Reliable & High Precision
Dosing Pumps

Model : DP/60/HYD/VIII

Multi Head Dosing Pump,
Space Saving, Modular Design with
any Combination of Plunger &
Diaphragm Heads & MOC's

SHAPOTOOLS

INSTALLATION, OPERATION & MAINTENANCE MANUAL REV.2

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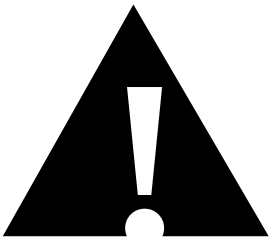


WARNING

This warning sign draws attention to safety precautions on the machine or included in these instructions. They indicate danger of injury!

1.0 SAFETY PRECAUTIONS & WARNINGS

1.1 COMPLY WITH SAFETY PRECAUTIONS

Read carefully all the safety precautions included in these operating instructions and all the warning signs attached to the machine. Make sure that the warning signs are kept in a legible condition and replace missing or damaged signs. Before starting, familiarize yourself with the operation of the equipment. It is too late when you are already working with the equipment! Never permit inexperienced personnel to operate the equipment.

1.2 DEFINITIONS QUALIFIED PERSON

For the purposes of this manual and product labels, a qualified person is one who is familiar with the installation, construction, operation and maintenance of this equipment and with hazards involved.

DANGER

For the purposes of this manual and product labels. **DANGER** indicates that loss of life, severe personal injury or substantial property damage WILL result if proper precautions are not taken.

WARNING

For the purposes of this manual and product labels, **WARNING** indicates that loss of life, severe personal injury or substantial property can result if proper precautions are not taken.

CAUTION

For the purposes of this manual and product labels, **CAUTION** indicates that minor personal injury or property damage CAN result if proper precautions are not taken.

NOTE

For the purposes of this manual and product labels, **NOTES** merely call attention to information that is especially significant in understanding and operating the drive.

DANGER & WARNING

CHILDREN AND THE GENERAL PUBLIC MUST BE PREVENTED FROM ACCESSING OR APPROACHING THE EQUIPMENT. THE EQUIPMENT MAY ONLY BE USED FOR THE PURPOSE SPECIFIED BY THE MANUFACTURER UNAUTHORIZED MODIFICATIONS AND THE USE OF SPARE PARTS AND ACCESSORIES THAT ARE NOT SOLD OR RECOMMENDED BY THE MANUFACTURER OF THE EQUIPMENT CAN CAUSE FIRES, ELECTRIC SHOCKS AND INJURIES. KEEP THESE OPERATING INSTRUCTIONS WITHIN EASY REACH AND GIVE THEM TO ALL USERS!

2.0 INTRODUCTION

SHAPOTOOLS Metering Pumps are compact controlled volume pump for Chemicals, Oils and light Slurries. The accuracies of the metered discharge volume is maintained as per API-675 standards under stable and correct operating conditions. Metering with repetitive accuracy is possible only with correct installation. NPSH data sheet DATA/NPSH/150 is enclosed at the end of the manual. Please fill it up and send it to us for each pump installation.

2.1 PLUNGER TYPE LIQUID ENDS

Applications - suitable for non-hazardous liquids.

STANDARD PLUNGER TYPE

- Due to their simple design they are quite economical.
- Low maintenance cost.
- They can be provided with lantern ring flushing connections.
- They have low NPSHR.
- They have high reliability.
- They can only be provided in metallic construction.

JACKETED PLUNGER HEAD

- Have advantages of standard plunger type.
- Jacketed heads can be provided in the case of molten liquid being pumped.
- The jacket encloses the check valves and gland chamber.
- The valves are cartridge type and can be removed for servicing without dismantling the suction and discharge connections or the heating fluid connections.

Important Note : Refer to 'Special instructions for Jacketed Metering Pumps' attached.

DOUBEL ACTING PISTON HEAD

- Generally for capacities greater than 10000 LPH per head and having low discharge pressures, double acting type piston pump heads can be provided.

REMOTE HEAD TYPE

- In case of handling liquids under extreme temperature conditions or in the case of explosive, hazardous or toxic liquids, a remote head is provided which can be isolated by means of a physical barrier from the surrounding environment. This arrangement can be provided on Plunger & Diaphragm liquid ends.

2.2 DIAPHRAGM TYPE LIQUID ENDS

Applications - suitable for conditions involving hazardous toxic, radioactive, expensive or poisonous liquid where any product leakage is not acceptable.

STANDARD DIAPHRAGM TYPE

- There is no leakage of the process fluid as it is hermetically sealed.
- The diaphragm has a long life as it is always in hydraulic balance with the liquid being pumped on one side and process fluid on the opposite side.
- The system is safe guarded by a built-in relief vacuum valve on the hydraulic side.
- Very high pumping pressures can be attained.
- The can be provided in metallic / plastic construction.

SANDWICH DIAPHRAGM TYPE

- Have advantages of standard diaphragm type pumps.
- There is no leakage of the process fluid as it is hermetically sealed.
- The diaphragm has a long life as it is always in hydraulic balance with the liquid being pumped on one side and process fluid on the opposite side.
- The system is safe guarded by a built-in relief vacuum valve on the hydraulic side.
- Very high pumping pressures can be attained.
- There is no intermediate fluid which virtually eliminates the possibilities of contamination of the pumped liquid.
- Diaphragm rupture detection is provided. In case one diaphragm ruptures the pump can continue to pump with second diaphragm till a convenient replacement time.

OPEN DISH DIAPHRAGM TYPE

- Have advantages of standard diaphragm type pumps.
- It is ideally suited for pumping slurries and viscous liquids
- They have low NPSHR.
- There are no restricted passages in the pumping chamber.
- They can be offered in Glandless / with gland design.

OPEN DISH SANDWICH DIAPHRAGM TYPE

- Have advantages of sandwich diaphragm type pumps.
- Have advantages of open dish diaphragm type pumps.

MECHANICALLY OPERATED DIAPHRAGM TYPE

- Due to their simply design they are quite economical & low maintenance cost.
- They have low NPSHR, high reliability, but, linearity & turn down ratio are less than hydraulic diaphragm type.
- There is no leakage of the process fluid as it is heremetically sealed and is ideally suited for pumping slurries and viscous liquids.
- There is no intermediate / hydraulic fluid which virtually eliminates the possibilities of contamination of the pumped liquid.
- There are no restricted passages in the pumping chamber.
- Suitable for maximum 8 kg/sq.cm. discharge pressure.

3.0 GENERAL INSTALLATION INSTRUCTIONS

3.1 The pump should be mounted on any surface which is ***flat and level***, with sufficient room left around the pump to facilitate maintenance.

3.2 ***Support & align*** all piping connections to the pump so that no stress is placed on pump fittings. Take expansion & contraction of pipes due to ***extreme temperature*** into consideration. **NOTE**

3.3 ***Flush and blow-out*** all pipelines before connecting the pump

3.4 Install a 'Y' type or Basket type ***strainer*** on the suction line of adequate ***effective*** area (the area of the element openings should be 6-8 times the pipe NB) and 60 mesh at least.

3.5 ***Safety valve*** must always be provided immediately after the discharge port before any other isolation valve, especially for plunger/mechanically operated diaphragm pumps. Pipe the outlet of the relief valve back to the suction tank or to drain, with the open end of the pipe visible at all times. **CAUTION**

3.6 The ***Pulsation damping*** element should be installed immediately after the discharge port, before the back pressure valve, if required.

3.7 A ***flooded suction*** is essential for optimum service. The suction pipe length should be as ***short*** as possible. The suction pipe should be sized for a flow ***four*** times greater than the maximum capacity of the pump. Generally the pipe & fittings starting from the tank nozzle upto the pump flange should be atleast equal to or preferably one size higher than pump NB. **NOTE**

3.8 Motor coupling to be properly aligned with pump coupling.

3.9 In the case of small pumps with threaded pipe connections, it is very important that the valve holders are ***not over tightened*** because this will lead to the distortion of the Teflon valve sealing rings. When fitting threaded suction and discharge pipes into the valve holders, care should be take to hold the holders with a spanner while screwing in the pipe, failing which the holders will tend to over tighten. For all pumps it is essential that valve holders are tightened parallel and just enough to overcome leakage. Over-tightening is ***NOT*** recommended nor necessary. **NOTE**

3.10 Install ***shut off valves*** with ***distance pieces*** on the suction and discharge side to facilitate servicing.

3.11 The suction piping must be absolutely ***leak tight***. Test piping with air pressure and soap solution for leaks.

3.12 Fill the gear box with ***approved*** oils upto the oil level. After the pump has been run for 10 to 15 minutes during the initial starting of the pump for the first time, the oil should be primed again up to the oil level, to ensure that the air within the crank case has been bled.

3.13 In the case of pumps with clamps for holding valves, it is essential that the studs or bolts holding the clamps are tightened such that the clamps are perfectly ***parallel*** to each other.

3.14 Ensure that electrical ***ground*** is firmly in place, on the base-plate. **DANGER NOTE**

3.15 NPSHR should be ***less*** than ***NPSHA*** as per the piping instructions given below.

3.16 For PNM Pumps, provide instrument air supply pressure of 5 to 7 Bar using Air Filter Regulator.

3.17 During Shipment Plugs are provided to prevent oil spillage. Plugs to be replaced with Breathers that are supplied loose, during commissioning.

RECOMMENDED OILS FOR GEARING UNIT:

(Specifications of oil : Flash P COC, ^{o}C: 240, Pour Point ^{o}C: -6, K.V. cSt: 152.2 @ 40 ^{o}C and 14.8 @ 100 ^{o}C, VI: 96)

M/s. Hindustan Petroleum	**ENKLO - 85**
M/s. Caltex	**REGAL OIL 'G'**
M/s. I.O.C.	**SERVO SYSTEM 533 / 68** **SERVOSYSTEM HLP 68**
M/S. Bharat Petroleum	**CABOL 150**
Castrol	**HYSPIN EP 150**
Shell	**TELLUS 150 / 320**

RECOMMENDED OILS FOR HYDRAULIC SYSTEM OF DIAPHRAGM PUMPS:

(Specifications of oil : Flash P COC, ^{o}C: 196, Pour Point ^{o}C: -9, K.V. cSt: 36.1 @ 40 ^{o}C and 5.9@ 100 ^{o}C, VI: 196)

M/s. Hindustan Petroleum	**Enklo - 44**
M/s. Caltex	**Regal Oil 'AA'**
M/s. I.O.C.	**Servo System 311 / 32** **Servosystem HLP 32**
M/S. Bharat Petroleum	**Hydrol - 37**
Castrol	**Hyspin EP 32**
Shell	**Tellus 37 / 22**

Note 1 : For Molten Phosphorus use Liquid paraffin/silicon oil for Hyd. Side.
(For Food application products: Use Distilled water / compatible fluid NOT Oil.

APPROXIMATE QUANTITY OF LUBRICANTS REQUIRED FOR GEAR BOX:

Model DP/12	**0.25 Litres**	**Model DP/60**	**3 Litres**
Model DP/20	**0.6 Litres**	**Model DP/90**	**9 Litres**
Model DP/30	**1.2 Litres**	**Model DP/70/II**	**9Litres**
Model DP/45	**2.5 Litres**	**Model DP/1.8 & DP/3**	**0.29 Litres**
MOD/15/312/II	**4.0 Litres**		

4.0 PIPING INSTRUCTIONS

NPSH data sheet DATA/NPSH/150 is enclosed at the end of the manual. Please fill it up in totality and send it to us for each pump installation. This is most important for proper pump installation. The information sent is fed into our computerized software which will suggest alterations if necessary. A schematic line diagram for various installation is enclosed. The general instructions however are as follows.

4.1 GENERAL

- The ***layout*** of various accessories is as follows:
- The suction strainer is to be provided on the suction line close to the pump suction flange.
- The suction pulsation damper (if necessary) provided between the suction strainer and the pump inlet (BOTTOM)
- The pump outlet (TOP) is first connected to the safety relief valve [before any other valve] and discharge pulsation damper (if necessary).
  Next, the back pressure valve (if necessary) is to be fitted.

  Avoid over sizing the pump to avail better accuracy.

4.2 SUCTION SIDE

- Always use a suction strainer of atleast 60 mesh & large effective area.
- The suction pipe should have minimal number of fittings and bends and should be as short as possible. Suction pipe & fittings to be atleast one size higher than the pump flange.
- Avoid pockets where vapors/air may accumulate
- Install suction pulsation dampers or oversize the suction pipe in those cases where the suction pipe is long. A stand pipe may also be provided.
- NPSHR can be calculated using the following formula

NPSHR = acceleration losses + pump internal losses (K_1) BAR

$$\text{Acceleration losses} = \frac{(\text{Sp Gr. @ PT.}) \times (\text{pipe lg. In M}) \times (\text{Stroke lg. In mm}) \times (\text{SPM})^2 \times (\text{Plunger dia In mm})^2}{C \times 10^7 \times (\text{Suction pipe diameter in mm})^2} \text{ BAR(A)}$$

C = 1.5	**FOR SIMPLEX AND DUPLEX PUMPS**
C = 4	**FOR TRIPLEX PUMPS**

Pump internal losses (K_1)

K1 = 0.15 BAR(A)	**FOR PLUNGER PUMPS**
K1 = 0.15 BAR(A)	**FOR GLANDLESS OPEN DISH DIAPHRAGM PUMPS**
K1= 0.35 BAR(A)	**FOR STANDARD DIAPHRAGM PUMPS**
K1 = 0.2 BAR(A)	**FOR OPEN DISH DIAPHRAGM PUMPS**
K1 = 0.4 BAR(A)	**FOR SANDWICH DIAPHRAGM PUMPS**
K1 = 0.2 BAR(A)	**FOR OPEN DISH SANDWICH DIAPHRAGM PUMPS**

4.3 DISCHARGE SIDE

- Always provide a ***pressure gauge*** (with isolation valve) next to the pump discharge flange, to ensure that the pump is not subjected to a pressure greater than the design pressure indicated on the pump nameplate.
- Always provide a ***safety relief valve*** as the first valve on the discharge line of a plunger/mechanically operated diaphragm pump. The outlet of the valve must be piped to drain or to the top of the suction tank.
- Never start the pump with the pump ***isolation valves*** closed. **WARNING**
- There should be a ***positive differential head*** (including acceleration and other losses) of at least 0.4 kg/sq.cm.a between the suction and the discharge side, the discharge being higher than the suction.
- A ***back pressure valve*** may be provided in case the above condition is not met. Alternatively, the discharge piping is to be raised above the discharge tank with a vent at the highest point.
- Provide a ***non return valve*** in the discharge line when the discharge pressure is high.
- A ***control valve*** for controlling the required flow should ***NEVER*** be provided on a metering (Positive Displacement) pump. For controlling the flow the stroke length of the pump or the motor speed should be adjusted to attain the desired flow. This can be achieved by having a pneumatic or electrical stroke variator which will control the flow in proportion to either a pneumatic signal of 0.2 to 1 kg/sq.cm. or a signal of 4 to 20 mA. It can also be controlled by varying the motor speed through an Inverter (VFD) in proportion to 4 to 20 mA. (In case VFD is provided then the motor HP should be double)

5.0 OPERATING INSTRUCTIONS

5.1 It is imperative that the recommended oil is filled upto the correct ***oil level*** before starting the pump.

NOTE

5.2 Check that ***direction of rotation*** of the motor is as per the arrow marking.

5.3 Set the stroke adjustment to ***zero*** setting.

5.4 Make certain the suction lines are ***filled*** with system fluid, and that the isolation valves are ***open*** on suction and discharge.

5.5 Refer to DP/INST/GA drawings enclosed at the end of the manual to familarise yourself with the various parts of the pump.

5.6 Start the pump with zero stroke setting increasing the stroke gradually and listen for any ***abnormal noise***. If present refer to the trouble shooting chart.

5.7 Adjust the setting to 30-40% of maximum capacity and operate for several minutes. Then increase the setting to the maximum and operate for several minutes. ***Repeat*** the procedure several times to ensure that the air is bled from the pump liquid end.

5.8 It is advisable to initially start the pump at low pressure to help in bleeding & then gradually bring it to rated pressure.

5.9 Do not force the stroke adjustment ***below zero and over 100%*** stroke setting, as this will damage the pump.

5.10 Check the relief valve setting, it should not be ***bypassing*** below pump rated pressure.

5.11 The pump is ready for ***on line*** service. Adjust capacity knob to the desired value. Each pump is tested at Shapotools works to conform that the performance meets the capacity and pressure requirements when tested with water.

5.12 If a ***drain point*** is provided near the pump discharge, then it may be ***opened*** to ease. bleeding of the pump head initially.

5.13 ***Calibrate*** the pump for the specific installation.

6.0 MAINTENANCE

- The pump is designed for reliable service with a minimum amount of maintenance.
- For interchangeability of spare parts, it is mandatory forr purchaser to inform pump model No. and pump serial number. These details are available on the pump nameplate.

CHECK LIST:

6.1 ***Oil level*** in the gear box.

6.2 Inspect the liquid end for indication of ***leakage or seepage*** - glands to be tightened as lightly as possible. Allow some leakage from the gland initially.

6.3 ***Oil / Grease*** all nipples where applicable.

6.4 After the first ***200 hours*** change the gear box oil. The next oil change is to be schedule after every ***2000 hours*** operation.

6.5 Oil the ***Cross head*** occasionally.

6.6 Clean the ***strainers***.

6.7 Ensure that the ***check valves*** are operating correctly & that suction as well as discharge check valves are assembled so that they ***open vertically upwards***. **CAUTION**

7.0 TROUBLE SHOOTING CHART

SYMPTOM	CAUSE	REMEDY
7.1.Pump won't operate	• Blown fuse • Open over load thermal • Low liquid level [where low level cu-off is used] • Broken wire • Jammed valve on piping. • Suction line not filled with liquid	• Check for short circuit or overload. • Reset • Fill tank • Locate and repair. • Locate and repair. • Vent pump according to operating instructions.
7.2.Pump does not deliver rated capacity	• Leaky suction piping • Starved suction • Air trapped • Worn or dirty valves or seat • Air sucked through glands • Excessive suction lift • Dirty Strainer • Relief valve bypassing	• Pressure test. Repair or replace defective piping • Replace suction pipe with larger size or increase static head. • Vent pump according to operation instructions • Clean, re-lap or replace • Tighten gland nut or replace gland packing • Rearrange the system to provide flooded suction. • Clean or replace. • Re-set it.
7.3.Pump delivers erratically	• Leaky suction line • Worn or dirty valves • Dirty filter • Hammer caused by cavitation • Bypassing relief valve • Leaking seal	• Repair or replace piping. • Clean, re-lap or replace • Clean or replace • Check pipeline size & length, strainer size • Repair or replace relief valve • Tighten seal or replace
7.4.Pump does not develop required pressure	• Relief valve leaking • Relief being actuated • Check valves leaking	• Repair or replace relief valve • System pressure exceeds pump rated pressure. Reset it • Clean or replace.

8.0 INSTRUCTIONS FOR HYDRAULICALLY OPERATED DIAPHRAGM PUMPS

8.1 GENERAL DESCRIPTION

- ***CONSTRUCTION & OPERATION***: Diaphragm type metering pumps are mainly used for handling hazardous, toxic or radioactive liquids where no leakage is permissible. A plunger/piston pulsates the diaphragm via a hydraulic fluid. The pump capacity is in proportion to the stroke length setting.
- The diaphragm has only one function, it is simply a moving partition with the pressure hydraulically balanced on both sides. The hydraulic oil is on one side & the product handled is on the other side.
- ***COMPENSATING VALVE***: Any leakage of hydraulic oil past the plunger/piston seals or the bleed valve, is replaced on the suction stroke through the automatic functioning of the compensating valve, which draws in replacement oil from the oil reservoir.
- ***PRESSURE RELIEF VALVE***: Any excess pressure built up in the hydraulic chamber or the liquid end is released through the pressure relief valve, back into the oil reservoir.
- **BLEED VALVE**: To vent any air in the hydraulic chamber.
- Depending on the pump model the above three valves can be combined in different permutations.
- Before leaving the works all hydraulically operated diaphragm pumps are filled with hydraulic oil and ***vented***. The compensating valve and the relief valves are set according to actual operating conditions and the pump is tested for rated capacity and pressure. ***It is recommended not to alter the compensating and relief valve settings.*** **NOTE**

8.2 FILLING OIL IN THE HYDRAULIC CHAMBER AND VENTING

FOR STANDARD DIAPHRAGM PUMPS

- ***Open*** the main valves on the suction & delivery lines. [delivery line to be at atmospheric pressure]
- Fill the oil reservoir with recommended ***hydraulic fluid***.
- Set the stroke to about 80% and start the pump.
- Operate the pump against ***negligible*** discharge pressure and depress the vacuum compensating valve ***very slightly*** and release in such a manner that the oil enters the main chamber on the suction stroke and is thrown out of the relief valve on the delivery stroke.. Repeat this operation frequently. Air bubbles will be seen rising in the oil reservoir.
- ***Top up oil level*** in the reservoir, such that the level is always higher than the cross holes in the valves.
- To set the vacuum compensating valve operate the pump against ***negligible*** discharge pressure.
- Unscrew the vacuum valve [small round nut] till the oil level in the reservoir moves up and down. Gradually tighten the vacuum valve [small round nut] till the movement of oil level just becomes stationery. Tighten the round nut further by approximately ***half a turn***.
- Tighten the vacuum valve lock nut [hexagonal] above the small round nut. **NOTE**
- The relief valve may now be set according to the pump relief valve set pressure by tightening the big nut and observing the pressure gauge reading. Further adjustment of the vacuum valve may be required to suit the operating conditions at site.
- In case if there is a valve on the discharge line, then close this valve for about 30 seconds. The oil will be found to circulate in the reservoir through the vacuum compensating and relief valve.
- The Relief Valve Nut may have to be tightened or loosened while observing the Pressure Gauge which is to be mounted by Purchaser on the discharge line near the pump discharge flange.

FOR OPEN DISH DIAPHRAGM METERING PUMPS (WITH GLAND)

- Bring the stroke setting to 10%.
- The suction valve should be fitted in position. The discharge valve may be removed and either water or process fluid should be filled till the top.
- Open the Oil Reservoir Cover and remove the Hexagonal Nut on the Relief Valve located in the Oil Reservoir. [***count*** the number of turns before the nut disengages]. Remove the Spring and pull out the Centre Spool from the Relief Valve.
- ***Fill oil*** in the Oil Reservoir with the recommended oil.
- The pump may now be started.
- Air will be seen to bubble out into the Hydraulic Oil Reservoir. As the bubbling progresses the Hydraulic Oil will be entering the pump chamber. Additional hydraulic oil may be added to the Oil Reservoir till the ***bubbling totally stops***.
- The stroke setting may gradually increased till oil does not spill out of the oil reservoir while moving up and down.
- Re-fit the spool in the Relief Valve together with Spring and re-fit the nut on top of the Relief valve. While tightening the Nut on the Relief Valve ***count*** the same number of turns while tightening as when opening.
- Increase the stroke setting gradually till it reaches about 75% of the stroke setting. Ensure that there are no air bubbles coming out into the Oil Reservoir. If required go on adding oil.
- Pump may now be started making sure that the isolation valves on the suction and discharge lines are ***open***. The pump may now be operated against full rated discharge pressure. The Relief Valve Nut may have to be tightened or loosened while observing the Pressure Gauge which is to be mounted by Purchaser on the discharge line near the pump discharge flange. The valve may be set for a cracking pressure of approximately 10% or 1 kg/sq.cm. higher than the rated discharge pressure. [The rated discharge pr. has been punched on the pump name-plate].
- When the pressure goes beyond the set pressure it will be observed that the hydraulic oil level in the Oil Reservoir moves up and down. The oil level in the Oil Reservoir should be approximately half the height of the Oil Reservoir. In any case the cross holes drilled for the Relief Valve for exit of oil into the Oil Reservoir should be ***below*** the oil level.

FOR OPEN DISH DIAPRHAGM METERING PUMPS (GLANDLESS)

- Bring the stroke setting to 10%.
- The suction valve should be fitted in position. The discharge valve may be removed and either water or process fluid should be filled till the top.
- Remove the relief valve nut and spool and fill recommended oil through the relief valve till the oil top-up and the air bubble stops.
- Re-fit the spool and lightly engage the nut.
- Gradually increase the stroke setting. It will be observed that the relief valve will start operating. (Oil will be seen to exit into the yoke oil reservoir through the hole.
- Pump may now be started making sure that the isolation valves on the suction and discharge lines are ***open***. The pump may now be operated against full rated discharge pressure. The Relief Valve Nut may have to be tightened or loosened while observing the Pressure Gauge which is to be mounted by Purchaser on the discharge line near the pump discharge flange. The valve may be set for a cracking pressure of approximately 10% or 1 kg/sq.cm. higher than the rated discharge pressure. [The rated discharge pr. has been punched on the pump name-plate].
- When the pressure goes beyond the set pressure it will be observed that the hydraulic oil level in the Oil Reservoir is discharged by the built-in relief valve.

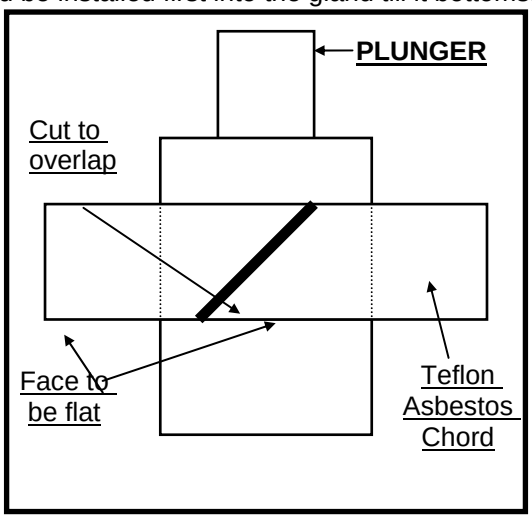
8.3 FAULTS IN HYDRAULIC CHAMBER OR INTERMEDIATE CHAMBER

FAULT: Pump fails to attain its prescribed delivery or the required pressure

CAUSE	REMEDY
• The level of hydraulic oil has fallen below the bottom edge of the compensating valve. This has allowed air to enter hydraulic chamber.	• Top up oil to cover the compensating valve and vent hydraulic and as per instructions.
• Diaphragm joint leaks	• Check Sealing Chord and replace. Also tighten head bolts.
• Plunger seal leaks	• If possible tighten seals or replace.
• Compensating valve or relief valves leaks	• Clean or re-lap
• Spring tension on compensating valve too low	• Tighten compensating valve nut as per instructions.
• Relief valve leaks	• Clean valve seat. • Replace if necessary.
*	

PROCEDURE FOR REPLACING THE GLAND PACKING SET

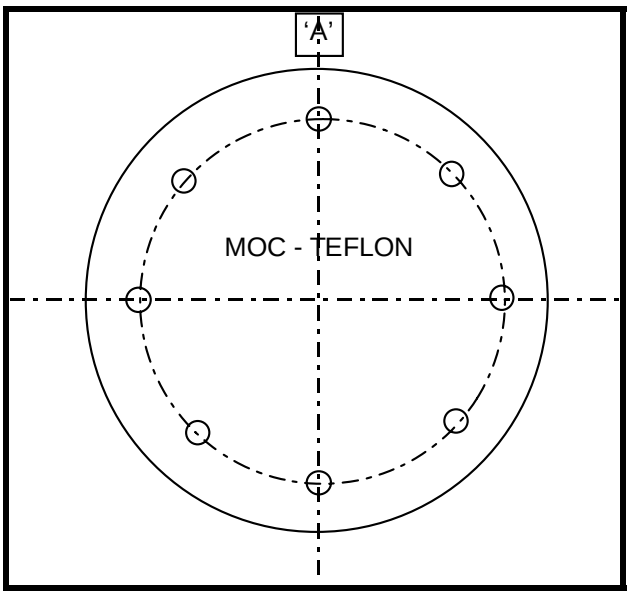
1. The Teflon throat ring which is thicker than the other rings should be installed first into the gland till it bottoms.
2. The remaining Teflon rings should all be inserted on to the plunger and pushed as far back as possible.
3. The plunger should then be inserted into the throat ring ready fitted in the gland.
4. The split Teflon asbestos chord should next be introduced in to the gland pocket without removing the plunger.
5. Care should be taken that inclined cut should overlap perfectly and should be tamped into place, so that on visual inspection a completely flat face of the chord will only be visible.
6. The next Teflon ring which has already been introduced on the plunger should be lowered into the gland without removing the plunger & tamped into place.
7. Procedure No.4 followed by procedure No.5 & 6 should be carried out till all the chords and rings have been introduced.
8. It is important to note that the inclined cuts in the chords should be staggered at 90 deg to each other.



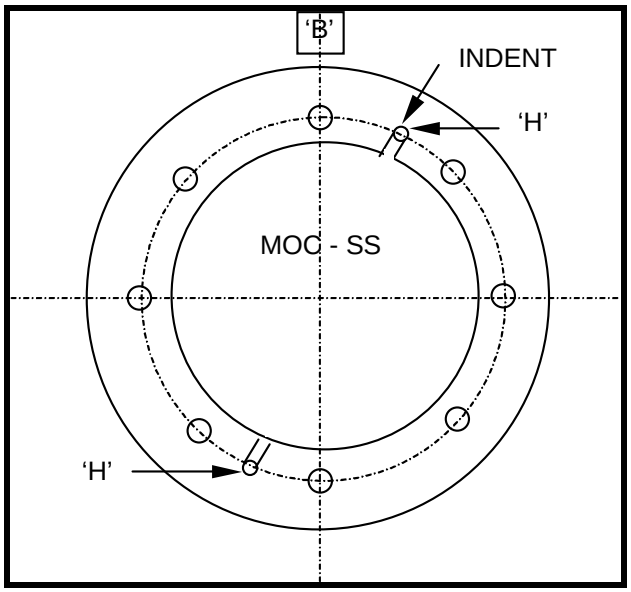
9. The backer ring may be introduced, if necessary after removing the plunger. Preferably the backer ring should be introduced with the plunger in place.
10. The complete head assembly should be introduced very carefully on the pump yoke and the stem of the plunger should be introduced into the cross head and care should be taken that the plunger stem bottom fully into the cross head. Collet nut can then be tightened. While doing the complete exercise of fitting the pump head on the yoke the entire weight of the pump head should be carefully supported so that the plunger stem which enters the cross head does not get bent.
11. Initially the gland should be kept reasonably loose to allow gland leakage. As the pumps starts operating the gland nut should be tightened in very small increments till there is only a minor gland leakage. It is wrong procedure to over-tighten the gland as this will result in damage to the plunger as well as the gland.

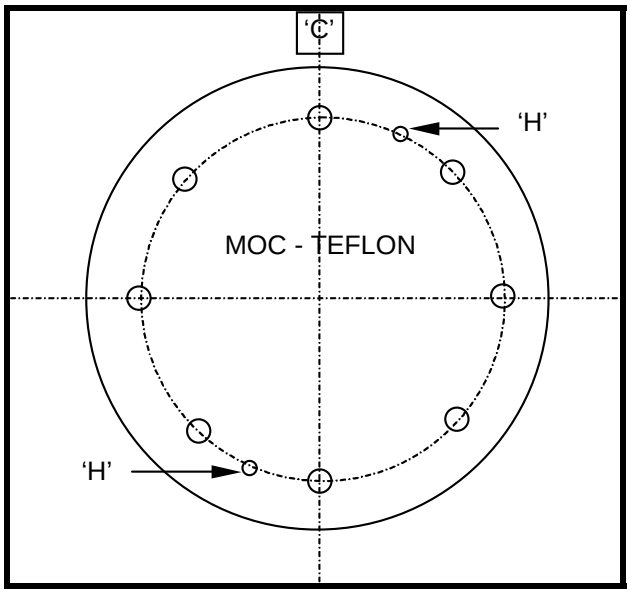
8.4 SANDWICH DIAPHRAGM TYPE METERING PUMPS

INSTALLING THE SANDWICH DIAPHRAGMS



- Sandwich diaphragm construction consist of a set of two diaphragms together with a spacer ring.
- Diaphragm 'C' should be fitted touching the head on which side the ***pressure*** gauge is fitted. Ring 'B' in the ***middle*** and diaphragm 'A' on the ***opposite side***.
- The small holes "H-H" in 'B' and 'C' should be ***aligned*** and should match the small holes in the pump head on the side where the pressure gauge 'E' fits.
  NOTE
- Before fitting the diaphragms they should be thoroughly ***cleaned*** on both faces. The pump head faces should also be thoroughly cleaned. Care should be taken to observe that diaphragm and pump head faces are ***free*** of any cuts or scratches.
- Apply a thin even coat of 'Wheel bearing Grade' grease to both faces of 'A', "B" and "C". Before assembly keeping holes 'H' and ***indent*** in ring 'B' ***free of grease***.
- Assemble the diaphragms with the pump heads and tighten clamping bolts ***evenly***. [In case of diaphragm pumps with plastic heads bolts should not be over-tightened to distort the plastic head.]
  NOTE

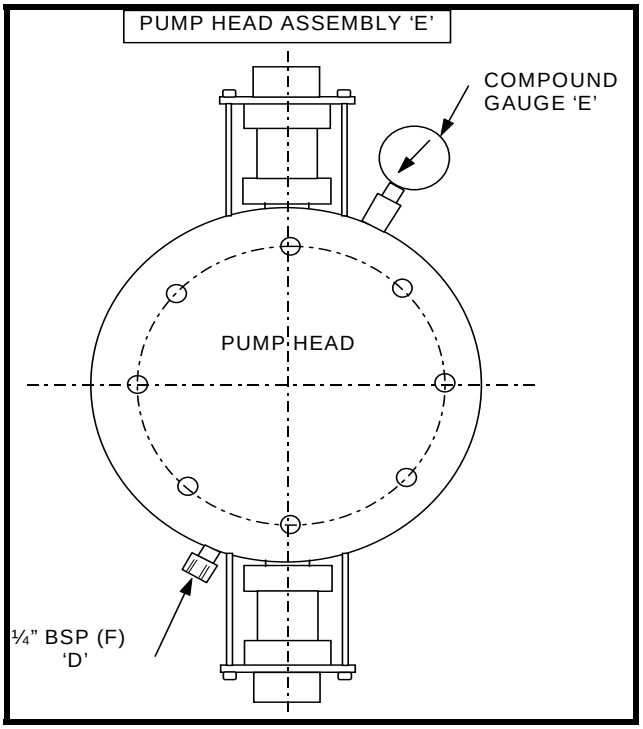




- Clean needle valve 'D' and its seat in pump head.
- Tighten needle valve 'D'.

- In case of either diaphragm ‘A’ or ‘C’ getting ruptured, the discharge pressure is indicated on compound gauge ‘E’ instead of atmospheric/vacuum pressure. The pump should then be stopped immediately and diaphragms replaced as per above instructions. Process liquid can be drained from nipple ‘D’.
- In case compound gauge ‘E’ shows a slight pulsing reading just above atmospheric pressure it means that there was some slight gap between diaphragm ‘A’ and ‘C’ during assembly and ***not*** that the diaphragm has ruptured. In this case create a vacuum through needle valve ‘D’ to evacuate the space by first loosening the needle valve ‘D’ and re-tightening it while vacuum is still being applied. A Vacuum pump can be temporarily connected to ¼” BSP F connection provided in needle valve ‘D’ for this purpose.
- Vacuuming may also be carried out if it is observed that flow-rate is coming less.
- In order to test the setup, blow air under ***low*** pressure through needle valve ‘D’ to remove obstruction in any passage. The compound gauge ‘E’ should indicate this pressure.

NOTE



9.0 INSTRUCTIONS FOR MECHANICALLY OPERATED DIAPHRAGM PUMPS

9.1 GENERAL DESCRIPTION

CONSTRUCTION & OPERATION: Diaphragm type metering pumps are mainly used for handling hazardous, toxic or radioactive liquids where no leakage is permissible. A plunger is threaded into a diaphragm which has a metallic insert and pulsates the same. The pump capacity is in proportion to the plunger stroke length setting.

9.2 INSTRUCTIONS FOR DISMANTLING AND RE-FITTING THE DIAPHRAGM

Loosen the bolts that hold the pump wetted head (dish) and dismantle the same. Avoid contact with any chemical hold up which may remain in the pump head. Unscrew the diaphragm and replace the same. Be sure to tighten the diaphragm till it bottoms. Do **not** adjust the position of the yoke.

In case the yoke has been dismantled for some reason the procedure for re-fitting the same is :

Tighten the yoke as far back as possible. Then tighten the diaphragm till it bottoms. Set the pump to 50% stroke setting. Rotate the motor shaft by hand until the diaphragm stops moving backwards. Now loosen the Yoke till it just touches the diaphragm. Adjust the position of the yoke so that the bolt holes are symmetrical to the vertical axis. Switch on the pump motor while the pump is still at 50% stroke setting. You should be able to observe the diaphragm move forward and backwards approximately equally with reference to the face of the yoke. Re-fit the pump head.

9.3 INSTRUCTIONS FOR SETTING THE ZERO POSITION SET SCREW

Dismantle the pump head to reveal the diaphragm. Rotate the thimble in the clock-wise direction till it shows 0%. Lock the thimble by tightening the locking screw. Loosen the grub screw, which holds the screw retainer in position. Unscrew the screw retainer the dismantle the entire stroke adjustment assembly. Adjust the set screw and re-fit the screw retainer. Rotate the motor shaft by hand and check if there is any movement of the diaphragm. In order to detect the movement of the diaphragm it is advised to provide a dial gauge against the face of the diaphragm. Repeat this process by trial and error until the diaphragm **just** stops moving. Tighten the lock nut for the set screw. Refit the screw retainer and lock it in position with the grub screw.

SHAPOTOOLS

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SPECIAL INSTRUCTIONS FOR JACKETED METERING PUMPS FOR HANDLING MOLTEN LIQUID

Our Metering pump Heads for handling molten Liquids are unique in design because they have the following special features:

1. The check valves are of Cartridge type and are removable for servicing without dismantling pump suction and discharge connections nor is there any need to remove the steam jacketing connection from the pump or piping.
2. The Jacket encompasses the entire valves together with glands, resulting in the liquid being in complete molten condition throughout the pump chamber.

INSTRUCTIONS FOR INSTALLATION/OPERATION

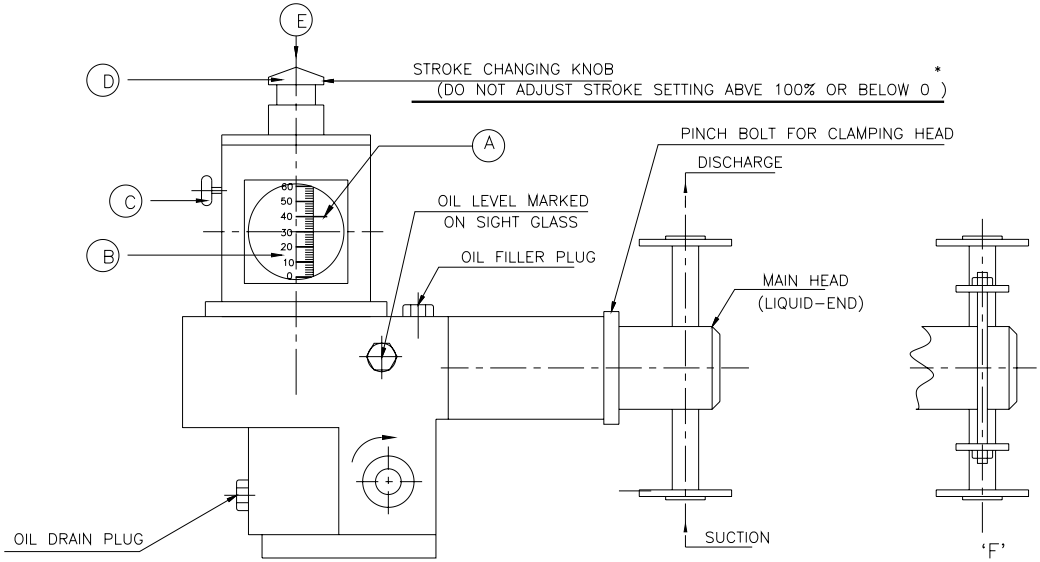
1. Before starting the pump it is important to check that the suction and discharge lines are heated up to ensure that the liquid is in a totally molten and free flowing stage. It is advisable to have drain point in the lines which may be opened to check the fluidity of the liquid being pumped.
2. Open the coupling guard, and while the pump is switched rotate the coupling to ensure that the plunger moves forward and backward freely. If the heating in the jacket is not adequate, then the plunger will not be able to move freely.
3. It is very essential to have a Jacketed Relief Valve immediately after the pump discharge or jacketed rupture disc should be provided.
4. A Micro relay can be provided on the motor starter, with an over ride. The over ride can be operated during start-up to avoid tripping of the starter. The Micro relay should be set to trip the motor at the slightest overload, which may result from lack of fluidity of the Sulphur. It is most essential to have thermocouples (temperature probes) spaced throughout the suction and discharge line and on the pump head and on the safety relief valve/rupture disk. These probes are to be coupled to the motor relay to trip the starter if the correct temperature has not been attained.
5. A jacketed Strainer of 60 mesh and very large effective area should be provided on the pump suction. It is advisable to have flooded suction with an NSPH of 1 M (minimum). However, discharge head must be higher than suction head.
6. The pump should be started at zero stroke setting and the setting should be gradually increased till full stroke. This is done because in case the liquid is not molten and free flowing, then excessive resistance may occur resulting in serious damage to the pump. The moment the stroke while being increased, results in a knocking sound, the pump stroke should immediately be brought to zero and the pump should be switched off. A check should be carried out to see that the liquid is free flowing. Needless to say that before starting the pump the discharge valve on the line should be fully opened. Stroke changing should never be attempted when the liquid is not molten because this will result in scoring of the plunger which will be held by the solidified liquid.
7. On initial start-up the pump should be taken from zero to maximum stroke in order to vent the entrapped air. Once the flow starts, then the desired stroke setting may be adjusted to give the required capacity. During the initial start-up it would be advisable to open the drain point at the discharge side thereby helping the pump to vent the air in the pump chamber.

In case if the pump is not giving the rated flow it may be due to either of the following reasons.:

a) Valves may be choked due to impurities and will require opening and cleaning of the valves. It is very important to refit the valves in the correct sequence and direction because if the discharge valve is fitted upside down it can result in instant breakage of the entire pump mechanism.
b) The Relief Valve may be by-passing the liquids. This can be rectified by adjusting the relief valve setting.
c) Air may not have been fully vented though the pump has been taken to full stroke setting initially. In this case if may: be necessary to increase and decrease the stroke several times to remove the air from the cylinder. In case if the pump still does not deliver the capacity required then; the nut holding the discharge valve may be slackened (not removed) to allow the valve cartridge to move up and down, while the pump is in operation for about two to three minutes, than the nut holding the valve should be retightened. This operation may have to be repeated several times before the air is totally bled.

&&&&&&&&&&

CAD.REF.	2005-INST-GA-003



INSTRUCTIONS FOR STROKE VARIATION:-

THE SCALE IS CALIBRATED FROM 0 TO 100% OF THE STROKE
TO ADJUST OUTPUT TURN KNOB 'D' AND SET REQUIRED CAPACITY
IN % INDICATED ON SCALE 'B' AGAINST POINTER 'A' (STROKE LOCKING KNOB 'C')
(EACH SMALL DIVISION ON SCALE B=5%)
FINAL ADJUSTMENT SHOULD BE MADE CLOCKWISE WHEN VIEWED IN DIRECTION OF ARROW 'E'

INSTRUCTIONS FOR DISMANTLING MAIN HEAD (LIQUID END)

LOOSEN PINCH BOLT, UNSCREW, GLAND NUT TAP OUT THE HEAD. THE GLAND SHOULD ALWAYS BE KEPT RESONABLY TIGHT OTHERWISE THE CROSS HEAD MAY STRIKE THE GLAND NUT CAUSING DAMAGE.
THE DISCHARGE AND THE SUCTION NIPPLES MUST BE OVERTIGHTENED OTHERWISE THE TEFLON VALVE SEALING RINGS WITHIN THE NIPPLE GET DESTROYED.

DIRECTION OF ROTATION

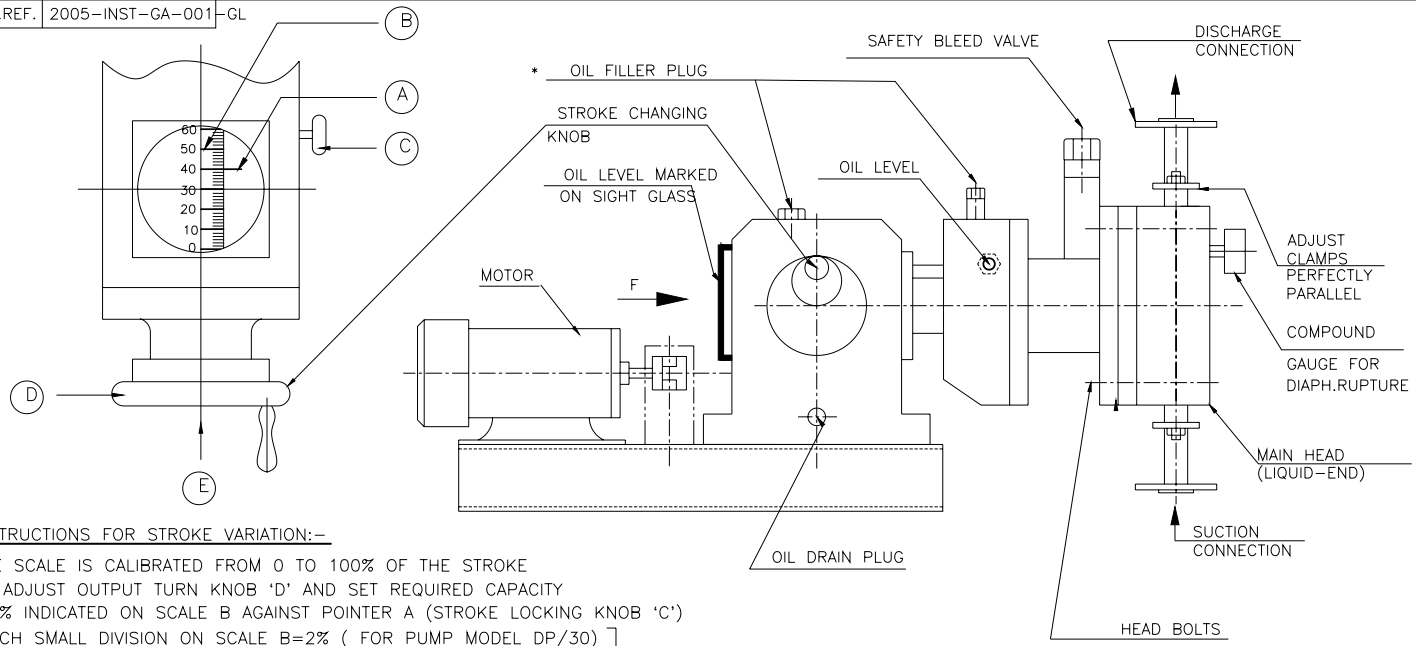
CLOCK-WISE LOOKING ON PUMP SHAFT.

IN CASE IF THE VALVES ARE CLAMPED AS SHOWN IN DRAWING 'F' THEN CLAMPS MUST BE ADJUSTED PERFECTLY PARALLEL.

SHAPOTOOLS
BAJASONS INDUSTRIAL ESTATE
CHAKALA ROAD, ANDHERI (EAST) MUMBAI-400 099

DRN. nk.	DATE 27.01.05	CHD. SMB	TOL. ± 5 mm.	SCALE- NTS.
SUB:- GA.SHOWING SALIENT FEATURES OF DP/20 MODEL				
DRG.NO.- DP/20/INST/GA/101			SHT. 1 OF 1	REV. 0

CAD.REF. | 2005-INST-GA-001-GL



INSTRUCTIONS FOR STROKE VARIATION:-

THE SCALE IS CALIBRATED FROM 0 TO 100% OF THE STROKE
TO ADJUST OUTPUT TURN KNOB 'D' AND SET REQUIRED CAPACITY
IN % INDICATED ON SCALE B AGAINST POINTER A (STROKE LOCKING KNOB 'C')

[(EACH SMALL DIVISION ON SCALE B=2% (FOR PUMP MODEL DP/30)
(EACH SMALL DIVISION ON SCALE B=1% (FOR PUMP MODEL DP/60)]

FINAL ADJUSTMENT SHOULD BE MADE CLOCKWISE WHEN VIEWED IN
DIRECTION OF ARROW 'E'

CAUTION DO NOT ADJUST STROKE BELOW 0% OR OVER 100%

INSTRUCTIONS FOR DISMANTLING MAIN HEAD (LIQUID END)

REMOVE HEAD BOLTS AND LOOSEN THE COLLET NUT. GENTLY TAP AND PULL OUT THE HEAD AND PLUNGER WHEN REPLACING MAKE SURE THAT THE PLUNGER HAS BOTTOMED FULLY IN ITS SEAT. IN CASE OF SPLIT TYPE COLLET THE PLUNGER SHOULD BE ASSEMBLED IN THE HEAD BEFORE FITTING THE HEAD ON THE PUMP, THE COLLET NUT SHOULD BE KEPT LOOSE INITIALLY AND THE PUMP COUPLING ROTATED BY HAND FOR 2 OR 3 STROKES, FINALLY BRING THE PLUNGER ON DISCHARGE STROKE (T.D.C.) AND TIGHTEN THE COLLET NUT.

DIRECTION OF ROTATION

LOOKING AT PUMP SHAFT IN DIRECTION OF ARROW 'F', DIRECTION OF ROTATION SHOULD BE CLOCKWISE.

GLAND NUT:-

SHOULD BE TIGHTENED JUST SUFFICIENTLY TO ALLOW SOME GLAND LEAKAGE.

* FILL OIL BEFORE COMMISSIONING PUMP.

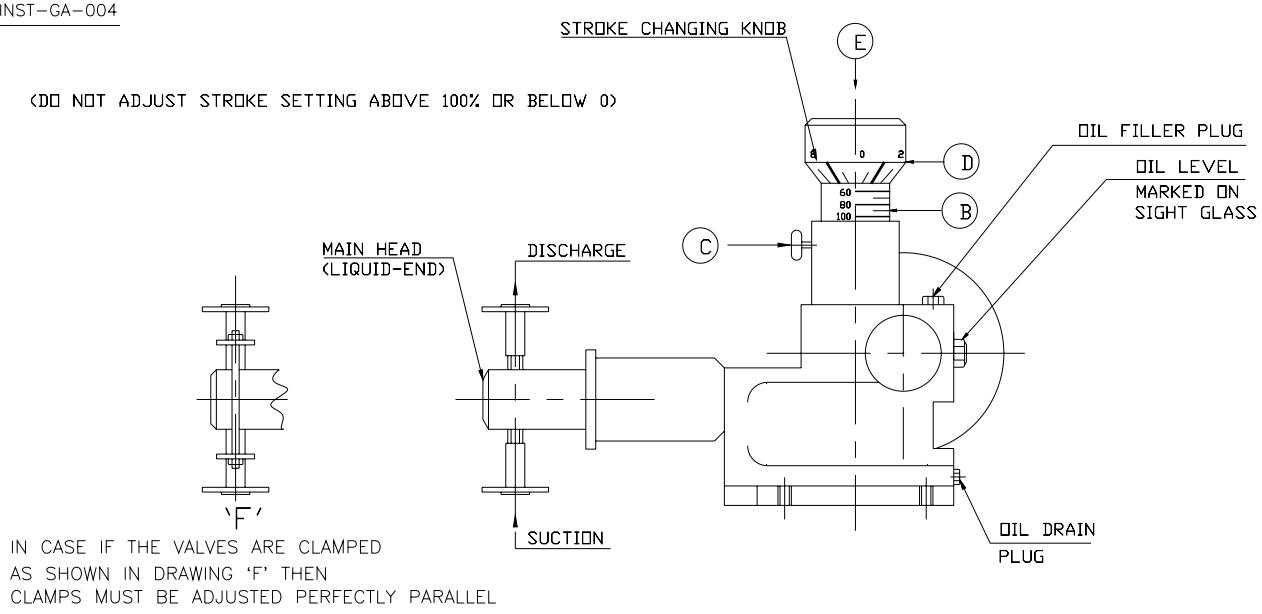
SHAPOTOOLS
BAJASONS INDUSTRIAL ESTATE
CHAKALA ROAD, ANDHERI (EAST) BOMBAY-400099

DRN. nk.	DATE 27.01.05	CHD. SMB	TOL. ± 5 mm. SCALE- NTS.

SUB:- GA.SHOWING SALIENT FEATURES OF DP MODEL

DRG.NO.- 2005-INST-GA-001-GL	SHT. 1 OF 1	REV. 0

CAD.REF. | 2005-INST-GA-004



IN CASE IF THE VALVES ARE CLAMPED
AS SHOWN IN DRAWING 'F' THEN
CLAMPS MUST BE ADJUSTED PERFECTLY PARALLEL

INSTRUCTIONS FOR STROKE VARIATION:-

THE SCALE IS CALIBRATED FROM 0 TO 100% OF THE STROKE
TO ADJUST OUTPUT TURN THIMBLE 'D' AND SET REQUIRED CAPACITY
IN % INDICATED ON LINEAR MAIN SCALE 'B' ALONG WITH THIMBLE 'D'
EACH SMALL DIVISION ON THIMBLE 'D' = 0.5%
EACH SMALL DIVISION ON LINEAR MAIN SCALE = 10%

FINAL ADJUSTMENT SHOULD BE MADE CLOCKWISE WHEN VIEWED IN
DIRECTION OF ARROW 'E'

INSTRUCTIONS FOR DISMANTLING MAIN HEAD (LIQUID END)

LOOSEEN PINCH BOLT, UNSCREW, GLAND NUT TAP OUT THE HEAD. THE GLAND SHOULD ALWAYS BE KEPT RESONABLY TIGHT OTHERWISE THE CROSS HEAD MAY STRIKE THE GLAND NUT CAUSING DAMAGE.

THE DISCHARGE AND THE SUCTION NIPPLES MUST NOT BE OVERTIGHTENED OTHERWISE THE TEFLON VALVE SEALING RINGS WITHIN THE NIPPLE GET DESTROYED.

DIRECTION OF ROTATION
CLOCK-WISE LOOKING ON PUMP SHAFT.

OIL CAPACITY = 280 cc.
STROKE LOCKING SCR. 'C'

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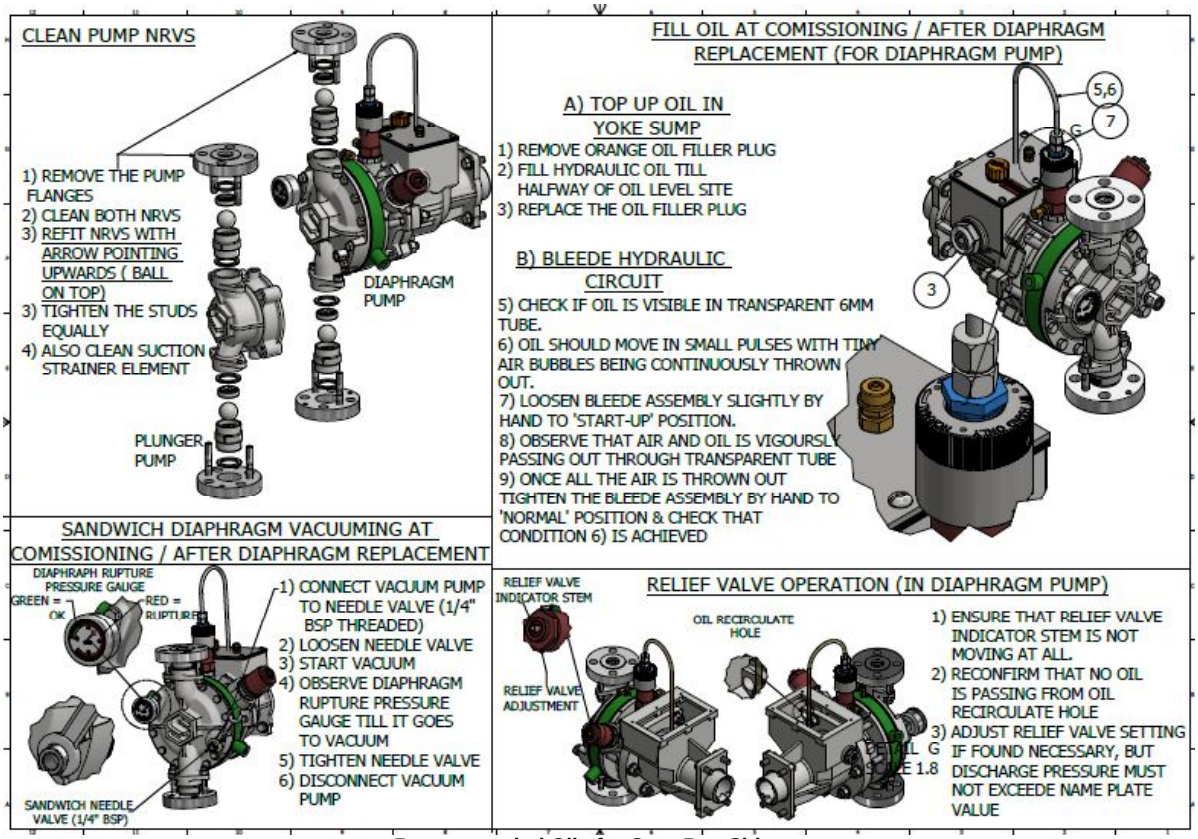
BAJASONS INDUSTRIAL ESTATE
CHAKALA ROAD, ANDHERI (EAST) BOMBAY-400099

DRN. nk.	DATE 27.01.88	CHD. SMB	TOL. ± 5 mm. SCALE- NTS.
SUB:- GA.SHOWING SALIENT FEATURES OF DP/12 MODEL			
DRG.NO.- DP/12/INST		SHT. 1 OF 1	REV. 0



Recommended Oils for Gear Box Side

(Specifications of oil : Flash P COC, °C: 240, Pour Point °C: -6, K.V. cSt: 152.2 @ 40 °C and 14.8 @ 100 °C, VI: 96)

M/s. Hindustan Petroleum	ENKLO - 85
M/s. Caltex	REGAL OIL 'G'
M/s. I.O.C.	SERVO SYSTEM 533 / 68 SERVOSYSTEM HLP 68
M/S. Bharat Petroleum	CABOL 150
Castrol	HYSPIN EP 150
Shell	TELLUS 150 / 320

RECOMMENDED OILS FOR HYDRAULIC SYSTEM OF DIAPHRAGM PUMPS:

(Specifications of oil : Flash P COC, °C: 196, Pour Point °C: -9, K.V. cSt: 36.1 @ 40 °C and 5.9@ 100 °C, VI: 196)

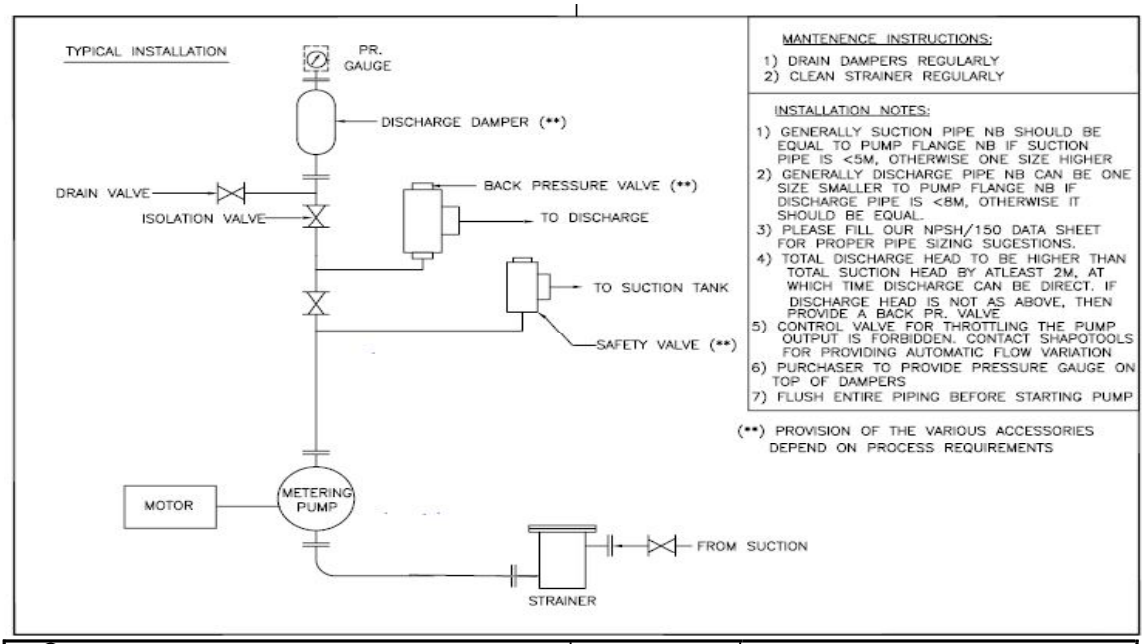
M/s. Hindustan Petroleum	Enklo - 44
M/s. Caltex	Regal Oil 'AA'
M/s. I.O.C.	Servo System 311 / 32 Servosystem HLP 32
M/S. Bharat Petroleum	Hydrol - 37
Castrol	Hyspin EP 32
Shell	Tellus 37 / 22

Note : for Molten Phosphorus use Liquid paraffin/silicon oil for Hyd. Side.

APPROXIMATE QUANTITY OF LUBRICANTS REQUIRED FOR GEAR BOX:

Model DP/12	0.25 Litres	Model DP/60	3.0 Litres
Model DP/20	0.6 Litres	Model DP/90	9.0 Litres
Model DP/30	1.2 Litres	Model DP/70/II	9.0 Litres
Model DP/45	2.5 Litres	Model DP/1.8 & DP/3	0.29 Litres

FREQUENCY : REPLACE / REPLENISH EVERY 6 MONTHS.



SHAPOTOOLS BAJSONS INDUSTRIAL ESTATE, CHAKALA ROAD, ANDHERI (E), MUMBAI -99	DATA SHEET DATA/NPSH/150 SHEET 1 OF 1	MADE BY : Lavina CHK. BY : SMB	DATE : DATE :

PURCHASER M/S.

1.	PO NO.	2.	ITEM NO.	DATE:		
2.	CAPACITY (LPH)	4.	PRESSURE (KG/CM^2)	AUTH.BY	CHK. BY	MADE BY
5.	OFFER NO.—	6.	MODEL			
7.	SPM:	8.	M.O.C. (WET)			

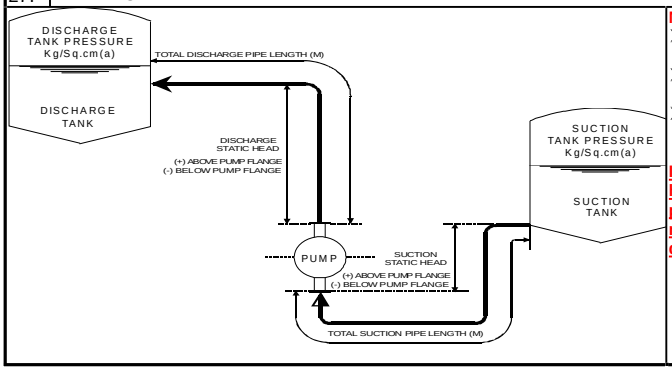
THE FOLLOWING INFORMATION IS TO BE PROVIDED BY THE PURCHASER

LIQUID SPECIFICATIONS (Purchaser to specify)

9.	LIQUID PUMPED :	10.	VISCOSITY AT P.T. (CP/SSU.)
11.	P.T. (^{O}C) 30	12.	BOILING POINT (^{O}C)
13.	VAPOR PR. AT PT. (m.m. of Hg.)	14.	SP.GR. AT P.T.
15.	CORROSION CAUSED BY	16a	SOLIDS PRESENT (YES / NO)
16b	PARTICLE SIZE / CONCENTRATION	16c	ABRASIVE NATURE OF PARTICLE (YES/ NO)

SUCTION & DISCHARGE CONDITIONS (Purchaser to specify)

CONDITIONS						**SUCTION**		**DISCHARGE**
17.	PRESSURE IN TANK (KG/Cm^{2}a)							
18	STATIC HEAD ABOVE PUMP FLANGE (MLC)					(+/-)		(+/-)
19.	TOTAL LENGTH OF PIPE (M)							
20.	PIPE NOMINAL BORE							
21.	STRAINER PROVIDED (YES / NO)							
22	BACK PRESSURE VALVE PROVIDED (YES/NO					N.A.		
23.	RELIEF VALVE SET PRESSURE (KG/Cm^{2}g)					N.A.		
24.	PULSATION DAMPER PROVIDED (YES / NO) / VOLUME (LIT)					/		/
25.	SUCT. FITTING	SIZE	QTY	EQUIV. LG. (M)	DISCH. FITTING	SIZE	QTY	EQUIVE. LG (M)
	ELBOW							
	TEE							
26.	NPSHA (MLC)							
27.	REMARKS							



NOTES:

- Discharge head to be higher than suction head by atleast 2 mt.
- Control valve on disch. side for throttling the pump output is forbidden.
- Purchaser to provide Pressure Gauge on discharge side of pump immediately after pump discharge flange before any other valve.

It is imperative that suction line should be atleast one size higher than pump suction flange NB (assuming suction pipe length is nominal). If this not implement pump will not perform correctly and can even result in serious damage because of cavitation.