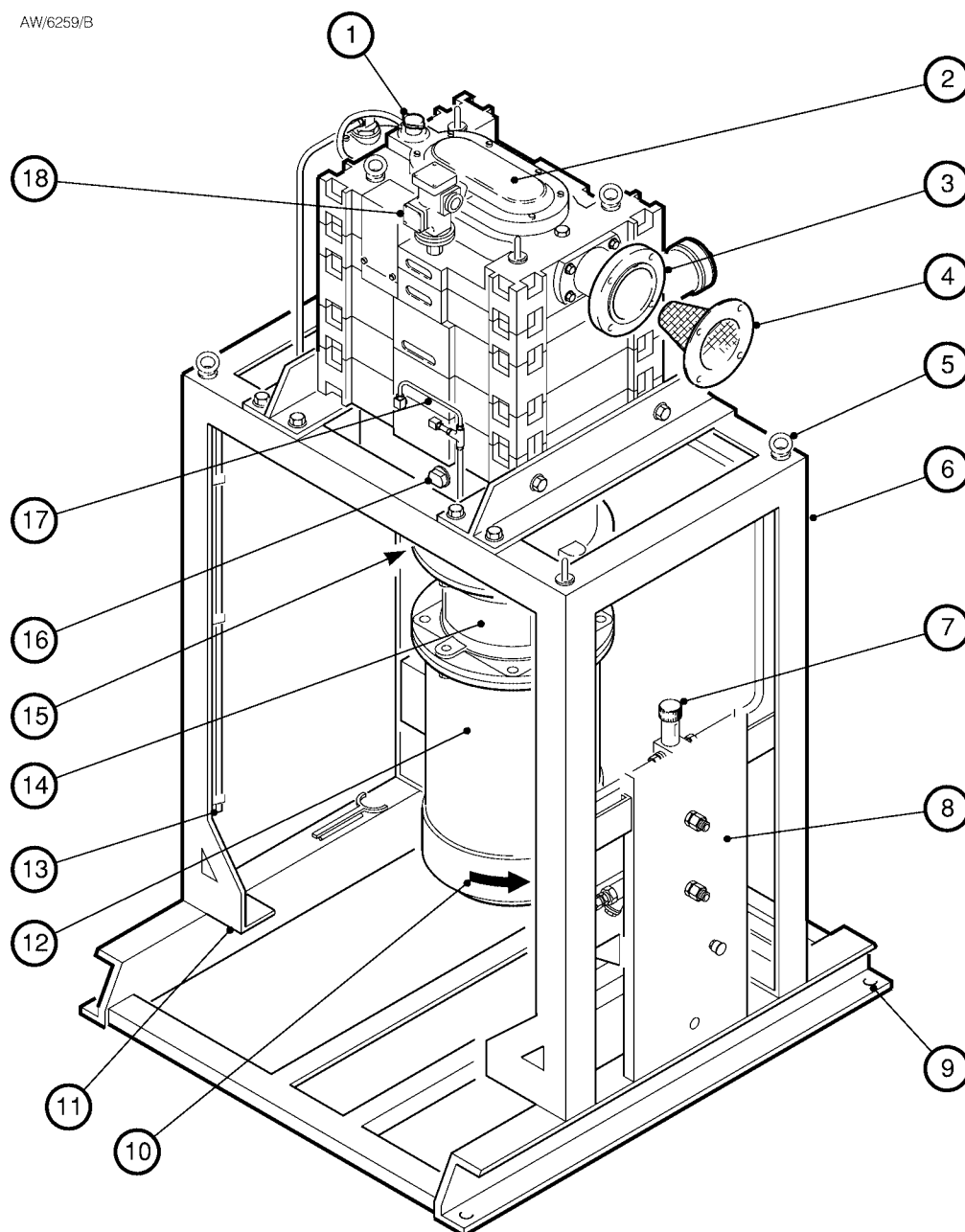
- Ambient temperature ≤ 77 °F.
- Pump outlet pressure ≤ 2.2 psig.
- Cooling-water supply temperature ≤ 68 °F.
- Cooling-water flow ≥ 158 US gallons h⁻¹.

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.

(Continued on page 6)

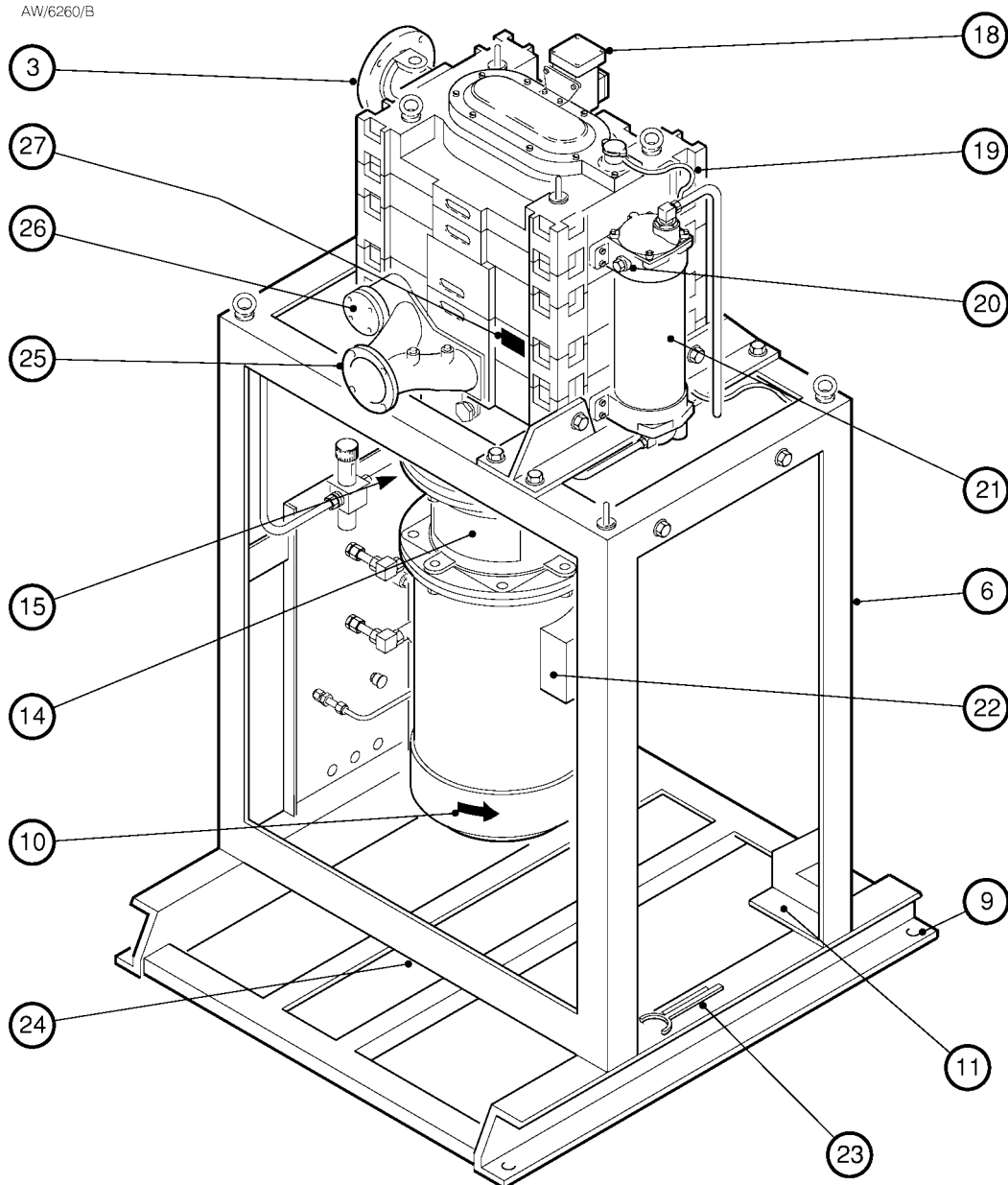
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- | | |
|-------------------------------------|---|
| 1. Coolant filler cap | 9. Fixing hole |
| 2. Bearing cover | 10. Direction of rotation arrow |
| 3. Pump-inlet | 11. Frame lower cross member (EDP200/EDP300 only) |
| 4. Inlet filter (in pump-inlet) | 12. Pump-motor |
| 5. Lifting bolt | 13. End of coolant overflow pipe |
| 6. Frame | 14. Coupling cover guard |
| 7. TCV (thermostatic control-valve) | 15. Oil-level sight-glass (behind frame) |
| 8. Services panel | 16. Oil filler-plug |

Figure 1 - The EDP pump: sheet 1 of 2

AW/6260/B



- | | |
|--|---|
| 17. Shaft-seals purge pipeline | 23. Torque limiter reset tool * and steel rod * |
| 18. Coolant jacket thermal snap-switch | 24. Frame lower cross members |
| 19. Coolant overflow pipe | 25. Pump-outlet |
| 20. Bleed plug (EDP60/EDP120 only) | 26. Pressure relief valve (EDP200/EDP300 only) |
| 21. Heat exchanger | 27. Pump case temperature measurement point |
| 22. Pump-motor terminal-box | |

* Pumps with a torque limiter only

Figure 1 - The EDP pump: sheet 2 of 2

US equivalents for pump certification

The approximate US equivalents for the 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.

1.9 Accessories

A number of accessories are available for the Drystar pumps; use these to configure the pump for specific applications. These accessories are listed in Section 7.4.

1.10 Ordering option

The basic EDP60 and EDP120 pumps are supplied with a drive coupling (see Section 1.6.2). If required, you can order these pumps to be supplied with a torque limiter fitted; refer to Section 1.6.3 for a description of the torque limiter operation.

2 TECHNICAL DATA

2.1 Operating and storage conditions

Ambient operating temperature range	40 to 105 °F
Maximum ambient operating humidity	90% RH
Maximum operating altitude	3281 ft (1000 m)
Environment	External, industrial location
Warm-up time *	45 min
Cool-down time †	3 h

* To a pump operating temperature of 131 °F.

† To a safe temperature for maintenance.

Table 1 - Operating and storage conditions

2.2 Performance

	EDP60	EDP120	EDP200	EDP300
Maximum pumping speed: cfm	60	119	177	250
Displacement (swept volume): cfm	96	140	223	350
Ultimate vacuum: torr	0.25	0.25	0.15	0.15
Maximum outlet pressure: psig	4.4	4.4	4.4	2.2

Table 2 - Performance data

2.3 Mechanical data

Dimensions	See Figure 2			
	EDP60	EDP120	EDP200	EDP300
Mass: lb	1540	1760	1820	1920
Coolant capacity: US gal	3.3	4.0	4.2	4.6
Cleaning solution required to flood the pump cavities (see Section 5.11): US gal	1.3	1.8	2.2	2.5

Table 3 - Mechanical data

2.4 Electrical data

	EDP60	EDP120	EDP200	EDP300
Nominal electrical supply frequency: Hz	60	60	60	60
Voltage tolerance	± 6%	± 6%	± 6%	± 6%
Full load and no-load current ratings	Refer to the motor rating label			
Typical pump rotational speed: r min ⁻¹	3580	3580	3580	3580
Pump motor rating: h.p.	7.5	15	20	30

Table 4 - Electrical data

2.5 Shaft-seals purge nitrogen supply

Supply pressure	29 to 147 psig
Regulated pressure to shaft-seals *	5 to 7 psig

* Above exhaust back-pressure.

Table 5 - Shaft-seals purge nitrogen supply data

2.6 Temperature control system

Water cooling system	Indirect water-to-coolant heat exchanger
Type	See Table 3
Coolant capacity	
TCV (Thermostatic Control valve)	
Sensor operating temperature range	50 to 175 °F
Maximum sensor temperature	265 °F
Thermal snap-switch	
Operating temperature range	120 to 212 °F adjustable
Contact rating	
Maximum voltage	240 V
Maximum current (inductive load)	5 A (inductive), 12 A (resistive)

Table 6 - Temperature control system data

2.7 Cooling-water data

Supply temperature range (see Section 1.8)	40 to 95 °F			
Maximum supply pressure	145 psig			
Minimum required pressure differential across supply and return	30 psig			
	EDP60	EDP120	EDP200	EDP300
Typical heat removed from pump by cooling-water	10239 btu h ⁻¹	13652 btu h ⁻¹	17100 btu h ⁻¹	17100 btu h ⁻¹
Maximum water consumption *				
Pump operating temperature 131 °F	40 US gal h ⁻¹	72 US gal h ⁻¹	72 US gal h ⁻¹	74 US gal h ⁻¹
Pump operating temperature 149 °F	31 US gal h ⁻¹	56 US gal h ⁻¹	56 US gal h ⁻¹	65 US gal h ⁻¹
Pump operating temperature 194 °F	11 US gal h ⁻¹	15.8 US gal h ⁻¹	9.5 US gal h ⁻¹	11 US gal h ⁻¹

* With a cooling-water supply temperature of 68 °F and an ambient temperature of 68 °F.

Table 7 - Cooling-water data

2.8 Coolant type

The pump is supplied filled with BOC Edwards coolant which is monopropylene based, and is both an antifreeze and a corrosion inhibitor. Spare BOC Edwards coolant is available: refer to Section 7.3. 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 8 may be suitable for use in the EDP 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 BOC Edwards coolant; BOC 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 8 - Possible alternative coolants

2.9 Lubrication data

Note: BOC Edwards Material Safety Data Sheets for some of the oils and greases specified below are available on request

Gearbox Oil capacity: minimum Oil capacity: maximum Recommended oil (supplied)	0.89 US gal 1.02 US gal Mobil SHC 629
High vacuum bearings Grease type Recommended grease	Perfluoropolyether Fomblin RT15

Table 9 - Lubrication data

2.10 Noise data

	EDP60	EDP120	EDP200	EDP300
Typical continuous A-weighted sound pressure level	73 dB(A) *	78 dB(A) *	79 dB(A)	82 dB(A)

* Tested in accordance with Pneurop PN8NTC2.

Table 10 - Noise data

2.11 Connections

Pump-inlet connection EDP60 EDP120, EDP200, EDP300	2 inch ANSI 150 lbf raised face flange 3 inch ANSI 150 lbf raised face flange
Pump-outlet connection EDP60, EDP120 EDP200, EDP300	1.5 inch ANSI 150 lbf raised face flange 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
Shaft-seals purge nitrogen inlet	1/4 inch compression fitting
Cooling-water supply Inlet Outlet	1/2 inch NPT female 1/2 inch NPT female
Middle-stage and gas-ballast purge port fittings type EDP60 EDP120, EDP200, EDP300	1/4 inch BSP 1/2 inch BSP

Table 11 - Connections data

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

Explosion-proof pumps

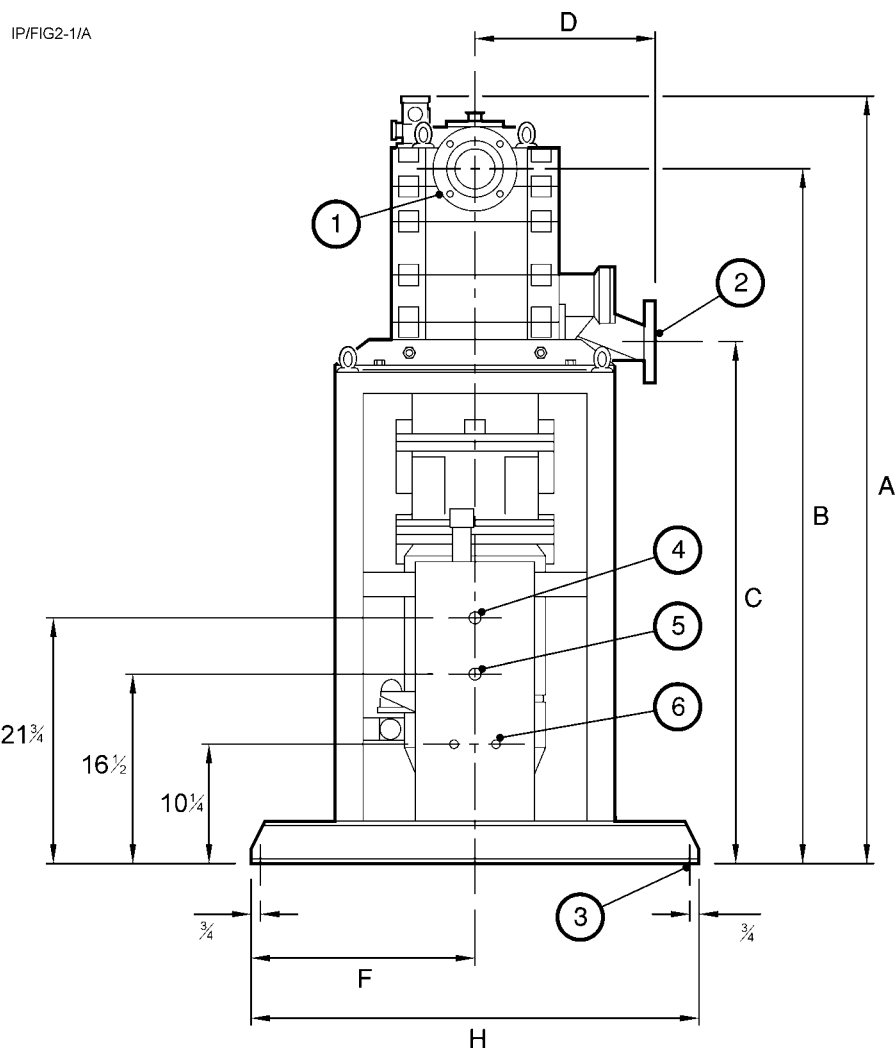
Hazardous Area	Division 1 and Division 2
Gas Group	Class I, Group C and D
Temperature classification	T3 (200 °C/392 °F)

Standard pumps

Safe Area designation only

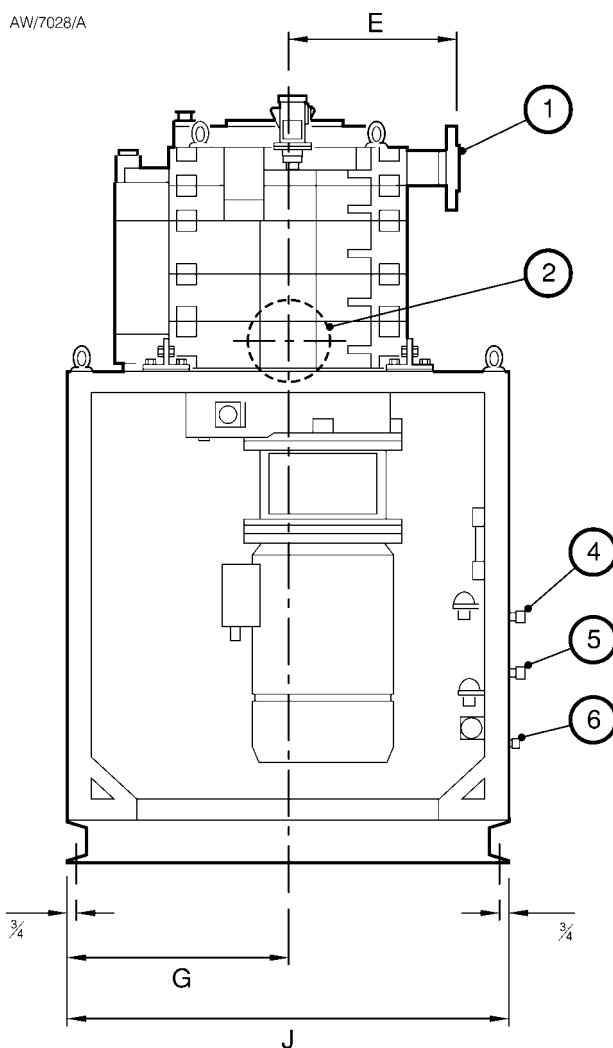
2.13 Materials of construction

Component	Materials
Stator Rotor Heat exchanger housing	BS2789, GR420/12, 420 N mm ⁻² , 12% ELONG
Shafts Gears	EN24T/BS 970 Pt. 1 1991 Grade 817M40T
Bearing housing Shaft sleeves Throwers Valve body Valve seat Valve pad	BS 970 Pt. 1 1991 Grade 416S21
Seal sleeves	BS 970 Pt. 1 1991 Grade 431S29
Shims	Stainless steel 302S25
Piston rings	EN 8/BS 970 Pt. 1 1991 Grade 080M40
Lip seals	Stainless steel 316/PTFE
Case 'O' rings	Viton
Valve 'O' ring	FEP coated Viton
Heat exchanger end caps	BS 1452 Grade 260
Heat exchanger tube stack	Cupro-nickel: 90% copper, 10% nickel
Heat exchanger tubestack baffles and end plates	Brass



1. Pump-inlet
2. Pump-outlet
3. Fixing hole: Ø0.7 inch (4 off)
4. Cooling-water outlet connection
5. Cooling-water inlet connection
6. Nitrogen supply inlet connection

Figure 2 - EDP pump dimensions: inches (sheet 1 of 2)




Key	EDP60	EDP120	EDP200	EDP300
A	62 ¹ / ₂	63 ³ / ₄	66 ¹ / ₄	67 ³ / ₄
B	55 ³ / ₄	57 ¹ / ₄	59 ¹ / ₂	61
C	44 ⁷ / ₈	44 ⁷ / ₈	45 ¹ / ₄	45 ¹ / ₄
D	13 ⁷ / ₈	13 ⁷ / ₈	14 ³ / ₄	14 ³ / ₄
E	17 ¹ / ₂	17 ⁵ / ₈	14 ¹ / ₄	14 ¹ / ₄
F	15 ¹ / ₄	15 ¹ / ₄	18 ³ / ₄	18 ³ / ₄
G	13 ³ / ₄	13 ³ / ₄	18 ³ / ₄	18 ³ / ₄
H	27 ¹ / ₂	27 ¹ / ₂	39 ¹ / ₄	39 ¹ / ₄
J	33 ¹ / ₂	33 ¹ / ₂	37 ¹ / ₂	37 ¹ / ₂

Figure 2 - EDP pump dimensions: inches (sheet 2 of 2)

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3 INSTALLATION


3.1 Safety

	<p style="text-align: center;">WARNING</p> <p>Obey the safety instructions listed below and take note of appropriate precautions. If you do not, you can cause injury to people and damage to equipment.</p>
---	---

- A suitably trained and supervised technician must install your EDP 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.
- Leak test the system after installation and seal any leaks found, to prevent leakage of hazardous substances out of the system and leakage of air into the system.
- If you will pump substances that may attack or react with the materials of construction of the pump (see Section 2.13), there may be a risk of a leak, or of contamination of the pump oil, or of a loss of pump performance. If you are in any doubt, consult BOC Edwards for advice.

- Consult BOC Edwards Publication P400-40-100 (Vacuum pump and vacuum system safety - chemical and industrial systems) before you install and use the EDP pump to process hazardous or flammable materials.

3.2 Unpack and inspect

	<p style="text-align: center;">WARNING</p> <p>Use suitable lifting equipment to move the pump. If you do not, you can injure yourself or damage the pump. Refer to Section 2.3 for the mass of the pump.</p>
---	---

1. Use a fork-lift truck or a pallet truck to place the pallet in a convenient position.
2. Remove the packing material from around the pump.
3. Remove small items 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 12. 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 6.1.


Drystar EDP Chemical Dry Vacuum Pumps

Quantity	Description	Check (✓)
1	EDP pump	<input type="checkbox"/>
1	Torque limiter reset tool *	<input type="checkbox"/>
1	Steel rod *	<input type="checkbox"/>
1	Fittings kit	<input type="checkbox"/>

* Pumps with a torque limiter only.


Table 12 - Checklist of items

3.3 Locate the pump




WARNING

Use suitable lifting equipment to move the pump. If you do not, you can injure yourself or damage the pump. Refer to Section 2.3 for the mass of the pump.



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.



WARNING

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

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

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).
- On EDP200 and EDP300 pumps, use a fork-lift or pallet truck through the frame lower cross members (Figure 1, items 11 and 24).

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 the coolant level

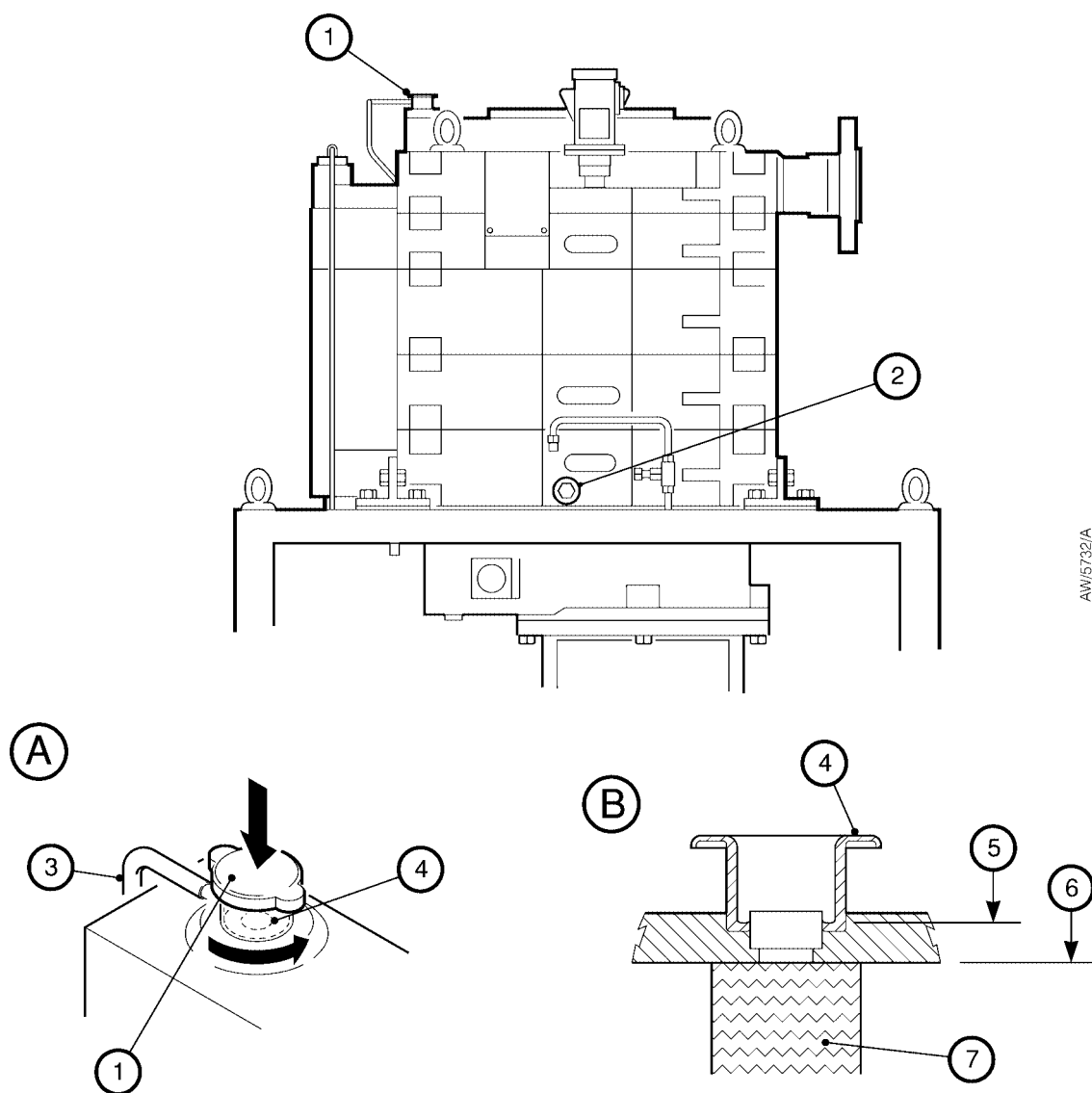
CAUTION

Ensure that you correctly fill the EDP60 and EDP120 pumps with coolant, as described below. If you do not, an air-lock may develop in the cooling-jacket and the pump may overheat.

Note: BOC Edwards coolant is available as a spare: refer to Section 7.3.

1. Refer to Figure 3, detail A. Press down the coolant filler-cap (1), turn it anticlockwise and remove it from the pump.
2. Refer to Figure 3, detail A. 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 10.
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, shake the container to fully mix the water and coolant, then remove the cap.
6. For EDP200 or EDP300 pumps continue at Step 9, otherwise continue at Step 7.

(Continued on page 18)



AW/5732/A

- 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

7. Refer to Figure 1. Remove the bleed plug (20) from the heat exchanger of the EDP60 or EDP120 pump.
8. Refer to Figure 3. Pour the coolant mix into the pump through the filler-tube (4) until coolant leaks from the bleed-port in the heat exchanger, then apply a suitable thread sealant to the threads of the bleed plug (Figure 1, item 20) and refit the bleed plug. If necessary repeat Steps 4 to 8 to mix and add more coolant when you pour the coolant mix into the pump.
9. Refer to Figure 3. 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 9 to mix and add more coolant.
10. 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 11, 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 5 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.

We recommend that you connect the electrical supply to the pump through a suitable current monitor.

On pumps without a torque limiter, we recommend that you configure the high current setting on the current monitor to switch off the pump-motor at a suitable overload current. This overload current must not exceed the maximum current rating shown on the rating plate on the pump-motor.

On pumps with a torque limiter, we recommend that you use one of the following methods to switch off the electrical supply to the pump-motor when the torque limiter trips:

- Configure the low current setting on your current monitor to switch off the electrical supply at a current consumption consistent with the no-load current of the pump-motor.
- Fit a rotation sensor to the coupling housing, and connect the sensor to your control equipment, which must be configured to switch off the electrical supply when the rotation sensor indicates that the torque limiter has tripped.

On pumps with a torque limiter, 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 tripped: refer to Section 4.

Earth (ground) studs are available on the pump (refer to Figure 5). If required, you can connect suitable earthing (grounding) strips to these earth (ground) studs to provide additional earthing (grounding) protection.

3.6.2 Connect the electrical supply to the pump-motor

	<p style="text-align: center;">WARNING</p> <p>On explosion-proof pumps, you must use a suitable explosion-proof cable gland to connect the electrical supply to the pump-motor. If you do not, the installation will not be explosion-proof.</p>
---	---

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 motor protection circuit-breaker which meets the full load current shown on the motor rating label.

Use a suitably rated six-core cable (three phase wires, earth (ground) wire and two control wires) to connect the electrical supply and your control equipment to the pump-motor, as described in the motor instruction manual supplied with the pump.

3.6.3 Connect the thermal snap-switch

	<p style="text-align: center;">WARNING</p> <p>Obey the safety instructions given below. If you do not, the installation may not be safe, and there may be a risk of fire or explosion and injury to people.</p>
---	--

- 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.
- 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.
- On explosion-proof pumps, you must use a suitable $\frac{1}{2}$ inch NPT cable gland to connect to the thermal snap-switch. If you do not, the installation will not be explosion-proof.
- Do not connect the thermal snap-switch into an intrinsically safe circuit if the snap-switch has been previously connected in any other type of circuit. If you do, the contacts in the snap-switch may have been damaged, and the circuit may not be safe.

(Continued on page 20)

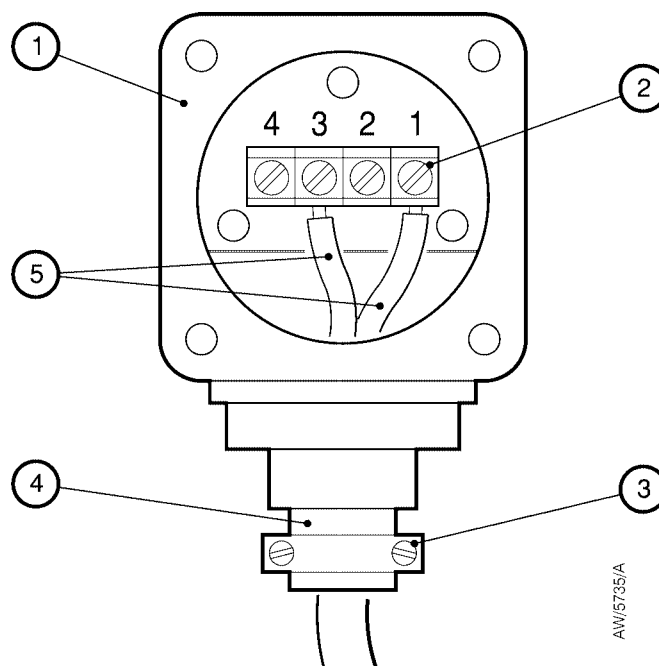
You **must** connect the thermal snap-switch to the electrical-overload control-loop of your contactor, so that the contactor will automatically switch off the pump if it is too hot: refer to Figure 5.

The thermal snap-switch will reset (that is, close again) when the pump cools down to a preset temperature (see Section 2.6). 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.

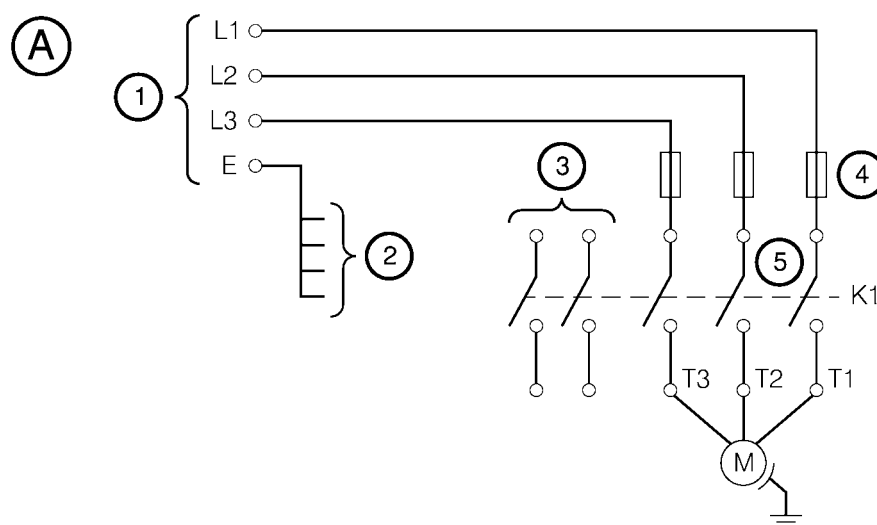
1. Remove the four bolts which secure the cover to the top of the thermal snap-switch (Figure 1, item 18), then remove the cover.
2. Pass a suitably rated two-core cable through the cable-gland.
3. Refer to Figure 4. Connect one wire of the cable to terminal 1 on the terminal block (2). Connect the other 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.



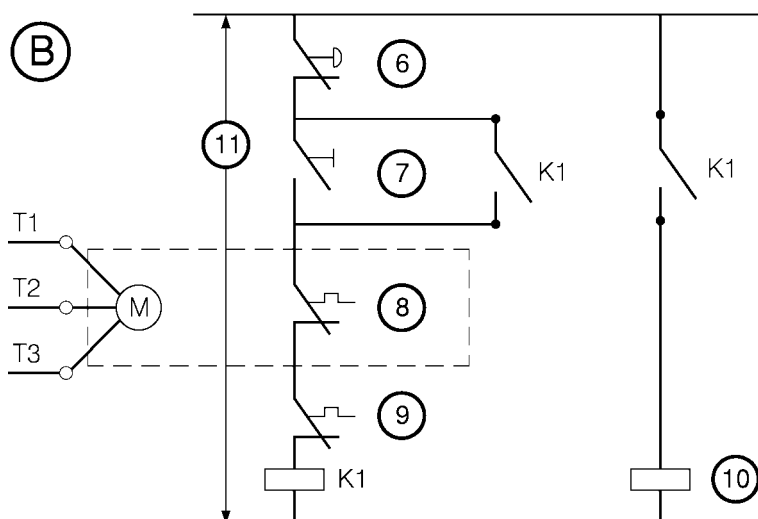
1. Thermal snap-switch (with cover removed)
2. Terminal block
3. Strain-relief screws (not supplied)
4. Cable gland (not supplied)
5. Wires

Figure 4 - Connect the thermal snap-switch

Drystar EDP Chemical Dry Vacuum Pumps



AW/5834/A



A Pump-motor connections


B Control circuit

1. To your electrical supply
2. Earth (ground) 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. Contactor

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


Figure 5 - Schematic diagram of the recommended electrical connections

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

When you check the direction of rotation with the coupling cover guard removed, take suitable precautions to prevent injury from the exposed rotating mechanisms.



WARNING

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

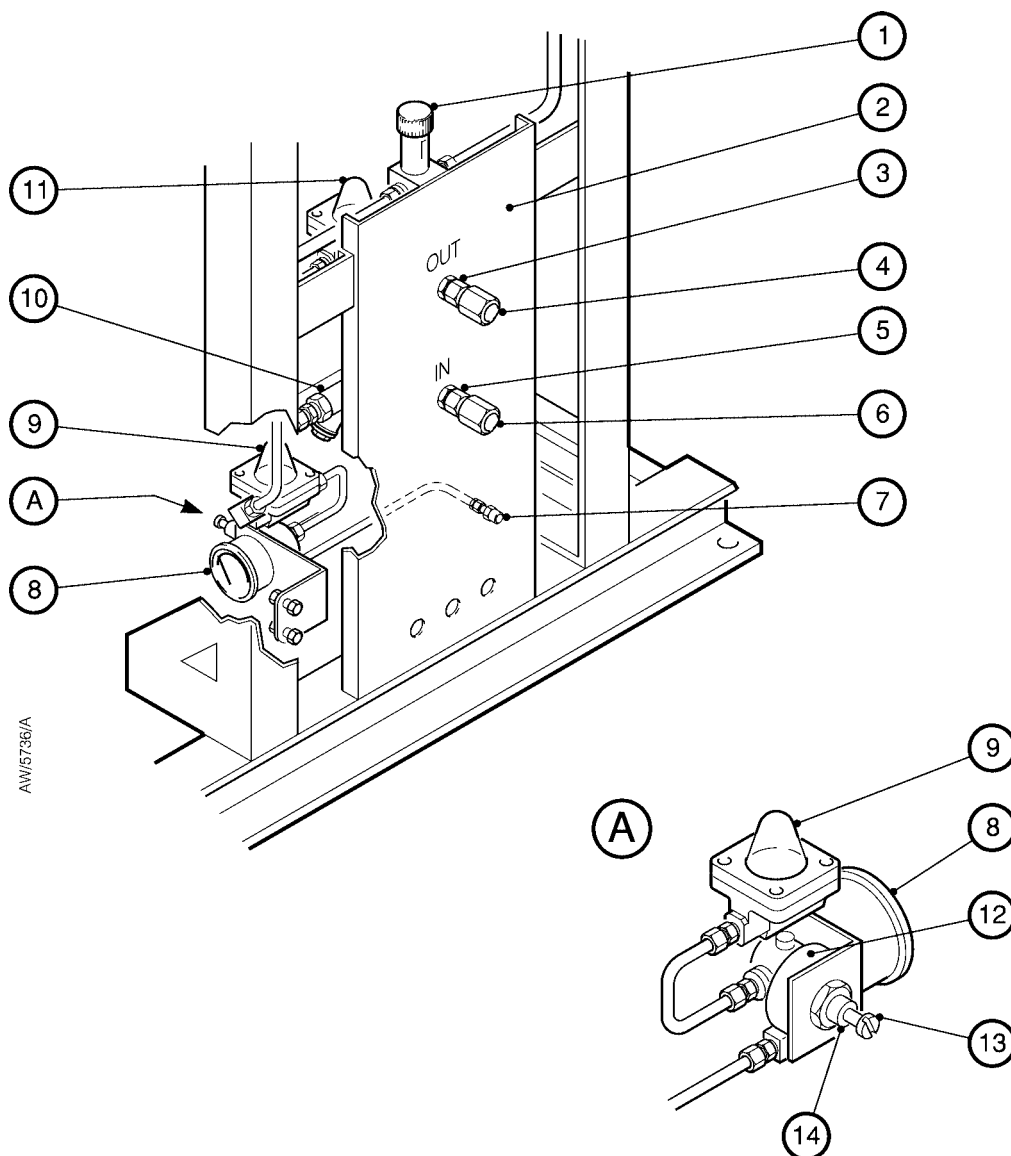
1. Refer to Figure 1. Remove the push-on blanking-caps fitted to the pump-inlet (3) and pump-outlet (25).
2. Remove the four bolts which secure the coupling cover guard (14) to the coupling cover (on the opposite side of the pump from the pump-outlet) and remove the coupling cover guard.
3. On pumps with a torque limiter watch the torque limiter plates (Figure 10, items 2, 3, 6), and on other pumps watch the coupling hub (Figure 20, item 16), and switch on the pump for one or two seconds, then switch the pump off. Take suitable precautions to prevent injury from the rotating torque limiter/coupling hub when you operate the pump with the coupling cover guard removed.

4. If the torque limiter plates or coupling hub 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 the motor instruction manual.
 - Repeat Steps 3 and 4 to ensure that the direction of rotation is now correct.
5. Refit the coupling cover guard (Figure 1, item 14) and secure with the four bolts. Tighten the bolts to a torque between 2.2 and 3.6 lbf ft (3 and 5 N m).

3.8 Connect the cooling-water supply

Refer to Figure 6 and connect the cooling-water supply as described below. If you need to connect more than one EDP 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.




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 6 - Services panel

3.9 Connect the shaft-seals purge nitrogen supply

	<p>WARNING</p> <p>Your nitrogen supply pressure must comply with the requirements of Section 2.5. If it does not, the shaft-seals purge pipelines may become over-pressurised and may explode.</p>
---	---

Use a rigid metal (such as stainless steel) pipeline with an outside diameter of $\frac{1}{4}$ 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 pipeline, 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 6 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).


3.10 Connect the pump-inlet and outlet

	<p>WARNING</p> <p>Obey the safety instructions given below. If you do not, the installation may not be safe, and there may be a risk of injury or death to people.</p>
---	---

- 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.

- 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.
- 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.
- Fit BOC 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-inlet to your process system

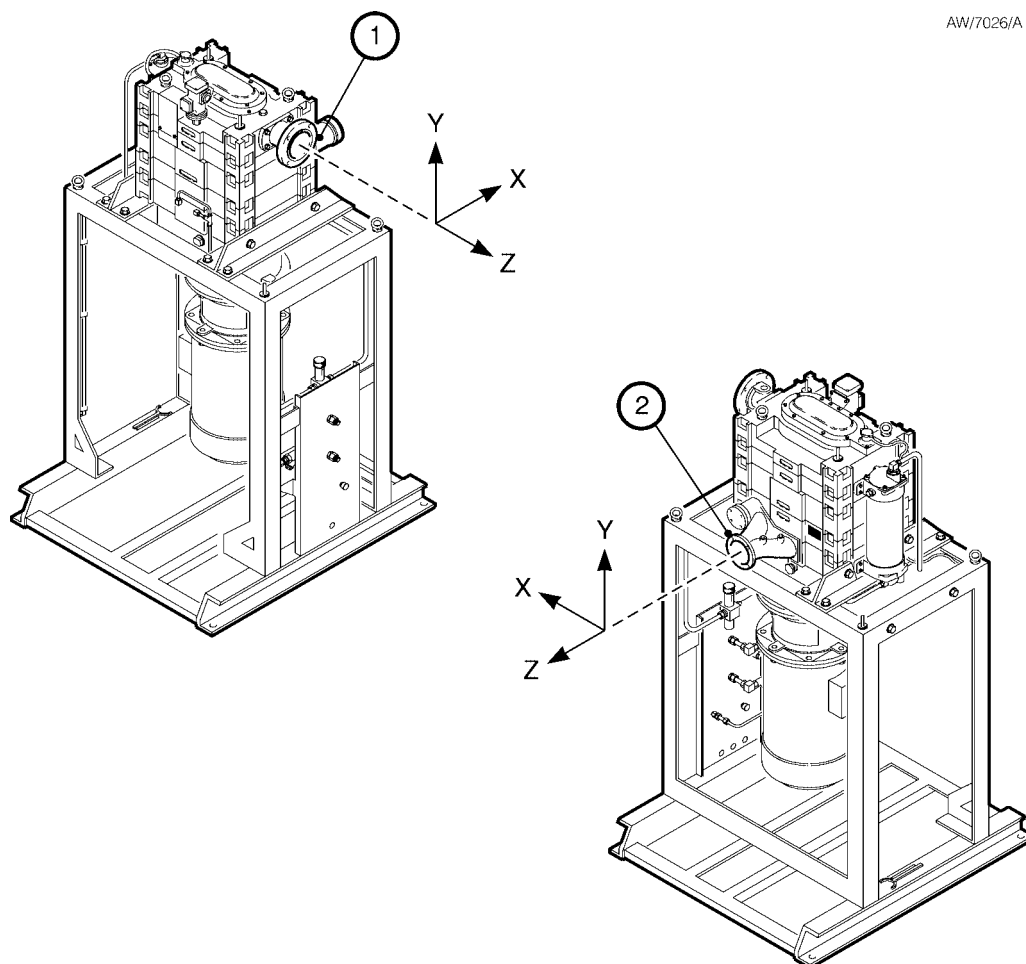
	<p>WARNING</p> <p>Do not exceed the load limits on the pump-inlet flange as specified in Figure 7. If you do, there will be a risk of leakage of process gases from the pump, or of damage to the pump.</p>
--	--

Note: Flame arrestors suitable for use with the pump are available as accessories: refer to Section 7.4.

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.
- Ensure that the loads on the pump-inlet flange do not exceed the limits specified in Figure 7.

(Continued on page 26)



1. Pump-inlet
2. Pump-outlet

F Force
M Moment
R Resultant
X Load orientation
Y Load orientation
Z Load orientation

Maximum force		Pump-inlet		Pump-outlet	
FX		±530 N	±120 lbf	±357 N	± 80 lbf
FY		±446 N	±100 lbf	±290 N	± 65 lbf
FZ		±669 N	±150 lbf	±446 N	±100 lbf
FR		±959 N	±215 lbf	±647 N	±145 lbf
Maximum moment		Pump-inlet		Pump-outlet	
MX		±476 Nm	±350 lbf ft	231 Nm	±170 lbf ft
MY		±360 Nm	±265 lbf ft	177 Nm	±130 lbf ft
MZ		±238 Nm	±175 lbf ft	115 Nm	± 85 lbf ft
MR		±645 Nm	±475 lbf ft	313 Nm	±230 lbf ft

Figure 7 - Flange loading limits

- 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 5.5.
 - 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 2.11.

3.10.2 Connect the pump-outlet to your exhaust system



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.



WARNING

Do not exceed the load limits on the pump-outlet flange as specified in Figure 7. If you do, there will be a risk of leakage of process gases from the pump, or of damage to the pump.

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.

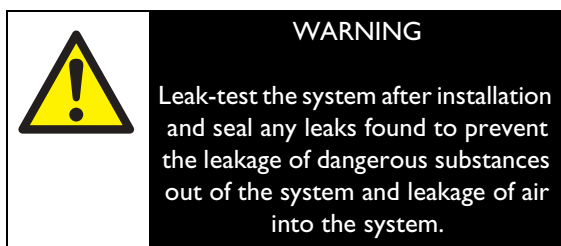
Note: Flame arrestors suitable for use with the pump are available as accessories: refer to Section 7.4.

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 2.11.

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



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 ft³ 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 (27). The thermal snap-switch is adjusted to open when the pump operating temperature reaches 176 °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 by a specific amount, we recommend that you adjust the thermal snap-switch by the same amount (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.

1. Refer to Figure 8. 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.

3.12.2 Commissioning procedure

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 6. 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; refer to Table 13 for the TCV settings for a pump operating temperature of 149 °F. 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 5 and 7 psig, above the exhaust back pressure. If you need to adjust the pressure:
 - Loosen the locknut (14) on the rear of the nitrogen pressure regulator (12).
 - Turn the adjuster (13) until the required pressure is shown on the pressure gauge.
 - Tighten the locknut (14).
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 purge nitrogen supplies.

3.12.3 Adjust the TCV (thermostatic control-valve)

Notes: As supplied, the TCV is adjusted for a pump operating temperature of 149 °F (measured at the point shown in Figure 1, item 27). 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).

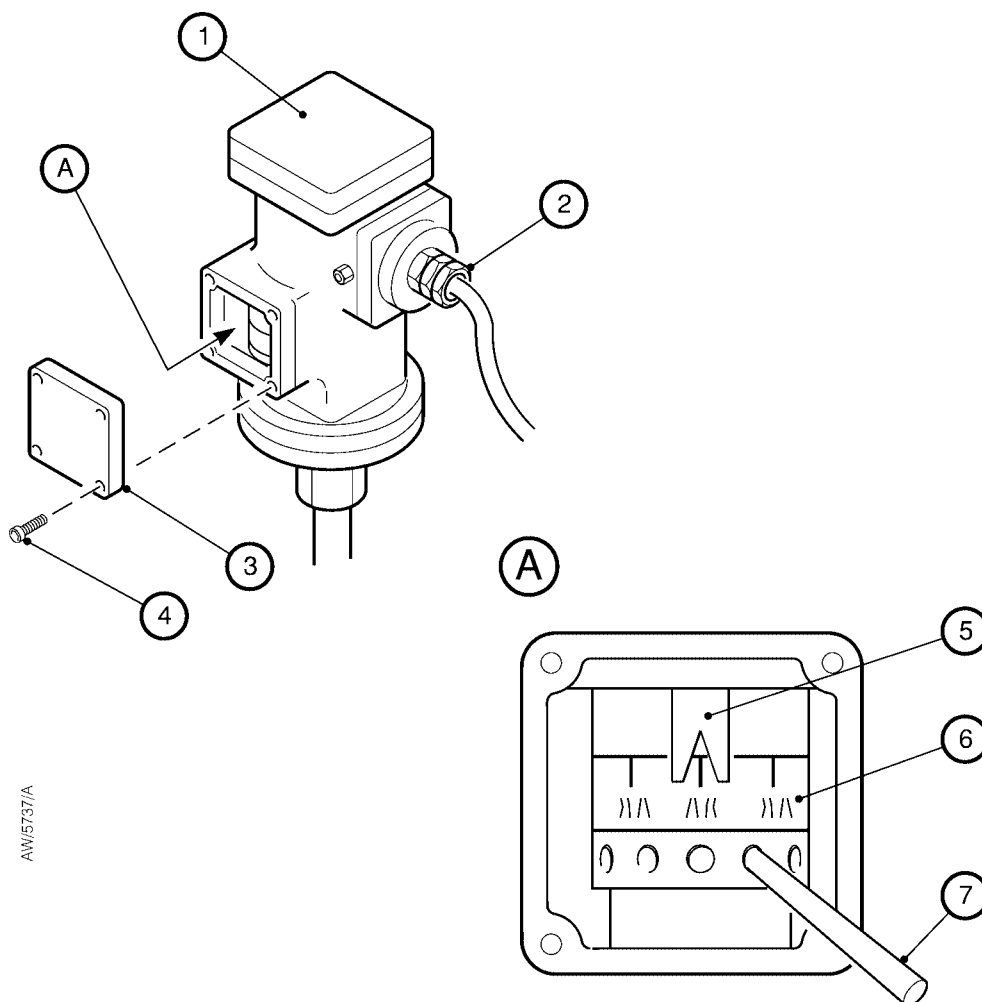
The minimum pump operating temperatures stated in Table 13 are with a cooling-water flow of 32 US gal h⁻¹ and with a cooling-water supply temperature of 68 °F.

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 the minimum and maximum pump operating temperatures shown in Table 6.

If you need to adjust the TCV to suit your operating conditions, turn the adjuster knob on the TCV (Figure 6, 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.

	EDP60	EDP120	EDP200	EDP300
Minimum pump operating temperature	140 °F	126 °F	104 °F	131 °F
Maximum pump operating temperature	194 °F	194 °F	194 °F	194 °F
TCV setting for pump operating temperature of 149 °F	4	4	4	3.5

Table 13 - TCV settings



AW/5737/A

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

Figure 8 - Adjust the thermal snap-switch

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4 OPERATION

4.1 Operational safety



WARNING

Obey the safety instructions given below. If you do not, the installation may not be safe, and there may be a risk of injury or death to people.

- 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.
- Because of the high gas temperatures in the pump, we recommend that you only pump gases in temperature classes T₁ to T₃ in normal operating conditions. Do not pump gases in temperature class T₄ unless you have contacted your supplier or BOC Edwards for advice.
- Do not operate the pump with a coupling cover guard removed. If you do, there will be a danger of injury or death from the rotating mechanisms.
- Do not operate the pump with the pump-inlet or -outlet open to atmosphere. If you do, there will be a danger of injury or death from the rotating mechanisms, from the exposure to vacuum, or from hot exhaust gases.
- If a pump with a torque limiter is located in a Division 1 hazardous area, do not let the pump-motor operate for more than 8 hours if the torque limiter has tripped and decoupled the pump-motor from the pump. If you do, the torque limiter may get very hot and there may be a risk of fire or explosion.

Note: The procedures in the following sections assume that you have a pump-inlet isolation-valve fitted to your pump.

4.2 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 following procedure 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 purge nitrogen supply is correct and adjust if necessary: refer to Section 3.12.2.
4. Switch on the pump.

4.3 Allow the pump to warm up



WARNING

During pump warm-up, coolant may drain out of the coolant overflow pipe. Take all necessary precautions if this may present a hazard.

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.

Leave the pump to operate (with the inlet isolation-valve closed) to allow the pump to warm up to its operating temperature, that is, until there is a flow of cooling-water through the heat exchanger:

- Without the inlet purge, warm-up takes approximately 30 to 45 minutes, depending on the ambient temperature.
- With an inlet purge pressure of 0.7 to 3.6 psig, warm-up time can be reduced to as little as 10 minutes.

(Continued on page 32)

Refer to Figure 6. When the pump has warmed up to its operating temperature (indicated by a flow of water in the cooling-water flow indicator, 11), you may start process pumping.

In the first 30 seconds of pumpdown, open the inlet isolation-valve slowly if there is liquid in the inlet pipeline, in order to minimize the ingress of liquid (entrained in the process gas stream) into the pump.

4.4 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.

4.5 Inspect and reset the torque limiter (pumps with a torque limiter only)



WARNING

Switch off the pump and isolate the pump from the electrical supply before you reset the torque limiter. Refit the coupling cover guard 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 trips and decouples the pump-motor from the pump, refer to Section 5.19.

4.5.1 Inspect the torque limiter

When the torque limiter has tripped and decoupled the pump-motor from the pump (see Section 1.6.3), use the following procedure to inspect the torque limiter before you reset it.

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 cover guards (Figure 1, item 14), then remove the guard.
3. Refer to Figure 9. Check the relative positions of the notches in the cage plate (2) to the openings in the slide plate (3):
 - If the notches in the cage plate are offset to the left of the openings in the slide plate, the torque limiter has tripped in the normal direction: continue at Step 4.
 - If the notches in the cage plate are offset to the right of the openings in the slide plate, the torque limiter has tripped in the reverse direction: do not continue with this procedure, but contact your supplier or BOC Edwards for advice.

4. Inspect the torque limiter. You must not continue with this procedure, but must contact your supplier or BOC Edwards (to arrange for service/replacement of the torque limiter) if:

- The rim of the slide plate (3) is cracked or broken.
- The edges of the cage plate (2) are burred.
- Any of the notches (Figure 10, item 1) in the drive plate are damaged.
- The slide plate (6) cannot be rotated freely (both clockwise and anticlockwise), or there are clicking sounds or indications of rubbing when the slide plate is rotated.
- Any of the components show signs of discolouration (due to overheating).

If the torque limiter does not have to be serviced/replaced, continue at Step 5.

5. Refer to detail B. If the pump-motor has been operated for more than 8 hours with the torque limiter tripped, check the gap (5) between the lower face of the drive plate (1) and the rim of the slide plate (3):

- If the gap (5) is 0.08 inches (2 mm) or more: continue at Section 4.4.2 to reset the torque limiter.
- If the gap (5) is less than 0.08 inches (2 mm): do not continue with this procedure, but contact your supplier or BOC Edwards (to arrange for service/replacement of the torque limiter).

4.5.2 Reset the torque limiter

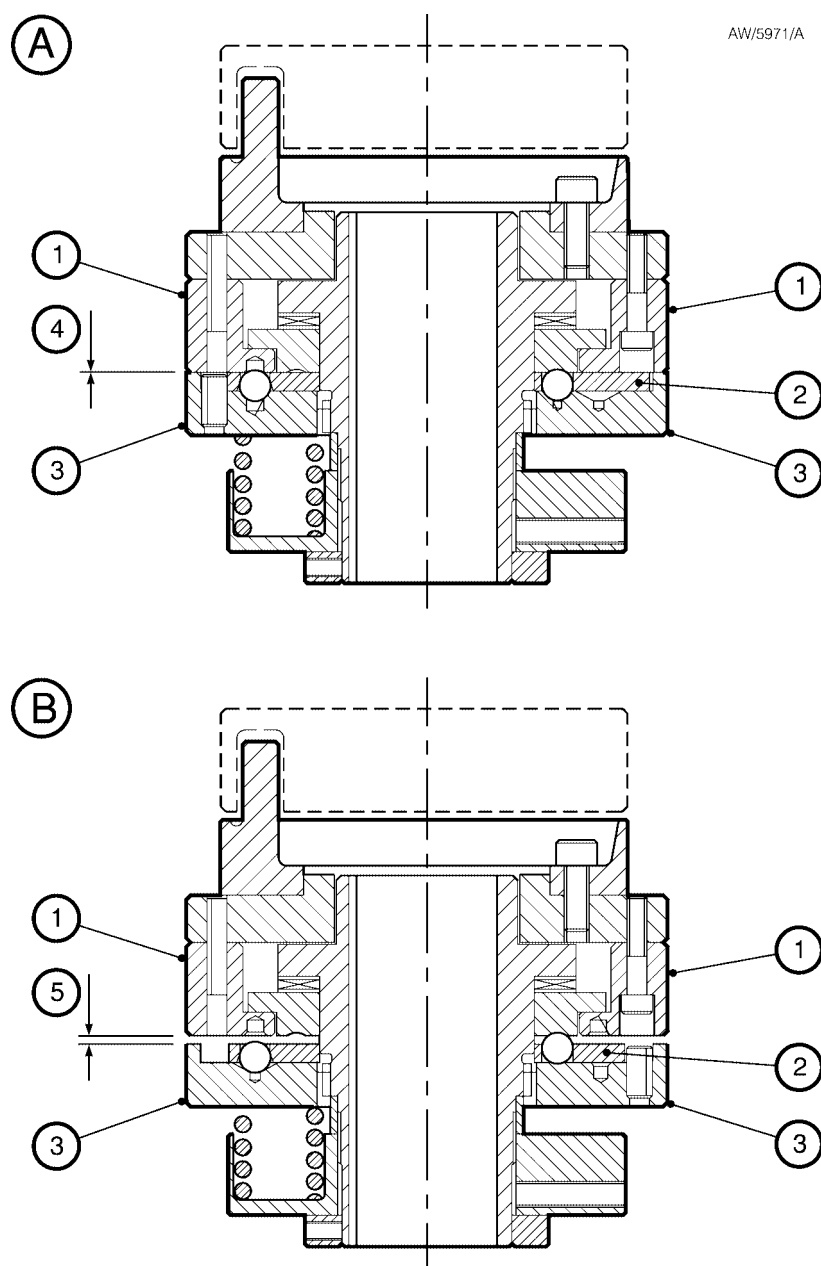
CAUTION

Only use the special tools supplied to reset the torque limiter. If you do not, you may damage the pump.

Note: A force of approximately 10% of the torque rating (that is, approximately 29.6 lbf ft, 40 N m) is required to reset the torque limiter. If you cannot easily reset the torque limiter, spray a light penetrating lubricant onto the cage plate, then try to reset the torque limiter again; if you still cannot reset the torque limiter, it may need to be serviced or replaced: contact your supplier or BOC Edwards.

1. Refer to Figure 10. Turn the drive plate (2) so that a notch (1) in the plate aligns with a notch on the cage plate (3).
2. Place the steel rod (7) in one of the holes in the thrust plate (6), then place the torque limiter reset tool (5) in the notches (1) in the drive plate (2) and cage plate (3).
3. 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 torque limiter resets and the pump-motor recouples to the pump.
4. Refer to Figure 9, detail A. Check that the torque limiter has reset correctly:
 - If the notches in the cage plate (2) are centred in the openings in the slide plate (3), continue at Step 5.
 - If the notches in the cage plate (2) are not centred in the openings in the slide plate (3), do not continue with this procedure, but contact your supplier or BOC Edwards to arrange for service/replacement of the torque limiter.

(Continued on page 36)



A Torque limiter engaged

B Torque limiter tripped (pump-
motor decoupled from the pump)

1. Drive plate

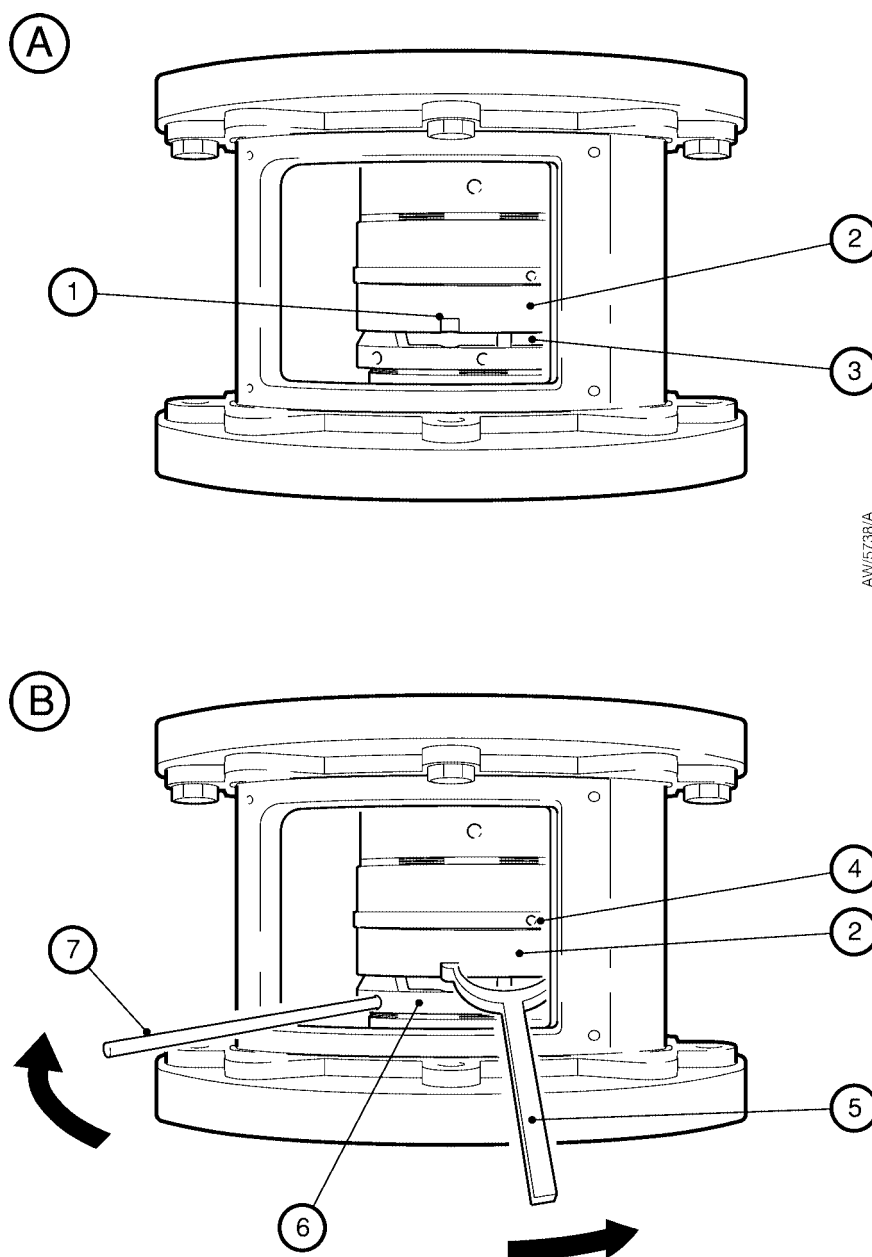
2. Cage plate

3. Slide plate

4. Gap (torque limiter engaged)

5. Gap (torque limiter tripped)

Figure 9 - Inspect the torque limiter



- 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. Slide plate
7. Steel rod

Figure 10 - Reset the torque limiter

5. Check the gap (4) between the lower face of the drive plate (1) and the rim of the slide plate (3):
 - If the gap (4) is 0.004 to 0.016 inches (0.1 to 0.4 mm): continue at Step 6.
 - If the gap (4) is > 0.016 inches (0.4 mm), this indicates that the torque limiter has not reset correctly: repeat this procedure from Step 1 to try to reset the torque limiter again. If you reset the torque limiter but the gap is still incorrect, contact your supplier or BOC Edwards to arrange for service/replacement of the torque limiter.
 - If the gap (4) is < 0.004 inches (0.1 mm): do not continue with this procedure, but contact your supplier or BOC Edwards to arrange for service/replacement of the torque limiter.
6. Refer to Figure 10. Remove the steel rod and torque limiter reset tool (7, 5), then use the four bolts to refit the coupling cover guard (Figure 1, item 14). Tighten the bolts to a torque between 2.2 and 3.6 lbf ft (3 and 5 N m).
7. Ensure that the cause of the torque limiter trip has been rectified (for example, if the pump has been flooded, ensure that the liquids have been drained from the pump), then switch on the pump.

5 MAINTENANCE

5.1 Safety

	<p>WARNING</p> <p>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.</p>
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- Ensure that the ambient atmosphere around the pump is not flammable before you start maintenance.
- 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 for at least three hours before you start maintenance work.
- Isolate the pump and other components in the process system from the electrical supply so that they cannot 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. BOC Edwards Material Safety Data Sheets for the fluorinated materials used in the pump are available on request: contact your supplier or BOC Edwards.
- Leak-test the system after maintenance 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 14 details the maintenance operations required 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 BOC 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 7.3.

Drystar EDP Chemical Dry Vacuum Pumps

Operation	Frequency	Refer to Section
Check the gearbox oil level and fill the gearbox with oil (if necessary)	Weekly	5.3
Check the shaft-seals purge supply	Weekly	5.4
Remove the inlet filter	After 1 month of operation	5.5
Inspect the pipelines and connections	3 monthly	5.6
Inspect the pressure relief valve and replace the hinge bushes, flap and 'O' rings (if necessary) *	Yearly or when necessary	5.7
Change the pump oil and clean the oil-level sight-glasses #	Yearly or when contaminated, whichever occurs first †	5.8
Relubricate/inspect the rotor bearings #	When necessary ‡	5.9
Check the coolant level and refill if necessary	Yearly	5.10
Flush the pump with cleaning solution	When necessary	5.11
Clean the cooling system #	Yearly or when necessary	5.12
Overhaul the pump Ø	3 yearly	5.13
Replace the pressure relief valve *	When necessary	5.14
Inspect the torque limiter ⌘	Yearly	5.15
Replace the pump-motor and drive coupling bushes \$	When necessary	5.16
Relubricate the motor bearings	When necessary ∞	5.17
Replace the motor bearings ⊕	When necessary	5.18

* EDP200 and EDP300 only.

You will need a Routine Maintenance Kit to do these maintenance operations.

† 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. For maximum pump reliability, we recommend that you change the gearbox oil when you relubricate the rotor bearings: refer to Table 15 in Section 5.9.

‡ The frequency of maintenance depends on the operating temperature of the pump: see Section 5.9.

Ø You must have an Upper Bearing Kit, a Lower Bearing Kit, a Swept Volume Kit and (for the EDP200 and EDP300 only) a Swing Pressure Relief Valve Overhaul Kit to overhaul the pump.

⌘ Pumps with a torque limiter only.


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

∞ Refer to Section 5.17.

⊕ You will need a Motor Bearing Kit to replace the motor bearings: see Section 7.3.

Table 14 - Maintenance plan

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


	<p style="text-align: center;">WARNING</p> <p>The gearbox may be pressurised. To remove the oil filler-plug, undo it slowly until the vent hole is visible, allow the gearbox to vent to atmosphere to reduce the pressure in the gearbox, then fully undo and remove the oil filler-plug. If you do not, hot (up to 194 °F) oil may be ejected under pressure from the gearbox and cause injury.</p>
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Note: 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 BOC Edwards for advice.

Figure 1 shows the locations of the two oil-level sight-glasses on the pump. Refer to Figure 11, 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 (3) and bonded seal (2): see Note above.
2. Fit a suitable funnel or nozzle to the oil filler-port (1), then pour oil 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).
3. If you overfill the gearbox: place a suitable container under the drain-port (6); unscrew and remove the drain-plug (4) and bonded seal (5) and allow the oil to drain from the gearbox until the oil level reaches the MAX mark on the sight-glass (see detail A), then refit and tighten the drain plug (4) and bonded seal (5).
4. Remove the funnel or nozzle from the oil filler-port (1), then refit the bonded seal (2) and oil filler-plug (3).

5.4 Check the shaft-seals purge supply

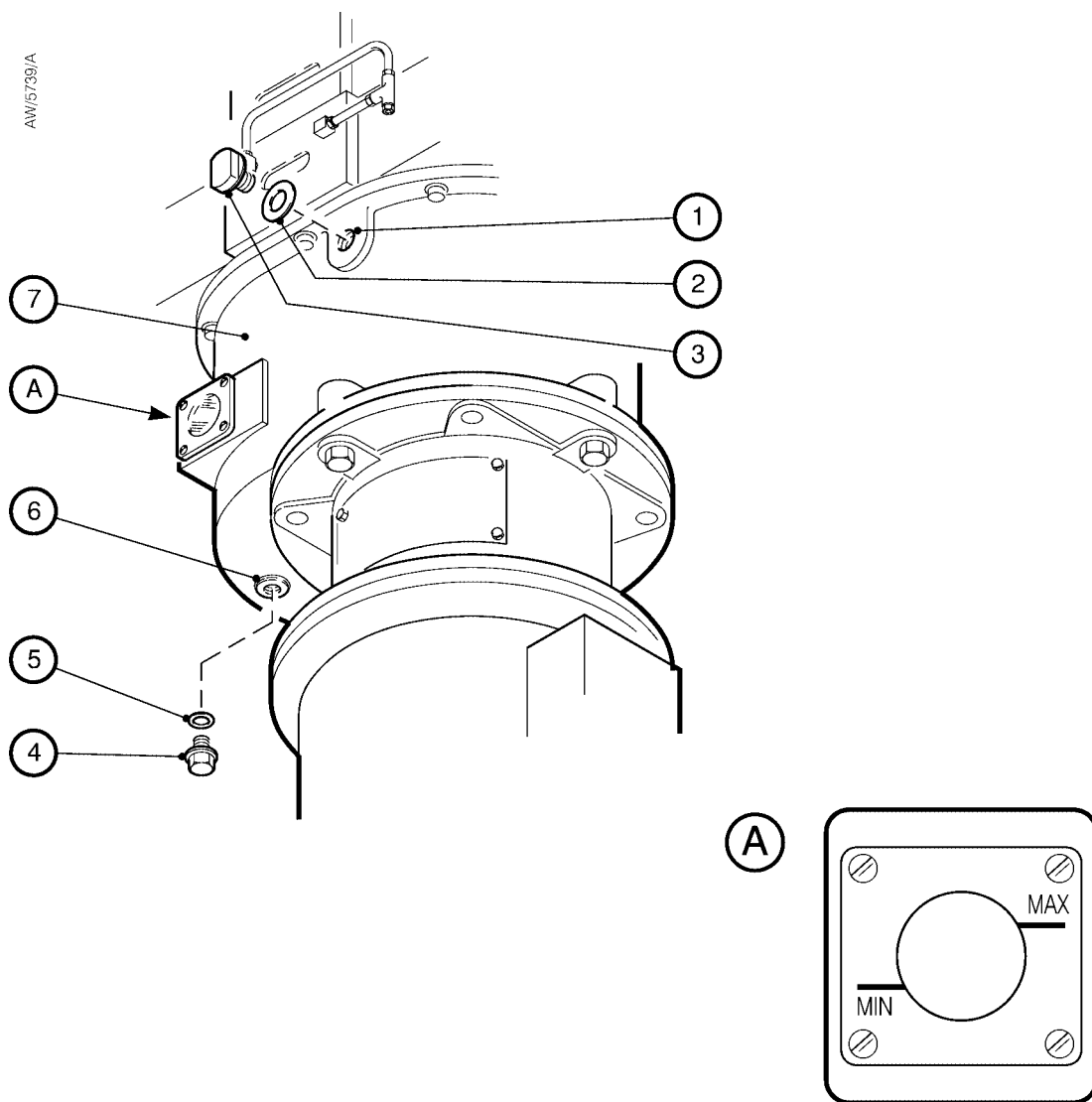
	<p style="text-align: center;">WARNING</p> <p>Your nitrogen supply pressure must comply with the requirements of Section 2.5. If it does not, the shaft-seals purge pipelines may become over-pressurised and may explode.</p>
---	---

1. Inspect the shaft-seals purge gas supply pipelines and connections; check that they are not corroded or damaged. Replace any pipelines and connections that are corroded or damaged.
2. Check that all of the shaft-seals purge gas supply connections are secure. Tighten any connections that are loose.
3. Check that your purge gas supply can provide the necessary pressure as specified in Section 2.5.

5.5 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.



A Oil-level sight-glass

- 1. Oil filler-port
- 2. Bonded seal
- 3. Oil filler-plug
- 4. Oil drain-plug ($1/2$ BSP)

- 5. Bonded seal
- 6. Oil drain-port
- 7. Gearbox

Figure 11 - Oil-level sight-glass and oil filling and draining connections

5.6 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.

5.7 Inspect the pressure relief valve and replace the hinge bushes, flap and 'O' ring (if necessary): EDP200 and EDP300 only

If you think that the pressure relief valve does not operate correctly, use the procedures in the following sections to remove, inspect and refit the valve.

5.7.1 Remove the valve from the pump

1. Refer to Figure 12. Remove the four M8 bolts (11) which secure the retainer (9) to the exhaust manifold (3).
2. Fit two of the bolts (11) into the jacking holes (10) and tighten the bolts to remove the retainer (9) from the exhaust manifold (3).

3. Remove the valve flap (7) and the valve body (2) assembly from the exhaust manifold (3).

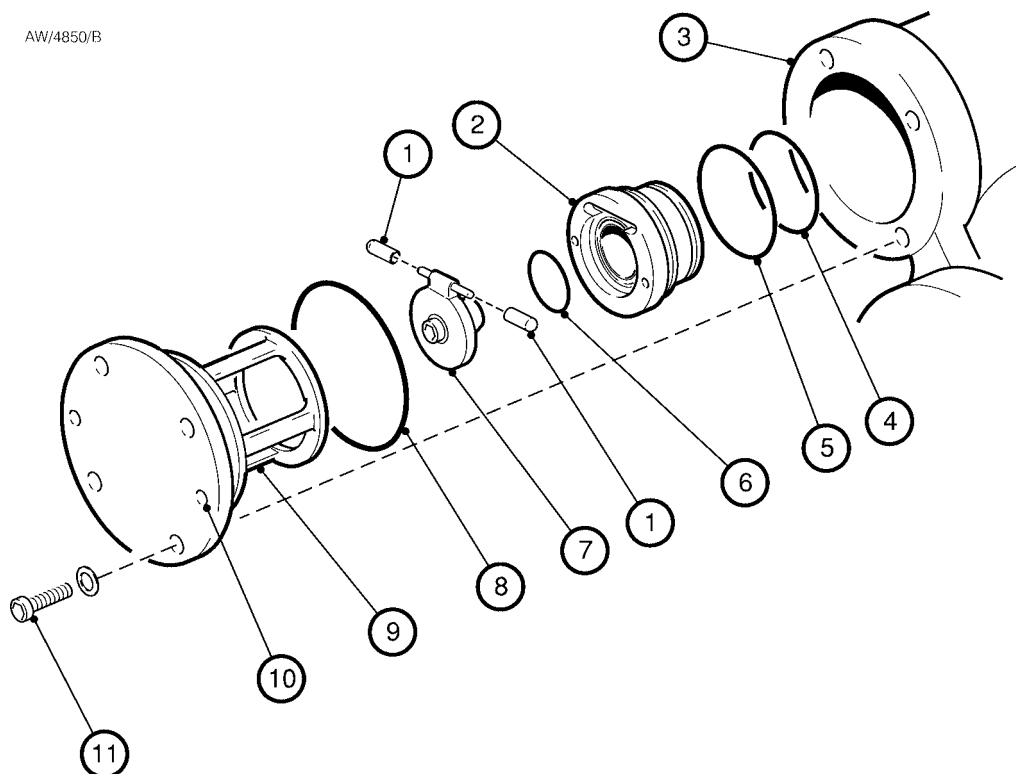
5.7.2 Clean and inspect the valve

1. Refer to Figure 12. Inspect the valve:
 - If the retainer (9) or valve body (2) are corroded or damaged, you must replace the pressure relief valve: refer to Section 5.14.
 - If any of the valve flap (7), the hinge bushes (1) or the valve 'O' ring (6) are damaged, replace the damaged component with a new component.
2. Clean the inside of the exhaust manifold (3) 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 components.
3. Inspect the 'O' rings (8, 5, 4) and, replace them if necessary.

5.7.3 Refit the valve to the pump

1. Refer to Figure 12. If necessary, refit the two hinge bushes (1) to the valve flap (7), then fit the valve flap to the valve body (2).
2. Refit the valve body (2) in the exhaust manifold (3).
3. Fit the retainer (9) to the exhaust manifold (3) and secure with the four bolts (11). Tighten the bolts to a torque of 7.4 lbf ft (10 N m).

AW/4850/B



- | | |
|---------------------|------------------|
| 1. Hinge bush | 7. Valve flap |
| 2. Valve body | 8. 'O' ring |
| 3. Exhaust manifold | 9. Retainer |
| 4. 'O' ring | 10. Jacking hole |
| 5. 'O' ring | 11. Bolt (4 off) |
| 6. Valve 'O' ring | |

Figure 12 - Exploded view of the pressure relief valve

5.8 Change the pump oil and clean the oil-level sight-glasses



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.

- Changing the oil in a pump from hydrocarbon to PFPE (Fomblin) could potentially cause a safety hazard. Fomblin pumps are generally used in hazardous applications which may involve the pumping of gases with high concentrations of oxygen. If hydrocarbon oil comes into contact with gases with an oxygen concentration greater than 25%, an explosion can occur.

Therefore, if you want to convert a pump that has been used with hydrocarbon oil to use PFPE (Fomblin) oil, you cannot simply flush the pump with new PFPE oil. You must return the pump to a BOC Edwards Service Centre for overhaul and cleaning by qualified BOC service engineers. The change in oil type requires a complete strip down of the pump, and thorough cleaning of all parts, so that all traces of hydrocarbon oil are removed.

- 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.
- The gearbox may be pressurised. To remove the oil filler-plug, undo it slowly until the vent hole is visible, allow the gearbox to vent to atmosphere to reduce the pressure in the gearbox, then fully undo and remove the oil filler-plug. If you do not, oil may be ejected under pressure from the gearbox.

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

1. Refer to Figure 11. Remove the oil filler-plug (3) and bonded seal (2); see Note above.
2. Place a suitable container under the oil drain-port (6); the container must have a capacity of at least 1.2 US gal.
3. Unscrew and remove the oil drain-plug (4) and bonded seal (5) and allow the oil to drain from the gearbox. Dispose of the bonded seal (5).
4. Refer to Figure 13. Undo and remove the four M5 screws (7) from the 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 11. Place a suitable funnel or nozzle into the oil filler-port (1).
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. Wipe clean the oil drain plug (4), then fit a new bonded rubber seal (5).
13. Fit the oil drain-plug (4) and bonded seal (5) to the drain-port (6).

14. Fill the gearbox through the funnel or nozzle, 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 or nozzle from the oil filler-port (1) and refit the oil filler-plug (3) and bonded seal (2) to the oil filler-port (1).
16. Dispose of the used oil safely: refer to Section 6.2.

5.9 Relubricate/inspect the rotor bearings

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

5.9.1 Introduction

The frequency of relubrication of the rotor bearings depends on the operating temperature of the pump. Table 15 shows the recommended frequencies.

For maximum pump reliability, we recommend that you change the gearbox oil when you relubricate the rotor bearings: refer to Section 5.3.

Use the procedures in the following sections to relubricate the rotor bearings.

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

Table 15 - Recommended rotor bearing relubrication frequencies

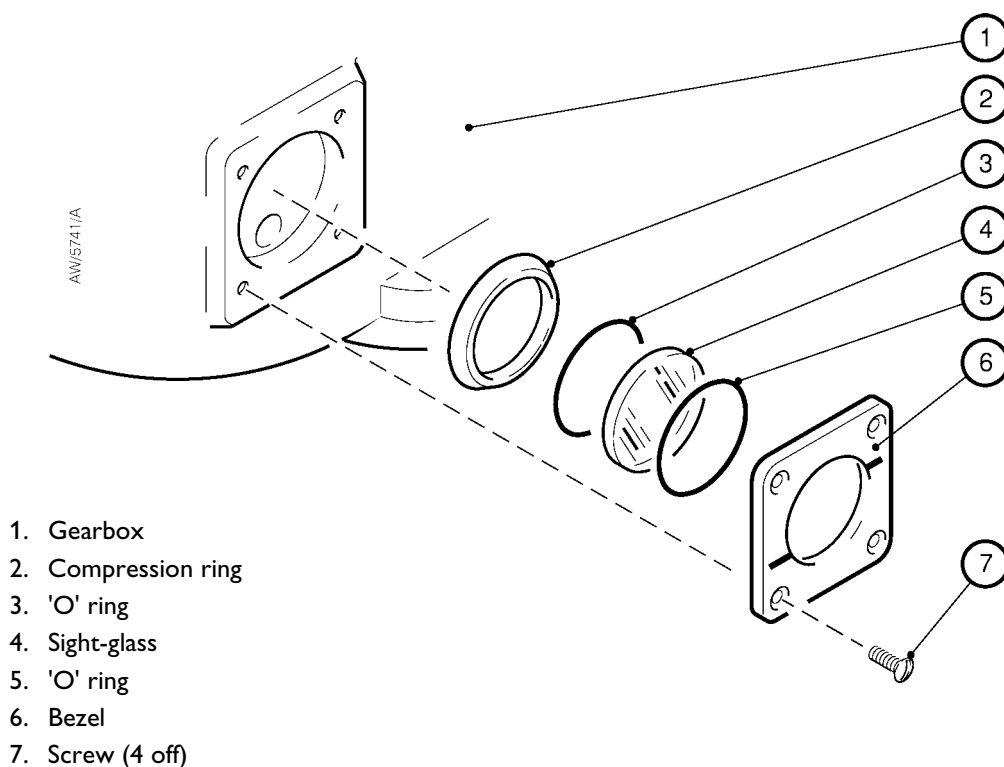
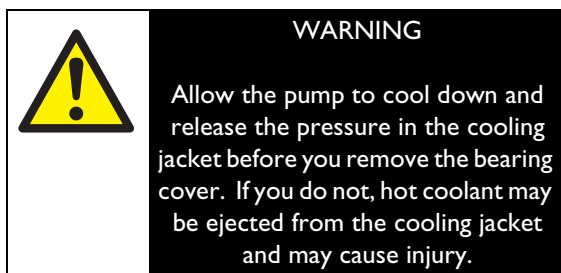


Figure 13 - Exploded view of an oil-level sight-glass

5.9.2 Remove the bearing cover and bearing caps



1. Refer to Figure 3. Wear thermal protective gloves and push down the coolant filler cap (1) and turn it anticlockwise by a $\frac{1}{4}$ of a turn (as shown in detail A) to release the pressure in the cooling jacket.
2. Refer to Figure 14. Remove the ten M10 bolts and spring-washers (15) which secure the bearing cover (5) to the high vacuum head-plate.
3. Remove the M6 screws and nuts which secure the thermal snap-switch to the support bracket.
4. Remove the bearing cover (5), the bearing cover 'O' ring (14) and the cooling-jacket 'O' ring (11). Discard the 'O' rings.
5. Remove the three M8 bearing cap retaining bolts (6) which secure the bearing cap (7) on the drive rotor shaft; ensure that you do not accidentally remove one or more of the bearing carrier bolts (16, see detail A), which are next to the bearing cap retaining bolts. Remove the bearing cap (7) and the bearing cap 'O' ring (8).
6. Repeat Step 5 to remove the bearing cap (12) and bearing cap 'O' ring on the driven rotor shaft.

5.9.3 Clean, inspect and relubricate the rotor bearings


1. Refer to Figure 14. Use a clean lint-free cloth to remove as much old grease as possible from the inside face of the bearing caps (7, 12) and from the top of the bearings. Do not use your fingers for this operation.


2. Inspect the bearings for obvious signs of wear or the presence of debris. If the bearings are worn, contact your supplier or BOC Edwards for advice.
3. If the bearings are in a satisfactory condition, use a suitable syringe to force approximately 1.8 oz of new Fomblin CR861 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.
4. Use a 24 mm A/F spanner to turn the drive rotor shaft (9) in the correct direction (13) three or four complete revolutions.
5. Press any grease forced out of the bearings back into the bearings.

5.9.4 Refit the bearing caps and bearing cover

1. Refer to Figure 14. Refit the bearing cap (7) with a new bearing cap 'O' ring (8) 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 (6) and refit the bolts to secure the bearing cap.
2. Repeat Step 1 to refit the bearing cap (12) on the driven rotor shaft.
3. Apply a light wipe of vacuum grease to the new bearing cover 'O' ring (14) and the water jacket 'O' ring (11), then place them in position on the high-vacuum head-plate.
4. Refit the bearing cover (5) to the high vacuum head-plate and secure with the ten bolts and spring washers (15).
5. Secure the snap-switch to the support bracket with the two M6 screws (4) and nuts (1).
6. Refer to Figure 3. Turn the coolant filler cap (1) clockwise to tighten it.
7. Dispose of the old grease safely: refer to Section 6.2.

5.10 Check the coolant level and refill if necessary

	<p>WARNING</p> <p>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.</p>
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	<p>WARNING</p> <p>Ensure that you correctly fill the EDP60 and EDS120 pumps with coolant, as described in the following sections. If you do not, an air-lock may develop in the cooling-jacket and the pump may overheat.</p>
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5.10.1 Refill the pump with BOC Edwards coolant

Note: To refill the pump with BOC Edwards coolant, you will require new coolant, available as a spare: refer to Section 7.3.

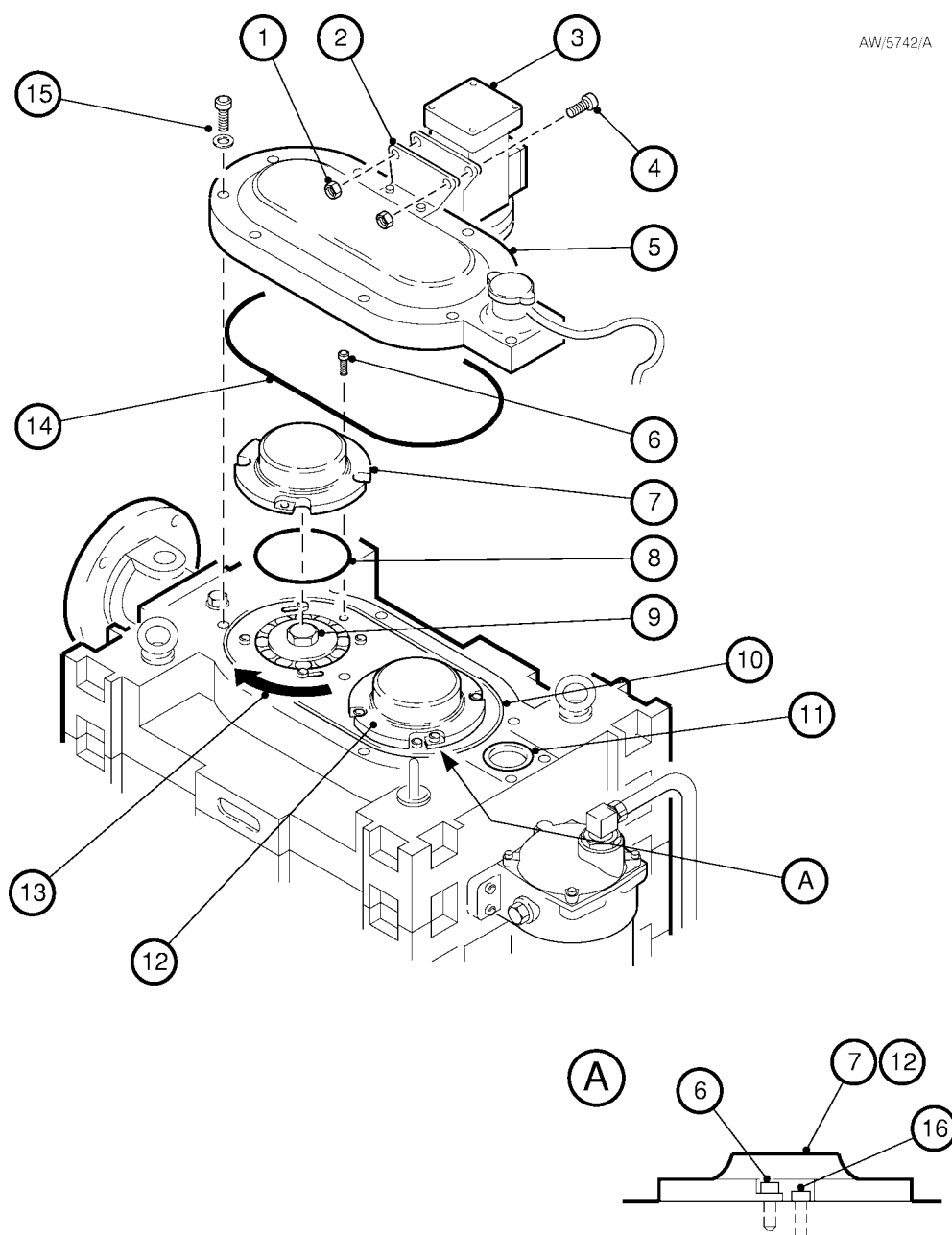
1. Refer to Figure 3. Wear thermal protective gloves and push down the coolant filler-cap (1) and turn it anticlockwise by a $\frac{1}{4}$ of a turn to release the pressure in the cooling-jacket: see detail A.
2. Remove any dirt or water-scale from the seal of the filler-cap (1) and from the filler-tube (4).
3. Look at the level of coolant (6) in the cooling-jacket. If the coolant level is more than approximately 1 inch below the bottom of the filler-neck (5, see detail B), continue at Step 4, otherwise continue at Step 5.
4. Fill the pump with new BOC Edwards coolant: use the procedure in Steps 4 to 9 of Section 3.4.
5. Refit the coolant filler-cap (1); press it down and turn it clockwise to secure it to the pump.

5.10.2 Fill the pump with a different coolant

Note: You will require a Routine Maintenance Kit (see Section 7.3) 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 2.4.

1. Refer to Figure 3. Wear thermal protective gloves and push down the coolant filler-cap (1) and turn it anticlockwise by a $\frac{1}{4}$ 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 $\frac{1}{2}$ 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): use the procedure in Steps 4 to 9 of Section 3.4.
9. Refit the coolant filler-cap (1); press it down and turn it clockwise to secure it to the pump.



- | | |
|-------------------------------|-----------------------------------|
| 1. M6 nuts | 9. Drive rotor shaft |
| 2. Bracket | 10. Bearing cover 'O' ring groove |
| 3. Thermal snap-switch | 11. Cooling-jacket 'O' ring |
| 4. M6 screws | 12. Bearing cap (driven shaft) |
| 5. Bearing cover | 13. Correct direction of rotation |
| 6. Bearing cap retaining bolt | 14. Bearing cover 'O' ring |
| 7. Bearing cap (drive shaft) | 15. Bolt and spring washer |
| 8. Bearing cap 'O' ring | 16. Bearing carrier bolt |

Figure 14 - Relubricate the rotor bearings

5.10.3 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 BOC Edwards for advice.

5.11 Flush the pump with cleaning solution

5.11.1 Introduction

You must use a cleaning solution suitable for the process substances pumped (refer to the warnings at the start of Sections 5.11.2 and 5.11.3). Note that to completely flood all the unblocked cavities in the pump, you will require the quantities of cleaning solution shown in Table 3.

1. Switch on the shaft-seals purge nitrogen 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:
 - Use the procedure in Section 5.11.2 if you want to remove deposits from a pump which has been operating correctly.
 - Use the procedure in Section 5.11.3 if the pump has seized.

5.11.2 Flush a pump which has been operating



WARNING

Use a cleaning solution which is suitable for the process materials pumped. If you do not, there may be a risk of explosion or pump damage.



WARNING

Ensure that you correctly refit the blanking plugs to the purge ports on the pump. Ensure that the threads in the purge ports are clean and free from damage, and that the plug is undamaged. Replace damaged plugs.

Note: *If the pump has a torque limiter and it has tripped and decoupled the pump-motor from the pump, do not reset the torque limiter (to 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 cover guards (14) and remove the guard.
2. Disconnect the exhaust pipeline from the pump-outlet (25) 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 15. Unscrew and remove the blanking plug from the gas ballast purge port (4). 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 to the port.

5. Undo and remove the blanking plug from the middle stage purge port (5). 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 to the port.
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 10. On pumps with a torque limiter, fit the steel rod (7) supplied into the hole (4) in the coupling adaptor, on other pumps, fit a suitable steel rod (not supplied) into the hole in the drive hub (Figure 19, item 5), then 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. If the pump has a torque limiter and it has tripped and decoupled the pump-motor, reset the torque limiter: refer to Section 4.5.
11. Use the four bolts to refit the coupling cover guard (14) to the pump. Tighten the bolts to a torque between 2.2 and 3.6 lbf ft (3 and 5 Nm).
12. Refit the pump-outlet (25) to your exhaust pipeline, then dispose of the deposits removed from the pump.

5.11.3 Flush a seized pump



WARNING

Use a cleaning solution which is suitable for the process materials pumped. If you do not, there may be a risk of explosion or pump damage.



WARNING

Ensure that you correctly refit the blanking plugs to the purge ports on the pump. Ensure that the threads in the purge ports are clean and free from damage, and that the plug is undamaged. Replace damaged plugs.

Note: If the pump has a torque limiter and it 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 cover guards (14) and remove the guard.
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 15. 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 (see Table 3 for the capacity of the pump), then leave the pump for at least one hour for the cleaning solution to fully react with the deposits in the pump.
7. Refer to Figure 10. If the pump has a torque limiter, fit the steel rod (7) supplied into the hole (4) in the coupling adaptor otherwise fit a suitable steel rod (not supplied) into the drive hub (Figure 20, item 5), then try to turn the pump clockwise:
 - If you cannot turn the pump, continue at Step 7 (to leave the pump for longer).
 - If you can turn the pump, continue at Step 8.
8. Place a suitable container under the pump-outlet (Figure 15, 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 blanking plugs (Figure 15, items 4 and 5) to allow the cleaning solution to drain out of the purge port(s), then refit the plug(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 1, item 3) 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 4.5.
14. Dispose of the used cleaning solution and deposits removed.

5.12 Clean the cooling system

5.12.1 Drain the coolant from the cooling system

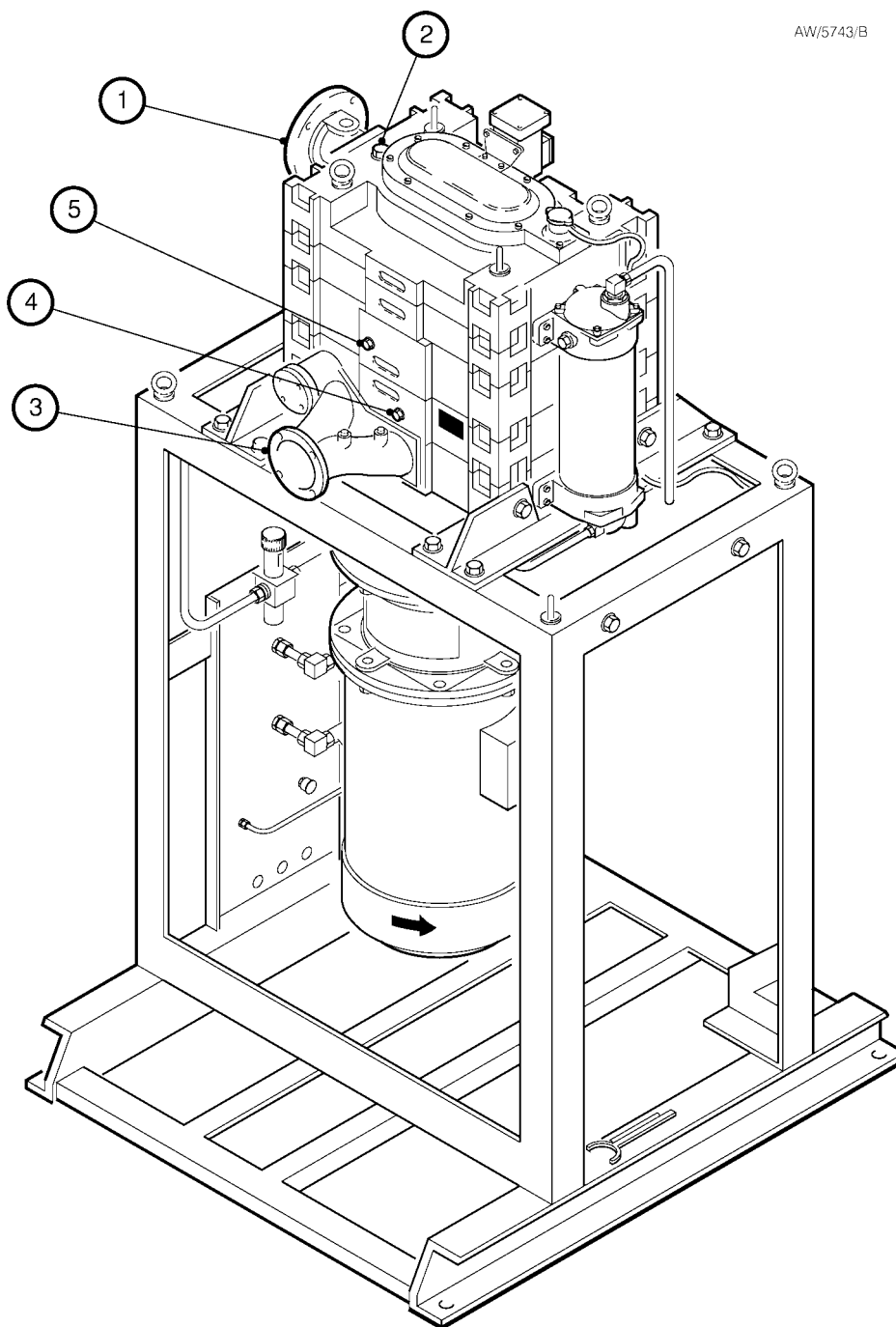


WARNING

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 $\frac{1}{4}$ 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 6. 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 3 and 4 of Section 5.10.2.
6. Refer to Figure 18. 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.



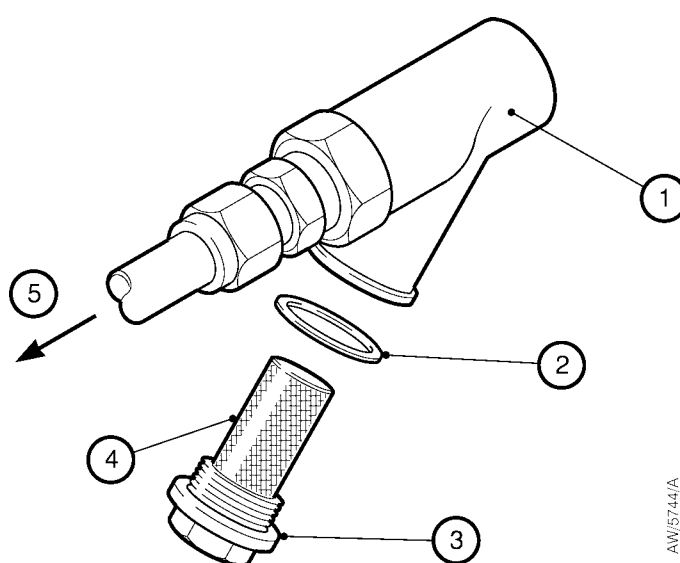
1. Pump inlet-flange
2. Inlet flush port
3. Pump outlet-flange
4. Gas ballast purge port
5. Middle stage purge port

Figure 15 - Flush the pump

5.12.2 Clean the cooling-water filter

The location of the water filter is shown in Figure 6, item 10.

1. Refer to Figure 16. 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).



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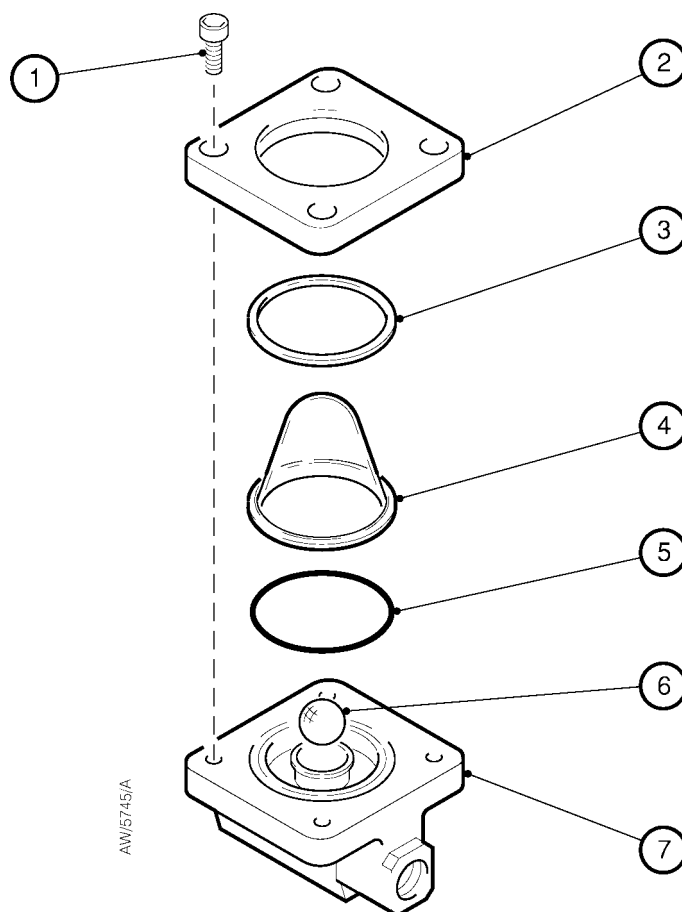
1. Water filter body
2. Gasket
3. Hex-head nut
4. Filter element
5. Direction of cooling-water flow

Figure 16 - Clean the cooling-water filter

5.12.3 Clean the cooling-water flow indicator

The location of the cooling-water flow indicator is shown in Figure 6, item 11.

1. Refer to Figure 17. 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 | 5. 'O' ring |
| 2. Bezel | 6. Ball |
| 3. Gasket | 7. Body |
| 4. Dome | |

Figure 17 - Clean the cooling-water flow indicator

5.12.4 Clean the heat exchanger

Refer to Figure 18 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 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 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 (400 mm) length of 0.2 inch (5 mm) 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 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 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).

5.12.5 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 8 of Section 5.9.2.
2. Refer to Figure 18. Refit the drain-plug (7) to the bottom end cap (6) of the heat exchanger.
3. Refer to Figure 6. Refit the fittings (4, 6) on your cooling-water supply and return pipelines to the connections (3, 5) on the services panel.

5.13 Overhaul the pump

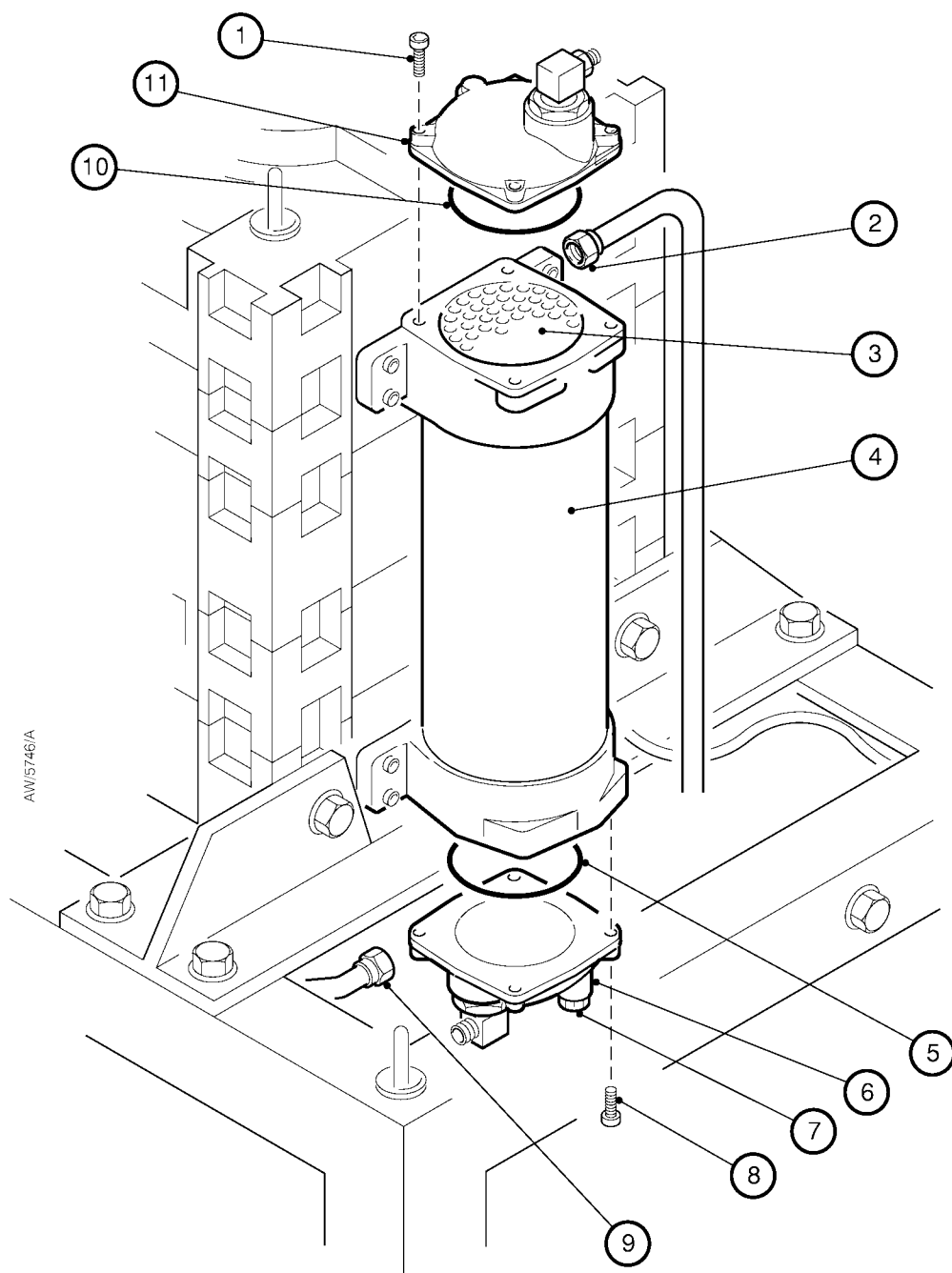
We recommend that the pump is given a major overhaul every three years.

Such an overhaul is outside the scope of this manual and should be done by qualified BOC Edwards service personnel: contact your supplier or BOC Edwards.

5.14 Replace the pressure relief valve (EDP200 and EDP300 only)

You must replace the pressure relief valve if it is damaged. The Pressure Relief Valve is available as a spare: refer to Section 7.3.

1. Refer to Figure 12. Undo and remove the four M8 bolts (11) which secure the valve retainer (9) to the exhaust manifold (3).
2. Place two of the bolts in the jacking holes (10) and tighten the bolts to remove the retainer (9) from the exhaust manifold.
3. Remove the 'O' ring (8), valve flap (7), hinge bushes (1), valve body (2) and 'O' rings (5, 4) from the exhaust manifold (3).
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.
5. Fit the new pressure relief valve to the exhaust manifold and secure with the four M8 bolts (11). Tighten the bolts to a torque of 7.4 lbf ft (10 Nm).



- 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 18 - Clean the heat exchanger

5.15 Inspect the torque limiter

1. Refer to Figure 1. Undo and remove the four M8 bolts which secure one of the coupling cover guards (14), then remove the guard.
2. Inspect the torque limiter. Refer to Figure 9. You must not continue with this procedure, but must contact your supplier or BOC Edwards (to arrange for service/replacement of the torque limiter) if:
 - The rim of the slide plate (3) is cracked or broken.
 - The edges of the cage plate (2) are burred.
 - Any of the notches (Figure 10, item 1) in the drive plate are damaged.
 - Any of the components show signs of discolouration (due to overheating).

If the torque limiter does not have to be serviced/replaced, continue at Step 3.

3. Refer to detail B. Check the gap (4) between the lower face of the drive plate (1) and the rim of the slide plate (3):
 - If the gap (4) is 0.004 to 0.016 inches (0.1 to 0.4 mm), the torque limiter is correctly engaged: continue at Step 4.
 - If the gap (4) is > 0.016 inches (4 mm), the torque limiter is not engaged correctly: re-engage the torque limiter (refer to Section 4.5), then recheck the gap. If the gap is still incorrect after you have re-engaged the torque limiter, do not continue with this procedure but contact your supplier or BOC Edwards to arrange for service/replacement of the torque limiter.
 - If the gap (4) is < 0.004 inches (0.1 mm): do not continue with this procedure, but contact your supplier or BOC Edwards to arrange for service/replacement of the torque limiter.


4. Refer to Figure 1. Use the four bolts removed in Step 1 to refit the coupling cover guard (14). Tighten the bolts to a torque between 2.2 and 3.6 lbf ft (3 and 5 N m).

5.16 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).

Note: You must ensure that the pump-motor, motor coupling and coupling housing assembly is adequately supported in the following procedures. The mass of the motor coupling and coupling housing is 68 lb on all pumps. The total mass of the pump-motor, motor coupling and coupling housing assembly on your pump is therefore $(68 + M)$ lb, where M is the mass of your pump-motor (in lb). Refer to the motor manual or to the data plate on the pump-motor for the pump-motor mass.

5.16.1 Lower the pump-motor and coupling housing (without the motor change frame)

	<p style="text-align: center;">WARNING</p> <p>Ensure that the pump-motor, motor coupling and coupling housing assembly does not fall over when you move it. If it falls over, it can cause injury to people. Refer to the Note in Section 5.16 to calculate the mass of the assembly.</p>
---	--

1. Refer to Figure 19 or 20. Remove the fixing bolts (12) which secure the coupling housing to the gearbox and 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). Ensure that the pump-motor, motor coupling and coupling housing assembly is adequately supported throughout and does not fall over.
2. Continue at Step 13 of Section 5.16.2.

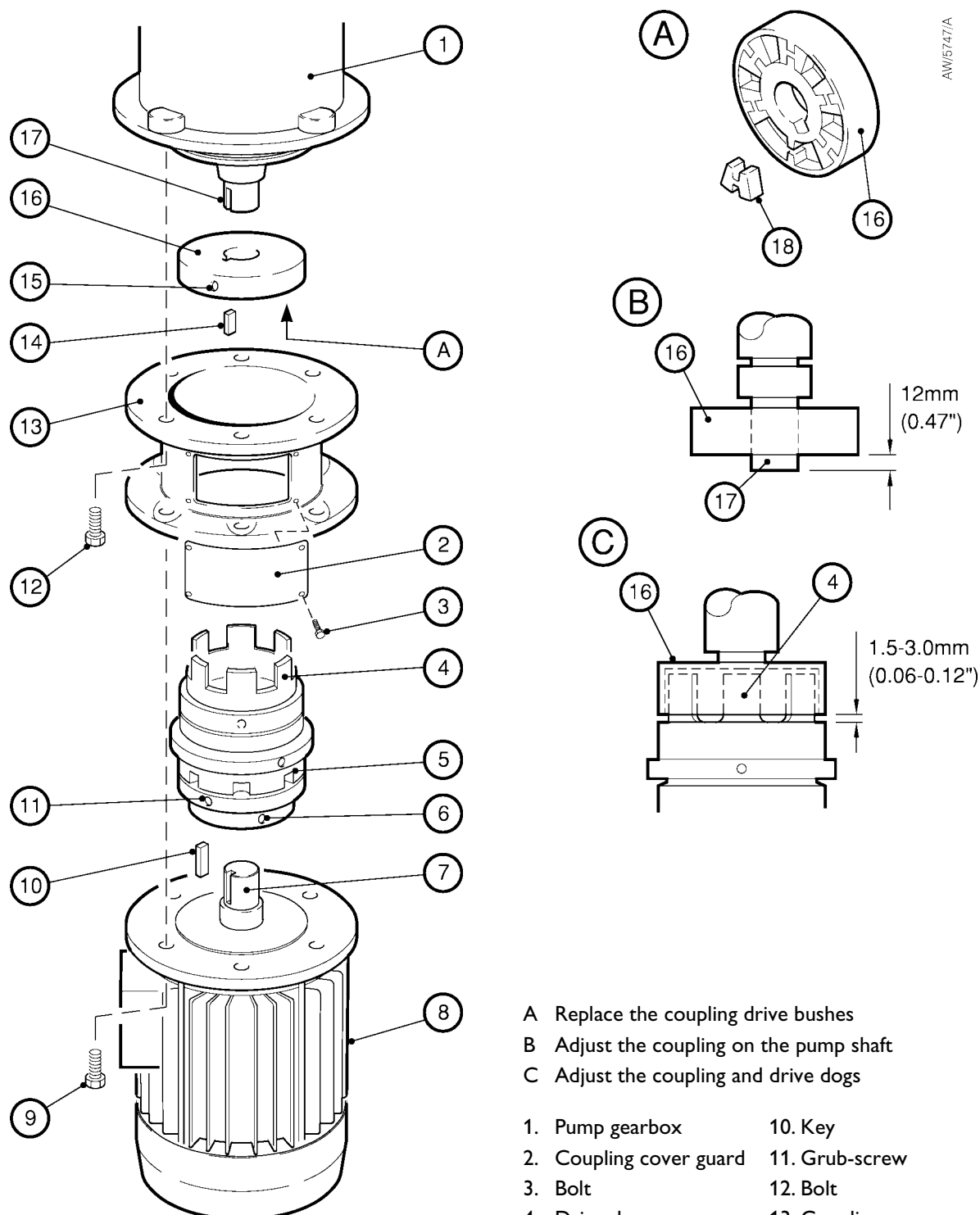


Figure 19 - Exploded view of the pump-motor, torque limiter and coupling housing (pumps with a torque limiter)

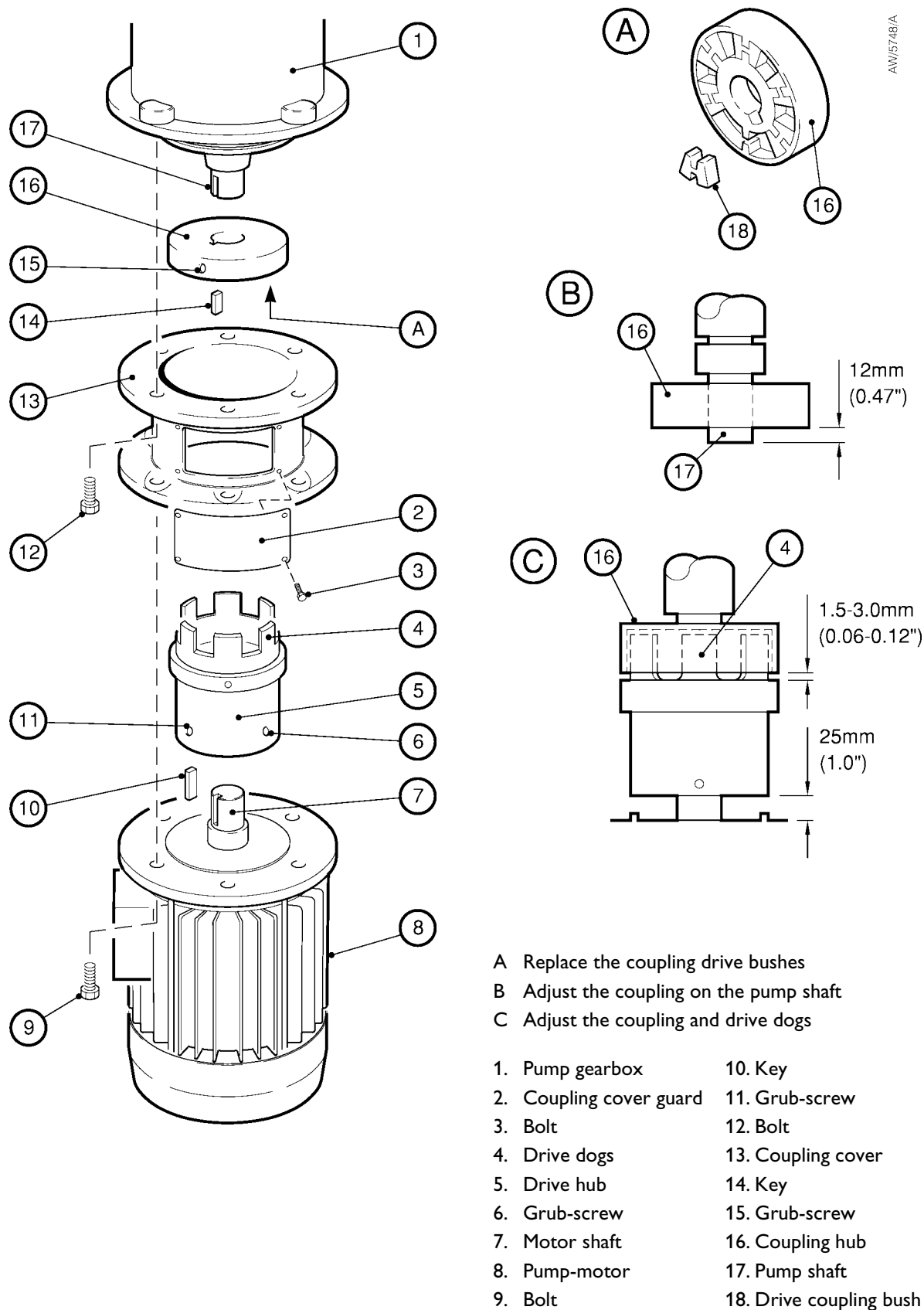


Figure 20 - Exploded view of the pump-motor, coupling drive and coupling housing
(pumps without a torque limiter)

5.16.2 Lower the pump-motor and coupling housing (with the motor change frame)



WARNING

Ensure that the pump-motor, motor coupling and coupling housing assembly does not fall over when you move it. If it falls over, it can cause injury to people. Refer to the Note in Section 5.16 to calculate the mass of the assembly.

1. Refer to Figure 21. 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 or 20. 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 21. 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 (as shown in Figure 21).
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).

5.16.3 Remove the coupling housing from the pump-motor

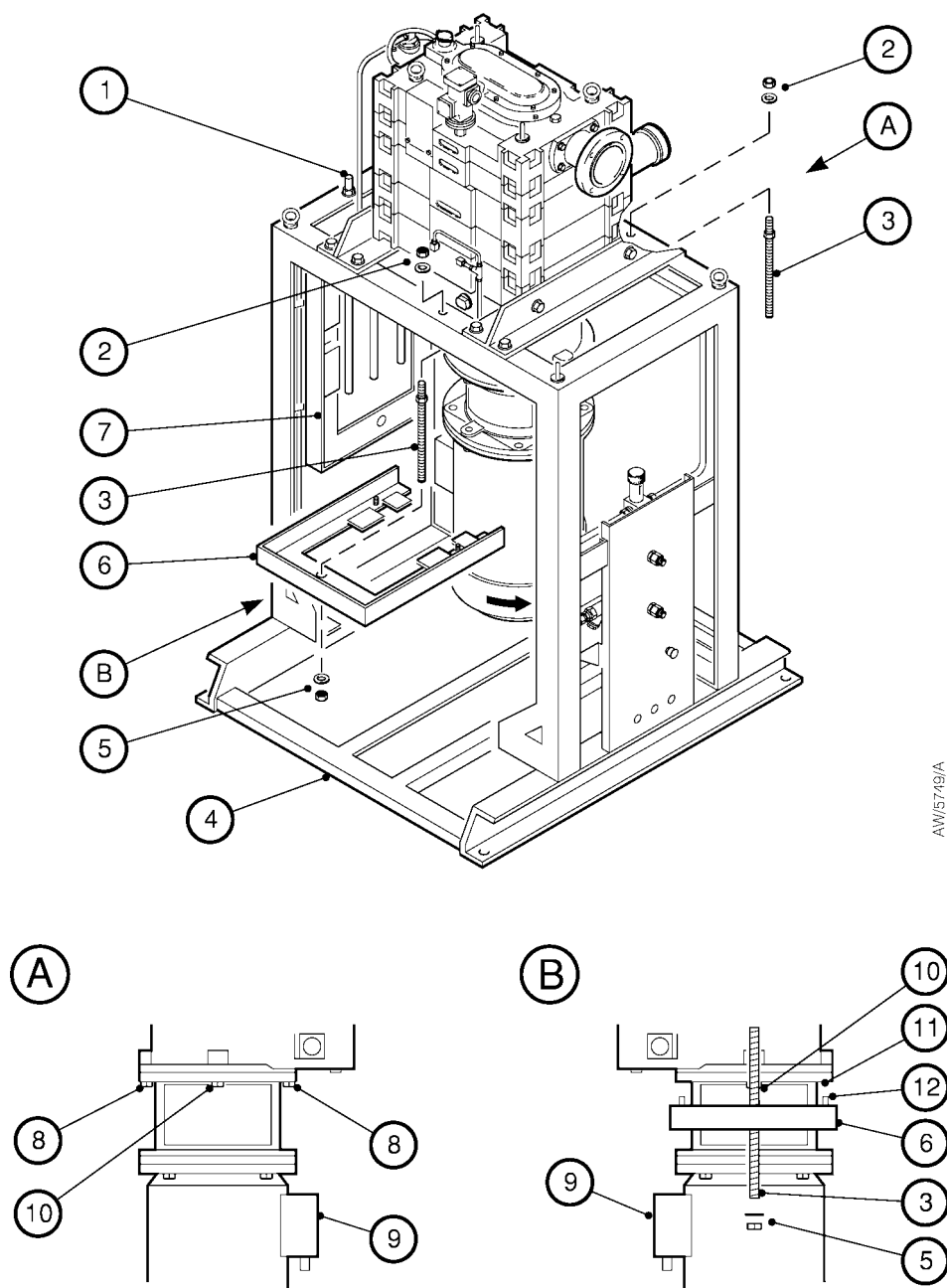
1. Refer to Figure 19 or 20. Remove the four bolts (9) which secure the pump-motor (8) to the coupling housing (13).
2. Take note of the orientation of the coupling housing on the pump-motor (so that you can refit it later in the same orientation), then lift the coupling housing from the pump-motor.

5.16.4 Replace the drive coupling bushes

1. Refer to Figure 19 or 20. Undo and remove the two grub-screws (15) in the coupling hub (16).
2. Slide the coupling hub (16) off the pump shaft (17) and remove the key (14) from the pump shaft. Dispose of the key.
3. Refer to detail A. Pull the drive coupling bushes (18) out of the coupling hub (16). Dispose of the bushes.
4. Fit the new drive coupling bushes (18) into the coupling hub (16).
5. Apply a suitable thread sealant (such as Loctite 242 Nutlock) to the new grub-screws (15) and screw the grub-screws into the coupling hub (16).
6. Fit the new key (14) into the pump shaft (17).
7. Refer to detail B. Slide the coupling hub (16) onto the pump shaft (17) and position it so that the bottom face of the coupling hub (16) is 0.47 inches (12 mm) above the end of the pump shaft.
8. Fully tighten the two grub-screws (15) to secure the coupling hub (16) and key (14) in place.

5.16.5 Remove the drive hub and fit to the new pump-motor (pumps without a torque limiter)

1. Refer to Figure 20. Undo and remove the grub-screw (11) and the grub-screw (6) on the drive hub (5).
2. Use a suitable puller tool to remove the drive hub (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 drive hub (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 drive hub (5) onto the motor shaft (7) and push it down until it will go no further. Check that the lower face of the drive hub is 1 inch above the motor flange (refer to detail C); if the gap is not correct, contact your supplier or BOC Edwards for advice.
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 drive hub (5). Fully tighten the grub-screws to secure the drive hub (5) to the motor shaft (7).



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

Figure 21 - Use the motor change frame to lower the pump-motor and coupling housing assembly

5.16.6 Remove the torque limiter and fit to the new pump-motor (pumps with a torque limiter)

1. Refer to Figure 19. Undo and remove the grub-screw (11) and the grub-screw (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. On the EDP80 pump, fit the torque limiter (5) onto the motor shaft (7) and push it fully down until the lower face of the torque limiter is 0.94 inches (24 mm) above the motor flange.

On the EDP120, EDP200 and EDP300 pumps, 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).


5.16.7 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 or drive coupling when you operate the pump.

1. Refer to Figure 19 or 20. Inspect the bottom flange of the coupling housing (13) 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 (13) onto the flange of the pump-motor (8). Ensure that the coupling housing is orientated correctly (as noted in Section 5.15.3): one of the coupling cover guards (2) must be at 90° to the terminal-box on the pump-motor.
3. Fit the four bolts (9) and tighten the bolts to secure the coupling housing (13) to the pump-motor (8); note that you will fully tighten the bolts in Section 5.16.8.

5.16.8 Refit the pump-motor and coupling housing to the pump (without the motor change frame)



WARNING


Ensure that the pump-motor, motor coupling and coupling housing assembly does not fall over when you move it. If it falls over, it can cause injury to people. Refer to the Note in Section 5.16 to calculate the mass of the assembly.

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 or drive coupling when you operate the pump.

1. Refer to Figure 19 or 20. Undo and remove the four bolts (3) which secure each of the two coupling cover guards (2) and remove the guard from the coupling cover (13).
2. Inspect the top flange of the coupling housing (13) and the bottom flange of the pump gearbox (1); they must be free of burrs and dirt. If necessary, clean or refinish the flanges.
3. Use suitable lifting equipment to lift the pump-motor and coupling housing onto the bottom of the pump frame. 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 is directly below the gearbox oil drain-plug.
4. Look through the access hole in the coupling housing (13) and use suitable lifting equipment to raise the pump-motor and coupling housing assembly, until the drive dogs (4) are almost engaged in the coupling hub (16). Ensure that the top flange of the coupling housing is level at all times.
5. Turn the torque limiter or coupling hub (16) until the drive dogs (4) align with the gaps between the drive coupling bushes (18) in the coupling hub (16).
6. Fully raise the pump-motor and coupling housing assembly so that the top flange of the coupling housing (13) locates against the bottom flange of the pump gearbox, and so that the bolt holes in the coupling housing align with the bolt holes in the gearbox.
7. Use the bolts (12) to secure the coupling housing and pump-motor assembly to the pump gearbox (1).
8. Refer to Figure 19 or 20, detail C. Check the gap between the bottom face of the coupling hub (16) and the inner faces of the drive dogs (4). If the gap is correct, continue at Step 10.
9. If the gap is not correct:
 - Check that the bottom flange of the coupling housing (13) is correctly located against the top flange of the pump-motor: refer to Section 5.16.7.
 - Check that the top flange of the coupling housing (13) is correctly located against the bottom flange of the pump gearbox (1): refer to Steps 1 to 7 and to the WARNING at the start of this section.
 - Check that the drive coupling or torque limiter (5) is correctly located on the motor shaft (7): refer to Section 5.16.5 or 5.16.6.
 - If the coupling housing and the drive coupling or torque limiter are correctly fitted, loosen the two grub-screws (15) on the coupling hub (16) and adjust the position of the coupling, then tighten the two grub-screws (15) again. Continue at Step 8 to check the gap is now set correctly.
10. Ensure that all of the fixing bolts (9, 12) are tightened to a torque between 94.4 and 97.4 lbf ft.
11. Use the four bolts (3) to secure each coupling cover guard (2) to the coupling housing. Tighten the bolts to a torque between 2.2 and 3.6 lbf ft.

5.16.9 Refit the pump-motor and coupling housing to the pump (with the motor change frame)



WARNING

Ensure that the pump-motor, motor coupling and coupling housing assembly does not fall over when you move it. If it falls over, it can cause injury to people. Refer to the Note in Section 5.16 to calculate the mass of the assembly.

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 or drive coupling when you operate the pump.

1. Refer to Figure 19 or 20. Undo and remove the four bolts (3) which secure each of the two coupling cover guards (2) and remove the guard from the coupling cover (13).
2. Inspect the top flange of the coupling housing (13) 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 21. 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 or 20. Look through the access hole in the coupling housing (13) 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 hub (16).
9. Turn the torque limiter or drive hub (5) until the drive dogs (4) align with the gaps between the drive coupling bushes (18) in the coupling hub (16).
10. Refer to Figure 21. 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 or 19, detail C. Check the gap between the bottom face of the coupling hub (16) 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 (13) is correctly located against the top flange of the pump-motor: refer to Section 5.16.7.
- Check that the top flange of the coupling housing (13) 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 or drive hub (5) is located on the motor shaft (7), so that the lower face of item (5) is against the shoulder on the motor shaft: refer to Section 5.16.5 or 5.16.6.
- If the coupling housing and the torque limiter or drive hub are correctly fitted, loosen the two grub-screws (15) on the coupling (16) and adjust the position of the coupling, then tighten the two grub-screws (15) again. Continue at Step 12 to check the gap is now set correctly.

14. Refer to Figure 20. 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 washers (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.

5.17 Relubricate the motor bearings



WARNING

Do not relubricate the motor bearings unless you have been suitably trained in the necessary procedures (and for explosion-proof motors, unless you are fully accredited/authorised to do so by the motor manufacturer). If you are not suitably trained, you may damage the motor and it may not operate correctly or safely.

5.17.1 Introduction

You must only relubricate the motor bearings of standard motors if you have been suitably trained in all of the necessary procedures.

You must only relubricate the motor bearings of explosion-proof motors if:

- You are fully accredited/authorised to do so by the motor manufacturer.
- You have been suitably trained in all of the necessary procedures.

5.17.2 General requirements

Take note of the following when you relubricate the motor bearings:

- Refer to the guidelines given in Section 5.17.3 for the relubrication intervals.
- Use the procedures in this manual to remove and refit the motor.
- Only use approved procedures to dismantle and reassemble the motor, and to relubricate the bearings.
- We recommend that you use Chevron SRI No. 2 or Shell Oil Dolium-R grease to relubricate the motor bearings.

(Continued on page 66)

Drystar EDP Chemical Dry Vacuum Pumps

- Only relubricate the bearings if they are in a satisfactory condition. The amount of grease you should use is shown in Table 16. Do not put too much grease into the bearings, or the motor may overheat.

5.17.3 Relubrication intervals

The required interval between motor bearing relubrication depends on a number of factors, such as ambient temperature and so on.

To determine the required intervals between relubrication:

- Refer to Table 17 which provides general guidelines on the required interval between relubrication.
- Refer also to the nameplate on the motor for relubrication intervals and grease quantities specific to that motor.

Note: The data given in Table 17 is for an ambient temperature of 77 °F. If the pump is operated in an ambient temperature of 104 °F, the required relubrication intervals will be 50% of those shown in the table.

Pump	Non-drive end bearing	Drive end bearing
EDP60, 460 V, 60 Hz, standard	0.2 fluid oz	0.4 fluid oz
EDP60, 460 V, 60 Hz, explosion-proof	0.2 fluid oz	0.4 fluid oz
EDP120, 460 V, 60 Hz, standard	0.2 fluid oz	0.6 fluid oz
EDP120, 460 V, 60 Hz, explosion-proof	0.2 fluid oz	0.6 fluid oz
EDP200, 460 V, 60 Hz, standard	0.2 fluid oz	0.6 fluid oz
EDP200, 460 V, 60 Hz, explosion-proof	0.2 fluid oz	0.6 fluid oz
EDP300, 460 V, 60 Hz, standard	0.4 fluid oz	0.6 fluid oz
EDP300, 460 V, 60 Hz, explosion-proof	0.4 fluid oz	0.6 fluid oz

Table 16 - Motor bearing relubrication grease required

Pump	Relubrication interval (months of operation)
EDP60, 460 V, 60 Hz, standard	6 to 12
EDP60, 460 V, 60 Hz, explosion-proof	6 to 12
EDP120, 460 V, 60 Hz, standard	6
EDP120, 460 V, 60 Hz, explosion-proof	6
EDP200, 460 V, 60 Hz, standard	6
EDP200, 460 V, 60 Hz, explosion-proof	6
EDP300, 460 V, 60 Hz, standard	6
EDP300, 460 V, 60 Hz, explosion-proof	6

Table 17 - Motor bearing relubrication intervals

5.18 Replace the motor bearings

	<p>WARNING</p> <p>Do not replace the motor bearings unless you have been suitably trained in the necessary procedures (and for explosion-proof motors, unless you are fully accredited/authorised to do so by the motor manufacturer). If you are not suitably trained, you may damage the motor and it may not operate correctly or safely.</p>
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You must only replace the motor bearings of standard motors if you have been suitably trained in all of the necessary procedures.

You must only replace the motor bearings of explosion-proof motors if:

- You are fully accredited/authorised to do so by the motor manufacturer.
- You have been suitably trained in all of the necessary procedures.

When you replace the motor bearings:

- Note that you will need the appropriate Motor Bearing Kit to replace the motor bearings: refer to Section 7.3.
- Use the procedures in this manual to remove and refit the motor.
- Only use approved procedures to dismantle and reassemble the motor, and to replace the motor bearings.

5.19 Fault finding

Symptom	Check	Actions
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 4.5.
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 5.11.3), then recouple the pump-motor to the pump (refer to Section 4.5).
	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 4.5).
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).
	Is the TCV incorrectly set ?	Check that the TCV is set to the required operating temperature. If necessary, adjust the TCV (refer to Section 3.12.3).
	Is the coolant level too low ?	Check that the coolant level in the pump is correct. If necessary, add coolant (refer to Section 5.10).
	Is the heat exchanger blocked ?	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 5.12).
	Has the pump seized because the thermal snap-switch (if fitted) 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 BOC Edwards for advice.

Table 18 - Fault finding (Sheet 1 of 3)

Drystar EDP Chemical Dry Vacuum Pumps

Symptom	Check	Actions
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.	<p>Does the thermal snap-switch (if fitted) not operate at the required temperature ?</p> <p>Has the TCV been set correctly ?</p> <p>Has the TCV failed ?</p>	<p>Check the operation of the thermal snap-switch as described above. Before you restart the pump, check the coolant level (refer to Section 5.10).</p> <p>Adjust the TCV to a lower temperature setting (refer to Section 3.12.3).</p> <p>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 BOC Edwards for advice.</p>
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 5.7 and 5.14).
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 ?	See above.
The gearbox and oil are contaminated with the process substances pumped.	<p>Has the shaft-seals purge nitrogen supply failed ?</p> <p>Have the seals in the pump failed ?</p>	<p>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 5.8).</p> <p>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 5.8).</p> <p>The seals must be replaced. Contact your supplier or BOC Edwards for advice.</p>

Table 18 - Fault finding (Sheet 2 of 3)

Drystar EDP Chemical Dry Vacuum Pumps

Symptom	Check	Actions
The gearbox is noisy.	Is the oil level low ?	Check the oil level and fill as necessary (refer to Section 5.3).
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 5.16).

Table 18 - Fault finding (Sheet 3 of 3)

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 5.8 and 5.12.1, 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 4.4, then disconnect the pump from the electrical supply.
2. Place a suitable container under the cooling-water connections on the services panel (Figure 6, 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 5.12.1. 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.

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.

Take particular care 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.

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7 SERVICE, SPARES AND ACCESSORIES

7.1 Introduction

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

Order spare parts from your nearest BOC 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 part.

7.2 Service

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

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

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

7.3 Spares and maintenance kits

The GENERAL spare parts and kits listed in Table 19 are available for the EDP pump.

7.4 Accessories

- A number of accessories are available for the EDP pumps, as listed below. Contact your supplier or BOC Edwards for details of these accessories.
- Exhaust Silencers (mild steel or stainless steel)
- Flame arrestors
- Acoustic enclosures and acoustic cover kits
- Gas ballast kits (for standard or flameproof pumps)
- Inlet purge kit (for standard or flameproof pumps)
- Motor change frame.

7.5 Ordering option

If required, you can order an EDP60 or EDP120 pump to be supplied with a torque limiter fitted, instead of the drive coupling; contact your supplier or BOC Edwards.

Drystar EDP Chemical Dry Vacuum Pumps

Spare/kit	Item Number
Mobil SHC 629 oil: 1 litre (0.26 US gal)	H110-23-010
Mobil SHC 629 oil: 4 litres (1.04 US gal)	H110-23-011
Drystar coolant *	H128-10-003
Pressure Relief Valve Assembly	A705-01-832
Routine Maintenance Kit	A705-01-825
Motor Fitment Kit	A705-01-805
Upper Bearing Kit	A705-01-826
Lower Bearing Kit: DPS/EDPS	A705-21-828
Swept Volume Kit	A705-01-827
'O' Ring Kit	A705-01-821
Swing Pressure Relief Valve Overhaul Kit	A705-01-833
Grease CR861	H113-50-116
Motor Bearing Kits †	
EDP60, 460 V, standard	A071-99-067
EDP60, 460 V, explosion-proof	A071-99-067
EDP120, 460 V, standard	A071-99-069
EDP120, 460 V, explosion-proof	A071-99-069
EDP200, 460 V, standard	A071-99-069
EDP200, 460 V, explosion-proof	A071-99-069
EDP300, 460 V, standard	A071-99-076
EDP300, 460 V, explosion-proof	A071-99-070

* 0.24 US gal as supplied, 0.53 US gal when diluted. To completely fill a pump with coolant, you will need 6 coolant containers for an EDP60, 7 containers for an EDP120, 8 containers for an EDP200 and 9 containers for an EDP300.

† You will need the correct Motor Bearing Kit to replace the motor bearings as described in Section 5.18.

Table 19 - Spares and maintenance kits