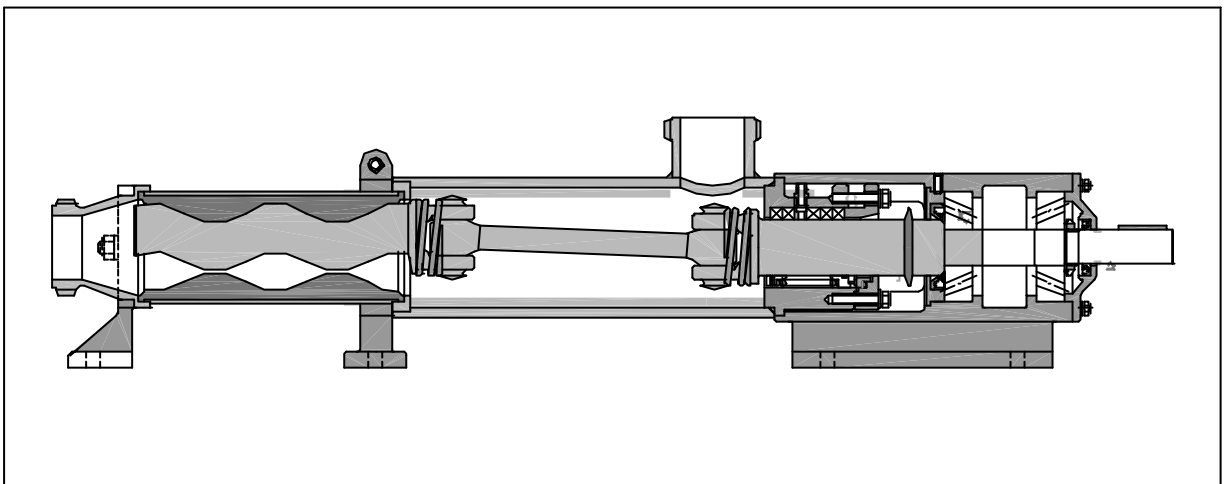


ROTOMAC PROGRESSIVE CAVITY PUMPS

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

'FAS-SERIES' ROTOMAC PUMPS



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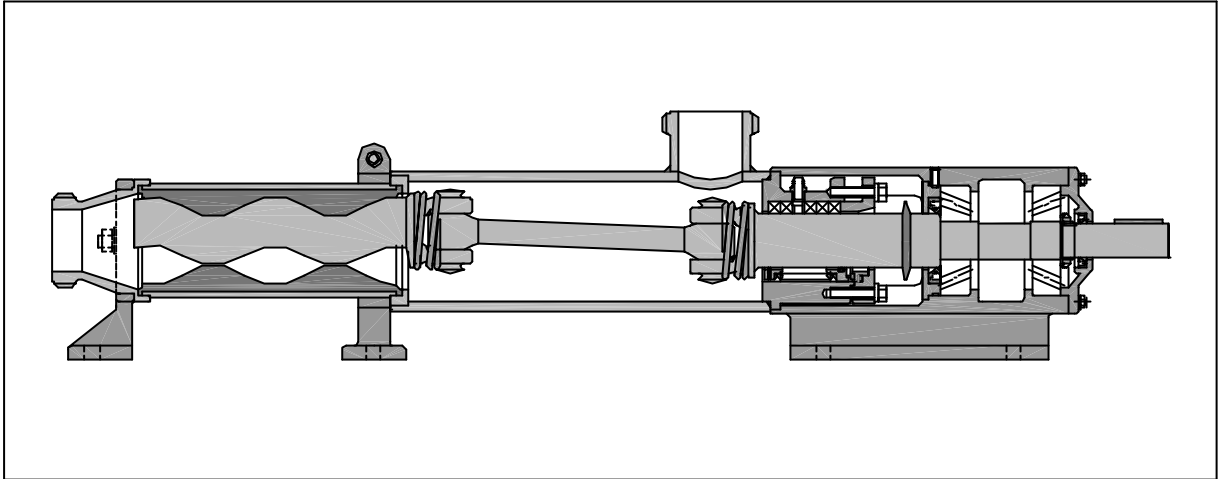
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'FAS-SERIES' ROTOMAC PUMPS



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1. SPECIFICATION

1.1 **BASICS:** Screw Pumps are a special type of Positive Displacement Pumps in which flow through the Pumping elements is truly axial. The **ROTOMAC** design uses a helix of steep pitch, deep root and well rounded apex, which rotates eccentrically in a static housing of similar design but of twice the pitch. The disparity in pitch gives rise to a cavity between rotor and stator as the rotor rotates and oscillates at the same time. The geometry of the cavity is defined by the advancing line of frictional contact between rotor and stator. During operation all parts of the cavity advance steadily from the intake side to the delivery side of the stator. The **ROTOMAC** progressing cavity pump is therefore of the positive displacement type but, unlike other such pumps, has a uniform pulse-free output in strict linear dependence on the rotational speed. They are compact, efficient, accurate and comparatively silent in operation.

1.2 **THEORY:** In screw pumps, it is the intermeshing of the threads & close fit of the surrounding housing which create one or more sets of moving seals between pump inlet & outlet. These sets of seals act as a labyrinth & provide the screw pump with its positive pressure capability. The successive sets of seals form fully enclosed cavities, which move continuously from inlet to outlet. These cavities trap liquid at the inlet & carry it along to the outlet, providing a smooth flow.

1.3 **DESIGN CONCEPTS:** The **'ROTOMAC' 6L Rotor – Stator Geometry** with characteristic advantages is being applied in manufacture of the Rotor and Stator. The developed design proved to enhance the service life and reduce cost of operation by
 (a) Wear of Rotor/Stator is considerably reduced due to low peripheral speed of the rotor,
 (b) Lower axial forces are transmitted to the joints and pump bearings due to the reduction in cross sectional area of the rotor,
 (c) Improved efficiency because of better volumetric and mechanical efficiency.

1.4 SCOPE

1.4.1 **'FAS' Series 'ROTOMAC' Pumps** are used for handling viscous / non viscous fluids, and pulped material in suspension. It is an ideal pump for handling Beverages, Beer, Chocolate, Milk, Cream, Ghee, Fruit Juices/Pulps, Squashes, Medicinal Formulations/Syrups, Tooth Paste, Lotions, Wines, Edible Oils, Tamarind/ Vegetable Extracts, Malt Extracts, Starch, Yeast, Sugar Syrup, Shampoo, Special/Medicinal Oils, etc.

1.4.2 This series of **'ROTOMAC' Pumps** are constructed in highly finished AISI-304/316/316L Stainless Steel housing/ wettable and rotating parts to meet 3A US Sanitary Standards. The resilient, torsion free metal bonded Stators are made of Non-Contaminating Polymer depending upon the compatibility of the pumping fluid. The Pump suction & discharge connections are supplied with IDF/SMS/DIN connections as per the customers' choice.

1.5 DUTY CONDITIONS:

'FAS' Series 'ROTOMAC' Pumps should be installed only on specific duties for which the have been supplied. In case pumps are required to be used for other applications, manufacturer's prior recommendation should be sought in the interest of safety, plant efficiency and the pump life.

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2 IMPORTANT NOTES

- 2.1 In order to achieve reliable performance and long service life, the pump must be checked and maintained at regular intervals, strictly according to the instructions.
- 2.2 These instructions should be placed at the disposal of operating and maintenance staff and should be carefully followed.
- 2.3 The manufacturer do not take any responsibility for damage occurring due to non-observance of these operating instructions.
- 2.4 Warning Plates on the pump showing correct direction of rotation, warning against Dry Running, must always be observed and kept completely legible.

3 INSTALLATION AND SAFETY RECOMMENDATIONS

- 3.1 'FAS' Series 'ROTOMAC' Pumps must be installed with their base plates mounted on a flat surface, grouted and bolted, thus ensuring firm fixing and reduction in noise and vibration. Sufficient space to be left for removal of the stator during the maintenance work.
- 3.1 All pipe works should be independently supported to avoid any load on the pump.
- 3.2 To eliminate vibration, the pump must be checked for proper alignment with the drive unit before and after the pipe fittings. Maximum permitted misalignment tolerances for a standard installation are – Radial Shift: 1 % of the largest external diameter in the pump assembly and the Angular Misalignment: $\pm 1^\circ 30'$

It is recommended that a vacuum gauge be fitted to the pump suction branch and a pressure gauge fitted to the delivery branch to facilitate continuous monitoring of the pump operating conditions.

- 3.3 When motor is being wired and checked for direction of rotation, it must be decoupled from the pump to prevent dry running. Wiring works of all electrical equipments should be carried out by qualified personnel and complied with the relevant national regulations.
- 3.4 Care must be taken to protect all electrical items from oil and water.
- 3.5 Belt Guard must be securely fixed in position to avoid contact with the running drive belts/ coupling. Pump Safety Devices are to be ensured in place before starting the pump.

4 PRE-OPERATIVE CAUTIONS

- 4.1 THE 'ROTOMAC' PROGRESSIVE CAVITY PUMPS SHOULD NEVER BE RUN IN A DRY CONDITION, EVEN FOR A FEW REVOLUTIONS AS THIS WILL DAMAGE THE RUBBER STATOR.
- 4.2 AS THE PUMP REQUIRES HIGH STARTING TORQUE, USE OF ONLY DIRECT -ON-LINE STARTER IS RECOMMENDED WITH SQUIRREL CAGE INDUCTION MOTOR.
- 4.3 'ROTOMAC' PROGRESSIVE CAVITY PUMPS SHOULD NEVER BE STARTED AGAINST CLOSED VALVES.

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5. START-UP AND ROTATION

5.1 The Pump Housing (03) must be filled with the relevant pumping media before starting. In case of high viscosity media, fill with a liquid. This initial filling is not for priming purpose; but to provide the necessary lubrication to the rubber stator until the pump primes itself.

5.2 When the pump is stopped, sufficient product is trapped in, to provide lubrication for the next starting, but if the pump is lying idle or it has been dismantled for servicing / relocation, the pump must be filled with relevant product and given a few turns by hand before starting.

5.3 **'FAS' Series 'ROTOMAC' Pumps** are normally arranged for counterclockwise rotation (viewing from the driving end) which results in the flange nearer to the driving end, being the suction. Pumps fitted with direction dependent seals should never be run in the opposite direction of the rotation arrow. In case where necessary, it is advisable to contact the Factory, to run the pump in the reverse direction so as to bring the delivery at the driving end.

5.4 Open the valves before starting the pump. Never run the pump against a closed outlet or inlet valve!

5.5 If the pump is having Mechanical Seal shaft sealing arrangement, connect the supply lines for the flushing and quenching fluids before the pump is put into operation.

6. GENERAL INFORMATION

6.1 **STUFFING BOX/GLAND PACKING:**
The packing is provided to arrest the entry of air in the system when the pump is under suction, and leakage of the product when the pump is under pressure. The Gland (07) should be tightened sufficiently with the help of the gland nuts (46) just to prevent the entry of air / leak when the pump is in operation. A slight drip from the gland (07) when the gland is working under pressure does not harm; but ensures lubrication of the packing. The Gland packing is not to be over tightened.

6.2 **SHAFT:**
Shaft is manufactured as on solid piece with yoke head, to carry the Universal Joint, which ensures a true concentric motion and does not disturb the gland packing/mechanical seal during operation.

6.3 **COUPLING ROD:**
Extra long Coupling Rod, connecting shaft to the rotor, minimize the wear and tear of the universal joints and increase the life of the pumps.

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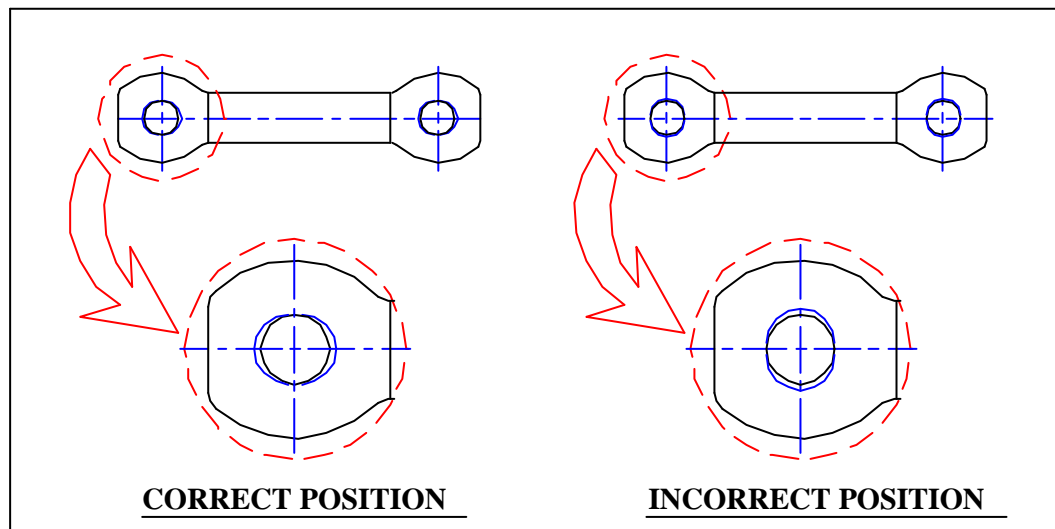
6. DISMANTLING:

- 7.1 Unscrew the 2 Hex. nuts (40) fitted to the tie rods (36) and place the tie rods to the sides away from the pump. Remove the End Support (57) & the End Cover (04). Unscrew the hex. nuts (42) and loosen the middle support (05) from the base plate. Withdraw the Middle Support (05).
- 7.2 Hold the pump coupling or the shaft (12) unscrew the Bonded Stator (24). If the stator offers some resistance, pour a little water through the opening to ease out this stiffness.
- 7.3 Slacken the Pump Housing (03) from the Bearing Housing (01) and withdraw the Pump Housing (03)
- 7.4 Compress the Pin Retainer Spring (17) towards the Rotor head and release the Coupling Rod Pin (15). Knock out the Coupling Rod Pin (15) from the rotor head and remove the Rotor (13). Remove the Pin Retainer Spring (17) from the rotor head.
- 7.1 Compress the Pin Retainer Spring (17) towards the Shaft head (12) and release the Coupling Rod Pin Retainer Spring (17). Knock out the and knock out the Coupling Rod Pin (15) from the Shaft head (12) and remove the Coupling Rod (14). Remove the Pin Retainer Spring (17) from the Shaft head (12).
- 7.2 Remove the ‘O’ Ring (25) from the face of the Stuffing Box (06).
- 7.3 Remove the pump coupling/pulley and shaft key (35) if fitted. Unscrew the 4 Hex. Bolts (44) from the Bearing Cover (02) and remove the bearing cover. Unlock the Bearing Lock Nut Washer (21) and unscrew the Bearing Lock Nut (20).
- 7.4 Unscrew the Grub Screw (45) holding the Grease Seal Housing (10) and loosen the gland nuts (47).
- 7.5 Place the Bearing Housing (01) along with the Shaft (12) over the hydraulic press and gradually apply pressure on the driving end of the Shaft (12) driving the same through the rear Taper Roller Bearing (23). The Shaft will come out with the Stuffing Box and Gland (12 & 6) / Mechanical Seal Housing and Seal Clamping Plate (8 & 9), Water Thrower (30), Grease Seal Housing with Grease Seal large (10 & 32), Ball Bearing inner (23) and the front Taper Roller Bearing (23) leaving both the bearing outer rings inside the Bearing Housing (01).
- 7.10 Place an appropriate size of steel plate of sufficient strength across the outer ring of the front Taper Roller Bearing (23) and press out the outer ring from the Bearing Housing (01). Repeat the same procedure to remove the outer ring of the rear Taper Roller Bearing (23) by reversing the Bearing Housing (01) on the hydraulic press.
- 7.11 Remove the front Taper Roller Bearing (23), Grease Seal Housing (10), Water Thrower (30), and Stuffing Box/Gland (06 & 07) / Mechanical Seal Housing/Seal Clamping plate (08 & 09) from the Shaft (12).
- 7.12 Clean all the parts removed and apply necessary anticorrosive treatment

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8 REASSEMBLY :

- 8.1 Start mounting the outer rings of the rear & front Taper Roller Bearings (23) facing outward to each other inside the Bearing Housing (01) using a mounting dolly or a clean length of tubing. Let the outer rings sit squarely on their seats provided inside the Bearing Housing (01).
- 8.2 Assemble Stuffing Box with Gland (06 & 07) / Mechanical Seal with Housing/Seal Clamping Plate (08 & 09) over the Shaft (12) close to the shaft head. Insert the Water Thrower (30). Insert Grease Seal Housing (10 fitted with Grease Seal Large (32)) on the Shaft (12).
- 8.3. Mount the inner ring with its roller and cage assembly of the front Taper Roller Bearing (23) on to the Shaft (12). Let the inner ring sit on the step of the Shaft (12), small end of the taper towards the driving end of the shaft. Fill the rollers with suitable grease. Offer the sub-assembly 8.2 to the sub-assembly 8.1 horizontally so that the shaft extension projects out from the Bearing Housing (01) and let the mounted inner ring sit in the outer ring of the front Taper Roller Bearing (23). Place the front end of the shaft (12) on a wooden piece along with the Bearing Housing (01). Grease and mount the inner ring with its roller and cage assembly of the rear Taper Roller Bearing (23) on the Shaft (12) and let the same sit in the outer ring. Place the Bearing Lock Nut washer (21) in place and screw the Bearing Lock Nut (20) and tighten the inner ring of the rear Taper Roller Bearing (23) as the Shaft (12) is rotated. When the shaft is no longer be rotated easily, loosen the Nut just enough to allow the shaft to rotate freely again. See that sufficient amount of grease is applied to the bearings.
- 8.4 Cover the bearing assembly with Bearing Cover (02) fitted with Grease Seal Small (31) by tightening the 4 Hex. Head Bolts (44) to the Bearing Housing (01).
- 8.5 Place the Grease Seal Housing (10) fitted with Grease Seal Large (32) and locate the same in its position in front of the front Taper Roller Bearing (23). Hold the Grease Seal Housing (10) to the Bearing Housing (01) with the Grub Screw (45).
- 8.6 Slide the Water Thrower (30) over the Shaft (12) and place it in front of the Grease Seal Housing (10).
- 8.7 Care should be taken while replacing the coupling rod bushes. The elongated holes in the bushes must face each other and fall-in line with the length of the coupling rod. The right method of fitting / pressing the coupling rod bushes in the coupling rod is shown as below:



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- 8.8 Connect the Coupling Rod (14) to the Shaft (12) head and to the Rotor head adopting the same procedures as applicable in reverse described in 7.4 and 7.5.
Place the 'O' Ring (25) in its position on the face of the Stuffing box (06).
- 8.9 Offer the Pump Housing (03) to the Bearing Housing (01).
- 8.10 Wet the Bonded Stator (24) and thread it over the Rotor (13). Home the Bonded Stator in position in the Pump Housing (03).
- 8.11 Slide the Middle Support (05) over the Stator (24).
- 8.12 Place the End Cover (04) with End Support (57) in position with the Stator (24).
- 8.13 Position the Tie Rods (36) in the securing grooves of the End Support (57). See that the Pump Housing (03) in Position with the Bearing Housing (01), the Stator in position with the Pump Housing (03), the End Cover (04) in position with the Stator (24) and the End Support (57) in position with the End Cover (04). Ensuring the above positions correct, secure the assembly with the Tie Rods (36), Spring washers (41) and the Hex. Nuts (40) to the required tightness.
- 8.14 Fasten the End Support (57) to the base plate.
- 8.15 Slide the Middler Support (05) to its position in front of the Pump Housing (03) and secure the same to the base plate. Tighten the Hex. Bolt/Nut (42/43) to tighten the Middle Support (05) to the Stator (24).
- 8.16 Place the Shaft Key (35) in its groove on the Shaft Extension (12) and mount the pulley / coupling.
- 8.17 Recheck that all the fasteners are fully tightened and completeness of the parts as per cross sectional drawing of 'FAS' Series of 'ROTOMAC' Progressive Cavity Pumps on page 11.
- 8.18 In cases of Four Stage pumps, Stator Support Rings (11) are provided one each with 'O' Ring (26) at the Pump Housing (03) face and the End Cover (04) to support the Bonded Stator (24) and seal the assembly.

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9. MECHANICAL SEAL (OPTIONAL)

- 9.1 Mechanical Seal (34) is fitted over the shaft (12) encased in the Mech. Seal Housing (08) and the static seal ring (lapped face facing forward) in the recess of the seal clamping plate(09).
- 9.2 Mechanical seal gives a perfect leak-proof joint. The seals are pre-loaded and assembled to give maximum efficiency. Care should be taken not to drop or scratch the lapped faces as this will render them incapable of forming a perfect seal.
- 9.3 Single Mechanical Seals work without additional equipments except for operating them with a rinsing or cooling system as required for the pumping medium.
- 9.4 **RINSING:** In case of rinsing as per API 610, Appendix D, Plan 32, where the media is having solids a clear rinse is fed in near the area of sliding surface which keeps the medium away from the seals. The pressure of the rinse is greater than that of the medium and sufficient in quantity.
- 9.5 **QUENCHING:** In case of quenching as per API 610, Appendix D, Plan 62, Quenching is commonly used in sealing engineering that applies a non pressurized external fluid to the atmospheric side of a mechanical seal. The quenching is applied when a single mechanical seal will not work or only to a limited extent without auxiliary measures.
- 9.6 **FITTING & REMOVAL OF MECHANICAL SEALS:** Remove the bolts holding the seal clamping plate to the mechanical seal housing. Withdraw the seal housing and unscrew the grub screw holding the Mechanical Seal to the shaft. Slide out the seal clamping plate and carefully push out the seal face.
- 9.7 Assembling of the seal is reversal of the above said procedure. Care is to be exercised for cleanliness and avoiding of foreign bodies in between the seal faces sliding surfaces. While assembling the seal on the shaft, apply some glycerine to the shaft and the seal housing area of the gaskets.

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10. FAULT FINDING & REMEDYING

Remedy

Fill the pump up, then pump through manually using a suitable appliance; if necessary use glycerine as lubricant in the stator.
Check order information. Examine electrical installation (possibly 2 phase operation).
Measure the pressure with a manometer and check against order details. Reduce the pressure or change the drive.
Remove foreign bodies and eliminate possible damage.
If the liquid medium temperature cannot be lowered, use a reduced diameter rotor.
Check whether the liquid medium agrees with the order requirements. Possibly change stator material.
Increase the liquid part of the medium.
Clean the pump and rinse through after each run.
Increase the suction liquid level, prevent turbulence and air bubble at the inlet.
Check seal and tighten pipe connections.
Stuffing box : tighten or renew. Mechanical seal : renew seals, eliminate solid deposits.
In the case of adjustable drives : increase the rpm. If necessary change the drive.
Warm up the pump (stator) to operating temperature first of all.
Decrease suction resistance, lower the temperature of the liquid medium, install the pump at a lower location.
Fill up the pump, provide for dry running protection, move the pipes.
Replace with a new stator or ensure correct liquid temperature.
Fit a new stator. Check the liquid medium agrees with order details; if necessary change the stator material.
Change rotor, establish the cause. Wear and tear, corrosion, cavitation; if necessary change to a different material or coating.
Replace relevant parts, carefully reseal and lubricate.
Re-align the unit.
Use a new connection and re-align the pump.
Replace bearing, lubricate, reseal. At higher temperatures observe the lubricant and the bearing.
In the case of adjustable drives : lower the rpm.
Measure the viscosity and compare with order details. If necessary adjust viscosity or change the drive.
Measure specific weight and compare with order details. If necessary adjust specific weight or change the drive.
Service stuffing box according to page 3 (6.1), if necessary renew worn shaft.
Replace fitted packing with another packing type.
Change electrical connection.
Replace relevant rings with new ones.
Replace elastomers. Check whether the liquid medium agrees with order details, if necessary change material.
Make necessary arrangement to meet the NPSH(r) of the pump.
Inspect and re-grease the bearings sufficiently.
Re-adjust the drive belts tension only to requirement without over tightening.

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11. MAINTENANCE AND SERVICE

Due to a simple assembly design of the Progressive Cavity Pumps, they need a little attention and replacements but as per the Maintenance & Service practice, the following are attended at regular intervals:

Cleaning: The pump should be regularly rinsed or cleaned where sedimentation deposits of medium is likely.

Temporary the Shutdown: If the pump is stopped temporarily for some time, the pump should be rinsed /cleaned if medium tends to solidify/ harden and glue up the Mechanical Seal.

Stator: When stopped for a long period, the elastomer along the contact line between the rotor and stator may become permanently distorted and this will increase the breakaway torque. It is advised to remove the stator from the pump and the same is stored in air-tight package in a cool/dry place away from light.

This case applies to Standby Pumps as well and they are to be operated from time to time otherwise the pump may seize when being started up.

Rotor: When stored for a long period, support on wooden blocks and cover to protect from damage.

Drive Belts & Coupling: Check the drive belts tension. If need be, adjust to proper tension. Excessively worn out belts are to be replaced by matched sets. Check the rubber bushes and coupling bolts for wear & tear and replace if necessary.

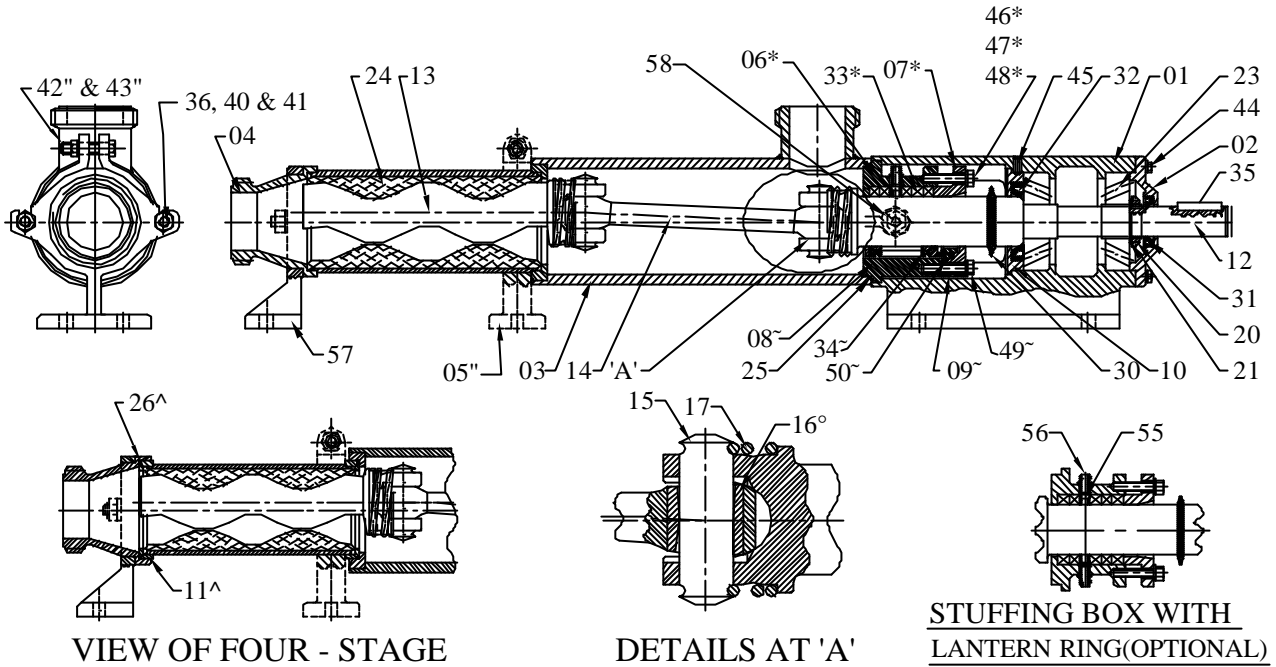
Bearings: The Shaft of the pump is mounted on heavy duty taper roller bearings which are lubricated for life in the factory. Should the bearings have to be removed, the old grease should be washed out and re-greased.

Lubricating Grease:

Operating Temperature Range °C	Grease (Example)
Minus 30 to + 120	"Shell" Alvania G3
Minus 30 to +180	"Kluber" Petamo GHY 443
Minus 35 to + 260	"Kluber" Barrieta L55/3

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12. CROSS-SECTIONAL ARRANGEMENT OF 'FAS-SERIES' PUMPS



Part No.	DESCRIPTION	No. off	Part No.	DESCRIPTION	No. off	Part No.	DESCRIPTION	No. off
01	BEARING HOUSING	01	20	BEARING LOCK NUT	01	41	SPRING WASHER for 40	02
02	BEARING COVER	01	21	LOCK NUT WASHER	01	42	HEX. NUT for 05	01
03	PUMP HOUSING	01	23	TAPER ROLLER BEARING	02	43	HEX. HEAD BOLT for 05	01
04	END COVER	01	24	BONDED STATOR	01	44	HEX. BOLT for 02	04
05	MIDDLE SUPPORT	01	25	'O' RING for 03	01	45	GRUB SCREW for 01	01
06	STUFFING BOX	01	26	'O' RING for 11	02	46	STUD for 06	02
07	GLAND	01	30	WATER THROWER	01	47	HEX. NUT for 46	02
08	MECH. SEAL HOUSING	01	31	GREASE SEAL for 02	01	48	SPRING WASHER for 47	02
09	SEAL CLAMPING PLATE	01	32	GREASE SEAL for 10	01	49	HEX. BOLT for 08	04
10	GREASE SEAL HOUSING	01	33	GLAND PACKING	Set	50	GASKET for 09	01
11	STATOR SUPPORT RING	02	34	MECHANICAL SEAL	01	55	LANTERN RING (OP.)	01
12	SHAFT	01	35	SHAFT KEY	01	56	NOZZLE (OP.)	01
13	ROTOR	01	36	TIE ROD	02	57	END SUPPORT	01
14	COUPLING ROD	01	40	HEX. NUT for 36	02	58	HEX. HEAD BOLT for 01	02
15	COUPLING ROD PIN	02						
16	COUPLING ROD BUSH	02						
17	PIN RETAINER SPRING	02						

NOTE :- 1.^ PART USED FOR PUMP SIZE:- FAS-02084, 03124, 04164, 05204, 06244, 07284 & 08324 ONLY.
 2." PART USED FOR PUMP SIZE:- FAS-03124, 04162 & ABOVE.
 3.° PART USED FOR PUMP SIZE:- FAS-03124 & ABOVE.
 4.* WHEN PUMP SUPPLIED WITH GLAND PACKING.
 5.~ WHEN PUMP SUPPLIED WITH MECHANICAL SEAL.

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Pump Type & Size	Bearing size (SKF No.)	Grease Seal		Gland Packing (Sq.mm)	Bearing		Mech. Seal Size (mm) (DIN 24960)
		Small (mm)	Large (mm)		Lock Nut (SKF)	Locking Washer (SKF)	
01561 01562 01564 02081 02082	30304	14 x 28 x 8	25 x 42 x 10	8	KM 4	MB 4	25
02084 03121 03122 03124	30306	22 x 38 x 8	38 x 62 x 10	10	KM 6	MB 6	38
04161 04162	30307	28 x 45 x 8	45 x 68 x 10	10	KM 7	MB 7	45
04164 05201 05202	30309	32 x 56 x 10	53 x 83 x 10	10	KM 9	MB 9	53
05204 06241 06242 07281	30311	38 x 65 x 10	60 x 100 x 10	12.5	KM 11	MB 11	60
06244 07282 07284 08321 08322 09361	30313	48 x 75 x 12	70 x 110 x 12	12.5	KM 13	MB 13	70
08324 09362 10401 10402	30315	60 x 90 x 12	80 x 120 x 12	16	KM 15	MB 15	80

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USE ONLY GENUINE “ROTOMAC” SPARE PARTS FOR REPLACEMENTS

RECOMMENDED STOCK OF WEAR PARTS FOR 2 YEARS TROUBLE FREE OPERATION

(Under Normal Operating Conditions)

Part No.	Description of Spare Parts	No. off / Pump Large set	No. off / Pump Small set
24	Bonded Stator	2	1
13	Rotor	1	-
14	Coupling Rod	1	-
15	Coupling Rod Pin	4	2
16	Coupling Rod Bush	4	2
34	Mechanical Seal (If applicable)	1	-
33	Gland Packing Set	2	1
25	‘O’ Ring	2	1
26	‘O’ Ring set (If applicable)	2	1

When sending enquiries for spares, please mention the following clearly:

Pump Sl. No.	Pump Type	Code
Part No.	Description of Spare Parts	Quantity
Material of Construction (as per Bill of Material)		

Address to:

ROTOMAC INDUSTRIES PVT. LTD.
 D-4A, PANKI INDUSTRIAL AREA, SITE-1,
 KANPUR – 208 022 (U.P) INDIA
 Tel: 2691704, 2691705 Fax: +91 (0512) 2691706
 E-mail: rotomac@vsnl.net
 Website: www.rotomacpump.com

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