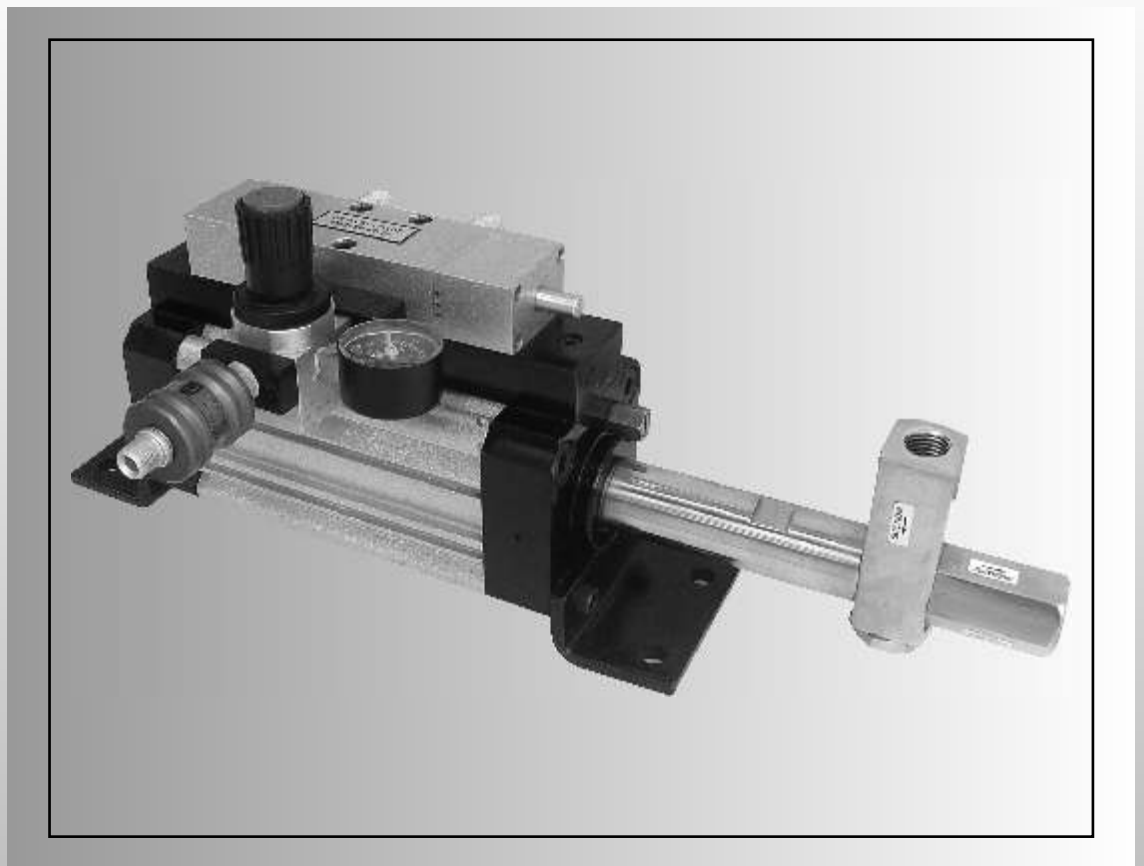


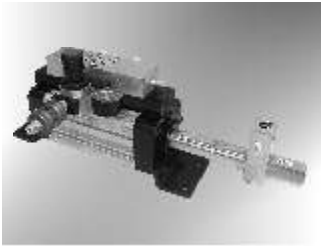


*Simplifying technology, redefining value*



# HYDRO-PNEUMATIC RECIPROCATING PUMP

M A N U A L



INTRODUCTION

GENERAL DESCRIPTION

PRINCIPLES OF OPERATION

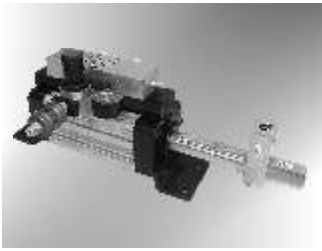
TYPICAL APPLICATIONS

INSTALLATION AND COMMISSIONING

PREVENTIVE MAINTENANCE &  
TROUBLESHOOTING

SECTION ASSEMBLY DRAWING

RECOMMENDED SPARES



We are very much thankful to you to purchase our unique, simplified, newly developed Hydro Pneumatic Reciprocating Pump. We are also very much thankful to you for keeping trust in us by getting our indigenously developed product in your working area.

Please read this Manual carefully before commissioning the pump.

The Manual describes the working, installation, troubleshooting and other information required for satisfactory performance and maintenance of our equipment.

Our "DUTTA" make Hydro Pneumatic Reciprocating Pump is the result of extensive development effort carried out to achieve well design, good overall service life and ease of maintenance.

Our Hydro Pneumatic Reciprocating Pump is a very reliable product, which will run for several years with a minimum preventive maintenance. In the failure of product, we request you to study the manual carefully in which troubleshooting instructions are given, before calling for service.

We believe in constantly improving our product and we look forward to your valued Suggestions, critical comments and observations which will help us in improving our product further.

The manual describes theory of working, installation, commissioning, trouble shooting and other information required for satisfactory performance and maintenance. In the event of failure/ breakdown at Pump, please read this manual thoroughly before calling for Service.

## GENERAL LAYOUT OF PUMP INSTALLATION

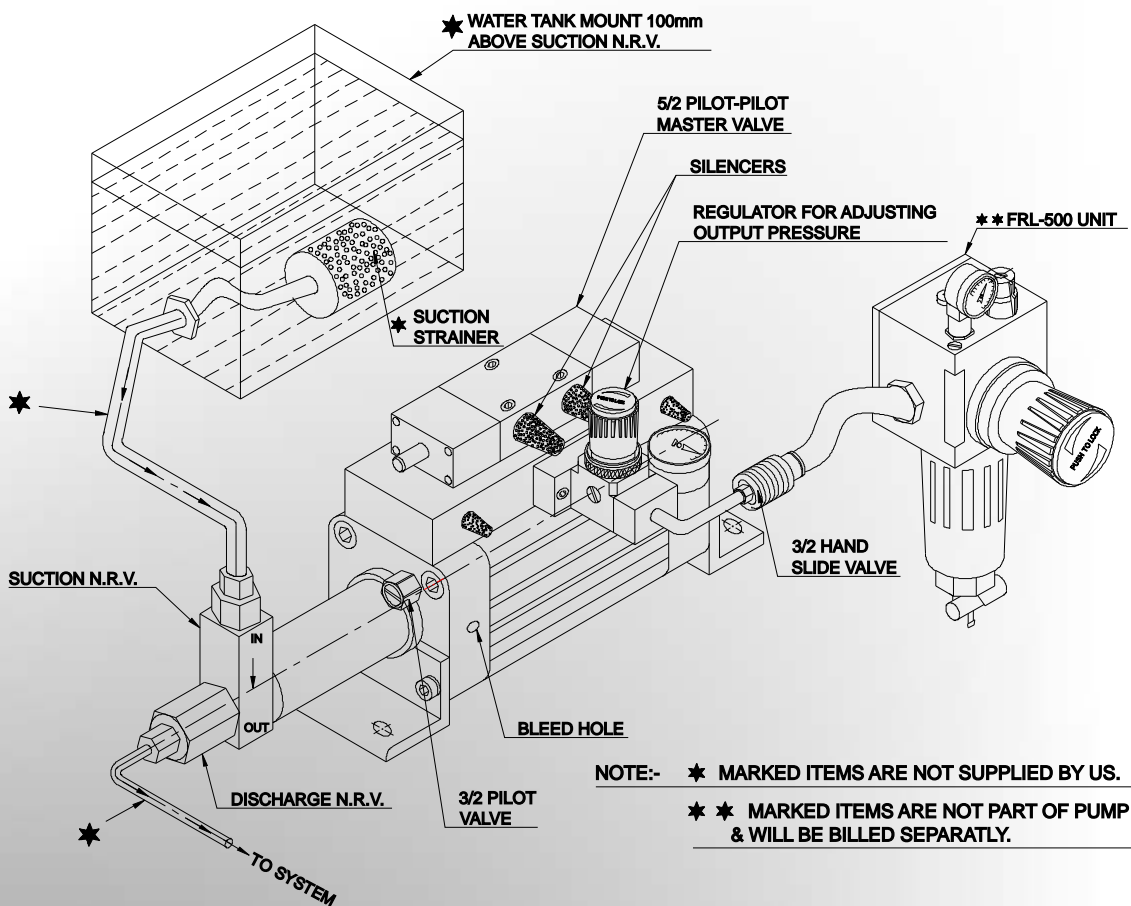
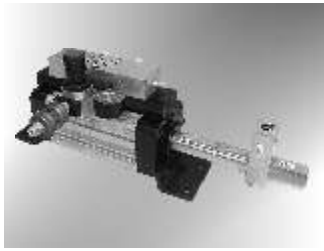


FIG. -A



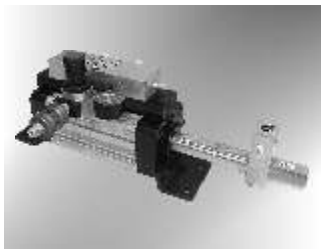
The general layout of components used in proper installation of our Hydro Pneumatic Reciprocating Pump is given in Fig. A. The principle of operation is given in Fig. B, Fig. C, Fig. D.

NOTE:-Items marked \* are not in our scope of supply for the pump assembly. The FRL is to be bought separately.

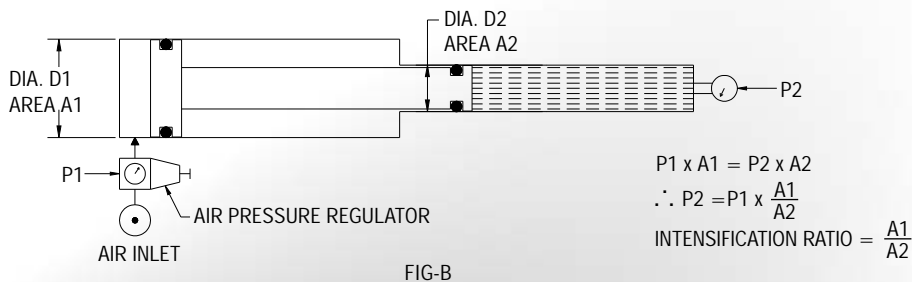
#### ADVANTAGES OF DUTTA MAKE HYDRO-PNEUMATIC PUMPS:-

Dutta make Hydro-Pneumatic Reciprocating Pumps are an efficient, low cost alternative to Motorized & hand operated pumps. Our salient features are as follows: -

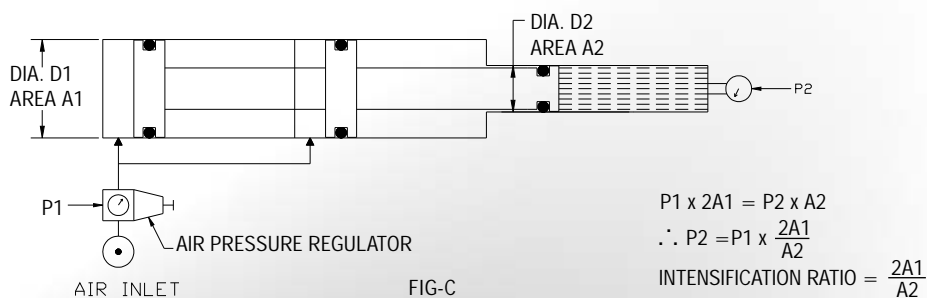
- ▶ It is compact and lightweight in construction.
- ▶ It has flexibility / adaptability for mounting in any direction.
- ▶ It has low air consumption. When used in conjunction with a low pressure high discharge centrifugal prefill pump, the energy consumption and time for building desired pressure is very low. Once pressure has built up there is no further consumption of compressed air.
- ▶ Once the desired set pressure is achieved, pump will stop & will run only to compensate the leakage if any. This action of pump is achieved automatically, thus preventing any excessive pressure than the desired pressure & there is no need of restarting pump in case of any leakage.
- ▶ Pump can be operated in hazardous location as it is operated by compressed air.
- ▶ It is designed for use with water & other non-corrosive liquids, as all wetted parts are made from stainless steel.



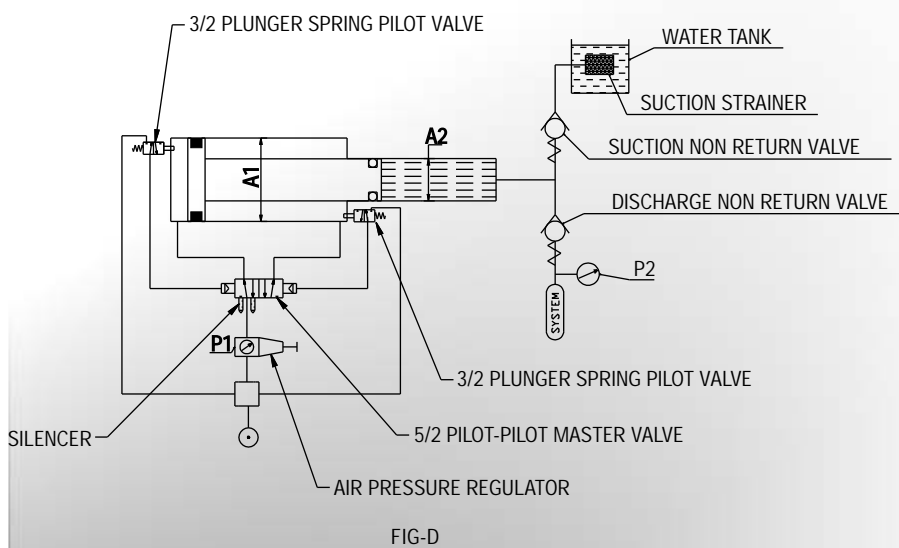
### INTENSIFIER-S

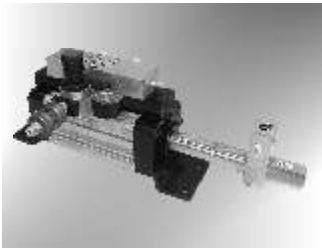


### INTENSIFIER-D



## PNEUMATIC CIRCUIT DIAGRAM FOR HYDROPNEUMATIC RECIPROCATING PUMP





The heart of DUTTA MAKE Hydro-Pneumatic Reciprocating Pumps is an air to liquid Intensifier which is diagrammatically shown in Fig. B.

The Pneumatic cylinder of large diameter D1 is coupled to a hydraulic cylinder of small diameter D2. When regulated compressed air at pressure P1 is applied on D1, the pressure P2 of liquid in D2 increases as per Pascal's Law.

$$P_1 \times A_1 = P_2 \times A_2 \quad \text{Where } A_1 = \frac{\pi}{4} \times D_1^2$$

$$\therefore P_2 = P_1 \times A_1/A_2 \quad \text{and} \quad A_2 = \frac{\pi}{4} \times D_2^2$$

The ratio A1/A2 is called the intensification ratio.

For high ratio pumps, area A1 is increased by coupling two pneumatic cylinders D1 to a single hydraulic cylinder D2 as shown in Fig. C. Low pressure, low ratio pumps are called Intensifier-S (Fig. B.) and high pressure, high ratio pumps are called Intensifier-D (Fig. C.) pumps can be identify by the last alphabetic in the model number.

The air to liquid intensifier shown in Fig. B & Fig. C. is converted into a pump by automatically reciprocating the pneumatic cylinder by suitable valves as shown in Fig. D.

When regulated air at pressure P1 is supplied through 5/2 pilot-pilot master Valve A, the cylinder piston starts moving to the right. When the piston presses the 3/2 Valve B, a pilot signal is given to the right end of Valve A, causing it to reverse & the cylinder piston starts moving to the left. When the piston presses 3/2 Valve C, a pilot signal is given to left end of Valve A, causing it to reverse & the piston starts moving to the right. Hence pneumatic piston starts reciprocating continuously as long as compressed air is supplied.

On the liquid side of the pump, a suction & discharge non-return valve is fitted. When the piston moves to the left, vacuum is created in the hydraulic cylinder & liquid is sucked in due to the opening of suction non-return valve. When the piston moves to the right, the suction non return valve shuts & the sucked liquid is discharged through the discharge non-return valve. The constant reciprocation of the cylinder causes suction & discharge of liquid in pulses. The discharged liquid is fed into the product, which has to be pressurized.

As liquid fills into product, pressure starts rising & when it reaches value P2, the forces in pump balance & pump stops reciprocating automatically to compensate for Leakage & maintain output pressure P2.

# TYPICAL PRESSURE TESTING UNIT

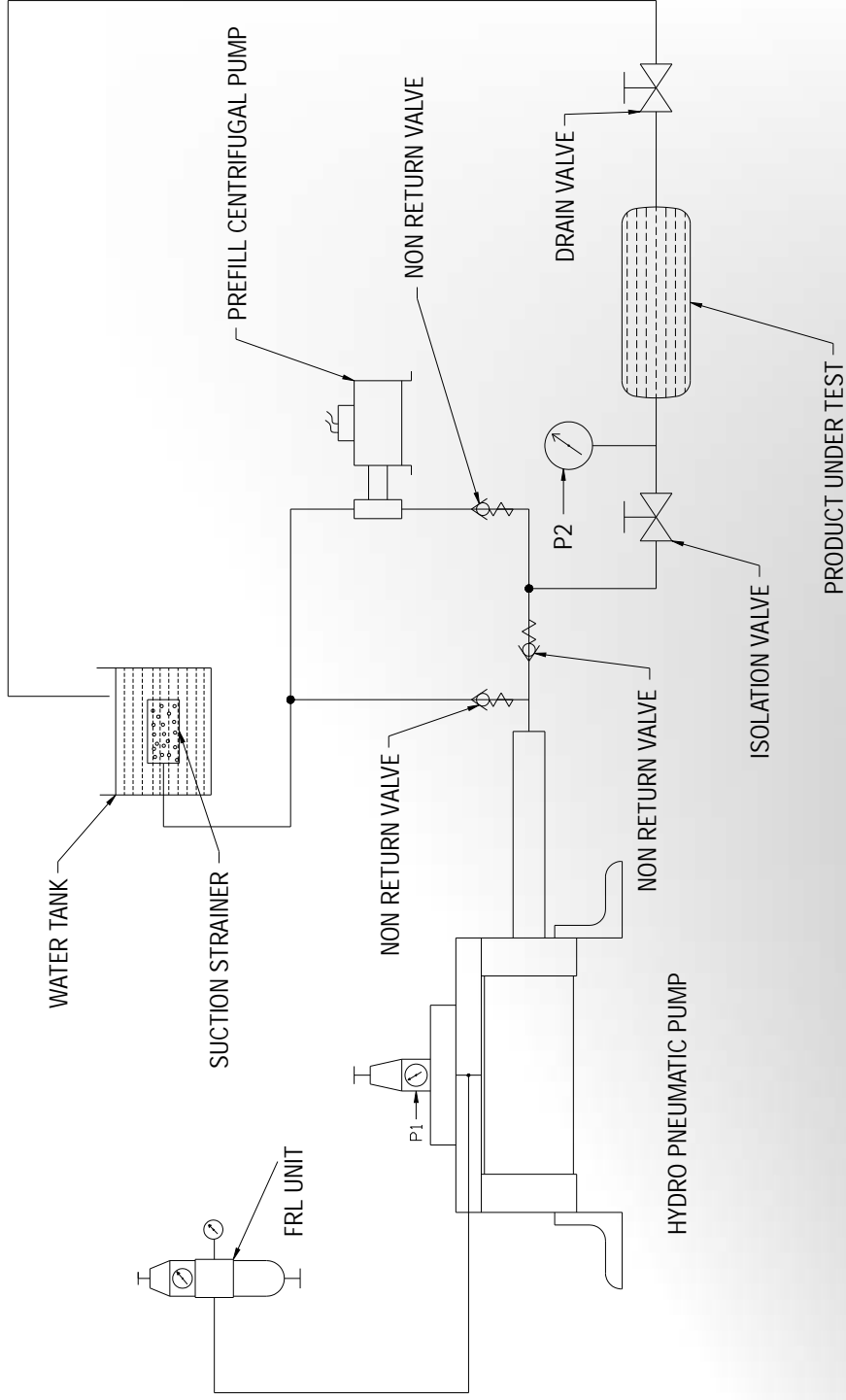
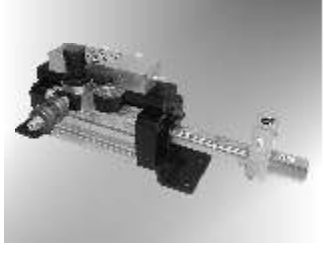
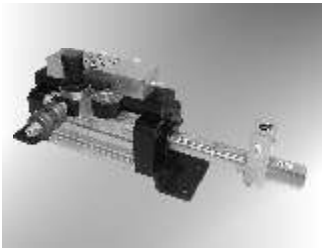


FIG-E







#### ▶▶ HYDROSTATIC PRESSURE TESTING:-

One of the most popular applications of "DUTTA MAKE" Hydro Pneumatic Reciprocating pumps are for pressure / burst testing of Castings, Valves, Hoses, Pressure Vessels etc. The general layout of a hydrostatic pressure testing setup is shown in Fig. E.

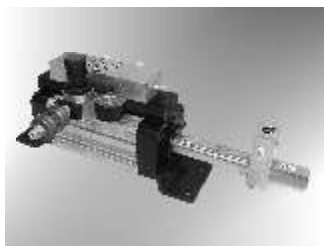
The product under test (ex. Casting) is first prefilled with water using a high discharge "CENTRIFUGAL PUMP". When all trapped air escapes & the casting is fully filled, the "DRAIN" valve & the "CENTRIFUGAL PUMP" are switched "OFF" & the "HYDRO PNEUMATIC PUMP" is switched "ON" When pressure in gauge P2 rises to the value set in regulator P1, the "ISOLATION" valve is closed & after a slight delay the "HYDRONEUMATIC PUMP" is switched "OFF". Any leakage in the product is detected by drop in pressure gauge P2.

The drain valve is opened to release pressure & drain the water after completion.

#### ▶▶ OTHER APPLICATIONS OF TESTING:-

Some of the applications where "DUTTA MAKE" Hydro Pneumatic Reciprocating Pumps can be used as a low cost alternative to hand operated & motorized hydraulic pumps: -Seat leakage test of control valves.

- ▶ Burst Strength Testing of pressurized vessels such as LPG / Nitrogen / Oxygen gas cylinders, storage tanks, hoses, pipes etc.
- ▶ Cyclic pressure / life testing of Pressure Gauges, Pressure Switches, Hoses etc
- ▶ Metered filling of liquid products such as soft drinks, juices, medicines etc. in packaging machines.
- ▶ Transferring of liquids from barrels, storage tank etc.
- ▶ Operation of single acting hydraulic cylinders used in lifting platforms, hydraulic clamps, compression molding presses etc.
- ▶ Isostatic pressing of powder metals & ceramics.
- ▶ Pumping of oil or grease in centralized lubrication



## TECHNICAL SPECIFICATIONS

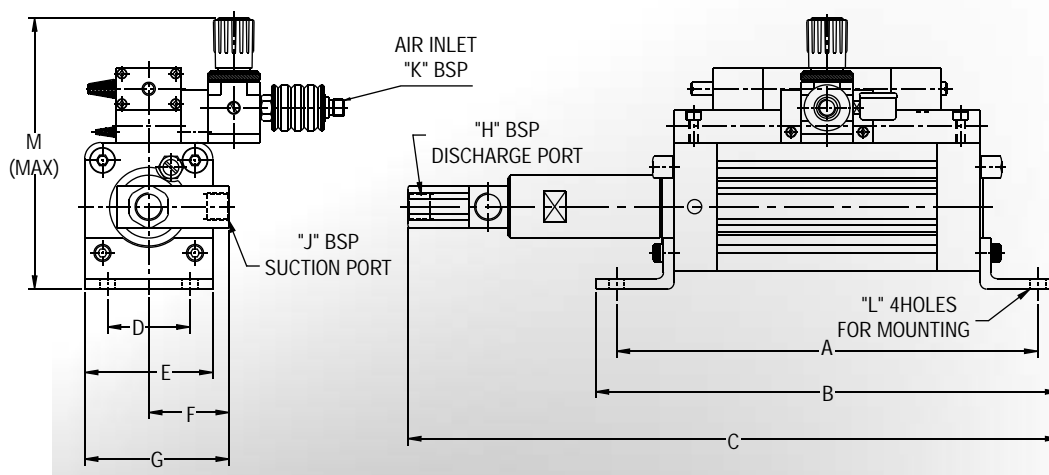
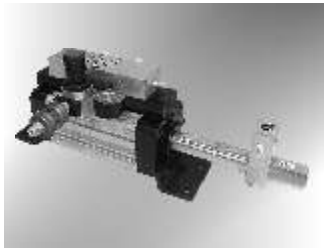


FIG - F

MODEL NO.	RATIO	Output Pr. at 5Kg/sq.cm	A	B	C	D	E	F	G	H BSP	J BSP	K BSP	L	M	FREE DISCHARGE LPM (APPROX)	FREE AIR CONSUMPTION LPM (APPROX)
80-10-S	64	320	322	354	505	63	99	68	117	1/2"	1/2"	1/4"	12	207	1.57	985
80-14-S	32	160	322	354	505	63	99	68	117	1/2"	1/2"	1/4"	12	207	2.76	985
80-16-S	25	125	322	354	505	63	99	68	117	1/2"	1/2"	1/4"	12	207	3.5	985
80-20-S	16	80	322	354	505	63	99	68	117	1/2"	1/2"	1/4"	12	207	5.0	985
80-25-S	10	50	322	354	505	63	99	68	117	1/2"	1/2"	1/4"	12	207	6.9	985
80-28-S	8	40	322	354	505	63	99	68	117	1/2"	1/2"	1/4"	12	207	7.9	985
100-10-S	100	500	320	348	505	75	110	100	155	1/2"	1/2"	1/4"	14	219	1.2	1150
100-14-S	51	255	320	348	505	75	110	68	123	1/2"	1/2"	1/4"	14	219	2.0	1150
100-16-S	40	200	320	348	505	75	110	68	123	1/2"	1/2"	1/4"	14	219	2.6	1150
100-20-S	25	125	320	348	505	75	110	68	123	1/2"	1/2"	1/4"	14	219	3.7	1150
100-28-S	12.75	64	320	348	505	75	110	68	123	1/2"	1/2"	1/4"	14	219	6.0	1150
100-32-S	9.75	48	320	348	505	75	110	68	123	1/2"	1/2"	1/4"	14	219	6.72	1150
160-32-S	25.0	125	354	394	527	115	186	68	161	1/2"	1/2"	1/2"	17	263	3.6	905
160-40-S	16	80	354	394	527	115	186	68	161	1/2"	3/4"	1/2"	17	263	5.7	905
160-56-S	8.0	40	354	394	527	115	186	68	161	1/2"	3/4"	1/2"	17	263	11.0	905
160-14-D	260	1300	552	592	725	115	186	100	193	1/2"	1/2"	1/2"	17	263	0.5	1330
160-20-D	128	640	552	592	725	115	186	100	193	1/2"	1/2"	1/2"	17	263	1.0	1330



### 1. INSTALLATION:-

Refer to Fig. A for general installation layout and Fig. F. for overall dimensions

- 1.1 Mount the pump using the four mounting holes provided. The Pump can be mounted horizontally, vertically, or at any angle.
- 1.2 Connect filtered, regulated, & lubricated ( FRL Set ) air supply to the inlet port on hand slide valve.

**CAUTION:** - The pump will fail prematurely if proper lubrication is not provided.

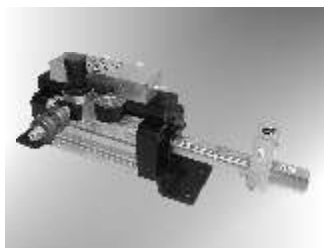
- 1.3 Ensure that the lubricator is filled with Hydraulic Oil. Set the lubricator in such a way that 2-3 drops of oil falls for every minutes.

The following grades of oil must be used: -

- |                 |                          |
|-----------------|--------------------------|
| HYDROL 32       | (Bharat Petroleum)       |
| SERVO SYSTEM 32 | (Indian Oil Corporation) |
| ENKLO 32        | (Hindustan Petroleum)    |

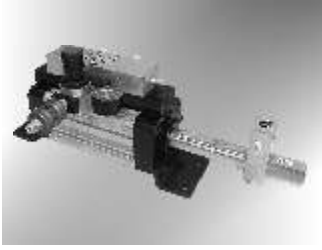
**CAUTION:** - Do not use any oil other than those recommended above. The seals may react chemically with some grades of oil.

- 1.4 Ensure that the inlet air supply to the FRL unit & from FRL unit to inlet of Pump has a minimum I.D. of 6mm for series 80 & series 100 pumps & I.D. of 13 mm for series 160 pump. It should be noted that the distance of FRL from pump should not be more than 2.5 meters.
- 1.5 Connect inlet water / oil supply from an overhead tank mounted preferably at least 100mm above pump. If applications demands that the tank has to be placed below the pump, then a foot valve has to be fitted in the suction line to avoid periodic priming.
- 1.6 Ensure that a 100mm mesh suction strainer is fitted in the liquid inlet line.
- 1.7 Ensure that the I.D. of the suction line is atleast 13mm for ½" BSP connection & 20mm for ¾" BSP connection. A smaller line or restricted suction line will create cavitation & the pump will run inefficiently.
- 1.8 Pipe the pump outlet to the system with suitable pipes / hoses which can withstand twice the pressure generated by the pump.



## 2 COMMISSIONING: -

- 2.1 Slide 3/2 Hand Slide Valve backward to shut air supply to the pump.
- 2.2 Rotate Regulator knob Turn anti-clockwise fully to achieve zero pressure condition.
- 2.3 Open main air supply. Set the regulator of FRL Unit to maximum of 6 Kgf/cm<sup>2</sup>
- 2.4 Slide 3/2 Hand Slide Valve forward.
- 2.5 Gradually rotate clockwise regulator knob again .As the pressure rises the pump will start reciprocating first slowly and then rapidly as the air pressure increases.
- 2.6 After a few strokes water / oil will start flowing freely in pulses from outlet hose. Shut the outlet line with a suitable valve. The pressure will immediately rise in the outlet line.
- 2.7 Adjust the regulator for the required value of outlet pressure.
- 2.8 While the pump is reciprocating, observe the rate of oil flow from the lubricator. Set the Lubricator as instructed in point 1.3 (1)
- 2.9 After the testing is over, shut the air supply by sliding the hand slide valve backwards. Open the drain valve in discharge line to release pressure.



### PREVENTING MAINTENANCE

#### ▶▶ DAILY

- ▶ Keep test & pump area clean. Wipe dry excess water /oil which might have splashed during testing.
- ▶ Ensure that the water /oil in the tank is clean.
- ▶ Observe oil level in the lubricator. The lubricator should be atleast ½ full.

CAUTION: - Ensure that the pump is not operated if the lubricator is empty. The pump will fail prematurely if it is run without lubrication.

- ▶ If the pump is used continuously and lubricator is set correctly as per instructions in point 1.3 (1) then lubricator should get empty in 1 week. If excess lubrication is released then a spray of oil will come from two exhaust silencers of the pump. If this happens then shut the lubricator fully and run the pump till spray of oil from valve exhaust ports stops. Now reset the lubricator as instructed in point 1.3 (1)
- ▶ When the pump is not in use, switch off air supply by sliding the 3/2-hand slide valve backwards.

#### ▶▶ WEEKLY

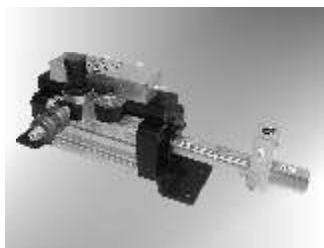
- ▶ Observe the leakage of liquid from bleed hole (Fig. A.). If there is excessive leakage then a seal will need replacement & order the spare seal kit before total breakdown takes place.
- ▶ Observe for leakage from joints in non-return valve assembly.

#### ▶▶ MONTHLY

- ▶ Replace the water / oil in the tank.
- ▶ Clean the tank and suction strainer before filling fresh water / oil.

#### ▶▶ YEARLY

- ▶ Replace the 2 exhaust silencers.
- ▶ Clean / Replace suction strainer in water / oil tank.
- ▶ Check the condition of pneumatic and hydraulic hoses and replace if necessary.



▶▶ THREE YEARS

- ▶ Replace the all rubber parts in the pump and valves. It is recommended that even though seals are not leaking after three years of installation, they should be replaced as properties of rubber parts deteriorate with time.
- ▶ Replaces bonded washer of Non return Valves. Check the internal part for damage and replaced complete Non return Valve assembly if required.

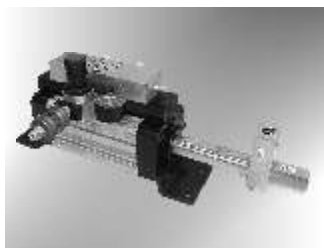
▶▶ GENERAL CAUTION

- ▶ Ensure that the pump is not operated above its rated capacity. In no case should it be operated Above an input air pressure of 5 Kgf/cm<sup>2</sup>
- ▶ Use only genuine spares, which should be procured directly from us or from our authorized dealers.
- ▶ The pump should be serviced by trained and authorized person only. Contact us directly or our authorized dealers for service and annual maintenance contract.

TROUBLESHOOTING:-

The pump does not reciprocate

- ▶ Check if main line pressure is minimum 4 Kgf/cm<sup>2</sup> and maximum 7 Kgf/cm<sup>2</sup>.
- ▶ Check if hand slide valve is pulled forward to "ON" position.
- ▶ Check if the air pressure regulator provided on the pump shows a pressure of minimum 2 Kgf/cm<sup>2</sup> and maximum of 6 Kgf/cm<sup>2</sup>.
- ▶ If above checks are okay and pump still does not reciprocate, then push the manual overrides on the sides of 5/2 master control valve. The pump cylinder should move in the direction of pushing. If this does not happen then
  - (i). 5/2 Master Control Valve is tight or jammed due to lack of lubrication. The free movement of the valve can be felt by pushing the manual overrides. Service the valve ensure correct lubrication is provided as described in point 1.3 (1). Refer to Fig. G for 5/2 Master Control Valve details.
  - (ii). The 3/2 Pilot Control Valves are jammed. These valves can be serviced without dismantling the pump. Refer to Fig. H for 3/2 Pilot Control Valve Details.



The pump reciprocates but there is no discharge of liquid

- ▶ Check the suction line for correct installation as described in point 1.4(1)
- ▶ Check for any leaks in the suction line. Leaking suction line will cause air to be sucked into the pump, causing cavitation.
- ▶ Check whether discharge line is fully open. It should be closed only after free flow of liquid is achieved.
- ▶ If all above checks are okay, then the suction non return valve is jammed, causing the sucked liquid to return back to tank instead of flowing from outlet. Service the non-return valve assembly. The pump stalls while reciprocating and there is continuous leakage of air from exhaust ports of 5/2 master valve.

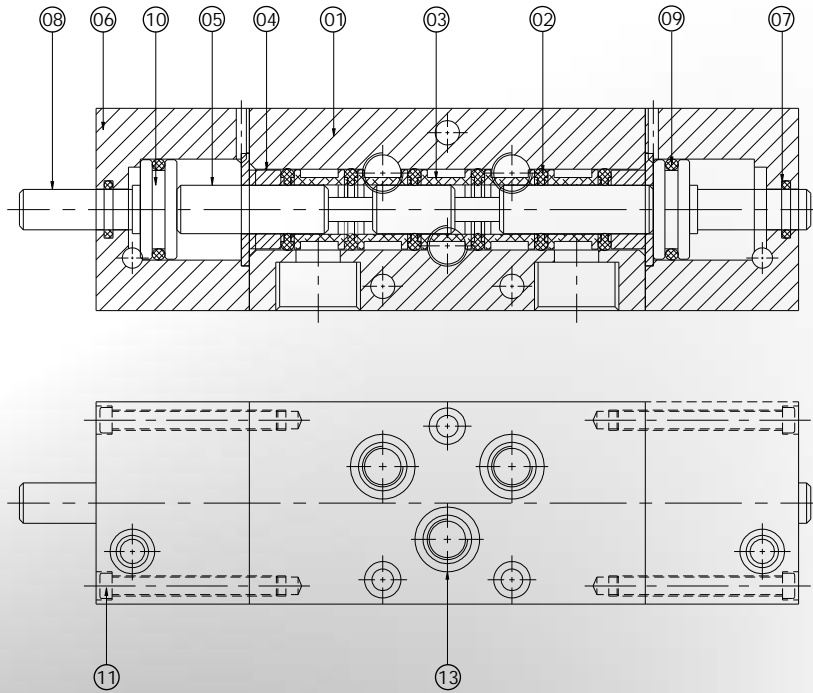
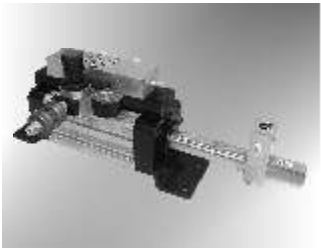
- ▶ The 5/2 master valve has got stuck in an intermediate position. Reset the valve by pushing the manual overrides. Check for free movement of the valve. If the valve is tight then service it.

The main line pressure has fallen below 3 Kgf/cm<sup>2</sup>. Check and ensure main line pressure is between 4 to 6 Kgf/cm<sup>2</sup>.

The outlet pressure cannot be varied

- ▶ Adjust the air pressure regulator fitted on the pump and observe if the pressure increases as the knob is rotated. If the pressure does not change then the air pressure regulator will need servicing. (Refer to fig 1)

5/2 PILOT-MASTER VALVE ASSEMBLY  
MODEL NO 083 01 00 000

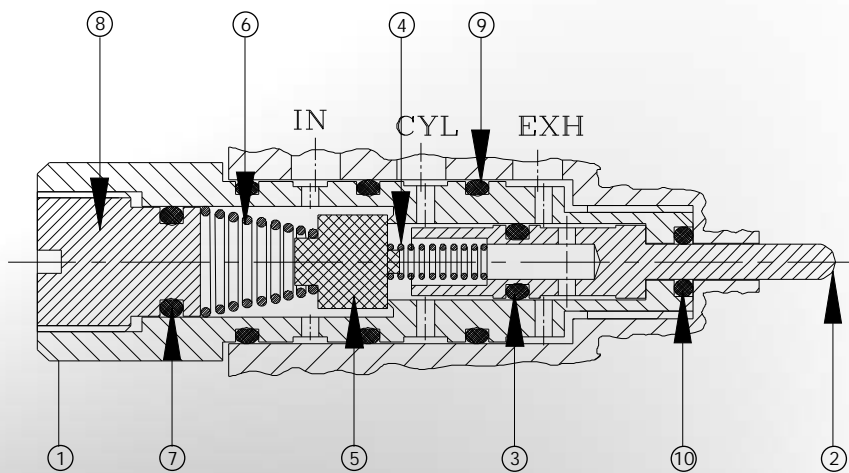
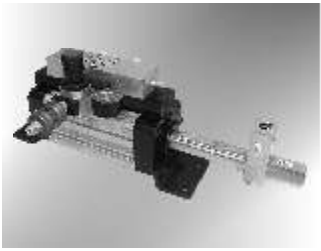


13	03	O, Ring	001 200N 0120
11	08	Allen Bolt	004 01 04 040
10	02	Pilot Guide	083 01 00 007
09	02	O' Ring	001 300N 0190
08	02	Pilot	083 01 00 006
07	02	O' Ring	001 220N 0100
06	02	Cap	083 01 00 005
05	01	Spool	083 01 00 004
04	02	Spacer	083 01 00 003
03	05	Cage	083 01 00 002
02	06	T-Ring	T-001
01	01	Body	083 01 00 001
ITEM	QTY.	DESCRIPTION	PART NO.

FIG-G



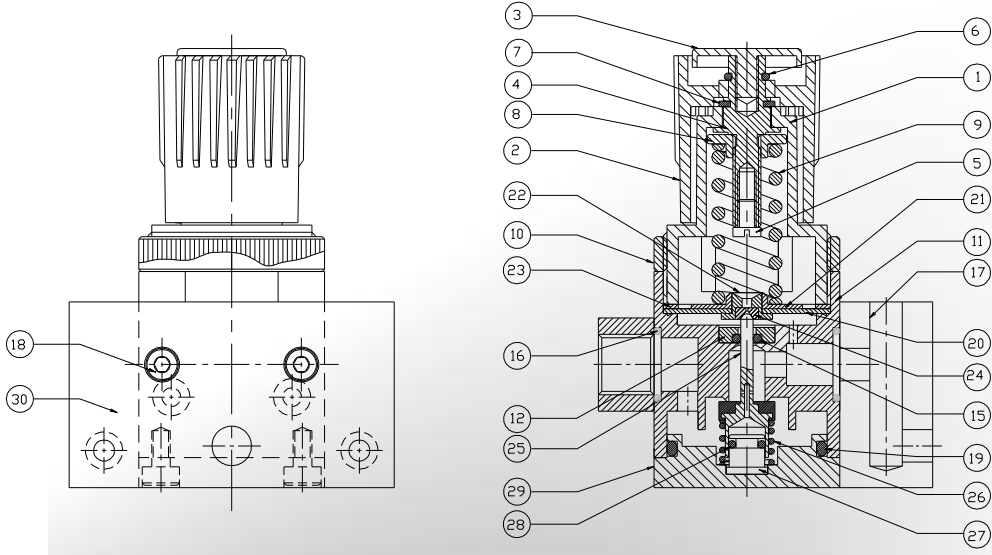
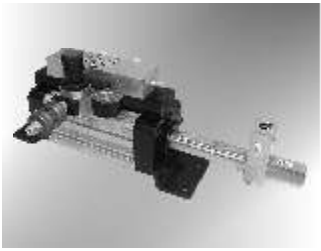
3/2 PLUNGER-SPRING PILOT VALVE ASSY.  
MODEL-082-01-00-000



10	1	'O,Ring	001 160N 0033
09	3	'O'Ring	001 130N 0110
08	1	Plug	082 01 00 006
07	1	'O'Ring	001 200N 0060
06	1	Taper Spring	082 01 00 005
05	1	Rubber Seat	082 01 00 004
04	1	Spring	082 01 00 003
03	1	'O' Ring	001 178N 0033
02	1	Plunger	082 01 00 002
01	1	Body	082 01 00 001
ITEM	QTY.	DESCRIPTION	PART NO.

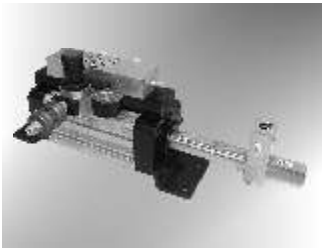
FIG-H

PRESSURE REGULATOR ASSEMBLY  
MODEL NO. 084-01-00-000



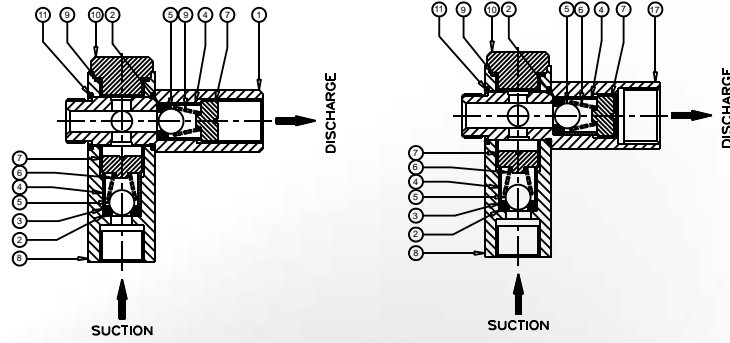
30	01	Manifold	084 01 00 003
29	01	End Cap	084 01 00 002
28	01	'O.Ring	001 200N 0042
27	01	Star	021 00 40 003
26	01	Spring	021 00 40 002
25	01	Jet	021 00 40 001
24	01	Diaphragm Bush	021 00 30 005
23	01	Diaphragm Washer	021 00 30 004
22	01	Rivet	021 00 30 003
21	01	Diaphragm Disc	021 00 30 002
20	01	Diaphragm	021 00 30 001
19	04	'O' Ring	001 300N 0300
18	01	Allen Bolt	004 01 04 012
17	01	Side Block	021 00 20 007
16	02	'O' Ring	001 200N 0120
15	01	'O' Ring	001 200N 0023
14	02	'O' Ring	001 200N 0050
13	01	1/8" Plug	021 00 20 003
12	01	Insert	021 00 20 002
11	01	Reg-Body	084 01 00 001
10	01	Locking	021 00 10 011
09	01	Parallel Spring	021 00 10 010
08	01	Leadscrew Nut	021 00 10 009
07	01	Circlip	003 03 007
06	01	'O' Ring	001 150N 0050
05	01	End Screw	006 01 04 006
04	01	Leadscrew Nut	021 00 10 004
03	01	Stopper	021 00 10 003
02	01	Housing Cap	021 00 10 002
01	01	Housing	021 00 10 001
ITEM	QTY.	DESCRIPTION	PART NO.

FIG-I



LOW PRESSURE N.R.V.  
FOR MODEL NO. ; 80-10-S, 80-14-S,  
80-16-S, 80-20-S, 80-25-S, 80-28-S, 100-14-S,  
100-16-S, 100-20-S, 100-28-S, 100-32-S

HIGH FLOW N.R.V.  
FOR MODEL NO. ; 160-40-S, 160-56-S.



HIGH PRESSURE N.R.V.  
FOR MODEL NO. ; 100-10-S, 160-14-D, 160-20-D.

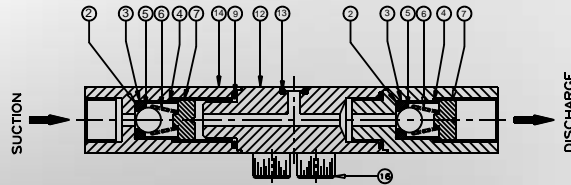
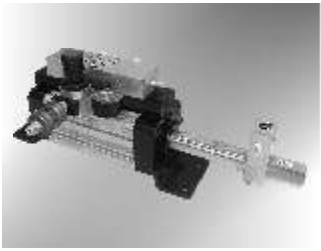


FIG. -J

17	1	High flow body	085 03 00 001
16	4	A.H. Bolt	004 01 12 300
15	1	O,Ring	001 250N 0080
14	1	High Pr. Suc. Body	085 02 00 003
13	1	High Pr. Dis. Body	085 02 00 002
12	1	Center Body	085 02 00 001
11	2	'O' Ring	001 250N 0220
10	1	Plug	085 01 00 008
09	1	'O' Ring	001 200N 0220
08	1	Suction Body	085 01 00 006
07	2	Loknut	085 01 00 005
06	2	Spring	085 01 00 004
05	2	Ball	008 02 012
04	2	Spacer	085 01 00 003
03	2	Bonded Washer	085 01 00 002
02	2	'O' Ring	001 150N 0015
01	1	Discharge Body	085 01 00 001
ITEM	QTY.	DESCRIPTION	PART NO.



Sr. No.	DESCRIPTION	QUANTITY
1	PUMP MODEL NO for Complete SEALKIT	1 Set
2	5/2 PILOT MASTER VALVE ASSEMBLY FOR PUMP	1 Set
3	<input type="checkbox"/> L.P <input type="checkbox"/> H.P <input type="checkbox"/> H.F NON RETURN VALVE ASSEMBLY	1 Set?
4	3/2 PLUNGER-SPRING PILOT VALVE ASSEMBLY	? 2 Set
5	<input type="checkbox"/> 1/4" <input type="checkbox"/> 1/2" PRESSURE REGULATOR FOR PUMP	1 Set
6	<input type="checkbox"/> 1/8" <input type="checkbox"/> 1/2" AIR SILENCERS	2 Set

NOTE : We are in a Position to Supply Individual Seals / Part as indicated in Section Assembly drawing Refer to fig.K

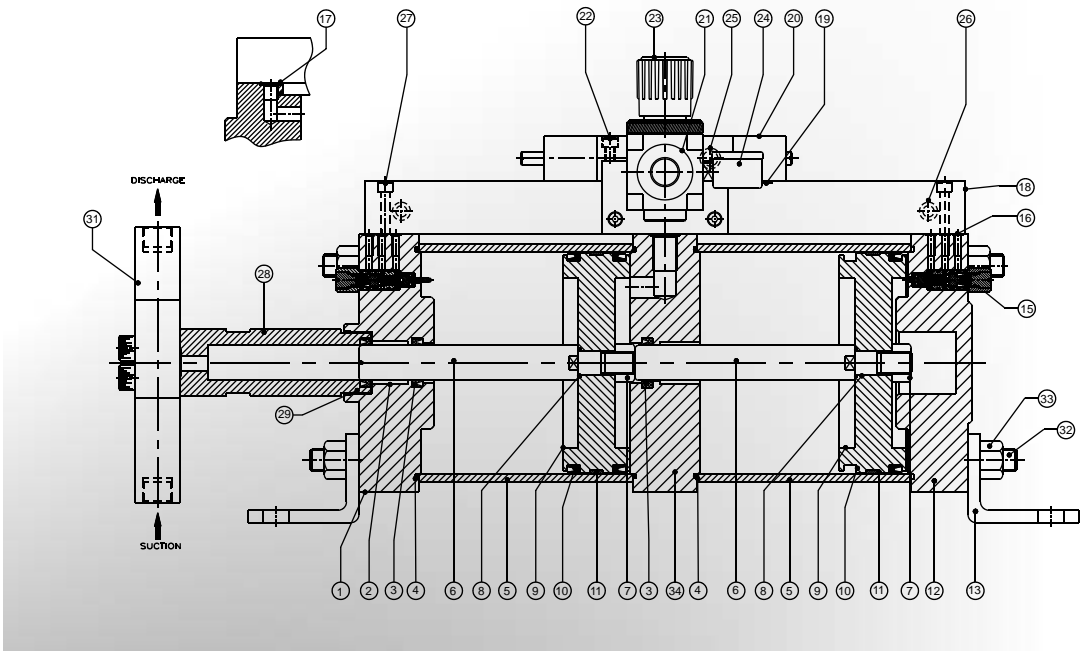
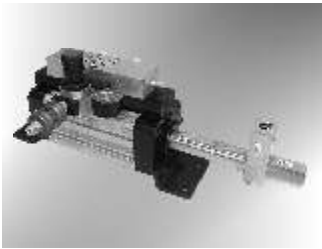
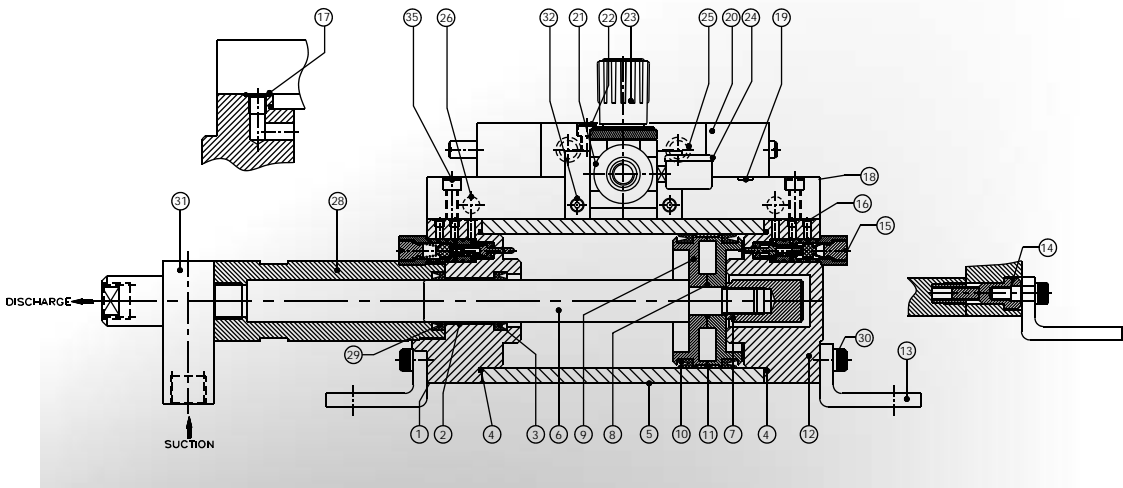


FIG-K





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## Dutta Control

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