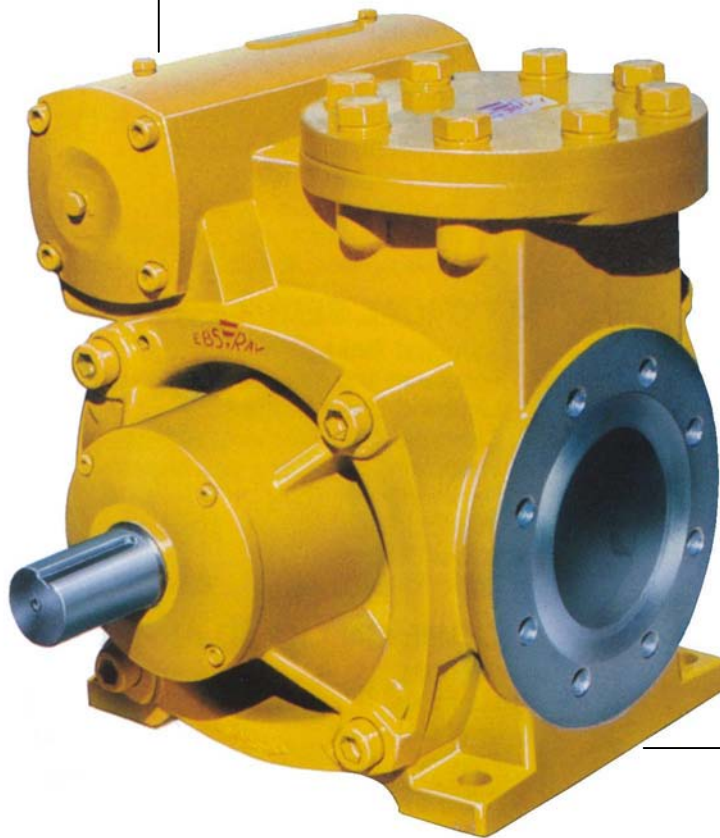


# EBSRAY PUMPS

## Installation, Operation & Maintenance Instructions



***V series  
Model V40***

## SECTION 1 - GENERAL

### INTRODUCTION

This publication is intended to assist those involved with the installation, operation and maintenance of EBSRAY Model V40 Type 51 and Type 52 Rotary Sliding Vane Pumps. The design, materials and workmanship incorporated in the manufacture of EBSRAY pumps make them capable of reliable operation over a long working life. Correct installation is essential. Service life is enhanced by periodic inspection and careful maintenance.

### 1.1 CAUTION

INSTALLATION AND SERVICING OF THIS EQUIPMENT SHOULD BE PERFORMED BY QUALIFIED COMPETENT PERSONNEL IN ACCORDANCE WITH RELEVANT STATUTORY REGULATIONS OR CODES, IN CONJUNCTION WITH THESE INSTRUCTIONS. When the equipment supplied utilises components other than those manufactured by EBSRAY e.g. couplings, speed reducers, electric motors etc, reference should be made to the original manufacturer's data before installation or servicing is commenced. Failure to observe these details may void the warranty.

### 1.2 WARNING

The pump must be operated within the original selected design parameters of speed, temperature, pressure and viscosity. Should any change be contemplated, please confer

with EBSRAY in order to verify the suitability of such a change.

### 1.3 TRANSPORTATION AND PACKING

Standard domestic packing is suitable for shipment in covered transports. Ports must be sealed to exclude ingress of solids. When received on site the pump should be stored in a dry covered area. If storage is required for other than a short period prior to installation, special preservatives and protective wrappings will be required.

### 1.4 INSPECTION ON RECEIPT – SHORTAGES

On receipt of equipment, check all items against the despatch documents and inspect for damage. Any damage or shortage incurred during transit should be noted on the packing note and on both your own and the carrier's copy of the consignment note, a claim should be made immediately on the transport company. Should a shortage be evident on receipt, notify EBSRAY immediately giving full details and packing note number.

### 1.5 HANDLING

Care should be used in moving pumps. A sling should be placed under or around a bare shaft pump to minimise stress on the shaft or pump flanges. Baseplate mounted units should be lifted from under the baseplate below both the pump and driver ensuring compliance with the relevant lifting codes.

## SECTION 2 - INSTALLATION

### 2.1 LOCATION

The pumping unit should be placed as close as practicable to the source of supply remembering to keep within the NPSH requirement of the pump. Ensure floor area and headroom allotted is sufficient for inspection and maintenance. Be sure to allow for crane or hoist access if required.

### 2.2 FOUNDATIONS

Baseplate units should be accurately installed. When on a concrete foundation, ensure that it has been poured on a solid footing. NOTE: Position foundation bolts to match baseplate foundation plan.

### 2.3 PIPELINE CONNECTIONS

All piping should be supported independently of and line up accurately with the pump ports. NOTE: Pumps with screwed connections should employ a pipe joint close to both the suction and discharge ports to facilitate ease of maintenance. **NEVER DRAW PIPING INTO PLACE BY USE OF FORCE AT THE PORT CONNECTIONS OF THE PUMP.**

### 2.4 STRAINER PROTECTION

The pump suction should always be protected by an efficient suction strainer of adequate size to accommodate the liquid viscosity conditions without causing excessive suction resistance.

### 2.5 ALIGNMENT

Alignment of the pump and driver is of extreme importance for trouble free mechanical operation. Baseplate mounted units are accurately aligned at the factory. To ensure this has been maintained during transit alignment **MUST BE** checked once before startup and again after the unit has been run under actual operating conditions.

NOTE: The following procedures are typical only and reference should be made to data for specific coupling types.

ANGULAR MISALIGNMENT as shown in Fig.1 should be corrected before eccentricity. Refer Fig.3; use feeler gauge reading at 90° intervals, the amount of correction necessary can be easily determined to bring shaft axes in line.

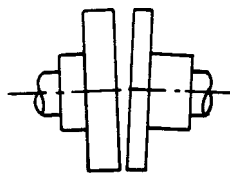


Figure 1

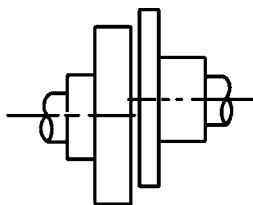


Figure 2

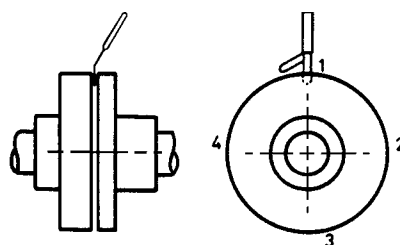


Figure 3

Misalignment due to ECCENTRICITY as shown in Fig.2 can now be corrected. Refer Fig.4; adjustment by use of shims under the driver or pump will effectively correct error in the vertical plane. Movement of one of the ends horizontally will correct error in the horizontal plane.

**NOTE:** If both coupling halves are of identical diameter, concentricity may be checked with a straight edge at 90° intervals.

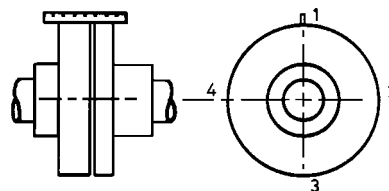


Figure 4

## SECTION 3 - OPERATION

### 3.1 DESCRIPTION

The EBSRAY Model V40 is a positive displacement sliding vane pump intended primarily for the transfer of low to medium viscosity liquids. In this pump the rotor/shaft assembly rotates within a cam form liner. Two EBSRAY balanced mechanical seals isolate the drive end and inspection end bearings from the pumpage. Single lip seals fitted adjacent to the bearings at each end, coupled with the integral drain holes in the bearing housings provide protection for the bearings in the event of leakage past the mechanical seals. The double row ball bearing on the drive end is locked to the shaft by means of a locknut and tabwasher and provides positive axial clearance positioning of the rotor whilst the roller bearing on the inspection end as well as ensuring radial positioning facilitates easy removal of the inspection end cover for a preliminary inspection of the pump. A lip seal is fitted to the drive end cap to minimise the ingress of dust/dirt along the shaft. A blanking plate is fitted to the spare port. The

pump is protected from excessive pressure rise by an integral bypass valve. The bypass valve is fully adjustable within the range of the spring fitted and is reversible for change of pump rotation and direction of liquid flow.

### 3.2 LUBRICATION

No 'in service' lubrication is required on EBSRAY's Model V40 pump.

### 3.3 START-UP CHECKLIST

- ▼ Alignment of couplings
- ▼ Direction of rotation
- ▼ Freeness of shaft
- ▼ Do not start pump against closed discharge valve or with suction valve throttled.
- ▼ DO NOT RUN PUMP DRY.

### 3.4 OPERATIONAL CHECKS

Inspect pump frequently during the first few hours of operation for such conditions as excessive heating of bearings, vibration or unusual noises etc.

## SECTION 4 - MAINTENANCE

PRIOR TO ANY DISASSEMBLY OR SERVICE VERIFY THAT ALL REQUIREMENTS OF STATUTORY REGULATIONS OR CODES ARE MET AND THAT SPECIFIC SITE REQUIREMENTS ETC ARE SATISFIED.

Some inspections and maintenance tasks, can be performed with the pump 'in line', so long as complete isolation, depressurising and purging procedures have been completed. However for major maintenance, it is recommended that the pump be removed from the installation. The following instructions regarding disassembly/reassembly are relative to major

maintenance. For vane replacement only see SECTION 7.

### 4.1 SPARE PARTS

1. When ordering spare parts, to ensure a minimum of delay and correct replacement to original specification, always quote the pump Serial Number which is located on the nameplate of the pump.
2. Advise the name, item number and quantity required. Refer to Drg No CMP103
3. Advise complete delivery instructions, transportation, etc.

**PARATION FOR DISASSEMBLY**

1. Obtain the appropriate Work Permit if required.
2. Isolate the pump from liquids in suction and discharge lines, depressurise and purge out any toxic, flammable, corrosive or air hardening liquids.
3. Isolate power supply to motor.
4. Note pump and bypass valve orientation relative to direction of pump rotation.
5. Disconnect porting connections.
6. Remove pump from installation.

**4.3 DISASSEMBLY**

Two M12 - 1.75 x 50mm Setscrews are required to aid Disassembly/Reassembly.

**CAUTION: TAKE CARE NOT TO DAMAGE COMPONENTS BY PRISING OR LEVERING IN ORDER TO RELEASE FITS.**

**Part 1 - Bypass Valve**

1. Unlock Locknut, remove Adjusting Screw, Locknut and Spring Washer from Bypass Valve Cover.
2. Remove Bypass Valve Cover and 'O'ring together with Valve Spring and Washer with its 'O'ring.
3. Remove Valve Spring, Retaining Washer and 'O' rings from Cover.
4. Remove Cartridge and 'O'ring together with Valve.
5. Remove 'O'ring and Valve from Cartridge.

**Part 2 - Pump**

1. Remove Pump Coupling Half from Shaft.
2. Remove Inspection End Bearing Housing Cap with 'O'ring.
3. Remove 'O'ring from Cap.
4. Remove Shaft Setscrew, Lockwasher and Washer.
5. Withdraw Inspection End Bearing Housing complete with cup of Roller Bearing and Lip Seal, to free Bearing Housing, screw two M12 - 1.75 x 50mm Setscrews into tappings provided. Bearing inner race cone and Spacer will remain on Shaft, Stationary Seal Face may remain on Shaft or may remain in place in Bearing Housing.

6. Remove Roller Bearing, Lip Seal and Stationary Seal Face 'O'ring from Bearing Housing.
7. Remove Bearing inner race cone and Spacer (and Stationary Seal Face if necessary) from Shaft.
8. Release two Grubscrews on Shaft Sleeve at least 1-1/2 turns. Note: Grubscrews lock into a location groove in the Shaft and must be backed off enough to not score the Shaft upon withdrawal of the Seal Sleeve.
9. Withdraw Rotating Seal Face and Seal Sleeve assembly. **CAUTION:** Do not remove Vanes at this stage as Pushrods will slide out and catch in Liner porting.
10. Withdraw Drive End Bearing Housing assembly comprising Rotor/Shaft assembly, Bearing Housing Cap with Lip Seal, Locknut and Lockwasher, Bearing Spacer with Lip Seal and Mechanical Seal. To avoid damage or injury take care to support Rotor/Shaft assembly during withdrawal. Also note orientation of Vanes relative to pump rotation to ensure correct reassembly. To free Bearing Housing screw two M12 - 1.75 x 50mm Setscrews into tappings provided.
11. Remove Vanes and Pushrods from Rotor and Body 'O'ring from Bearing Housing.
12. Remove Drive End Bearing Housing Cap.
13. Remove Lip Seal and 'O'ring from Bearing Housing Cap.
14. Remove Bearing Locknut and Lockwasher from Shaft.
15. Stand Rotor/Shaft assembly vertically with drive end of Shaft sitting on a block of wood on workbench. Remove the Bearing Housing assembly by gently tapping the end of the Shaft on the block of wood, then remove the Spacer.
16. Remove the Ball Bearing, Lip Seal, Stationary Seal Face and 'O'ring from Bearing Housing.
17. Release two Grubscrews on Shaft Sleeve at least 1-1/2 turns. Note: Ensure Grubscrews clear Shaft as before. (Refer step 8)
18. Withdraw Rotating Seal Face and Seal Sleeve assembly.
19. If required remove Liner from Body. Note orientation.
20. If required remove Port Blanking Plate and Gasket.

**INSPECTION**

1. Inspect Rotor/Shaft assembly and Liner. If damage or excessive wear is evident, it is recommended to replace both components. Note: The Rotor is a Shrink fit on the shaft and is pinned for positive axial location.
2. Inspect Vanes for wear or damage - Refer Table 1.
3. Inspect Vane Pushrods for wear, damage and straightness. Replace as required.
4. Inspect both Mechanical Seals. Replace worn or damaged components.
5. Inspect Spacers for damage or excessive wear. Replace as required.
6. Inspect Bypass Valve assembly and components for wear or damage. Replace or refurbish as required.
7. It is recommended that all 'O'rings and Lip Seals be replaced at every overhaul.
8. Inspect both Bearings for wear. It is recommended on major overhauls that both Bearings be replaced.

**STANDARD GENERAL CLEARANCE AND SIZES FOR TEMPERATURES 0 - 100°C**  
(All dimensions are in millimetres) Model V40

Radial Rotor to Liner clearance measured at 12 o'clock position	0.025 - 0.070
Total axial clearance: Liner minus Rotor length measured along axis	0.40 - 0.50
Total Vane clearance: Liner minus Vane Length measured along axis	0.30 - 0.40
Standard Vane height:	45.70 - 46.00
Recommended maximum wear on Vane height	4.0

- Notes:
1. Dimensions stated are design parameters.
  2. High suction lift capability and optimum performance are achieved when the pump is maintained within these dimensions, however adequate performance may still be achieved with clearances and dimensions outside those stated if application parameters allow.
  3. If installing new Vanes or Liner, check their lengths to comply with the clearances as stated.

**4.5 REASSEMBLY – PRELIMINARY**  
(Refer Drawing No. CMP103)

1. Ensure all parts are clean and free from sharp edges, burrs etc.
2. Lightly smear all 'O'rings, Oil Seals and lapped faces of Mechanical Seals with a compatible good quality lubricant before assembling.
3. Ensure correct orientation of components in Bypass Valve: For clockwise pump rotation, Adjusting Screw position is opposite drive end. For anti-clockwise pump rotation, Adjusting Screw position is at drive end.
4. Lap Bypass Valve into Seat of Cartridge. Ensure no lapping compound residue remains on components after lapping.
5. Assemble both mechanical seal rotating seal faces to seal sleeves as follows:
  - (a) Fit two 'O'rings to each seal sleeve.
  - (b) Place a dab of grease on each of the six springs and fit the springs into the locating holes in the seal sleeve.
  - (c) Position the rotating seal face on the seal sleeve, ensuring the ends of the six springs

- locate in the mating holes in the seal face and the three drive pins locate correctly.
- (d) Check that the rotating seal face is free to follow axially by spring pressure when fitted to the Shaft, by compressing the seal sleeve and rotary seal face by hand.
  6. Press fit lip seal into drive end bearing housing cap ensuring the sealing lip faces outwards from pump. (refer Drg. No CMP103)
  7. Pack bearings with a good quality lubricant.

**4.6 REASSEMBLY**

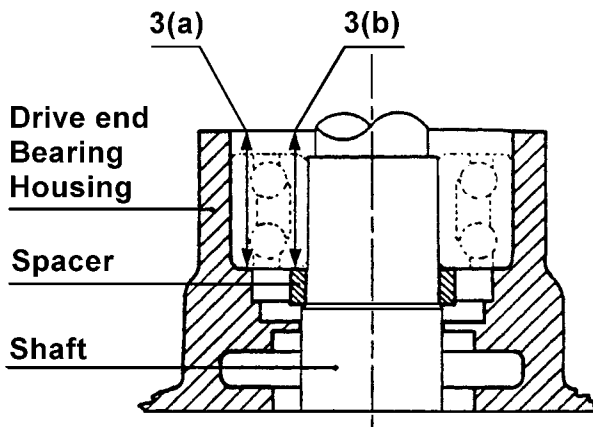
Part 1 – Pump

1. Measure width of liner and width of rotor. The difference is the total axial clearance of the rotor from the bearing housings. The standard general axial clearance is 0.40-0.50mm. It is recommended that the drive end axial clearance be set at 1/3 of the total axial clearance.
2. With the rotor/shaft assembly supported vertically on the workbench and the drive end of the shaft uppermost, fit spacer to shoulder on shaft and sit the drive end bearing housing in position so that it rests on the rotor.



out the seal in place, measure the following using a depth micrometer:

- (a) Vertical distance from outside face of drive end bearing opposing bearing contact face.
- (b) Vertical distance from outside face of drive end bearing housing to drive end face of Spacer.

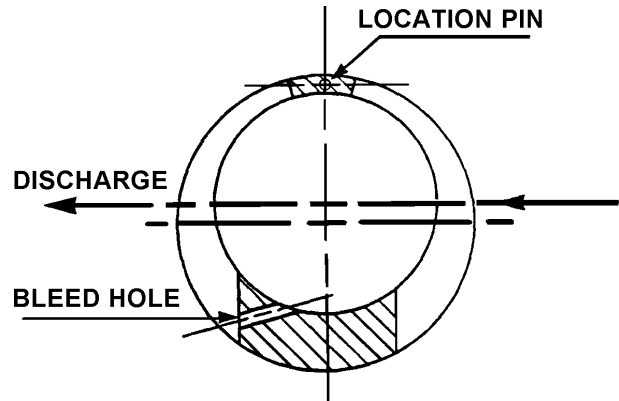


**Figure 5**

The thickness of shims that will be required between the spacer and bearing to obtain correct clearance is equal to the distance  $3(b) - 3(a) + 1/3$  of total axial clearance.

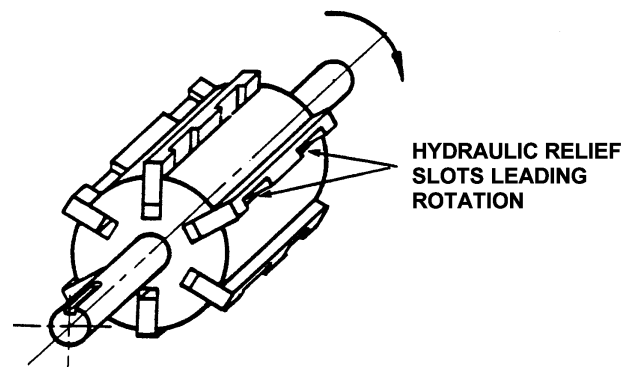
4. Remove bearing housing and spacer, apply a medium strength thread locking adhesive to both seal grub screws and position in seal sleeve. Push seal sub-assembly over drive end of shaft, locating so that grub screws engage shaft drive end location groove. Lock grub screws onto shaft.
5. Fit mechanical seal stationary face with 'O'ring to bearing housing, also fit lip seal to bearing housing with lip towards mech. seal.
6. Ensure mechanical seal faces are lubricated and free from foreign matter.
7. Lower drive end bearing housing vertically downwards over end of shaft.  
**CAUTION: CARE MUST BE TAKEN NOT TO DAMAGE CARBON SEAL FACES.**
8. Fit spacer and required number of shims to shaft. Lubricate spacer before fitting to prevent damage to lip seal.
9. Fit bearing into housing via pressure applied to inner ring of ball race until it locates against spacer/shims. (Be careful of threads)
10. Fit lockwasher and locknut to shaft. After tightening, recheck clearance then bend tab to secure locknut in position.
- 10a Fit bearing cap (remove 'O'-ring from cap for easy removal).
11. Using feeler gauges between rotor and housing re-check axial clearance.

12. Fit 'O' Ring to drive end bearing housing cap and fit cap to drive end bearing housing.
13. Fit location pins to both ends of Liner so that half of the pin protrudes from liner.
14. Fit liner into body with the bleed hole toward pump discharge and thick section to bottom of pump (Refer Fig. 6). Leave liner protruding about 10mm from drive end.



**Figure 6**

15. Locate pump body upside-down on work bench and support horizontally in this position. (i.e. with Bypass Valve Housing below pump foot)  
**NOTE: This is the recommended position for insertion of the Rotor/Shaft assembly as it makes insertion into the liner less complicated.**
16. Fit three vane pushrods and six vanes to rotor as follows:  
**NOTE: THE HYDRAULIC RELIEF SLOTS IN VANE MUST LEAD THE DIRECTION OF ROTATION AND VANE PLATES MUST FACE THE PUSHRODS. (Refer Fig. 7)**



**Figure 7**

17. Support the rotor/shaft/bearing assembly vertically on the work bench so that the inspection end is facing upwards. Insert three vanes followed by three pushrods and then the three remaining vanes. Temporarily tie with a strap in order to hold vanes in position.

- Fit body 'O' ring to drive end bearing housing.
  19. Mechanical assistance may be required to lift the mass of the rotor/shaft/bearing assembly for insertion of the rotor/shaft within the liner. Insert the rotor/shaft assembly into the protruding drive end of the liner ensuring that the location pin protruding from the Liner fits into the location hole in the drive end bearing housing (Note: When inserting, be careful of vanes in liner slots). Once the vanes are secured by the liner, remove the strap and slide the rotor until the liner and rotor are contained fully within the body.
  20. Fasten the drive end bearing housing to the body using four M20 x 55mm cap head set screws.
  21. Rotate assembly on work bench for access to inspection end.
  22. Fit lip seal to inspection end bearing housing with sealing lip facing towards the housing drain hole.
  23. Fit 'O'ring to stationary seal face, then fit stationary seal face inspection end bearing housing. CAUTION: TAKE CARE NOT TO DAMAGE CARBON FACE.
  24. Apply a medium strength thread locking adhesive to both seal grubscrews and position in seal sleeve.
  25. Fit seal sub-assembly to shaft, locating so that grubscrews engage shaft inspection end location groove. Lock grubscrews onto shaft. Lubricate seal face.
  26. Fit body 'O' ring to inspection end bearing housing and fit bearing housing over end of shaft. Position so that location pin in liner fits into location pin hole in housing. CAUTION: CARE MUST BE TAKEN NOT TO DAMAGE CARBON SEAL FACES.
  27. Fasten the inspection end bearing housing to the body using four M20 x 55mm cap head setscrews.
  28. Lubricate and fit spacer to shoulder on shaft.
  29. Fit inner roller bearing cone to shaft above spacer.
  30. Fit outer bearing cone to bearing housing.
  31. Apply thread locking adhesive to thread of shaft setscrew, fit setscrew washer, spring washer and setscrew to inspection end of shaft and tighten setscrew to 68 - 75 Newton-metres.
  32. Turn pump to the normal upright position on work bench and rotate shaft by hand tool to ensure rotor assembly turns freely.
  33. Fit 'O'ring to inspection end bearing cap, apply a smear of grease to 'O'ring and fit bearing cap to inspection end bearing housing.
  34. Check rotation again to ensure pump turns freely.
  35. If required fit port blanking plate with gasket to body.
  36. Refit pump coupling half.
- Part 1 –Bypass Valve
- NOTE: ENSURE CORRECT ORIENTATION WITH REFERENCE TO PUMP ROTATION. (see 4.5)
1. Fit 'O' ring to cartridge.
  2. Position bypass valve in cartridge.
  3. Fit cartridge assembly into body.
  4. Fit retaining washer 'O'ring and cover 'O'ring to cover.
  5. Lubricate bore and slide retaining washer over 'O'ring onto cover boss and check for freedom of movement.
  6. Position spring over retaining washer.
  7. Fit cover assembly to body so that end of spring locates on top of valve.
  8. Fit adjusting screw with locknut and spring washer to cover.
- Note: The bypass valve will require re-setting when the pump is recommissioned. Do not exceed original specified differential pressure. For increased bypass pressure, rotate adjusting screw in clockwise direction (i.e. screw in). For decreased bypass pressure, rotate adjusting screw anticlockwise (i.e. screw out).
- Always lock locknut after any adjustment is made and rewire seal if required.
9. Fit two plugs to top of body (gauge tappings) with an approved thread sealant.
  10. If applicable, fit plug to end of cartridge with an approved thread sealant.

## SECTION 5 - TROUBLE SHOOTING

### 5.1 FAILURE TO DELIVER LIQUID

1. Incorrect direction of rotation.
2. Suction filter/strainer blocked or leaking air.
3. Liquid too viscous.
4. No liquid in tank.
5. High static discharge on pump combined with air in suction pipe.
6. Valves closed or air leaks in suction system.
7. Excess internal clearances.

### 5.2 LOW OUTPUT

1. Pump speed too low.
2. Cavitation or vaporisation on suction side of pump.
3. Obstruction in suction or discharge pipe.
4. Air leakage in suction pipes or fittings.
5. Bypass valve setting too low - increase pressure by screwing In screw. DO NOT exceed system design pressure or overload driver.
6. Differential pressure higher than specified duty point.
7. Viscosity of liquid lower than specified duty point.
8. Pump parts worn - have pump reconditioned or replace worn parts.

### 5.3 EXCESSIVE POWER CONSUMPTION

1. Obstruction in discharge line.
2. Pump operating outside the specified duty point (i.e. high pressure or viscosity)
3. Rotating parts binding - disassemble pump and inspect.
4. Misalignment between pump and driver - check coupling and realign as required.

5. Inherent pipe stresses causing distortion of pump and casing - rectify and realign before reassembling.
6. Bearings worn - inspect and replace as required.

### 5.4 PUMP IS NOISY

1. Air leakage in suction piping.
2. Cavitation due to insufficient NPSH available i.e. suction conditions extreme - reduce suction losses.
3. Pump running dry - remove blockages in suction line/strainer.
4. Pump and driver misaligned - check coupling and realign as required.
5. Rotating elements binding or broken - disassemble and inspect.
6. Bearings worn - inspect and replace as required.

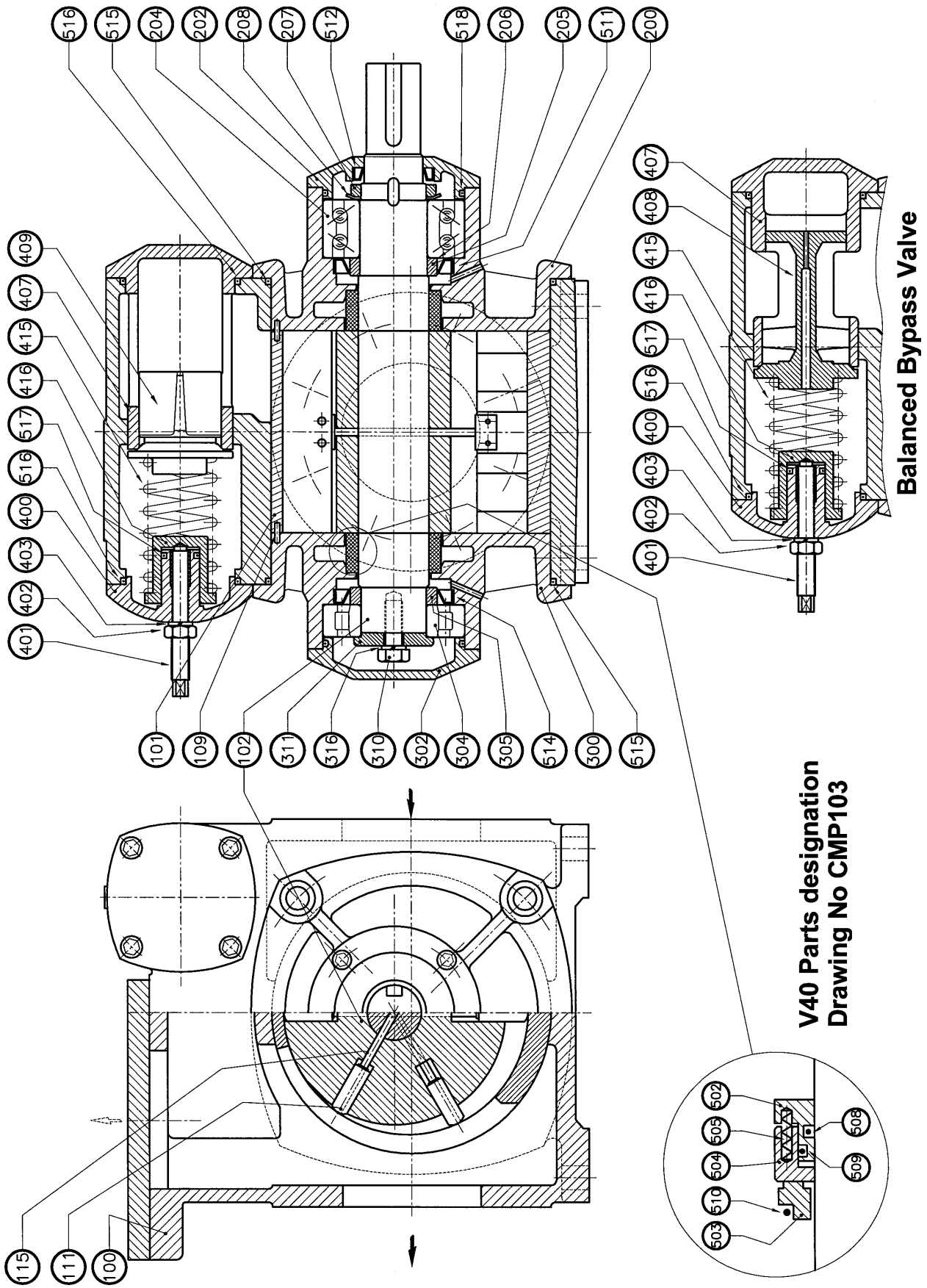
### 5.5 LEAKAGE

1. From covers and flanges:
  - a) Setscrews not tight - retighten.
  - b) Damaged 'O' ring seals or gaskets - replace.
  - c) Check for thermal expansion of product when locked between valves either side of pump. Remove hydraulic lock potential.
2. From Mechanical Seals: (as evidenced by product leaking from 6 o'clock position drain holes in bearing Housings)
  - a) Mechanical seals incorrectly installed, worn or damaged - replace.
  - b) Misalignment between pump and driver causing excessive shaft distortion - check coupling and realign as required.
  - c) Worn or damaged shaft in seal zone - replace rotor/shaft.
  - d) Excess system pressure –
    - i) check for obstructions in discharge line.
    - ii) check for thermal expansion of product when locked between valves either side of pump. Remove hydraulic lock potential.



## SECTION 6 - PARTS DESIGNATION

CAT #	DESCRIPTION	QUANTITY
100	Body	1
101	Liner	1
102	Rotor/shaft assembly	1
109	Location pin – liner	2
111	Vane	6
115	Vane push rod	3
200	Drive end bearing housing	1
202	Drive end bearing housing cap	1
204	Drive end bearing	1
205	Spacer-drive end bearing	1
206	Shims –bearing spacer	As required
207	Shaft locknut	1
208	Tabwasher – Shaft locknut	1
300	Inspection end bearing housing	1
302	Inspection end bearing housing cap	1
304	Inspection end bearing	1
305	Spacer - inspection end bearing	1
310	Setscrew - inspection end shaft	1
311	Washer - inspection end shaft setscrew	1
316	Lockwasher - inspection end shaft setscrew	1
400	Cover - bypass valve	1
401	Adjusting screw - bypass valve	1
402	Locknut - bypass valve adjusting screw	1
403	Lockwasher bypass valve adjusting screw	1
407	Cartridge bypass valve	1
408	Balanced bypass valve	1
409	Poppet bypass valve	1
415	Spring - bypass valve	1
416	Retaining washer - bypass valve spring	1
502	Shaft sleeve	2
503	Stationary seal face	2
504	Rotating seal face	2
505	Spring - mechanical seal	12
508	'O'ring - shaft	2
509	'O'ring – shaft sleeve	2
510	'O'ring - stationary seal face	2
511	Lip seal - drive end bearing housing	1
512	Lip seal - drive end bearing housing cap	1
514	lip seal ~ inspection end bearing Housing	1
515	'O'ring – body	2
516	'O'ring - bypass valve cover	2
517	'O'ring - bypass valve retaining washer	1
518	'O'ring - bearing housing cap	2
604	Port blanking plate (not numbered on drawing)	1
605	Gasket – port blanking plate (not numbered on drawing)	1



**V40 Parts designation  
Drawing No CMP103**

**Balanced Bypass Valve**

## SECTION 7 - INSTRUCTIONS FOR CHANGING VANES

1. Read section 1.1 and section 4 up to and including 4.2
2. Remove inspection end bearing housing cap with 'O'ring.
3. Remove shaft setscrew, lockwasher and washer.
4. Withdraw inspection end bearing housing complete with cup of roller bearing and lip seal. To free bearing housing screw two M12 - 1.75 x 50mm setscrews into tappings provided. Stationary seal face may remain in bearing housing or on shaft. Bearing inner race cone and spacer should remain on shaft.
5. Remove inner race cone and spacer from shaft.
6. Refit stationary seal face (if it has been dislodged) with it's 'O'ring to inspection end bearing housing.  
TAKE CARE NOT TO DAMAGE SEAL FACE. CAUTION: DO NOT REMOVE VANES YET.
7. Only the vanes in the UPPER area of the rotor should be removed first. Removing vanes from the lower area of the rotor will allow pushrods to fall out and become stuck in liner ports. Note orientation of vanes (see section 4.6 - 16. and Fig.7) and as each vane is removed replace it with a new one. The shaft should be turned by hand tool until all vanes have been replaced.
8. Check that vanes are shorter than liner by the required amount (0.3" - 0.4"). If required remove UPPER vanes and alter length to suit. Rotate rotor and repeat procedure until all vanes are the correct length.
9. Cheek body 'O'ring on inspection end bearing housing then fit bearing housing over end of shaft. Position so that location pin In liner fits into location pin hole in housing.  
CAUTION CARE MUST BE TAKEN NOT TO DAMAGE MECHANICAL SEAL FACES.
10. Fasten the inspection end bearing housing to the body using four M20 x 55mm cap head setscrews.
11. Lubricate and fit spacer to shoulder on shaft.
12. Fit inner roller bearing cone -to shaft above spacer.
13. Apply thread locking adhesive to thread of shaft setscrew, fit setscrew washer, spring washer and setscrew to inspection end of shaft and with tension wrench tighten setscrew to 68 - 75 Newton-metres.
14. Cheek rotation to ensure pump turns freely.
15. Apply a smear of grease to 'O'ring and fit bearing cap to inspection end bearing housing.

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