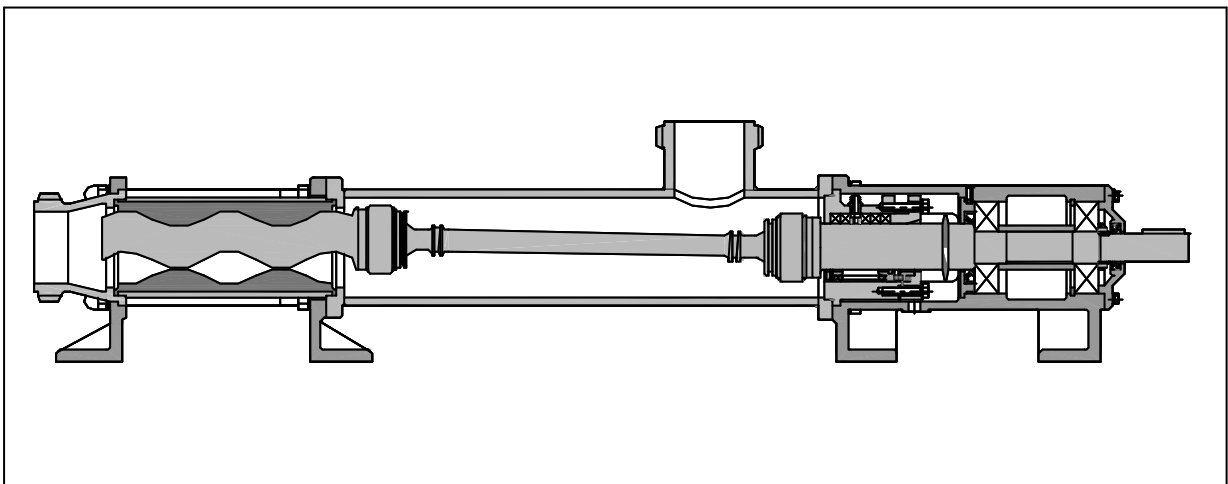


ROTOMAC PROGRESSIVE CAVITY PUMPS

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

'FA-SERIES' ROTOMAC PUMPS



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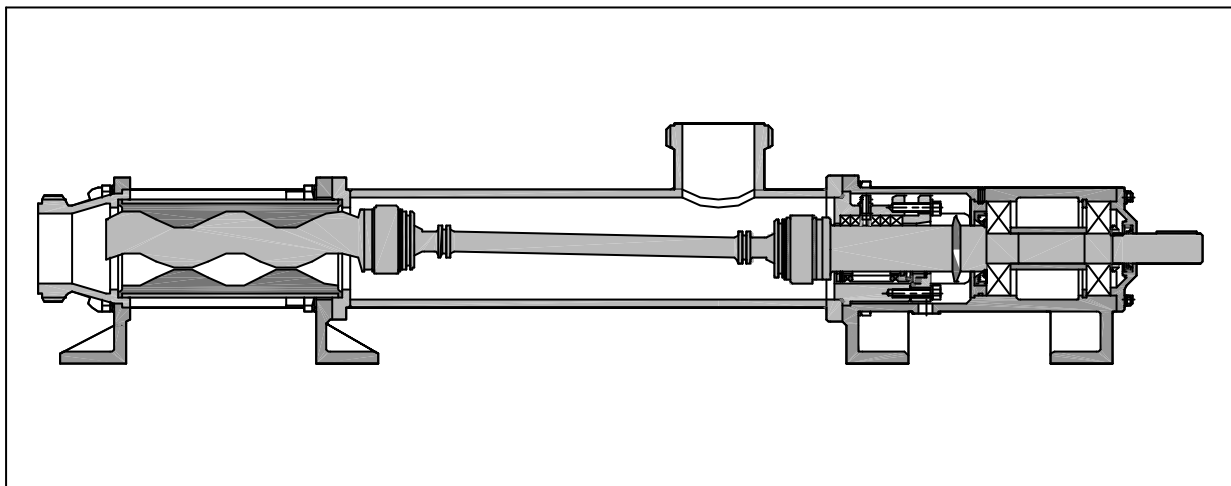
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ROTOMAC PROGRESSIVE CAVITY PUMPS ::#:: THE FINE ART OF PUMPOLOGY

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'FA-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 liquid is carried between screw threads on one or more rotors and is displaced axially as the screws rotate & mesh. In all other rotary pumps the liquid is forced to travel circumferentially, thus giving the screw pump with its unique axial flow pattern and low internal velocities, a number of advantages in many application where liquid agitation or churning is objectionable. The Single Screw Pump exists only in a limited number of configurations. The rotor thread is eccentric to the axis of rotation and meshes with internal threads of the stator (rotor housing), alternatively the stator is made to wobble along the pump centerline.

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 pressure gradient in the pump element of all types of screw pumps produces various hydraulic reaction forces. The mechanical and hydraulic techniques employed for absorbing these reaction forces are among the fundamental differences in the type of screw pumps produced by various manufacturers. Another fundamental difference lies in the method of engaging or meshing the rotors and maintaining the running clearances between them.

1.4 SCOPE

1.4.1 'FA' 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, Butter, Diced Vegetables, Fruit Juices/Pulps, Squashes, Medicinal Formulations/Syrups, Tooth Paste, Lotions, Ice Creams, Tomato Pastes, Wines, Edible Oils, Tamarind/ Vegetable Extracts, Malt Extracts, Starch, Yeast, Edible Gelatine, Glucose, Sugar Syrup, etc.

1.4.2 These type of **'ROTOMAC'** Pumps are constructed in highly finished AISI-304/316/316L Stainless Steel housing/ wetttable and rotating parts. 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 connections as per the customers' choice.

1.5 DUTY CONDITIONS:

'FA' 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 'FA' 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.
- 3.2 All pipe works should be independently supported to avoid any load on the pump.
- 3.3 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: $\pm 1^{\circ} 30'$
- 3.4 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.
- 3.5 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.
- 3.6 Care must be taken to protect all electrical items from oil and water.
- 3.7 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 **'FA' 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 are 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.

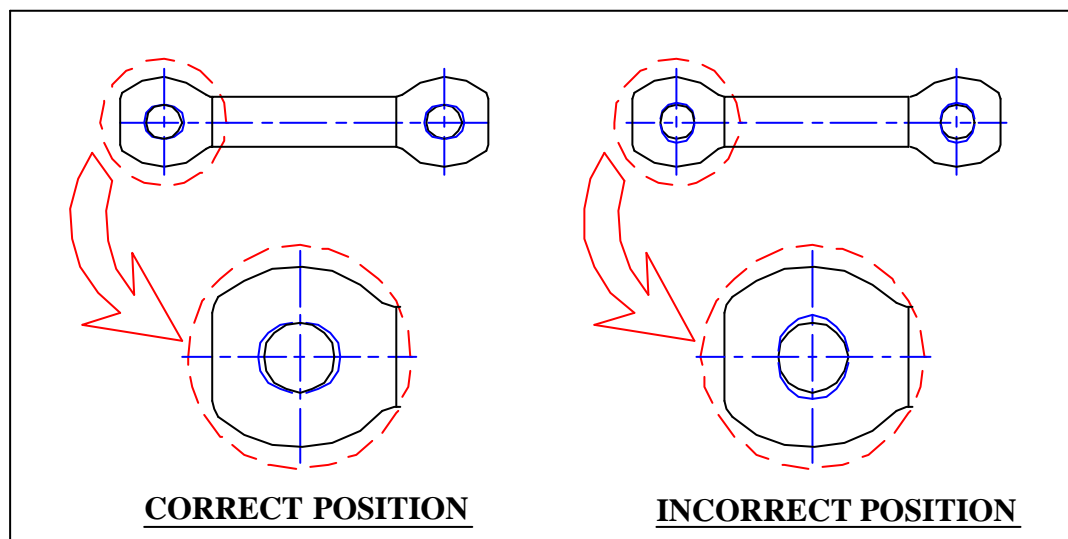
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- 7. DISMANTLING:**
- 7.1 Unscrew the 4 domed nuts (40) fitted to the tie rods (36) and remove the end cover (04). After loosening the Hex. Nuts (42) unscrew the hex. nuts (42) and loosen the middle support (05). Unscrew the tie rods (36) from the pump housing (03). 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 Unscrew the 4 Domed nuts (37) holding the pump housing (03) to the bearing housing (01) and withdraw the pump housing (03).
- 7.4 **Option – FAP/FAM/FAN:** Slip back the Pin Retainer Sleeve (17) and slide them over the Coupling Rod (14) from the rotor end. Knock out the Coupling Rod Pin (15) and withdraw the Rotor (13). Remove the 'O' Rings (28) from the rotor head.
- Option – FAB:** Slip out the boot seal retainer (18). Slip back the Pin Retainer Sleeve (17) over the Boot Seal (29) and slide them over the Coupling Rod (14) from the rotor end. Knock out the Coupling Rod Pin (15) and withdraw the Rotor (13). Remove the Boot Seal (29) and the 'O' Rings (28) from the rotor head. Remove the Boot Seal (29), Boot Seal Retainer and the Pin Retainer Sleeve from the Coupling Rod (14)
- Option – FAS:** Compress the Pin Retainer Spring (58) and knock out the Coupling Rod Pin (15). Withdraw the Rotor (13) and remove the Pin Retainer Spring (58) from the rotor head.
- 7.5 Execute the above procedures as applicable at the other end of the coupling rod and withdraw the Coupling Rod (14) from the Shaft (12) head.
- 7.6 Remove the pump coupling/pulley and shaft key (30) if fitted. Unscrew the 4 Hex. Bolts (44) from the Bearing Cover (02) and remove the bearing cover. Open out the Locking Washer (21) and unscrew the Bearing Locknut (20).
- 7.7 Unscrew the Grub Screw (45) holding the Grease Seal Housing (10) and loosen the gland nuts (47).
- 7.8 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). The Shaft along 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 Bearing Spacer (19) will come out of the Bearing Housing (01).
- 7.9 Extract the Bearing (23) and the Internal Circlip (22) from the bearing Housing (01).
- 7.10 Remove the Bearing Spacer (19), Inner 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).
- 7.11 Clean all the parts removed and apply necessary anticorrosive treatment

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8 REASSEMBLY :

- 8.1 Place the internal Circlip (22) in its groove in the Bearing Housing (01). Insert Ball Bearing (23) and tight it with the Bearing Cover (02) (not fitted with Grease Seal Small (31) with the help of 4 Hex. head Bolts (44).
- 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.
- 8.3 Insert the Water Thrower (30). Insert Grease Seal Housing (10) with Grease Seal Large (32) fitted. Insert inner Ball Bearing (23) over the Shaft (12) fitted with grease and also insert Bearing Spacer (19) on the shaft.
- 8.4 Offer the sub-assembly (8.3) to the sub-assembly (8.1) horizontally so that the shaft extension projects out from the Bearing Cover (02).
- 8.5 Place the sub-assembly (8.4) on hydraulic press resting on the bearing cover (02) and press the Shaft (12) down so that the inner Ball Bearing (023) acquires its position.
- 8.6 Unscrew the 4 Hex. Head Bolts (44) and remove the Bearing Cover (02) from the Bearing Housing (01).
- 8.7 Lock the Bearing with Bearing Lock Nut (20) and secure it with Locking Washer (21).
- 8.8 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).
- 8.9 Place the Grease Seal Housing (10) in its position and lock it with the Grub Screw (45).
- 8.10 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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- 8.11 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.
In option FAB, before placing the boot seal in its position on the rotor head, the same is to be filled with a suitable non-contaminating synthetic lubricating oil/grease.
- 8.12 Offer the Pump Housing (03) to the Bearing Housing (01) with 'O' Ring (25) in its position and secure the Pump Housing fitted with the Studs (37) by the Domed Nuts and Spring Washers (38 & 39).
- 8.13 Wet the Bonded Stator (24) and thread it over the Rotor (13). Home the Bonded Stator in position in the Pump Housing (03).
- 8.14 Screw the 4 Tie Rods (36) in the Pump Housing (03). Fit the Middle Support (05) and tighten it with Hex.nuts/Sp. Washers (42 & 43).
- 8.15 Insert the End Cover (04) with End Support (57) over the Tie Rod end (36) and secure them with the Domed Nuts/Sp. Washers (40/41)
- 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 'FA' Series of 'ROTOMAC' Progressive Cavity Pumps.
- 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:

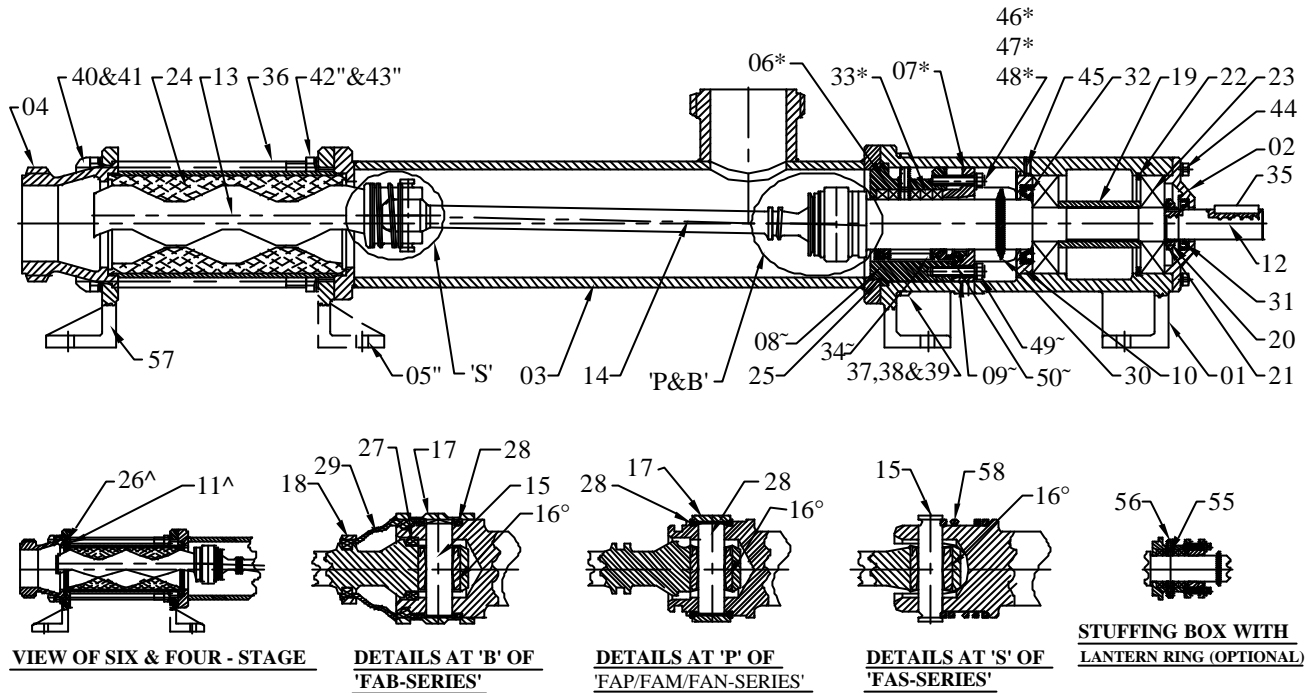
- Cleaning:** The pump should be regularly rinsed or cleaned where sedimentation deposits of medium is likely.
- Temporary the Shutdown:** If the pump is stopped temporarily for some time, the pump should be rinsed /cleaned if medium tends to solidify/ harden and glue up the Mechanical Seal.
- Stator:** 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 'FA-SERIES' PUMPS



Part No.	DESCRIPTION	No. off	Part No.	DESCRIPTION	No. off	Part No.	DESCRIPTION	No. off
01	BEARING HOUSING	01	19	BEARING SPACER	01	37	STUD for P.No.-03	04
02	BEARING COVER	01	20	BEARING LOCK NUT	01	38	DOMED NUT for P.No.-37	04
03	PUMP HOUSING	01	21	LOCKING WASHER	01	39	SP. WASHER for P.No.-38	04
04	END COVER	01	22	CIRCLIP (Internal)	01	40	DOMED NUT for P.No.-36	04
05	MIDDLE SUPPORT	01	23	BALL BEARING	02	41	SP. WASHER for P.No.-40	04
06	STUFFING BOX	01	24	BONDED STATOR	01	42	HEX. NUT for P.No.- 05	04
07	GLAND	01	25	'O' RING for P.No.- 03	01	43	SP. WASHER for P.No.-42	04
08	MECH. SEAL HOUSING	01	26	'O' RING for P.No.- 11	02	44	HEX. BOLT for P.No.-02	04
09	SEAL CLAMPING PLATE	01	27	'O' RING for P.No.- 14	02	45	GRUB SCREW for P.No.-01	01
10	GREASE SEAL HOUSING	01	28	'O' RING for P.No.- 17	04	46	STUD for P.No.-06	02
11	STATOR SUPPORT RING	02	29	BOOT SEAL	02	47	HEX. NUT for P.No.-46	02
12	SHAFT	01	30	WATER THROWER	01	48	SP. WASHER for P.No.-47	02
13	ROTOR	01	31	GREASE SEAL for P.No.-02	01	49	HEX. BOLT for P.No.-08	04
14	COUPLING ROD	01	32	GREASE SEAL for P.No.-10	01	50	GASKET for P.No.-09	01
15	COUPLING ROD PIN	02	33	GLAND PACKING	Set	55	LANTERN RING (OP.)	01
16	COUPLING ROD BUSH	02	34	MECHANICAL SEAL	01	56	NOZZLE (OP.)	01
17	PIN RETAINER SLEEVE	02	35	SHAFT KEY	01	57	END SUPPORT	01
18	BOOT SEAL RETAINER	02	36	TIE ROD	04	58	PIN RETAINER SPRING	02

NOTE:-

1. * PART USED FOR PUMP SIZE:- 6FA-15/32 , 4FA-16/20/21/23/30 , 2FA-25/38/40 & ABOVE.
2. ^ PART USED FOR PUMP SIZE:- 6FA-15/32/50 & 4FA-16/20/30/40/50/60/80 ONLY.
3. ° PART USED FOR PUMP SIZE:- 6FA-32 , 4FA-30 , FA-40 & ABOVE.
4. * WHEN PUMP SUPPLIED WITH GLAND PACKING.
5. ° WHEN PUMP SUPPLIED WITH MECHANICAL SEAL.
6. PART No. 11 & 26 NOT APPLICABLE FOR FAM-SERIES PUMPS.
7. PART No. 11, 16 & 26 NOT APPLICABLE FOR FAN-SERIES PUMPS.
8. PART No. 18, 27, 29 & 58 NOT APPLICABLE FOR FAP-SERIES PUMPS.
9. PART No. 58 NOT APPLICABLE FOR FAB-SERIES PUMPS.
10. PART No. 16, 17, 18, 27, 28 & 29 NOT APPLICABLE FOR FAS-SERIES PUMPS.

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13. STANDARD PARTS DETAIL

Pump Type & Size *	Bearing Size (SKF No.)	Bearing		Grease Seal		Gland Packing (Sq.mm.)	Mech. Seal Size (mm.) (DIN 24960)
		Lock Nut (SKF)	Locking Washer (SKF)	Small (mm.)	Large (mm.)		
FA-16 2FA-16 FA-21 2FA-21	6304	KM4	MB4	14x28x8	28x42x10	6	28
4FA-16 4FA-21 FA-23 2FA-23 4FA-23 FA-25 2FA-25 FA-35	6404	KM4	MB4	18x30x7	28x62x10	6	28
FA-38 2FA-38 FA-43	6406	KM6	MB6	28x45x8	45x70x12	10	45
FA-52 2FA-52	6408	KM8	MB8	32x56x12	53x83x12	10	53
4FA-52 FA-62 2FA-62 FA-75 2FA-75	6409	KM9	MB9	38x65x12	60x100x12	12.5	60
4FA-62 FA-82 2FA-82	6411	KM11	MB11	48x75x12	70x110x12	15	70

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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
25,26 & 28	'O' Ring set	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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