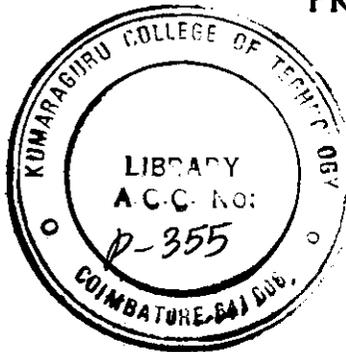


# DESIGN AND FABRICATION OF HYDRAULIC PRESS FOR COIR DUST COMPACTION

*Sponsored by " FLUIDICS PVT. LTD., CBE - 6 "*

PROJECT WORK 1998 - 99



Submitted by

*K. Arvind*

*S Arun shankar*

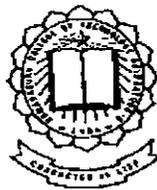
*S. Boopathi*

*P. 355*

Guided by

**Prof. T. L. SITHARAMA RAO M.E., Ph.D.,**

In partial fulfillment of the requirements for the award of the degree of bachelor of engineering in  
Mechanical Engineering of the Bharathiar University, Coimbatore - 641 046.



1998 - 99

Department of Mechanical Engineering

**Kumaraguru College of Technology**

Coimbatore 641 006.

# Kumaraguru College of Technology

Coimbatore - 641 006

Department of Mechanical Engineering

## CERTIFICATE

This is to certify that the Report entitled

*DESIGN AND FABRICATION OF HYDRAULIC PRESS  
FOR COIR DUST COMPACTION*

has been submitted by

Mr. ....

In partial fulfillment of the requirements for the Award of Degree of Bachelor of Engineering in the Mechanical Engineering branch of the Bharathiar University, Coimbatore - 641 046 during the academic year 1998 - 99.



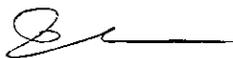
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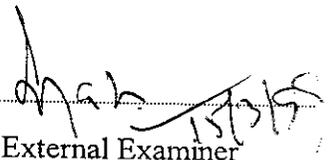
.....  
Head of the department

Certified that the candidate was examined by us in the Project Work Viva-Voce examination held on .....<sup>15-3-99</sup>.....and

the University Register Number is .....



.....  
Internal Examiner

  
15/3/99

.....  
External Examiner

# FLUIDICS

C-6, KLR BUILDINGS • 207, SASTRY ROAD • RAM NAGAR • COIMBATORE 641 009  
PHONE : (0422) 236914 • TEL / FAX : (0422) 532081

99 - March - 12

## CERTIFICATE

This is to certify that the following students of final year mechanical engineering branch of **KUMARAGURU COLLEGE OF TECHNOLOGY ,COIMBATORE** have participated in design and fabrication of hydraulic press for coir dust compaction and they have successfully completed the project in all aspects.

- 1) Arvind . k
- 2) Arun shankar .s
- 3) Boopathy . s

They have shown keen interest and involved with total dedication at various stages of the project. In the process, they have acquired a good working knowledge of standards and norms in the field of Hydraulics.

I am sure that they would come out successful in flying colours in all their future endeavours.

I wish them all success in their future career.

For: *[Handwritten Signature]*  
Signature

## ACKNOWLEDGEMENT

Working in this project was a privilege to us for we had an informative, enjoyable and knowledge gaining experience. During the course of this project we were exposed to the actual industrial work and its limitations. Only a whole hearted and able guidance made this project a successful one for us.

At the outset we acknowledge the kindness and generosity of our beloved principal Dr. **K.K. PADMANABHAN** B.Sc.,(Engg), M. Tech., Ph.D., for giving us an opportunity to submit this project.

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Our sincere thanks are also due to Mr. **M. BALAGURU**, AMIE., PGDMIT., of M/s. ACME Engg. who has helped us in the design of the project.

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# SYNOPSIS

Oil hydraulics is a versatile source of power. The rapidly emerging trend for using hydraulics has given a new dimension for the word 'AUTOMATION' in industry. It is the intricate process in which many of the engineering, scientific, social, economic and other aspects are closely inter-related making them a sort of union where the opposites combine with expediency called for the development of the process.

Coconut is an important oil seed and cash crop grown in Asian, South Pacific and South American countries. The husk, the shell and the copra are useful products besides the leaves and stem. It has both industrial and agricultural uses. Due to this it is preferred by foreign buyers. Since the coir pith is voluminous it is required to compact it for economic containerisation and profitable export.

This project is to design and fabricate hydraulic press for "COIR DUST COMPACTION" process of 150 Ton capacity. This press compacts coir dust in the form of briquettes of required size. The press uses hydraulic cylinders and power packs for compaction.

This project is designed for better utilization of power pack to maximum extent that would result in minimum power usage, better handling, improved production, less idle-time and reduced production cost, these factors make this power press as a versatile unit for export of coir dust.

# CONTENTS

Title	Page No.
1.0 INTRODUCTION	
1.1 COMPONENTS OF A FLUID POWER SYSTEM	1
1.2 ADVANTAGES	3
1.3 APPLICATIONS	4
1.4 PROBLEM DEFINITION	5
1.5 CONCEPTUAL DESIGN	5
2.0 POTENTIALS OF COIR PITH	
2.1 PHYSICAL PROPERTIES	8
2.2 CHEMICAL PROPERTIES	8
2.3 ENRICHMENT OF COIR PITH	9
2.4.1. AGRICULTURAL USES	9
2.4.2. INDUSTRIAL USES	10
2.5 BRIQUETTING OF COIR PITH	11
3.0 HYDRAULIC ELEMENTS	
3.1 PUMPS	12
3.2 PRESSURE CONTROL RELIEF VALVE	18
3.3 DIRECTION CONTROL SYSTEMS	21
3.4 ACTUATORS	27
3.5 ACCESSORIES	29
4.0 HYDRAULIC ELEMENTS	
NOMENCLATURE	
POWER PACK DESIGN	
4.1 CYLINDER DESIGN	39
4.2 PUMP DESIGN FOR HIGH VOLUME FLOW	41
4.3 EJECTION CYLINDER	42
4.4 PUMP DESIGN OF LOW VOLUME FLOW	43
4.5 SELECTION OF MOTOR	44
4.6 DETERMINING PIPE LINE DIMENSIONS	45
4.7 DETERMINATION OF RESERVOIR CAPACITY	48
4.8 DESIGN OF HEAT EXCHANGERS	50
4.9 SELECTION OF ELEMENTS	53

5.0	STRUCTURAL DESIGN	
5.0	DESIGN OF TOP FRAME	59
5.1	DESIGN OF BOTTOM FRAME	62
5.2	DESIGN OF PUNCH HOLDER	65
5.3	DESIGN OF SUPPORTING COLUMNS	67
5.4	DESIGN OF EJECTION CYLINDER DIE CONNECTOR	68
5.5	DESIGN OF HEXAGONAL NUTS	70
6.0	FRAME CONSTRUCTIONS	
6.1	BOTTOM SUPPORT FRAME	72
6.2	TOP SUPPORT FRAME	72
6.3	MOULD ASSEMBLY	73
6.4	PUNCH HOLDER	73
6.5	SUPPORTING COLUMNS	73
6.6	HEXAGONAL NUTS	74
6.7	EJECTION CYLINDER HOLDER	74
6.8	PUNCH SUPPORT FRAME	74
6.9	GUIDES	75
7.0	INSTRUCTIONS FOR CHANGING SIZE OF THE MOULD ASSY.	76
8.0	PROJECT ESTIMATION	82
9.0	TECHNICAL SPECIFICATION	88
10.0	DRAWINGS	88
11.0	MAINTENANCE INSTRUCTIONS	90
12.0	PRE OPERATION INSPECTION ITEMS	96
13.0	TROUBLE SHOOTING FOR HYDRAULIC SYSTEM	98
14.0	CONCLUSION	100
15.0	APPENDIX A	
16.0	APPENDIX B	
17.0	BIBLIOGRAPHY	

# INTRODUCTION

## 1.0 HYDRAULICS AND FLUID POWER

Fluid power is the muscle that moves industry. This is because fluid power is used to push, pull regulate or drive virtually all the machines of modern industry.

Fluid power has the advantages in the following four major categories :

- Ease and accuracy of control
- Multiplication of force
- Constant force or torque
- Simplicity, safety and economy

## 1.1 COMPONENTS OF A FLUID POWER SYSTEM :

There are 6 basic components required in a hydraulic circuit.

1. A tank to hold the liquid.
2. A pump to force the liquid through the system.
3. An elastic motor to drive pump.
4. Valves to control liquid direction, pressure and flow rate.
5. An actuator to convert the energy of the liquid into mechanical force or torque to do useful work.

6. Piping, which carries the liquid from one location to another.

Oil hydraulics is a branch of science for transmitting and controlling energy through the medium of pressurised oil. It is postulated on Pascal's law named after Blaise Pascal who enunciated the law.

The law states that " Pressure applied anywhere to a body of confined fluid is transmitted and diminished to every portion of surface of containing vessel". The mathematical expression to above statement is given by

$$P = \frac{F}{A}$$

Where,

P = Pressure

F = Force

A = Area

In hydraulic system, the pump pumps the fluid from reservoir to the discharge pipe which are controlled by valves. The three control system which are widely used in hydraulic systems are

- (a) Control of liquid pressure
- (b) Control of liquid flow rate
- (c) Control of direction of flow of fluid

Hydraulic motor and cylinders are used for developing rotary and linear motion respectively. The pressurised fluid is directed by valves to the actuator and the speed of actuator depends upon flow rate. The seals are provided to arrest the leakage of fluid. The relief valves are provided to arrest the flow to the reservoir if the setting pressure is reached.

## **1.2 ADVANTAGES :-**

It's advantages over conventional systems are listed below.

1. Variable speed :
  - Possible by controlling the flow of fluid using flow control valve
2. Reversible :
  - This is done by use of direction control valves.
3. Over load protection :
  - A pressure relief valve / unloading valve / reducing valve protects whole system components from over loading

4. Compact :

- Because of high speed and pressure capabilities they have a very small weight to power output ratio.

5. Predictable performance :

- Losses are minimum due to less number of moving parts and so gives expected performance.

6. Self automated lubrication :

- The oil which is used in the system also acts as a lubricator.

7. Noise vibration control :

- Due to elegant and simple control systems, it does silent operation and no vibration is produced.

8. Longer life .

9. Flexibility .

10. Efficient and dependable .

11. Simple installation .

12. Easy maintenance .

### 1.3 APPLICATIONS :

The merits of hydraulic system are

1. In machine tools like planners etc.

2. Earth moving equipment (Paving M/c.)
3. Hydraulic transmission (presses)
4. Material handling equipment
5. Hydraulic pumps for power transmission in injection moulding M/c.

#### **1.4 PROBLEM DEFINITION :**

Coir pith is a bye product in the process of defibring coconut husk. Coir pith is fluffy and occupies more volume. But, it finds an extensive use as a manure for germination of seeds and for industrial applications.

Processed coir pith is preferred by foreign buyers and so it has a high export value but since it occupies more volume, it needs to be compacted for economic containerization and profitable exports by saving freight charges. So, the idea is to compact the coir pith in the form of briquettes.

#### **1.5 CONCEPTUAL DESIGN :**

This project aims at compacting the coir dust by the use of hydraulic press. The coir dust is compacted in the form of rectangular slabs of different sizes as required by the customer.

The slab sizes is required by the customer are :

Size no.	Breadth mm	Length mm	Height mm
1	390	1170	30
2	390	970	30
3	390	770	30

The hydraulic press is designed and fabricated along with the power pack and its accessories. The punch and die are also designed and fabricated as per the size requirement. Vane pumps are used to pump the flow from reservoir to main cylinder and ejection cylinders. The punch is attached to the main cylinder and process of compaction is effected by use of DC valves.

The finished products after compaction process are removed from the press by lifting the die assembly with help of ejection cylinders which lifts the die. The ejection cylinders are controlled for their flow rate with use of DC valves.

The ejection cylinders are very small in size when compared to main cylinders and so their volume flow rate differs from that of the main cylinders. The reservoir has a capacity of 1100 lts and is completely sealed to ensure dust free environment. The oil in reservoir is also cooled by a shell and tube type heat exchanger. The oil is also filtered by separate off-line filtration.

## 2.0 POTENTIALS OF COIR PITH.

The elastic cellular cork like material forming the non-fibrous tissue of the husk is referred as coir pith. Nearly 10,000 nuts yield one tone of fibre and an equal amount of pith. The coir pith is also called as " coco peat" After composing with pluerotus fungus , it is called composed coir pith.

### 2.1 PHYSICAL PROPERTIES :

Bulk density (g/cc)	0.1525
Particle density (g/cc)	0.4916
Porosity (%)	76.77
Volume expansion of 100 ml (%)	22.92
Moisture on dry sample (dried at 105 <sup>0</sup> C)	11.90% by weight

### 2.2 CHEMICAL PROPERTIES :

PH	5.89
Nitrogen (%)	0.68
Phosphorous (%)	0.09
Potassium (%)	0.78

Calcium (%)	0.84
Magnesium (%)	0.36
Pentosan (%)	9.48
Iron (%)	0.07
Manganese (PPM)	64.50
Zinc PPM	80.00
Copper (PPM)	3.10
Lignin (%)	30.00
Total phenols (mg/g)	50.00
C : N ratio	60.10

## **2.3 ENRICHMENT OF COIR PITH**

The efficiency of coir pith could be improved by enriching it with other organic manures as well as inorganic nutrients. This is achieved by using coir pith as a bedding material or by the addition of required nutrient Element during composing.

### **2.4.1. AGRICULTURAL USES OF COIR PITH**

Coir pith is used as a source of organic manure and also as soil amendment.

## **WHY BRIQUETTING ?**

The coir pith is preferred by foreign buyers as it is bio-degradable, has high moisture retentivity and soft texture for easy penetration of roots and better permeation of nutrients. Coir pith is exported through closed containers. As such a container of 20 ft. will hold only about 1000 kg of coir pith, if it is converted to briquettes it will hold 12000kgs. This briquetting is very essential for profitable export as it saves ocean freight. The fibrous nature and spongy structure of coir pith provides opportunity for using it as a soil conditioner. With water, these briquettes will attain original structure.

Since, huge quantities of coir pith is available in south India, Profitable use of this pith will go a long way in improving the economic condition of the farmers, besides providing oppportunity for employment through cottage industries in rural sectors.

### **3.0 HYDRAULIC ELEMENTS**

#### **3.1 PUMPS:**

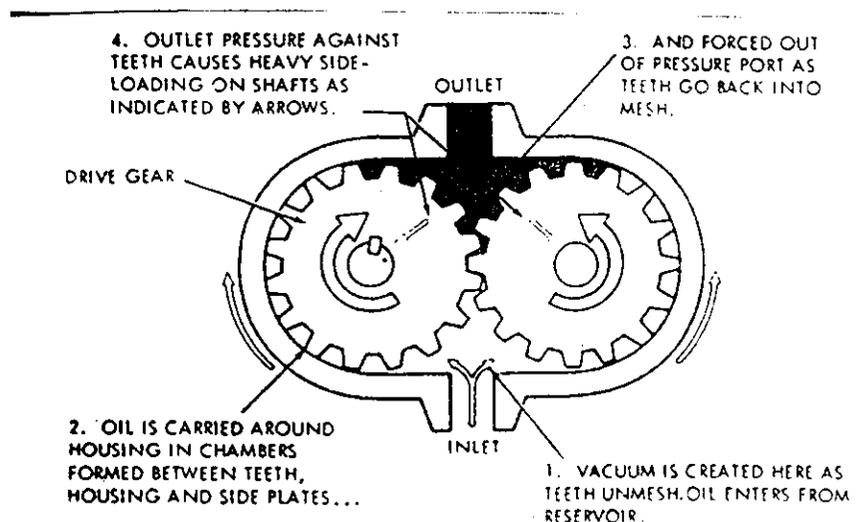
Pumps convert mechanical energy in to hydraulic energy. Hydraulic energy is a combination of potential (pressure) and kinetic (flow) energy. Pump creates the flow and the pressure is due to external resistance. Pumps used in hydraulic systems are positive displacement types. These pumps trap fluid in discrete segments and force it out at the delivery, thus displacing a fixed volume of fluid per revolution. Pumps that are considered for the press circuit are discussed below.

#### **GEAR PUMP :**

The external gear pump is the simplest and the most commonly used variety of pump. It consists of two spur of equal diameter meshing with each other and enclosed in a body with two intersecting bores, with suitable bearings in the end covers. One of the gears is driven by the external source such as electric motor. The rotation of gears creates a partial vacuum in

the chamber formed by the gear teeth coming gradually out of the mesh. Oil from the pump is sucked in to the chambered carried around between the teeth to be forced out of the delivery port by the pair of teeth coming into the engagement.

The performance of the pump depends upon both the volumetric and mechanical efficiencies. Volumetric efficiency reduces with wear of rubbing surfaces. Present day pumps are therefore provided with built in features to compensate clearances. Gear pumps are fixed in common application for constant volume hydraulic system and lubrication in gearboxes.



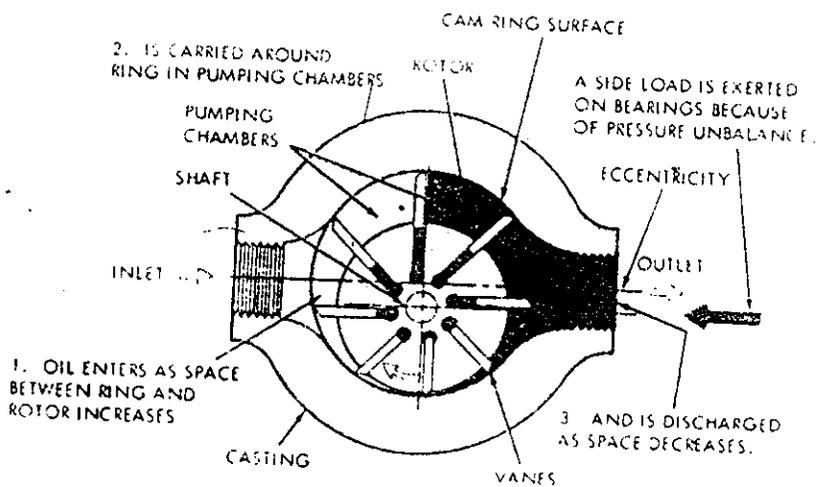
***Advantages: -***

1. simplicity and compactness
2. low cost
3. less sensitive to contamination
4. High operating speed.

**VANE PUMP :**

Sliding vane tube pump is the most commonly used type in machine tool hydraulic systole. The pump consists of circular rotor mounted eccentrically inside a circular stator ring. The rotor has suitable slots to accommodating radially moving vanes. The vanes of similar width as the rotor, press against the stator ring to provide the radial sealing between the adjacent chambers and hence between the inlet and outlet ports. The pump construction lends the flexibility providing variable delivery feature built in to these pumps. Vane pumps are basically of two

types. Unbalanced type is having the suction and the delivery ports diagonally opposite and hence the rotor will be subjected to an unbalanced load, thus limiting the working pressure to about 70 kgf/cm<sup>2</sup>. In the unbalanced vane pump design, the load on the rotor is balanced by providing a pair of diametrically opposite suction & delivery ports. A disadvantage of this construction is that it cannot be built with a variable delivery feature. Balanced type of pumps are generally used for pressure up to 170 kgf/cm<sup>2</sup>.



In a single vane pump the centrifugal forces of the vane provide contact between the vane tips and the cam track.

This being dependent on the speed does not provide for uniform sealing conditions. This drawbacks overcome by pressurizing the underside of vane taking sufficient care to balance the forces on the vane to avoid the excessive wear of the cam track.

***Advantages : -***

- 1) low cost with respect to power output
- 2) less noisy
- 3) long service life
- 4) Variable delivery and pressure compensation features are possible.

**PISTON PUMP:**

The reciprocating pump is the simplest type of piston pump. These pumps are generally restricted to lubrication systems because of the fluctuation of flow. The swash plate design of axial piston with port plate valuing is commonly used design, because of simplicity valuing and compactness. It consists of cylinder block with several piston placed in the bores parallel

to the axis of rotation. As the cylinder block rotates the piston held pressed against the inclined plate (swash plate) reciprocate in their respective bores thereby drawing in oil from the inlet port and forcing it out through outlet port. The width of the bands in between the two ports are as to avoid any inter port leakage during crossover of the flow passage on the cylinder block from low to high pressure side and vice versa.

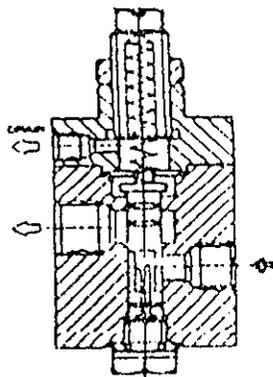
These pumps are compact and can work with maximum operating efficiencies (volumetric efficiency 90-95%, overall efficiency 80-85%) at operating pressure ranging up to  $400 \text{ kg/cm}^2$ . they are therefore commonly used as in high-pressure applications such as presses. The variable delivery feature of the pumps renders their use as a pressure compensated pumps for economical power utilization in different types of systems.

### 3.2 PRESSURE CONTROL RELIEF VALVE

#### RELIEF VALVE:

Relief valve protects the other elements in the system from excessive pressure by delivering the excess fluid to the tank when the system pressure tends to exceed the set valve. The pre load on the spring determines the system pressure and can be adjusted.

The pressure at which a relief valve cracks open is termed as the cracking pressure. The pressure when the valve is fully open to bypass the full rated flow is full flow pressure. The difference between the two is due to extra compression of the spring at higher valve opening.



RELIEF VALVE

Ball and poppet valves suffer from high-pressure overrides and chatter spool type compound relief valves (of direct acting type) provides stable and smooth operation with superior pressure-flow characteristics.

### **UNLOADING VALVE:**

These valves are used to off load the pump flow back to tank at a low pressure when not required by the system. unloading helps in reducing considerably the generation heat due to unused energy in the system. The primary port pressure is independent of spring setting in the valve. On receiving in the remote pilot signal, the spool lifts against the spring to unload the pump flow in the reservoir.

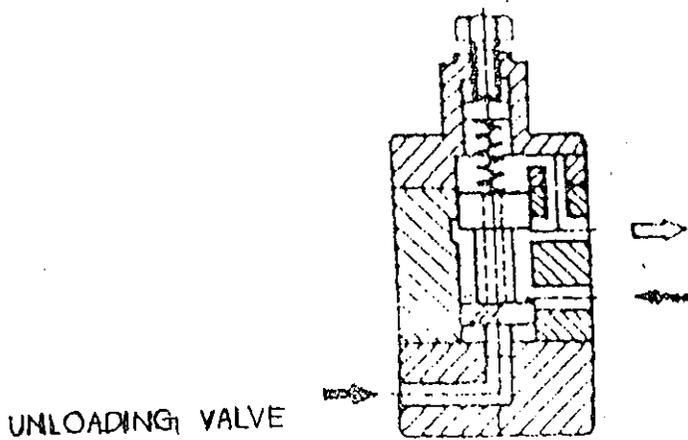
### **COUNTER BALANCE VALVE :**

These valves provide sufficient backpressure in all hydraulic systems to balance a weight or load to prevent its descent due to gravity. It consists of a relief valve and a pressure free flow check valve.

## **PRESSURE REDUCING VALVES:**

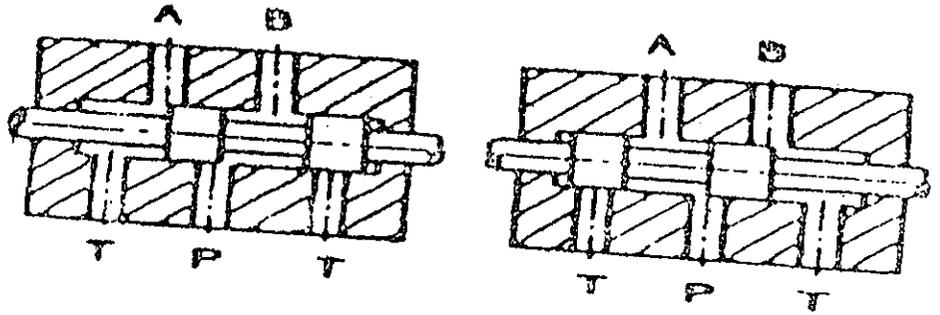
These valves are used to maintain in a secondary branch reduced pressure, which is lower than the relief valve setting. Unlike relief and unloading valves, these are normally open two-way valves, which receives the actuating signal from the downstream side.

For a given pressure differential across the orifice, the flow rate can be varied by changing the flow across section  $A_0$ . A major disadvantage of these simple devices is that any variation in load pressure affects the flow through the valve because of the change of pressure across the orifices. Pressure compensated flow control valves provide constant flow for any particular valve setting by maintaining a constant pressure drop across the orifice. Change in temperature and the corresponding change in the viscosity of the oil do affect the flow rates from the offices type valves. To overcome this problem, temperature compensated valves are used.



### 3.3 DIRECTION CONTROL SYSTEMS:

These valves are deployed to steer the flow to selected slow paths in any part of the circuit. The spool type valves both of the linear as well as the rotary movement is devised for the purpose. Owing to the feasibility of application on different modes of control for their operation the linear spool valves are the most commonly used types. Many different mode of actuation are possible in direction control valves. Manual control is the simplest where the spool movement is achieved by movement of a lever.



DIRECTION CONTROL VALVES

### SOLENOID VALVE:

These valves are actuated either by A.C or D.C. the A.C operated valves have a drawback in that they tend to burn due to heavy current drawn in event of the improper closure of the plunger. They are however popular from the point of ease of deriving the control voltage. At high pressure and low flow rate, large operating forces are required making solenoid control untidy. Solenoid operated valves have very fast response.

## **PILOT OPERATED SOLENOID VALVES:**

Where high pressure the large flow rates are involved solenoid directly cannot operate the valves. Hence a two stage electro hydraulic valves are devised. In such valve a low pilot pressure supply from the first stage solenoid valve is used to shift the spool of the main valve by providing restriction in the pilot line regulated speed of spool shift is obtained.

## **CHECK VALVE:**

Check valve (non-return valve) is used to control the direction of a flow in a circuit to the extent that they permit flow in only one direction. Commonly used modification from the standard design is the pilot operated check valve. These valves are operated as a pilot pressure to permit flow in reverse direction but can control standard valve.

## **PILOT CHECK VALVES:**

Four types of check valves are used for pilot service. These are the normally open type, normally closed type, and barrier type and decompression type.

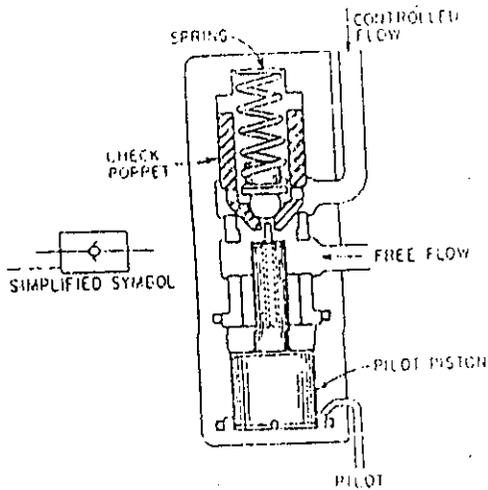
### ***NORMALLY OPEN TYPE:***

This type will permit flow in either direction until a pilot pressure of sufficient magnitude is placed on the pilot connection to force the poppet tightly against the seat. The poppet acts as ram and closes off the line the seat is smaller in diameter than the main bore. Pressure in one direction acts on the shoulder area of the poppet, consisting of the major bore diameter minus the seated area, and causes it to open if there is no pressure on the pilot line or if there is insufficient pressure to balance out the areas. Pressure in the opposite direction is effective against the face of the poppet.

### ***NORMALLY CLOSED TYPE:***

This shows a normally closed, pilot-operated check valve. This valve will permit free flow in one direction. In the other direction the flow is stopped until a sufficient pilot pressure is applied on the pilot-piston assembly to force the poppet off the seat. Note the relative area of the pilot-piston and the seated area of the check poppet. The ratio between the pilot-piston area and the seated area of the poppet will determine the pilot-line pressure necessary to upset the poppet and urge it against the spring. A flow through the valve from either direction will impinge in the face of the pilot piston adjacent to the poppet. If this flow meets the resistance, it can reflect pressure against the pilot piston face (and negative part or) all of the pilot pressure, so that the poppet will tend to close against the seat. If the valve is used to divert fluid to a low-pressure area, this may not be a problem. But if the valve is used to divert fluid in to another high-pressure area, performance may be very unsatisfactory.





Normally closed pilot operated check valve.

### **BARRIER TYPE :**

A barrier sleeve is provided to minimize the difference in areas. The actuating piston is of relatively small diameter just large pressured poppet towards the spring and open the passage between the ports. The poppet between the barrier sleeve and the piston face is drained to a low-pressure area. Valves of this type provide a control for the stored energy in an accumulator the high velocity flow from the accumulator is isolated from the actuating

piston so that the pilot pressures taken from the accumulator will not be nullified when the pilot valve opens the two main ports to each other.

### **3.4 ACTUATORS:**

It converts hydraulic energy into mechanical energy. They may be a motor or a cylinder.

#### **HYDRAULIC MOTOR:**

Most of the hydraulic pumps can principally function as motors. Hydraulic motors are in principal constant torque devices and have flat torque-speed characteristics, to a given specific output flow and a set system pressure.

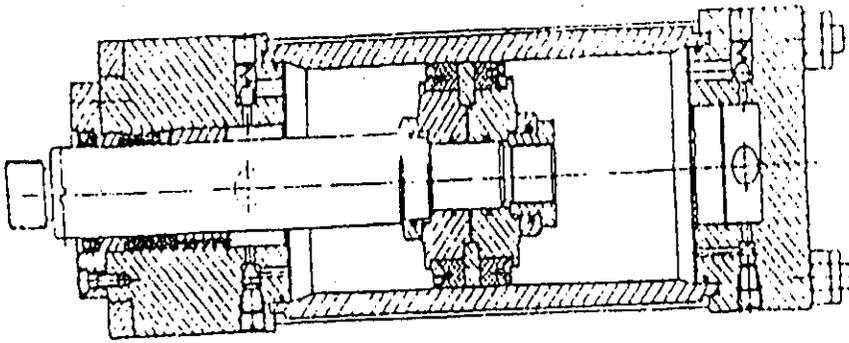
#### **HYDRAULIC CYLINDERS:**

Cylinders provide a linear drive and are the most commonly used hydraulic devices. A cylinder essentially consists of a piston located in a tubular housing and a piston rod passing

through one of the end covers. The ports provided in the end cover permits entry and return of the hydraulic oil.

Standard cylinders are generally made of cold drawn seamless steel tubes. The tubes are bored or ground and finish bored to the required size. A surface finish between 0.2 to 0.4 micrometer is generally desired, especially when using rubber seals for piston. The pistons are of high grade CI, mechanite or bronze. Sealing elements such as O-ring, piston rings, cup seals are used for the piston.

Piston rods are made of medium carbon steel or case hardened steel depending upon the application and service conditions. The rods should be strong enough to prevent buckling. The rod is supported and guided by a bearing in the end cover O-ring or multi lip seals are generally provided for rod sealing. The end cover is made of high-grade cast iron or steel. They are either screwed to the tube or held together by the rods. Supply ports are provided on the end covers. They are located at the topmost point with respect to the cylinder mounting to enable automatic scavenging of trapped air.



CONSTRUCTION OF HYDRAULIC CYLINDERS

### 3.5 ACCESSORIES:

#### **FILTER:**

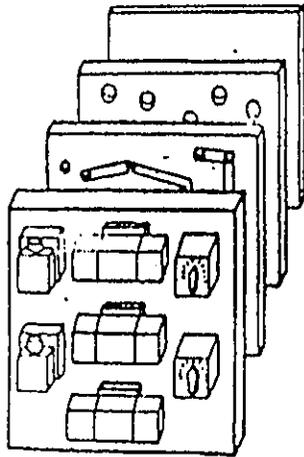
Contamination of oil in the hydraulic system is the single biggest source of failure of hydraulic components and system. Filtering media offers resistance to flow where by the contamination in the fluid is retained back from flowing through with the fluid because of fineness of the flow passage and tortuous flow path. Filters are integral units housing the filter elements in the intended direction. The filter cartridges are generally held in position by a spring. Often the filter housing

include a valve to bypass the unfiltered fluid to a down stream at pre determined pressure difference.

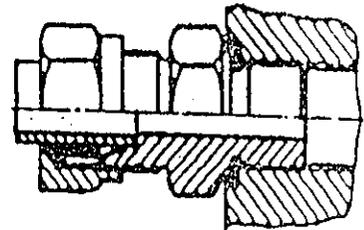
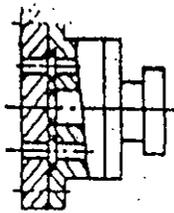
### **CONNECTING ELEMENT:**

Inter connection of various elements in a hydraulic system is obtained through several methods-tubing, hoses and panel mountings. The panel mounting of elements connecting each other by passages within a block it has the advantage of making the assembly neat and compact since it dispenses with elaborate pipes, hoses and fittings. The panel may be single block with drilled inter connecting passages or an assemblage of grooved plate held together by suitable bonding material.

Tube connection with end fittings is commonly employed for this purpose in fluid power applications. The body end of the coupling is screwed in to the body of the washer in between to provide a leak proof joint at body-coupling interface. Tubes for the above couplings are specified by their outer diameter. Cold drawn seamless steel tubes of adequate wall thickness to withstand the system pressure are chosen for the purpose.



PANEL MOUNTING



FURRELE FITTINGS

### **RESERVOIR:**

These are essentially storage tanks for the system fluid, although they may often facilitate to mounting of atleast a part of the hydraulic system. Reservoirs are to be generally kept separated from the machine for reasons of isolation of thermal condition and ease of servicing.

Points to be reckoned in designing a reservoir are: -

1. sealing of fluid chamber from external source of contamination
2. sizing of reservoir:-
  - a) To hold adequate volume of fluid reckoning the amount of oil that may drain back from the system either during a portion of cycle or at the time of servicing.
  - b) To have sufficient radiating area for dissipating the heat generated in the system so that fluid temperature in the tank does not exceed 60 C. a separate cooler may have to be included if the tank tends to be too large.
3. the bottom of the reservoir is kept above the ground level to facilitate draining, cleaning  
and improved heat dissipation.
4. Drain plug to drain the entire content of the oil.
5. The convenient access for cleaning the inside of the reservoirs-  
clean out openings is to be provided in case of reservoirs with permanently fitted top covers.
6. Provision for a breather hole with a filter.

7. Provision for filter cup with wire mesh screen.
8. Fluid level indicator showing the maximum and minimum level of fluid in the reservoir.
9. Inside of the reservoir is to be oil resistant painted.
10. Baffle plates to separate pump suction and return lines.

Reservoirs are generally sized 3 – 5 times the pump discharge per minute. Tanks are generally rectangle in shape. Too shallow a reservoir does not provide enough surface area for heat dissipation. Too deep and narrow tank does not provide enough surfaces for proper separation of entrained bubbles of foam.

Pressure gauge with snubbers and gauge shut off valves is to be provided at suitable locations with respect to the relief valve and operators position. The fluid in the reservoir is required to be cleaned prior to entry into the system to a level of contamination acceptable for satisfactory functioning of the circuit. Location of filters, filtration capacity, flow and pressure rating and dirt holding capacity of filter elements are to be reckoned while providing filtration however when critical components are servo

valves are used, a pressure line filter of suitable micron rating immediately behind the valve is essential.

### **SEALS AND PACKINGS:**

Seals are devices for closing gaps to prevent leakage or make pressure tight joints and also to prevent the entry of air and dirt from outside in to the system. A wide variety of seals of different shapes and materials are used. They are classified as static and dynamic seals.

### **STATIC SEALS:**

They are employed to provide a seal between two relatively static or nearly static components. Compression gaskets sandwiched between two surfaces provide sealing at the interface. Non-metallic gaskets of cork and paper can be used for pressures in the range of 1-2 kgf/cm<sup>2</sup>. Metallic gaskets in the form of flat sheets, corrugations, round cross section, etc are used for pressures as high as 1000 kgf/cm<sup>2</sup>. Gaskets and beadings are used for applications such as door flanges and covers of reservoirs. Elastomeric O-rings are commonly used for static

## **ROTARY SEALS:**

The seals for rotary applications may either be lip seals or mechanical seals. The rotary shaft seals of nitrile, rubber are commonly used. Mechanical seals are applied for applications where rotary seals are inadequate. These are applicable for pressure ranges upto  $200 \text{ kgf/cm}^2$  and peripheral speeds of  $250 \text{ cm/sec}$ . These seals can be either of face or brushing type for radial and axial leakages.

For high pressure applications the fluid pressure itself may be conveniently used to provide the sealing with judicious design to keep down the friction power loss and wear rate. Materials of construction for sealing faces can be carbon, plastic or ceramics against metal and metal oxides or carbides. These seals can withstand high pressures and speeds and can operate even under conditions of poor surface finish and lubrication.

ceiling applications such as flanges, flange fittings and in cylinders. O-rings are generally circular and mounted with a certain pre load. Static O-rings are known to have been used for ceiling pressure upto  $2000 \text{ kgf/cm}^2$ . The static pre load of about 10% to 15% more than the volume of O-ring so as to permit free flow of the material of O-ring at right angles to the squeeze.

### **DYNAMIC SEALS:**

Dynamic seals are required to seal the annular gap between two components with relative movement. The movement may be rotary or reciprocating.

### **RECIPROCATING SEALS:**

The dynamic seals for sealing between two relatively reciprocating parts can be O-rings, lipped seals and piston rings. Lipped seals and O-rings provide intimate contact of the seal with the surface it is rubbing against, filling even the undulations due to surface roughness and ovality of the bore to provide through sealing. Elastomeric O-rings are very popular for dynamic applications because of low cost and small size. These rings as in the case of static applications are mounted with a pre load to

provide initial sealing .The use of these rings for working pressures beyond 100 kgf/cm<sup>2</sup> is not recommended since they tend to get extruded through the clearance. Rings of other cross sections such as delta,square ,multi lobed and quad rings are used in place of O-rings for minimum twisting and squeezing through.

Lip types are by far the most commonly used seals for sealing two sliding parts. They are assembled with light preload and proper arrangements for pressurizing and lubricating the seals.

## 4. 0 HYDRAULIC CIRCUIT DESIGN :

### NOMENCLATURE

$D_p$  - Diameter of piston

$D_r$  - Diameter of the rod

$P$  - Pressure (Kg/cm)

$F$  - Force

$A$  - Area of C/S

$Q$  - Flow rate

H.P. - Horse power

$F_H$  - Hoop's stress

## POWER PACK DESIGN

### 4.1 MAIN CYLINDER DESIGN (2 NOS):

#### Design of piston and piston rod:

For the calculation of tonnage required let us consider the punch of max size. i.e. 1170 x 390 x 30

Therefore the area of contact of the punch with coir dust - 390 x 1170  
- 456300 mm<sup>2</sup>  
- 4463 cm<sup>2</sup>

As the compaction ratio required is 8:1 the coir dust has to be compressed with a pressure of 32 Kg/cm<sup>2</sup>

Therefore the tonnage required is calculated as

$$\begin{aligned} &= \text{Contact area} \times \text{pressure required} \\ &= 4563 \times 32 = 146.016 \text{ tonnes} \end{aligned}$$

Therefore approximating the tonnage required to 150 tonnes. The tonnage is seperated out for 2 cylinders each of 75 tonnes. In the circuit a force of 75000 kg for each cylinder and pressure of 160 kg/cm<sup>2</sup> is required.

$$\begin{aligned} P &= F/A \\ 160 &= \frac{75000}{\pi/4 \times D_p^2} = 24.43 \text{ cm (selecting next closet valve)} \\ D_p &= 25\text{cm} \end{aligned}$$

For high pressure applications, diameters of rod = 0.5 to 0.65 times Dp

Assuming multiplication factor = 0.56

$$D_r = 0.56 \times 250 = 140\text{mm}$$

### THICKNESS OF CYLINDER :

Calculating thickness of cylinder, Hoop's stress must be considered.

$$F_H = P d / 2t$$

$$F_H = 0.8 \times \text{yield stress} / \text{factor of safety}$$

For EN - 8 material,

Yield stress = 2400 kg/cm<sup>2</sup> from design data handbook.

Therefore,

$$F_H = 0.8 \times 2400 / 3.2$$

$$F_H = 600 \text{ kgf} / \text{cm}^2$$

$$F_H = P D / 2t$$

$$t = \frac{P D}{2 \times F_H} = \frac{160 \times 25}{2 \times 600}$$

$$t = 33.3 \text{ mm}$$

Standardising,  $t = 35\text{mm}$

$$\begin{aligned} \text{Outer dia of cylinder} &= D_p + 2t \\ &= 250 + (2 \times 35) \\ &= 120 \text{ mm} \end{aligned}$$

## 4.2 PUMP DESIGN FOR HIGH VOLUME FLOW :

The piston has to travel for a stroke length of 400 mm in 12 sec during forward stroke and 10 second in reverse stroke.

$$\begin{aligned}\text{Therefore, velocity} &= 400 / 12 \\ &= 33.33 \text{ mm / sec} \\ &= 3.33 \text{ cm / sec}\end{aligned}$$

From continuity equation :

$$\begin{aligned}Q &= A \times V \\ &= \frac{\pi}{4} \times 25^2 \times 3.33 \\ &= 1634.60 \text{ cm}^3 / \text{sec} \\ &= 98076.59 \text{ cm}^3 / \text{min} \\ &= 98 \text{ lpm}\end{aligned}$$

20% allowance of pressure is given on selecting pump. So design pressure = 190 Kg/cm<sup>2</sup>

$$\text{volume flow rate , } Q = 98 \text{ lpm}$$

For high and low pressure volume flow rate a balanced vane pump is selected.

Type	-	Yuken
Make	-	Double pump
PVR	-	50 - 150 - FF - 45 - 140 REAA

## TO DETERMINE THE PISTON ROD DIMENSIONS :

Piston rod should travel 400 mm in 12 sec

Forward velocity = 3.33cm / sec

Piston rod during retraction should travel 400 mm in 8 sec

Therefore, reverse velocity= 5cm/sec

Max. velocity = 300cm/min

From continuity equation ,  $Q = A \times V$

$$98000 = \pi / 4 \times [25^2 - dr^2] \times 300$$

$$dr = 13.39 \text{ cm}$$

$$= 140 \text{ mm}$$

### 4.3 DESIGN OF EJECTION CYLINDER (2 NOS):

A force of 1500 kg and pressure of 20kg / cm<sup>2</sup> is required for each cylinder

We know,  $P = F/A$

$$20 = \frac{1500}{\pi/4 \times D_p^2}$$

$$D_p = 9.77 \text{ cm} = 10 \text{ cm.}$$

### THICKNESS OF CYLINDER:

Hoop's stress =  $F_H = PD/2t$

$$F_H = 0.8 \times \text{yield stress} / \text{F.O.S.}$$

For EN - 39 mtl, yield stress = 400 kgf/cm<sup>2</sup>

$$\text{So, } F_H = 0.8 \times 1400 / 3 = 106.40 \text{ kgf/ cm}^2$$

$$106.40 = \frac{20 \times 10}{2 \times t}$$

$$t = 10 \text{ mm}$$

Outer dia of cylinder :

$$= D_p + 2t = 100 + (2 \times 10)$$

$$= 120 \text{ mm}$$

$$\text{Reverse velocity} = 80 / 3 = 2.66 \text{ cm / sec}$$

$$\text{Forward velocity} = 80 / 5 = 1.6 \text{ cm / sec}$$

$$\text{Flow of pump} = 20 \text{ lpm}$$

$$20000 = \pi / 4 (D_p^2 - d_r^2) \times 5$$

$$= \pi / 4 (10^2 - d_r^2) \times 100$$

$$\text{Therefore, } d_r = 6.78 \text{ or } 7 \text{ cm} = 70 \text{ mm}$$

$$\text{Mounting} = \text{Rod end flange mounting}$$

#### 4.4 PUMP DESIGN FOR LOW VOLUME FLOW :

During forward stroke the piston has to travel a stroke length of 80mm in 5 sec and during reverse stroke in 3 sec.

$$\text{Reverse velocity} = 80 / 3 = 2.66 \text{ cm / sec}$$

$$\text{Forward velocity} = 80 / 5 = 1.6 \text{ cm / sec}$$

$$\text{From continuity equation} = Q = A \times V$$

$$= \pi/4 (D_p^2) \times V$$

$$= \pi/4 \times 10^2 \times 1.6$$

$$\begin{aligned}
Q &= 125.66 \text{ cm}^3 / \text{sec} \\
&= 7540 \text{ cm}^3 / \text{min} \\
&= 7.5 \text{ lpm} \\
&= 10 \text{ lpm}
\end{aligned}$$

finding the next closest value available for the pump we take it as 20 lpm. 20% of allowance given for the pressure in case of selection of pump. So for a pressure of 20 kg/cm<sup>2</sup> in ejection cylinder, 20% addition approximates to 24 kgf/cm<sup>2</sup>.

In the flow rate required in ejection cylinder a pump of type as given below is selected

Type : Fluidics  
 Make : PVR IT - 17 - F - RAA

#### 4.5 FOR SELECTION OF MOTOR

Max volume of flow required is considered

$$\begin{aligned}
\text{Hp} &= \frac{\text{Flow (lpm)} \times \text{pressure (kgf / cm}^2\text{)}}{500} \\
&= \frac{98 \times 160}{500} = 31.36 \text{ Hp} \\
&= 32 \text{ Hp}
\end{aligned}$$

To determine the motor power required for ejection cylinder flow

$$\text{Low volume high pressure flow motor} = \frac{\text{Flow (lpm)} \times \text{pr (kgf/cm}^2\text{)}}{\text{-----}}$$

500

$$= 30 \times 30 / 500$$

$$= 1.3 \text{ Hp}$$

$$= 2 \text{ Hp}$$

#### 4.6 TO DETERMINE THE CONDUCTOR PIPE LINE DIMENSIONS

Flow thro' pipe lines = 98 lpm

Now, considering additional 20% flow to give compensation for losses due to leakages

$$\text{Flow} = 1.2 \times 98$$

$$= 117.6$$

$$= 120 \text{ lpm}$$

$$Q = 2 \text{ lps}$$

$$Q = 2000 \text{ cm}^3 / \text{sec}$$

Taking the velocity considerations, the recommended velocities

considerations are, at pump inlet line = 61 - 122 cm/sec

At working lines = 214 - 600 cm/sec

From continuity equation,

$$Q = A \times V,$$

To work in safe conditions, choosing a middle value we take

$$2000 = \frac{\pi d^2}{4} \times 450$$

$$d = \text{cm}$$

$$\text{Approx. } d = 2.5 \text{ cm}$$

For suction lines,

$$Q = A \times V$$

for an efficient suction at inlet  $V = 120 \text{ cm/sec}$

$$2000 = \frac{\pi}{4} \times d^2 \times 120$$

$$d = 4.46 \text{ cm}$$

$$d = 4.5 \text{ cm}$$

Considering flow through ejection cylinders,

$$\text{Flow thro' pipe lines} = 20 \text{ lpm}$$

An additional 20% flow to account for losses of leakages in flow.

$$\text{Flow} = 1.2 \times 20$$

$$= 24 \text{ lpm}$$

$$= 0.4 \text{ lps}$$

$$Q = 400 \text{ cm}^3 / \text{sec}$$

Now again considering the velocity ranges recommended.

$$\text{Pump inlet lines} = 61 - 122 \text{ cm/sec}$$

$$\text{Working lines} = 214 - 600 \text{ cm/sec}$$

From continuity equation,

Due to a small volume flow choosing velocity to min value range

$$v = 250 \text{ cm/sec for working lines}$$

$$400 = \frac{\pi}{4} \times d^2 \times 250$$

$$d = 1.4 \text{ cm}$$

For suction lines,

$$Q = A \times V$$

For maximum suction we take velocity near max range, i.e, 120 cm/sec

$$400 = \frac{\pi}{4} \times d^2 \times 250$$

$$d = 4.24 \text{ cm}$$

Wall thickness of pipe lines :

The formula for calculation of pipe thickness (ref IS 6631.72) is given below

$$T = \frac{10.2 Pd}{200\sigma + P} + x$$

t = minimum pipe thickness (in mm)

P = design pressure (in N/mm<sup>2</sup>)

D = inner dia of pipe (in mm)

$$\sigma = \frac{\text{minimum tensile strength (in N/mm}^2\text{)}}{9.81 \times \text{F.O.S.}}$$

x = allowance for screwing

$$p = 192 \text{ kg/cm}^2$$

$$= 19.2 \text{ N/mm}^2$$

$$\sigma = 370 / 9.81 \times 4 = 9.42 \text{ N / mm}^2$$

$$x = 0.125 d$$

for suction lines min wall thickness :

$$= \frac{10.2 \times 4.5 \times 19.2}{200 + 4.42 + 19.2} + 0.125 \times 45$$

$$= 10.84 \text{ mm}$$

III ly for pressure lines,

$$t = \frac{10.2 \times 2.5 \times 19.2}{200 + 9.42 + 19.2} + 0.125 \times 2.5$$

$$t = 5.69 = 6 \text{ mm}$$

we select hot finish seamless (HFS) pipes to avoid leakage from the system.

#### 4.7 Determination of reservoir capacity:

The reservoir capacity is generally 4 to 5 times capacity of hydraulic pump

$$\text{for high volume flow} = 120 \text{ lpm}$$

$$\text{low volume} = 20 \text{ lpm}$$

$$\text{Double pump} = 150 + 20 \text{ lpm} = 170 \text{ lpm}$$

$$\text{Single pump} = 20 \text{ lpm}$$

$$\text{Therefore total lpm} = 190 \text{ lpm}$$

$$\text{Reservoir capacity} = 5 \times 190 = 950$$

$$\text{Taking 10\% allowances} = 1.1 \times 950$$

$$= 1054 \text{ litres}$$

Approximately the capacity of reservoir = 1100 litres

$$\begin{aligned}
 &= 0.28 \text{ kg/sec} \\
 \text{Heat capacity of oil} &= 0.28 \times 9.15 \\
 &= 2.56 \text{ watts} \\
 \text{Hence, } C_{\min} &= C_h \\
 &= 2.56 \text{ w,} \\
 C_{\max} \quad C_c &= 4180 \text{ w} \\
 C_{\min} / C_{\max} &= 0.0062
 \end{aligned}$$

The application side of equipment calls for an effectiveness of 0.85 for which NTU value is 2.2 (HMT data book)

$$\text{NTU} = \frac{UA}{C_{\min}}$$

Substituting we have,

$$A = \frac{110 \times A}{2.56}$$

$$A = 0.05 \text{ m}^2$$

We select a shell and tube type heat exchanger with 2 tubes with water as the fluid flowing through tube and oil around the tube.

$$\begin{aligned}
 \text{Hence, area / tube} &= 0.05 / 2 \\
 &= 0.025 \text{ m}^2 \\
 \pi D L &= 0.025
 \end{aligned}$$

#### 4.8 Design of heat exchangers :

Here, we use NTU method of heat exchange analysis as we do not know terminal temperatures.

1. Inlet temperature of water =  $30^{\circ}\text{C}$
2. Secific heat capacity of oil( $C_n$ ) =  $915\text{ J/KgK}$
3. Specific heat capacity of water ( $C_c$ ) =  $4180\text{ J/Kgk}$
4. overall heat transfer co-efficient,  $U$  =  $110\text{ W/m}^2\text{ K}$

#### CALCULATIONS :

$$\text{Heat capacity of water (Cc)} = c_c \times m_c$$

$$\text{Where } m_c \text{ is mass flow rate of wats} = 1\text{Kg/sec}$$

$$\text{Hence, } c_c = 1 \times 4180 = 4.18\text{ Kw}$$

$$\text{Heat capacity of oil (cn)} = c_n \times m_n$$

To determine  $m_n$ ,

From reference, sp. Gravity of servosystem 68 oil = 0.85

$$\text{i.e. } \rho_{oil} / \rho_{water} = 0.85$$

$$\rho_{oil} = 850\text{ kg/m}^3$$

$$\text{Hence mass flow rate of oil, } m_n = \rho_{oil} \times \text{flow rate}$$

$$= \frac{850 \times 20 \times 10^{-3}}{60}$$

L = 30 cm

= 0.3 m

Therefore, D = 26mm

### **SPECIFICATIONS :**

Type of heat exchanger : Shell and tube

Dia of tube : 26 mm

Length of tube : 300 mm

No. of tubes : 2

#### **4.9 SELECTION OF ELEMENTS :**

##### **FILLER BREATHER :**

It is used to fill the lubrication oil. It controls contamination and allows the tank to breathe in and out.

Make : ~~ICT~~ *Hydrosmith*

##### **SUCTION STRAINER :**

It is used for straining the oil getting into the pump.

Make : **Hydrosmith** *Hydrosmith*

Type : **2 1/2" CSS 2.075** *2 1/2" CSS 2.075*

##### **INLINE CHECK VALVE :**

This is one way valve and it permits free flowing only one direction.

It avoids excessive pressure built up into the system.

Make : **Yuken**

Type : ~~CH-10-5-2080~~ *CH-10-5-2080*

##### **MANUAL OPERATED DC VALVE (2 NOS) :**

It permits the flow from pump to the actuator in the energised position the fluid will flow to the cylinder and in the de-energised position to the tank.

### **VALVE : 1(FOR MAIN CYLINDER CONTROL)**

Maximum operating pressure : 165 kg/cm<sup>2</sup>

Type : manually operated

Make : Fluidics

Mode : DMG - 06 - 3D60 - 50

### **VALVE 2 :(for ejection cylinder control)**

Maximum operating pressure : 20 kg/cm<sup>2</sup>

Type : manually operated

Make : fluidics

Mode : DMG - 06 - 3D60 - 50

### **PRESSURE CONTROL MODULE**

To control double pumps of high-low system. It unloads low pressure pump when the system pressure rises above the pressure set on unloaded valve.

Max. setting pressure : 165 kg/cm<sup>2</sup>

Min. setting pressure : 20 kg/cm<sup>2</sup>

Make : Hydrosmith

Type : PCM 30 - 16 -50/31

### PILOT OPERATED CHECK VALVE :

It is used to arrest the leakage of fluid and allows the fluid to reservoir when there is excess pressure built up in the system which is sensed through a pilot connection.

Make : Hydrosmith

Type : CI 30 TFI

### PRESSURE RELIEF VALVE :

The pressure relief valve is to direct pump flow into the tank when the system pressure exceeds setting pressure.

Make : Hydrosmith

Type : ~~DP RH 10 T 200~~ 25

### HYDRAULIC POWER UNIT :

It comprises of reservoir - 1200 litres filled to the midlevel of oil level indicator. A filler breather serves to fill in the tank and also facilitates the tank to breath when oil level when raises or lowers.

An electric motor of <sup>25</sup>30 HP x 1440 RPM coupled to double vane pump mounted on bracket through flexible coupling is provided. A suction strainer the oil being sucked into the pump. Discharge of pump enters the pressure

control module thro' a check valve. Both the high volume low pressure and low volume high pressure flows reach the PCM.

The discharge pressure is controlled by setting on PCM - a maximum pressure of 165 kgf/cm<sup>2</sup> for high pressure and a minimum setting pressure of 20 kgf/cm<sup>2</sup> for low pressure flow.

When valve is energised the flow from PCM is passed on to the cylinder through a pilot operated check valve and the forward stroke takes place.

Whenever valve 1 is de energised, the flows back to the tank during retraction stroke. When the valve 1 is neutral position the cylinder are made to stand still with use of decompression poppet provided in the pilot operated check valve.

To operate the ejection cylinder, electric motor of 2HP X 1440 PRM coupled to a single vane pump mounted on foot bracket through flexible coupling is provided. The discharge of pump reaches the DC valve 2 controlled by a pressure relief valve.

The discharge pressure of pump is controlled by a pressure setting of 20 kg/cm<sup>2</sup> in the pressure relief valve. When the valve2 is energised the flow takes place from the pump to the ejection cylinder and valve 2 is de energised position the flow takes place vice versa. During neutral position of valve2 system remains idle as oil circulation prevented.

Glycerine filled pressure gauges are used to indicate the pressure in pressure relief valve & PCM. The off-line filtration and cooling of oil is provided in the return line from ejection cylinder . cork sheet gaskets are fixed below the top plate of the reservoir and cut outs to prevent dust entry into the oil. A drain plug is provided at floor level of tank.

The tank has suitable lifting eyes provided on all four corners of tank.

## 5.0 STRUCTURAL DESIGN

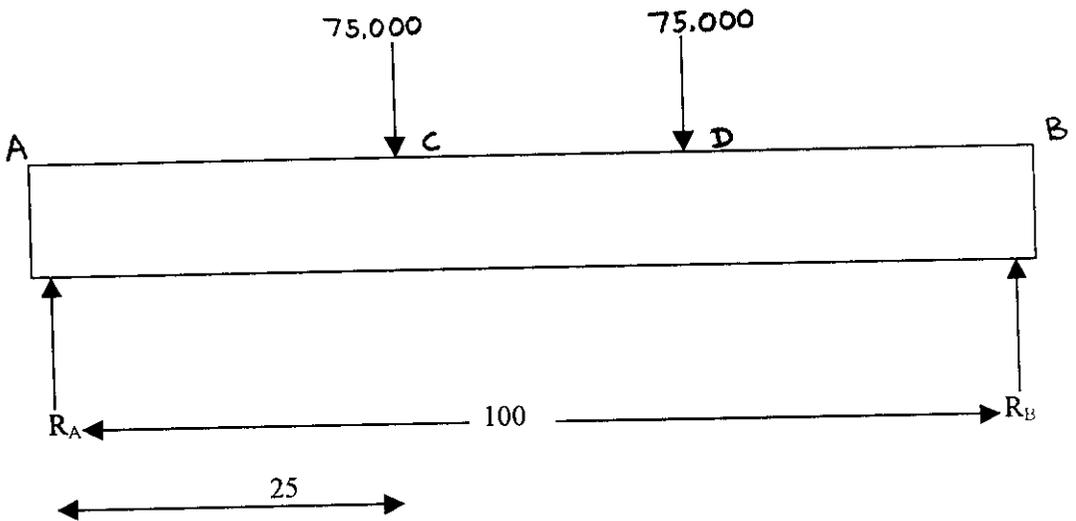
### 5.1 DESIGN OF TOP FRAME :

Material : MS

Total load acting - 150000 kg

Allowable tensile stress - 3600 kg / cm<sup>2</sup> (from design data book)

$$R_A + R_B = 150000$$



Taking moments about  $R_A$

$$R_B \times 100 - 75000 \times 75 - 75000 \times 25 = 0$$

$$R_B = 75000 \text{ kg}$$

$$R_A = 75000 \text{ kg}$$

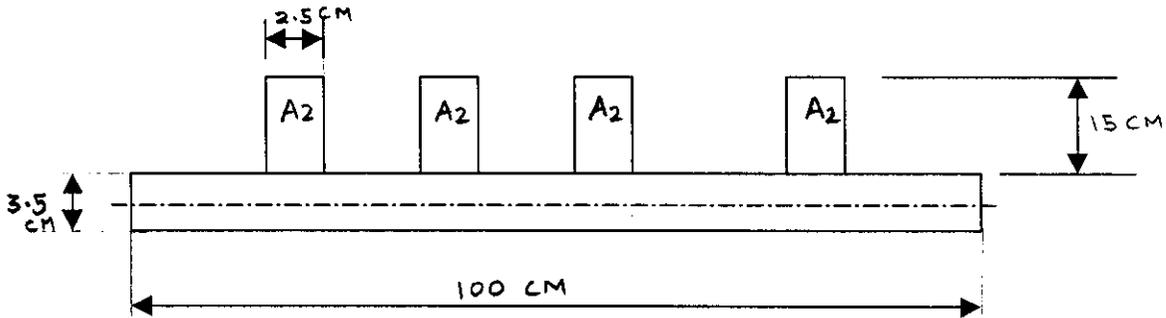
**TO FIND THE BENDING MOMENT :**

$$\text{B.M. at C} = 75000 \times 25$$

$$= 1.875 \times 10^6 \text{ kg cm}$$

$$\begin{aligned} \text{B.M. at D} &= 75000 \times 75 - 75000 \times 25 \\ &= 1.875 \times 10^6 \text{ kg cm} \end{aligned}$$

**To find distance of centroidal axes from bottom**



$$A_1 = 100 \times 3.5 = 350 \text{ CM}^2$$

$$A_2 = 2.5 \times 15 = 37.5 \text{ cm}^2$$

$$Y_1 = 3.5 / 2 = 1.75 \text{ cm}^2$$

$$Y_2 = 3.5 + 15 / 2 = 11 \text{ cm}$$

$$\begin{aligned} \bar{Y} &= \frac{A_1 Y_1 + 4 (A_2 Y_2)}{A_1 + 4A_2} \\ &= \frac{350 \times 1.75 + 4 (37.5 \times 11)}{350 + 4 (37.5)} \\ &= 2262.5 / 500 \\ &= 4.53 \text{ cm} \end{aligned}$$

**TO FIND MOMENT OF INERTIA :**

$$\begin{aligned} I_{xx} &= \frac{b_1 d_1^3}{12} + b_1 d_1 k_1^2 + \frac{b_2 d_2^3}{12} + b_2 d_2 k_2^2 \\ &= \frac{100 \times (3.5)^3}{12} + 350 \times (2.78)^2 + \frac{100 \times (3.5)^3}{12} + 350 \times (2.78) \\ &= 5335.14 \text{ cm}^4 \end{aligned}$$

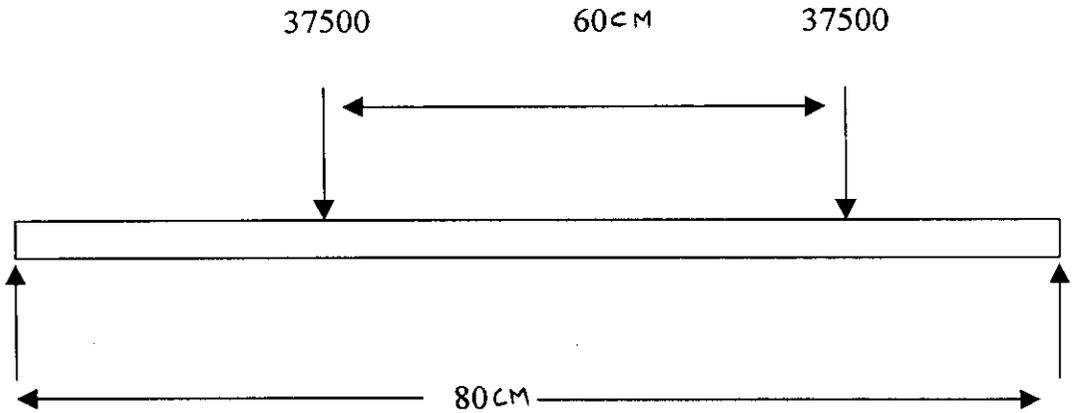
Tensile stress  $F_t = M / Z$

$$\begin{aligned} &= M / \left\{ \frac{I}{Y} \right\} \\ &= \frac{M}{I} \times Y \\ &= \frac{1.875 \times 10^6 \times 4.53}{5335.14} \\ &= 15.92 \text{ kg/cm}^2 \end{aligned}$$

therefore the design is safe.

## 5.2 DESIGN OF BOTTOM FRAME :

Material : MS



$$R_A + R_B : 75000 \text{ Kg}$$

$$R_A : 37500 \text{ kg}$$

$$R_B : 37500 \text{ kg}$$

### TO FIND THE BENDING MOMENTS :

$$\text{Taking moments at c} = 37500 \times 100 = 3.75 \times 10^6 \text{ kg cm}$$

$$\text{at D} = 37500 \times 70 - 37500 \times 60$$

$$= 3.75 \times 10^6 \text{ kg cm}$$

## TENSILE STRESS :

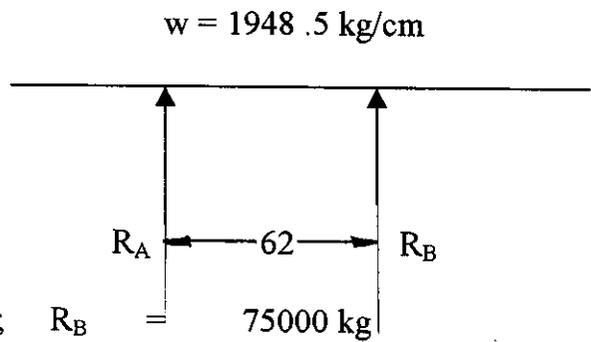
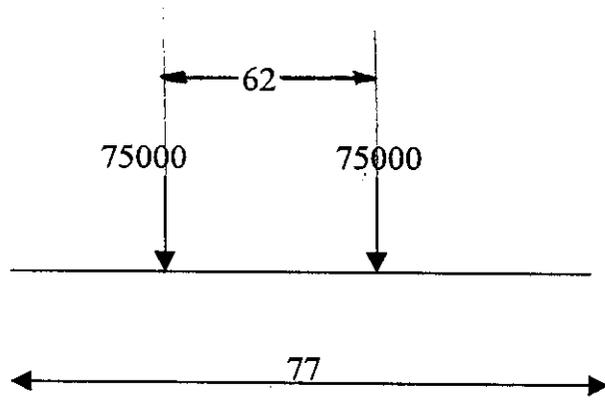
$$\begin{aligned} F_t &= M / Z \\ &= [ M / I ] \times \overline{Y} \\ &= \frac{3.75 \times 10^6 \times 25.2}{54582.73} \\ &= 1731.32 \text{ kg / cm}^2 \end{aligned}$$

Therefore the design is safe.

### 5.3 DESIGN OF PUNCH HOLDER :

The material : MS

The load encountered by the Punch holder is a UDL



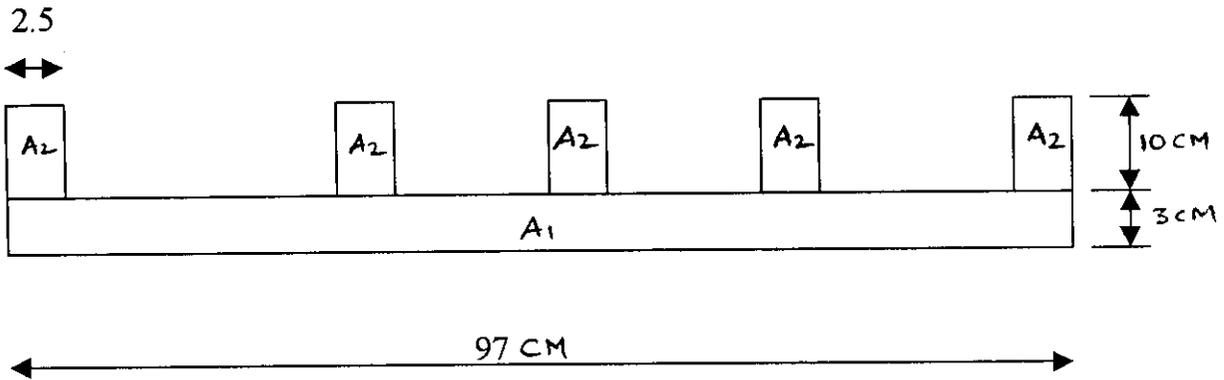
$$R_A = 75000 \text{ kg}; \quad R_B = 75000 \text{ kg}$$

To find the bending moments :

$$\text{Moment at A} = 54.80 \times 10^3 \text{ kg cm}$$

$$\text{at B} = 54.80 \times 10^3 \text{ kg cm}$$

**TO FIND THE DISTANCE OF CENTROIDAL AXIS FROM BOTTOM:**



$$A_1 = 77 \times 3 = 231 \text{ cm}^2$$

$$A_2 = 10 \times 2.5 = 25 \text{ cm}^2$$

$$Y_1 = 35 / 2 = 8 \text{ cm}$$

$$Y_2 = 3 + 5 \text{ cm}$$

$$\begin{aligned} \bar{Y} &= \frac{A_1 Y_1 + 5 (A_2 Y_2)}{A_1 + 5 A_2} \\ &= \frac{231 \times 1.5 + 5 \times 25 \times 1.5}{231 + 5 \times 25} \\ &= 3.78 \text{ cm} \end{aligned}$$

**TO FIND MOMENT OF INERTIA :**

$$I_{xx} = \frac{b_1 d_1^3}{12} + m_1 k_1^2 + \frac{b_2 d_2^3}{12} + m_2 k_2^2$$

$$= \frac{77 \times 3^3}{12} + 231 \times (2.28)^2 + \frac{2.5 \times (10)^3}{12} + 25 (4.22)^2$$

$$= 2027.62 \text{ cm}^4$$

**TENSILE STRESS :**

$$M / I = \frac{F}{Y}$$

$$F = \frac{54.80 \times 10^3}{2027.62} \times 3.78$$

$$= 1102.16 \text{ kg / cm}^2$$

Therefore the design is safe.

**5.4 DESIGN OF SUPPORTING COLUMNS :**

- Material of rod : MS
- Total load acting : 150000 kg
- No. of columns : 4
- Load on each column : 37500
- Allowable tensile stress : 3600 kg / cm<sup>2</sup> (from design data book)

The maximum diameter of the column is 8.6 cm and it comes in contact with the top of bottom frames of the press .

Minimum diameter : 8.6 cm

$$\text{Maximum tensile strength (F}_t\text{)} = \frac{\text{Load}}{\text{Area}}$$

Each column carries about 37500 kg

$$\text{Design stress} = \frac{\text{Allowable stress}}{\text{Factor of safety}}$$

$$\begin{aligned}\text{Factor of safety} &= 2 \\ &= 3600 / 2 \\ &= 1800 \text{ kg / cm}^2\end{aligned}$$

$$\begin{aligned}\text{Therefore } F_t &= \frac{37500}{\pi / 4 \times 8.6^2} \\ &= 645.57 \text{ Kg / cm}^2\end{aligned}$$

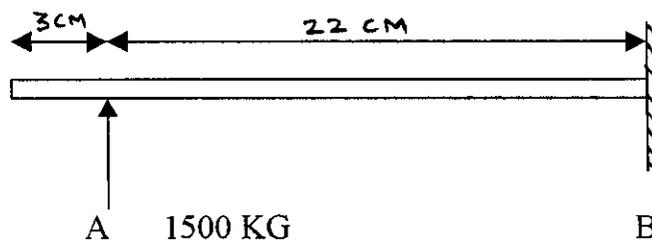
So, the design is safe.

### 5.5 DESIGN OF EJECTION CYLINDER DIE CONNECTOR :

$$\text{Material} = \text{MS}$$

$$\text{No. of elements} = 2$$

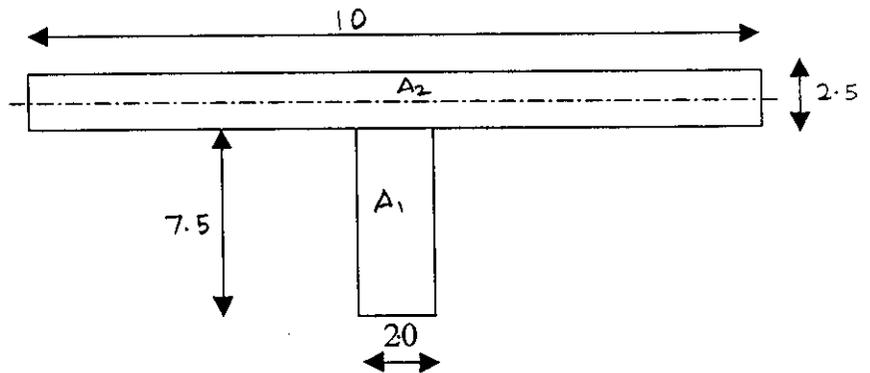
A total load of 3 tonnes is exerted by ejection cylinder. So about 1500 kg is exerted on each connector.



**TO FIND BENDING MOMENTS :**

$$\begin{aligned} \text{Moment at B} &= 1500 \times 22 \\ &= 330 \times 10^2 \text{ kg cm} \end{aligned}$$

**TO FIND THE DISTANCE OF CENTROIDAL AXIS :**



$$A_1 = 7.5 \times 2 = 15 \text{ cm}^2$$

$$A_2 = 10 \times 2.5 = 25 \text{ cm}^2$$

$$Y_1 = 3.75 \text{ cm}$$

$$Y_2 = 8.75 \text{ cm}$$

$$\bar{Y} = \frac{A_1 Y_1 + (A_2 Y_2)}{A_1 + A_2}$$

$$= \frac{15 \times 3.75 + 25 \times 8.75}{15 + 25}$$

$$= 6.875 \text{ cm}$$

### TO FIND MOMENT OF INERTIA :

$$\begin{aligned} I_{xx} &= \frac{b_1 d_1^3}{12} + m_1 k_1^2 + \frac{b_2 d_2^3}{12} + m_2 k_2^2 \\ &= \frac{2.0 \times (7.5)^3}{12} + 15 \times (3.125)^2 + \frac{10 \times (25)^2}{12} + 25 \times (1.875)^2 \\ &= 317.71 \text{ cm}^4 \end{aligned}$$

### TENSILE STRESS :

$$\begin{aligned} P &= \frac{M}{I} \times Y \\ &= \frac{330 \times 10^2}{317.71} \times 6.875 \\ &= 714.09 \text{ kg / cm}^2 \end{aligned}$$

Therefore the design is safe.

### 5.6 DESIGN OF HEXOGONAL NUTS :

Material = MS

Load acting = Shear stress & crushing stress

$$\text{Design shear stress} = \frac{\text{Allowable shear stress}}{\text{Factor of safety}}$$

$$F_b = P / \pi d_c b_n$$

Where

$$d_c = \text{minor diameter}$$

$$b = \text{width of thread}$$

$$n = \text{number of threads in engagement}$$

$$\text{No of threads} = 3 \text{ TPI}$$

$$\text{Thread length} = 17.5 \text{ cm}$$

$$\text{Therefore number of threads } n = 21$$

$$\text{Minor diameter } d_c = 8.6 \text{ cm}$$

$$\text{Width of thread } b = 0.6 \text{ cm}$$

There are 4 hexagonal nuts. Therefore the load shared by each nut is 37500 kg

$$f_b = \frac{37500}{\pi \times 8.6 \times 0.6 \times 21}$$

$$d = \text{major diameter}$$

$$\text{Major diameter of thread} = 10.6 \text{ cm}$$

$$\text{therefore } F_{cr} = \frac{37500}{\pi (10.6^2 - 8.6^2) 21}$$

$$= 62.12 \text{ kg / cm}^2$$

therefore the design is safe.

## **6.0 FRAME CONSTRUCTION**

The entire press assembly is fabricated by using Mild steel (MS) material. Since the top and bottom portion of press are connected and supported by 4 columns, the type of construction is called tie-rod construction. The various components and their contribution to the press frame are detailed below.

### **6.1 BOTTOM SUPPORT FRAME :**

This is the frame which transmits the entire weight of press assembly into the ground effectively and safely. This bottom support frame is a welded assembly made of MS plates of 35 mm thickness and which are suitably reinforced for load transmission. The dimension of bottom support frame is 1300 x 800 x 635 mm.

The frame has suitable provisions for supporting columns and mounting for other accessories, which has to be fixed for the bottom frame. (Ref. Dwg no.002).

### **6.2 TOP SUPPORT FRAME :**

This portion of the press accommodates the main cylinder (2 nos.). The frame is made with MS plates which are welded suitably. Since it has to withstand weight of main cylinders it is to be suitably reinforced. The top

portion is supported by the use of four supporting columns which rests on bottom frame. The size of bottom 1000 x 800 x 400mm (Ref : dwg no. : 001).

### **6.3 MOULD ASSEMBLY (PUNCH AND DIE) :**

The die portion of the mould assembly is placed on the floor of bottom support frame. The punch portion is connected to main cylinders by the use of punch holder. The die portion has suitable provisions for accommodating, the ejection cylinder mould connector which is attached to the ejection cylinder. The entire mould assembly is made up of MS. (Ref. Dwg no. 009).

### **6.4 PUNCH HOLDER :**

The punch holder serves the necessity of connecting the punch to the main cylinders. The punch holder is made of MS steel plates and is drilled with holes of size M12 to secure the punch to it. At the sides it has provisions to attach punch support frame. The size of punch holder is 775 x 380 x 205mm. (Ref. Dwg no.006).

### **6.5 SUPPORTING COLUMNS :**

These columns are made of steel shafts and are in 4 nos. These are hard chrome plated and have a high quality of surface finish in order to

provide aesthetic appearance and reduce wear and tear. The size of the column is 1650 mm in length and of step dia 86 mm and 100mm. (Ref. Dwg no. 003).

## **6.6 HEXAGONAL NUTS :**

The hexagonal nuts are of special type as they are cut from hollow steel shafts of dia 86mm. They are internally threaded for about 3 TPI and main nut is of height 100 mm and lock nut is of height 45 mm. Those nuts are used to secure the top and bottom frames of press.

## **6.7 EJECTION CYLINDER HOLDER :**

This is small mounting bracket which is a welded assembly fixed on to the sides of bottom support frame in order to hold the ejection cylinder. (Ref. Dwg. no. 008).

## **6.8 PUNCH SUPPORT FRAME ;**

This is a support frame attached to the sides of punch holder when the punch of size 1170 x 390 x 30 mm. To avoid bending of this punch at the extreme ends, this frame is provided as a supporter. (Ref. Dwg no. 011).

## **6.9 GUIDES :**

As the ejection cylinder is actuated the die lifts up. The die has to lift up in a linear fashion. So, to ensure this and to arrest any angular movements, four semicircular guides are provided which guide the die between supporting columns. These are made up of MS and they are of thickness 70 mm. They are secured to the die with help of bolts.

## 7.0 INSTRUCTIONS FOR CHANGING THE SIZE

### OF THE MOULD ASSEMBLY

#### MOULD ASSEMBLY 1:

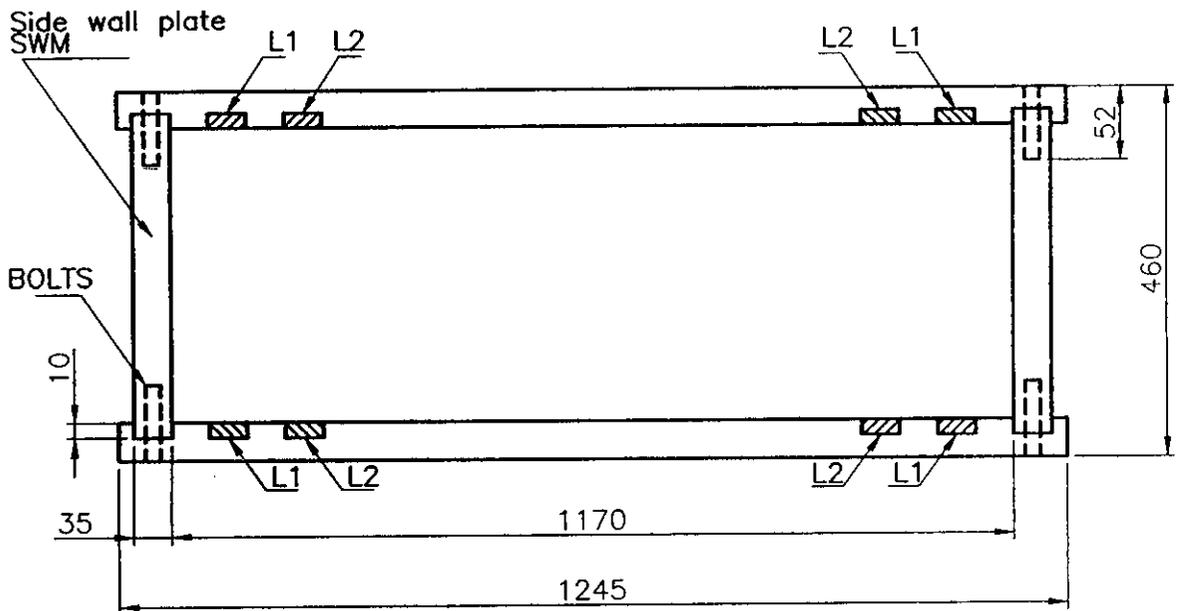


FIG 1: STANDARD MOULD SIZE FOR SLAB

390 X 1170 X 30 MM

=> L1, L2 - Liners

# PUNCH ASSEMBLY 1

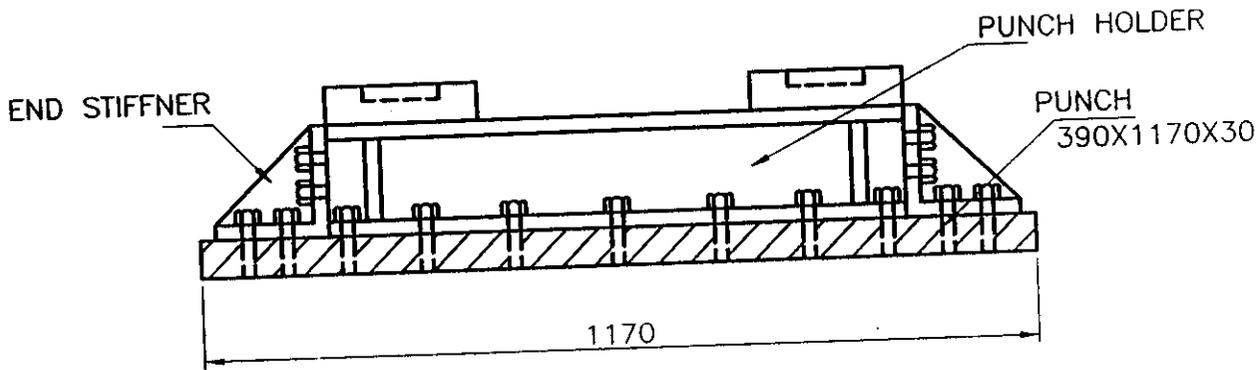


FIG 1.1 : PUNCH ASSEMBLY FOR STANDARD SIZE  
OF SLAB 390 X 1170 X 30 MM

- 1) Punch is fixed to punch holder and secured through bolts.
- 2) End stiffener frame E1 (Quantity – 2 nos.) are secured through bolts to the sides of punch holder and top of punch.

## MOULD ASSEMBLY 2:

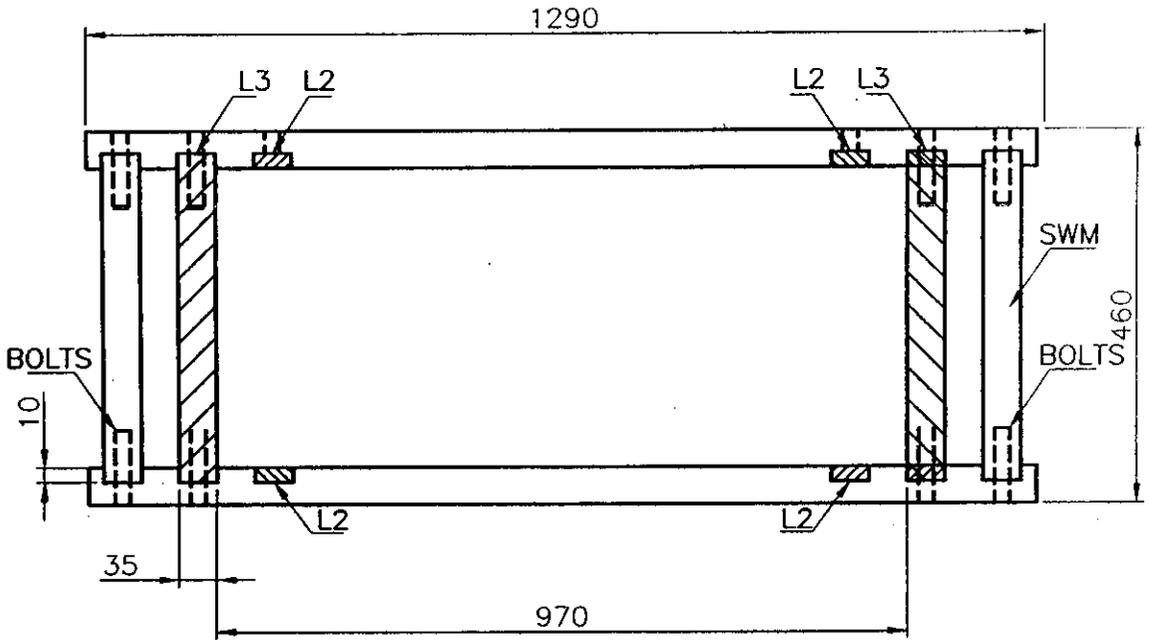


FIG 2: MOULD ASSEMBLY FOR STANDARD SLAB  
SIZE 390 X 970 X 30 mm

- 1) Remove the liners L1 (4 nos.)
- 2) Slide side wall plates L3(2 nos.) and secure through bolts
- 3) Liners L2(4 nos.) to be in position
- 4) Side wall plate SWM to be in position

## PUNCH ASSEMBLY 2:

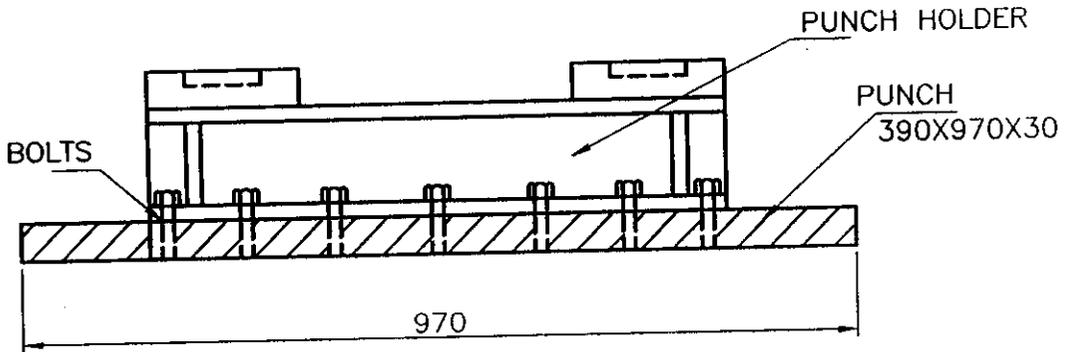


FIG 2.1: Punch assembly for standard size of slab  
390 x 970 x 30 mm

- 1) Punch 390 x 970 x 30 is removed from the punch holder by loosening bolts.
- 2) End supporting frames E1 (2 no.s) are removed from punch holder.
- 3) Punch 390 x 970 x 30 is attached to punch holder and secured through bolts.

## MOULD ASSEMBLY 3:

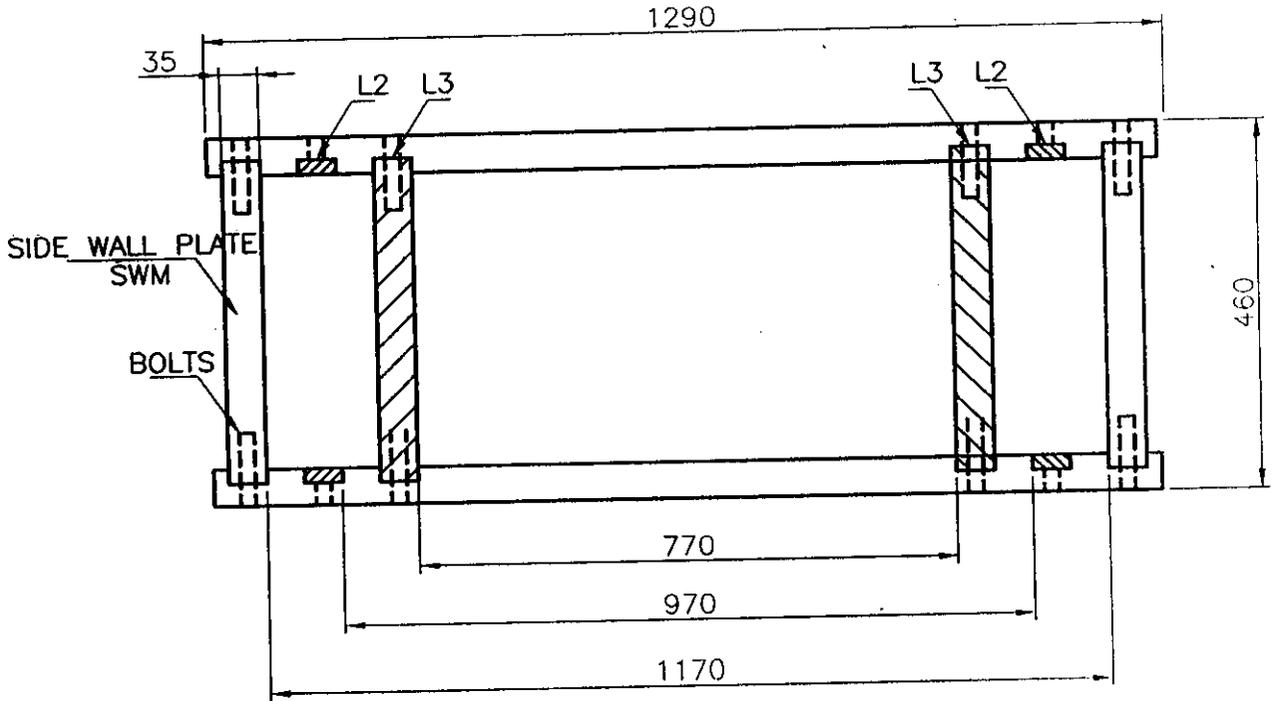


FIG 3: Mould assembly for slab size 390 x 770 x 30mm

- 1) Remove the liners L2 (4 nos.)
- 2) Slide side wall plates L3(2 nos.) and secure through bolts.
- 3) Liners L2 (4 nos.) to be in position.
- 4) Side wall plates SWM to be in position.

## PUNCH ASSEMBLY 3:

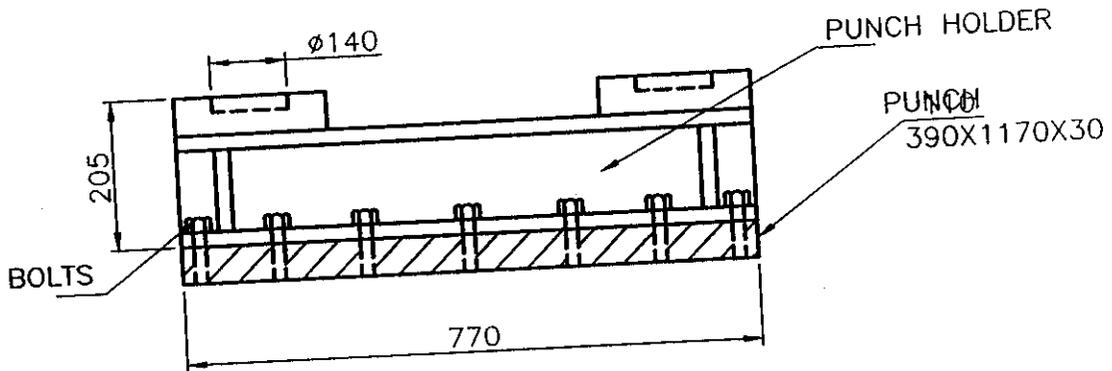


FIG 3.1: Punch assembly for slab size  
390 x 770 x 30mm

- 1) Punch 390 x 770 x 30 is removed from punch holder.
- 2) Punch 390 x 770 x 30 is attached to punch holder and secured through bolts.

## 8.0 PROJECT ESTIMATION (COSTING)

### 8.1 HYDRAULIC POWER UNIT (TABLE - A) :

Sl. No.	Name of the component	Make	Qty	Purchased / mfrd.	Rate / piece	Cost Rs.
1	Tank - 1100 lts	Fabricated	1	Mfrd.		12000
2	Filler - breather FB5 25	ICT	1	Purchased	300	300
3	oil level indicator 5"	ICT	1	Purchased	175	175
4	Suction strainer (2 1/2" BSP CSS 2.075	ICT	1	Purchased	345	345
5	Double pump PVR 50150 - FF-45- 140- REAA	Yuken	1	Purchased	22600	22600
6	Foot mounting bracket	Fabricated	1	Mfrd.	600	600
7	Flexible coupling Hy48	Hydex	1	Purchased	560	560
8	Electric motor 30HP/1440 rpm foot mounting	NGEF	1	Purchased	33000	33000
9	Inline check valve CII - 10 5 - 2080	Yuken	1	Purchased	740	740
10.1	Manual operator DC valve DMG - 06 - 3D60 - 50	Yuken	1	Purchased	3100	3100
10.2	Sub plate for above 3/4" BSP	Hydro smith	1	Purchased	350	850
11	Pressure control module PCM 30/16 - 50/315	Poly hydron	1	Purchased	6800	6800
12.1	Pressure gauge dia 4" (0 - 210 bar) Glycerine filled BC/PM	Pricol	1	Purchased	1040	2080

13	Manual operated DC valve DMG - 06 - 3D60 - 50	Yuken	1	Purchased	3100	3100
14	Pilot operated check valve CI30T11	Poly hydron	1	Purchased	200	200
15	Suction strainer 1" BSP CSS 2.018	ICT	1	Purchased	540	540
16	Foot bracket	Fabricated	1	Manufactured	580	580
17	Flexible coupling Hy 29	ICT	1	Purchased	4100	4100
18	Pump PVR - 17 - 17 F-RAA	Yuken	1	Purchased	3800	3800
19	Electric motor 2 HP/1440 rpm, foot mounting	Stark	1	Purchased	1140	1140
20	Pressure relief valve DPRH - 10 - T - 200	Poly hydron	1	Purchased	4600	4600
21	Oil water cooler dia 5" x 24" L	Guru engg.	1	Mfrd.	775	775
22	RLF SM 2.08 with double indicator	ICT	1	Purchased		
					Total (RS)	110495

### 8.2 MAIN CYLINDER COSTING (TABLE B)

component	Material	Qty	Rate Rs. Ps.	Mat cost in Rs. (A)	Machining cost				Total machinin g cost in (Rs)	Total cost (A + B)
					Turning (hrs) charge	Planning (hrs) charge	Grinding hrs charge	Plating / drilling (hrs)charge		
Front cover	MS	76	32.50	2470	(15) 900			(12) 800	1700	4170
Back cover	MS	71	32.50	2307.5	(18) 1080			(5) 460	1080	3387.5
Mount flange	MS	52	25	1300	(9) 540	(6) 450			1450	2750
Washer (2 nos)	MS	16	27.50	440	(6) 360				365	1800
Piston rod	MS	87	36	3132	(15) 900	(7) 490		(7) 490	5390	8522
Piston	CI	46	24.50	1127	(8) 430				430	1607
Cylinder	Seamless tube	110	44	8104	(22) 1320			(14) 1750	3070	8174
G.M bush	G.M.	15.6	160	2496	(9) 540				540	3036
seals	Rubber									4500
								Total (for 1cylinder) Rs.		35646.50
								Total cost (for 2 cylinder ) Rs.		71293

Plating charge

Turning charge

: : Rs. 110/hr. Shaping/planning charges

: : Rs. 60/hr Drilling charges

: : Rs. 40/hr Grinding charges

: : Rs. 75/hr

: : Rs. 70/hr

### 8.3 EJECTION CYLINDER COSTING(TABLE : C)

component	Material	Qty	Rate Rs. Ps.	Mat cost in Rs. (A)	Machining cost					Total machining	Total cost (A + B)
					Turning (hrs) charge	Plamming (hrs) charge	Boring /honing charge	Grindin g hrs charge	plating drilling (hrs)charge		
Front cover	MS	17	32.50	552.5	(7) 420					660	1212.5
Back cover	MS	14	32.50	455	(10) 600					600	4055
Mount flange	MS	23	25	595	(3) 180	(4) 300		(2) 220		700	1275
Washer (2nos)	MS	12	27.5	320	(2) 120					120	450
Piston rod	MS	25	36	900	(8) 480			1000		1760	2660
Piston	CI	15	24.50	367.5	(5) 300		(4) 280			300	667.50
Cylinder	Seamless steel tube	30	44	1320	(12) 720				(7) 280	1000	2320
GM brush	G.M.	5.6	160	876	(6) 360					360	1256
Seals	Rubber										1200
											12096
											24192

- Plating charges : Rs. 110/hr.
- Turning charges : Rs. 60/hr
- Grinding charges : Rs 70/hr.
- Shaping/planning charges : Rs. 75/hr.
- Drilling charges : Rs. 40/hr.

**8.4 STRUCTURAL COSTING (TABLE D)**

No.	component	Material	Qty	Rate Rs.	Mat cost in Rs. (A)	Machining cost					Total charge in (Rs)	Total cost (A + B)
						Turning welding (hrs) charge	Plannin g (hrs) charge	Drilling / slotting (hrs) charge	Grinding (hrs) charge	Plating (hrs) charge		
1	Top position and frame assy.	MS	660	30	19800	6600		200	420		7220	27020
2	Bottom position press frame assy.	MS	780	30	23400	8250					8250	31650
3	Supporting columns (4 nos)	MS	760	30	28800				230	400	630	29430
4	Ejection cylinder mounting bracket (2 nos)	MS	40	30	1200	210			180		390	1590
5	Hexogonal buts (16 nos)	MS	60	30	1800			400			400	2200
6	Punch holder	MS	120	42	5040	900		310	200		1410	6450
7	Mould assy. (punch and die)	MS	580	30	17400	420		140	320		1080	18480
8	Valve mounting	MS	20	30	600	200		80			280	880
9	Basement plate	MS	92	30	2760			220	130		350	3110
	Total										total	1,20,810



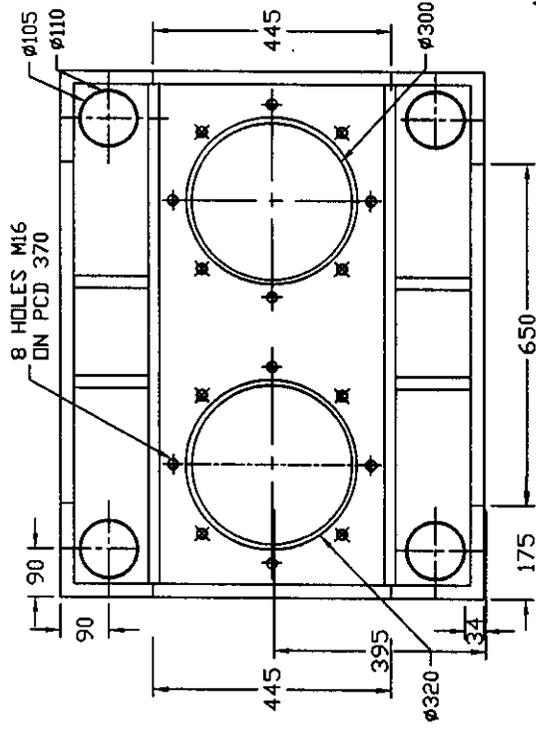
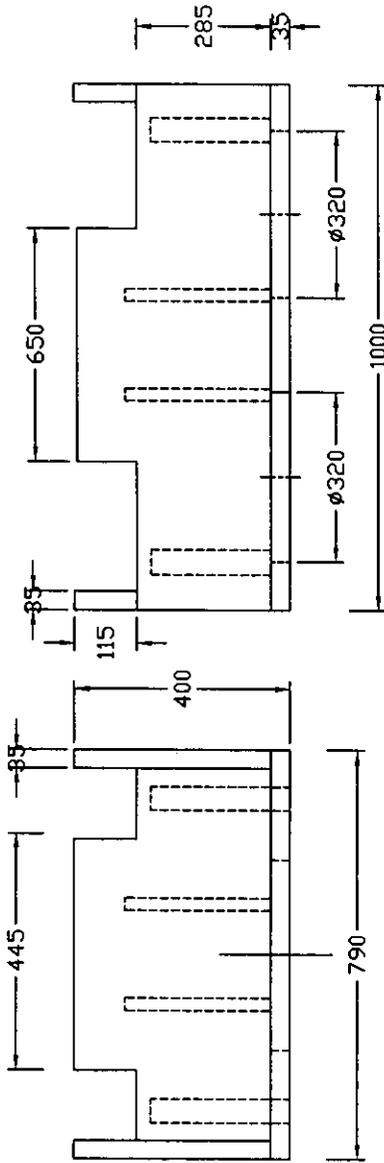
## 9.0 TECHNICAL SPECIFICATION

S.N o.	Details	Values	
1	Press capacity	T	150
2	Product size	mm x mm x mm	i) 390x1170x30 2) 390x970x30 3) 390x770x30
3	Hydraulic cylinders Type: Upstroking double acting		
3.1	Main cylinder	Bore Dia mm Piston rod Dia mm Stroke mm Quantity nos.	250 140 400 2
3.2	Ejection cylinder	Bore Dia mm Piston rod Dia mm Stroke mm Quantity nos.	100 70 80 2
4	Operating pressure	Kg /cm <sup>2</sup>	160

5	Time taken		
5.1	Main cylinder	Punch down    sec Punch up        sec	12 10
5.2	Ejection cylinder	Punch down Punch up	3 sec 5 sec
6	Hydraulic power unit	hp/kW	30 / 22.2
	Off-line filtration	hp/kw	2 / 1.5
7	Hydraulic oil tank volume	litres	1100

• **OVER ALL SIZES:**

	Base size (mm x mm)	Height (cm)	Weight (kg)
Power unit	1600 x 1100	733	2500
Press unit	1300 x 800	1970	1500



ALL DIMENSIONS IN MM

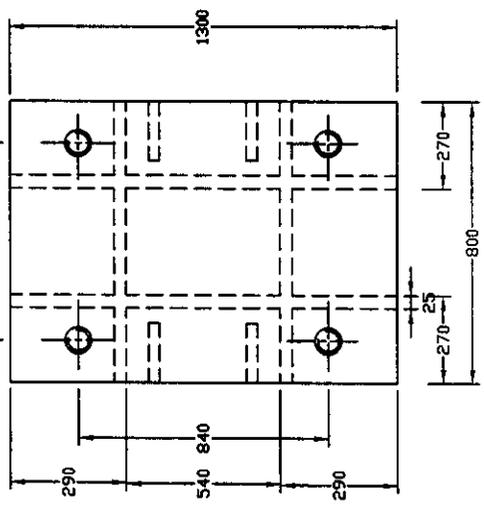
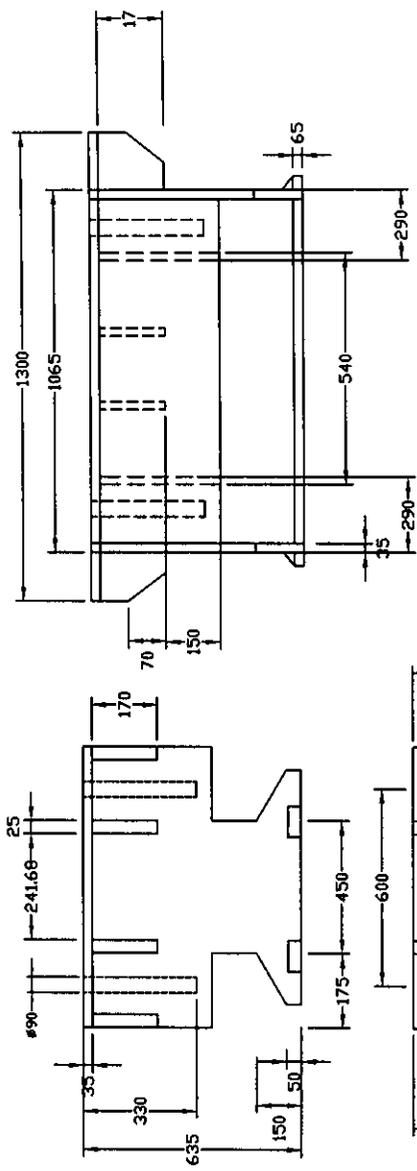
KCT PROJECT WORK

TOP FRAME ASSEMBLY

MAT : MS      SCALE : NTS      QTY : 1 NO.

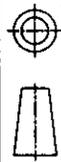
DRN :      APP :            DRG. NO. 001

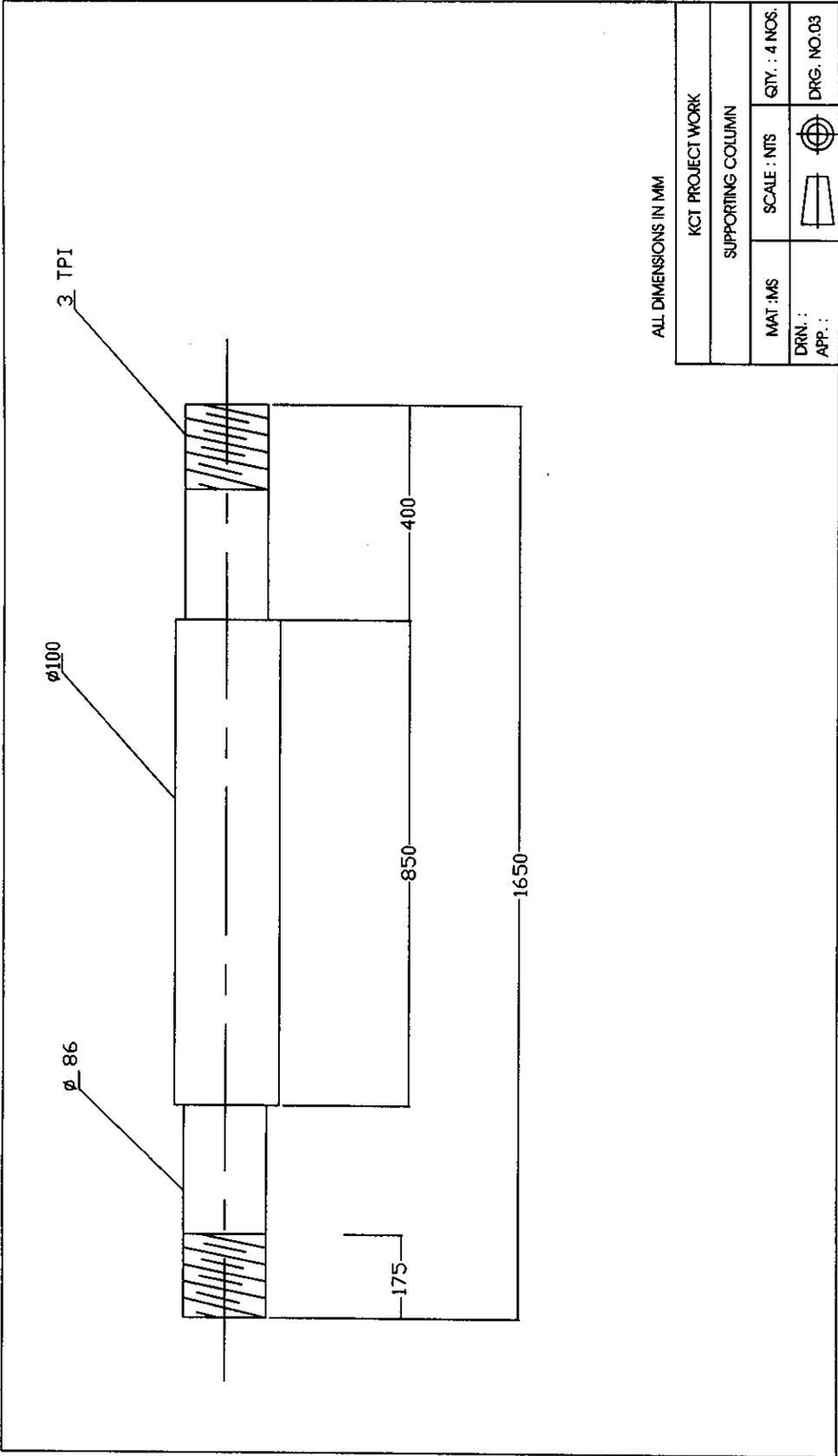




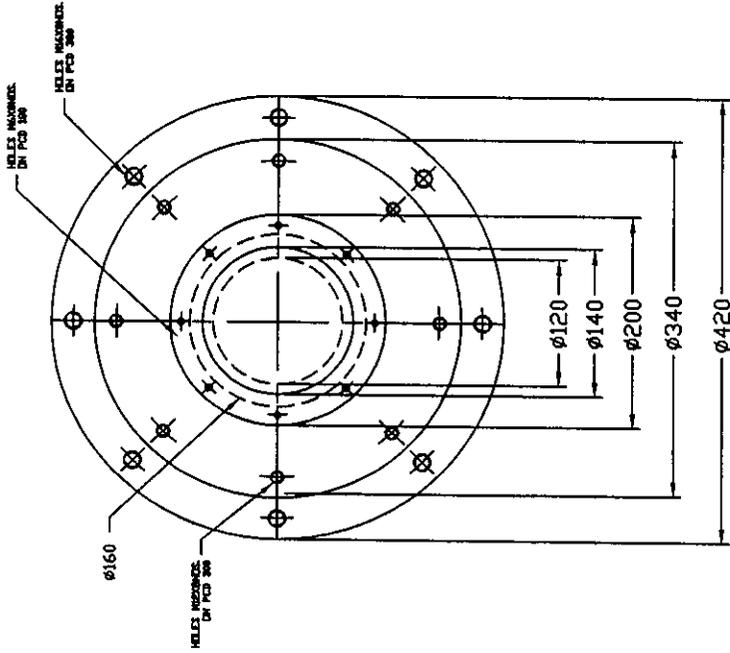
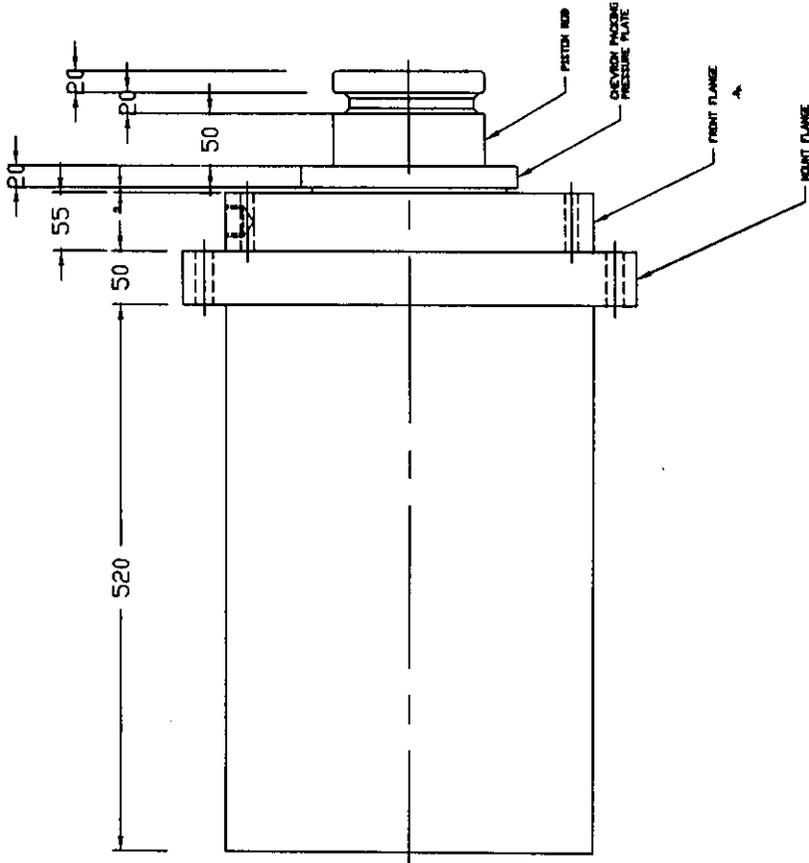
ALL DIMENSIONS IN MM

KCT PROJECT WORK	
BOTTOM FRAME ASSEMBLY	
MAT :MS	SCALE : NTS
DRN : :	QTY : 1 NO
APP : :	DRG. NO. 002



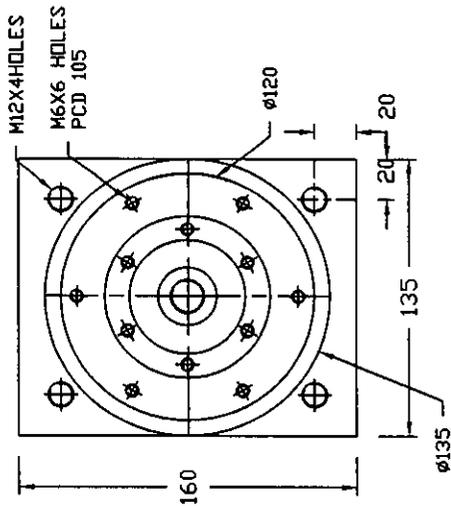
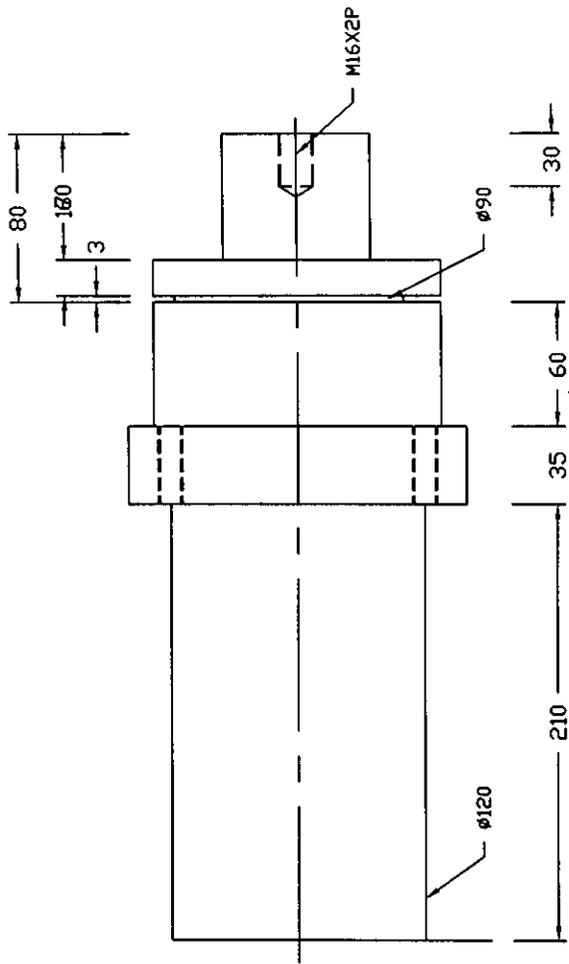


KCT PROJECT WORK	
SUPPORTING COLUMN	
MAT : MS	SCALE : NTS
DRN : APP :	QTY : 4 NOS.
	DRG. NO.03



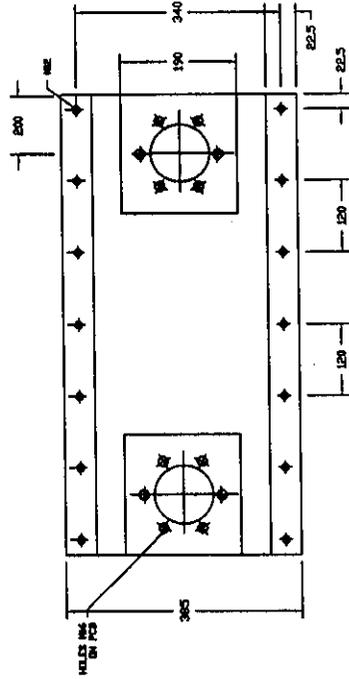
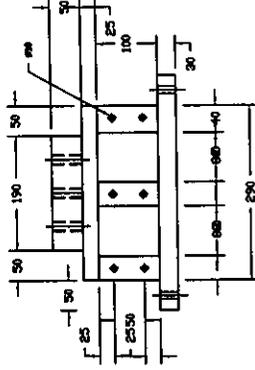
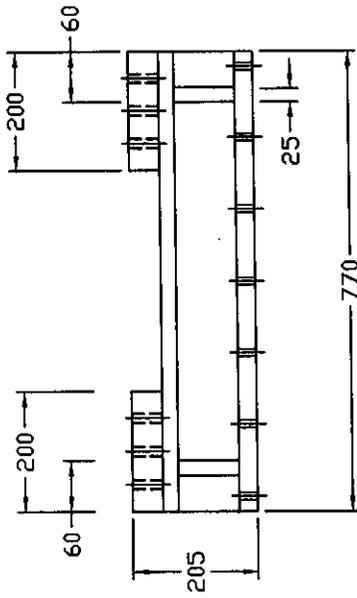
ALL DIMENSIONS IN MM

KCT PROJECT WORK		QTY. : 2 NOS.	
MAIN CYLINDER		DRG. NO. 004	
MAT. : MS	SCALE : NTS		
DRN. :	APP. :		



ALL DIMENSIONS IN MM

KCT PROJECT WORK	
EJECTION CYLINDER	
MAT:MS	SCALE: NTS
DRN: :	QTY: 2 NOS.
APP: :	DRG. NO. 005



ALL DIMENSIONS IN MM

KCT PROJECT WORK

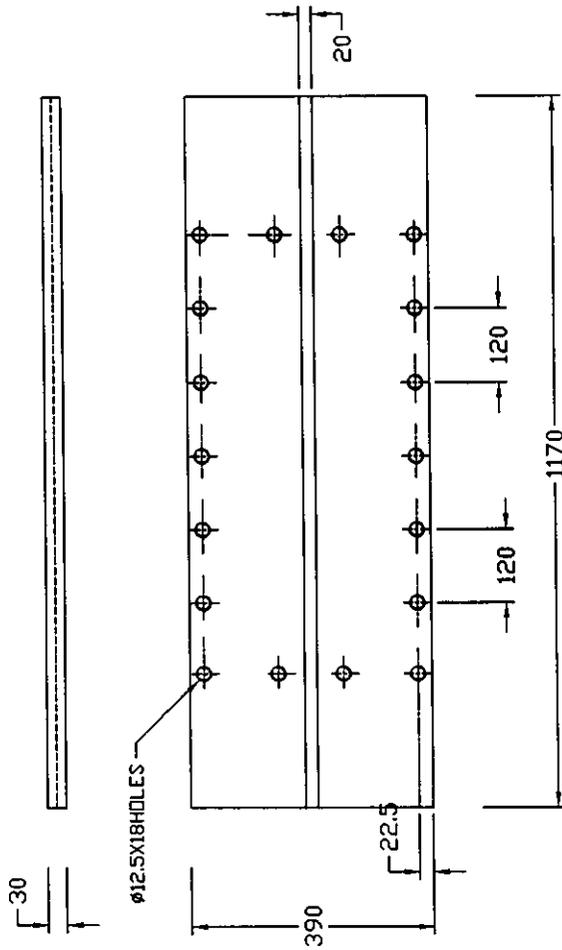
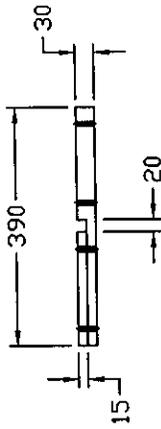
PUNCH HOLDER

MAT : MS      SCALE : NTS      QTY. : 1 NO.

DRN. :  
APP. :

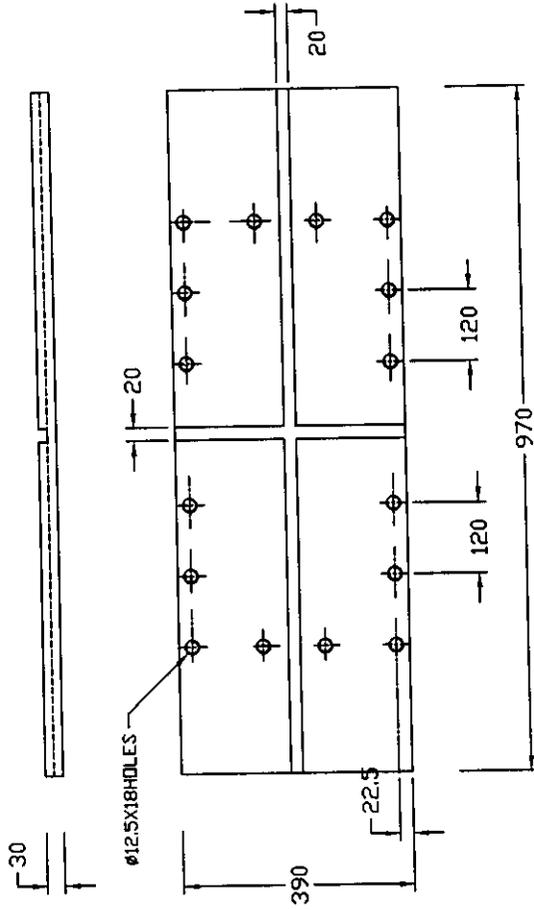
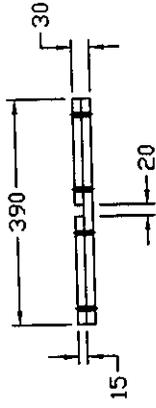


DRG. NO. 006



ALL DIMENSIONS IN MM

KCT PROJECT WORK	
PUNCH 390 X 1170 X 30	
MAT :MS	SCALE : NTS
DRN. :	QTY. : 1NO.
APP. :	DRG. NO. 007.1



ALL DIMENSIONS IN MM

KCT PROJECT WORK

PUNCH 390 X 970 X 30

MAT : MS

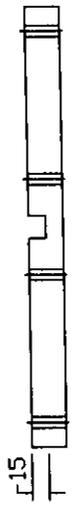
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QTY. : 1 NO.

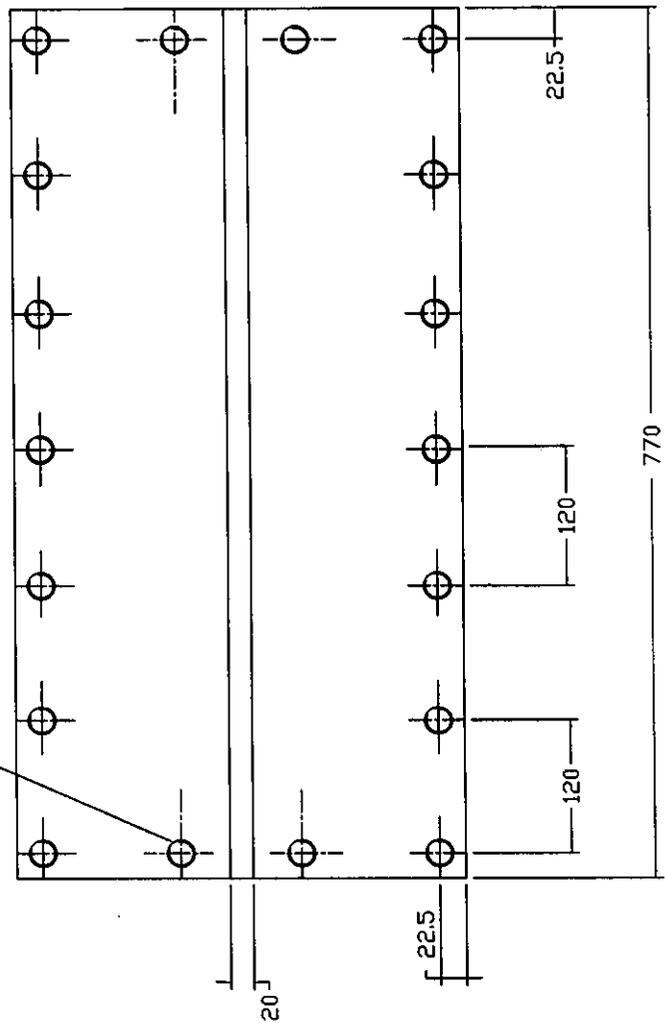
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DRG. NO. 07.2

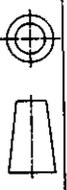


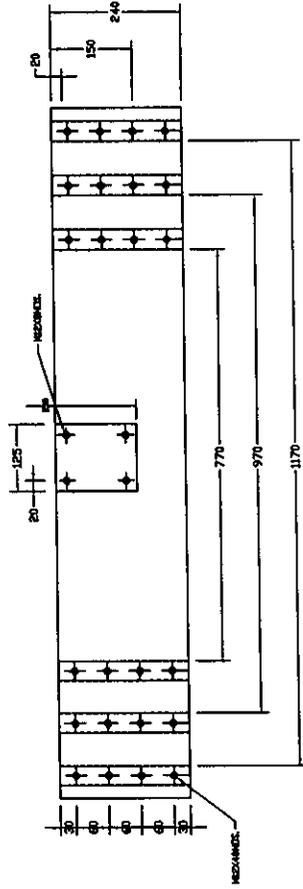
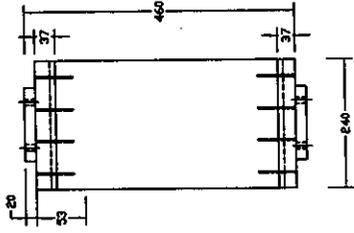
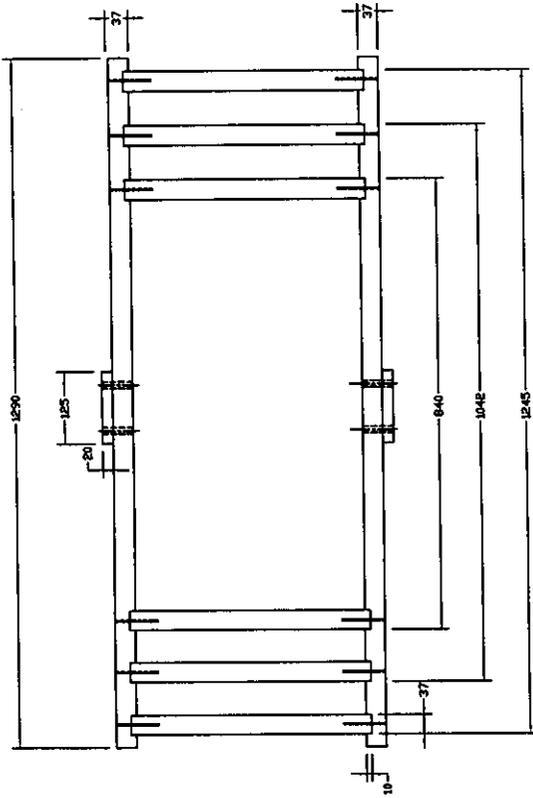
HOLE  $\varnothing 12.5 \times 18 \text{NDS}$



ALL DIMENSIONS IN MM

KCT PROJECT WORK	
PUNCH 390 X 770 X 30	
MAT : MS	SCALE : NTS
DRN : APP :	QTY : 1 NO.
	DRG. NO.07.3





ALL DIMENSIONS IN MM

KCT PROJECT WORK

MOULD ASSEMBLY

MAT :MS

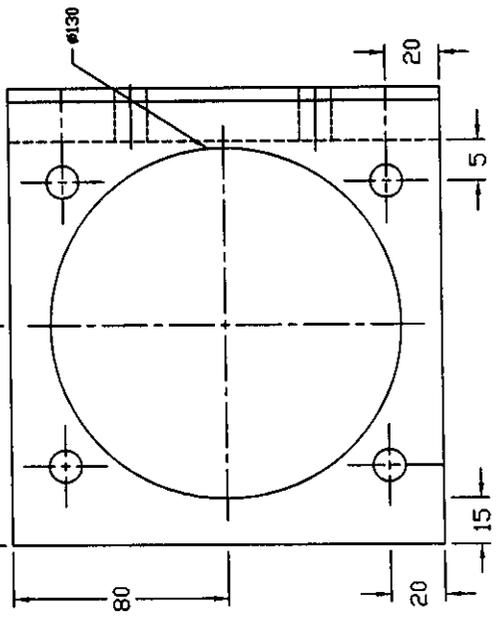
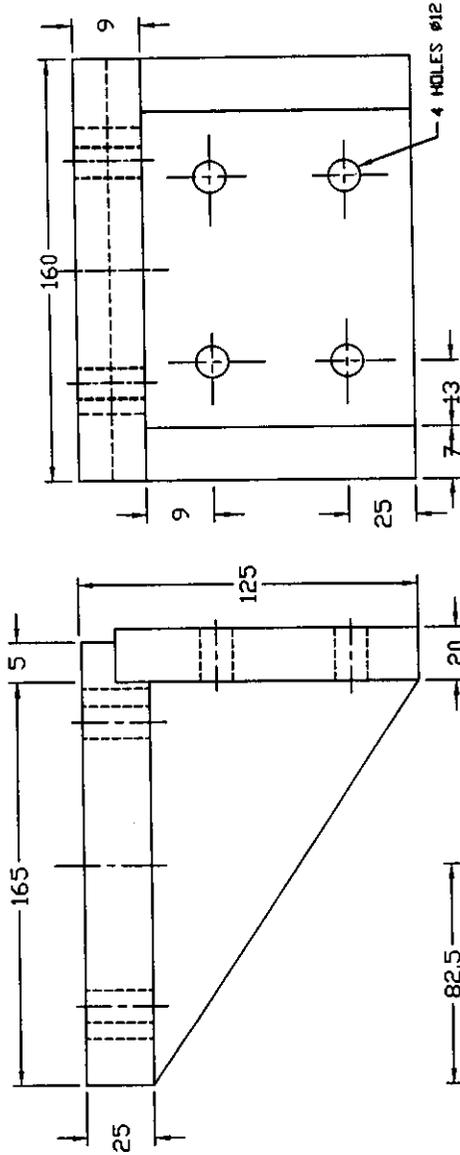
SCALE : NTS

QTY. :

DRN. :  
APP. :



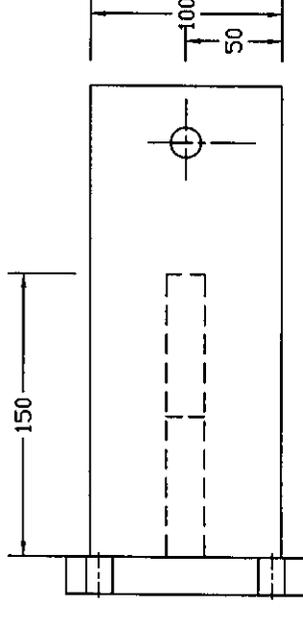
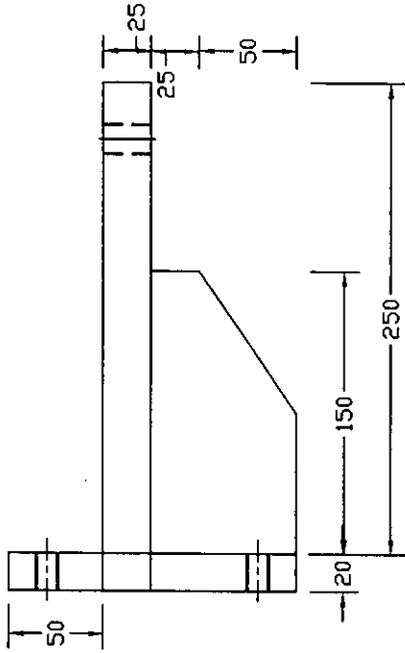
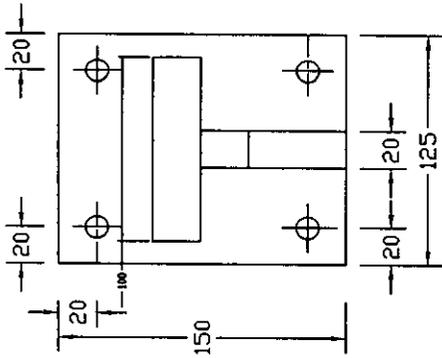
DRG. NO. 009



ALL DIMENSIONS IN MM

KCT PROJECT WORK			
EJECTION CYLINDER MOUNTING BRACKET			
MAT :MS	SCALE : NTS	QTY. : 2 NOS.	
DRN. :			DRG. NO.008
APP. :			





ALL DIMENSIONS IN MM

KCT PROJECT WORK

EJECTION CYLINDER - MOULD CONNECTOR FRAME

MAT : MS SCALE : NTS QTY : 2 NOS.

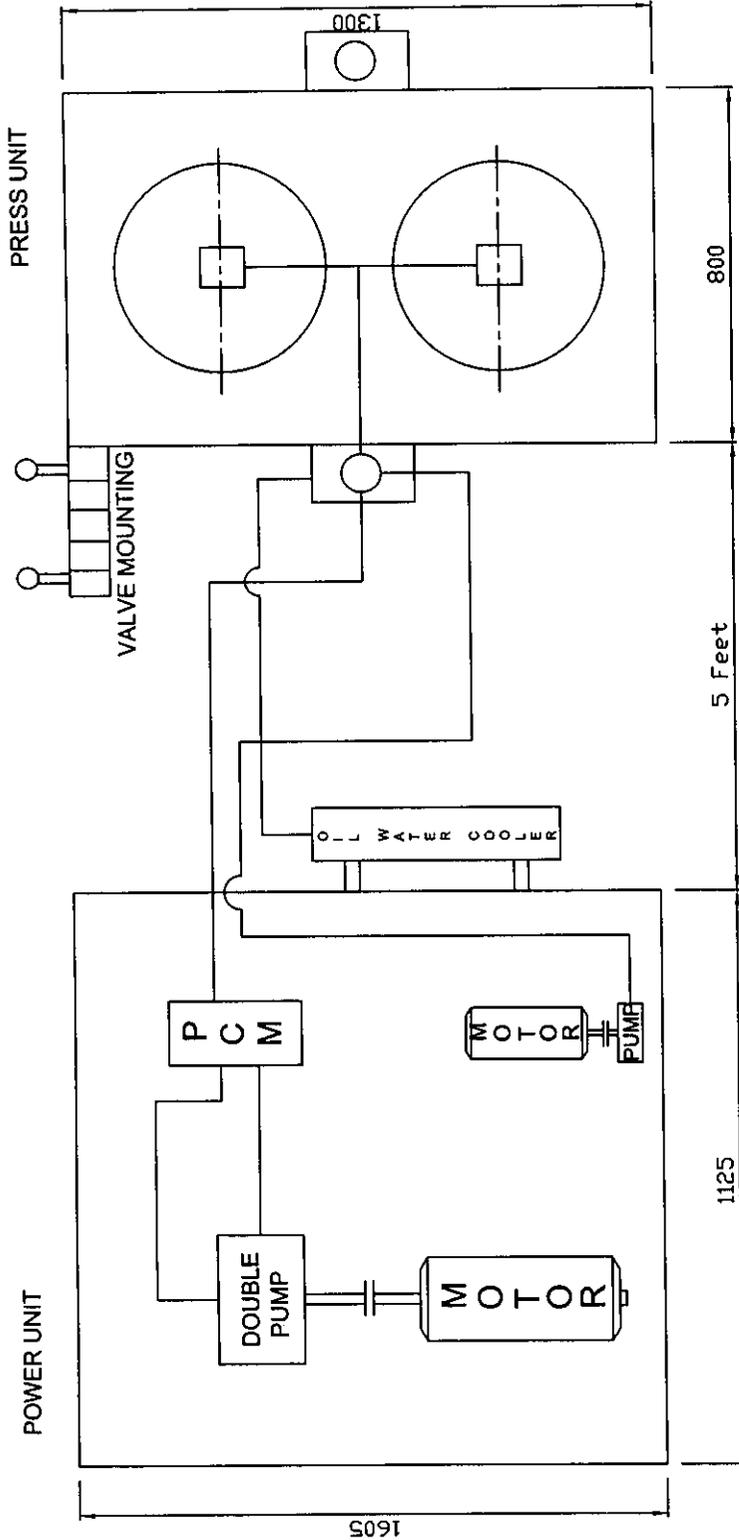
DRN. :  
APP. :



DRG. NO. 010



# ASSEMBLY LAYOUT



ALL DIMENSIONS IN MM

KCT PROJECT WORK	
ASSEMBLY LAYOUT	
MAT : MS	SCALE : NTS
DRN. :	QTY. :
APP. :	DRG. NO. 012

POWER UNIT MAX HEIGHT 1150mm

PRESS MAX HEIGHT 1970mm

## 11.0 MAINTENANCE INSTRUCTIONS

Circuit diagram identification	Name and model code of the component	Qty	Function	Maintenance instruction	Source
1	<p>Tank size 1600x 1100x 750                      Tank capacity 1100 litres                      Tank is made of steel plate. The top plate is welded to prevent dust ingress into the oil reservoir. The cutouts in the tank are closed by split sheet metal that covers with cork gasket pasted on its inside. For drainage a plug is fixed at the bottom level of the tank. A baffle plate is provided to separate suction and return lines and break in bubbles.</p>	1	<ul style="list-style-type: none"> <li>-To store and supply lubrication oil.</li> <li>- Used as a platform to support the system components.</li> <li>- Acts as a heat sink</li> </ul>	<ul style="list-style-type: none"> <li>- Keep the tank in dust free atmosphere as far as possible.</li> <li>- Check oil level before switching on the system</li> <li>- Fill oil through filler breather only</li> </ul>	Hydromith
2	<p>Filler breather                      Make: ICT                      This is installed on the top plate of the tank</p>	1	<ul style="list-style-type: none"> <li>-To fill the lubrication oil.</li> <li>- Controls the contamination while filling.</li> <li>-Allows tank to breathe in and out.</li> </ul>	to be periodically removed and cleaned	Hydromith

3	Oil level indicator 5" -to be used for this tank only.	1	-To check the oil level in the tank.		Hydros mith
4	Suction strainer 2 ½ " BSP CSS 2.075 Strainer is placed atleast 2 inch above the bottom of the tank	1	- to strain oil getting into pump	- Periodically remove and clean the strainer using brush and air. - Hand tighten can be easily removed for cleaning.	Hydros mith
5	Double vane pump PVR 50150-FF-45-140-REAA	1		-The discharge of the pump is 170 lpm (LP) and 50 lpm(HP)	Fluidics
6	Foot bracket	1			Hydros mith
7	Flexible coupling HY 48	1	-To couple pump and motor.		Hydros mith
8	Electric motor 30 HP x 1440 rpm 3 phase, induction type 415 volts AC. (double ended shaft -foot mounting)	1	- Used to drive the pump		Beard's e ll Ltd, Cbe.

9	In line check valve CIT-10-5-2080	1	- Permits free flow in only one direction.		Fluidics
10.1	Manual operated dc valve DMG-06-3D60-50	1	- to permit the flow from the pump to the main actuators		Fluidics
10.2	Subplate for above ¾ " BSP	1			Hydros mith
11	Pressure control module PCM 30/16- 50/31 5	1	- to control double pumps of hi-low system. unloads low pressure pump when system pressure rises above the pressure set on unloader valve. - Relieves the  hi - pressure pump when system pressure reaches setting value.	LP-20 kg/cm <sup>2</sup>  HP- 165kg/cm <sup>2</sup> (Max.setting)	Hydros mith

12.1	Pressure gauge Dia 4 " (0 – 210 bar)	2	- to measure pressure in the delivery line of the pump		Hydros mith, Vamaja eng. Cbe.
12.2	Glycerine filled BC/PM				
13.1	Manual operated DC valve DMG-06-3D60-50	1	to permit the flow from the pump to the ejection cylinder		Fluidics
13.2	Subplate 1 ¼ " BSP	1			Hydros mith
14	Pilot operated check valve CI30T11	2			Hydros mith

**OFF – LINE FILTRATION**

15	Suction strainer 1 " BSP CSS 2.010 Strainer is placed atleast 2 inch above the bottom of the tank	1	- To strain oil getting into pump.	-Periodically remove and clean the strainer using brush and air.  Hand tighten; can be easily removed for cleaning.	Hydros mith
16	Foot bracket	1			Hydros mith
17	Flexible coupling HY28	1	- To couple pump and motor.		Hydros mith

18	Pump PVR IT-17-F-RAA	1		- The discharge of the pump is 18 lpm.	Fluidics
19	Electric motor 2 HP x 1440 rpm 3 Phase induction type 415 volts , AC foot mounting	1	- Used to drive the pump.		Stark
20	Pressure relief valve DPRH-10-T-200	1	- The relief valve is used to divert the pump flow into the tank when pressure exceeds the set pressure.	- Using relief valve pressure set at 20 kg/cm <sup>2</sup> . - Pump should be aligned with electric motor.	Hydros mith
21	Oil water cooler Dia 5 " x 24 " length - Shell tube type  Double pass for water	1	- To cool oil flowing into the system by water. - Keeps oil at a temperature of 50'c maximum.	- The copper tubes  -bundle can be removed for servicing - To be checked periodically for smooth oil flow	Guru engg

22	RLF SM2.08 $\mu$ 25 $\mu$ With clog indicator	1			Hydros mith
23	Main cylinder Dia 250x Dia 140 x 400 St	2			Hydros mith
24	Ejection cylinder Dia 100 x Dia 70 x 80 St	2			Hydros mith

Equipment	Daily inspection	Periodical inspection
6. Air bleeder	<p>(4) Flow control valve Oil leak - check for any leak through gasket and plug</p> <p>Contamination/deformation - remove the cap and check for contamination and deformation in elements</p>	<p>(5) Check for loose, deformation, and wear in solenoid unit</p> <p>(6) Check for rust in each part</p> <p>Replacing elements - remove the cap and replace the elements</p>
7. Temperature switch	Check if it operates normally	
8. Pressure switch	Check if it operates normally	
9. Pressure gauge	Check if it operates normally	
10. Accumulator	<p>(1) Sealed gas pressure As for the bladder type, reduce the pressure to zero and fit the pressure gauge on the gas sealing side for measurement</p> <p>(2) Gas leak Apply soap water to the gas sealed part for the bladder type and the gas sealed part and cover packing for the piston type</p>	
11. Actuator	Check if it operates smoothly	<p>A. Cylinder</p> <p>(1) Oil leak - check for internal and external leak through piston packing and rod packing</p> <p>(2) Check for wear and damage of rod and loosened bolts</p> <p>(3) Inner surface of cylinder (overhauling) Check wear, deformation, damage to packings, rust in parts, and dust and other foreign matter built-up</p> <p>B. Oil motor</p> <p>(1) Amount of drain</p> <p>(2) Noise</p>
12. Piping	Oil leak through joints Check visually and by contact for oil leak through flanges and nipples (also, vibration in piping system)	<p>(1) Check for loosened parts and vibration</p> <p>(2) Check for rust</p>

# 12.0 PRE-OPERATION INSPECTION ITEMS FOR HYDRAULIC SYSTEM

Equipment	Daily inspection	Periodical inspection
1. Hydraulic pump	(1) Unusual sound - check by ears (no load / load) (2) Temperature in casing Check by contact and thermometer (3) Oil leak Check visually for oil leak through shaft and joint	(1) Wear of oscillating parts Check packings, drive shafts, bearing units, and oscillating units by overhauling (2) Check for discoloration of parts due to property and change of hydraulic oil and check for sludge dissolved by heat in oscillating parts as well as dust and other foreign matters in oil
2. Tank	(1) Oil temperature - check by thermometer (2) Oil leak - check visually for oil leak through side faces of tank and oil gauge	(1) Check for rust inside (2) Check for any unusual condition and clean inside
3. Cooler	Cooling capacity Check temperature differences in oil inlet/outlet and water inlet/outlet pipes touching them, and adjust an amount of water	(1) Scale - Overhaul the cover to check for scale built up on the entrance of fixed pipes (2) Corrosion and wear of pipes Check for any change in pipe surfaces, corrosion, damage and small holes on pipe surfaces in oil inlet/outlet parts, and contacting parts
4. Filter	Clogging - check by indicator	(1) Cleaning of elements (2) Dust Check amount of dust built-up and discoloration by measuring their size, extent, and state of progress (3) Check for swelling and damage to packings
5. Valve	(1) Pressure control valve ① Unusual sound - check for chattering and flow sound ② Temperature - check by touching the casing (2) Solenoid valve ① Unusual sound - check for any unusual sound at the time of switching ② Temperature - check by touching the casing ③ Oil leak - check visually for oil leak to gasket and solenoid side (3) Directional control valve (logic valve) Oil leak - check for any leak through mounting faces due loosening of bolts	(1) Pressure control valve Check for any damage on contact faces of poppet and seat Check operation of plunger Check for damage, wear, one-side contact, surface roughness, damage, rust and dust built-up in oscillating parts of main unit and seat (2) Solenoid valve ① Check for wear and damage of spool ② Check for deformation and strain in push rods ③ Check for wear and damage of oscillating parts of main unit ④ Check for damage and deformation of springs

## 13.0 TROUBLE SHOOTING

Trouble	Cause	Remedy
No oil discharge from the pump	The motor rotates in wrong direction immediately	Stop the motor immediately
	Oil level in the tank is too low	Add oil to a standard level
	Air enters the suction pipe system	Locate the leak and repair
	Pump shaft rotates too slow to suck oil	Increase the speed above the minimum speed recommended in manufacturer's brochure
	Viscosity of oil is too high to suck oil	Use oil with recommended viscosity
	Piping on the suction side has excess volume	Rotate the pump while draining air from the discharge side
No pressure produced	Set pressure for the relief valve is too low	Adjust the set pressure with reference to pressure gauge
	The relief valve is locked in opening position	Remove dust in the valve seat
	Oil flowing in the pressure supply system returns to the tank freely	Check each system
	Oil flowing in the hydraulic pipe control system returns to the tank freely	Check if each valve operates normally, and if not, make the adjustment Check the spool type of directional control valve
Noise generated from from the pump	Air enters through the joint between the pump and suction pipe	Apply oil to the joint while checking the sound, and tighten the joint where the sound lowered
	Air enters through shaft packing of pump	Apply oil around the shaft while checking the sound, and replace the packing where the sound lowered
	Cores of pump shaft and motor shaft do not come out	Reinstall the shafts
	Air bubbles in oil	Check if the return pipe is in the oil or if it is far from the suction pipe
	The pump rotates too fast	Slow down the pump below the maximum speed recommended in the brochure
	Viscosity of oil is too high	Use recommended oil
	The filtration device is too small	Replace with larger one
	The suction pipe or filtration device is clogged	Clean the filtration device immediately

Trouble	Cause	Remedy
Unusual heat produced	Viscosity of oil is too high	Check if the oil is old or if has adequate viscosity
	Internal leak is excessively large	Check for wear or loosening of packings, excess wear of pistons, pumps and cylinders, and repair
	Discharge pressure is too large	Check the pressure gauge, and set the relief valve at a level required for maximum load
	The oil cooler does not work	Check if oil is bypassing or if cooling water is passing normally
Accumulator circuit malfunctions	Check if electric circuit, solenoid valve, pilot circuit and unloading valve operate normally	Check for pressure drop of sealed gas, internal leak, piston damage, and damage to rubber bag
	Improper tank design	If the tank capacity is small in relation to pump discharge, install additional oil cooler or unloading circuit
Pressurized oil leak	Rated pressure for packings is incorrect	Check if the packings are suitable for operating pressure
	Packings are made of unsuitable material	Check if synthetic rubber and other oil resistance material are used, and if not, replace with suitable ones
	Packings are damaged	Check for damage, twist, any, replace with new ones
	Seal faces are not properly secured	Check for poor accuracy, incorrect installation, burr, inclusion of foreign matters, and if any, correct them
Malfunctioning	The speed decreases with temperature rise	Check if the pump efficiency decreases or if internal leak of valves and cylinders is large, and if any, repair or replace
	Knocking	Check for poor fitting, air inclusion, or excess tightening of packings in oscillating part, and if any, correct them
	Switching shock is too large	Check for excessively high working pressure or excessively fast switching speed, and if any, change the valve type (use the bypass valve) or use the choke valve
	Specified feed speed cannot be attained	Check for excess resistance in the pipe line and inclusion of foreign matters in the valve ports, and if any correct or remove them.
	General control valve does not operate properly.	Check pump discharge.
	Solenoid does not operate properly	Check for poor fitting of valves, pistons or spools, internal leak, back pressure, one side tightening, foreign matters in the valve, and scale built up, and if any, correct them
		Check for sticking of spools, insufficient magnet force, voltage drop, foreign matters in solenoid, and overheating of solenoid, and if any, correct or replace them.

## CONCLUSION

The hydraulic press for coir dust compaction has been planned, design, fabrication and trial production taken.

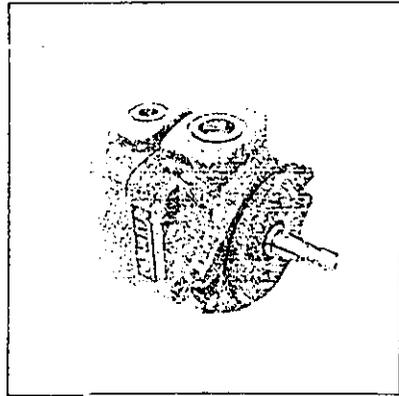
The features of the compaction press when compared to conventional presses are as described below.

- Instead of using a single cylinder of ledger diameter which increases the press size it is replaced by dual cylinders thereby reducing press size.
- Conventional die is replaced by an adjustable die which is flexible for different sizes as designed.
- Usage of economical power pack by employing double pump for operation.
- Employing ejection cylinders for lifting die after compaction, instead of removing products in conventional presses.

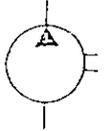
The power pack and power design and fabrication are completed under guidance of M/s. Fluidics, Ganapathy, Coimbatore and it is now at present used at M/s. Sivanthi coir products, Tuticorn, Tamilnadu.

## ■ PVRIT Series Single Vane Pumps

These Pumps are widely used as a source of hydraulic power. They combine stable performance and robust construction with a wide range of delivery rates.



Graphic Symbol



## ■ Ratings

Model Number	Max Opt. Pressure kgf/cm <sup>2</sup>	Output Flow and Input Power	Shaft Speed Range Rpm		Mass kg.	
			Max	Min	Foot Mounting	Flange Mounting
PVRIT-4	125	Refer to page 26 & 27	1500*	750	8.5	5.5
PVRIT-6	175					
PVRIT-8						
PVRIT-10						
PVRIT-12						
PVRIT-15						
PVRIT-17						

\* For speed above 1500 rpm, consult factory for information

## ■ Model Number Designation

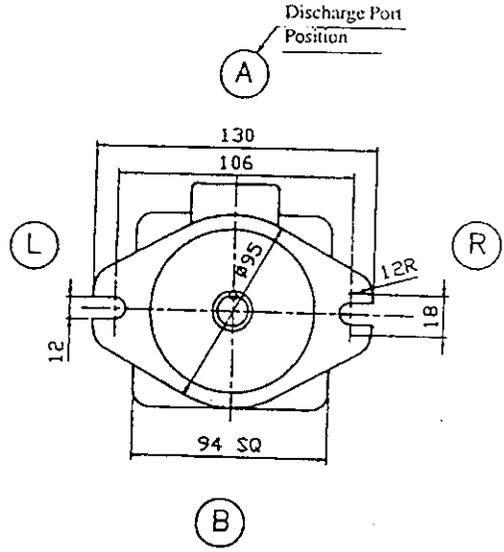
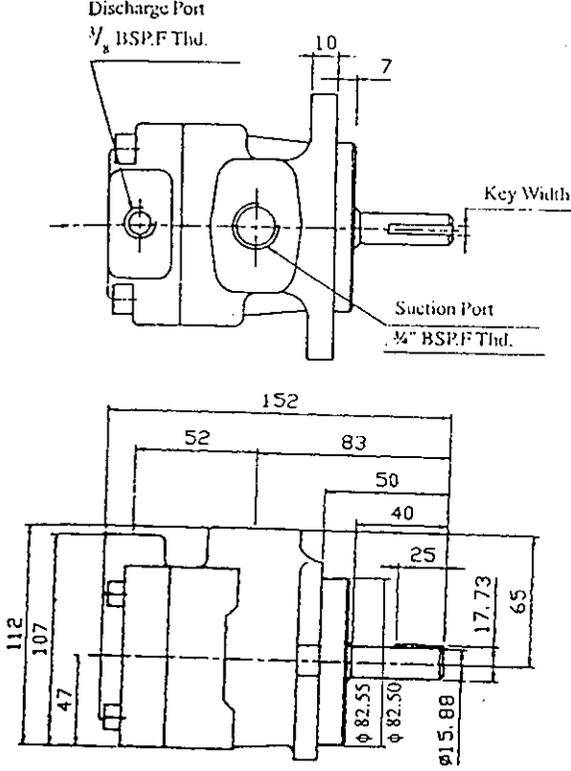
F	PVRIT	-4	-L	-R	A	-20	80
Applicable Hyd. Fluids	Series Number	Nominal Displacement cc/rev	Mounting	Direction of Rotation Viewed From Shaft Side	Discharge Port Position	Design * Number	Design Stand
F: For Phosphate Ester Type Fluids (Omit if not required)	PVRIT	4, 6 8, 10 12, 15 17	L: Foot Type F: Flange Type	R: Clockwise (Normal) L: Counter Clockwise	See Drawing A: Normal (Upwards) B: Bottom R: Right L: Left	20	80

\* Design numbers subject to change, but installation dimension remain as shown as per design number 20 through 29.

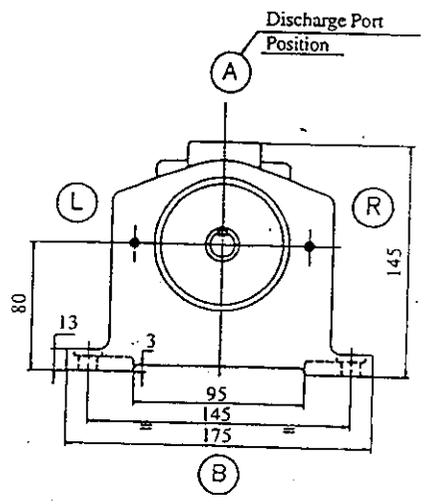
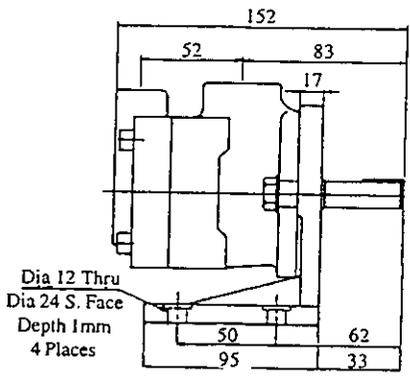
PVR1T-\*\*\*-2080

DIMENSION IN MILLIMETRES

Flange Mounting

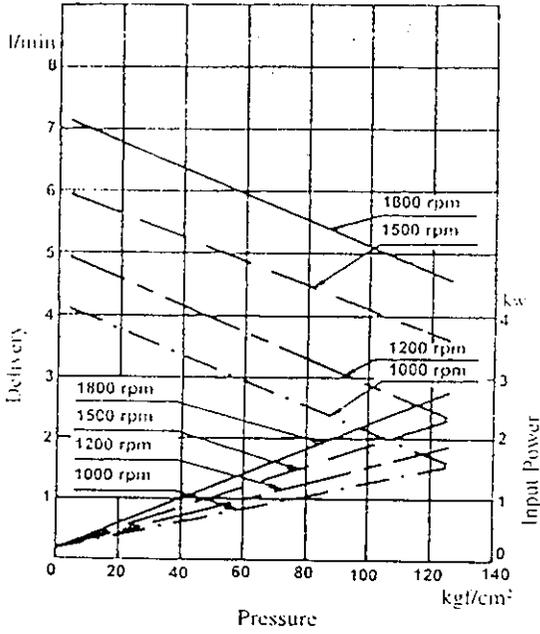


Foot Mounting

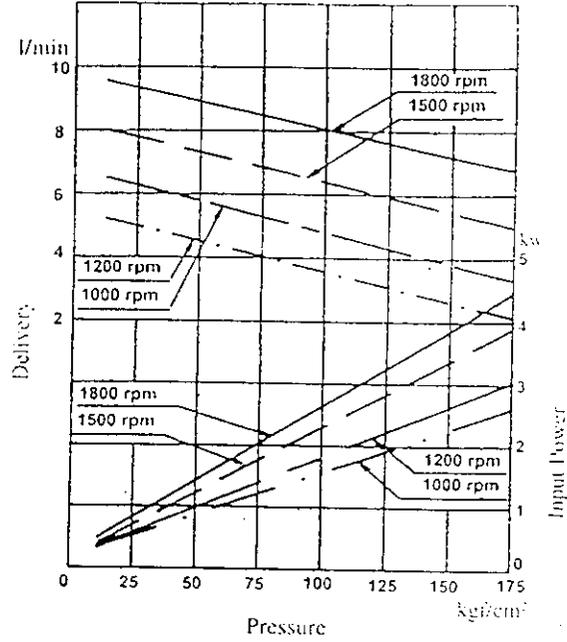


# Typical Pump Characteristics Viscosity 20 cSt Temp 50°C

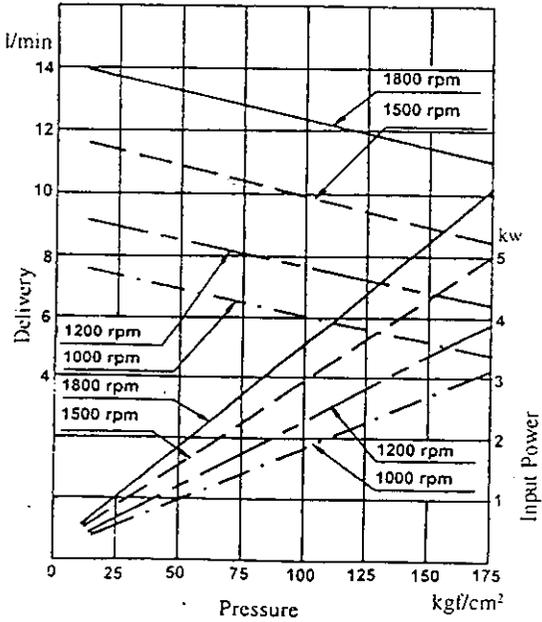
● PVR1T - 4



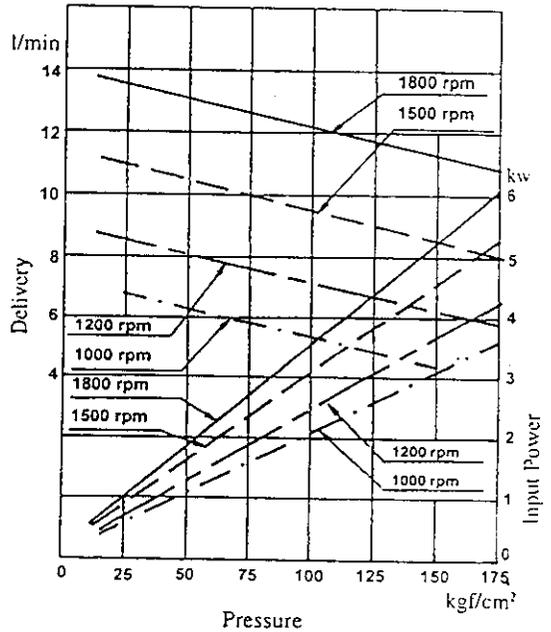
● PVR1T - 6



● PVR1T - 8

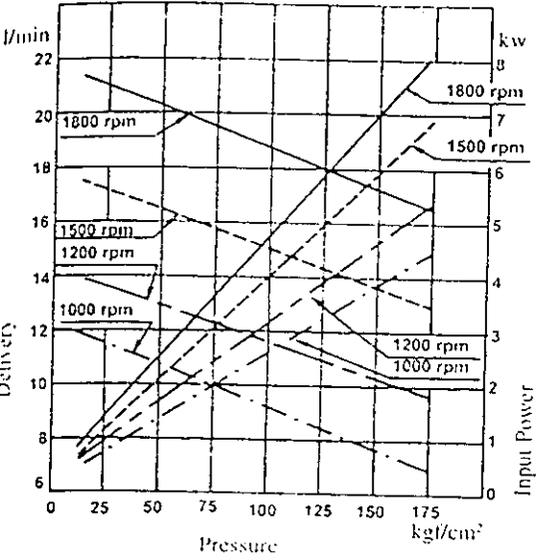


● PVR1T - 10

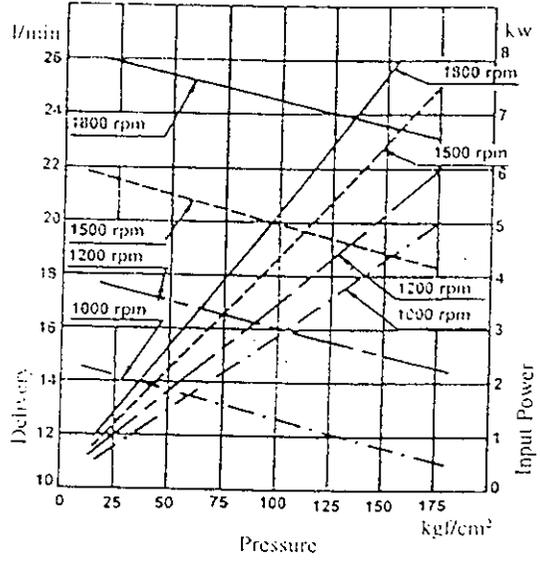


## Typical Pump Characteristics Viscosity 20 Cst Temp 50° C

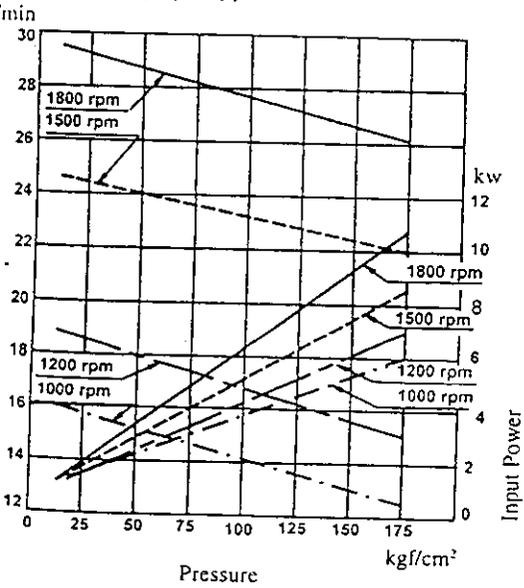
● PVR1T - 12



● PVR1T - 15



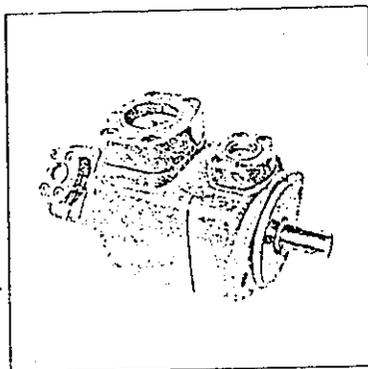
● PVR1T - 17



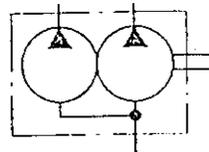
Vane Pumps

## ■ PVR 50150 Series Double Vane Pumps

These double pumps consist of one PVR50 and one PVR150 series single pumps combined in tandem within a single housing and driven by a common shaft. Fluid delivered from the two separate ports can be either supplied to separate or common circuits.



Graphic Symbol



## ■ Model Number Designation

F-	PVR50150	-L	-F	-13	-60	-R	E	A	A	14	80	
Applicable Hydraulic Fluids	Series Number	Mounting	Type of Pipe Connection	Small Volume Pump Nominal Displacement cm <sup>3</sup> /rev	Large Volume Pump Nominal Displacement cm <sup>3</sup> /rev	Direction of Rotation	Small Volume Pump Discharge Position	Large Volume Pump Discharge Position	Suction Port Position	Design NO.	Design Std.	
F: Phosphate Ester Type Fluids (Omit if not required)	PVR50150	L: Foot Mounting F: Flange Mounting	F: Flange Attachment	13, 20 26, 30 36, 39 45	60, 70 90, 110 140	R: Clockwise (Normal) L: Anticlockwise	As viewed from shaft end				14	80
										14	80	

\* Design numbers subject to change but installation dimensions remain as shown

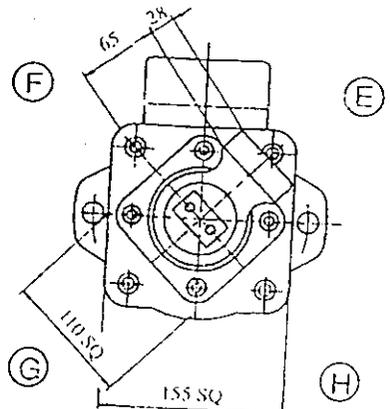
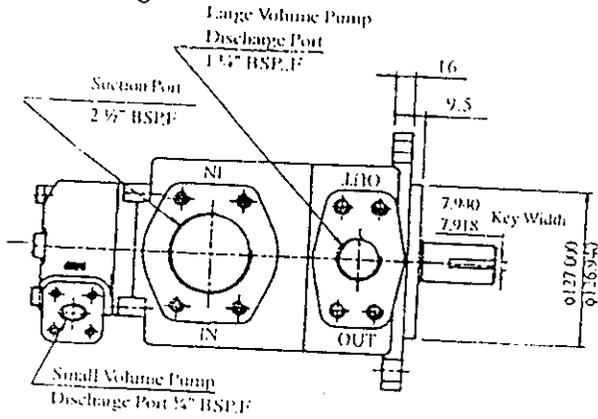
## ■ Ratings

Model Number	Max. Operating Pressure kg/cm <sup>2</sup>	Output Flow and Input Power	Shaft Speed Range RPM		Mass Kg.	
			Max.	Min.	Flange Mounting	Foot Mounting
PVR50150	175	Refer Page 30, 31 and 34	2000	600	42.5	49

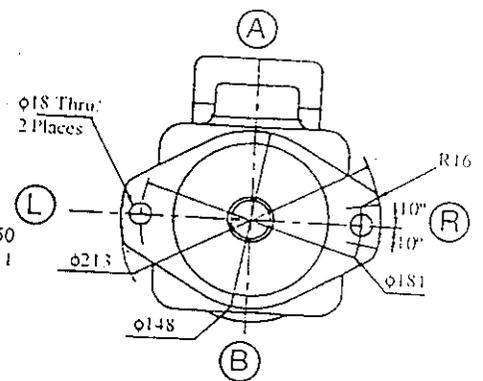
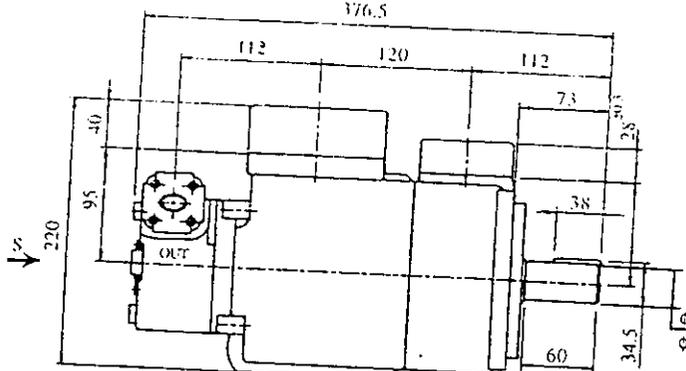
# PVR50150

## Flange Mounting

DIMENSION IN MILLIMETRES

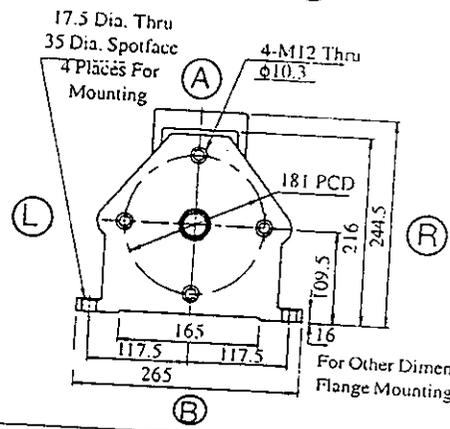
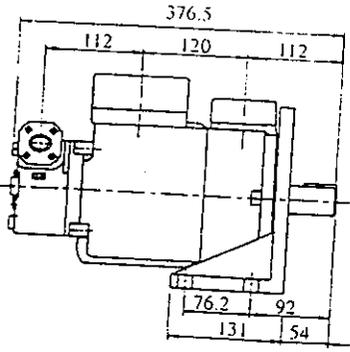


View on Arrow - S



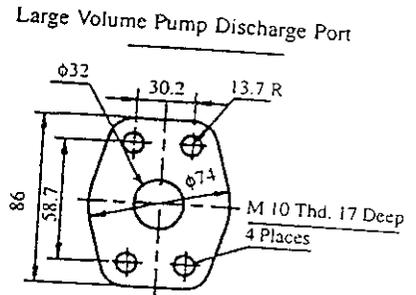
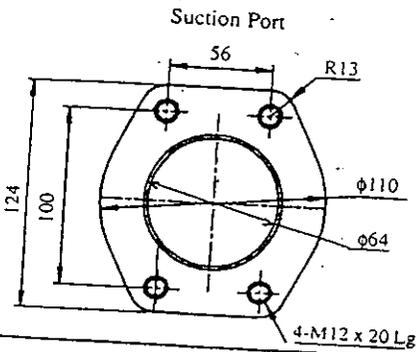
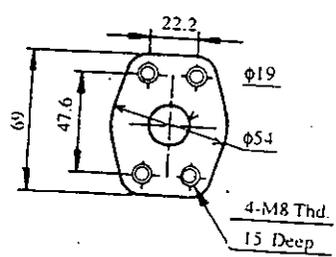
Note: The Suction and Delivery Ports are always with Flange Connection only

## Foot Mounting



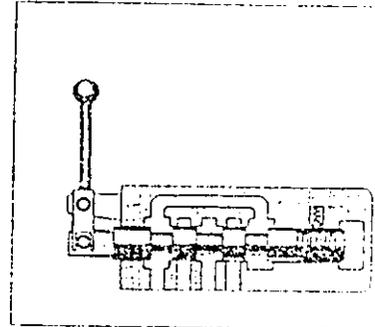
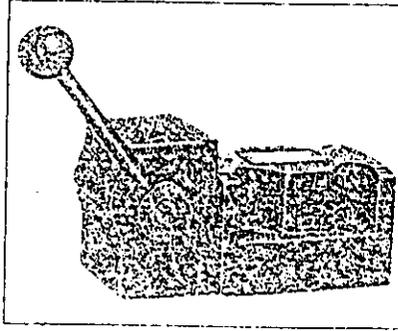
For Other Dimensions See Flange Mounting

## For Reference: Dimensions of Pipe Flange Mounting Surface



## Manually Operated Directional Valves

These valves may be used to manually shift the spool position and change the direction of oil flow.



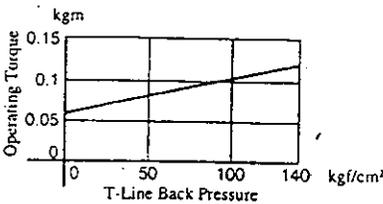
### Ratings

Model Numbers	Maximum Flow $l/min$				Max. Operating Pressure $kgf/cm^2$	Max. T-Line Back Pressure $kgf/cm^2$	Mass $kg$
	70 $kgf/cm^2$	140 $kgf/cm^2$	210 $kgf/cm^2$	315 $kgf/cm^2$			
DMG-01-3C#-10	35	35	100	---	250	140 <sup>*)</sup>	1.8
DMG-01-3D#-10							
DMG-01-2D#-10							
DMG-01-2B#-10							
DMG-03-3C#-50	100 <sup>*)</sup>	100 <sup>*)</sup>	100 <sup>*)</sup>	---	250	160	4.0
DMG-03-3D#-50							
DMG-03-2D#-50							
DMG-03-2B#-50							
DMG-06-3C#-50	500	500	500	500	315	210 <sup>*)</sup>	11.5
DMG-06-3D#-50							
DMG-06-2D#-50							
DMG-06-2B#-50	420	300	250	200			12

Note : Max. flow indicates a ceiling flow which does not affect the normal function (changeover) of the valve.

- 1. Varies depending of the spool type. For the details, see the "List of Standard Spool Functions" for DSC-03 Series Solenoid Operated Directional Valves (page 139 or 140 at 50 Hz rated voltage.)
- 2. Over operating torque varies depending on the T-Line back pressure. See the right-hand figure.
- 3. If the T-Line back pressure exceeds 70  $kgf/cm^2$ , directly connect the drain port to the reservoir.

### DMG-01 Lever Operating Torque



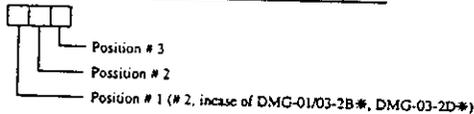
**Model Number Designation**

F-	DM	G	-03	-2	B	2	A	-50
Special Seals	Series Number	Type of Connection	Valves size	No. of Valve Position	Spool-Spring Arrangement	Spool Type	Special Two Position Valve	Design Number
F: Special seals for phosphate ester type fluids (Omit if not required)	DM: Manually Operated Directional Valves	G: Sub-plate Mounting	01	3	C: Spring Centred	2-3	A*, B* (Omit if not required)	10
			03		D: No-spring Detented	4-40 5-6 60-7		50
			06	B: Spring Offset	8-9 12	50		
See the table for combinations.								

Refer to column "valves with centre position and one offset position" (special 2-position valve) on page 168.

**List of Spool Type**

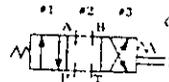
Spool Type	DMG-01			DMG-03			DMG-06	
	3C 3D	2D	2B	3C 2D	2D	2B	3C 3D	2D 2B
2	○	○	○	○	○	○	○	○
3	○	○	○	○	○	○	○	○
4	○	—	—	○	—	—	○	○
40	○	—	—	○	—	—	○	○
5	○	—	—	—	—	—	—	—
	○	—	—	—	—	—	○	—
6	—	—	—	—	—	—	○	—
	—	—	—	—	—	—	—	—
60	○	—	—	○	—	—	○	—
	—	—	—	—	—	—	—	—
7	○	○	—	—	—	—	○	○
8	○	○	○	—	—	○	—	—
9	○	—	—	○	—	—	○	—
10	○	—	—	○	—	—	○	—
11	○	—	—	—	—	—	○	—
12	○	—	—	○	—	—	○	—



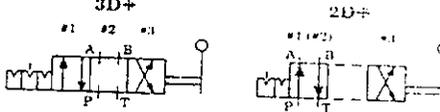
Note : The ○ mark indicate the spool type available for each type.

**Graphic Symbols**

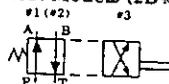
Spring Centred Models (3C+)



No-Spring Detented Models (3D+)



Spring Offset Models (2B\*)



Position #2 is applied for models DMG-01-2B\* and DMG-03-2B\*2B\*.

## ■ Sub-plates

Valve Model Numbers	Sub-plate Model Numbers	Thread Size	Approx. Mass kg
DMG-01	DSGM-01-3080	1/8 BSP.F	0.8
	DSGM-01X-3080	1/4 BSP.F	0.8
DMG-03	DSGM-03-2180	3/8 BSP.F	3.0
	DSGM-03X-2180	1/2 BSP.F	3.0
	DSGM-03Y-2180	3/4 BSP.F	4.7
DMG-06	DSGM-06-5080	3/4 BSP.F	8.5
	DSGM-06X-5080	1 BSP.F	8.5

- Sub-plates are available. Specify sub-plate model from the table above. When sub-plates are not used, the mounting surface should have a good machined finish.
- Shareable with Solenoid Operated Directional Valves and Solenoid Controlled Pilot Operated Directional Valves. For dimensions, refer to the right table then see the corresponding pages.

- Sub-plate dimensions appearing page

Sub-plate Model No.	Page
DSGM-01±	136
DSGM-03±	136
DSGM-06±	166

## ■ Mounting Bolts

Model Numbers	Socket Head Cap Screw	Qty.	Tightening Torque kgm
DMG-01	M5 x 45 Lg	4	0.5-0.7
DMG-03	M6 x 35 Lg	4	1.2-1.5
DMG-06	M12 x 60 Lg	6	10.0-12.3

## ■ Instructions

- Avoid connecting the Tank Port "T" to a line with possible surge pressure.

## ■ Pressure Drops

The following characteristics are based on the following conditions: viscosity of the fluid: 35 cSt (160 SSU) Specific Gravity: 0.850

- For any other viscosity, multiply the factors in the table below.

Viscosity	cSt	15	20	30	40	50	60	70	80	90	100
	SSU	77	98	141	186	232	278	324	371	417	464
Factor		0.81	0.87	0.96	1.03	1.09	1.14	1.19	1.23	1.27	1.30

- For any other specific gravity (G'), the pressure drop ( $\Delta P'$ ) may be obtained from the formula below.

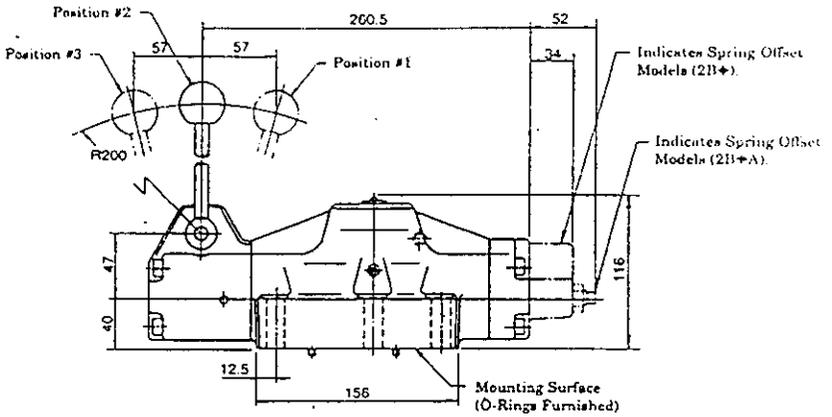
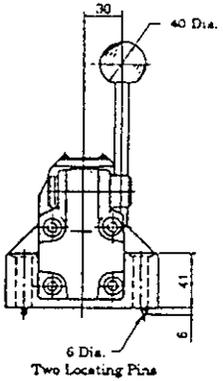
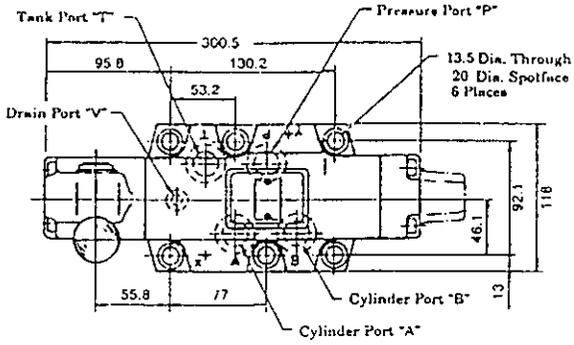
$\Delta P' = \Delta P G'/G$  where,  $\Delta P$  is a value on the following chart and G is 0.850.

Spool Type	Pressure Drop Curve Number				
	P→A	B→T	P→B	A→T	P→T
2	②	②	②	②	—
3	③	②	③	②	②
4	②	③	②	②	—
40	②	②	②	②	—
5	③	②	②	②	—
6	③	②	②	②	①
60	③	②	③	②	①
7	②	②	②	②	—
8	②	—	②	—	—
9	③	②	③	②	—
10	②	②	②	②	—
11	③	②	②	②	—
12	②	②	②	②	—

Directional Controls

DMG-06-\*\*\*-50

DIMENSION IN MILLIMETERS

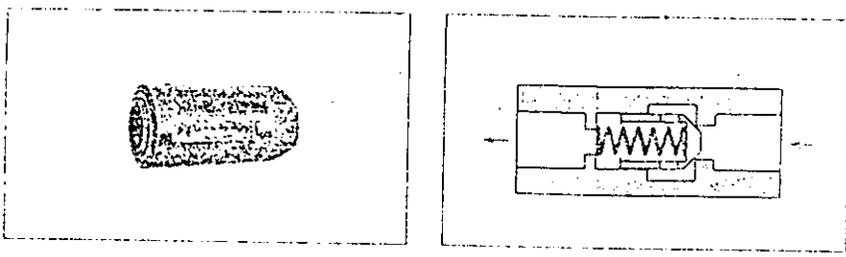


Note : For the valve mounting surface dimensions, see the dimensional drawing of the sharable sub-plate in page 159 .



## In-Line Check Valves

These valves allow free flow in one direction and prevent flow in the reverse direction. Cracking pressure specified is the pressure required to open the valve and allow free flow.



Graphic Symbol



### Ratings

Model Number	Rated Flow l/min	Max. Operating Pressure kgf/cm <sup>2</sup>	Cracking Pressure kgf/cm <sup>2</sup>	Mass kg
T-02-※-2180	12	210	0.35	0.10
T-03-※-2080	30		2.00	0.18
T-06-※-2080	80		3.5	0.65
T-10-※-2080	200		5.00	2.1

Rated flow is the approximate flow rate, when there is a free flow pressure drop of maximum 3 kgf/cm<sup>2</sup> the fluid has a specific gravity of 0.85 and a kinematic viscosity of 20cSt (100 SSU), and the cracking pressure is 0.4 kgf/cm<sup>2</sup>.

### Model Number Designation

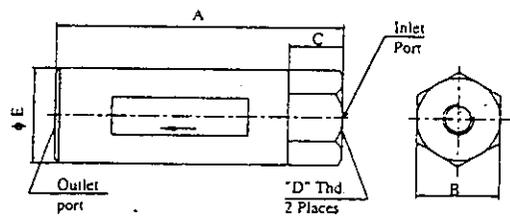
CIT	T	-03	30	20	※
Series Number	Type of Connection	Valve Size	Cracking Pressure kgf/cm <sup>2</sup>	Design Number	Design Standards
In-Line Check-Line	T: Threaded Connection	02	5 : 0.35	21	80
		03	30 : 2.0	20	
		06	50 : 3.5	20	
		10	75 : 5.0	20	

For in-line check valves, standard type (for petroleum base oil) can be used phosphate ester type fluid.

Pressure Drop

- T-02-※-2180
- T-03-※-2080
- T-06-※-2080
- T-10-※-2080

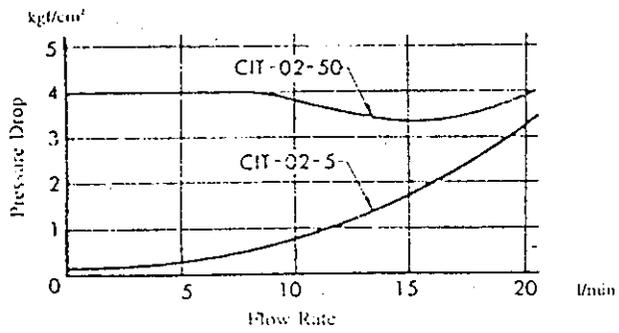
DIMENSION IN MILLIMETERS



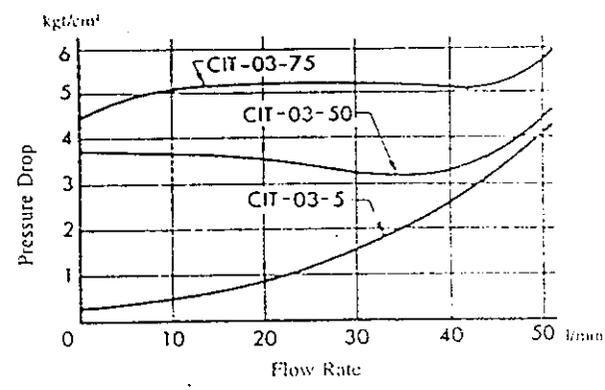
Model Numbers	mm				"D" Thd.
	A	B	C	E	
CIT-02-※-2180	65	22	15	25.4	¼ BSP.F
CIT-03-※-2080	70	28	20	33	¼ BSP.F
CIT-06-※-2080	95	38	25	44	¼ BSP.F
CIT-10-※-2080	132	58	30	67	1¼ BSP.F

# Pressure Drop

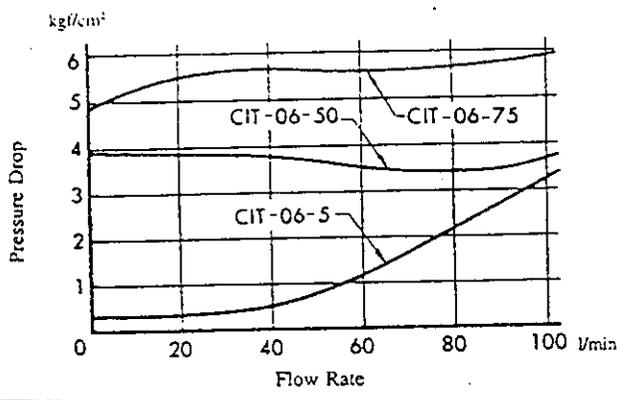
④ CIT-02



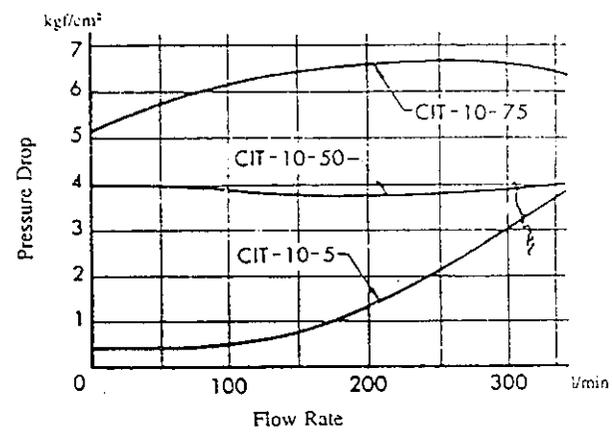
⑤ CIT-03



⑥ CIT-06

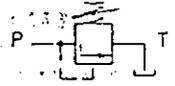


⑦ CIT-10



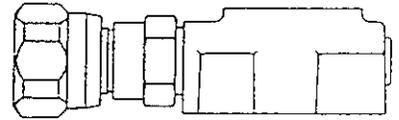


# PRESSURE RELIEF VALVES DPR

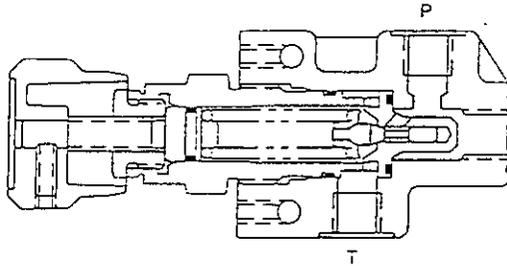


## Description

- Direct acting valve.
- Guided poppet design.
- Cushion arrangement for greater stability and noise control.
- Three sizes.
  - 06, 10 and 20.
- Three mounting styles
  - Threaded cartridge.
  - Threaded port body.
  - Subplate mounting body.
- Six pressure ranges
  - Upto 25, 50, 100, 200, 315 and 400 bar.
- Two options for pressure adjustment
  - With set screw and Lock nut.
  - With hand knob.



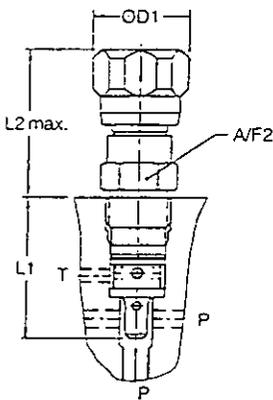
## Section



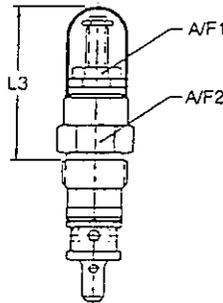
## Unit Dimensions

### Threaded cartridge and cavity details

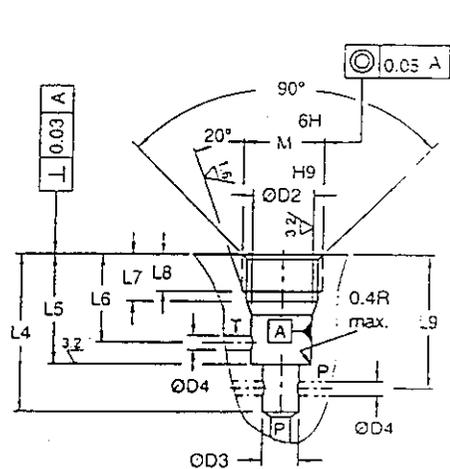
Dimensions in mm



Cartridge with hand knob for pr. adjustment.



Cartridge with set screw for pr. adjustment.



Cartridge cavity machining details.

Table No. 1

Size	Mass		M	OD1	OD2	OD3	OD4	L1	L2	L3	±0.5		±0.2		±0.2		Tightening torque Nm.
	Kg.	A/F1									A/F2	L4	L5	L6	L7	L8	
6	0.45	19	30	M28 x 1.5	43	25	15	64	64	65	65	45	35	19	15	55	120
10	0.9	22	36	M35 x 1.5	48	32	19	77	82	80	80	52	41	23	18	69	140
20	1.6	22	46	M45 x 1.5	60	40	24	103	85	78.5	110	70	54	27	21	91.5	170

Polyhydron Pvt. Ltd.  
78-80, Machhe Industrial Estate, Machhe  
Belgaum - 590 014, INDIA.

Phone : +91-(0)831-411001  
Fax : +91-(0)831-411002

## BIBLIOGRAPHY

Sl.No.	Book name	Author	Edition
1	Industrial hydraulics	John pippenger	Tata McGraw hill
2	Industrial hydraulics	Exposito	Prentice hall
3	Industrial hydraulics		Vickers manual
4	Hydraulic equipment		Yuken catalogue
5	Machine design text book	R.S. Khurmi, J.K. Gupta	S. Chand publications
6	Strength of materials	S. Ramamurtham R. Narayanan	Dhanpat rai & sons
7	Design data book	P.S.G.	DPV printers
8	Hydraulic equipment		Polhydron catalogue
9	Cor pith potential wealth in India	Devaraj G.	Surya publications
10	Exportable coir products in Tamilnadu	Kamaraj C.M.	Gaurav publications

threaded port body

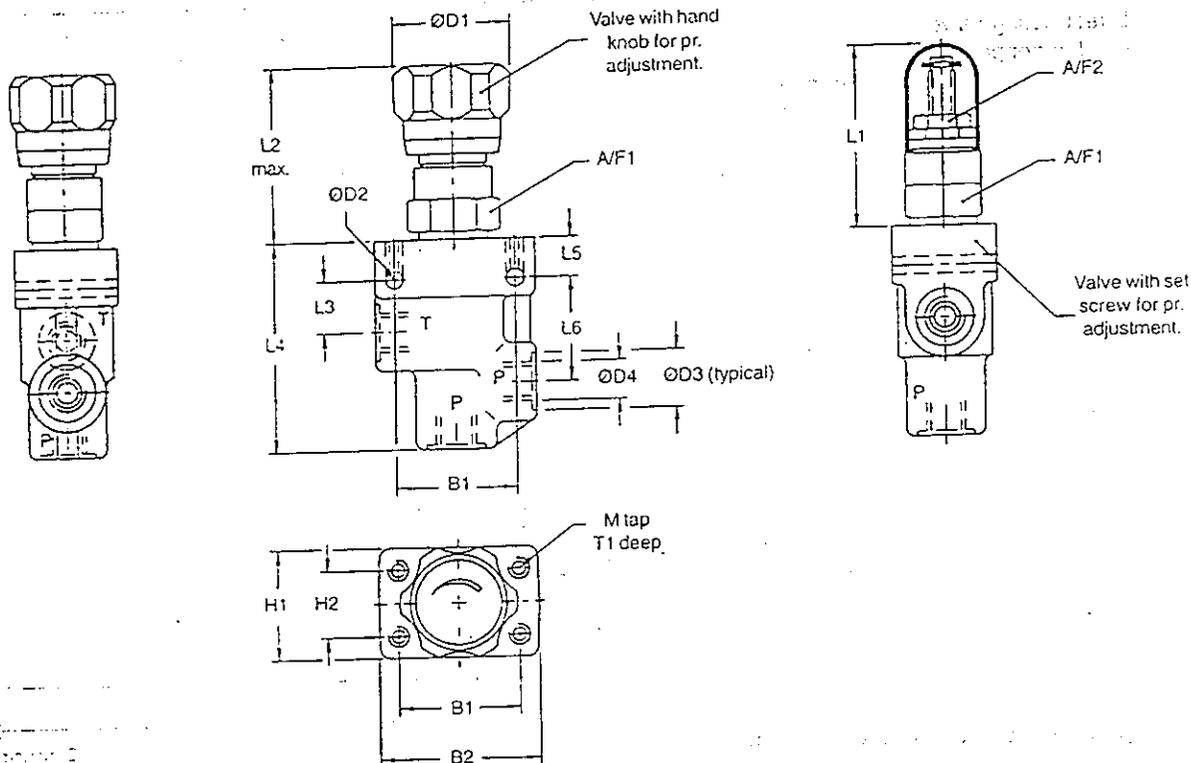


Table No. 2

Size	Mass Kg.	B1	B2	ØD1	ØD2	ØD3	ØD4	M	A/F1	A/F2	L1	L2	L3	L4	L5	L6	H1	H2	T1
6	1.2	45	60	43	6.6	22	G1/4	M6	30	19	65	64	20	80	15	40	40	25	11
10	2.8	60	80	48	9	30	G1/2	M8	36	22	80	82	22	100	20	49	60	40	15
20	6.2	70	100	60	9	44	G1	M8	46	22	78.5	85	34	135	20	65	70	50	15

Subplate mounting body

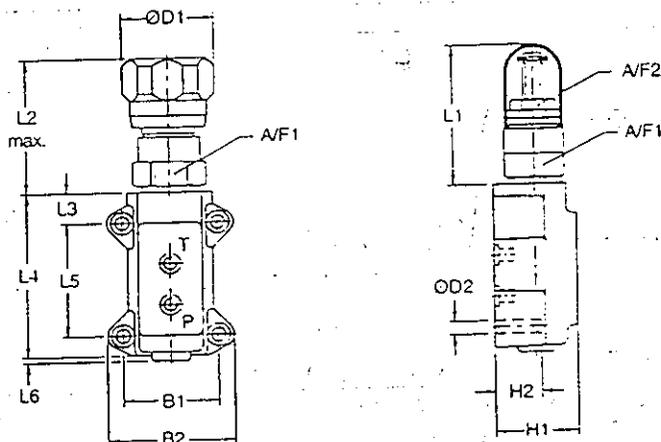


Table No. 3

Size	Mass Kg.	B1	B2	ØD1	ØD2	A/F1	A/F2	L1	L2	L3	L4	L5	L6	H1	H2
6	1.1	45	60	43	6.6	30	19	65	64	15	80	55	4	40	21
10	2.4	60	80	48	9	36	22	80	82	20	100	70	5	55	28
20	6.2	70	100	60	9	46	22	78.5	85	20	135	100	5	70	70



# DIRECT ACTING PRESSURE RELIEF VALVES DPR

ENGINEERING

2

Threaded port body

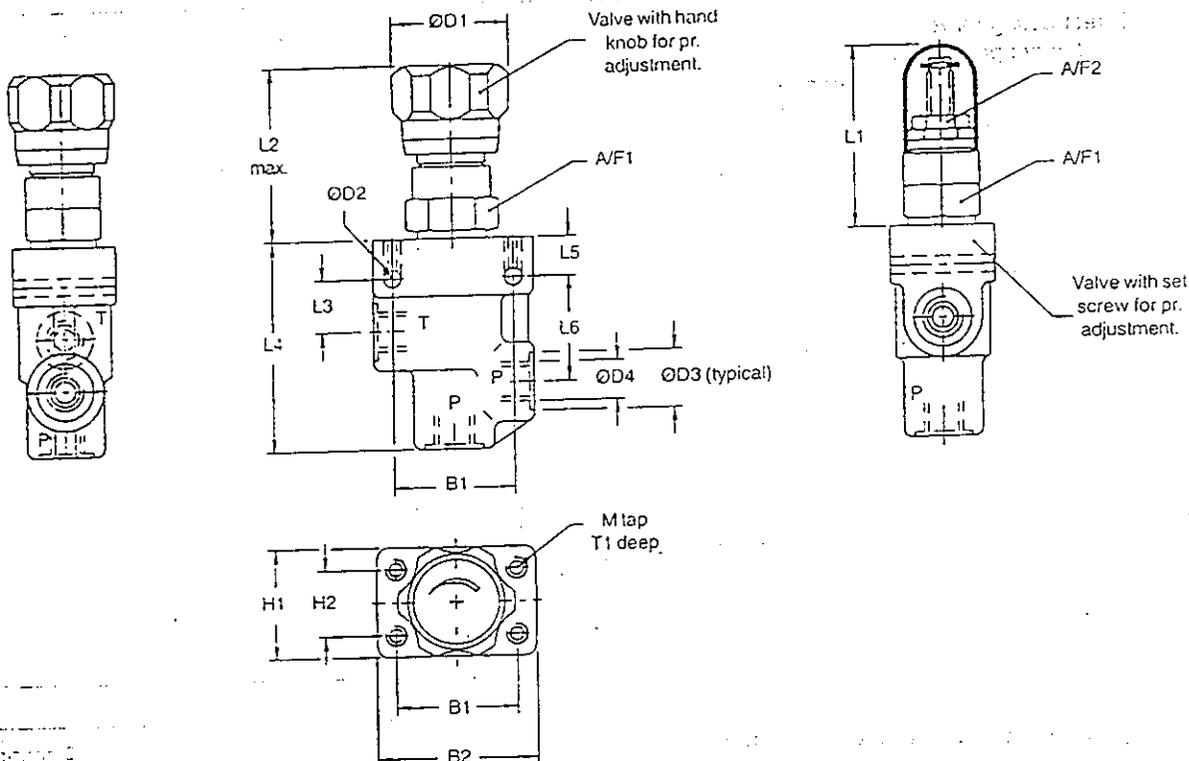


Table No. 2

Size NG	Mass Kg.	B1	B2	OD1	OD2	OD3	OD4	M	A/F1	A/F2	L1	L2	L3	L4	L5	L6	H1	H2	T1
6	1.2	45	60	43	6.6	22	G1/4	M6	30	19	65	64	20	80	15	40	40	25	11
10	2.8	60	80	48	9	30	G1/2	M8	36	22	80	82	22	100	20	49	60	40	15
20	6.2	70	100	60	9	44	G1	M8	46	22	78.5	85	34	135	20	65	70	50	15

Subplate mounting body

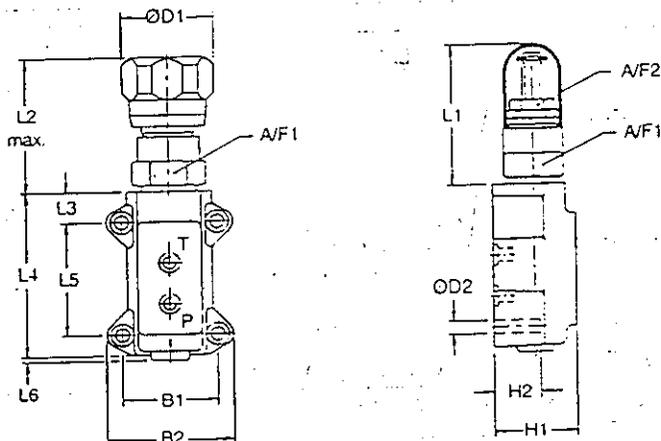


Table No. 3

Size	Mass Kg.	B1	B2	OD1	OD2	A/F1	A/F2	L1	L2	L3	L4	L5	L6	H1	H2
6	1.1	45	60	43	6.6	30	19	65	64	15	80	55	4	40	21
10	2.4	60	80	48	9	36	22	80	82	20	100	70	5	55	28
20	6.2	70	100	60	9	44	22	78.5	85	34	135	20	5	70	70



# DIRECT ACTING PRESSURE RELIEF VALVES DPR

ENGINEERING

4

## Technical Specifications

Construction .....	Direct acting, poppet type.
Mounting style .....	Threaded cartridge. Threaded port body or subplate mounting body.
Interface .....	Factory standard
	Note : Subplate mounting valves having interface as per ISO 6462-AB-03-4-C (Draft) and ISO 6462-AR-06-2-A (Draft) are also available on request. Please ask for details
Mounting position .....	Optional
Flow direction .....	From P to T
Operating pressure	
For port P .....	400 bar.
For port T .....	315 bar.
Pressure setting ranges .....	Upto 25, 50, 100, 200, 315 and 400 bar.
Hydraulic medium .....	Mineral Oil
Viscosity range .....	10 Cst. to 380 Cst
Fluid temperature range .....	-20 °C to +70 °C
Fluid cleanliness requirement .....	As per ISO 16/13 or better.
Mass .....	Refer individual table.

## Ordering Code

