Project- Reduction in Hydraulic Oil Consumption

By 10% For Financial Year 2015-2016

Name-

Roll no-

Collage name-

Acknowledgement

Industrial training is a crucial period in engineering curriculum since it exposes a student to the real world which he or she is going to enter after the completion of the degree .I would like to acknowledge **TATA MOTORS,** Jamshedpur for providing me an opportunity to work on the project.

I would like to express my deep gratitude to my Project Head **MR. Y.M. SAKHRE (AGM , Engine Maintenance)** for

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Signature
Aniruddha Choudhury`
B Tech (Mechanical Engineering)

Signature
Training In charge

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ABOUT TATA MOTORS

Tata Motors Limited (formerly **TELCO**, short for **Tata Engineering and Locomotive Company**) is an Indian multinational automotive manufacturing company headquartered in Mumbai, Maharashtra, India and a subsidiary of the Tata Group .It is India's largest automobile company, with consolidated revenues of INR 2,32,834 crores (USD 38.9 billion) in 2013-14. Established in 1945,Tata Motors is India's largest & only fully integrated automobile company .Tata Motors began manufacturing commercial vehicles in 1954 with a 15 year collaboration agreement with Daimler Benz of Germany.

Its products include passenger cars, trucks, vans, coaches, buses, construction equipment and military vehicles. It is the world's 17th-largest motor vehicle manufacturing company, fourth-largest truck manufacturer, and second-largest bus manufacturer by volume.

Tata Motors has auto manufacturing and assembly plants in Jamshedpur, Pantnagar , Lucknow , Sanand, Dhanwad, and Pune in India, as well as in Argentina, South Africa, Thailand, and the United Kingdom. Tata Motors, also listed in the **NEW YORK STOCK EXCHANGE** (September 2004), has emerged as an international automobile company.

The first unit of the TATA motors was established in Jamshedpur in the year 1945. The whole unit is covering a vast area of 822 acres in Jamshedpur city. The city is called Tatanagar because of the establishment of this unit here. The plant manufactures Tata Motors' entire range of medium and heavy commercial vehicles (M&HCV), including the Tata Prima, both for civilian and defence applications. The four major divisions of TATA motors are Engine Factory, Truck Factory and Cab factory and Cowl Factory. Because of the divestments in March 2000, the Axle and engine plants were hived off into the independent subsidiaries.

Tata Motors' principal subsidiaries include Tata Daewoo , Tata Hispano , Jaguar Land Rover , Telco Construction Equipment , TML Drivelines Ltd

TATA DAEWOO : It is a commercial vehicle manufacturer headquartered in Gunsan , Jeollabuk-do , South Korea and a wholly owned subsidiary of Tata Motors .It is the second largest heavy commercial vehicle manufacturer in South Korea & was acquired by Tata Motors in 2004.Tata Motors has jointly worked with Tata Daewoo to develop trucks such as Novus & World trucks & buses including Globus & Starbus.

TATA HISPANO : Motors Carrocera , S.A. is a bus & coach cabin manufacturer based in Zaragoza , Aragon , Spain and a wholly owned subsidiary of Tata Motors . Tata Hispano has plants in Zaragoza , Spain and Casablanca , Morocco . Tata motors first acquired a 21% stake in Hispano Carrocera S.A. in 2005 , & purchased the remaining 79% for an undisclosed sum in 2009 making it a fully owned subsidiary , subsequently renamed Tata Hispano

Jaguar Land Rover : JLR PLC is a British premium automaker headquartered in Whitley , Coventry , United Kingdom and has been a wholly owned subsidiary of Tata Motors since June 2008,when it was acquired from Ford Motor Company.Its principal activity is the development, manufacture and sale of Jaguar luxury and sports cars and Land Rover premium four wheel drive vehicles.It also owns the currently dormant Daimler,Lanchester & Rover brands.

Telco Construction Equipment(TCE) : TCE is a joint venture between Tata Motors & Hitachi which focuses on excavators and other construction equipments.

TML Drivelines Ltd. : It is a wholly owned subsidiary of Tata Motors engaged in the manufacturing of gear boxes and axles for heavy & medium commercial vehicles.It has production facilities in Jamshedpur and Lucknow.TML Forge division is also a recent acquisition of TML Drivelines.TML drivelines was formed through the merger of HV Transmission(HVTL) and HV axles (HVAL).

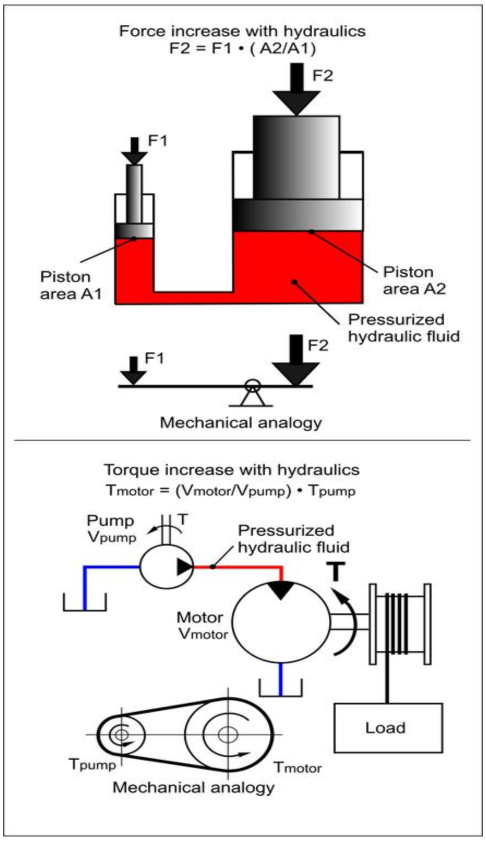
INTRODUCTION OF HYDRAULICS

The word "hydraulics" is based on the Greek word for water and originally meant the study of the physical behaviour of water at rest and in motion. Today, the meaning has been expanded to include the physical behaviour of all liquids, including hydraulic fluid. Hydraulic systems are not new to aviation. Early aircraft had hydraulic brake systems. As aircraft became more sophisticated, newer systems with hydraulic power were developed.

A hydraulic drive system is a drive or transmission system that uses pressurized hydraulic fluid to power hydraulic machinery. The term hydrostatic refers to the transfer of energy from flow and pressure, not from the kinetic energy of the flow.A hydraulic drive system consists of three parts: The generator (e.g. a hydraulic pump), driven by an electric motor, a combustion engine or a windmill; valves, filters, piping etc. (to guide and control the system); and the actuator (e.g. a hydraulic motor or hydraulic cylinder) to drive the machinery.

Principle of hydraulic drive system

Pascal's law is the basis of hydraulic drive systems. As the pressure in the system is the same, the force that the fluid gives to the surroundings is therefore equal to pressure × area. In such a way, a small piston feels a small force and a large piston feels a large force. The same principle applies for a hydraulic pump with a small swept volume that asks for a small torque, combined with a hydraulic motor with a large swept volume that gives a large torque. In such a way a transmission with a certain ratio can be built. Most hydraulic drive systems make use of hydraulic cylinders. Here the same principle is used — a small torque can be transmitted into a large force.



By throttling the fluid between the generator part and the motor part, or by using hydraulic pumps and/or motors with adjustable swept volume, the ratio of the transmission can be changed easily. In case throttling is used, the efficiency of the transmission is limited. In case adjustable pumps and motors are used, the efficiency, however, is very large. In fact, up to around 1980, a hydraulic drive system had hardly any competition from other adjustable drive systems.

Nowadays, electric drive systems using electric servo-motors can be controlled in an excellent way and can easily compete with rotating hydraulic drive systems. Hydraulic cylinders are, in fact, without competition for linear forces. For these cylinders, hydraulic systems will remain of interest and if such a system is available, it is easy and logical to use this system for the rotating drives of the cooling systems, also.

Classification of a hydraulic drives

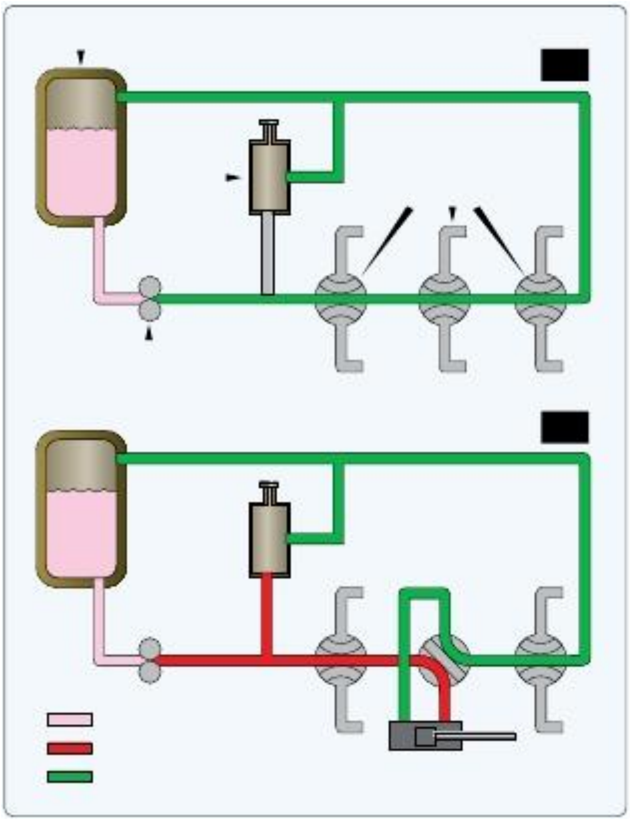
Hydraulic drives are traditionally divided into three classes. These are:

- Industrial hydraulics.
- Mobile hydraulics
- Aircraft hydraulics

The classification is basically due to the fact that components are classified in these categories, although some overlap exists between industrial and mobile hydraulics, aircraft hydraulics components are highly specialized due to extreme requirements on weight and certification

HYDRAULIC SYSTEM COMPONENTS

Open Center Hydraulic Systems:



An open center system is one having fluid flow, but no pressure in the system when the actuating mechanisms are idle. The pump circulates the fluid from the reservoir, through the selector valves, and back to the reservoir. The open center system may employ any number of subsystems, with a selector valve for each subsystem. Unlike the closed center system, the selector valves of the open center system are always connected in series with each other. In this arrangement, the system pressure line goes through each selector valve. Fluid is always allowed free passage through each selector valve and back to the reservoir until one of the selector valves is positioned to operate a mechanism. When one of the selector valves is positioned to operate an actuating device, fluid is directed from the pump through one actuator returns to the selector valve and flows back to the reservoir.

Operation of the system following actuation of the component depends on the type of selector valve being used. Several types of selector valves are used in conjunction with the open center system. One type is both manually engaged and manually disengaged. First, the valve is manually moved to an operating position. Then, the actuating mechanism reaches the end of its operating cycle, and the pump output continues until the system relief valve relieves the pressure. The relief valve unseats and allows the fluid to flow back to the reservoir. The system pressure remains at the relief valve set pressure until the selector valve is manually returned to the neutral position. This action reopens the open center flow and allows the system pressure to drop to line resistance pressure.The manually engaged and pressure disengaged type of selector valve is similar to the valve previously discussed. When the actuating mechanism reaches the end of its cycle, the pressure continues to rise to a predetermined pressure. The valve automatically returns to the neutral position and to open center flow.

Closed-Centre Hydraulic Systems:

In the closed-centre system, the fluid is under pressure whenever the power pump is operating. The three actuators are arranged in parallel and actuating units B and C are operating at the same time, while actuating unit A is not operating. This system differs from the open-center system in that the selector or directional control valves are arranged in parallel and not in series. The means of controlling pump pressure varies in the closed-centre system. If a constant delivery pump is used, the system pressure is regulated by a pressure regulator. A relief valve acts as a backup safety device in case the regulator fail

HYDRAULIC FLUID

Hydraulic fluids, also called hydraulic liquids, are the medium by which power is transferred in hydraulic machinery. Common hydraulic fluids are based on waste, mineral oil or water. Examples of equipment that might use hydraulic fluids include excavators and backhoes, hydraulic brakes, power steering systems, transmissions, garbage trucks, aircraft flight control systems, lifts, and industrial machinery.

Hydraulic systems like the ones mentioned above will work most efficiently if the hydraulic fluid used has zero compressibility. Hydraulic fluid is a medium to transfer power in the system or the machinery. Hydraulic fluids play a very important role in the developing world. The fluids are classified on the basis of their viscosity, which makes a chart which is useful for the industries to select the fluid for the particular function.

Composition

- Base stock

The original hydraulics fluid, dating back to the time of ancient Egypt, was water. Beginning in the 1920s, mineral oil began to be used more than water as a base stock due to its inherent lubrication properties and ability to be used at temperatures above the boiling point of water. Today most hydraulic fluids are based on mineral oil base stocks.Natural oils such as rapeseed (also called canola oil) are used as base stocks for fluids where biodegradability and renewable sources are considered important. Other base stocks are used for specialty applications, such as for fire resistance and extreme temperature applications. Some examples include: glycol, esters, organophosphate ester, polyalphaolefin, propylene glycol, and silicone oils.

- Other components

Hydraulic fluids can contain a wide range of chemical compounds, including: oils, butanol, esters (e.g. phthalates, like DEHP, and adipates, like bis(2-ethylhexyl) adipate), polyalkylene glycols (PAG), organophosphate (e.g. tributylphosphate), silicones, alkylated aromatic hydrocarbons, polyalphaolefins (PAO) (e.g. polyisobutenes), corrosion inhibitors (incl acid scavengers), anti-erosion additives, etc.

- Biodegradable hydraulic fluids

Environmentally sensitive applications (e.g. farm tractors and marine dredging) may benefit from using biodegradable hydraulic fluids based upon rapeseed (Canola) vegetable oil when there is the risk of an oil spill from a ruptured oil line. Typically these oils are available as ISO 32, ISO 46, and ISO 68 specification oils. ASTM standards ASTM-D-6006, Guide for Assessing Biodegradability of Hydraulic Fluids and ASTM-D-6046, Standard Classification of Hydraulic Fluids for Environmental Impact are relevant.

Types of hydraulic fluids

According to ISO there are three different types of fluids according to their source of availability and purpose of use.

.1. *Mineral-Oil based Hydraulic fluids*

As these have a mineral oil base, so they are named as Mineral-oil-Based Hydraulic fluids. This kind of fluids will have high performance at lower cost. These mineral oils are further classified as HH, HL and HM fluids. Type HH fluids are refined mineral oil fluids which do not have any additives. These fluids are able to transfer power but have less properties of lubrication and unable to withstand high temperature. These types of fluid have a limited usage in industries. Some of the uses are manually used jacks and pumps, low pressure hydraulic system etc.
Type HL fluids are refined mineral oils which contain oxidants and rust inhibitors which help the system to be protected from chemical attack and water contamination. These fluids are mainly used in piston pump applications. HM is a version of HL-type fluids which have improved anti-wear additives. These fluids use phosphorus, zinc and sulphur components to get their anti-wear properties. These are the fluids mainly used in the high pressure hydraulic system.

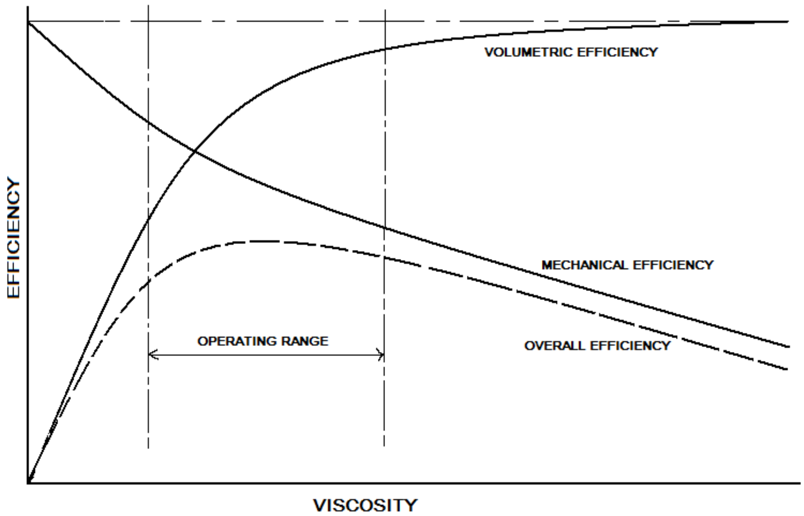
2. *Fire Resistant Fluids*

These fluids generate less heat when burnt than those of mineral oil based fluids. As the name suggests these fluids are mainly used in industries where there are chances of fire hazards, such as foundries, military, die-casting and basic metal industry. These fluids are made of lower BTU (British Thermal Unit) compared to those of mineral oil based fluids, such as water-glycol, phosphate ester and polyol esters. ISO have classified these fluids as HFAE(soluble oils), HFAS(high water-based fluids), HFB(invert emulsions), HFC(water glycols), HFDR(phosphate ester) and HRDU(polyol esters).

. Selection of hydraulic fluid for the system

Effect of viscosity on system performance

The performance of pumps and motors are the important parameters for the overall efficiency of the system. There are two types of hydraulic efficiencies. One is mechanical efficiency and other is volumetric efficiency of the system. Mechanical efficiency relates to frictional losses in system and volumetric efficiency relates to flow losses in the system. Both of these depend on the viscosity of the fluid.



As shown in the below figure viscosity of fluid is directly proportional to volumetric efficiency and inversely proportional to mechanical efficiency of the system. So fluid should be selected satisfying both these efficiencies for the maximum overall efficiency of the system

Functions and properties

The primary function of a hydraulic fluid is to convey power. In use, however, there are other important functions of hydraulic fluid such as protection of the hydraulic machine components. The table below lists the major functions of a hydraulic fluid and the properties of a fluid that affect its ability to perform that function:[2]

Function	Property
Medium for power transfer and control	• Non compressible (high bulk modulus) • Fast air release • Low foaming tendency • Low volatility
Medium for heat transfer	• Good thermal capacity and conductivity
Sealing Medium	• Adequate viscosity and viscosity index • Shear stability
Lubricant	• Viscosity for film maintenance

	• Low temperature fluidity • Thermal and oxidative stability • Hydrolytic stability / water tolerance • Cleanliness and filterability • Demulsibility • Antiwear characteristics • Corrosion control
Pump efficiency	• Proper viscosity to minimize internal leakage • High viscosity index
Special function	• Fire resistance • Friction modifications • Radiation resistance
Environmental impact	• Low toxicity when new or decomposed • Biodegradability
Functioning life	• Material compatibility

CHARACTERISTICS OF A GOOD HI-PERFORMANCE HYDRAULIC FLUID

- Viscosity Thickness or resistance to flow; must be suited to system design Most equipment manufacturers will specify a viscosity range for proper operation. Greenplus will meet or exceed those specified limits.
- Viscosity vs. Temperature Variation of viscosity with temperature (viscosity Index); must be minimal viscosity change with temperature change Greenplus has less variations with temperature change. Greenplus acts as a multi-viscosity oil. Maintains a stable viscosity through a wide operating temperature range.
- Storage Capability Minimal change in storage or use Greenplus shelf life is good, maintaining its characteristics indefinitely.

- Lubricity Film formation and friction reduction Greenplus has an affinity for metal and a reluctance to run off. Excellent film is maintained with our higher Viscosity Index (239).
- Metal Compatibility Minimal effect, physically and chemically, on metals, seals, gaskets and hoses Vegetable based lubricants are known for their compatibility with seals, gaskets and hoses. Greenplus is even better because of natural additives.
- Heat Transfer Capability High specific heat and thermal conductivity to dissipate heat Users typically report excellent heat transfer performance, equal or superior to petroleum products.
- Compressibility Low compressibility Greenplus is non-compressible.
- Volatility Minimal evaporation and bubble formation to reduce fluid loss and cavitation Greenplus has a very high flash point (279°C) and is very difficult to vaporize.
- Forming Tendency Foam or entrained air increases compressibility Non-petroleum defoamer additive keeps fluid free of air entrainment and eliminates foaming.
- Toxicity Meets or exceeds regulatory and safety standards affecting workers and the environment. Greenplus is safe for workers compared with petroleum. Environmental bio assay of LC50>10,000 ppm in a spill. Not considered a toxic oil under US OPA 90.
- Environmental Compatibility Minimal effect on the environment as the result of an accidental spill or disposal. Reflected in government legislation which allows treatment of vegetable oil lubricants as less environmentally dangerous than petroleum and synthetics in a spill situation.

Environmental Acceptable Hydraulic Fluids (EAHF) These fluids are basically used in the application where there is a risk of leakage or spills into the environment, which may cause some damage to the environment. These fluids are not harmful to the aquatic creatures and they are biodegradable. These fluids are used in forestry, lawn equipment, off-shore drilling, dams and maritime industries. The ISO have classified these fluids as HETG (based on natural vegetable oils), HEES (based on synthetic esters), HEPG (polyglycol fluids) and HEPR (polyalphaolefin types).

Hydraulic oils Classification

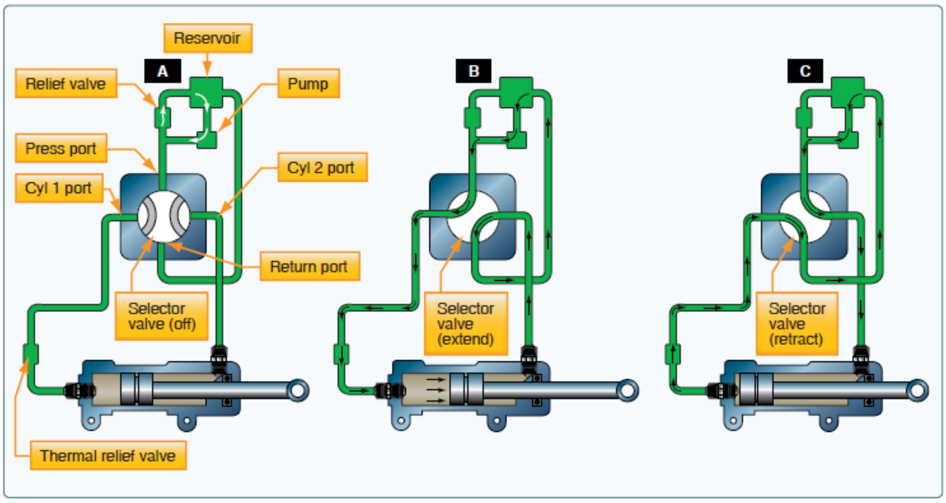
SL.no	Hydraulic Oil	Description
1	Hydraulic oil 68 Classification and specification DIN 51524: HLP 68	High performance hydraulic oil with optimal anti-wear properties (AW-Additives) and high load capacity of the lubrication film. Its excellent oxidation resistance delivers good performance at higher temperatures and extended operating intervals. Antioxidants and corrosion-inhibitors, high pressure absorption, good ageing and temperature resistance, no foam absorbance, good demulsification. Neutral toward ferrous metals and almost all nonferrous metals, wristbands and gasket-materials.
2	Hydraulic oil 46	Excellent stability against oxidation. • High Viscosity Index. • Very good protection against wear. • Good water demulsibility
3	Hydraulic oil 32	HYDRAULIC OIL HM 32 is a high performance anti wear hydraulic oil developed for use in high pressure hydraulic systems operating under moderate to severe conditions in mobile and industrial services. HYDRAULIC OIL HM 32 oil is formulated with carefully selected base stocks fortified with additives to provide excellent protection towards wear, rust and oxidation. it is formulated with field proven thermally stable, zinc based anti wear additives. It provides excellent water demulsibility as well as de-aeration
4	Hydraulic oil spin15	It is formulated with high quality refined mineral base stocks in combination with a special EP-additive technology to achieve the following performance

HYDRAULICS VALVES

Flow Control Valves

Flow control valves control the speed and/or direction of fluid flow in the hydraulic system. They provide for the operation of various components when desired and the speed at which the component operates. Examples of flow control valves include: selector valves, check valves, sequence valves, priority valves, shuttle valves, quick disconnect valves, and hydraulic fuses.

Selector Valves



A selector valve is used to control the direction of movement of a hydraulic actuating cylinder or similar device. It provides for the simultaneous flow of hydraulic fluid both into and out of the unit. Hydraulic system pressure can be routed with the selector valve to operate the unit in either direction and a corresponding return path for the fluid to the reservoir is provided. There are two main types of selector valves: open-center and closed-center. An open center valve allows a continuous flow of system hydraulic fluid through the

valve even when the selector is not in a position to actuate a unit. A closed-center selector valve blocks the flow of fluid through the valve when it is in the NEUTRAL or OFF Selector valves may be poppet-type, spool-type, piston-type, rotary-type, or plug-type. Regardless, each selector valve has a unique number of ports. The number of ports is determined by the particular requirements of the system in which the valve is used. Closed-centered selector valves with four ports are most common in aircraft hydraulic systems. These are known as four-way valves. illustrates how this valve connects to the pressure and return lines of the hydraulic system, as well as to the two ports on a common actuator. Most selector valves are mechanically controlled by a lever or electrically controlled by solenoid or servo. The four ports on a four-way selector valve always have the same function. One port receives pressurized fluid from the system hydraulic pump. A second port always returns fluid to the reservoir. The third and forth ports are used to connect the selector valve to the actuating unit. There are two ports on the actuating unit. illustrates the internal flow paths of a solenoid operated selector valve. The closed center valve is shown in the NEUTRAL or OFF position. Neither solenoid is energized. The pressure port routes fluid to the center lobe on the spool, which blocks the flow.

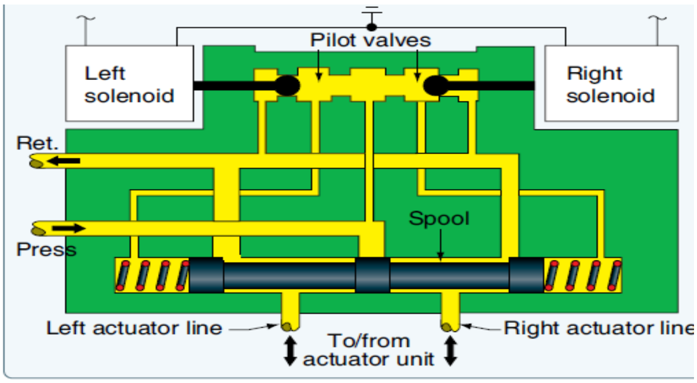
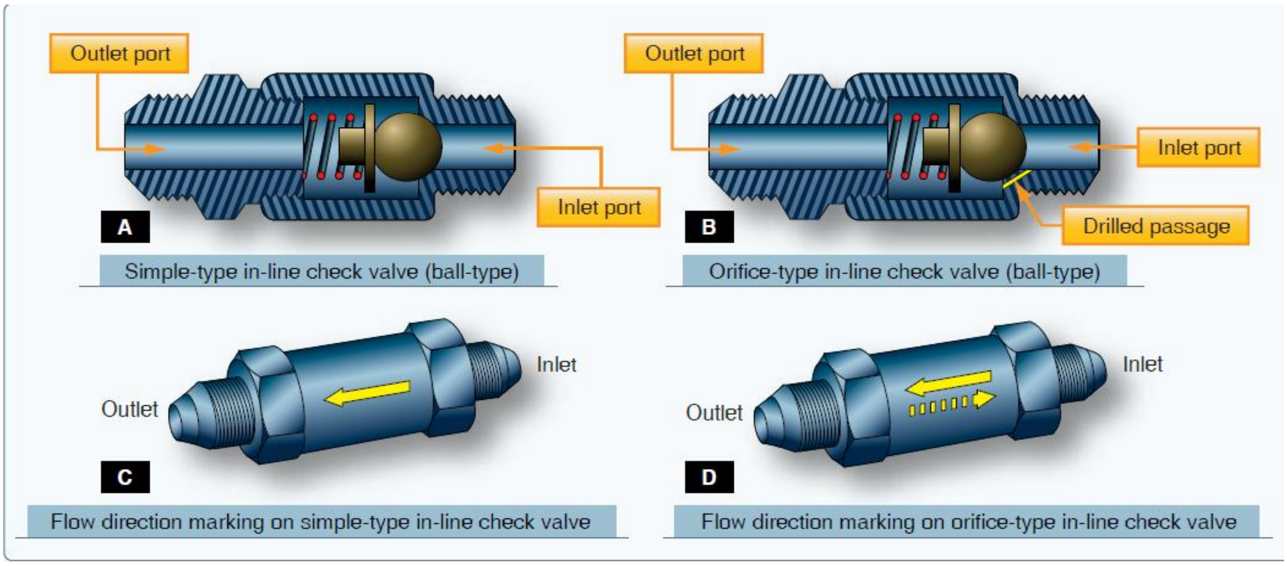
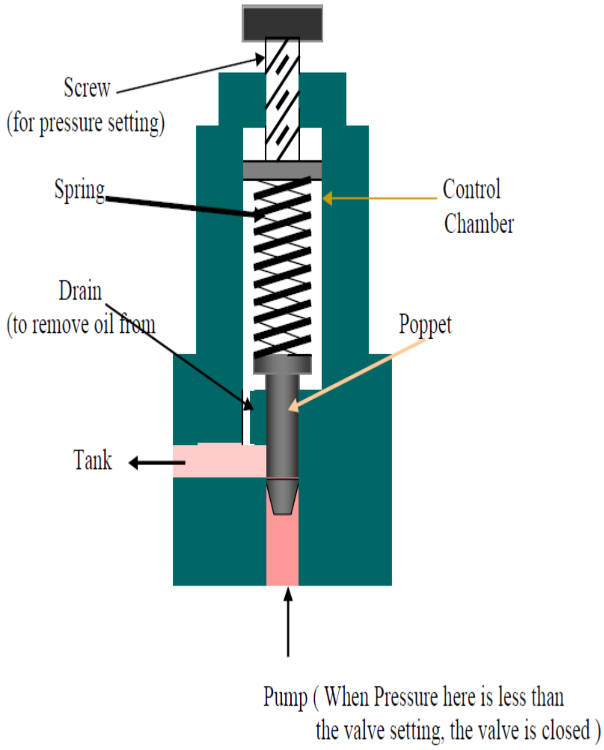


Figure 12-36. *Servo control valve solenoids not energized.*



PRESSURE CONTROL VALVE

These are the units ensuring the control of pressure. A throttling orifice is present in the valve and by variation of orifice, the pressure level can be controlled or at a particular pressure, a switching action can be influenced.



Classification: Basically one differentiates between pressure regulating and pressure switching valves. Pressure regulation valves are for maintaining a constant pressure in a system. Pressure switching valves, apart from a definite control function they also perform a switching action. Such valves not only provide a switching signal, as in the case of pressure switches, but also operate themselves as a DCV type of switching within the hydraulic system. In the case of pressure switching valves the piston or spool of the valve remains at a definite position either open or closed depending on the control signal (Yes or No). The control signal is generally external to the valve. In the case of pressure regulating valves the piston or spool takes up in between position depending on the variable pressure and flow characteristics. As in DCV these valves can also have the valve element either poppet or spool.. With poppet the sealing is good. But small movement of poppet allows large flows thereby excessive dropof pressure than required. This results is impact effect. The spool type of valves allow very fine control or throttling of flows. But of course, the sealing is not very good.

Opening and closing pressure difference:

The minimum pressure at which the valve action starts is called as the opening or cracking pressure. The difference between the cracking pressure (commencement of flow) and the pressure obtained at maximum flow (normal flow without change of spring force) is referred as the “**opening pressure difference**”.

Similarly the difference between the pressure corresponding to nominal flow and no flow during closing of the valve is referred as “**closing pressure difference**”. This is larger than the opening due to the flow forces acting in the opening direction as also the hysterisis in the spring.

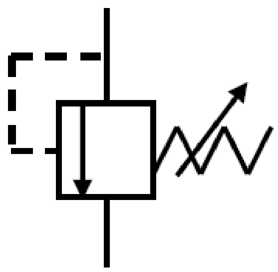
Different types of pressure control valves: Pressure control valves are usually named for their primary function such as relief valve, sequence valve, unloading valve, pressure reducing valve and counterbalance valve.

1. Pressure Relief valve:

One of the most important pressure control is the relief valve. Its primary function is to limit the system pressure. Relief valve is found in practically all the Hydraulic system. It is normally a closed valve whose function is to limit the pressure to a specified maximum value by diverting pump flow back to the tank.

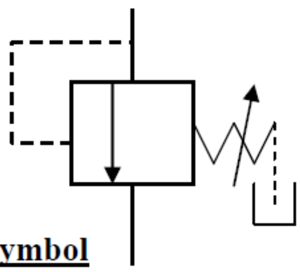
There are two basic design, a) direct operated or inertia type, b) the pilot operated design (compound relief valve).

Direct type of relief valve: The direct type of relief valve has two basic working port connection. One port is connected to pump and the other to the tank. The valve consists of a spring chamber (control chamber) with an adjustable bias spring which pushes the poppet to its seat, closing the valve. A small opening connecting the tank is provided in the control chamber to drain the oil that may collected due to leakage, thereby preventing the failure of valve



2 Sequence valve:

A sequence valve’s primary function is to divert flow in a predetermined sequence. It is a pressure- actuated valve similar in construction to a relief valve and normally a closed valve. The sequence valve operates on the principle that when main system pressure overcomes the spring setting, the valve spool moves up allowing flow from the secondary port.



Symbol

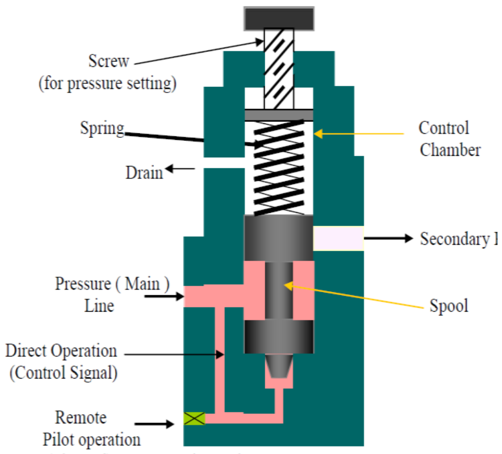


Fig 4.29b. **Sequence valve**

3.Pressure Reducing Valve:

Pressure reducing valve is used to limit its outlet pressure. Reducing valves are used for the operation of branch circuits, where pressure may vary from the main system pressures.

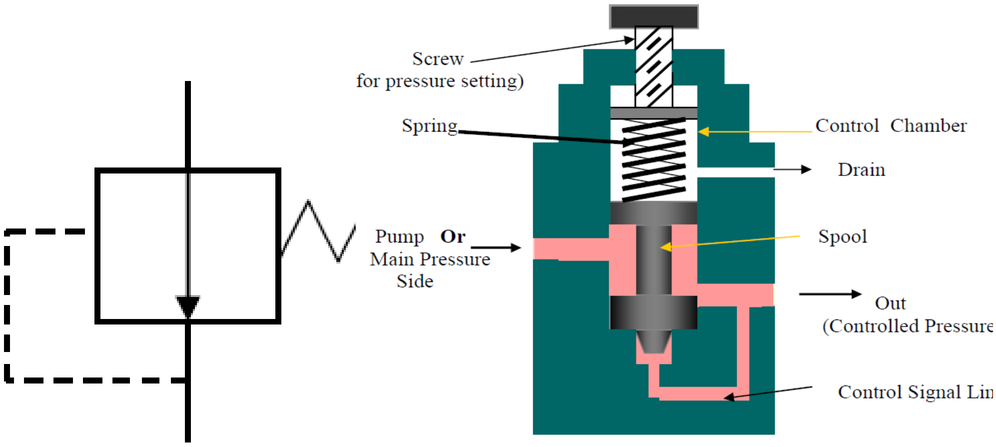


Fig 4.32a Pressure Reducing Valve

Directional control valves

As the name implies directional control valves are used to control the direction of flow in a hydraulic circuit. They are used to extend, retract, position or reciprocate hydraulic cylinder and other components for linear motion. Valves contains ports that are external openings for fluid to enter and leave via connecting pipelines, The number of ports on a directional control valve (DCV) is usually identified by the term **" way".** For example, a valve with four ports is named as four-way valve.

Directional control valves can be classified in a number of ways:

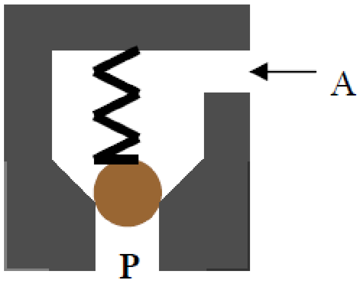
1. According to type of construction :
- Poppet valves
- Spool valves

2. According to number of working ports :
- Two- way valves
- Three – way valves
- Four- way valves.

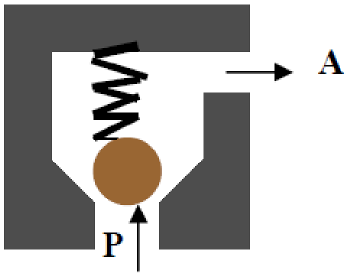
3. According to number of Switching position:
- Two – position
- Three - position

4. According to Actuating mechanism:
- Manual actuation
- Mechanical actuation
- Solenoid (Electrical) actuation
- Hydraulic (Pilot) actuation
- Pneumatic actuation
- Indirect actuation

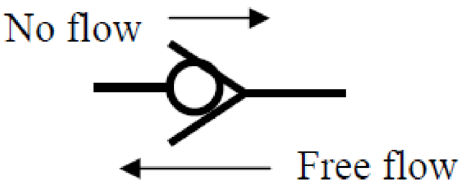
2 / 2 DCV (Poppet design) :-



a. Valve Closed

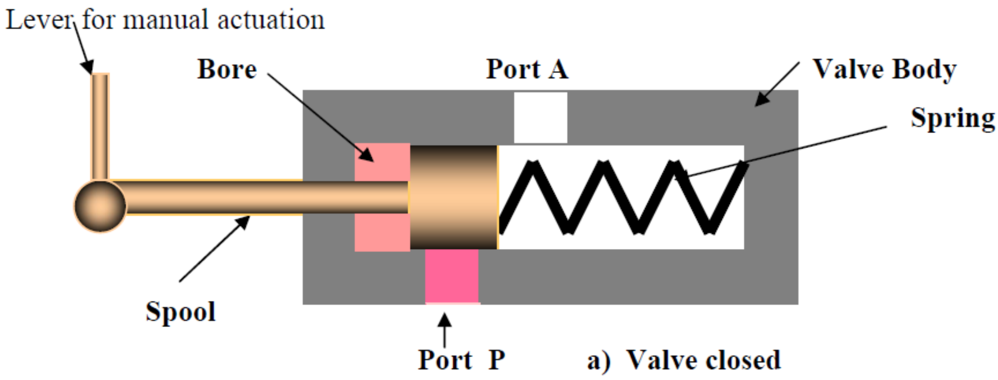


b. Valve Opened

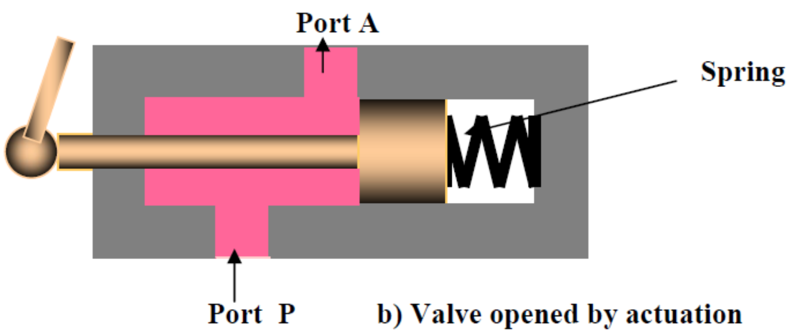


4.6c. **Symbol of 2/2 poppet valve (Check valve)**

1. **Two-way valve (2/ 2 DCV):**



a) Valve closed



b) Valve opened by actuation

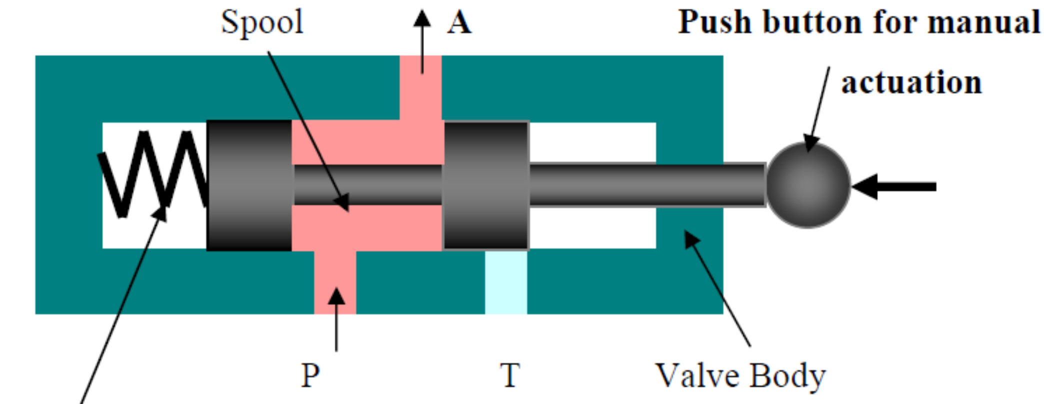
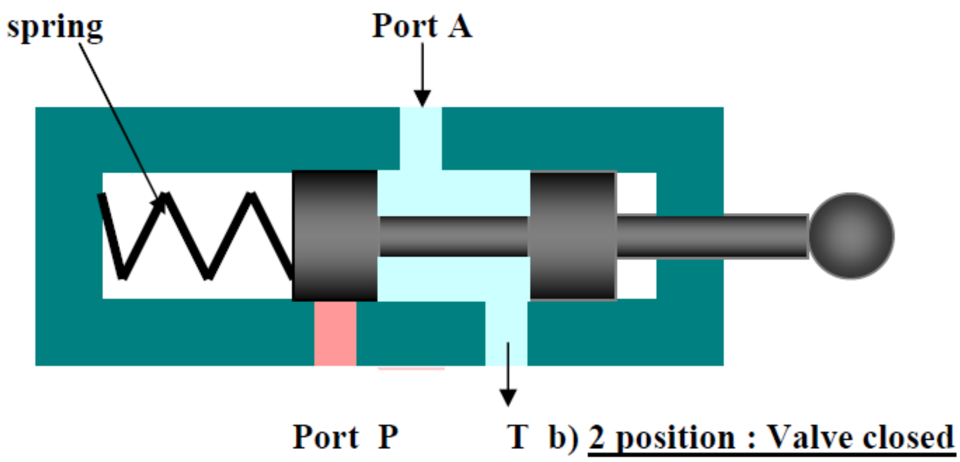


Fig a. 1 position: P to A , T blocked



b) 2 position : Valve closed

HYDRAULIC CIRCUIT DESIGN AND ANALYSIS

A Hydraulic circuit is a group of components such as pumps, actuators, and control valves so arranged that they will perform a useful task. When analyzing or designing a hydraulic circuit, the following three important considerations must be taken into account:

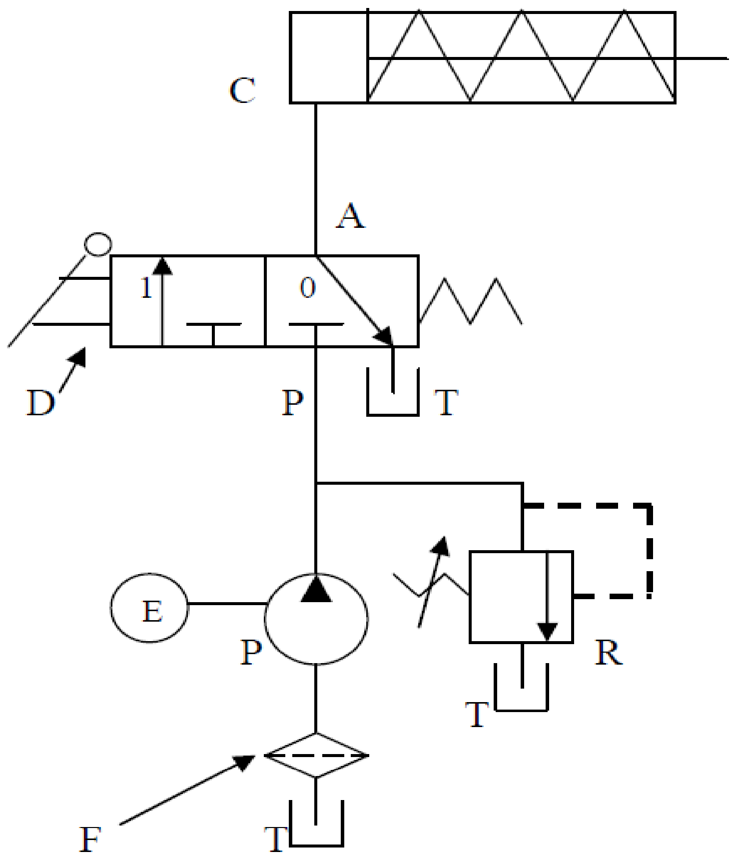
1. Safety of operation
2. Performance of desired function
3. Efficiency of operation

It is very important for the fluid power (Hydraulics and Pneumatics) designer to have a working knowledge of components and how they operate in a circuit. Hydraulic circuits are developed through the use of graphical symbols for all components. The symbols have to conform to the ANSI specification.

1 >*Control of a Single- Acting Hydraulic Cylinder*:

A single-acting cylinder can exert a force in only the extending direction as fluid from the pump enters the blank end of the cylinder (usually left side of the piston). Single- acting cylinder do not retract hydraulically. Retraction is accomplished by using gravity or by the inclusion of a compression spring in the rod end.

Force during extension stroke is , Fext = p * AP
Velocity during extension stroke is , **vP ext = QP / AP**
The force and velocity during retraction stroke depends upon spring rate as single – acting cylinder do not retract hydraulically



ჳ 5.2. **Control of Single -Acting Hydraulic Cylinder**.

C = Single acting cylinder

P = Pump

E = Electric Motor

T = Tank

F = Filter

R = Relief Valve

D =2-position, 3 way DCV Manually operated and spring return

2>***Control of Double -Acting Hydraulic Cylinder*** :

Double –Acting cylinders can be extended and retracted hydraulically. Thus, an output force can be applied in two directions

The output force (F) and piston velocity of double acting cylinder are not the same for extension and retraction strokes. During the extension stroke, fluid enters the blank end (A) of the cylinder through the entire circular area of the piston (AP).However during the retraction stroke, fluid enters the rod end through the smaller annular area between the rod and cylinder bore (AP – AR), where AP = piston area , and AR = rod area. Since AP = is grreater than (AP – AR), the retraction velocity is greater than the extension velocity since the pump flow rate is constant.Similarly during the extension stroke, fluid pressure bears on the entire area of the piston(AP). However during the retraction stroke, fluid pressure bears on the smaller annular area (AP – AR). The difference in area accounts for the difference in output force, with the output force is greater during extension.

Extending stroke :

Force, Fext = p * AP -------- 1

Velocity, vext = Qp / AP -----2

Retraction Stroke :

Force, Fret = p * (AP – Ar) --- 3

Velocity, vret = Qp / (AP – Ar) --- 4

It can be seen from the above 4 equations that force during extension stroke and velocity of piston during retraction stroke is greater for the same operating pressure and flow rate.

The power developed by a hydraulic cylinder for either the extension or retraction stroke, can be found out by (velocity multiplied by force) or from (flow rate multiplied by operating pressure)

Power (kW) = vp (m / s) * F (kN) = Q (m3 / s) * p (kPa)

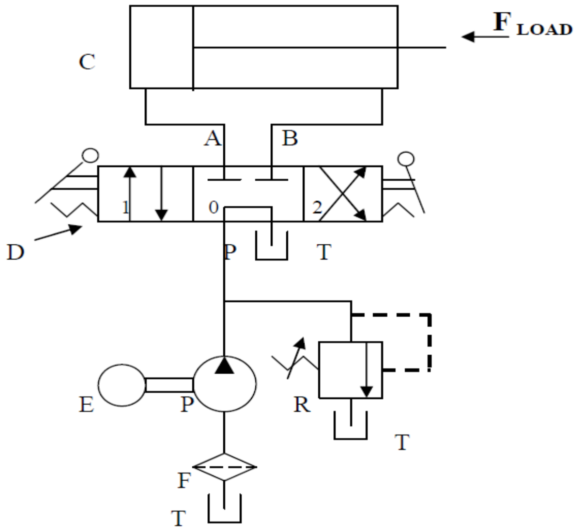


Fig 5.4. **Control of Double -acting hydraulic cylinder.**

C = Double acting cylinder

P = Pump

E = Electric Motor

T = Tank

F = Filter

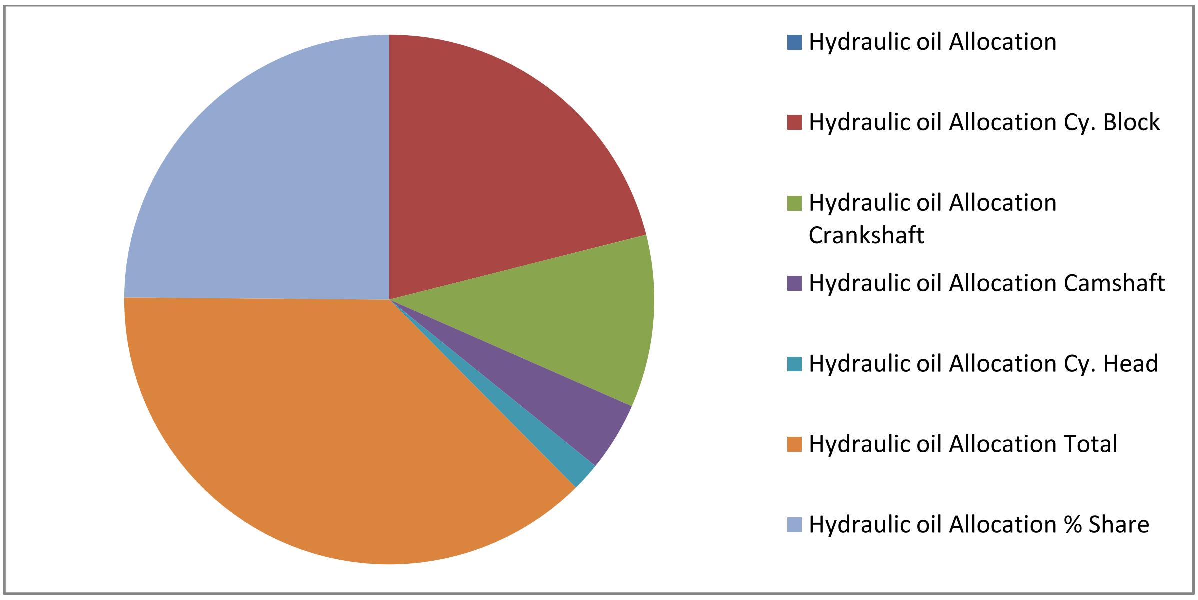
R = Relief Valve

D =3-position, 4 way ,Tandem center, Manually operated and Spring Centered DCV

DATA ANALYSIS ON HYDRAULIC OIL CONSUMPTION FOR LAST THREE YEAR TRENDS

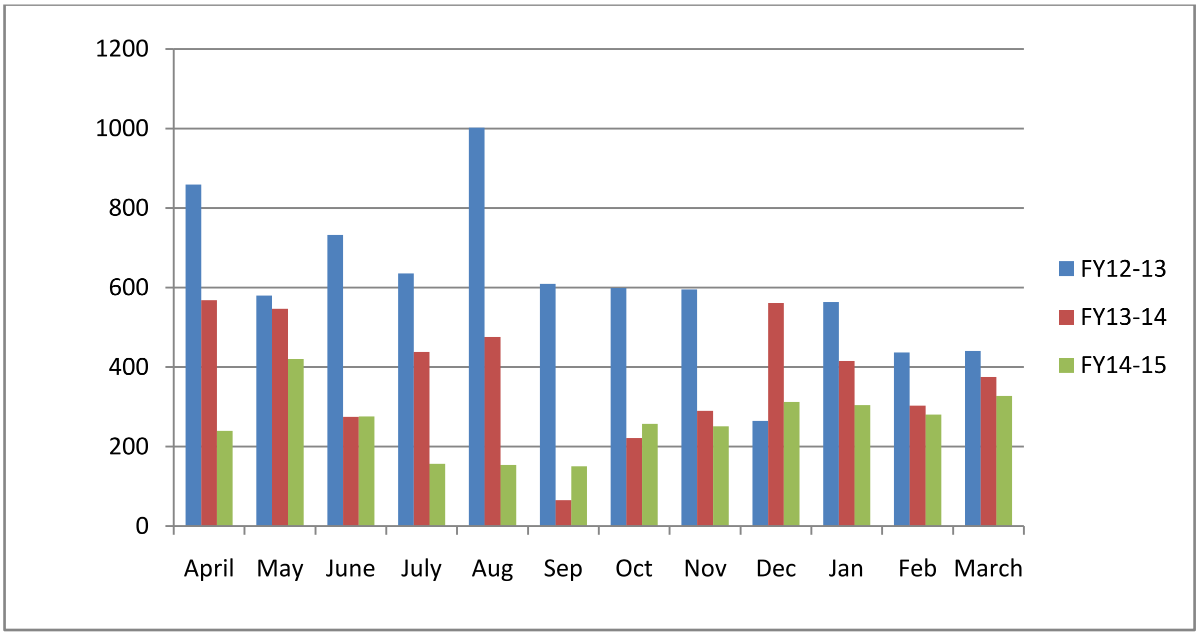
HYDRAULIC OIL ALLOCATION

Hydraulic oil Allocation						
	Cy. Block	Crankshaft	Camshaft	Cy. Head	Total	% Share
Hyd-68	60	30	12	5	107	**70.86093**
Hyd-32	10	15	3	9	37	**24.50331**
Hyspin-15	0	6	1	0	7	**4.635762**
Total	70	51	16	14	151	



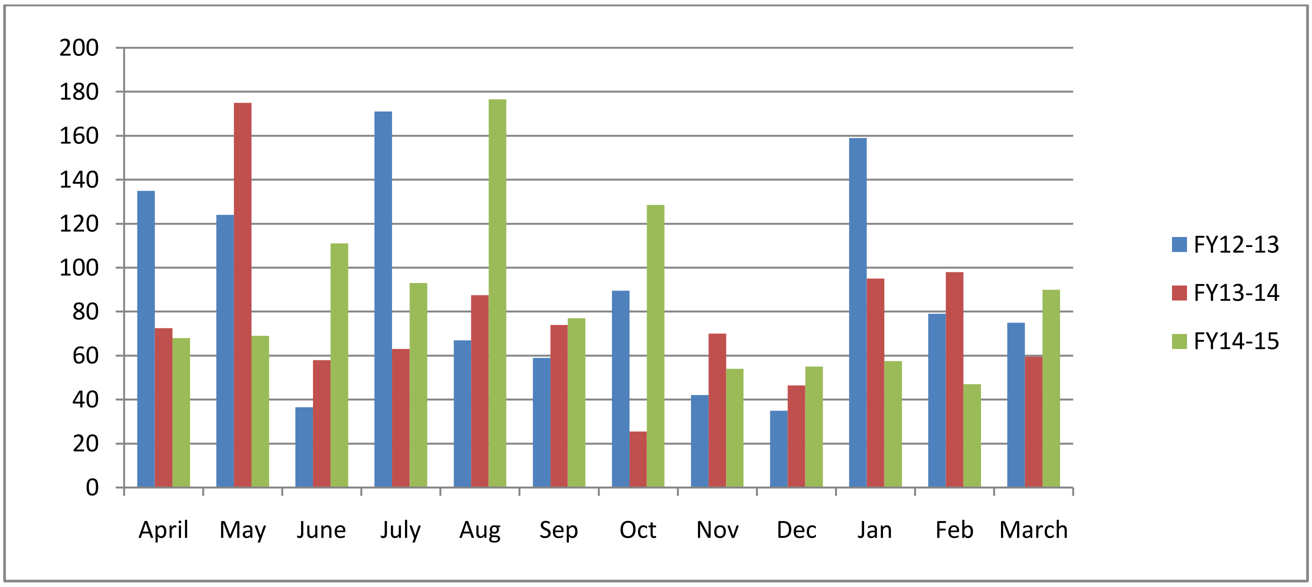
HYDRAULIC 68- Data for last three years

	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
FY12-13	859	580	733	635	1002	610	599	595	265	563	437	441
FY13-14	568	547	275	438	476	65	221	290	561	415	303	375
FY14-15	240	420	276	156.5	154	150	257	251	312	304	281	327



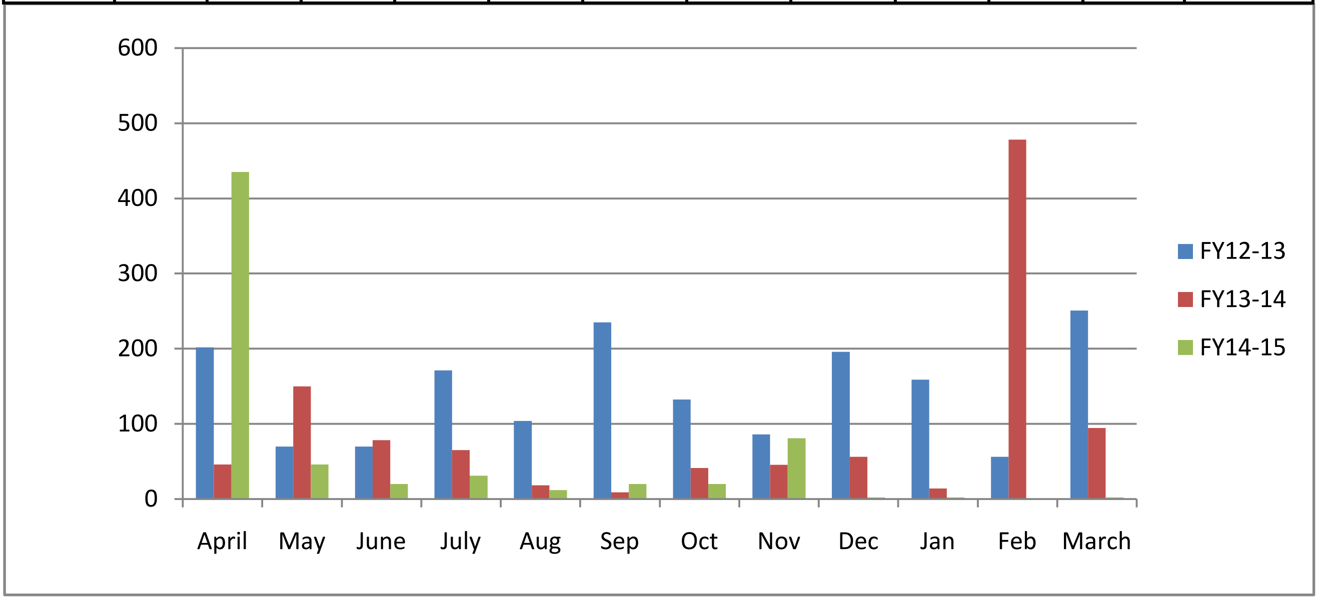
HYDRAULIC -32

	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
FY12-13	135	124	36.5	171	67	59	89.5	42	35	159	79	75
FY13-14	72.5	175	58	63	87.5	74	25.5	70	46.5	95	98	59.5
FY14-15	68	69	111	93	176.5	77	128.5	54	55	57.5	47	90



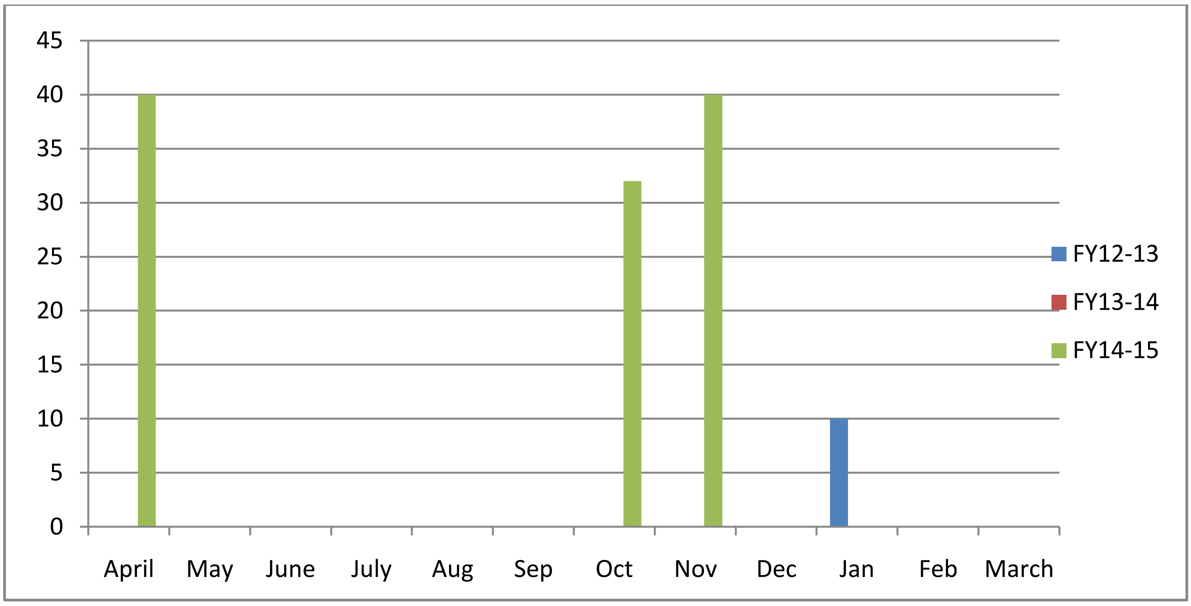
Hyspin-15

	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
FY12-13	202	70	70	171	104	235	132.5	86	196	159	56	251
FY13-14	46	150	78.5	65	18.5	09	41.5	45.5	56	14	478	94.5
FY14-15	435	46	20	31	12	20	20	81	02	02	00	02



Hyd-46

	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
FY12-13	0	0	0	0	0	0	0	0	0	10	0	0
FY13-14	0	0	0	0	0	0	0	0	0	0	0	0
FY14-15	40	0	0	0	0	0	32	40	0	0	0	0

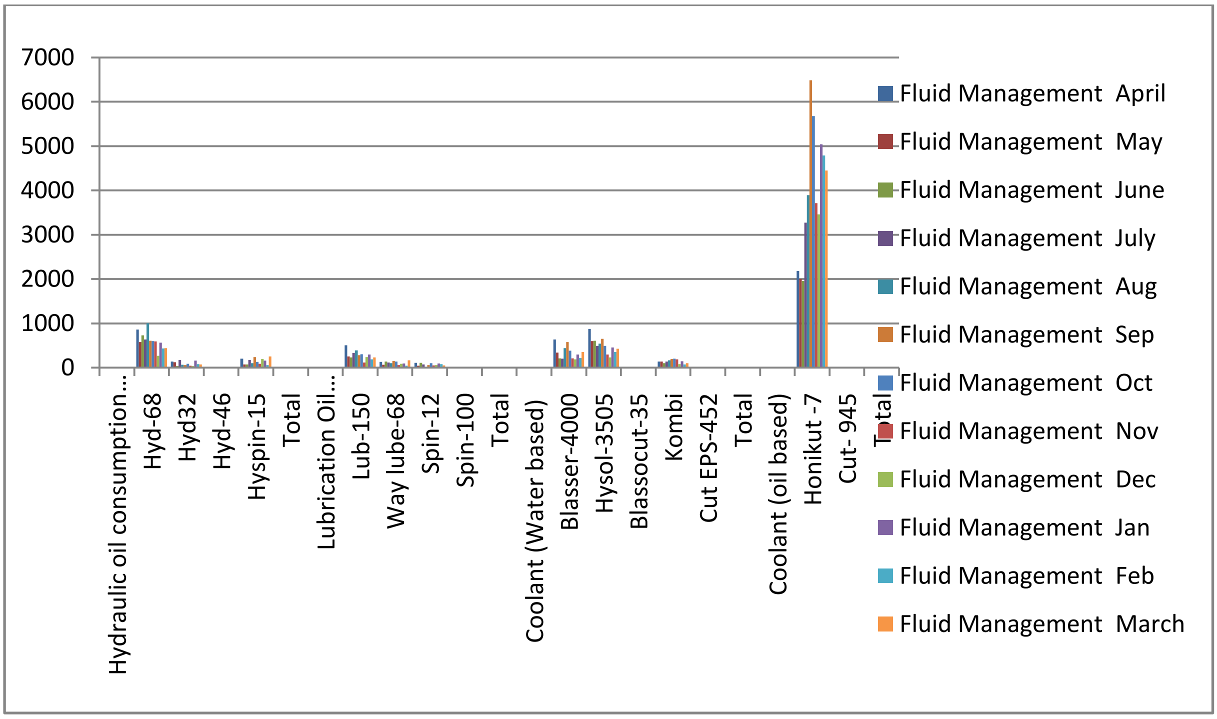


Total Oil consumption in blockline , head, cam, camshaft for financial year and its tending graphs

- *year 2012-2013*

Fluid Management												
	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
Hydraulic oil consumption for FY 12-13												
Hyd-68	859	580	733	635	1002	610	599	595	265	563	437	441
Hyd32	135. 00	124. 00	36.5 0	171. 00	67.0 0	59.0 0	89.5 0	42.0 0	35.0 0	159 .00	79.00	75.0 0
Hyd-46	0	0	0	0	0	0	0	0	0	10	0	0
Hyspin- 15	202. 00	70.0 0	70.0 0	171. 00	104. 00	235. 00	132. 50	86.0 0	196. 00	159 .00	56.00	251. 00
Total												
Lubrication Oil Consumption For FY 12-13												
Lub-150	506. 00	250. 50	232. 00	330. 00	388. 50	283. 00	304. 50	119. 00	236. 50	296 .50	185.10	228. 00
Way lube-68	132. 00	67.0 0	134. 00	116. 00	98.0 0	152. 50	139. 50	60.0 0	88.0 0	93. 50	45.00	164. 50
Spin-12	111. 00	42.0 0	109. 00	69.00	18.00	60.50	99.00	48.00	56.00	91.0 0	82.00	48.00
Spin-100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0 0	0.00	0.00
Total												
Coolant (Water based)												

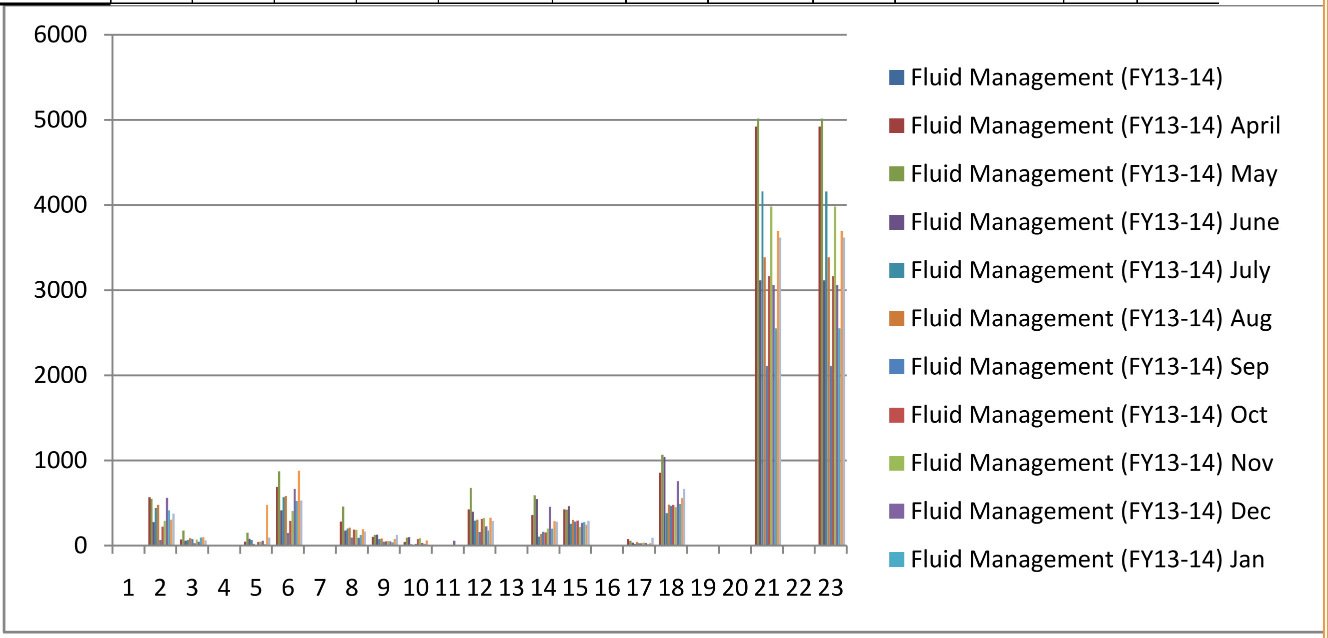
Blasser-4000	638.00	343.00	209.00	203.00	444.00	577.50	385.00	208.00	188.00	297.00	214.00	357.00
Hysol-3505	872.00	599.50	604.00	492.00	543.00	650.00	494.00	295.00	230.00	454.00	355.00	426.00
Blassocut-35	0	0	0	0	0	0	0	0	0	0	0	0
Kombi	135.00	137.00	103.00	139.00	168.00	198.00	200.00	189.00	82.00	147.00	72.00	104.00
Cut EPS-452												
Total												
Coolant (oil based)												
Honikut -7	2180.00	2000.00	1955.00	3275.00	3892.00	6485.00	5680.00	3715.00	3460.00	5045.00	4790.00	4452.00
Cut- 945	0	0	0	0	0	0	0	0	0	0	0	0
Total												
Polymer												
Polymer	157.00	159.00	112.00	430.00	193.00	149.00	80.00	40.00	82.00	87.00	5.00	270.00
AntiRust												
Rustilo	0.00	0.00	0.00	210.00	0.00	210.00	0.00	0.00	0.00	0.00	0.00	0.00
Techniclean SF												
Techniclean SF	949.00	711.00	418.00	590.00	595.00	819.00	387.00	268.00	172.00	443.00	445.00	340.00



- **FY 2013-2014**

Fluid Management (FY13-14)												
	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
Hydraulic oil consumption for FY 13-14												
Hyd-68	568	547	275	438	476	65	221	290	561	415	303	375
Hyd32	72.50	175.00	58.00	63.00	87.50	74.00	25.50	70.00	46.50	95.00	98.00	59.50
Hyd-46	0	0	0	0	0	0	0	0	0	0	0	0
Hyspin-15	46.00	150.00	78.50	65.00	18.50	9.00	41.50	45.50	56.00	14.00	478.00	94.50
Total	686.5	872	411.5	566	582	148	288	405.5	663.5	524	879	529
Lubrication oil consumption for FY 13-14												
Lub-150	282.00	456.50	176.00	199.50	211.00	93.00	188.50	184.00	91.50	122.50	190.00	165.00
Way lube-68	101.00	123.50	126.00	77.00	82.00	45.00	48.00	51.00	47.00	37.00	77.00	124.50
Spin-12	41.00	95.00	96.00	16.00	12.00	20.00	74.00	87.50	31.00	17.00	59.00	0.50
Spin-100	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	56.50	0.00	0.00	0.00
Total	424.00	675.00	398.00	292.50	305.00	158.00	310.50	322.50	226.00	176.50	326.00	290.00
Coolant (Water based)												
Blasser-4000	357.00	589.00	544.00	106.00	135.00	161.00	155.00	198.00	455.00	200.00	285.00	284.00
Hysol-3505	426.00	422.00	462.50	254.00	302.00	280.50	294.00	218.00	268.00	274.00	245.00	290.00
Blassocut-35												
Kombi	74.00	55.00	33.00	18.00	43.00	26.00	28.00	33.00	31.00	16.00	26.00	92.00
Cut EPS-452	857.00	1066.00	1039.50	378.00	480.00	467.50	477.00	449.00	754.00	490.00	556.00	666.00
Total												
Coolant (oil based)												
Honikut-7	4920.00	5015.00	3115.00	4160.00	3385.00	2110.00	3165.00	3982.00	3060.00	2552.00	3697.00	3618.00
Cut-945												
	4920.00	5015.00	3115.00	4160.00	3385.00	2110.00	3165.00	3982.00	3060.00	2552.00	3697.00	3618.00
Polymer												
Polyme	385.	90.0	48.0	55.0	148.00	5.0	56.0	10.00	105.	0.00	71.	30.0

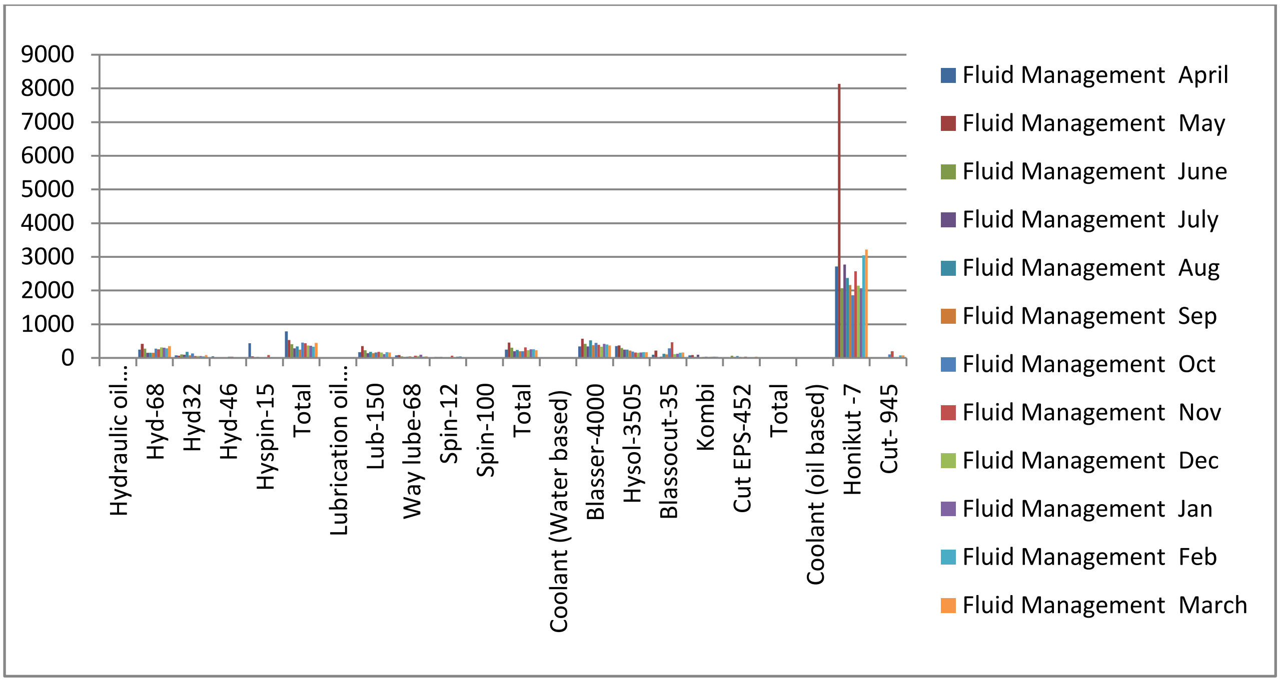
r	00	0	0	0		0	0		00		00	0
AntiRust												
Rustilo	0.00	0.00	210.00	0.00	210.00	210.00	0.00	0.00	0.00	0.00	0.00	0.00
Techniclean SF												
Techniclean SF	460.00	570.00	252.00	200.00	302.00	312.00	238.00	400.00	353.00	530.00	588.00	280.00



- **FY 2014-2015**

Fluid Management												
	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
Hydraulic oil consumption for FY 14-15												
Hyd-68	240	420	276	156.5	154	150	272	257	312	304	281	357
Hyd32	68.00	69.00	111.00	93.00	176.50	77.00	128.50	54.00	55.00	57.50	47.00	90.00
Hyd-46	40	0	0	0	0	0	32	40	0	0	0	0
Hyspin-15	435.00	46.00	20.00	31.00	12.00	20.00	20.00	81.00	2.00	2.00	0.00	2.00
Total	783	535	407	280.5	342.5	247	452.5	432	369	363.5	328	449
Lubrication oil consumption for FY 14-15												
Lub-150	170.50	347.00	230.50	143.00	179.00	147.00	163.00	178.50	167.00	118.50	170.00	162.50
Way lube-68	68.50	81.00	49.00	26.00	39.00	45.00	29.50	66.00	57.00	98.00	40.50	52.50

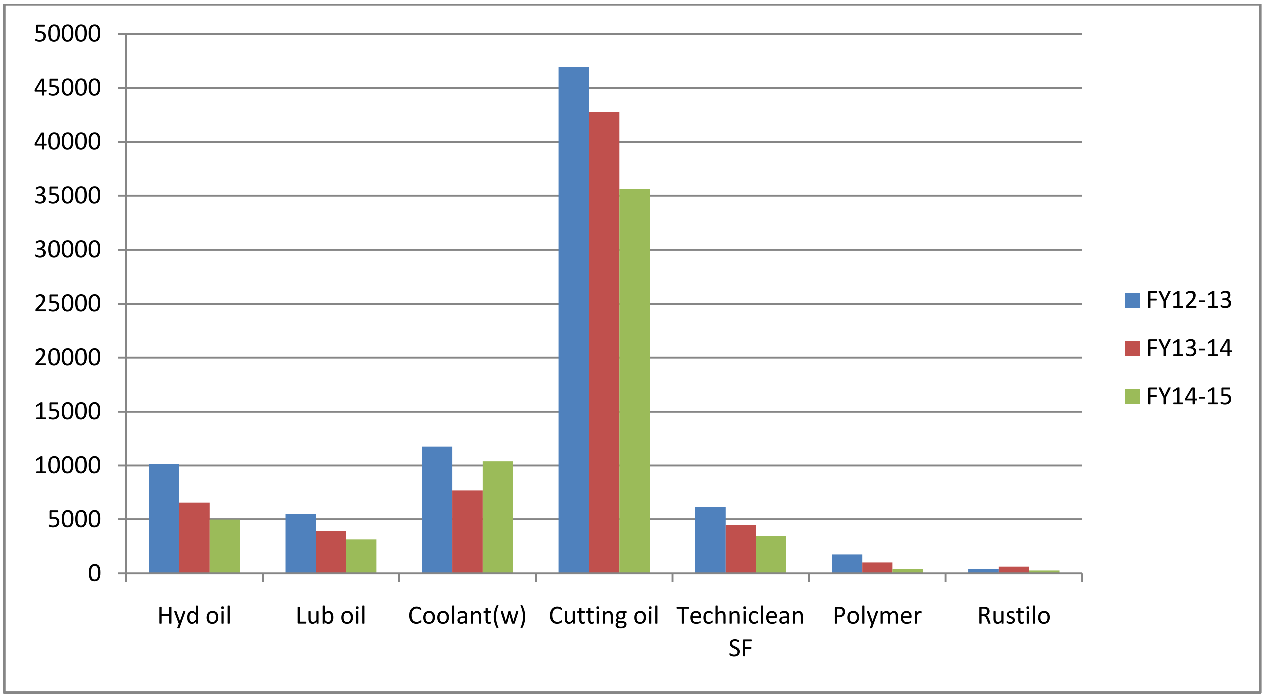
Spin-12	6.00	28.00	30.00	26.00	17.50	10.00	8.00	71.00	4.00	43.50	43.50	16.50
Spin-100												
Total	245.00	456.00	309.50	195.00	235.50	202.00	200.50	315.50	228.00	260.00	254.00	231.50
Coolant (Water based)												
Blasser-4000	338.00	568.00	418.50	345.00	521.50	381.00	447.50	392.00	330.50	417.00	394.50	369.50
Hysol-3505	345.00	369.50	298.00	248.00	245.00	214.00	185.00	164.00	154.00	159.50	175.60	169.20
Blassocut-35	88	220	3	41	127	105	279	462	114	125	150	160
Kombi	68.00	86.00	34.00	92.00	16.00	33.00	31.00	32.00	41.00	41.00	37.00	17.00
Cut EPS-452	0	0	66	27	61	25	7	40	12	25.5	23	38
Total												
Coolant (oil based)												
Honikut-7	2716.00	8136.00	2070.00	2770.00	2370.00	2165.00	1863.00	2573.00	2151.00	2075.00	3046.00	3220.00
Cut- 945	0	0	0	0	0	0	100	198	0	20	80	80
Total	2716.00	8136.00	2070.00	2770.00	2370.00	2165.00	1963.00	2771.00	2151.00	2095.00	3126.00	3300.00
Polymer												
Polymer	35.00	95.00	0.00	6.00	30.00	51.00	25.00	15.00	35.00	16.00	72.00	25.00
AntiRust												
Rustilo	0.00	0.00	0.00	40.00	13.00	100.00	10.00	0.00	95.00	3.00	3.00	10.00
Techniclean SF												
Techniclean SF	326.00	457.00	108.00	129.00	166.00	233.00	339.00	330.00	303.00	385.00	345.00	349.50
	326.00	457.00	108.00	129.00	166.00	233.00	339.00	330.00	303.00	385.00	345.00	349.50



YOY(litres) (Last three year total oil consumptions)

so yellow box indicates that oil consumption increased with respect to last year

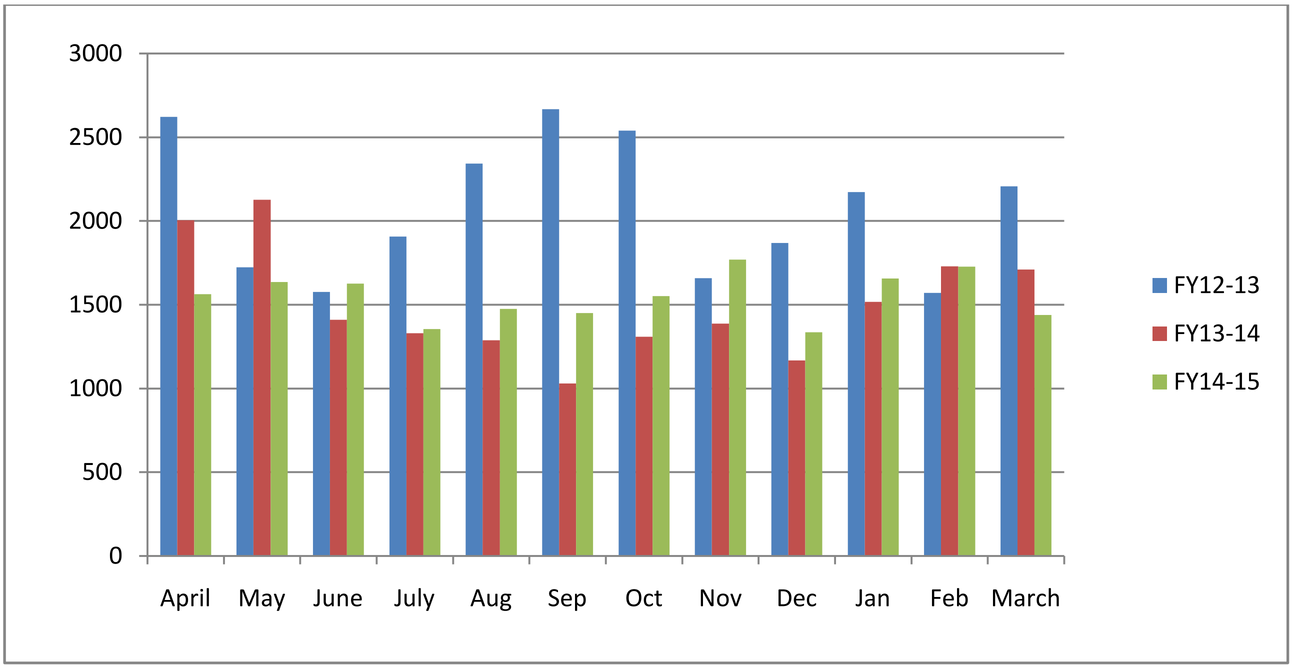
Fluids	FY12-13	FY13-14	FY14-15
Hyd oil	10133.5	6555	4989
Lub oil	5483.1	3904	3132.5
Coolant(w)	11752	7680	10376.3
Cutting oil	46929	42779	35633
Techniclean SF	6137	4485	3470.5
Polymer	1764	1003	405
Rustilo	420	630	274



Equivalent engine

Production report for last three years

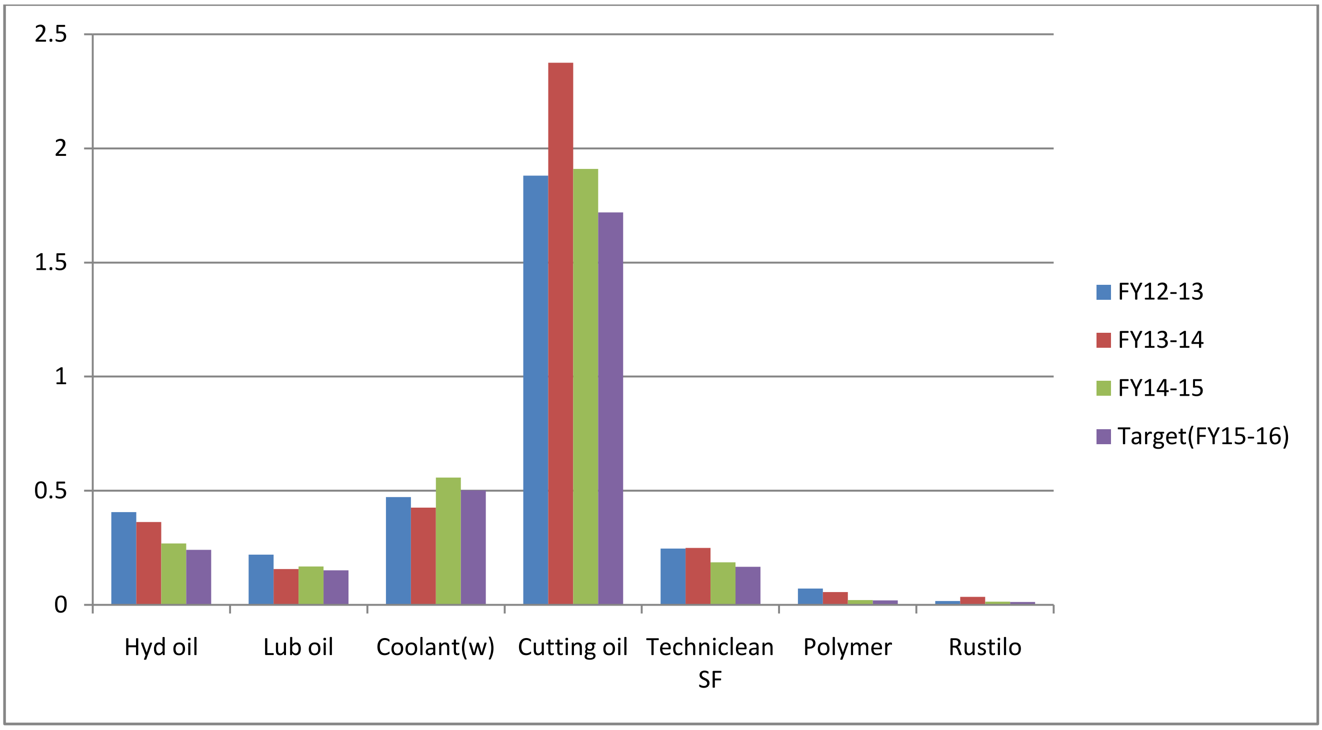
FY	April	May	June	July	Aug	Sep	Oct	Nov	Dec	Jan	Feb	March
FY12-13	2621	1723	1577	1907	2343	2667	2540	1659	1869	2172	1571	2207
FY13-14	2005	2126	1410	1330	1288	1029	1308	1388	1168	1517	1730	1710
FY14-15	1563	1635	1627	1354	1476	1450	1552	1770	1336	1656	1727	1439



YOY Equivalent

So the specific oil consuption per machine per year data, Yellow indicates increased consumpyion with respect to previous year and we have taken 10% reduction target specific consumption on financial year 2015-2016

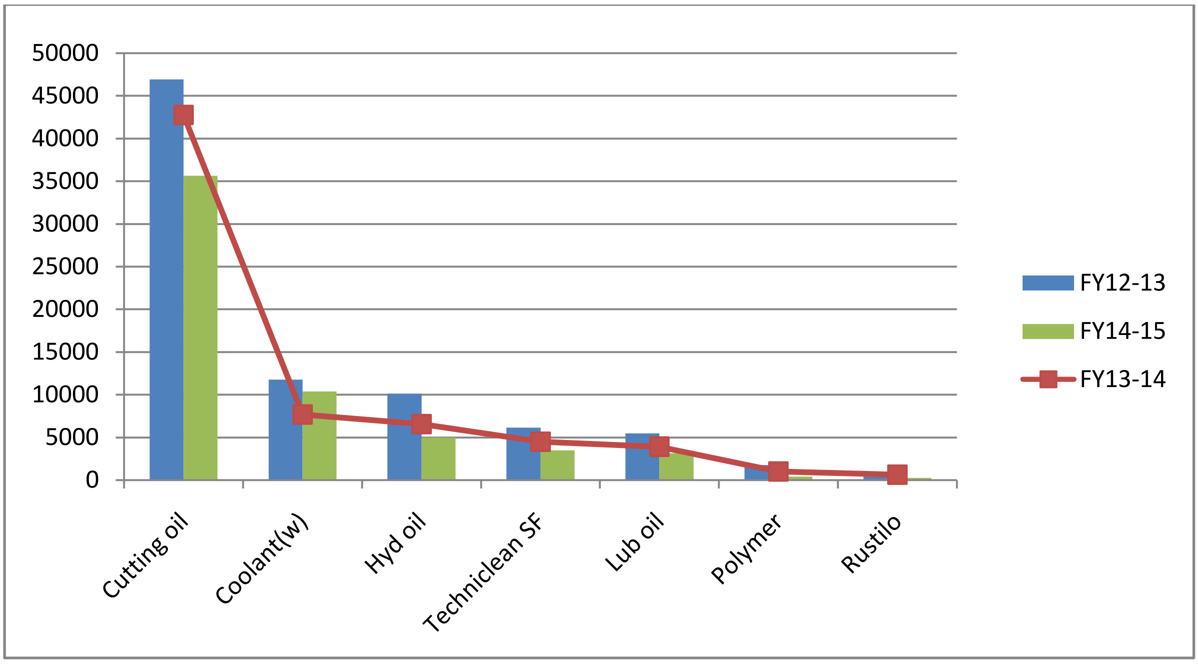
Fluids	FY12-13	FY13-14	FY14-15	Target(FY15-16)
Hyd oil	0.407	0.363	0.26844	0.24
Lub oil	0.2205	0.157	0.1685	0.15
Coolant(w)	0.472	0.426	0.558	0.50
Cutting oil	1.88	2.375	2	1.72
Techniclean SF	0.246	0.249	0.186	0.17
Polymer	0.0709	0.0556	0.0217	0.02
Rustilo	0.0168	0.0349	0.0147	0.01



PARETO CHARTS

YOY(litres)

Fluids	FY12-13	FY13-14	FY14-15	cumulative 12-13	cumulative13-14	cumulative14-15	cumulative12-13%	cumulative13-14%	cumulative14-15%
Cutting oil	46929	42779	35633	46929	42779	35633	715.9267735	75.03244817	69.87095648
Coolant (w)	11752	7680	10376.3	58681	50459	46009.3	895.2097635	88.50282387	90.21732097
Hyd oil	10133.5	6555	4989	68814.5	57014	50998.3	1049.801678	100	100
Techniclean SF	6137	4485	3470.5	74951.5	61499	54468.8	1143.424867	107.8664889	106.8051288
Lub oil	5483.1	3904	3132.5	80434.6	65403	57601.3	1227.072464	114.7139299	112.9474904
Polymer	1764	1003	405	82198.6	66406	58006.3	1253.983219	116.4731469	113.7416345
Rustilo	420	630	274	82618.6	67036	58280.3	1260.390542	117.5781387	114.2789073



SCALE LEVEL OBSERVATION

Leakage Point : Clamping cylinder

BEFORE

DATE	25/6/15	26/6/15	27/6/15	28/6/15	29/6/15	30/6/15
LEVEL GUAGE STATUS (in inches)	26	23	22	19	17	16

AFTER:

DATE	2/6/2015	3/6/2015	4/6/2015	5/6/2015	6/6/2015	8/6/2015
LEVEL GUAGE STATUS (in inches)	26	26	26	26	26	26

RESULT: Hydraulic oil level is almost constant in the hydraulic tank.

Therefore, there is no Leakage point

Reasons for Hydraulic Oil Leakage

A. **Hydraulic Fluid Contamination**

Experience has shown that trouble in a hydraulic system is inevitable whenever the liquid is allowed to become contaminated. The nature of the trouble, whether a simple malfunction or the complete destruction of a component, depends to some extent on the type of contaminant.

Two general contaminants are:

- Abrasives, including such particles as core sand, weld spatter, machining chips, and rust.

- Non-abrasives, including those resulting from oil oxidation and soft particles worn or shredded from seals and other organic components.

B. Insufficient machinery operation if hydraulic equipment has a leakage which will directly relate to performance And reducing performance efficiency
C. Sealing Action not done regularly which leads to oil leakage brings in loss of oil
D. Proper oil cleaning in regular interval not happening which leads to oil leakage
E. Hydraulic Tank cleaning if not done in regular interval it will leads to oil leakage

Recommendation for prevention of Hydraulic Oil Leakage

1> *Contamination Control*

Filters provide adequate control of the contamination problem during all normal hydraulic system operations. Control of the size and amount of contamination entering the system from any other source is the responsibility of the people who service and maintain the equipment. Therefore, precautions should be taken to minimize contamination during maintenance, repair, and service operations. As an aid in controlling contamination, the following maintenance and servicing procedures should be followed at all times:

- Maintain all tools and the work area (workbenches and test equipment) in a clean, dirt-free condition.
- A suitable container should always be provided to receive the hydraulic liquid that is spilled during component removal or disassembly procedures.
- Before disconnecting hydraulic lines or fittings, clean the affected area with dry cleaning solvent.
- All hydraulic lines and fittings should be capped or plugged immediately after disconnecting.
- Before assembly of any hydraulic components, wash all parts in an approved dry cleaning solvent.
- After cleaning the parts in the dry cleaning solution, dry the parts thoroughly and lubricate them with the recommended preservative or hydraulic liquid before assembly. Use only clean, lint-free cloths to wipe or dry the component parts.
- All seals and gaskets should be replaced during the reassembly procedure. Use only those seals and gaskets recommended by the manufacturer.
- All parts should be connected with care to avoid stripping metal slivers from threaded areas. All fittings and lines should beinstalled and torqued in accordance with applicable technical instructions.

Scheduling Data for Oil cleaning report for contamination removal:

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	Sep-14																													
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
14	4004631	M36-6009B	6370	●																													
15	4004091	M-4175	6380				●																										
16	4004632	M36-0329	6370								●																						
17	4005233	M 60-0021(HMT ECC DIA GRIND CSG500*600)	6381											●																			
18	4005238	M 60-0017(TAL LINE BORING M/C)	6370															●															
19	4005234	M 60-0022(BFW HMC H650)	6380																		●												
20	4005609	100 DIA HONNING M/C 60-0147	6370																						●								
21	4005264	M 60-0011 (NEW LANDIS CRANK SHAFT)	6380																									●					
22	4005610	97 DIA HONNING M/C 60-0148	6370																													●	

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	Oct-14																														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
23	4005239	M 60-0024(TAL CAM ECC MILLING M/C)	6381		●																													
24	4009472	M15-6069A	6370						●																									
25	4005599	MASS BALNCING & CENTER DRIL. 60-0012	6380									●																						
26	4009475	M15-6070B	6370													●																		
27	4009466	M60-0085	6380																●															
28	4005228	M60-0006	6370																				●											
29	4010651	M60-0173 NEW LANDIS-2	6380																							●								

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	Nov-14																														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
30		M50-0436	6380	●																														
31		M36-6076A	6370				●																											
32		M36-6070A	6380							●																								
33		M36-6076B	6370												●																			
34		PREMIERE	6381																			●												
35		LINE BORING	6370																								●							
36		M-4316	6381																															●

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	Dec-14																														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
37		M10-4002	6370				●																											
38		M15-4182	6370									●																						
39		M10-4046	6370														●																	
40		M10-4029	6370																		●													
41		M10-4016	6380																							●								
42		M50-0509	6370																													●		

Jan-15

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
43		M10-4003	6370			●																												
44		M50-0621	6370							●																								
45		M50-510	6380												●																			
46		M50-0511	6370																	●														
47		M50-0482	6370																						●									
48		M36-4029	6370																											●				

Feb-15

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
49		M60-0059	6370		●																													
50		M50-0454	6370						●																									
51		M36-4019	6380											●																				
52		M60-0058	6370																●															
53		M36-6009A	6380																					●										
54		M60-0148	6370																											●				

Mar-15

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
55		ABRO-1	6380		●																													
55		ABRO-2	6380						●																									
55		M60--0085	6380												●																			
55		M60-0024	6381																	●														
55		M60-0012	6380																					●										
55		M50-0436	6380																										●					

Apr-15

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
56		LINE BORING	6370		●																													
57		M-4319	6381						●																									
58		M60-0012	6380										●																					
59		K.W.S-18	6380															●																
60		M50-0001	6380																					●										
61		M60-0083	6380																												●			

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
				May-15																														
62		M50-0424	6380		●																													
63		J.4.M	6380								●																							
64		ELOTHERM	6380																		●													
65		M36-7933	6380																							●								
66		M50-0432	6380																													●		
67																																		

SL NO.	EQU. NO.	MACHINE NO.	B.C. NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
				Jun-15																														
68		M10-4175	6380				●																											
69		M10-4195	6380											○																				
70		M10-4194	6380																		○													
71		M50-0435	6380																							○								
72		M50-0503	6380																														○	
73																																		

2> Hydraulic System Flushing

When inspection of hydraulic filters or hydraulic fluid evaluation indicates that the fluid is contaminated, flushing the system may be necessary. This must be done according to the manufacturer's instructions; however, a typical procedure for flushing is as follows:

1. Connect a ground hydraulic test stand to the inlet and outlet test ports of the system. Verify that the ground unit fluid is clean and contains the same fluid as the aircraft.
2. Change the system filters.
3. Pump clean, filtered fluid through the system, and operate all subsystems until no obvious signs of contamination are found during inspection of the filters. Dispose of contaminated fluid and filter. Note: A visual inspection of hydraulic filters is not always effective.
4. Disconnect the test stand and cap the ports.
5. Ensure that the reservoir is filled to the full line or proper service level.

3> *Millipore oil patch Test For fluid Particulate Contamination*

It is designed for rapid detection of particulate contamination in hydro-carbon based hydraulic fluids, bulk chemicals, boiler water and lubricating oils. it detects significant changes in cleanliness through dependable & sensitive test result

SL NO.	Machine No	AREA	Date of Sampling	Product	Appearance	Moisture (Visual) Nil/Emulsion	Patch Test(mg) (RECOMD. DIRT CONTENT 10mg)	REMARKS
1	M36-6076A	Block Line	15.07.14	Hyd 68	Clear	Nil	8.56	WITHIN THE LIMIT. OIL IS FIT FOR USE
2	M36-6009A	Block Line	16.05.13	HYD 68	Clear	Nil	13.35	NOT WITHIN THE SPECS. OIL NEEDS TO BE FILTERED
3	MAKINO-4	Block Line	17.05.13	HYD 32	Clear	Nil	11.48	NOT WITHIN THE SPECS. OIL NEEDS TO BE FILTERED
4	M10-4194	Block Line	18.05.13	HYD 68	Clear	Nil	9.1	WITHIN THE LIMIT. OIL IS FIT FOR USE
5	M50-0329	Block Line	15.07.14	HYD 68	Clear	Nil	12.0	NOT WITHIN THE SPECS. OIL NEEDS TO BE FILTERED
6	M50-0454	Block Line	16.07.14	HYD 68	Clear	Nil	13.5	NOT WITHIN THE SPECS. OIL NEEDS TO BE FILTERED
7	M36-6076A	Block Line	16.07.14	HYD 68	Clear	Nil	13.3	NOT WITHIN THE SPECS. OIL NEEDS TO BE FILTERED
8	M-147	Block Line	18.07.14	Honikut-7	Clear	Nil	12.62	NOT WITHIN THE SPECS. OIL NEEDS TO BE FILTERED
9	M50-0431	Block Line	16.07.14	HYD 68	Clear	Nil	10.0	WITHIN THE LIMIT. OIL IS FIT FOR USE

Sl. NO.	Machine No	AREA	Date of Sampling	Product	Appearance	Moisture (Visual) Nil/Emulsion	Patch Test(mg)	REMARKS
1	M50-0436	CRANKSHAFT	05.12.14	HYD-68	VISUAL	NIL	9.7	WITHIN THE LIMIT.OIL IS FIT FOR USE
2	M50-0434	CRANKSHAFT	07.12.14	HYD-68	VISUAL	NIL	5	WITHIN THE LIMIT.OIL IS FIT FOR USE
3	ABRO-2	CRANKSHAFT	09.12.14	HYD-68	VISUAL	NIL	11.4	NOT WITHIN THE SPECS.OIL NEEDS TO BE FILTERED
4	ABRO-1	CRANKSHAFT	18.12.14	HYD-68	VISUAL	NIL	5.2	WITHIN THE LIMIT.OIL IS FIT FOR USE
5	M60-0085	CRANKSHAFT	10.01.15	HYD-68	VISUAL	NIL	8.9	NOT WITHIN THE SPECS.OIL NEEDS TO BE FILTERED
6	M60-0024	CAMSHAFT	13.01.15	HYD-68	VISUAL	NIL	3	WITHIN THE LIMIT.OIL IS FIT FOR USE
7	M-4316	CAMSHAFT	09.01.15	HYD-68	VISUAL	NIL	4.3	WITHIN THE LIMIT.OIL IS FIT FOR USE
8	H.M.T	CAMSHAFT	13.10.14	HYD-68	VISUAL	NIL	1.4	WITHIN THE LIMIT.OIL IS FIT FOR USE
9	M36-5657	CAMSHAFT	11.10.14	HYD-68	VISUAL	NIL	12.5	NOT WITHIN THE SPECS.OIL NEEDS TO BE FILTERED
10	M50-0329	BLOCKLINE	13.10.14	HYD-68	VISUAL	NIL	5.9	WITHIN THE LIMIT.OIL IS FIT FOR USE
11	M60-0148	BLOCKLINE	14.10.14	HYD-68	VISUAL	NIL	12.4	NOT WITHIN THE SPECS.OIL NEEDS TO BE FILTERED
12	M36-6009B	BLOCKLINE	11.10.14	HYD-68	VISUAL	NIL	9.6	WITHIN THE LIMIT.OIL IS FIT FOR USE

4> *Hydraulic tank Cleaning*:

Regular cleaning of hydraulic tank should be done in to remove the contaminants present in oil to prevent the hydraulic oil leakage.The contaminants present in tank may lead to cuts in hydraulic machine and finally may lead to leakage.It is to allow the tank to be inspected for maintenance to perform within a tank.
Automated tank cleaning machine work as a irrigation sprinkler. Hot water forced throw jet nozzle which rotates through a cleaning pattern and sprays water.

SCHEDULING OF HYDRAULIC TANK CLEANING

SI. NO.	MACHINE NO.	Coolant being used	FREQ	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14
1	MAKINO-1	B-4000	2 MONTH			12.08.14				
2	MAKINO-3	B-4000	2 MONTH			22.08.14	02.09.14			29.12.14
2	MAKINO-4	B-4000	2 MONTH	24.06.14		12.08.14		14.10.14		09.12.14
3	MAKINO-5	HYSOL-3505	2 MONTH			06.08.14		12.10.14		10.12.14
4	MAKINO-6	B-4000	2 MONTH	23.06.14	25.07.14	29.08.14		16.10.14		27.12.14
5	MAKINO-7	B-4000	2 MONTH		19.07.14		05.09.14		19.11.14	
6	MAKINO-8	B-4000	2 MONTH		12.07.14		06.09.14		22.11.14	11.12.14
7	MAKINO-9	B-4000	2 MONTH		11.07.14	11.08.14	11.09.14	10.10.14	10.11.14	05.12.14
8	INT WASHING	TSF	2 MONTH	26.06.14		26.08.14		19.10.14		05.12.14
9	FINAL WASHING	TSF	2 MONTH	17.06.14		28.08.14		18.10.14	26.11.14	
10	LEAK TEST	TSF	2 MONTH					14.10.14		09.12.14
11	HOT BATH	TSF	2 MONTH			23.08.14		14.10.14 ,16.10.14		09.12.14

Thank You Tata Motors