A710-03-855
Issue D

Maintenance Instructions

ESDP12, ESDP30 and ESDP30A Scroll Pumps

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Associated publications

Publication title Publication Number

List of Tools

Tool

3 mm Allen key
1-3/4" Spanner
1/2" Drive Extension
1/2" Drive Tommy Bar
1/4" Allen key
½" Drive Extension 125 mm long
13 mm Spanner
17 mm Allen Socket
19 mm Spanner
22 mm Extra Deep Socket
22 mm Spanner
24 mm Socket
24 mm Spanner
27 mm Spanner
3/8" Allen key

Tool

M16 Nuts
M16 Washers
M16 x 120 mm Screw
M16 x 150 Hexagonal Head screws
M6 Screw
Medium Emery Cloth
Medium Flat Blade Screwdriver
Nylon Face Hammer
Paint Trolley
Permanent Ink Marker Pen
Piston Ring Expander
Plywood
Pressure test rig
Punch
Ratchet or T-bar

Contents

Tool

32 mm Spanner
4 mm Allen key
5/8" Long series Allen key
6 mm Allen key
7½" Spread Sliding Leg Gear Puller
8 mm Allen key
9/16" Spanner
A70501095 Mounting Plate 1
A70501096 Mounting Plate 2
A70501097 Mounting Plate 3
Bench Press
Blanking Plate Test Adapter
Engineer Scriber
Engineer's Vice
Feeler gauge strip 0.08 mm
Flat blade screw driver
Fomblin grease
Gear Cover Oil
Hammer
Hydrocarbon Oil
IS 0200120 Enerpac RCH-121 Set
Large Flat Blade Screwdriver
Lifting Eyes, Shackles and Strop
Loctite 242
Loctite 577
Loctite 601
Loctite 641
M12 Washers
M12 x 30 Hexagonal Head Screws

Tool

Sanding Block
Swagelok 316 FGR Blanks
TDS10271 GV LV Seal Assembly Tool
TDS10504 GV Service Cart
TDS10568 Roots Rotor Sleeve (GV410/260)
TDS10569 Rotor Sleeve
TDS10572 LV MS Rotor Sleeve
TDS10575 LV Rotor Sleeve 410
TDS10612 Roots Rotor Sleeve (GV600)
TDS10614 Seal Assembly Press
TDS10615 Seal Carrier
TDS7730 Shaft Locking Plate
TDS7732 LV Sleeve Setter
TDS7733 Shaft Locking Tool
TDS7734 LV Bearing Tool
TDS7735 LV Bearing Tool
TDS7736 Rotor Extractor
TDS7737 Seal Insert Tool
TDS7767 GV Dowel Height Setter
TDS7768 GV Dowel Height Setter
TDS7889 Rotor Sleeve Washer
TDS7891 Pin Depth Tool
TDS8064 HN9 C Spanner
TDS8311 Insert Tool
TDS8638 LV Head-plate Water Jacket Seal
Torque Wrench 150 lb./ft - with ½" Drive
Two sets of 6 mm (D) x 100 mm (L) studs and nuts
Water Pressure Test Rig

1 Introduction

1.1 Scope and definitions

This manual describes the service procedures for the Edwards ESDP12, ESDP30 and ESDP30A scroll pumps.

Read this manual before you service the scroll pump.

This manual contains important safety information which is highlighted as WARNING and CAUTION instructions; you must obey these instructions. The use of WARNINGS and CAUTIONS is defined below.

WARNING

Warnings are given where failure to observe the instruction could result in injury or death to people.

CAUTION

Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.

1.2 Safety

WARNING

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

- Ensure that the technician who will dismantle and service the pump has been suitably trained.
- Ensure that the technician who will dismantle and service the pump 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.
- If the pump has been contaminated with dangerous process substances, operate the pump with nitrogen inlet purge for 15 minutes or more, then operate the pump at atmospheric pressure for two or three minutes, before you disconnect the pump from the process and exhaust-extraction systems.
- Allow the pump to cool to a safe temperature before you start work.
- Do not reuse O-rings if they are damaged.
- Dispose of components and grease safely (see Section 1.3).
- Protect sealing surfaces from damage.
- Do not touch or inhale the thermal breakdown products of fluorinated materials which may be present if the pump has been heated to 260°C and above. These breakdown products are very dangerous. The pump may have overheated if it was misused, if it malfunctioned or if it was in a fire. Fluorinated materials in the pump include greases and seals.
- Ensure that you service the pump as described in this manual. If you do not, you can damage the pump.
- Leak test the pump after work is complete and seal any leaks found to prevent leakage of dangerous substances out of the pump and leakage of air into the pump.

Note: Edwards Material Safety Data Sheets for the seals, oils and greases used in the pump are available on request: contact your supplier or Edwards.

1.3 Disposal

Dispose of used components and grease safely in accordance with all local and national safety and environmental requirements. Take particular care with the following:

- Fluoroelastomers which have decomposed as the result of being subjected to high temperatures.
- Components which have been contaminated with dangerous process substances.

1.4 Equipment and materials required

To use the procedures described in this manual, you will require certain tools and equipment; these are listed below.

- General hand tools, which include metric hexagonal keys, flat and cross-head (Posidrive) screwdrivers, and metric sockets and spanners.
- ESDP12 special tools kit (see Appendix A1), when you service an ESDP12 pump
- ESDP30/ESDP30A special tools kit (see Appendix A2), when you service an ESDP30 or ESDP30A pump
- Blocks
- Soft drift
- Lint-free cloth
- Service kits (see Section 3)
- Fume-extraction equipment for the safe extraction of dangerous process substances.

Throughout this manual, we refer to grease and thread sealant. We recommended that you use the following:

- Thread sealant - Use Loctite 242* or Loctite 243.
- Grease -Use the grease supplied in the service kits. If you use a different grease, you may damage the bearings.

2 Parts List

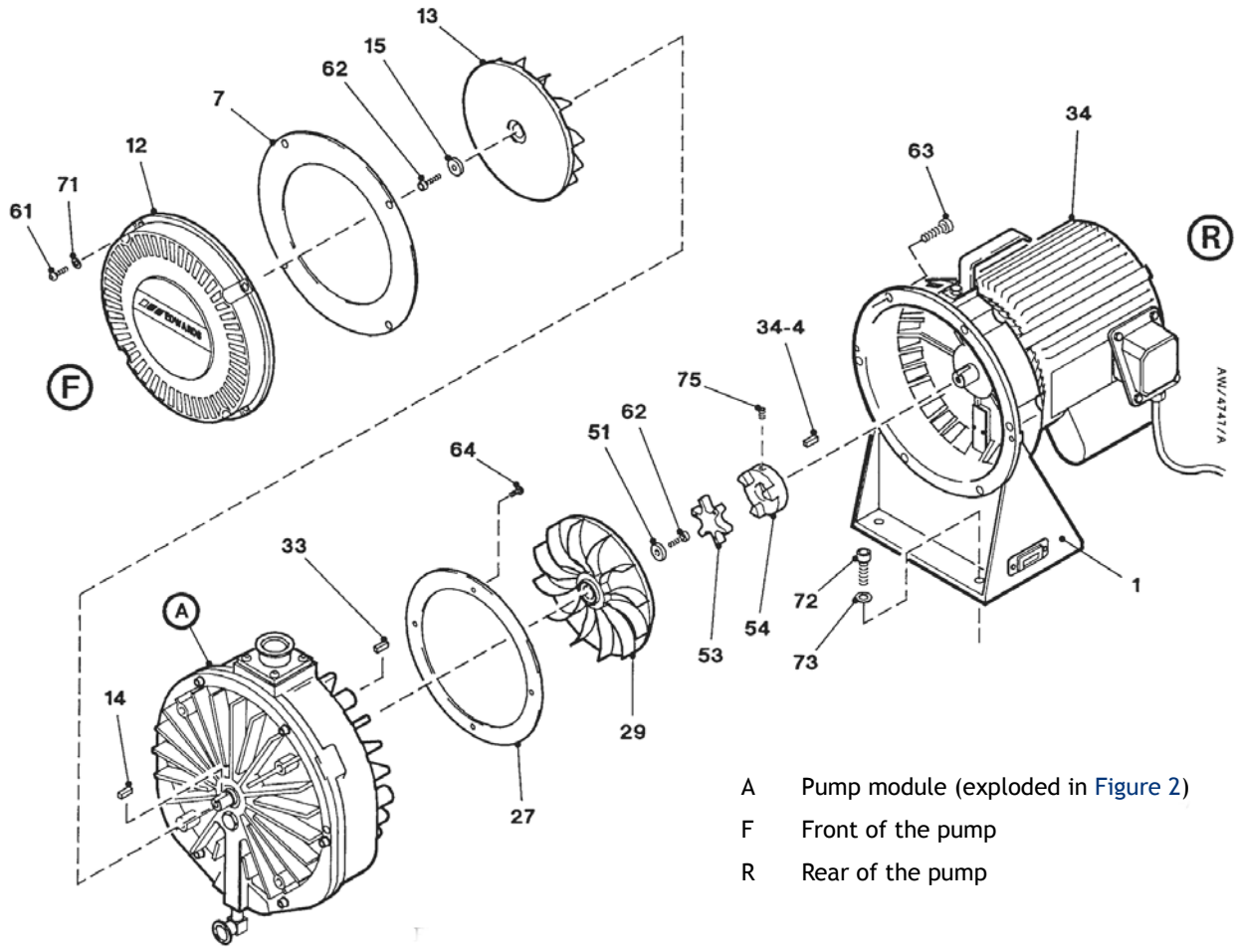
Exploded and sectional views of the scroll pumps are shown as follows:

- The ESDP12 scroll pump is shown in Figure 1 to 4.
- The ESDP30 scroll pump is shown in Figure 5 to 8.
- The ESDP30A scroll pump is shown in Figure 9 to 12.

The component parts of the ESDP12 pump shown on Figures 1 to 4 are listed in Table 1. The component parts of the ESDP30 and ESDP30A pump shown on Figure 5 to 12 are listed in Table 2. When you read Table 1 and 2, take note of the following:

- The 'part number' is the number of the component part shown on the figures.
- Where a part number is greater than 100, the part number applies to an assembly of a number of component parts (as shown on the figures) rather than an individual component part.
- The entries in the 'Spares Kit(s)' column are cross references to the kits and assemblies listed in Table 3 (see Section 3). If a part has an entry in this column, then the component part is included in the referenced assembly or kit(s).
- If a part has an entry in the 'Item Number' column, then the part is available as a spare and the entry defines the Item Number of the spare part.

Figure 1 - Exploded View of the ESDP12 Pump

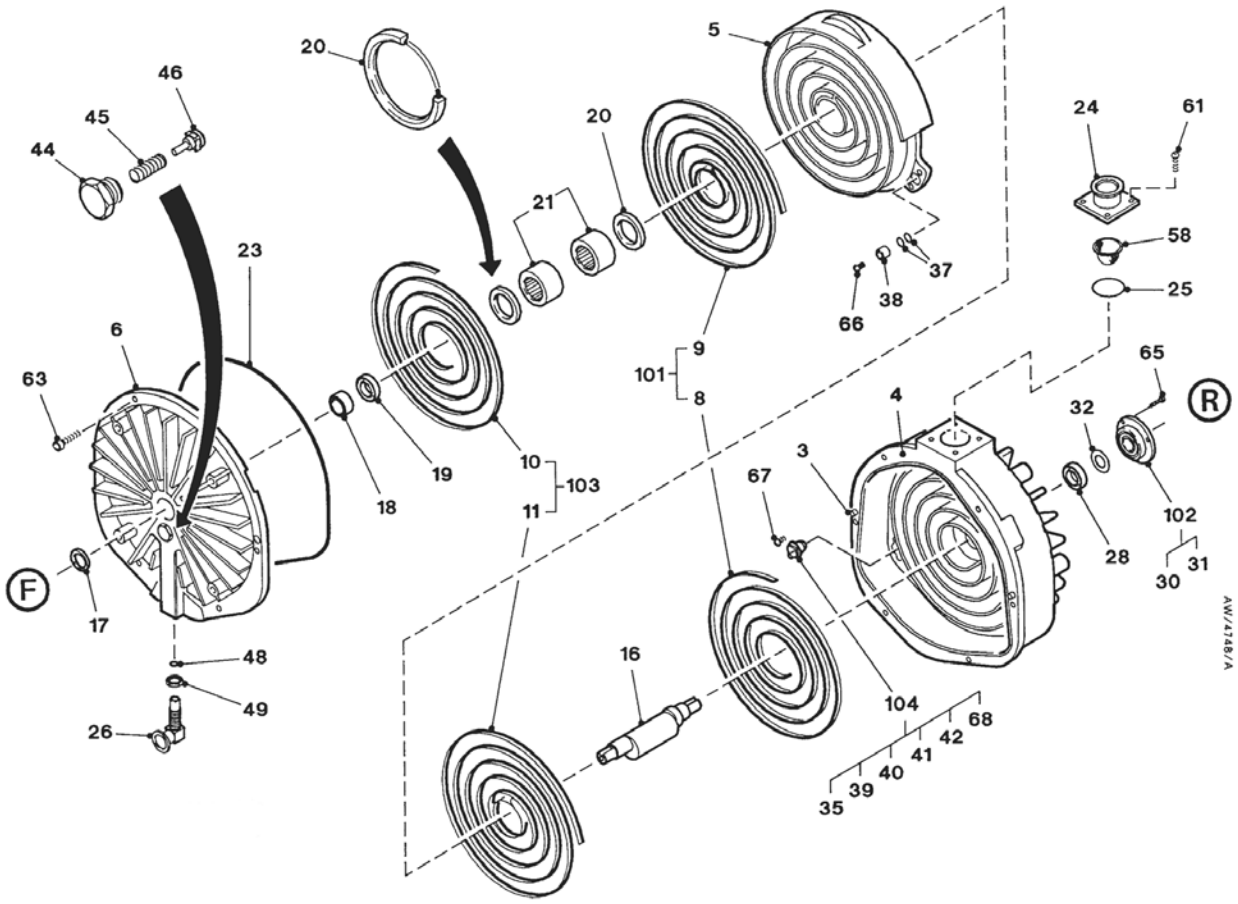


A Pump module (exploded in Figure 2)

F Front of the pump

R Rear of the pump

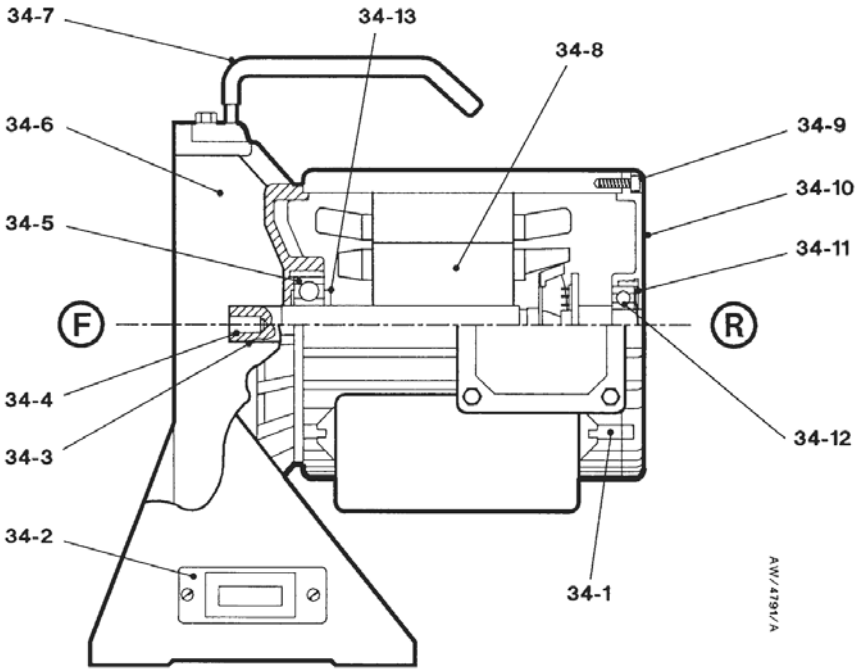
Figure 2 - Exploded View of the ESDP12 Pump Module



F Front of the pump module

R Rear of the pump module

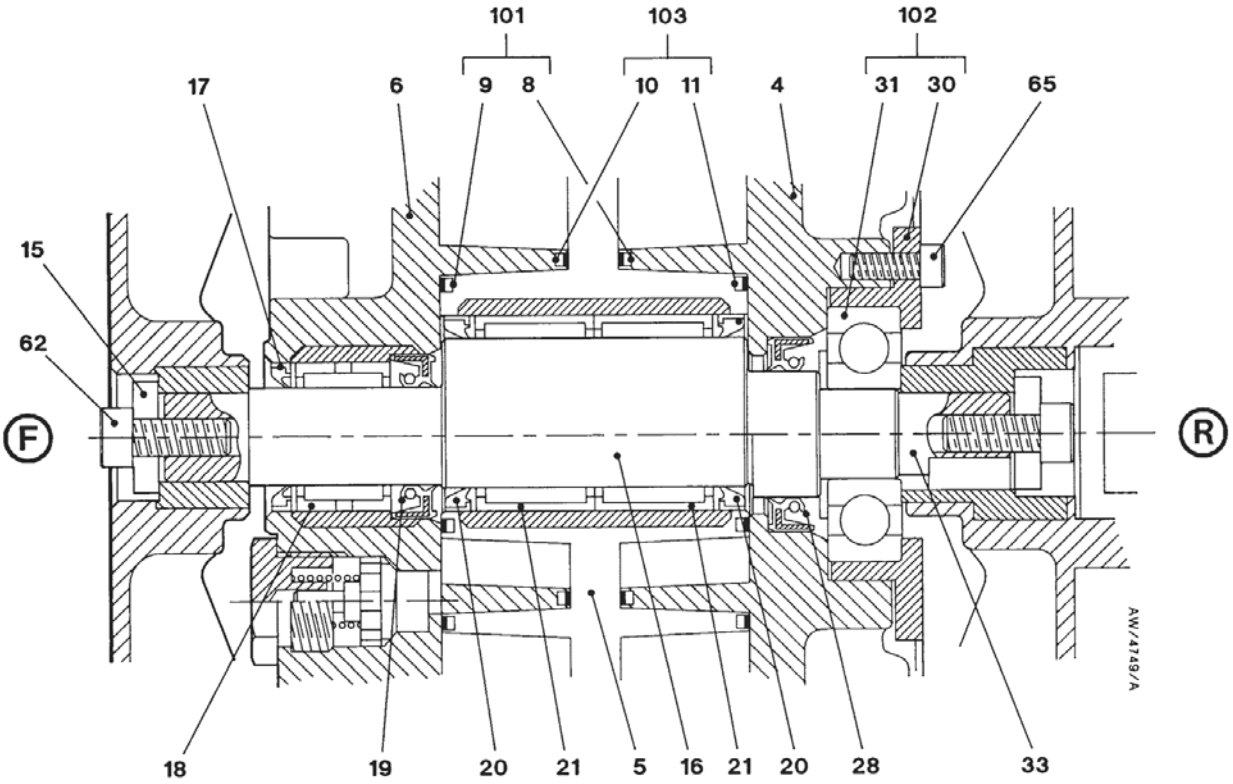
Figure 3 - Sectional View of the ESDP12 Motor Assembly



F Front of the motor assembly

R Rear of the motor assembly

Figure 4 - Sectional View of the ESDP12 Scrolls, Crank Shaft and Bearings to Show the Seal Orientations



F Front of the pump module

R Rear of the pump module

Table 1 - ESDP12 Parts List

Part Number	Description	Qty	Spares kit(s) or assembly	Item Number
1	Base	1		
3	Dowel	4		
4	Rear fixed scroll	1		A710-02-013
5	Orbiting scroll	1		A710-02-015
6	Front fixed scroll	1		A710-02-014
7	Cover plate	1		
8	Tip seal	1	2 *, 6	
9	Tip seal	1	2 *, 6	
10	Tip seal	1	2 #, 6	
11	Tip seal	1	2 #, 6	
12	Fan cover	1		A710-02-024
13	Front fan	1		A710-02-017
14	Parallel key	1		
15	Plain washer	1		
16	Crank shaft	1		A710-02-012
17	Grease seal 16 i.d.	1	1	
18	Needle bearing	1	2	
19	Shaft seal 16 i.d.	1	1	
20	Grease seal 24 i.d.	2	1	
21	Needle bearing	1 pair	2	
23	'O' ring	1	1	
24	Inlet flange	1		A710-02-018
25	'O' ring	1		A710-02-027
26	Outlet flange	1		A710-02-019
27	Cover plate	1		
28	Shaft seal 20 i.d.	1	1	
29	Rear fan	1		A710-02-016
30	Bearing case	1	2 †	
31	Ball bearing	1	2 †	
32	Spacer	1		
33	Parallel key	1		
34	Motor assembly	1	4	
34-1	Stator	1	4	
34-2	Hours meter	1	4	A710-03-022
34-3	Shaft	1	4	
34-4	Key	1	4	
34-5	Front bearing	1	2, 4, 7	

Parts List

Table 1 - ESDP12 Parts List

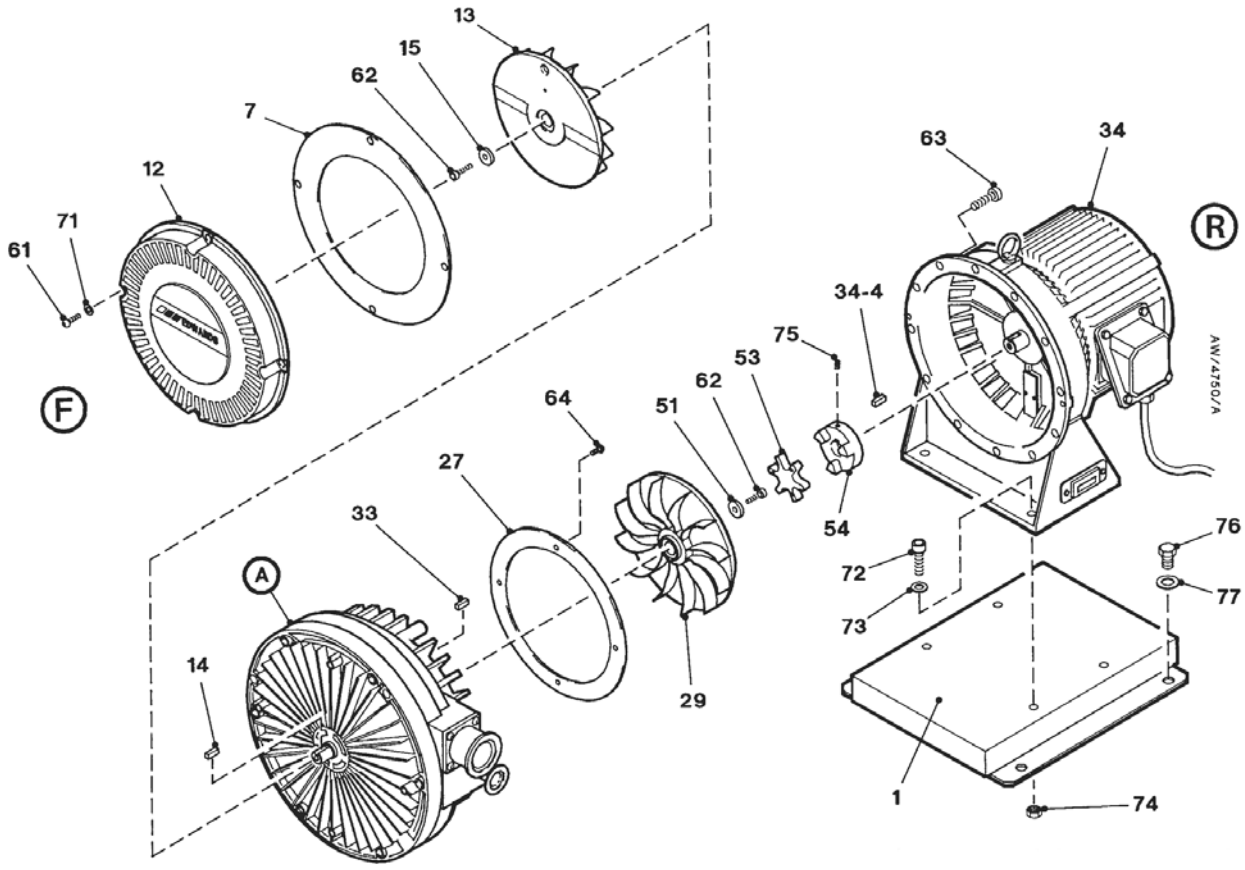
Part Number	Description	Qty	Spares kit(s) or assembly	Item Number
34-6	Coupling cover	1	4	
34-7	Lifting handle	1	4	
34-8	Rotor	1	4	
34-9	Hex head bolt	4	4	
34-10	Motor end-plate	1	4	
34-11	Spring washer	2	4	
34-12	Rear bearing	1	2, 4, 7	
34-13	Washer	1		
35	Inner race	3	3	
37	'O' ring	6	3	
38	Needle bearing	3	3	
39	Crank pin	3	3	
40 S	pacer sleeve	3	3	
41	Spacer sleeve	3	3	
42	Ball bearing	6	3	
44	Outlet valve guide	1	1	
45	Outlet valve spring	1	1	
46	Outlet valve stem	1	1	
48	'O' ring	1		
49	Nut	1		
50	Plug	1		
51	Washer	1		
53	Coupling element	1		A710-02-023
54	Coupling hub	1		
58	Inlet screen	1		A710-02-021
61	Dome head screw M6 x 12	8		
62	Cap head screw M6 x 16	2		
63	Cap head screw M6 x 16	12		
64	Cross head screw M5 x 8	4		
65	Cap head screw M5 x 12	3		
66	Cross head bolt M3 x 4 6	3		
67	Cross head bolt M4 x 5 6	3		
68	Cross head bolt M5 x 8 3	3		
71	Plain washer M6	4		
72	Hex head bolt M10 x 25	4		
73	Washer M10	4		
75	Grub screw	1		
101	Tip seal (clockwise)	1	2	

Table 1 - ESDP12 Parts List

Part Number	Description	Qty	Spares kit(s) or assembly	Item Number
102	Bearing kit	1	2	
103	Tip seal (anticlockwise)	1	2	
104	Crank pin assembly	3	3	

* Included in kit 2 as part 101
\# Included in kit 2 as part 103
† Included in kit 2 as part 102

Figure 5 - Exploded View of the ESDP30 Pump



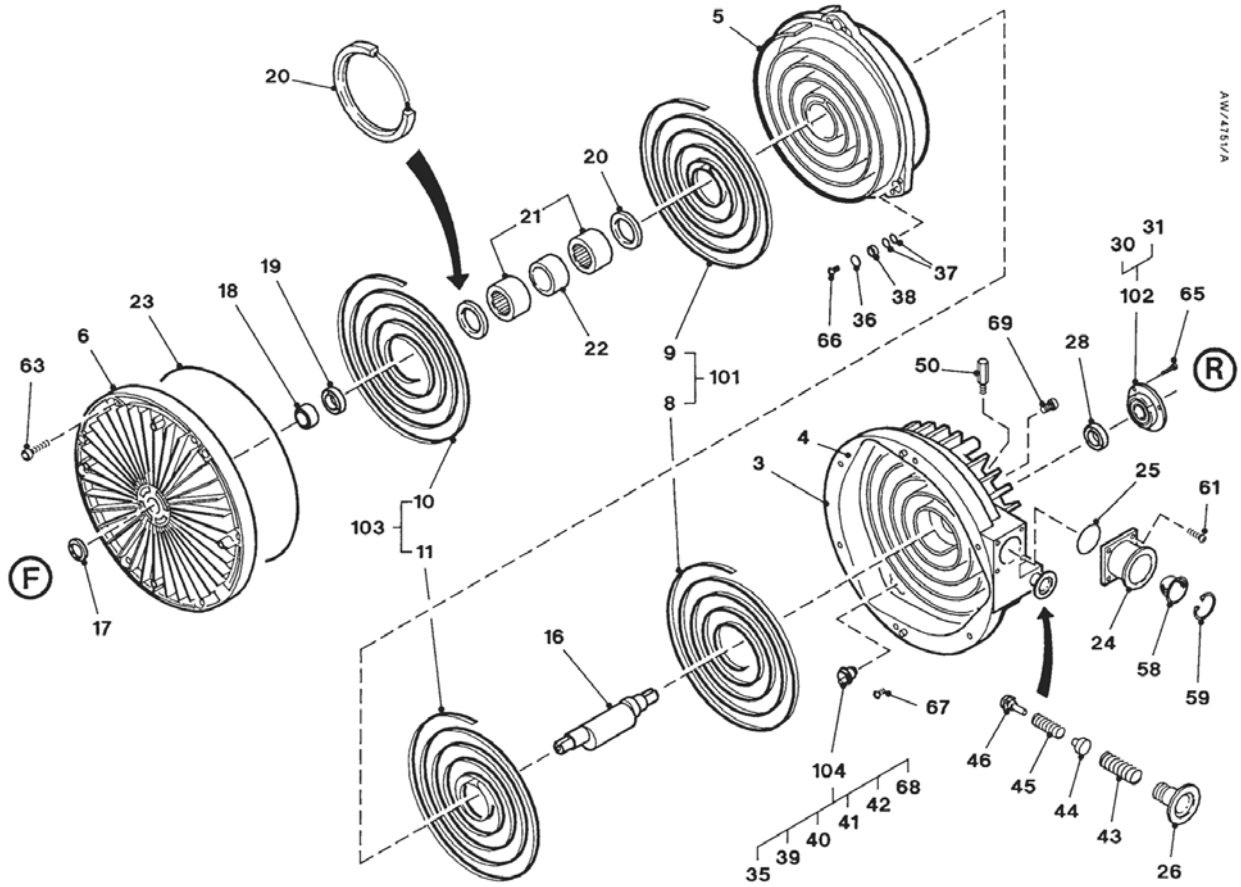
A Pump module (exploded in Figure 6)

F Front of the pump

R Rear of the pump

Parts List

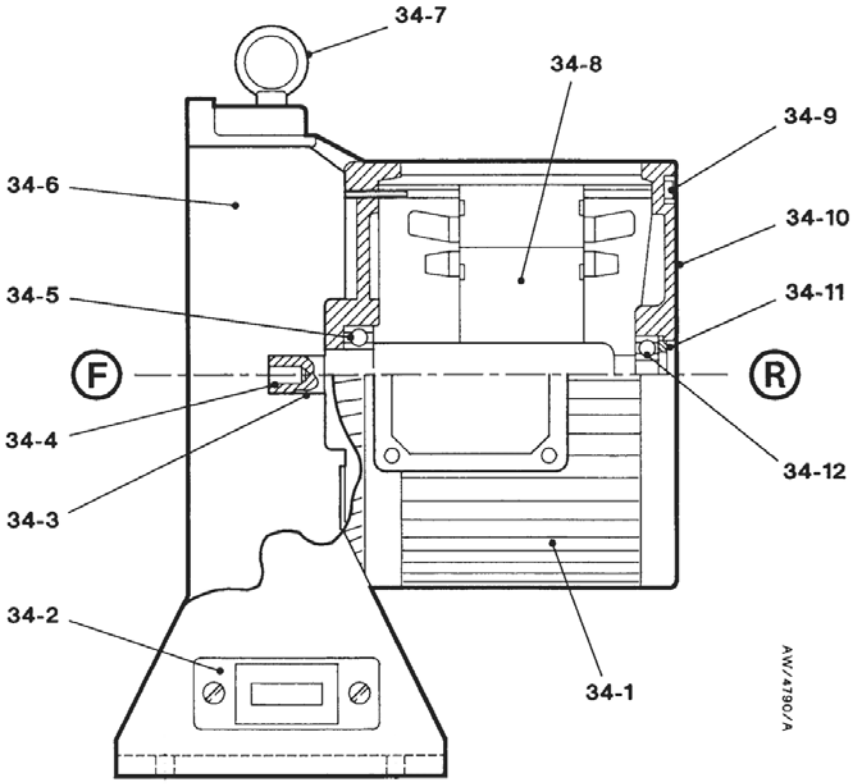
Figure 6 - Exploded View of the ESDP30 Pump Module



F Front of the pump module

R Rear of the pump module

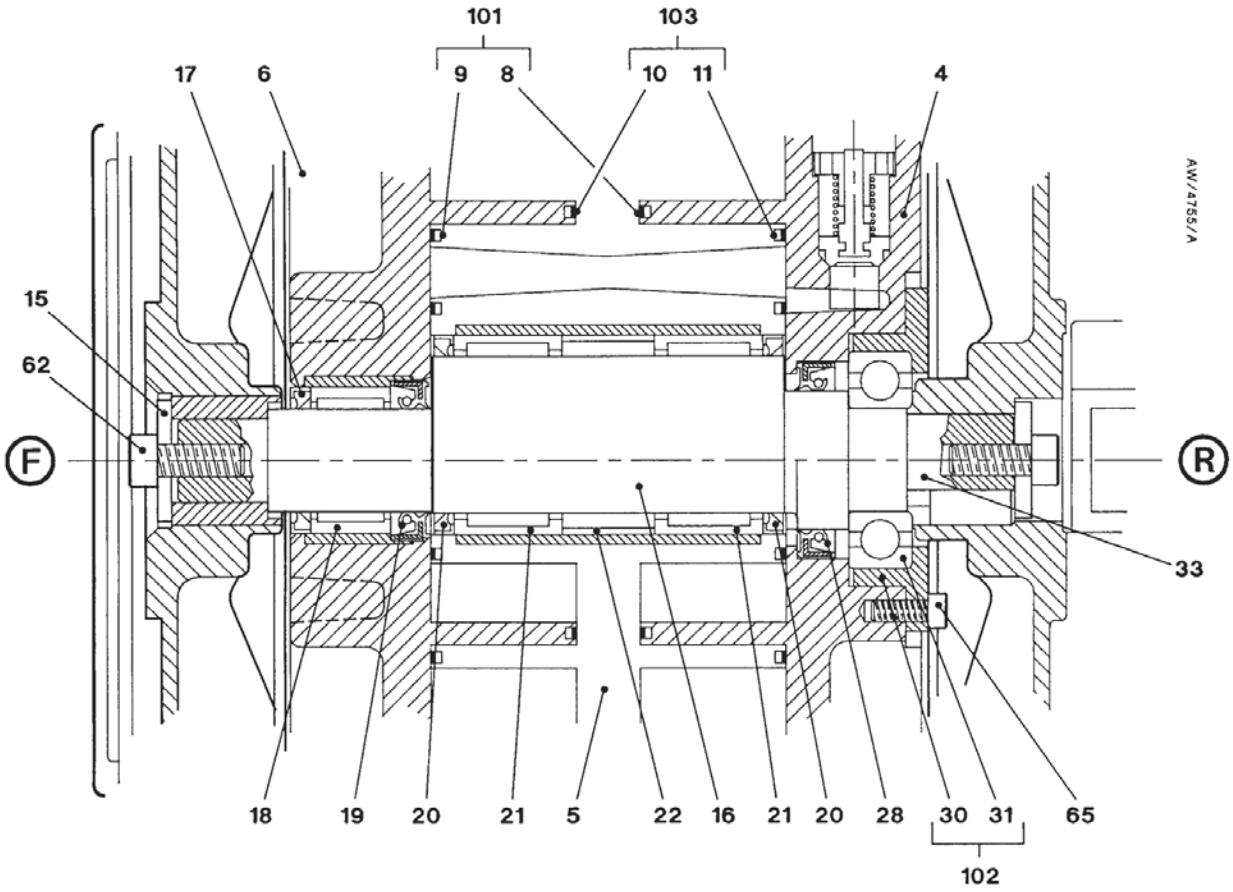
Figure 7 - Sectional View of the ESDP30 Motor Assembly (3-Phase Motor Shown)



F Front of the motor assembly

R Rear of the motor assembly

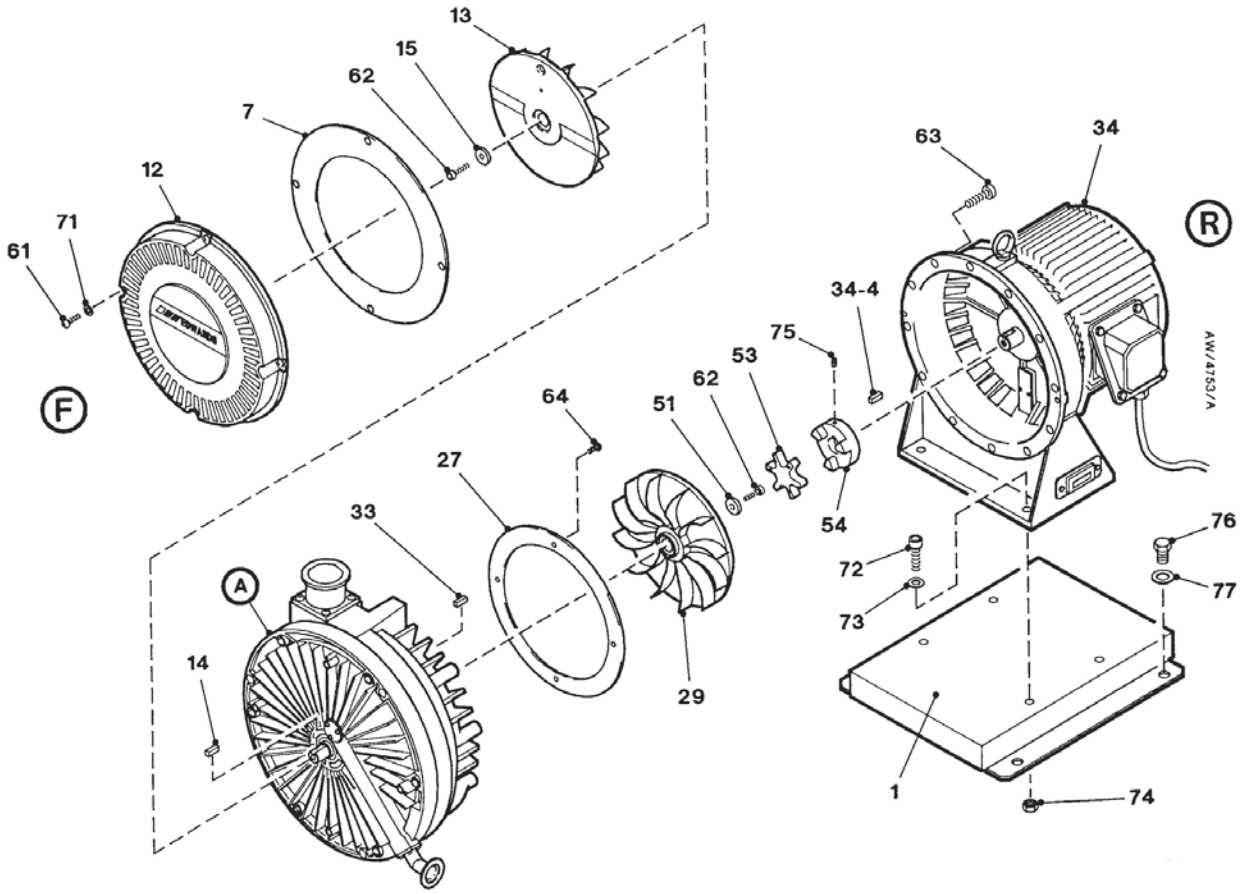
Figure 8 - Sectional View of the ESDP30 Scrolls, Crank Shaft and Bearings to Show the Seal Orientations



F Front of the motor assembly

R Rear of the motor assembly

Figure 9 - Exploded View of the ESDP30A Pump

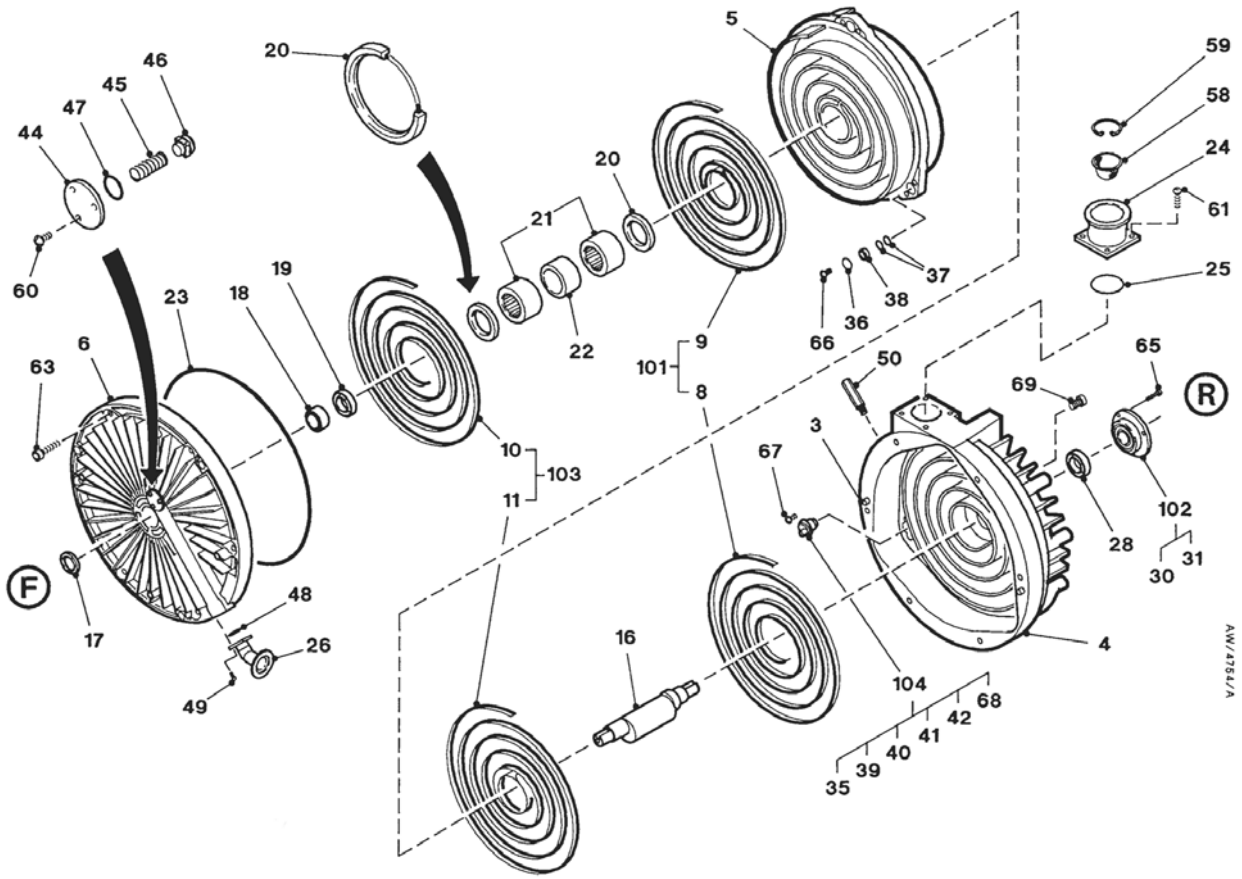


A Pump module (exploded in Figure 10)

F Front of the pump

R Rear of the pump

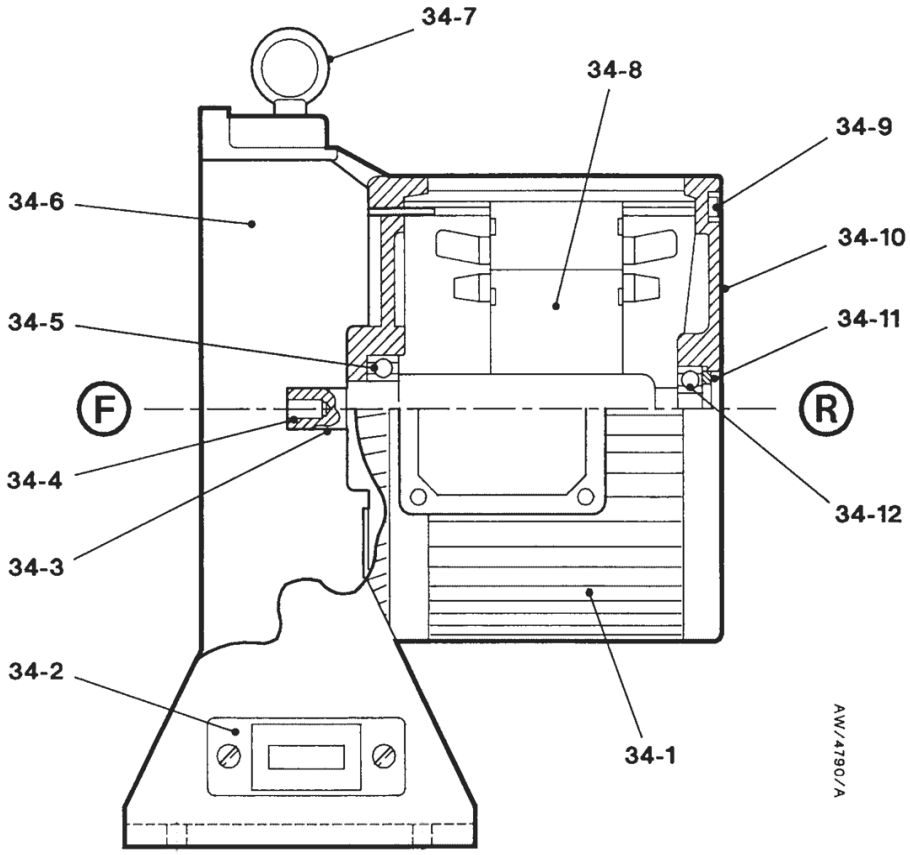
Figure 10 - Exploded View of the ESDP30A Pump Module



F Front of the motor assembly

R Rear of the motor assembly

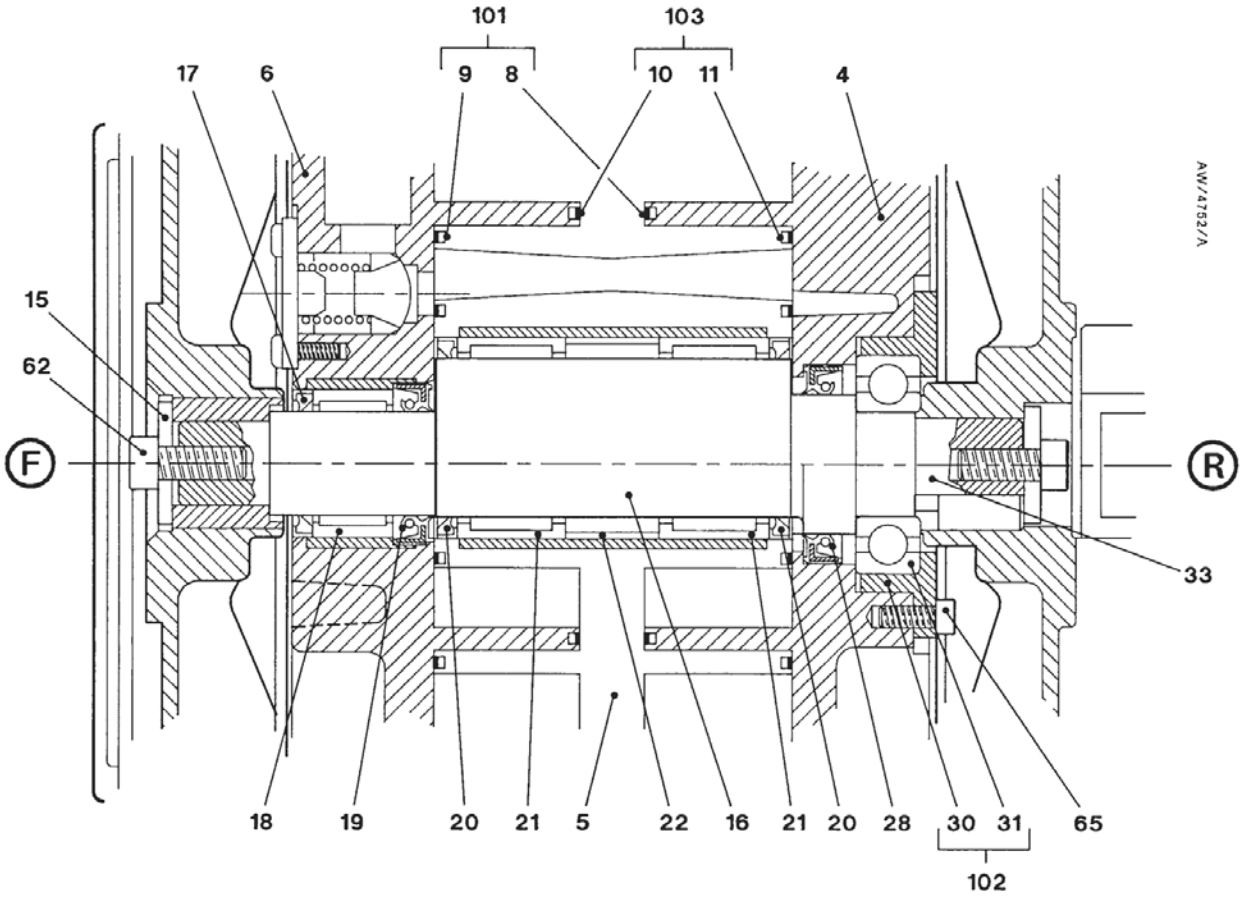
Figure 11 - Sectional View of the ESDP30A Motor Assembly (3-Phase Motor Shown)



F Front of the motor assembly

R Rear of the motor assembly

Figure 12 - Sectional View of the ESDP30A Scrolls, Crank Shaft and Bearings to Show the Seal Orientations



F Front of the motor assembly

R Rear of the motor assembly

Table 2 - ESDP30/ESDP30A Parts List

Part Number	Description	Qty		Spares kit(s) or assembly	Item Number
		ESDP30	ESDP30A		
1	Base	1	1		
3	Dowel	4	4		
4	Rear fixed scroll - ESDP30	1	-		A710-03-013
4	Rear fixed scroll - ESDP30A	-	1		A710-03-113
5	Orbiting scroll	1	1		A710-03-015
6	Front fixed scroll - ESDP30	1	-		A710-03-014
6	Front fixed scroll - ESDP30A	-	1		A710-03-114
7	Cover plate	1	1		
8	Tip seal	1	1	2 *, 6	
9	Tip seal	1	1	2 *, 6	
10	Tip seal	1	1	2 #, 6	
11	Tip seal	1	1	2 #, 6	
12	Fan cover	1	1		A710-03-024
13	Front fan	1	1		A710-03-017
14	Parallel key	1	1		
15	Plain washer	1	1		
16	Crank shaft	1	1		A710-03-012
17	Grease seal 20 i.d.	1	1	1	
18	Needle bearing	1	1	2	
19	Shaft seal 20 i.d.	1	1	1	
20	Grease seal 30 i.d.	2	2	1	
21	Needle bearing	1 pair	1 pair	2	
22	Spacer sleeve	1	1		
23	'O' ring	1	1	1	
24	Inlet flange	1	1		A710-03-018
25	'O' ring	1	1		A710-03-027
26	Outlet flange - ESDP30	1	-		A710-03-019
26	Outlet flange - ESDP30A	-	1	A710-03-119	
27	Cover plate	1	1		
28	Shaft seal 26 i.d.	1	1	1	
29	Rear fan	1	1		A710-03-016
30	Bearing case	1	1	2 †	
31	Ball bearing	1	1	2 †	
33	Parallel key	1	1		
34	Motor assembly	1	1	4, 5	
34-1	Stator	1	1	4, 5	
34-2	Hours meter	1	1	4, 5	A710-03-022
34-3	Shaft	1	1	4, 5	
34-4	Key	1	1	4, 5	

Table 2 - ESDP30/ESDP30A Parts List

Part Number	Description	Qty		Spares kit(s) or assembly	Item Number
		ESDP30	ESDP30A		
34-5	Front bearing	1	1	2, 4, 5, 7	
34-6	Coupling cover	1	1	4, 5	
34-7	Lifting bolt	1	1	4, 5	
34-8	Rotor	1	1	4, 5	
34-9	Hex head bolt	4	4	4, 5	
34-10	Motor end-plate	1	1	4, 5	
34-11	Spring washer	1	1	4, 5	
34-12	Rear bearing	1	1	2, 4, 5, 7	
35	Inner race	3	3	3	
36	Cover plate	3	3		
37	'O' ring	6	6	3	
38	Needle bearing	3	3	3	
39	Crank pin	3	3	3	
40	Spacer sleeve	3	3	3	
41	Spacer sleeve	3	3	3	
42	Ball bearing	6	6	3	
43	Spring	1	-	3	A710-03-029
44	Outlet valve guide	1	-		
44	Outlet valve cover	-	1		
45	Outlet valve spring	1	1	1	
46	Outlet valve stem	1	1	1	
47	'O' ring	-	1	1	
48	'O' ring	-	1		
49	Cap head screw M4 x 10	-	4		
50	Plug	1	1		
51	Washer	1	1		
53	Coupling element	1	1		A710-03-023
54	Coupling hub	1	1		
58	Inlet screen	1	1		A710-03-021
59	Circlip	1	1		
60	Dome head screw M4 x 10	-	3		
61	Dome head screw M6 x 12	4	4		
62	Cap head screw M6 x 16	2	2		
63	Cap head screw M8 x 22	12	12		
64	Dome head screw M5 x 8	4	4		
65	Cap head screw M5 x 12	3	3		
66	Cross head bolt M3 x 4	6	6	3	
67	Cross head bolt M4 x 5	6	6	3	
68	Cross head bolt M5 x 8	3	3	3	

Table 2 - ESDP30/ESDP30A Parts List

Part Number	Description	Qty		Spares kit(s) or assembly	Item Number
		ESDP30	ESDP30A		
69	Plug	1	-		
71	Plain washer M6	4	4		
72	Hex head bolt M10 x 25	4	4		
73	Washer M10	4	4		
74	Nut	4	4		
75	Grub screw	1	1		
76	Hex-head bolt M10	4	4		
77	Washer	4	4		
101	Tip seal (clockwise)	1	1	2	
102	Bearing kit	1	1	2	
103	Tip seal (anticlockwise)	1	1	2	
104	Crank pin assembly	3	3	3	

* Included in kit 2 as part 101
\# Included in kit 2 as part 103
† Included in kit 2 as part 102

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3 Spares Kits and Assemblies

Note: Spare parts for the pumps are listed in Table 1 and 2 (see Section 2).

The spare assemblies and kits are listed in Table 3 and the contents of these assemblies and kits are listed in Table 4 to 7. Use the service kits to service the pump every year, as follows:

- Use the Minor Service Kit only to service the pump at the end of the first, third, fifth and every subsequent 'odd' year of operation.
- Use the Major Service Kit together with the Minor Service Kit to service the pump at the end of the second, fourth, sixth and every subsequent 'even' year of operation.
- Use the Tip Seals Kit to replace the tip seals at any time, if there are signs of tip seal wear.

The motor bearings kit (Item Number A710-03-805) and the flexible coupling kit (Item Number A710-03-806) are upgrade kits. If required, use the ESDP30A Retrofit Kit (Item Number A710-03-028) to reconfigure an ESDP30A pump so that the pump outlet is next to the pump inlet, as on the ESDP30 pump. Use these kits as described in the instructions supplied with the kits.

Table 3 - Kits and Spare Assemblies

Kit/assembly Number	Kit	Item Number			Refer to Table
		ESDP12	ESDP30	ESDP30A	
1	Minor Service Kit	A710-02-820	A710-03-820	A710-03-821	4
2	Major Service kit	A710-02-800	A710-03-800	A710-03-800	5
3	Crank Pin Kit	A710-02-006	A710-03-006	A710-03-006	6
4	Motor assembly: 1-phase	A710-02-010	A710-03-010	A710-03-010	#
5	Motor assembly: 3-phase	A710-02-011	A710-03-011	A710-03-011	#
6	Tip Seals Kit	A710-02-026	A710-03-026	A710-03-026	7
7	Motor Bearings Kit	A710-02-805	A710-03-805	A710-03-805	#

* Table 1 or 2 reference. # The component parts of the motor assembly are shown in Figure 2, 6 and 10.

Table 4 - Contents of the Minor Service Kit

Part Number	Description	Qty		
		ESDP12	ESDP30	ESDP30A
17	Grease seal	1	1	1
19	Shaft seal	1	1	1
20	Grease seal	2	2	2
23	Stator 'O' ring	1	1	1
28	Shaft seal	1	1	1
44	Outlet valve guide	-	1	-
45	Outlet valve spring	1	1	1
46	Outlet valve	1	1	1
48	Exhaust flange 'O' ring	1	-	-
-	Grease syringe and grease	1	1	1

Table 5 - Contents of the Major Service Kit

Part Number	Description	Qty
18	Needle bearing	1
21	Needle bearing	1 pair
34-5	Front bearing	1
34-12	Rear bearing	1
101	Tip seal (clockwise)	1
102	Bearing kit	1
103	Tip seal (anticlockwise)	1

Table 6 - Contents of the Crank Pin Kit

Part Number	Description	Qty	
		ESDP12	ESDP30/30A
35	Inner race *	2	1
37	'O' ring	4	2
38	Needle bearing	2	1
39	Crank pin *	2	1
40	Spacer sleeve *	2	1
41	Spacer sleeve *	2	1
42	Ball bearing *	4	2
66	Cross head bolt M3 x 4	4	2
67	Cross head bolt M4 x 5	4	2
68	Cross head bolt M5 x 8 *	2	1
104	Crank pin assembly *	2	1

* Parts 35, 39 to 42 and 68 are supplied assembled into part 104.

Table 7 - Contents of the Tip Seals Kit

Part Number	Description	Qty
8	Tip seal	1
9	Tip seal	1
10	Tip seal	1
11	Tip seal	1

4 Service the ESDP12 Pump

WARNING

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

Note: All of the figures in the following sections are keyed as follows:

- *Key numbers which are circled identify ESDP12 special tools (as illustrated in Appendix A1).*
- *Key numbers which are not circled identify component parts of the pump, as shown in Figure 1 to 4 and listed in Table 1.*

The following procedures refer to the 'front' and 'rear' of pump components. The front of a component is the face of the component which is nearest to the outside face of the fan cover (Figure 1, item 12). The rear of a component is the face of the component which is nearest to the motor (Figure 1, item 34).

The fan cover (12) has a label which states the pump serial number. If you replace the fan cover, peel the label off of the old fan cover and place the label on the new fan cover.

4.1 Preparation

Before you service the pump, use the following procedure to prepare the pump.

1. Use a suitable cleaning solution to clean your work surfaces and tools.
2. If the pump has been contaminated with dangerous process substances, operate the pump with nitrogen inlet purge for 15 minutes or more, before you disconnect it.
3. Operate the pump with the inlet at atmospheric pressure for two or three minutes to remove any dust or contaminants from the pump, before you disconnect it.
4. Switch off the pump, disconnect it from the electrical supply and from the process and exhaust-extraction systems, then move the pump to where you will dismantle it.

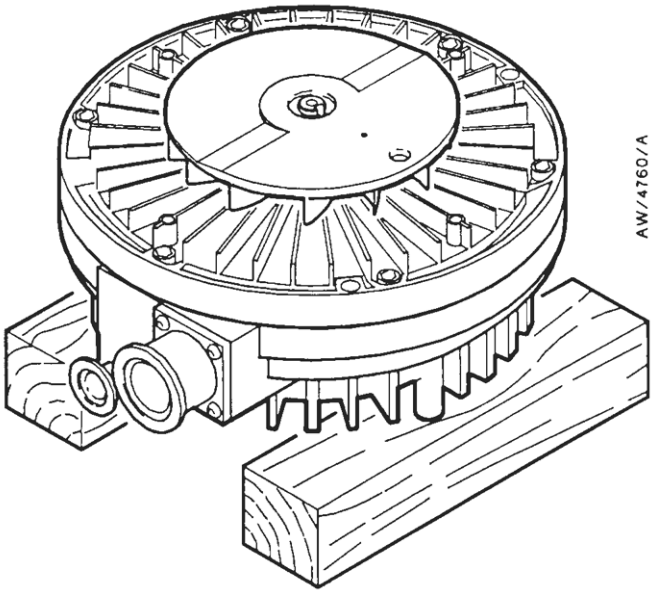
4.2 How to use the Minor Service Kit

4.2.1 Dismantle the pump

1. Refer to Figure 1. Remove the four M6 dome head screws (61) and plain washers (71) which secure the fan cover (12), then remove the fan cover and the cover plate (7).
2. Turn the front fan (13) and take note of the resistance required to turn the fan.
3. Loosen the six M6 cap head screws (63) which secure the motor (34) to the rear fixed scroll (4).
4. Turn the pump so that the pump rests on the motor (34) and so that the front fan (13) faces upwards.
5. Remove the six cap head screws (63) and lift the pump body (A) off of the motor (34). If you cannot easily lift the pump body off of the motor, place two of the cap head screws into the jacking holes on the motor flange and tighten the screws to push the pump body off of the motor flange: refer to the pump instruction manual.
6. Place the rear fixed scroll on suitable blocks (of height 55 mm or more), with the front fixed scroll (6) upwards: see Figure 13.
7. Remove the M6 cap head screw (62) and plain washer (15) which secures the front fan (13) to the crank shaft (16), then remove the front fan (13) and the parallel key (14) from the crank shaft. If necessary, use a screwdriver to lever the fan off of the crank shaft.

8. Refer to Figure 2. Alternately and evenly loosen the six M6 cap head screws (63) which secure the front fixed scroll (6) to the rear fixed scroll (4).
9. Remove the six M6 screws (63), then remove the front fixed scroll (6).
10. Pull the orbiting scroll (5) out of the rear fixed scroll (4); if necessary, turn the crank shaft (16) to assist you to remove the orbiting scroll.
11. Refer to Figure 1. Turn over the pump, so that the rear fan (29) is upwards.
12. Remove the M6 cap head screw (62) which secures the rear fan (29).
13. Remove the rear fan (29) and the plain washer (51).
14. Remove the parallel key (33) from the crank shaft (16). Refer to Figure 2; remove the crank shaft (16) from the rear fixed scroll (4); if necessary, use a hammer and a soft drift to knock the crank shaft out of the fixed scroll.

Figure 13 - Place the Pump on Blocks (ESDP30 Shown)



4.2.2 Inspect and clean the pump

1. Refer to Figure 2. Inspect the rear (inner) surface of the front fixed scroll (6), the front (inner) surface of the rear fixed scroll (4), and both the front and the rear surfaces of the orbiting scroll (5). If any of the surfaces are coated with deposits, you must clean them:
    - We recommend that you use a mild abrasive pad (such as Scotchbrite) to remove the deposits. Do not use harsh abrasive methods, such as shot blasting, or you may damage the pump.
    - If you use a wet cleaning method, you must dry the components thoroughly before you reassemble the pump: dry the components in an oven or vacuum dry them. If you do not thoroughly dry the components, water may become lodged in the components and the performance of the pump may be poor (temporarily or permanently).
2. The front fixed scroll (6), the rear fixed scroll (4) and the orbiting scroll (5) are made from aluminium and have a black outer anodised coating; inspect the rear (inner) surface of the front fixed scroll (6), the front (inner) surface of the rear fixed scroll (4) and the front and the rear surfaces of the orbiting scroll (5) again:
    - If there are scratches or chips or areas of localised wear which have completely removed the outer anodised coating and have revealed the (silver) aluminium, you must replace the component.

- If there are just light scratches in the outer anodised coating (that is, no aluminium shows), refinish the surface of the component to remove the scratch; if you do not, tip seal wear will be excessive when you reassemble and operate the pump.

3. Inspect the crank shaft (16) where it locates in the shaft seals (19, 28)/grease seals (20). If the crank shaft is worn to a depth of 0.06 mm (that is, its diameter is reduced by 0.12 mm) or more, you must replace the crank shaft.

4.2.3 Replace the shaft seal in the rear fixed scroll

1. Refer to Figure 2. Remove the three M5 cap head screws (65) which secure the bearing case (30) to the rear fixed scroll (4), then use two screwdrivers to prise the bearing case (30) upwards and remove the bearing case (30) and ball bearing (31).
2. Refer to Figure 14. Put tool 1 into the shaft seal (28) from the front (interior) of the rear fixed scroll (4). Put tool 5 on the opposite side of the rear fixed scroll.
3. Align the holes in tools 1 and 5, then insert a short bolt through tool 5 and into tool 1. Tighten the bolt to remove the shaft seal (28), then unscrew the bolt and remove tools 1 and 5.
4. Fill the syringe with grease, then use the syringe to put 0.2 g (0.1 cm3) of grease on the lips of the new shaft seal (28), then lightly grease the outer case of the shaft seal.
5. Refer to Figure 15. Put the new shaft seal onto tool 1 so that the open side of the shaft seal faces the tool and the closed side of the shaft seal faces away from the tool.
6. Insert tool 1 (with the shaft seal) into the bore of the rear fixed scroll (4).
7. Put tool 2 on the front (interior) side of the rear fixed scroll (4) so that it locates in the bore of the rear fixed scroll and aligns with tool 1.
8. Insert a bolt through tool 2 and into tool 1, then tighten the bolt to draw the shaft seal (28) into the seal housing, until a sudden increase in the torque required to turn the bolt indicates that the shaft seal is fully in the rear fixed scroll (4).
9. Remove the tools and check that the shaft seal is fully in the seal housing in the rear fixed scroll (4) and is not damaged.
10. Remove any excess grease from the front face of the shaft seal (28).
11. Refer to Figure 2. Place thread sealant on the three M5 cap head screws (65), then use the screws to refit the bearing case (30) to the rear fixed scroll (4).

4.2.4 Replace the shaft seal and grease the bearing in the front fixed scroll

1. Refer to Figure 16. From the front (exterior) of the front fixed scroll (6), insert tool 4 into the shaft bore of the front fixed scroll (6).
2. On the rear (interior) side of the front fixed scroll (6), put tool 5 over the end of tool 4, then insert a bolt through tool 5 and into tool 4 and tighten the bolt by hand.
3. Ensure that tool 4 is in the bore and that tool 5 is squarely located on the scroll, then tighten the bolt to remove the shaft seal (19), grease seal (17) and needle bearing (18).
4. Use a clean lint-free cloth to clean the bore of the seal housing and to clean the outside surfaces of the needle bearing, if it is to be refitted to the pump.
5. If the old needle bearing (18) is to be reused, take careful note of the position of the code letters on the needle bearing, so that you can refit the bearing in the same axial orientation.
6. Use a clean lint-free cloth to remove as much grease as possible from the needles of the needle bearing (18).

7. Use the syringe to put 1.0 g (0.5 cm3) of grease into the bearing, then ensure the grease is evenly spread over the needles of the needle bearing.
8. Refer to Figure 17. Put the needle bearing (18) over the end of tool 4. When you refit the old needle bearing, ensure you refit it in the same axial orientation as noted in Step 5.
9. Insert tool 6 into tool 5, then insert both tools into the shaft bore from the rear (interior) of the front fixed scroll (6).
10. Ensure that tools 5 and 6 are still correctly positioned, then, from the front (exterior) side of the front fixed scroll (6), insert tool 4 (with the needle bearing) into the shaft bore in the front fixed scroll until it engages with tools 5 and 6.
11. Put a bolt through tool 5 and into tool 4 and tighten by hand.
12. Ensure that all the tools are correctly aligned, then tighten the bolt to draw in the needle bearing. A sudden increase in the torque required to tighten the bolt indicates that the needle bearing is fully located in the front fixed scroll.

Figure 14 - Remove the Shaft Seal from the ESDP12

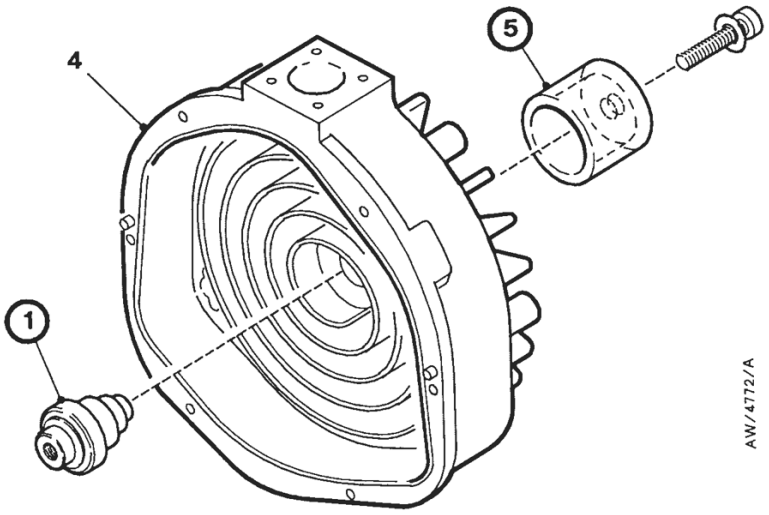
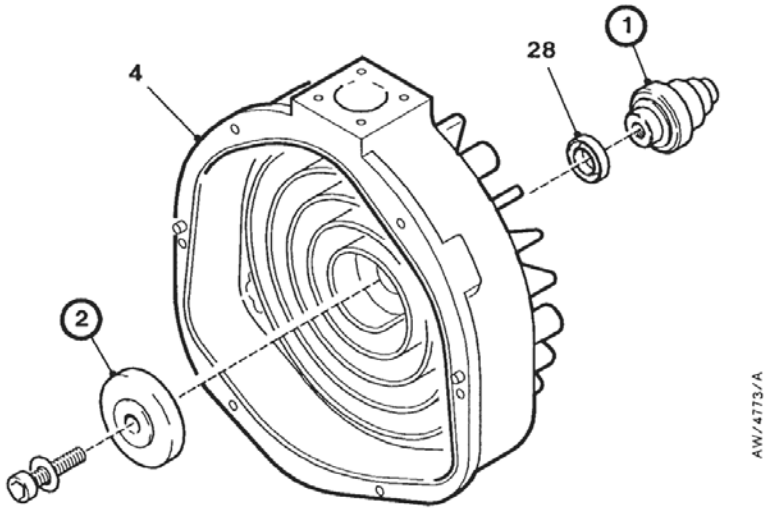


Figure 15 - Fit the New Shaft Seal to the ESDP12



13. Remove the bolt and tools 4, 5 and 6, then check that the needle bearing (18) is correctly located in the shaft bore and that the face of the bearing is level with the step in the bore.
14. Refer to Figure 18. Put tool 7 over tool 4, lightly grease the new grease seal (17), then place the grease seal over the end of tool 4. Ensure that the grease seal (17) is correctly orientated, so that the open side of the seal faces away from the bearing (see Figure 3).
15. Repeat Steps 9 to 13 above to draw the grease seal (17) into the shaft bore.
16. Use the syringe to put 0.2 g (0.1 cm3) of grease between the lips of the new shaft seal (19). Lightly grease the outer case of the shaft seal.
17. Refer to Figure 19. Place the shaft seal (19) over tool 8, then insert the tools (with the shaft seal) into the shaft bore of the front fixed scroll (6).
18. Fit tool 2 on the other side of the front fixed scroll, then fit a bolt through tool 2 and into tool 8 and tighten by hand.
19. Ensure that all the tools are correctly aligned, then tighten the bolt to draw in the shaft seal. A sudden increase in the torque required to tighten the bolt indicates that the shaft seal is fully located in the front fixed scroll.
20. Remove the bolt and the tools, then check that the shaft seal (19) is not damaged. Ensure that the shaft seal is squarely located in the seal housing and does not protrude above the rear (interior) face of the front fixed scroll (6), and that the grease seal (17) is still correctly located.
21. Remove any grease or pared off rubber from the rear of the front fixed scroll (6).
22. Ensure that the lips of the shaft seal (19) and the gap between the grease seal (17) and the bearing is full of grease, then wipe off any excess grease from the outside face of the seals (17 and 19).

4.2.5 Replace the orbiting scroll grease seals and grease the bearings

1. Refer to Figure 2. Use a small flat bladed screwdriver to lever the grease seals (20) out of the front and rear of the orbiting scroll (5). If you cannot easily lever out the grease seals:
    - Use tools 8, 10, 11 and 12 to push the bearings (in either direction) partly out of the scrolls (refer to Section 4.3.2), then lever out the grease seals.
    - Use tools 11, 12 and 13 to correctly reposition the bearings: see Figure 23.
2. Use a clean lint-free cloth to remove as much old grease as possible from the two needle bearings (21) in the shaft bore of the orbiting scroll (5).
3. Refer to Figure 24. Put tool 14 over the end of tool 13. Fit one of the new grease seals (20) over the end of tool 13; ensure that the grease seal is correctly orientated, so that the open face of the seal faces away from the tool and towards the bearing. Fit the tools into the bearing bore of the orbiting scroll (5).
4. Put tool 11 on the opposite side of the orbiting scroll, then put tool 12 over tool 11. Insert a bolt through tool 12 and into tool 13 and tighten by hand.
5. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the grease seal (20) into position. A sudden increase in the torque required to turn the bolt indicates that the grease seal is fully in the orbiting scroll.

Figure 16 - Remove the Shaft Seal, Grease Seal and Needle Bearing from the ESDP12

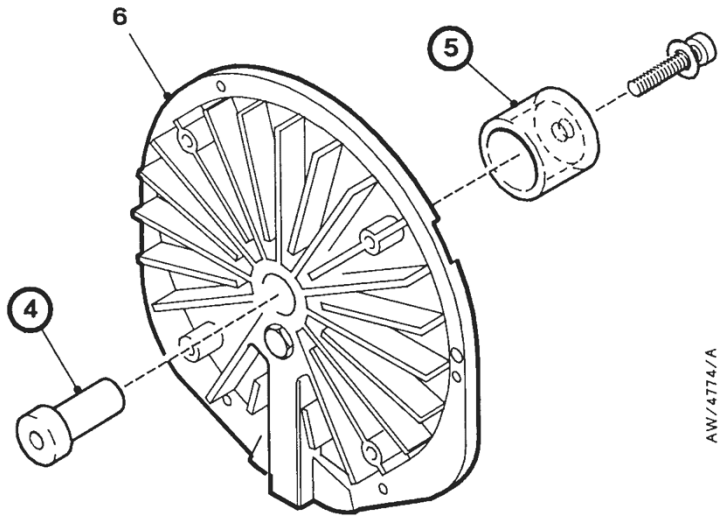
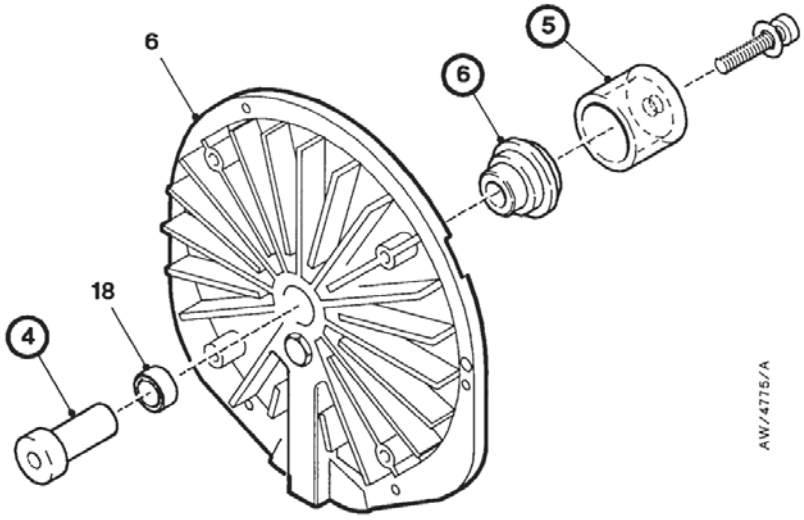


Figure 17 - Fit the New Needle Bearing to the ESDP12



6. Remove the bolt and tools from the pump.
7. From the opposite side of the orbiting scroll, repeat Steps 3 to 6 to fit the other new grease seal
8. Use the syringe to put 1.8 g (0.9 cm3) of grease into each of the two needle bearings (21), then ensure the grease is evenly spread over the bearings.
9. Ensure that the gaps between the grease seals (20) and the bearings are full of grease, then wipe off any excess grease from the outside face of the grease seals (20).
10. Use a clean lint-free cloth to remove any old grease from the crank shaft (16).

4.2.6 Clean the tip seals and the tip seal grooves

1. Refer to Figure 2. Carefully remove the tip seals (9, 11) from the orbiting scroll (5) and the tip seals (8, 10) from the fixed scrolls.

2. Use a soft clean cloth to wipe any debris off of the tip seals and from the tip seal grooves in the fixed and orbiting scrolls.
3. Refit the tip seals in the fixed and orbiting scrolls: start at the centre of each scroll.

4.2.7 Grease the locator bearings

1. Refer to Figure 2. Use a clean lint-free cloth to remove as much old grease as possible from the three needle bearings (38) around the orbiting scroll (5).
2. Use the syringe supplied to put 0.1 g (0.05 cm3) of new grease into each of the three bearings (38), ensure that the grease is evenly spread over the bearings.

4.2.8 Replace the outlet valve

1. Refer to Figure 2. Undo and remove the outlet valve cover (44) from the front (exterior) of the front fixed scroll (6).
2. Remove the old outlet valve (46) and spring (45) from the front fixed scroll (4). Dispose of the components: see Section 1.3.
3. Fit the new outlet valve (46) and spring (45) into the front fixed scroll (6). 4.
4. Place thread sealant onto the thread of the outlet valve cover (44), then screw the cover into the front fixed scroll (6).

Figure 18 - Fit the Grease Seal to the ESDP12

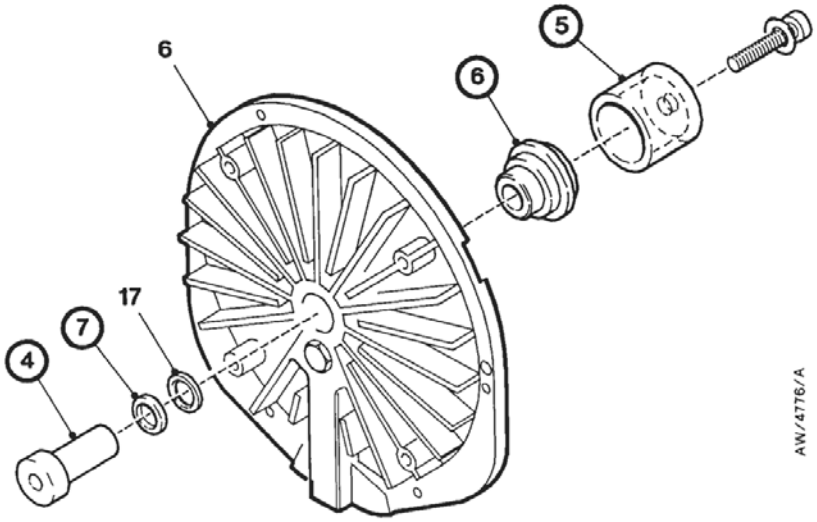
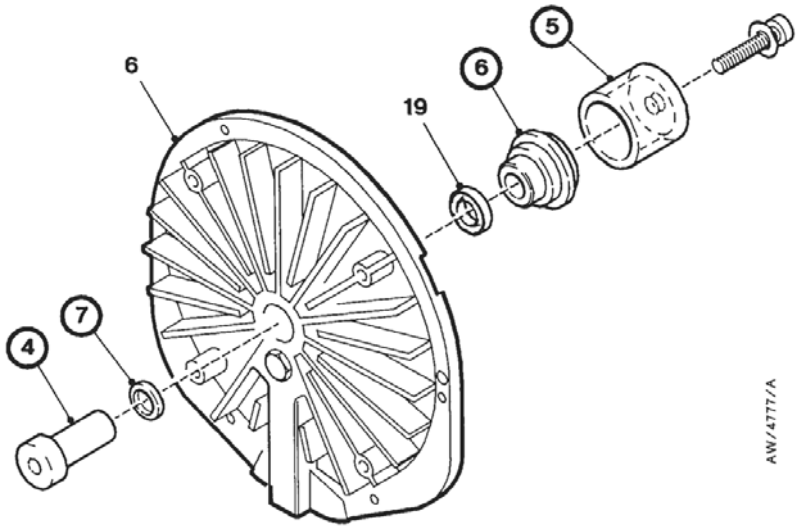


Figure 19 - Fit the Shaft Seal in the ESDP12 Seal Housing



4.2.9 Reassemble the pump

Note: Ensure that the tip seals (Figure 2, items 8 and 11) remain in place when you fit the orbiting scroll. If a tip seal comes out of the tip seal groove, you will not be able to fully engage the orbiting scroll on the crank shaft.

1. Refer to Figure 2. Clean the sealing faces and the O-ring grooves in the front fixed scroll (6) and the rear fixed scroll (4).
2. Hold the rear fixed scroll (4) vertical and insert the crank shaft (16); ensure the crank shaft is correctly orientated, then insert the parallel key (33).
3. Refer to *Figure 1*. Fit the rear fan (29), then apply thread sealant to the M6 cap head screw (62) and use the screw and plain washer (51) to secure the fan to the shaft.
4. Refer to Figure 2. Position the crank shaft (16) and the three crank pins (39) so that they are all offset downwards. Turn the orbiting scroll (5) so that the position of the open end of the scroll corresponds with the position of the open end of the scroll on the rear fixed scroll (4), then fit the orbiting scroll (5) onto the crank shaft. If necessary, turn the crank shaft (16) backwards and forwards while you push on the orbiting scroll (5).
5. Lightly lubricate the new stator O-ring (23) with vacuum grease, then place the O-ring around the shoulder on the front fixed scroll (6).
6. Align the front fixed scroll (6) so that the two holes on the flange will locate over the two dowels (3) on the rear fixed scroll (4), then fit the front fixed scroll onto the rear fixed scroll. Ensure that the tip seals (9, 10) and the stator O-ring (23) remain in place when you fit the front fixed scroll.
7. Refit the six M6 cap head screws (63) to secure the front fixed scroll (6) to the rear fixed scroll (4) and tighten by hand.
8. Progressively tighten the six screws: tighten one screw, then tighten the screw on the opposite side of the pump, then tighten the next pair of screws, and so on.
9. Refer to *Figure 1*. Fit the parallel key (14) and the front fan (13), then turn the front fan by hand. There should be slight resistance, but you should be able to fully rotate the front fan. The resistance against rotation should only be slightly more than when you turned the fan in Section 4.2.1. If the fan is very stiff to turn, the tip seals may not be properly located in their tip seal grooves. Dismantle the pump, refit the tip seals, then reassemble the pump.
10. When the fan rotation is acceptable, fit the plain washer (15), then apply thread sealant to the cap head screw (62) and use the screw to secure the front fan to the shaft.

4.2.10 Fit the motor to the pump

1. Refer to *Figure 1*. Place the motor assembly (34) and base (1) down so that they rest on the rear of the pump motor and so that the motor shaft (34-8) is upwards.
2. Align the keyway on the rear fan (29) with the key (34-4) fitted in the keyway on the motor shaft (34-8) and lower the pump onto the motor shaft. Place the flexible coupling element (53) in the coupling hub (54), then lower the pump onto the motor shaft, so that the coupling element engages in the slots on the rear of the rear fan (29).
3. If necessary, lift the pump slightly and turn the fixed scrolls assembly so that the inlet flange is at the top of the pump, then fully lower the pump so that the motor shaft fully engages and the two dowels on the rear of the rear fixed scroll (4) engage in the locating holes in the motor flange.
4. Insert the six cap head screws (63) and tighten by hand to loosely secure the pump to the motor.
5. Progressively tighten the six screws: tighten one screw by one or two turns, then tighten the screw on the opposite side of the pump, then tighten the next screw, and so on.

   As you tighten the screws, occasionally turn the front fan (13) to check that the pump is free to rotate. If the pump does not rotate freely, the motor is incorrectly fitted to the pump: dismantle the motor from the pump, then refit the motor to the pump.
6. Fit the fan cover-plate (7) and the fan cover (12) and secure with the dome head screws and plain washers (61, 71).

4.3 How to use the Major Service Kit

4.3.1 Dismantle the pump

1. Dismantle the pump as described in Section 4.2.1.
2. Inspect the pump as described in Section 4.2.2.

4.3.2 Replace the orbiting scroll bearings and grease seals

1. Refer to Figure 2. Remove the tip seals (8, 9) from the orbiting scroll (5).
2. Refer to Figure 20. From the front side of the orbiting scroll (5), fit tool 8 into the shaft bore of the scroll. From the other side of the orbiting scroll, put tool 10 over tool 8, then fit tool 11 over tool 8.
3. Insert a bolt through tool 12 and into tool 8 and tighten by hand.
4. Ensure that all of the tools are seated squarely on the orbiting scroll (5), then tighten the bolt to remove the grease seal (20).
5. Remove the tools.
6. Refer to Figure 21. Repeat Steps 2 to 5 (with the tools on the opposite side of the orbiting scroll) to remove the needle bearings (21) and the second grease seal (20).
7. Use a clean lint-free cloth to clean the bore of the orbiting scroll (5).
8. Refer to Figure 22. Put one of the new needle bearings (21) over the end of tool 13 and put the end of the tool in the bore of the orbiting scroll (5).
9. From the other side of the orbiting scroll (5), fit tool 10 to the end of tool 13.
10. Put tool 11 over the end of tool 10, then fit tool 12. Fit a bolt through tool 12 and into tool 13 and tighten by hand.

Figure 20 - Remove the First Grease Seal from the ESDP12

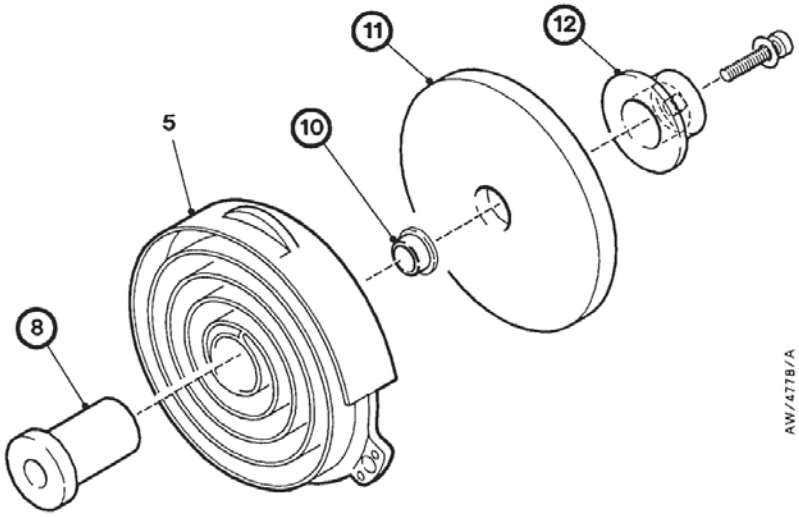
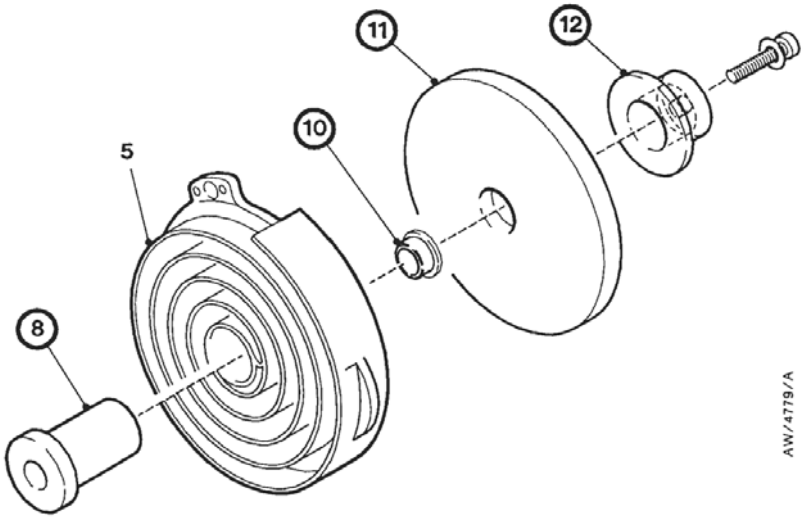


Figure 21 - Remove the Second Grease Seal and Needle Bearings from the ESDP12



11. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the new needle bearing (21) into position. A sudden increase in the torque required to turn the bolt indicates that the needle bearing is fully in the orbiting scroll. Undo the bolt and remove the tools.

12. Refer to Figure 23. Put the second new needle bearing (21) over the end of tool 13 and put the end of the tool in the bore of the orbiting scroll (5) and through the bore of the first new needle bearing.

13. Fit tools 11 and 12 to the opposite side of the orbiting scroll (5), then fit a bolt through tool 12 and into tool 13.

14. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the new needle bearing (21) into position. A sudden increase in the torque required to turn the bolt indicates that the needle bearing is fully in the orbiting scroll. Undo the bolt and remove the tools.

15. Refer to Figure 24. Put tool 14 over the end of tool 13. Fit one of the new grease seals (20) over the end of tool 13; ensure that the grease seal is correctly orientated, so that the open face of the seal faces away from the tool and towards the bearing. Fit the tools into the bearing bore of the orbiting scroll (5).

16. Put tool 11 on the opposite side of the orbiting scroll, then put tool 12 over tool 11. Insert a bolt through tool 12 and into tool 13 and tighten by hand.

Figure 22 - Fit the First Needle Bearing in the ESDP12 Orbiting Scroll

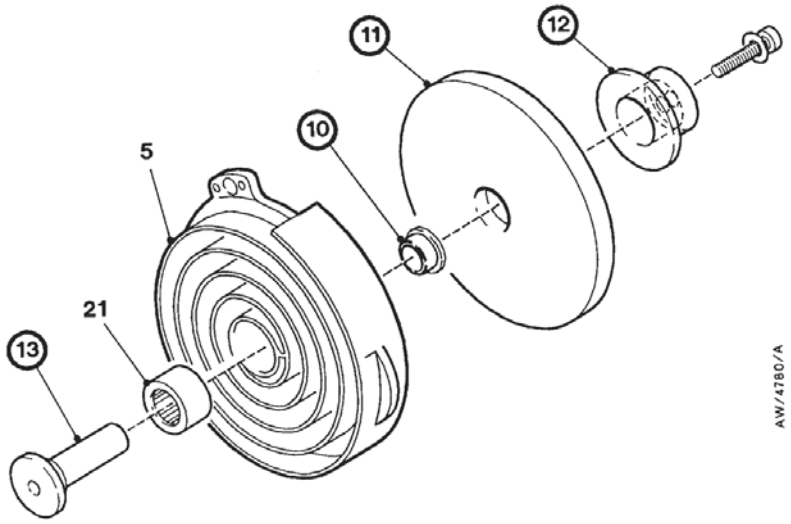
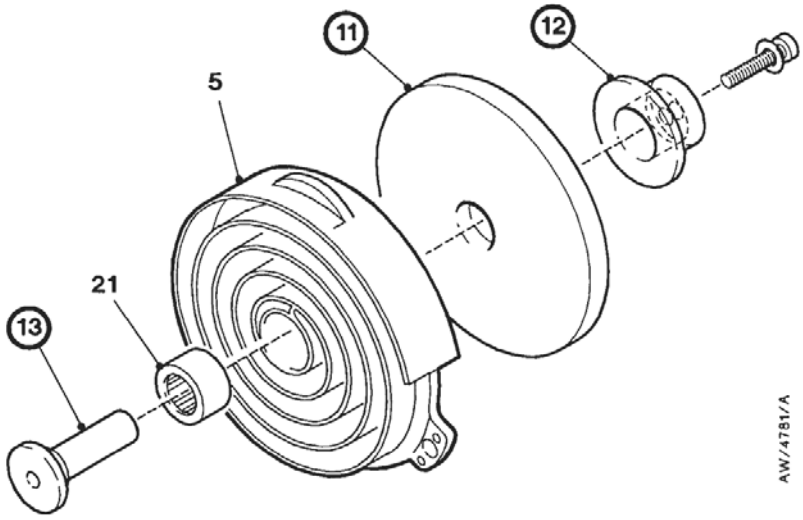


Figure 23 - Fit the Second Needle Bearing in the ESDP12 Orbiting Scroll



17. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the grease seal (20) into position. A sudden increase in the torque required to turn the bolt indicates that the grease seal is fully in the orbiting scroll.

18. Remove the bolt and the tools, then, from the opposite side of the orbiting scroll, repeat Steps 15 to 17 to fit the other new grease seal (20).

19. Fill the syringe with grease, then use the syringe to put 0.2 g (0.1 cm3) of grease in the new grease seals (20). Lightly lubricate the outer faces of the new grease seals.

20. Remove any excess grease from the outside faces of the grease seals (20).

4.3.3 Replace the needle bearing in the front fixed scroll

1. Refer to Figure 2. Use the procedure in Section 4.2.4 to replace the needle bearing (18) in the front fixed scroll (6) with the new needle bearing supplied in the kit. Replace the shaft seal (19) and the grease seal (17) when you replace the needle bearing.

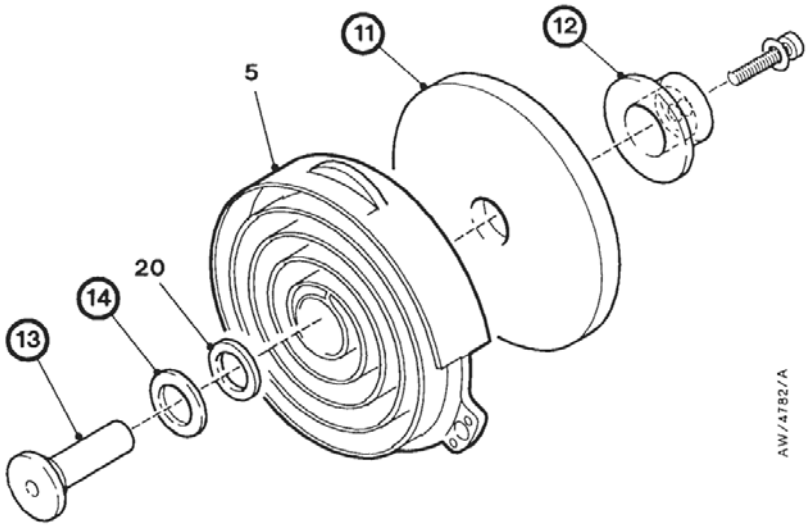
2. Ensure that the lips of the shaft seal (19) and the gap between the grease seal (17) and the bearing are sufficiently greased, then wipe off any excess grease from the outside face of the seals (17 and 19).

4.3.4 Replace the ball bearing in the rear fixed scroll

Note: The new bearing is supplied already greased and sealed. You do not need to put more grease in the bearing.

1. Refer to Figure 2. Remove the three M5 hex head bolts (65) which secure the bearing case (30) to the rear fixed scroll (4), then use two screwdrivers to prise up the bearing case (30) and remove the bearing case (30) and ball bearing (31). Replace the shaft seal (28) as described in Section 4.2.3.
2. Fit the new ball bearing (31) and bearing case (30) into the rear fixed scroll and secure with the three M5 hex head bolts (65).

Figure 24 - Fit the Grease Seal in the ESDP12 Orbiting Scroll



4.3.5 Replace the tip seals

Note: You must thoroughly clean the tip seal grooves (see Step 3 below), as the tip seals must be free to move within the tip seal grooves. If the tip seals are not free to move, the rotors may strike one another, or poor ultimate vacuum may result.

The tip seals have a hard black sealing surface with a soft white backing. When you fit a tip seal, insert the white backing material into the tip seal grooves; the hard sealing material must always face outwards from the tip seal groove. When fitted, the top face of the black sealing materials should be approximately 0.5 mm above the top of the tip seal groove.

Refer to Figure 2. The Major Service Kit contains clockwise and anticlockwise tip seals:

- Use the clockwise tip seal to replace the tip seal in the front of the orbiting scroll (5) and the front of the rear fixed scroll (4).
- Use the anticlockwise tip seal to replace the tip seal in the rear of the orbiting scroll (5) and the rear of the front fixed scroll (6).

The tip seals naturally follow the curvature of the scrolls and should be easy to fit into the tip seal grooves. If you have to force the tip seals in, you are probably trying to fit the tip seal the wrong way round: remove the tip seal, turn it around and fit it the correct way.

The tip seal grooves in the fixed scrolls have a constriction (pinch point) near the centre of the scroll to aid retention of the tip seals. Ensure that the tip seals are fully inserted in these constrictions.

Use the following procedure to replace the tip seals.

1. Remove the tip seal (8) from the front of the rear fixed scroll (4): start at the outer edge of the scroll and slowly pull the tip seal from the scroll.
2. Repeat Step 1 to remove:
   - The tip seal (10) from the rear of the front fixed scroll (6).
   - The tip seals (9, 11) from the front and rear of the orbiting scroll (5).
3. Use clean soft cloth to thoroughly clean the tip seal grooves in the front and rear fixed scrolls (6, 4) and the orbiting scroll (5).
4. Start at the centre of the front of the orbiting scroll (5) and press the new (clockwise) tip seal (9) into the tip seal groove. When you reach the end (outside) of the tip seal groove, cut the tip seal (9) approximately 5 mm short of the end of the groove, then press the end of the tip seal into the tip seal groove.
5. Use the rest of the new clockwise tip seal and repeat Step 4 to fit the new tip seal (8) to the rear fixed scroll (4).
6. Start at the centre of the rear of the orbiting scroll (5) and press the new (anticlockwise) tip seal (11) into the tip seal groove. When you reach the end (outside) of the tip seal groove, cut the tip seal approximately 5 mm short of the end of the groove, then press the end of the tip seal into the tip seal groove.
7. Use the rest of the new anticlockwise tip seal and repeat Step 6 to fit the new tip seal (10) to the front fixed scroll (6).

4.3.6 Reassemble the pump

Reassemble the pump as described in Section 4.2.7.

4.3.7 Replace the motor bearings

1. Refer to *Figure 1*. Loosen the grub screw (75) and remove the coupling hub (54) from the motor shaft (34-3).
2. Refer to Figure 4. Remove the key (34-4) from the shaft (34-3).
3. Remove the four M5 hex head bolts (34-9) which secure the motor end-plate (34-10), then tap off the end-plate from the motor. Ensure that you retain the spring washer (34-11) from the bearing recess in the motor end-plate.
4. Carefully remove the rotor (34-8) from the stator (34-1); if necessary, tap out the rotor from the key end (34-4) of the shaft.
5. Use a bearing puller to remove the front and rear bearings (34-5, 34-12) and the washer (34-13) and ensure that the rear bearing mating surfaces on the motor shaft (34-3) are clean.
6. Lightly lubricate the rear bearing (34-12) and mating surfaces of the motor shaft and place the bearing over the shaft.
7. Place a sleeve (which has a diameter slightly larger than the diameter of the shaft) over the shaft to engage with the inner bearing race.
8. Use a bearing press on the sleeve to fully fit the bearing. Alternatively, carefully hammer onto the sleeve to drive the bearing into position; do not allow the sleeve to come into contact with the outer bearing race or damage the motor shaft.
9. Refit the washer (34-13) on the motor shaft, then repeat Steps 6 to 8 to fit the front bearing (34-5) onto the motor shaft.
10. Ensure that the bearing circlip is located in the deepest part of the eccentric circlip groove of each of the new bearings. Carefully refit the rotor (34-8) into the stator (34-1).

11. Ensure that the two spring washers (34-11) are in position in the rear bearing recess in the motor end-plate (34-10), then fit the motor end-plate to the motor and tap it into place.
12. Use the four M5 hex head bolts (34-9) to secure the motor end-plate (34-10).
13. Refit the key (34-4) to the shaft (34-3).
14. Fit the coupling hub (54) to the motor shaft and tighten the grub screw (75) to secure the coupling hub in place.

4.3.8 Fit the motor to the pump

Refit the motor to the pump as described in Section 4.2.8.

4.4 How to use the Crank Pin Kit

Note: You will require one Crank Pin Kit to replace all of the crank pins in the pump.

Use the following procedure to replace the crank pins. Note that Crank Pin Kits are discretionary items. You should only use a Crank Pins Kit when the crank pins fitted to the pump are no longer serviceable.

1. Dismantle the pump as described in Steps 1 to 13 of Section 4.2.1, then inspect the pump as described in Section 4.2.2.
2. Refer to Figure 2. Remove the cross head bolt (66) which secures one of the needle bearings (38) to the orbiting scroll (5).
3. Push out the needle bearing (38) from the orbiting scroll (5).
4. Use a small screwdriver to prise the two O-rings (37) out of the orbiting scroll (5).
5. Insert the two new O-rings (37) into the O-ring grooves in the orbiting scroll (5).
6. Push the new needle bearing (38) into the orbiting scroll (5).
7. Apply thread sealant to the cross head bolt (66) and refit the bolt to the orbiting scroll (5).
8. Repeat Steps 2 to 7 to change the other needle bearing and O-rings, if required.
9. Undo and remove the two cross head bolts (67) which secure one of the crank pin assemblies (104) in the rear fixed scroll (4), then remove the crank pin assembly.
10. Place the new crank pin assembly (104) in the rear fixed scroll (4).
11. Apply thread sealant to the two cross head bolts (67), then use the bolts to secure the crank pin assembly (104) in the rear fixed scroll (4).
12. Repeat Steps 9 to 11 to replace the other crank pin assembly, if required.
13. Reassemble the pump as described in Section 4.2.7.

4.5 Replace the Motor Assembly

1. Refer to *Figure 1*. Loosen the six M6 cap head screws (63) which secure the motor (34) to the rear fixed scroll (4).
2. Turn the pump so that the pump rests on the motor (34) and so that the front fan (13) faces upwards.
3. Remove the six cap head screws (63) and lift the pump body off of the motor (34). If you cannot easily lift the pump body off of the motor, place two of the cap head screws into the jacking holes on the motor flange and tighten the screws to push the pump body off of the motor flange: refer to the ESDP30 instruction manual.
4. Loosen the grub screw (75) and remove the coupling hub (54) from the motor shaft.

5. Fit the coupling hub (54) to the new motor shaft and tighten the grub screw (75) to secure the coupling hub in place.
6. Fit the new motor and base to the pump as described in Steps 1 to 5 of Section 4.2.8.

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5 Service the ESDP30 or ESDP30A Pump

WARNING

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

Note: All of the figures in the following sections are keyed as follows:

- *Key numbers which are circled identify ESDP30/ESDP30A special tools (as illustrated in Appendix A2).*
- *Key numbers which are not circled identify component parts of the pump, as shown in Figure 5 to 12 and listed in Table 2.*

The following procedures refer to the 'front' and 'rear' of pump components. The front of a component is the face of the component which is nearest to the outside face of the fan cover (Figure 5 or 9, item 12). The rear of a component is the face of the component which is nearest to the motor (Figure 5 or 9, item 34).

The fan cover (12) has a label which states the pump serial number. If you replace the fan cover, peel the label off of the old fan cover and place the label on the new fan cover.

5.1 Preparation

Before you service the pump, use the following procedure to prepare the pump.

1. Use a suitable cleaning solution to clean your work surfaces and tools.
2. If the pump has been contaminated with dangerous process substances, operate the pump with nitrogen inlet purge for 15 minutes or more, before you disconnect it.
3. Operate the pump with the inlet at atmospheric pressure for two or three minutes to remove any dust or contaminants from the pump, before you disconnect it.
4. Switch off the pump, disconnect it from the electrical supply and from the process and exhaust-extraction systems, then move the pump to where you will dismantle it.

5.2 How to use the Minor Service Kit

5.2.1 Dismantle the pump

1. Before you start to dismantle an ESDP30 pump, take note of the orientation of the inlet-flange, so that you can reassemble the pump with the inlet-flange in the same orientation.
2. Refer to Figure 5 (ESDP30) or 9 (ESDP30A). Remove the four M6 dome head screws (61) and plain washers (71) which secure the fan cover (12), then remove the fan cover and the cover plate (7).
3. Turn the front fan (13) and take note of the resistance required to turn the fan.
4. Loosen the six M8 cap head screws (63) which secure the motor (34) to the rear fixed scroll (4).
5. Turn the pump so that the pump rests on the motor (34) and so that the front fan (13) faces upwards.
6. Remove the six cap head screws (63) and lift the pump body off of the motor (34). If you cannot easily lift the pump body off of the motor, place two of the cap head screws into the jacking holes on the motor flange and tighten the screws to push the pump body off of the motor flange: refer to the pump instruction manual.
7. Place the rear fixed scroll on suitable blocks (of height 55 mm or more), with the front fixed scroll (6) upwards: see Figure 13.

8. Remove the M6 cap head screw (62) and plain washer (15) which secures the front fan (13) to the crank shaft (16), then remove the front fan (13) and the parallel key (14) from the crank shaft. If necessary, use a screwdriver to lever the fan off of the crank shaft.
9. Alternately and evenly loosen the six M8 cap head screws (63) which secure the front fixed scroll (6) to the rear fixed scroll (4).
10. Remove the six M8 screws (63), then remove the front fixed scroll (6).
11. Pull the orbiting scroll (5) out of the rear fixed scroll (4); if necessary, turn the crank shaft (16) to assist you to remove the orbiting scroll.
12. Turn over the pump, so that the rear fan (29) is upwards.
13. Remove the M6 cap head screw (62) which secures the rear fan (29).
14. Remove the rear fan (29) and the plain washer (51).
15. Remove the parallel key (33) from the crank shaft (16), then remove the crank shaft (16) from the rear fixed scroll (4); if necessary, use a hammer and a soft drift to knock the crank shaft out of the fixed scroll.

5.2.2 Inspect and clean the pump

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Inspect the rear (inner) surface of the front fixed scroll (6), the front (inner) surface of the rear fixed scroll (4), and both the front and the rear surfaces of the orbiting scroll (5). If any of the surfaces are coated with deposits, you must clean them:
   - We recommend that you use a mild abrasive pad (such as Scotchbrite) to remove the deposits. Do not use harsh abrasive methods, such as shot blasting, or you may damage the pump.
   - If you use a wet cleaning method, you must dry the components thoroughly before you reassemble the pump: dry the components in an oven or vacuum dry them. If you do not thoroughly dry the components, water may become lodged in the components and the performance of the pump may be poor (temporarily or permanently).
2. The front fixed scroll (6), the rear fixed scroll (4) and the orbiting scroll (5) are made from aluminium and have a black outer anodised coating; inspect the rear (inner) surface of the front fixed scroll (6), the front (inner) surface of the rear fixed scroll (4) and the front and the rear surfaces of the orbiting scroll (5) again:
   - If there are scratches or chips or areas of localised wear which have completely removed the outer anodised coating and have revealed the (silver) aluminium, you must replace the component.
   - If there are just light scratches in the outer anodised coating (that is, no aluminium shows), refinish the surface of the component to remove the scratch; if you do not, tip seal wear will be excessive when you reassemble and operate the pump.
3. Inspect the crank shaft (16) where it locates in the shaft seals (19, 28)/grease seals (20). If the crank shaft is worn to a depth of 0.06 mm (that is, its diameter is reduced by 0.12 mm) or more, you must replace the crank shaft.

5.2.3 Replace the shaft seal in the rear fixed scroll

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Remove the three M5 cap head screws (65) which secure the bearing case (30) to the rear fixed scroll (4), then use two screwdrivers to prise the bearing case (30) upwards and remove the bearing case (30) and ball bearing (31).
2. Refer to Figure 25. Put tool 1 into the shaft seal (28) from the front (interior) of the rear fixed scroll (4). Put tool 2 on the opposite side of the rear fixed scroll.
3. Align the holes in tools 1 and 2, then insert a short bolt through tool 2 and into tool 1. Tighten the bolt to remove the shaft seal (28), then unscrew the bolt and remove tools 1 and 2.

4. Fill the syringe with grease, then use the syringe to put 0.2 g (0.1 cm3) of grease on the lips of the new shaft seal (28), then lightly grease the outer case of the shaft seal.
5. Refer to Figure 26. Put the new shaft seal onto tool 1 so that the open side of the shaft seal faces the tool and the closed side of the shaft seal faces away from the tool.
6. Put tool 3 into the seal housing on the rear (exterior) side of the rear fixed scroll (4), then insert tool 1 (with the shaft seal) into tool 3. Note that tool 3 is a guide for the correct location of the shaft seal in the bore of the scroll.
7. Put tool 2 on the front (interior) side of the rear fixed scroll (4) so that it locates in the bore of the rear fixed scroll and aligns with tool 1.
8. Insert a bolt through tool 2 and into tool 1, then tighten the bolt to draw the shaft seal (28) into the seal housing, until a sudden increase in the torque required to turn the bolt indicates that the shaft seal is fully in the rear fixed scroll (4).
9. Remove the tools and check that the shaft seal is fully in the seal housing in the rear fixed scroll (4) and is not damaged.

Figure 25 - Remove the Shaft Seal from the ESDP30/30A

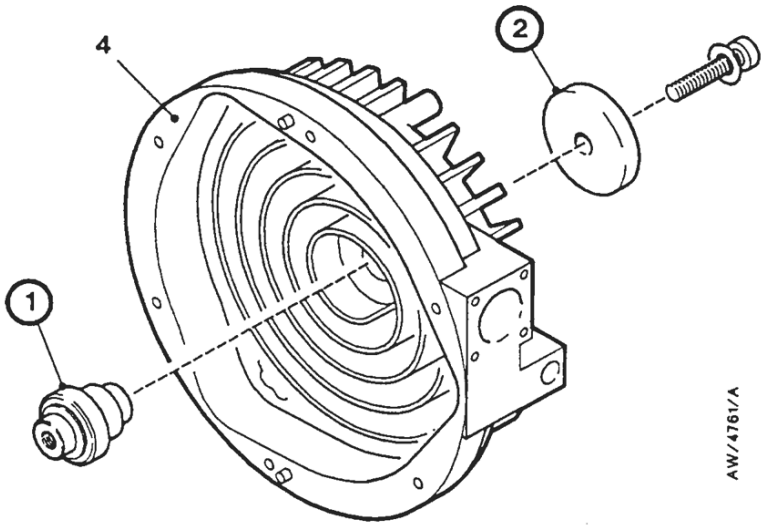


Figure 26 - Fit the New Shaft Seal to the ESDP30/30A

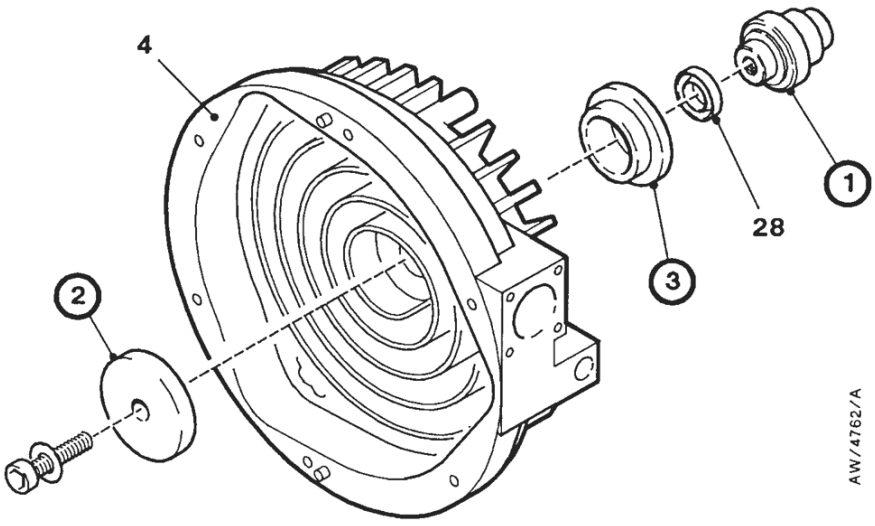


Figure 27 - Remove the Shaft Seal, Grease Seal and Needle Bearing from the ESDP30/30A

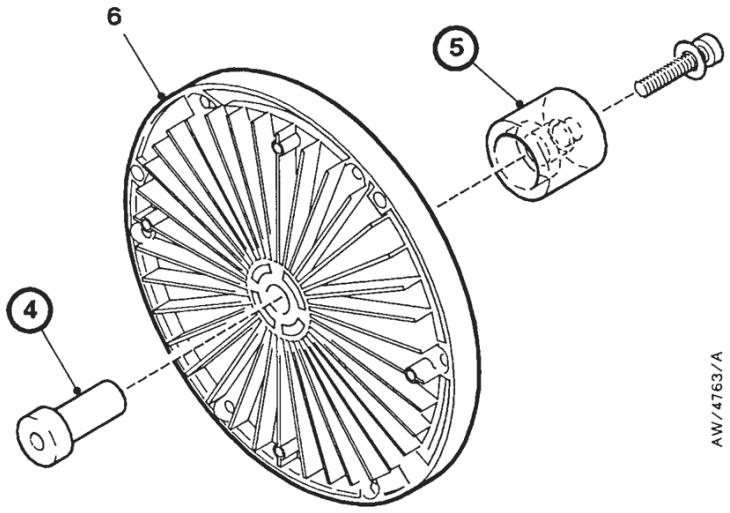
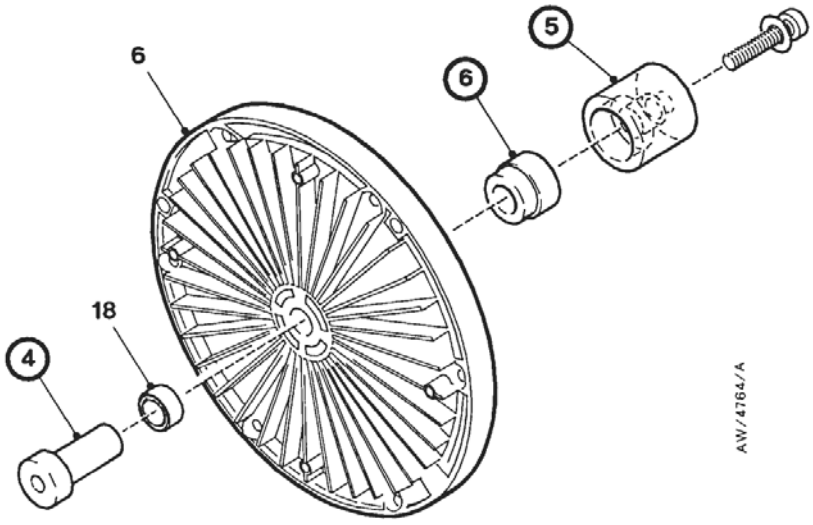


Figure 28 - Fit the New Needle Bearing to the ESDP30/30A



10. Remove any excess grease from the front face of the shaft seal (28).
11. Place thread sealant on the three M5 cap head screws (65), then use the screws to refit the bearing case (30) to the rear fixed scroll (4).

5.2.4 Replace the shaft seal and grease the bearing in the front fixed scroll

1. Refer to Figure 27. From the front (exterior) of the front fixed scroll (6), insert tool 4 into the shaft bore of the front fixed scroll (6).
2. On the rear (interior) side of the front fixed scroll (6), put tool 5 over the end of tool 4, then insert a bolt through tool 5 and into tool 4 and tighten the bolt by hand.
3. Ensure that tool 4 is in the bore and that tool 5 is squarely located on the scroll, then tighten the bolt to remove the shaft seal (19), grease seal (17) and needle bearing (18).
4. Use a clean lint-free cloth to clean the bore of the seal housing and to clean the outside surfaces of the needle bearing, if it is to be refitted to the pump.

5. If the old needle bearing (18) is to be reused, take careful note of the position of the code letters on the needle bearing, so that you can refit the bearing in the same axial orientation.
6. Use a clean lint-free cloth to remove as much grease as possible from the needles of the needle bearing (18).
7. Use the syringe to put 1.0 g (0.5 cm3) of grease into the bearing, then ensure the grease is evenly spread over the needles of the needle bearing.
8. Refer to Figure 28. Put the needle bearing (18) over the end of tool 4. When you refit the old needle bearing, ensure you refit it in the same axial orientation as noted in Step 5.
9. Insert tool 6 into tool 5, then insert both tools into the shaft bore from the rear (interior) of the front fixed scroll (6).
10. Ensure that tools 5 and 6 are still correctly positioned, then, from the front (exterior) side of the front fixed scroll (6), insert tool 4 (with the needle bearing) into the shaft bore in the front fixed scroll until it engages with tools 5 and 6.
11. Put a bolt through tool 5 and into tool 4 and tighten by hand.
12. Ensure that all the tools are correctly aligned, then tighten the bolt to draw in the needle bearing. A sudden increase in the torque required to tighten the bolt indicates that the needle bearing is fully located in the front fixed scroll.
13. Remove the bolt and tools 4, 5 and 6, then check that the needle bearing (18) is correctly located in the shaft bore and that the face of the bearing is level with the step in the bore.
14. Refer to Figure 29. Put tool 7 over tool 4, lightly grease the new grease seal (17), then place the grease seal over the end of tool 4. Ensure that the grease seal (17) is correctly orientated, so that the open side of the seal faces away from the bearing (see Figure 7 (ESDP30) or 11 (ESDP30A)).
15. Repeat Steps 9 to 13 above to draw the grease seal (17) into the shaft bore.
16. Use the syringe to put 0.2 g (0.1 cm3) of grease between the lips of the new shaft seal (19). Lightly grease the outer case of the shaft seal.
17. Refer to Figure 30. Place the shaft seal (19) over tool 8, so that the closed face of the shaft seal is against the tool and the open face of the shaft seal faces the bearing.
18. From the rear (interior) of the front fixed scroll (6), insert tool 8 (with the shaft seal) into the shaft bore of the front fixed scroll (6).
19. Put tool 2 on the front (exterior) of the front fixed scroll (6), then put a bolt through tool 2 and into tool 8 and tighten the bolt by hand.
20. Ensure that the tools are correctly aligned, then tighten the bolt to draw the shaft seal (19) into the seal housing. A sudden increase in the torque required to tighten the bolt indicates that the shaft seal is fully located in the front fixed scroll.
21. Undo the bolt and remove the tools and check that the seal is not damaged. Ensure that the shaft seal is squarely located in the seal housing and does not protrude above the rear (interior) face of the front fixed scroll (6), and that the grease seal (17) is still correctly located.
22. Remove any grease or pared off rubber from the rear of the front fixed scroll (6).
23. Ensure that the lips of the shaft seal (19) and the gap between the grease seal (17) and the bearing is full of grease, then wipe off any excess grease from the outside face of the seals (17 and 19).

5.2.5 Replace the orbiting scroll grease seals and grease the bearings

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Use a small flat bladed screwdriver to lever the grease seals (20) out of the front and rear of the orbiting scroll (5).
2. Use a clean lint-free cloth to remove as much old grease as possible from the two needle bearings (21) in the shaft bore of the orbiting scroll (5).

3. Refer to Figure 35. Put tool 14 over the end of tool 13. Fit one of the new grease seals (20) over the end of tool 13; ensure that the grease seal is correctly orientated, so that the open face of the seal faces away from the tool and towards the bearing. Fit the tools into the bearing bore of the orbiting scroll (5).
4. Put tool 11 on the opposite side of the orbiting scroll, then put tool 12 over tool 11. Insert a bolt through tool 12 and into tool 13 and tighten by hand.
5. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the grease seal (20) into position. A sudden increase in the torque required to turn the bolt indicates that the grease seal is fully in the orbiting scroll.
6. From the opposite side of the orbiting scroll, repeat Steps 3 to 5 to fit the other new grease seal (20).
7. Use the syringe to put 2.8 g (1.4 cm3) of grease into each of the two needle bearings (21), then ensure the grease is evenly spread over the bearings.
8. Ensure that the gaps between the grease seals (20) and the bearings are full of grease, then wipe off any excess grease from the outside face of the grease seals (20).
9. Use a soft clean cloth to remove any old grease from the crank shaft (16).

5.2.6 Clean the tip seals and the tip seal grooves

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Carefully remove the tip seals (9, 11) from the orbiting scroll (5) and the tip seals (8, 10) from the fixed scrolls.
2. Use a soft, clean lint-free cloth to wipe any debris off of the tip seals and from the tip seal grooves in the fixed and orbiting scrolls.
3. Refit the tip seals in the fixed and orbiting scrolls: start at the centre of each scroll.

5.2.7 Grease the locator bearings

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Use a clean lint-free cloth to remove as much old grease as possible from the three needle bearings (38) around the orbiting scroll (5).
2. Use the syringe supplied to put 0.4 g (0.2 cm3) of new grease into each of the three bearings (38), ensure that the grease is evenly spread over the bearings.

5.2.8 Replace the outlet valve: ESDP30

1. Refer to Figure 6. Remove the outlet flange (26) and spring (43) from the rear fixed scroll (4).
2. Remove the old outlet valve guide, spring, valve stem and O-ring (44 to 47) from the rear fixed scroll (4). Dispose of the components: see Section 1.3.
3. Fit the new spring (45) onto the new valve stem (46), then insert the valve stem into the new valve guide (44).
4. With the outlet-port horizontal, use the spring (43) to push the new valve assembly into the outlet-port of the rear fixed scroll (4). When the valve is correctly seated, the large spring (43) should be level with the end of the outlet-port and should not be compressed.
5. Place thread sealant onto the thread of the outlet flange (26), then screw the outlet flange into the rear fixed scroll (4).

Figure 29 - Fit the Grease Seal in the ESDP30/30A

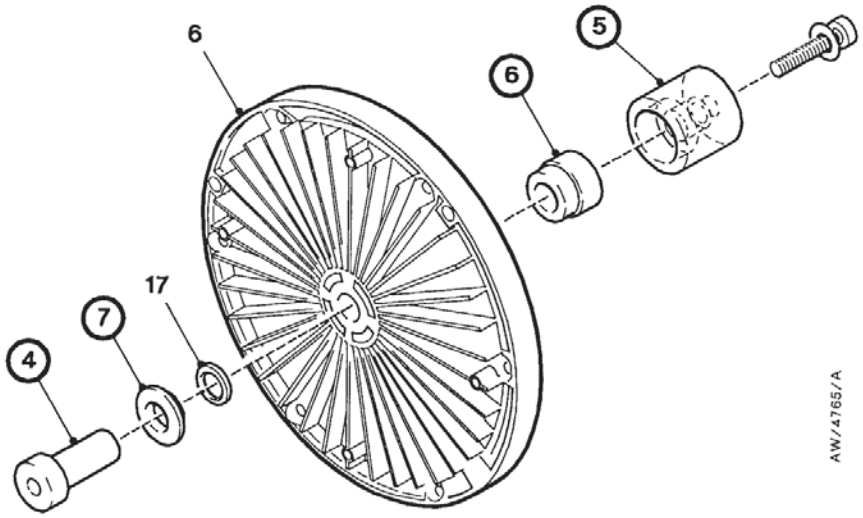
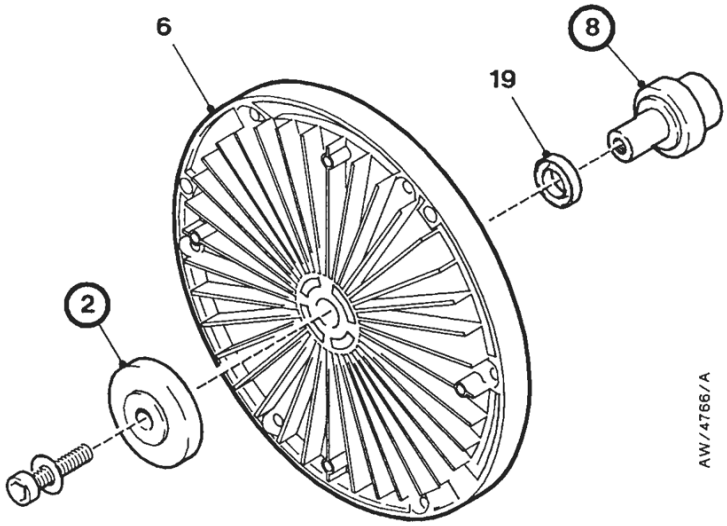


Figure 30 - Fit the Shaft Seal in the ESDP30/30A Seal Housing



5.2.9 Replace the outlet valve: ESDP30A

1. Refer to Figure 10. Undo and remove the three screws (43) which secure the outlet valve cover (44) and remove the cover from the front fixed scroll (6).
2. Remove the spring (45) and outlet valve (46) from the front fixed scroll (6).
3. Fit the new outlet valve (46) and spring (45) to the front fixed scroll (6); ensure that the valve is correctly seated and that none of the four lobes become caught in the outlet duct.
4. Remove the O-ring (47) from the cover (44), clean the O-ring then refit it to the cover.
5. Refit the outlet valve cover (44) and secure with the three screws (43).

5.2.10 Reassemble the pump

Note: Ensure that the tip seals (8, 11) remain in place when you fit the orbiting scroll. If a tip seal comes out of the tip seal groove, you will not be able to fully engage the orbiting scroll on the crank shaft.

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Clean the sealing faces and the O-ring grooves in the front fixed scroll (6) and the rear fixed scroll (4).
2. Hold the rear fixed scroll (4) vertical and insert the crank shaft (16); ensure the crank shaft is correctly orientated, then insert the parallel key (33).
3. Fit the rear fan (29), then apply thread sealant to the M6 cap head screw (62) and use the screw and plain washer (51) to secure the fan to the shaft.
4. Position the crank shaft (16) and the three crank pins (39) so that they are all offset downwards. Turn the orbiting scroll (5) so that the position of the open end of the scroll corresponds with the position of the open end of the scroll on the rear fixed scroll (4), then fit the orbiting scroll (5) onto the crank shaft. If necessary, turn the crank shaft (16) backwards and forwards while you push on the orbiting scroll (5).
5. Lightly lubricate the new stator O-ring (23) with vacuum grease, then place the O-ring around the shoulder on the front fixed scroll (6).
6. Align the front fixed scroll (6) so that the two holes on the flange will locate over the two dowels on the rear fixed scroll (4), then fit the front fixed scroll onto the rear fixed scroll. Ensure that the tip seals (9, 10) and the stator O-ring (23) remain in place when you fit the front fixed scroll.
7. Refit the six M8 cap head screws (63) to secure the front fixed scroll (6) to the rear fixed scroll (4) and tighten by hand.
8. Progressively tighten the six screws: tighten one screw, then tighten the screw on the opposite side of the pump, then tighten the next pair of screws, and so on.
9. Fit the parallel key (14) and the front fan (13), then turn the front fan by hand. There should be slight resistance, but you should be able to fully rotate the front fan. The resistance against rotation should only be slightly more than when you turned the fan in Section 5.2.1.

   If the fan is very stiff to turn, the tip seals may not be properly located in their tip seal grooves. Dismantle the pump, refit the tip seals, then reassemble the pump again.
10. When the fan rotation is acceptable, fit the plain washer (15), then apply thread sealant to the cap head screw (62) and use the screw to secure the front fan to the shaft.

5.2.11 Fit the motor to the pump

1. Refer to Figure 5 (ESDP30) or 9 (ESDP30A). Place the motor assembly (34) and base (1) down so that they rest on the rear of the pump motor and the motor shaft (34-8) is upwards.
2. If the pump is an ESDP30 with a serial number less than SF700 and you have not replaced the fixed coupling with a flexible coupling, align the keyway on the rear fan (29) with the key (34-4) fitted in the keyway on the motor shaft (34-8) and lower the pump onto the motor shaft.

   If the pump is an ESDP30A, or is an ESDP30 with a serial number greater than SF700, or if you have replaced the ESDP30 fixed coupling with a flexible coupling, place the flexible coupling element (53) in the coupling hub (54), then lower the pump onto the motor shaft, so that the coupling element engages in the slots on the rear of the rear fan (29).
3. If the pump is an ESDP30, lift the pump slightly and turn the fixed scrolls assembly (Figure 5, item A) so that the inlet flange is in the same orientation as noted in Section 5.2.1.
4. Fully lower the pump so that the motor shaft fully engages and the two dowels on the rear of the rear fixed scroll (4) engage in the locating holes in the motor flange.
5. Insert the six cap head screws (63) and tighten by hand to loosely secure the pump to the motor.

6. Progressively tighten the six screws: tighten one screw by one or two turns, then tighten the screw on the opposite side of the pump, then tighten the next screw, and so on. As you tighten the screws, occasionally turn the front fan (13) to check that the pump is free to rotate. If the pump does not rotate freely, the motor is incorrectly fitted to the pump: dismantle the motor from the pump, then refit the motor to the pump.
7. Fit the fan cover-plate (7) and the fan cover (12) and secure with the dome head screws and plain washers (61, 71).

5.3 How to use the Major Service Kit

5.3.1 Dismantle the pump

1. Dismantle the pump as described in Section 5.2.1.
2. Inspect the pump as described in Section 5.2.2.

5.3.2 Replace the orbiting scroll bearings and grease seals

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Remove the tip seals (8, 9) from the orbiting scroll (5).
2. Refer to Figure 31. Push tool 9 into the bearing of the orbiting scroll (5) until the four spring-loaded claws on the tool engage under the bearing.
3. Put tool 10 over tool 9, then fit tools 11 and 12 over tool 10. Insert a bolt through tool 12 and into tool 9 and tighten by hand.
4. Ensure that all of the tools are seated squarely on the orbiting scroll (5), then tighten the bolt to remove the grease seal (20) and the needle bearing (21).
5. Remove the tools and then remove the spacer sleeve (22) from the bearing bore.
6. Refer to Figure 32. Repeat Steps 2 to 4 (with the tools on the opposite side of the orbiting scroll) to remove the other needle bearing (21) and the grease seal (20). You can use tool 8 instead of tool 9 to do this.
7. Use a clean lint-free cloth to clean the bore of the orbiting scroll (5) and the bearing spacer sleeve (22).
8. Refer to Figure 33. Put one of the new needle bearings (21) over the end of tool 13 and put the end of the tool in the bore of the orbiting scroll (5). From the other side of the orbiting scroll (5), fit tool 10 to the end of tool 13.
9. Put tool 11 over the end of tool 10, then fit tool 12. Fit a bolt through tool 12 and into tool 13 and tighten by hand.
10. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the new needle bearing (21) into position. A sudden increase in the torque required to turn the bolt indicates that the needle bearing is fully in the orbiting scroll. Undo the bolt and remove the tools.
11. Refer to Figure 34. Put the spacer sleeve (22) into the bore of the orbiting scroll (5).
12. Put the second new needle bearing (21) over the end of tool 13 and put the end of the tool in the bore of the orbiting scroll (5) and through the bore of the first new needle bearing.
13. Fit tools 11 and 12 to the opposite side of the orbiting scroll (5), then fit a bolt through tool 12 and into tool 13.
14. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the new needle bearing (21) into position. A sudden increase in the torque required to turn the bolt indicates that the needle bearing is fully in the orbiting scroll. Undo the bolt and remove the tools.
15. Ensure that the spacer sleeve (22) will not rotate and is trapped between the two needle bearings (21).

16. Refer to Figure 35. Put tool 14 over the end of tool 13. Fit one of the new grease seals (20) over the end of tool 13; ensure that the grease seal is correctly orientated, so that the open face of the seal faces away from the tool and towards the bearing. Fit the tools into the bearing bore of the orbiting scroll (5).
17. Put tool 11 on the opposite side of the orbiting scroll, then put tool 12 over tool 11. Insert a bolt through tool 12 and into tool 13 and tighten by hand.
18. Ensure that the tools lie flat on the orbiting scroll, then tighten the bolt to draw the grease seal (20) into position. A sudden increase in the torque required to turn the bolt indicates that the grease seal is fully in the orbiting scroll.
19. From the opposite side of the orbiting scroll, repeat Steps 16 to 19 to fit the other new grease seal (20).
20. Fill the syringe with grease, then use the syringe to put 0.2 g (0.1 cm3) of grease in the new grease seals (20). Lightly lubricate the outer faces of the new grease seals.
21. Remove any excess grease from the outside faces of the grease seals (20).

Figure 31 - Remove the First Grease Seal and Needle Bearing from the ESDP30/30A

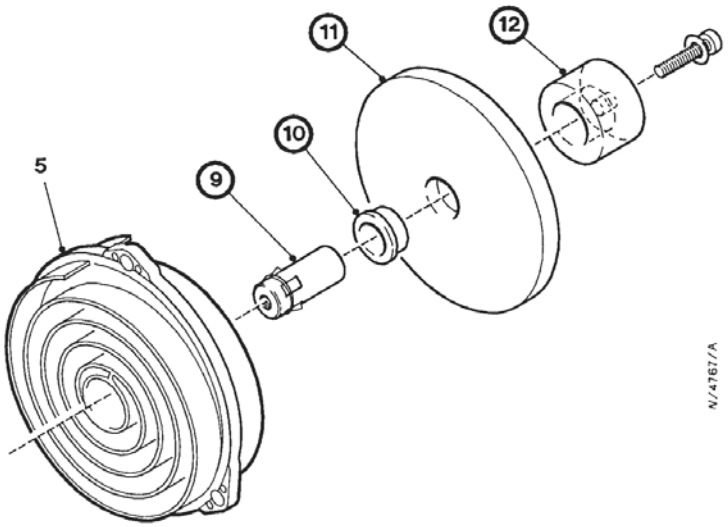


Figure 32 - Remove the Second Grease Seal and Needle Bearing from the ESDP30/30A

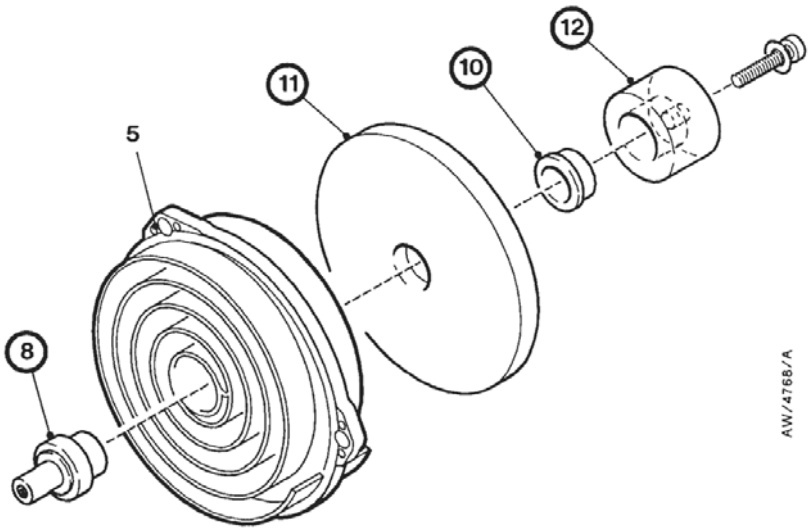


Figure 33 - Fit the First Needle Bearing in the ESDP30/30A Orbiting Scroll

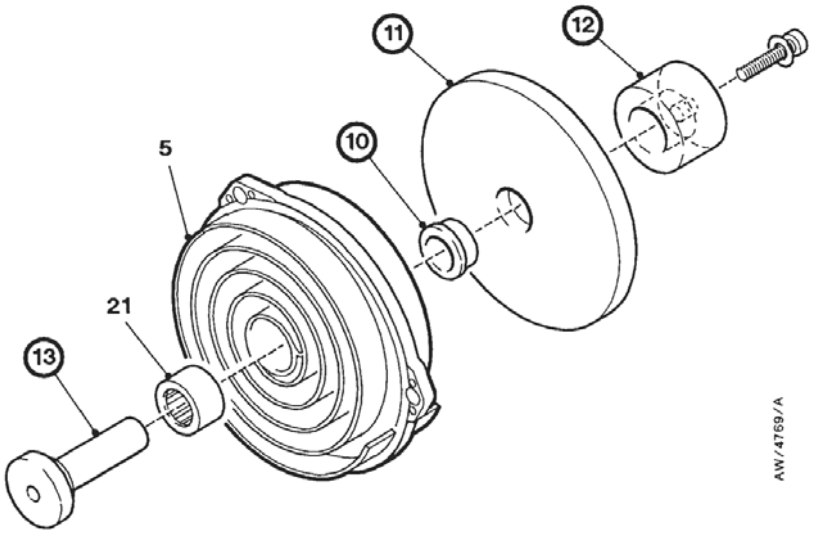
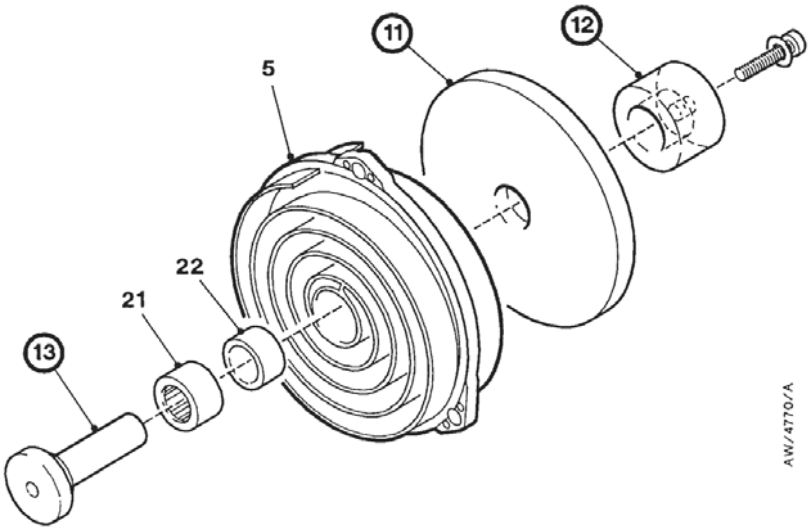


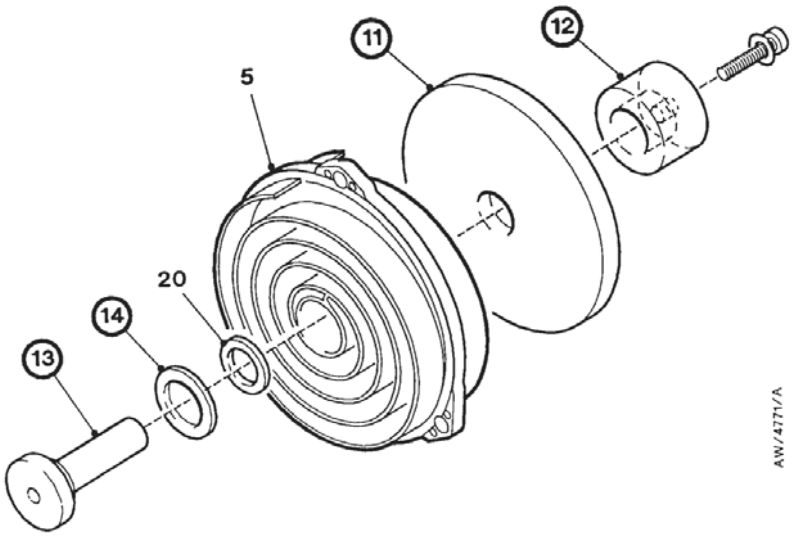
Figure 34 - Fit the Second Needle Bearing in the ESDP30/30A Orbiting Scroll



5.3.3 Replace the needle bearing in the front fixed scroll

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Use the procedure in Section 5.2.4 to replace the needle bearing (18) in the front fixed scroll (6) with the new needle bearing supplied in the kit. Replace the shaft seal (19) and the grease seal (17) when you replace the needle bearing.
2. Ensure that the lips of the shaft seal (19) and the gap between the grease seal (17) and the bearing are sufficiently greased, then wipe off any excess grease from the outside face of the seals (17 and 19).

Figure 35 - Fit the Grease Seal in the ESDP30/ESDP30A Orbiting Scroll



5.3.4 Replace the ball bearing in the rear fixed scroll

Note: The new bearing is supplied already greased and sealed. You do not need to put more grease in the bearing.

1. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Remove the three M6 hex head bolts (65) which secure the bearing case (30) to the rear fixed scroll (4), then use two screwdrivers to prise up the bearing case (30) and remove the bearing case (30) and ball bearing (31). Replace the shaft seal (28) as described in Section 5.2.3.
2. Fit the new ball bearing (31) and bearing case (30) into the rear fixed scroll and secure with the three M6 hex head bolts (65).

5.3.5 Replace the tip seals

The tip seals have a hard black sealing surface with a soft white backing. When you fit a tip seal, insert the white backing material into the tip seal grooves; the hard sealing material must always face outwards from the tip seal groove. When fitted, the top face of the black sealing materials should be approximately 0.5 mm above the top of the tip seal groove.

Refer to Figure 6 (ESDP30) or 10 (ESDP30A). The Major Service Kit contains a clockwise tip seal and an anticlockwise tip seal:

- Use the clockwise tip seal to replace the tip seal in the front of the orbiting scroll (5) and the front of the rear fixed scroll (4).
- Use the anticlockwise tip seal to replace the tip seal in the rear of the orbiting scroll (5) and the rear of the front fixed scroll (6).

The tip seals naturally follow the curvature of the scrolls and should be easy to fit into the tip seal grooves. If you have to force the tip seals in, you are probably trying to fit the tip seal the wrong way round: remove the tip seal, turn it around and fit it the correct way.

The tip seal grooves in the fixed scrolls have a constriction (pinch point) near the centre of the scroll to aid retention of the tip seals. Ensure that the tip seals are fully inserted in these constrictions.

Note: You must thoroughly clean the tip seal grooves (see Step 3 below), as the tip seals must be free to move within the tip seal grooves. If the tip seals are not free to move, the rotors may strike one another, or poor ultimate vacuum may result.

Use the following procedure to replace the tip seals.

1. Remove the tip seal (8) from the front of the rear fixed scroll (4): start at the outer edge of the scroll and slowly pull the tip seal from the scroll.
2. Repeat Step 1 to remove:
   - The tip seal (10) from the rear of the front fixed scroll (6).
   - The tip seals (9, 11) from the front and rear of the orbiting scroll (5).
3. Use clean soft cloth to thoroughly clean the tip seal grooves in the front and rear fixed scrolls (6, 4) and the orbiting scroll (5).
4. Start at the centre of the front of the orbiting scroll (5) and press the new (clockwise) tip seal (9) into the tip seal groove. When you reach the end (outside) of the tip seal groove, cut the tip seal (9) approximately 5 mm short of the end of the groove, then press the end of the tip seal into the tip seal groove.
5. Use the rest of the new clockwise tip seal and repeat Step 4 to fit the new tip seal (8) to the rear fixed scroll (4).
6. Start at the centre of the rear of the orbiting scroll (5) and press the new (anticlockwise) tip seal (11) into the tip seal groove. When you reach the end (outside) of the tip seal groove, cut the tip seal approximately 5 mm short of the end of the groove, then press the end of the tip seal into the tip seal groove.
7. Use the rest of the new anticlockwise tip seal and repeat Step 6 to fit the new tip seal (10) to the front fixed scroll (6).

5.3.6 Reassemble the pump

Reassemble the pump as described in Section 5.2.8.

5.3.7 Replace the motor bearings

Note: Ensure that the motor bearings are non-creep bearings. If necessary, use an ESDP30/ESDP30A Motor Bearings Kit to replace the bearings with new non-creep bearings.

1. Refer to Figure 5 (ESDP30) or 9 (ESDP30A). If the pump has a flexible coupling, loosen the grub screw (75) and remove the coupling hub (54) from the motor shaft (34-3).
2. Remove the key (34-4) from the shaft (34-3).
3. Remove the four M5 hex head bolts (34-9) which secure the motor end-plate (34-10), then tap off the end-plate from the motor. Ensure that you retain the spring washer (34-11) from the bearing recess in the motor end-plate. If the pump has a single-phase motor, ensure that you do not damage the centrifugal switch mechanism when you remove the motor end-plate.
4. Carefully remove the rotor (34-8) from the stator (34-1); if necessary, tap out the rotor from the key end (34-4) of the shaft.
5. Use a bearing puller to remove the front and rear bearings (34-5, 34-12) and ensure that the rear bearing mating surfaces on the motor shaft (34-3) are clean.
6. Lightly lubricate the rear bearing (34-12) and mating surfaces of the motor shaft and place the bearing over the shaft.
7. Place a sleeve (which has a diameter slightly larger than the diameter of the shaft) over the shaft to engage with the inner bearing race.
8. Use a bearing press on the sleeve to fully fit the bearing. Alternatively, carefully hammer onto the sleeve to drive the bearing into position; do not allow the sleeve to come into contact with the outer bearing race or damage the motor shaft.
9. Repeat Steps 6 to 8 to fit the front bearing (34-5) onto the motor shaft.
10. Ensure that the bearing circlip is located in the deepest part of the eccentric circlip groove of each of the new bearings. Carefully refit the rotor (34-8) into the stator (34-1).

11. Ensure the spring washer (34-11) is in position in the rear bearing recess in the motor end-plate (34-10), then fit the motor end-plate to the motor and tap it into place.
12. Use the four M5 hex head bolts (34-9) to secure the motor end-plate (34-10).
13. Refit the key (34-4) to the shaft (34-3).
14. If the pump has a flexible coupling, fit the coupling hub (54) to the motor shaft and tighten the grub screw (75) to secure the coupling hub in place.

5.3.8 Fit the motor to the pump

Refit the motor to the pump as described in Section 5.2.9.

5.4 How to use the Crank Pin Kit

Note: You will require three Crank Pin Kits to replace all of the crank pins in the pump.

Use the following procedure to replace the crank pins. Note that Crank Pin Kits are discretionary items. You should only use a Crank Pins Kit when the crank pins fitted to the pump are no longer serviceable.

1. Dismantle the pump as described in Steps 1 to 13 of Section 5.2.1, then inspect the pump as described in Section 5.2.2.
2. Refer to Figure 6 (ESDP30) or 10 (ESDP30A). Remove the two cross head bolts (66) which secure one of the cover plates (36) to the orbiting scroll (5), then remove the cover plate.
3. Push out the needle bearing (38) from the orbiting scroll (5).
4. Use a small screwdriver to prise the two O-rings (37) out of the orbiting scroll (5).
5. Insert the two new O-rings (37) into the O-ring grooves in the orbiting scroll (5).
6. Push the new needle bearing (38) into the orbiting scroll (5).
7. Refit the cover plate (36), apply thread sealant to the two cross head bolts (66) and use the bolts to secure the cover plate.
8. Repeat Steps 2 to 7 above to change the other two needle bearings and O-rings, if required.
9. Undo and remove the two cross head bolts (67) which secure one of the crank pin assemblies (104) in the rear fixed scroll (4), then remove the crank pin assembly.
10. Place the new crank pin assembly (104) in the rear fixed scroll (4).
11. Apply thread sealant to the two cross head bolts (67), then use the bolts to secure the crank pin assembly (104) in the rear fixed scroll (4).
12. Repeat Steps 9 to 11 to replace the other two crank pin assembles, if required.
13. Reassemble the pump as described in Section 5.2.8.

5.5 Replace the Motor Assembly

1. Refer to Figure 5 (ESDP30) or 9 (ESDP30A). Loosen the six M8 cap head screws (63) which secure the motor (34) to the rear fixed scroll (4).
2. Turn the pump so that the pump rests on the motor (34) and so that the front fan (13) faces upwards.
3. Remove the six cap head screws (63) and lift the pump body off of the motor (34). If you cannot easily lift the pump body off of the motor, place two of the cap head screws into the jacking holes on the motor flange and tighten the screws to push the pump body off of the motor flange: refer to the ESDP30 instruction manual.

4. If the pump has a flexible coupling, loosen the grub screw (75) and remove the coupling hub (54) from the motor shaft.
5. Remove the four hex head bolts (72) and plain washers (73) which secure the motor (34) to the base (1) and remove the motor from the base.
6. Use the four hex head bolts (72) and plain washers (73) to secure the new motor to the base (1).
7. If the pump has a flexible coupling, fit the coupling hub (54) to the new motor shaft and tighten the grub screw (75) to secure the coupling hub in place.
8. Fit the new motor and base to the pump as described in Steps 1 to 5 of Section 5.2.9.

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6 Test the Pump

Note: You must test the pump after you have serviced it. You will require a leak detector, a three-phase ammeter and voltmeter and a pressure gauge (a Pirani gauge or a capacitance manometer).

6.1 Preparation

Note: You must operate the pump as described in Step 3 below to bed-in the tip seals.

1. Connect an electrical supply to the pump as described in the pump instruction manual.
2. Record the pump serial number and its operating hours for future reference.
3. If you have changed the tip seals:
   - Seal the pump inlet.
   - Switch on the electrical supply to the pump and operate the pump for approximately fifty hours, to bed-in the tipseals.
   - Switch off the electrical supply to the pump and remove the seal from the pump inlet.
   - Fit a suitable toggle-valve to the pump inlet.
   - Switch on the electrical supply to the pump and quickly open and shut the toggle-valve 10 times or more, to discharge any dust from the pump.
   - Switch off the electrical supply to the pump.

6.2 Leak test the pump

1. Connect a suitable leak detector (for example, a Edwards Spectron 300, 3000 or 5000) to the inlet of the pump.
2. Connect suitable pipework or ducting to the outlet of the pump.
3. Start the leak detector and switch on the electrical supply to the pump; ensure that the pump rotates in the correct direction.
4. Leave the pump to operate for three minutes, to allow the pressure to stabilise.
5. Place a plastic bag over the pump, and spray helium into the bag for one minute or more.
6. Leak test the pump. The leak rate must be 1 x 10 mbar l s(1 x 10 Pa l s) or less.

6.3 Check the operating current consumption

1. Disconnect the leak detector from the pump inlet and from the pump outlet.
2. Connect a suitable isolation-valve (to which you can connect a pressure gauge) to the pump inlet.
3. Switch on the pump and measure the electrical current consumption. Check that the current consumption is less than shown in Table 8, 9 or 10.
4. If the current consumption is correct, continue at Section 6.4 to check the ultimate pressure of the pump, otherwise continue at Step 5 below.
5. If the current consumption is higher than the values shown in Table 8, 9 or 10 and you have fitted new tip seals:
   - Switch off the pump and remove the front fixed scroll from the rear fixed scroll.
   - Check that the tip seals are correctly fitted to the fixed and orbiting scrolls.

- Reassemble the pump.

6. Switch on the pump and measure the electrical current consumption again. If the current is still too high:
   - Switch off the pump.
   - Refer to Figure 2, 6 or 10. Loosen the bolts (63) which secure the front fixed scroll to the rear fixed scroll.
   - Fit suitable shims between the sealing faces of the front and rear fixed scrolls, then tighten the bolts (3).
   - Switch on the pump and leave it to operate for one hour, then switch off the pump.
   - Remove the shims and tighten the bolts (63) again.
   - Switch on the pump and measure the electrical current consumption again. If the current is still too high, the motor may be damaged or faulty.

Table 8 - Full Load Current Ratings (A): ESDP12

Electrical supply frequency	Electrical supply voltage (V)			
	100	115	200	230
50 Hz	6.5	-	3.3	3.1
60 Hz	5.8	5.1	2.9	2.5

Table 9 - Full Load Current Ratings (A): ESDP30/30A, 3-Phase Electrical Supply

Electrical supply frequency	Electrical supply voltage (V)					
	200	208	230	380	415	460
50 Hz	2.7	-	-	1.57	1.63	-
60 Hz	2.6	2.5	2.5	-	-	1.47

Table 10 - Full Load Current Ratings (A): ESDP30/30A, 1-Phase Electrical Supply

Electrical supply frequency	Electrical supply voltage (V)			
	100	115	200	230
50 Hz	8.5	-	4.3	3.9
60 Hz	7.7	6.7	3.9	3.4

6.4 Check the ultimate pressure

1. Connect a suitable pressure gauge to the isolation-valve on the pump inlet and open the valve.
2. Operate the pump (with the inlet isolation-valve open) for one hour.
3. Look at the pressure gauge. For ESDP12 pumps, if the ultimate pressure is 0.016 mbar (1.6 Pa) or less, the pump can be returned to service. For ESDP30/30A pumps, if the ultimate pressure is 0.01 mbar (1 Pa) or less, the pump can be returned to service.

   If the ultimate pressure is higher than the pressure specified above, the surfaces of the pumps scrolls may have absorbed water; continue at Step 4 to remove the water.
4. Close the inlet isolation-valve and remove the pressure gauge from the inlet isolation-valve.

5. Fit a suitable T-piece to the inlet isolation-valve. Fit an air bleed valve to one port of the T-piece and fit a suitable capsule dial gauge to the other port.
6. Fully open the inlet isolation-valve, then adjust the air bleed valve to give a pump inlet pressure of approximately 50 mbar (5×10^3 Pa).
7. Leave the pump to operate for two hours or more.
8. Close the air bleed valve, then repeat this procedure from Step 2 to check the ultimate pressure again.

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7 Fault Finding

Table 11 - Fault Finding

Symptom	Check	Action
The ultimate vacuum of the pump is poor.	Has the pump been incorrectly used in an application in which water, solvents or very dusty materials are pumped ?	Dismantle and clean the pump; remove all contamination from the tip seals and surfaces inside the pump. If the pump will be used on the application again, ensure that maintenance is carried out more frequently.
	Are the tip seals worn (the tip seals must be 2.55 mm or more high) or is there an accumulation of dust inside the pump ?	Dismantle and clean the pump and replace the tip seals (if necessary). Ensure that the pump is installed correctly: it must be horizontal ± 5°.
	Are the tip seals too tight in the tip seal grooves ?	Remove the tip seals, clean the tip seals and the tip seal grooves, then refit the tip seals.
	Have the stator O-ring or the fixed scroll sealing faces been damaged ?	Dismantle the pump and inspect the O-ring and the sealing surfaces for damage. If the O-ring is damaged, replace it. If the sealing faces are lightly damaged, use fine abrasive paper to refinish the surfaces. If the sealing faces on the scroll(s) are heavily damaged, replace the scroll(s).
	Is there a loss of motor torque (and pump speed) ?	Check that the electrical supply is correct; rectify any problem found.
	Are the bolts which secure the fixed scroll loose ?	Loosen all of the bolts, then retighten them: refer to Section 4.2.9 (ESDP12) or 5.2.10 (ESDP30/30A).
	Have the tip seals worn unevenly ?	Dismantle the pump and inspect the tip seals. If they are worn unevenly, the bolts which secure the fixed scrolls were incorrectly tightened. Replace the tip seals, then reassemble the pump correctly.
	Has the outlet valve failed or jammed ?	Dismantle and inspect the outlet valve. If dirty, clean the outlet valve. If the outlet valve is damaged, you must replace it.
The pump stalls (the motor trips out with current overload)	Is the motor correctly connected to the electrical supply ?	Check that the electrical connections in the pump motor are correct and check that the current overload is correctly rated for the electrical supply. Rectify any problem found.
	Have the tip seals been incorrectly fitted ?	Dismantle the pump and check the installation of the tip seals. Replace the tip seals if necessary.
	Has dust accumulated in the pump ?	Dismantle and clean the pump. When the pump is re-installed, install a filter or trap to collect the dust before it enters the pump. Ensure that the pump is maintained more frequently.
	Are the bearings dirty or damaged ?	Dismantle the pump and inspect the bearings. If dirty or if there is insufficient grease on the bearings, clean and regrease the bearings. If the bearings are damaged, they must be replaced.
	Is the outlet valve jammed ?	Dismantle and inspect the outlet valve. If dirty, clean the outlet valve. If the outlet valve is damaged, you must replace it.
	Is the pump operating at too high a temperature ?	Ensure that the pump is operated in an area where the air flow through the fans is not restricted and where the ambient temperature is 5 to 40°C.

Table 11 - Fault Finding

Symptom	Check	Action
The pump is noisy.	Are there signs of axial contact (even very light signs) between the rotor and stator and are the tip seals flush ?	Clean the tip seal grooves and replace the tip seals.
	Is there solid material inside the pump ?	Dismantle and clean the pump.
	Is the pump installation attitude incorrect ?	Ensure that the pump is installed correctly: it must be horizontal ± 5°.
	Are the orbiting or fixed scroll bearings dirty or damaged ?	Dismantle the pump and inspect the bearings. If dirty or if there is insufficient grease on the bearings, clean and regrease the bearings. If the bearings are damaged, they must be replaced.
	Is the outlet valve dirty or jammed ?	Dismantle and clean the outlet valve.
	Has the shaft seal or grease seal failed ?	Dismantle the pump and inspect the seals; replace as necessary.
	Are the bolts which secure the scrolls loose ?	Loosen all of the bolts, then retighten them: refer to Section 4.2.9 (ESDP12) or 5.2.10 (ESDP30/30A).
	Are the pump shafts misaligned ?	If the bolts which secure the motor to the pump are loose, loosen all of the bolts, then retighten them: refer to Section 4.2.9 (ESDP12) or 5.2.10 (ESDP30/30A). If the bolts are not loose, the shaft bearing in the rear fixed scroll may be incorrectly installed; dismantle the pump and check the installation of the bearings and refit or replace as necessary.
	Are the bolts which secure the fans loose ?	Dismantle the pump and check the bolts; retighten if necessary.
There is vibration when the pump operates.	Are the pump and motor shafts misaligned ?	Remove the pump from the motor, re-align the shafts and reassemble.
	Are the scrolls touching due to operation at too high a temperature ?	Ensure that the pump is operated in an area where the air flow through the fans is not restricted and where the ambient temperature is 5 to 40 °C.
	Are the scrolls touching due to dust in the pump ?	Dismantle and clean the pump. When the pump is re-installed, install a filter or trap to collect the dust before it enters the pump.
	Have the shaft seals overheated due to lack of lubrication ?	Ensure that the pump is maintained more frequently.
	Are the tip seals fitted incorrectly ?	Dismantle the pump and inspect the bearings and shaft seals; relubricate/replace as necessary.
	Has a bearing failed ?	Dismantle the pump and inspect the tip seals; refit or replace as necessary.
	Are the bolts which secure the fixed scrolls or the motor loose ?	Dismantle the pump and check the crank pin, orbiting scroll and shaft bearings; regrease/replace as necessary.
	Are the fans not properly secured ?	Check the bolts; loosen then retighten as necessary: refer to Section 4.2.9 (ESDP12) or 5.2.10 (ESDP30/30A).

Table 11 - Fault Finding

Symptom	Check	Action
The pump operating temperature is too high.	Are the orbiting and fixed scrolls rubbing ?	Dismantle the pump and check for bearing failure or incorrect installation. Replace as necessary.
	Are the tip seals fitted incorrectly ?	Dismantle the pump and inspect the tip seals; refit or replace as necessary.
	Have the bearings overheated because of too much grease ?	Dismantle the pump, then clean and regrease the bearings.
	Have the bearings overheated because of insufficient lubrication ?	Dismantle the pump and inspect the bearings; clean and regrease the bearings as necessary.
	Is the cooling-air flow to the pump restricted ?	Ensure that the pump is operated in an area where the air flow through the fans is not restricted.
	Is the ambient air temperature too high ?	Ensure that the pump is operated in an area where the ambient temperature is 5 to 40°C.

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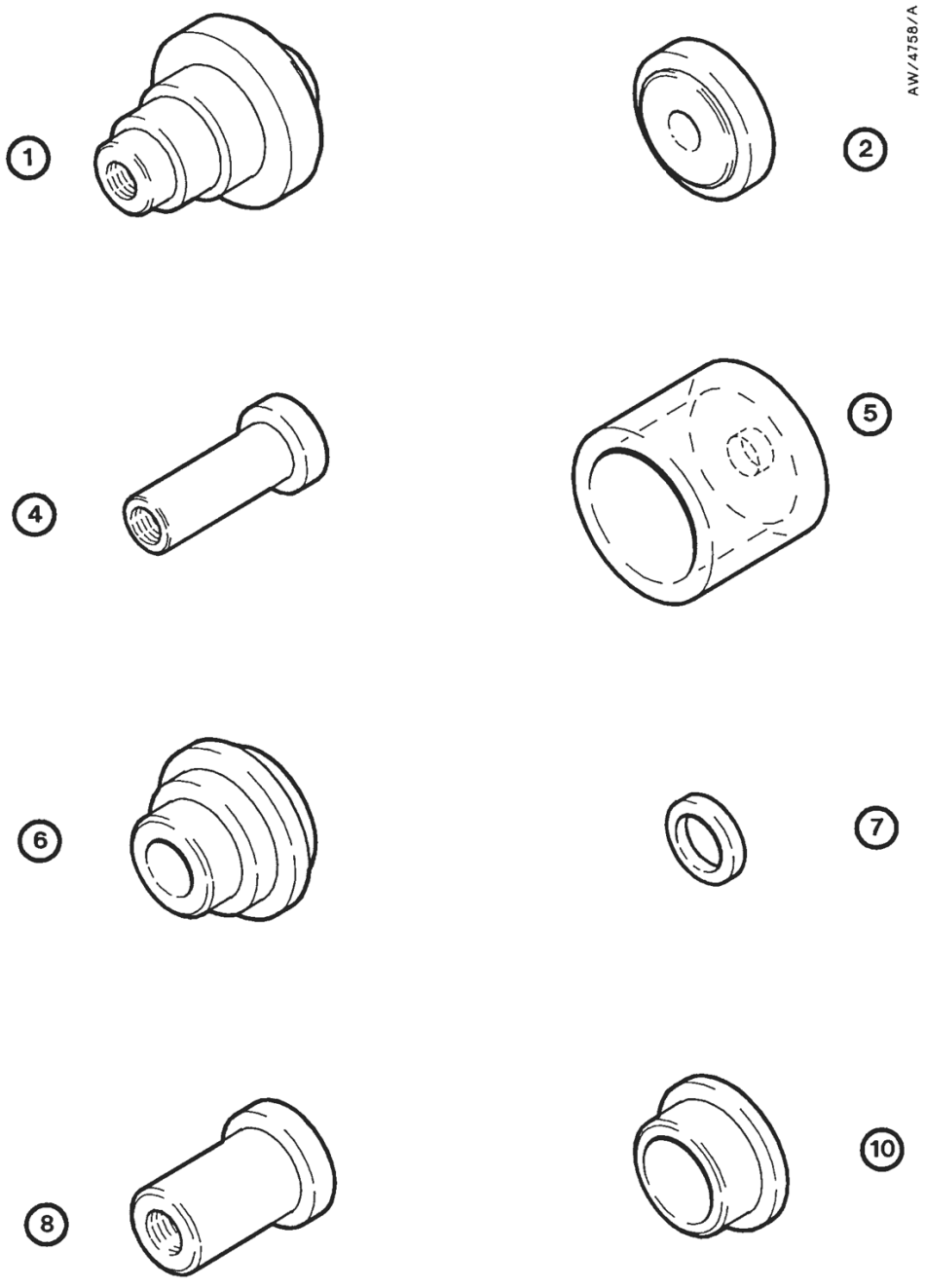
Appendix A1 ESDP12 Special Tools

Twelve special tools are required to service the ESDP12 pump. These tools are available in a kit: the Item Number for the kit is given below. The individual tools are shown in Figure 36. Table 10 shows the uses for the tools.

Kit	Item Number
ESDP12 Special Tools Kit	A710-02-025

Figure A1 - ESDP12 Special Tools: Sheet 1 of 2



Appendix A1

Figure A1 - ESDP12 Special Tools: Sheet 2 of 2

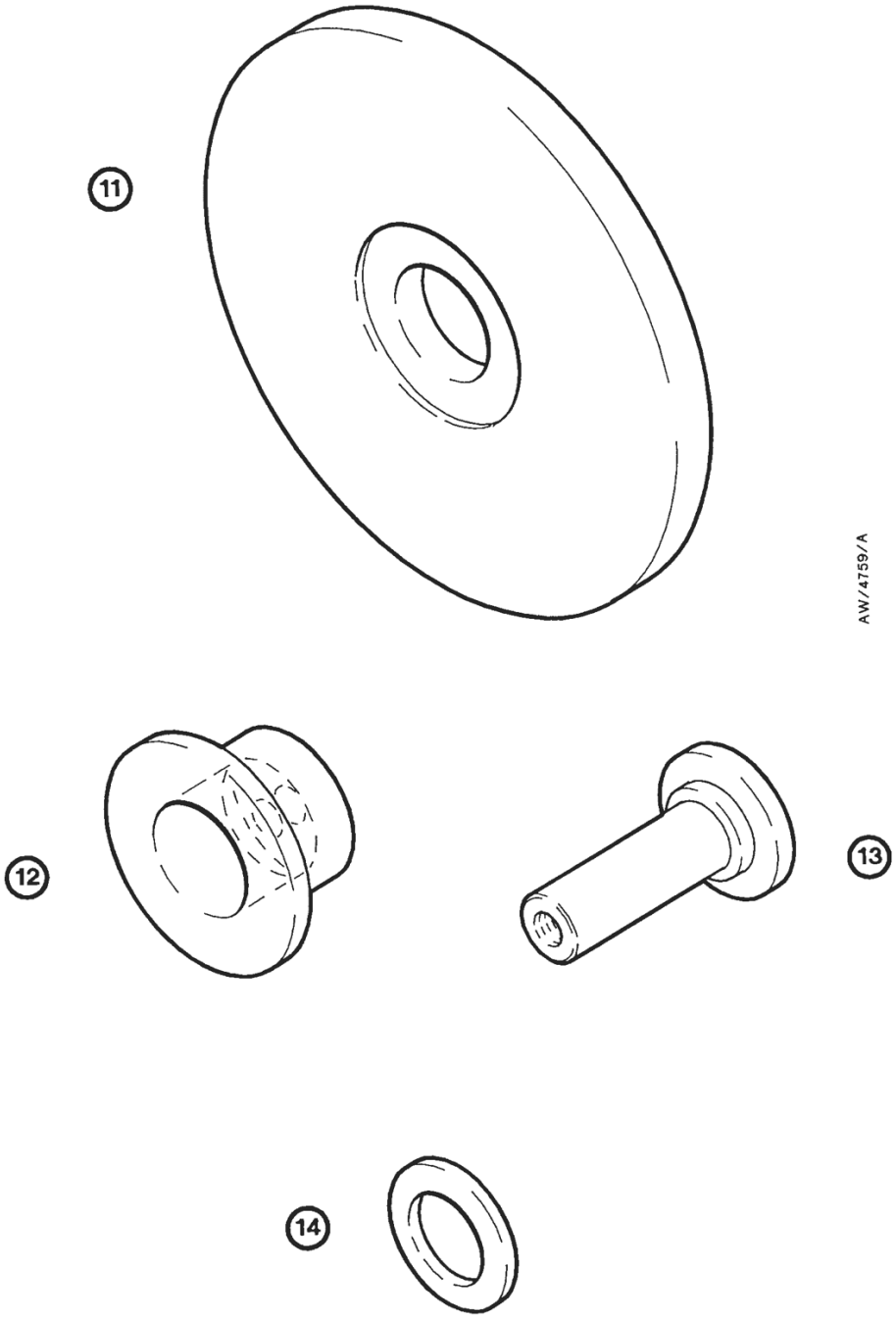
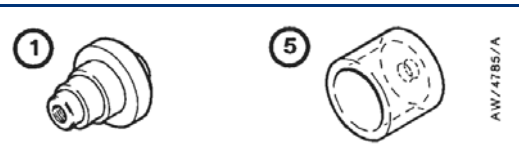
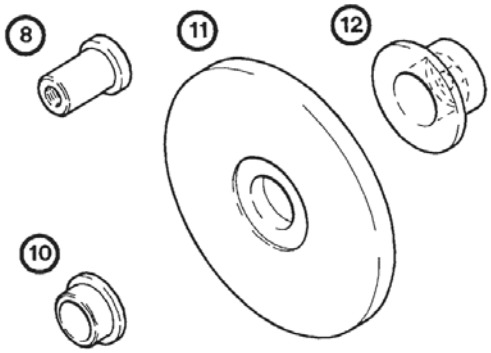
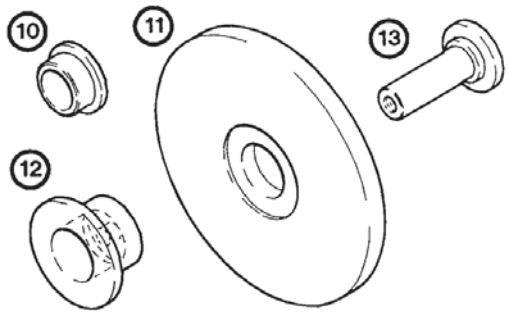
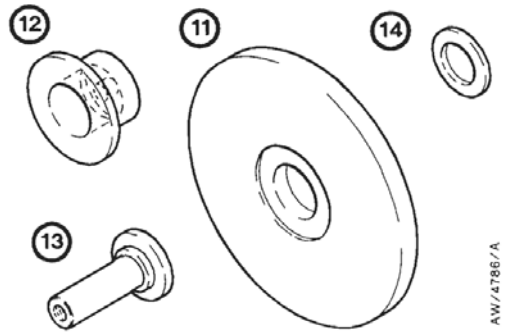


Table A1 - Use of the ESDP12 Special Tools

Applicable part(s) of the pump	Tools used to	Tools
Shaft seal (28) Rear fixed scroll (4)	Remove the shaft seal	
Shaft seal (28) Rear fixed scroll (4)	Insert the shaft seal	
Needle bearing (18) Front fixed scroll (6) Grease seal (17) Shaft seal (19)	Remove the needle bearing and shaft seals	
Needle bearing (18) Front fixed scroll (6)	Insert the needle bearing	
Grease seal (17) Front fixed scroll (6)	Insert the grease seal	
Shaft seal (19) Front fixed scroll (6)	Insert the shaft seal	
Needle bearing (18) Grease seal (20) Orbiting scroll (5)	Remove the needle bearing and grease seal	

Appendix A1

Table A1 - Use of the ESDP12 Special Tools

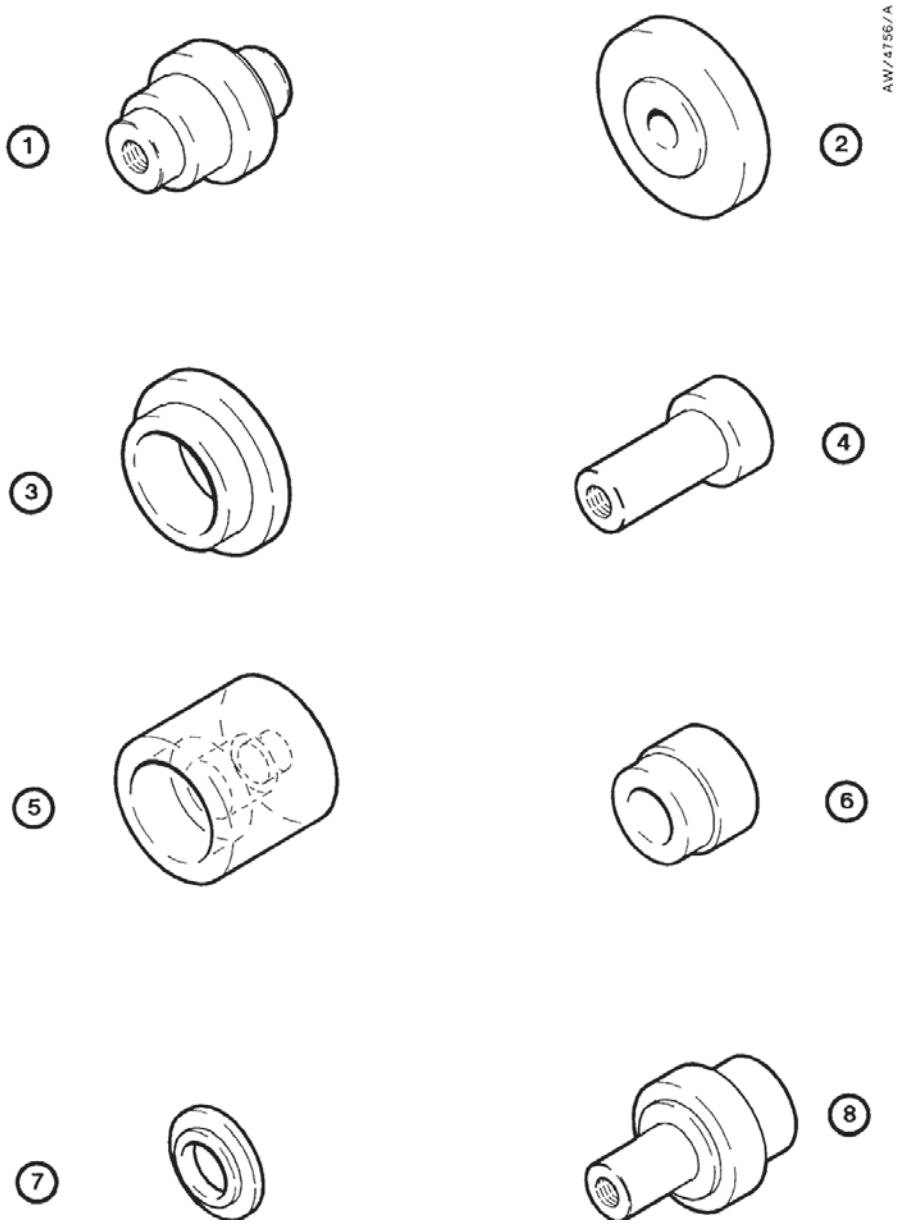
Applicable part(s) of the pump	Tools used to	Tools
Needle bearing (18) Orbiting scroll (5)	Insert the needle bearing	
Grease seal (20) Orbiting scroll (5)	Insert the grease seal	

Appendix A2 ESDP30/ESDP30A Special Tools

Fourteen special tools are required to service the ESDP30 and ESDP30A pumps. These tools are available in a kit: the Item Number for the kit is given below. The individual tools are shown in Figure 37. Table 11 shows the uses for the tools.

Kit	Item Number
ESDP30/ESDP30A Special Tools Kit	A710-03-025

Figure A2 - ESDP30/ESDP30A Special Tools: Sheet 1 of 2



Appendix A2

Figure A2 - ESDP30/ESDP30A Special Tools: Sheet 2 of 2

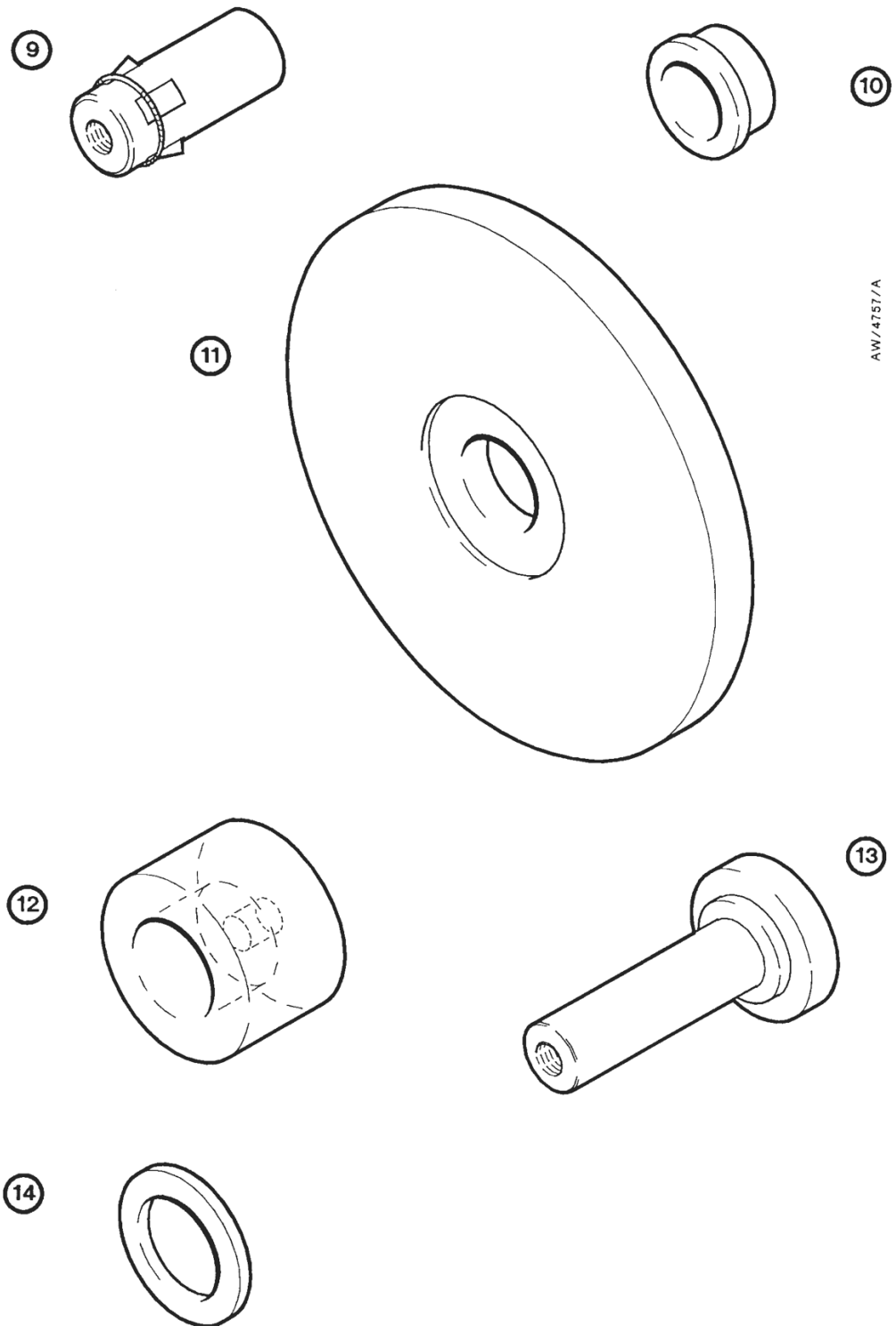
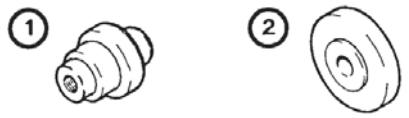
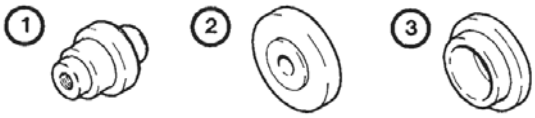
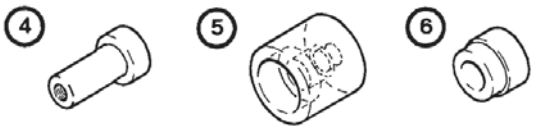
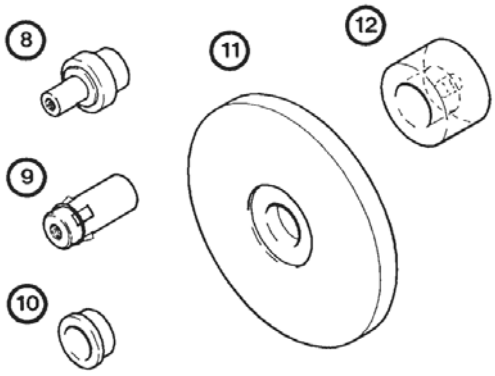
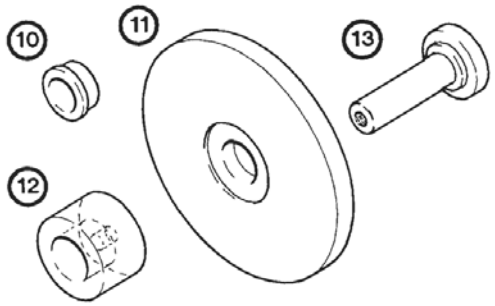


Table A2 - Use of the ESDP30/ESDP30A Special Tools

Applicable part(s) of the pump	Tools used to	Tools
Shaft seal (28) Rear fixed scroll (4)	Remove the shaft seal	
Shaft seal (28) Rear fixed scroll (4)	Insert the shaft seal	
Needle bearing (18) Front fixed scroll (6) Grease seal (17) Shaft seal (19)	Remove the needle bearing and shaft seals	
Needle bearing (18) Front fixed scroll (6)	Insert the needle bearing	
Grease seal (17) Front fixed scroll (6)	Insert the grease seal	
Shaft seal (19) Front fixed scroll (6)	Insert the shaft seal	
Needle bearing (18) Grease seal (20) Orbiting scroll (5)	Remove the needle bearing and grease seal	

Appendix A2

Table A2 - Use of the ESDP30/ESDP30A Special Tools

Applicable part(s) of the pump	Tools used to	Tools
Needle bearing (18) Orbiting scroll (5)	Insert the needle bearing	
Grease seal (20) Orbiting scroll (5)	Insert the grease seal