UNIT V

PART-A

TROUBLE SHOOTING AND APPLICATIONS

1. What is the difference between pressure switch and a temperature switch? Nov/Dec 2012

Pressure switches open or close contacts based on the system pressure. Temperature switches senses change in temperature and open or close contacts when a predetermined temperature is reached.

2. **Define low cost automation? May/June2013**

Low-cost automation is defined as a technology that creates some degree of automation around the existing equipment, tools and methods, using mostly the standard equipment available in the market.

3. **What is the use of temperature switch? (April/May2008)**

Temperature switches are used in a variety of industrial and technical processes. If a preset temperature is reached, then the temperature switch opens or closes a corresponding switch contact. Depending on the requirements, mechanical or electronic switches can be used

4. **How is the speed of a cylinder controlled in pneumatic system? (Nov/Dec 2009)**

When cylinder piston extends, air behind it is compressed because air can't escape easily. When you tighten the flow control screw, movement of the piston slows down because air is restricted even further. Controls the speed of a cylinder or restricts air flow. Simply turn the needle valve to adjust air speed.

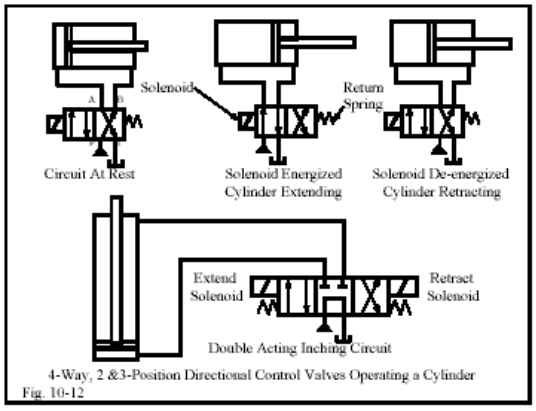
5. **Mention the area in a pneumatic system, which should be given higher importance during maintenance? (Nov/Dec 2009)**

- Always ensure that you have an accurate circuit as well as the functional diagram of the pneumatic system. If any changes are made after installation, ensure that they are made in the directions as well.
- Do take care that the impulse valves of the system is protected from excess of dirt, mechanical shocks and cooling water.
- Imprints of the elements and the units should be accurate and easily visible.
- The valve openings that are given by the manufacturers should only be used.

6. **Do not drill the elements of the system for a new opening. (April/may2015)**

- If you need an additional opening, discuss it with the manufacturer and they might design a custom system for you.
- The service unit of the system should be clearly visible and easy to service. If possible, also ensure that it is placed higher that the other elements.
- Do not increase the throttle that what is needed and specified by the manufacturer.
- If you are dismantling the cylinders or valves, do take care of its sealing materials. Even while assembling them again, ensure that they are properly placed.
- Actuated valves, though appear easy to work with, but are known to cause serious problems. Thus, it is good to ensure that they are controlled in the proper direction and at the required speeds only.

7. **Draw a sketch of a graphical symbol for 3 position 4 ways solenoid energized pilot operated tandem DCV (April/May2010)**



8. What is meant by automation? (April/may2015)

Automation of a process plant (or) a flow line is done by means of specially designed machinery and equipments, which represent the highest level of automation. Chemical processing and automated assembly lines are examples of such automation.

9. What is a power pack? Nov/Dec 2011, Nov/Dec 2012

A hydraulic power pack is a self-contained unit that consists mainly of a motor, a reservoir and a hydraulic pump. Using fluid to transmit power from one location to another, hydraulic power packs can generate massive amounts of power which can be used to drive hydraulic machinery.

10. **When to use timer and relay? Why?(Nov/Dec2012)**

Their purpose is to control an event based on time. The difference between relays and time delay relays is when the output contacts open & close: on a control relay, it happens when voltage is applied and removed from the coil on time delay relays, the contacts can open or close before or after some time delay

11. Mention any two rules of pneumatic system in low cost automation (April/May 2005)

Pneumatic systems are popularly used for low cost automation (LCA) applications due to their low cost, ease of fabrication, and safe operation.

12. What you understand by single shot sequencing? (April/May 2005)

By sequencing a number of cylinders, various machining and tooling operations may easily be obtained in a machine. By using sequencing, the cylinders can be actuated one after another in sequences like clamping, drilling, unclamping, *etc.*

13. What is power pack? (Nov/Dec2005)

Power pack consists of a pump, electric motor, reservoir and associated valving assembled to one unit to supply pressurized fluid. They are relatively small in size and provide functions of pressure, direction and flow control within the basic package.

14. How do you Microprocessor differ from PLC? (Nov/Dec2005)

The advantages of PLCs over microprocessors are given below :

1. PLCs are rugged and designed to withstand vibrations, temperature, humidity and noise.
2. The interfacing for inputs and outputs is inside the controller.
3. They are easily programmed and have an easily understood programming language.

15. . What is a Microprocessor? (May/June 2006)

Microprocessor is the central processing unit (CPU) of a micro-computer. It is the heart of the microcomputer. It is a semiconductor device. It includes arithmetic and logic unit, register arrays, and control circuits on a single chip.

16. What are the important component of hydraulic power pack(Nov/Dec2006)

Hydraulic power pack consists of the pump, drive motor, mechanical couplings, oil reservoir, strainers, filters, coolers, *etc.*

17. State the role of PLC in fluid power industry. (Nov/Dec2006)

PLCs are designed as a replacement for hard-wired electro-mechanical relays to control fluid power systems.

18.What is the use of temperature switch. (Nov/Dec2008)

A temperature switch is an instrument that automatically senses a change in temperature and opens or closes an electrical switching element when a predetermined temperature point is reached.

19. What is a step counter? (May/June 2008)

A step counter is a digital modular counter constructed from stepping units. A stepping unit is built from memory valve and a preswitched AND valve with two inputs.

20. **What is the meaning of the term troubleshooting? (May/June 2008)**

The term troubleshooting means an organized and systematic study of the problem and a logical approach to the difficulty faced in the system

UNIT-V

PART-B

1.List out various operating problems associated with pumps, valves and various faults, possible causes and suitable remedy for each problem. (Apr/May2005)

Trouble/Fault	Probable causes	Remedial actions
I. PUMP		
1. Pump delivering insufficient or no oil	Wrong direction of shaft	Must be reversed immediately to prevent seizure and breakage of parts due to lack of oil
	Pump shaft turning too slowly to prime itself	Check minimum speed recommendation and momentarily increase rpm, to rectify
	Clogged strainer or suction pipe line	Clean strainer or suction pipe line. Remove foreign matter
	Strainer capacity insufficient	Replace with a strainer whose capacity is more than twice the maximum flow rate
	Air leak in suction line	Add oil and check oil level in reservoir. Check for leaks and repair
	Faulty rotating part in the pump body	Check by listening to the sound. Remove the cover and check the internal mechanism. Replace, if necessary
	Oil leak in pump casing due to seizure or wear of pump sliding parts	Check the sliding parts
	Low level of oil in the reservoir	Add the oil recommended as per the indicator line
	Oil viscosity too heavy to pick up prime or too light causing excessive slippage	Use oil as per recommendation

Trouble/Fault	Probable causes	Remedial actions
2. Pump developing unstable or zero pressure	Pump not delivering oil for any of the above reasons	Apply the above remedies
	Relief valve setting not high enough	Correct valve setting by using pressure gauge
	Relief valve sticking open	Check relief valve. If necessary, dismantle and clean valve
	Clogged orifice of the relief valve	Overhaul and clean relief valve
	Mis-assembly, mis-connection or mis-operation of various valves in the circuit	Must be corrected
	Faulty performance of various valves or excessive oil leakages in the circuit through actuators and valves *etc.*	Test each component separately and repair
	Faulty pressure gauge	Check and replace if necessary
	Partially clogged suction line or suction strainer	Clean and remove foreign matter
3. Pump making noise	Misalignment of pump and prime mover	Check and rectify
	Strainer capacity insufficient	Replace with a strainer whose capacity is more than twice the maximum flow rate
	Air leak at pump's suction pipe joints or from shaft packing of the pump	Pour oil on suspected joints while listening for change in sound. If sound stops, tighten the joint
	Air remains in pump casing	Eliminate air through the air breather
	Small size of suction pipe	Replace so that the flow velocity on the suction side will be approximately 0.5 to 1
	Coupling misalignment	Re-align properly
	Pump bolts very loose	Tighten
	Resonance noises in the system	Reinforce by installing supports to eliminate resonance
	Air bubble or too much foam in suction oil.	Check to be certain that the return lines are below oil level and well separated from suction lines.
	Very high viscosity.	Use recommended oil.
	Pump running too fast.	Check the recommended maximum speed.

Trouble/Fault	Probable causes	Remedial actions
4. Pump oil over-heated	Faulty oil cooler	Repair
	Insufficient size of oil reservoir	Increase capacity or install an oil cooler
	Pump pressure too high	Readjust relief valve setting
	Excessive flow velocity	Replace piping
	Seizure of pump's sliding parts	Dis-assemble and repair. Check for foreign matter in oil and see if the pump casing is filled with oil
5. Internal leakage around pump	Shaft packing worn out	Replace
	Top cover packing damaged	Change the packing and apply clamping torque on the cover as per manufacturer's recommendation
6. Excessive wear	Abrasive matter in the hydraulic oil being circulated through	Install an adequate filter or replace oil more often
	Viscosity of oil very low at working conditions	Check pump manufacturer's recommendations or consult your hydraulic engineer
	Sustained high pressure above the maximum pump rating	Check maximum setting of the relief valve
	Misaligned drive or tight belt drive	Check and rectify
	Air recirculation causing chatter in the system	Remove air from the system
7. Breakage of parts inside pump housing	Excessive pressure above maximum pump rating	Adjust relief valve properly
	Seizure due to lack of oil	Check oil level in reservoir and cleanness of strainer and any other possible restrictions in suction lines

B. RELIEF VALVES

1. Erratic pressure	Dirt in oil	Clean strainer and flush the system
	Worn poppet or seat	Lap the poppet or replace
	Piston sticking in the main body	Check and rectify

Trouble/Fault	Probable causes	Remedial actions
2. No or low pressure	Vent connection open	Check and rectify
	Balance hole plugged	Check and rectify
	Poppet not seating properly	Check, lap and repair
3. Excessive noise or chatter	High oil velocity	Check and rectify
	Faulty or worn poppet or seat	Check, lap or replace
	Excessive tank line pressure	Check and rectify
	Long vent line or pressure setting too close to that of another valve in the circuit	Check and rectify
	Valve setting too close to the system operating pressure	Set relief valve at least 10 bar higher than the required working pressure of the system
III. DIRECTIONAL CONTROL VALVES (DCVs)		
1. Faulty or incomplete shifting	Worn out control linkage, shift pin, *etc.*	Check and repair
	Insufficient pilot pressure	Check and rectify
	Burned out solenoid	Check and replace
	Worn spring centering mechanism	Check and replace
2. Cylinder creeping or drifting	Valve spool not centering properly	Check and rectify
	Valve spool not shifting completely	Check and replace
	Valve spool or body worn out	Check and rectify
	Leakage past the piston in the cylinder	Check and overhaul the cylinder
IV. SEQUENCING VALVES		
1. Premature movement of secondary operation	Valve set too low	Check and set it higher
	Excessive load on primary cylinders	Check and adjust accordingly
2. No movement or slow secondary operation	Sequence valve setting too high	Check and adjust again
	Relief valve setting too close to that of sequence valve	Should have at least 10 bar differential
	Valve spool binding in body	Check and repair
V. UNLOADING VALVES		
1. Fails to completely unload pump	Valve setting too high	Set correctly
	Remote pressure setting too low	Adjust properly
	Valve spool binding in body	Overhaul valve

Trouble/Fault	Probable causes	Remedial actions
VI. COUNTERBALANCE VALVES		
1. Will not support load	Valve setting too low	Set properly
	Dirt under integral check valve	Flush the system
	Valve spool and body worn out	Replace worn out parts
	Leakage past the piston in the cylinder	Check and overhaul the cylinder
VII. FLOW CONTROL VALVES		
1. Variation in feed	Sticking hydrostat	Overhaul valve
	Cylinder or motor leakage	Overhaul cylinder or motor
	Change in oil viscosity	Check and replace oil
	Improper pressure drop across valve	Adjust correctly
	Inadequate lubrication of machine parts	Check and do the necessary rectifications
VIII. REMOTE FLOW CONTROL VALVES		
1. External leakage	Back pressure in drain line or defective seals	Drain directly to reservoir or replace seals
2. Feed rate variation	Hydrostatic pressure compensator inoperative or sticking hydrostat	Clean valve and flush system. Polish hydrostat and metering spool. Replace defective seals
3. Maximum flow not obtainable	Contaminants in the throttling orifice. Metering spool binding or not shifting fully. Insufficient voltage in torque motor	Clean valve. Check torque motor coils and input current. Re-align properly
4. Check valve-inoperative	Dirt lodged between the mating faces or finished faces	Disassemble and flush thoroughly

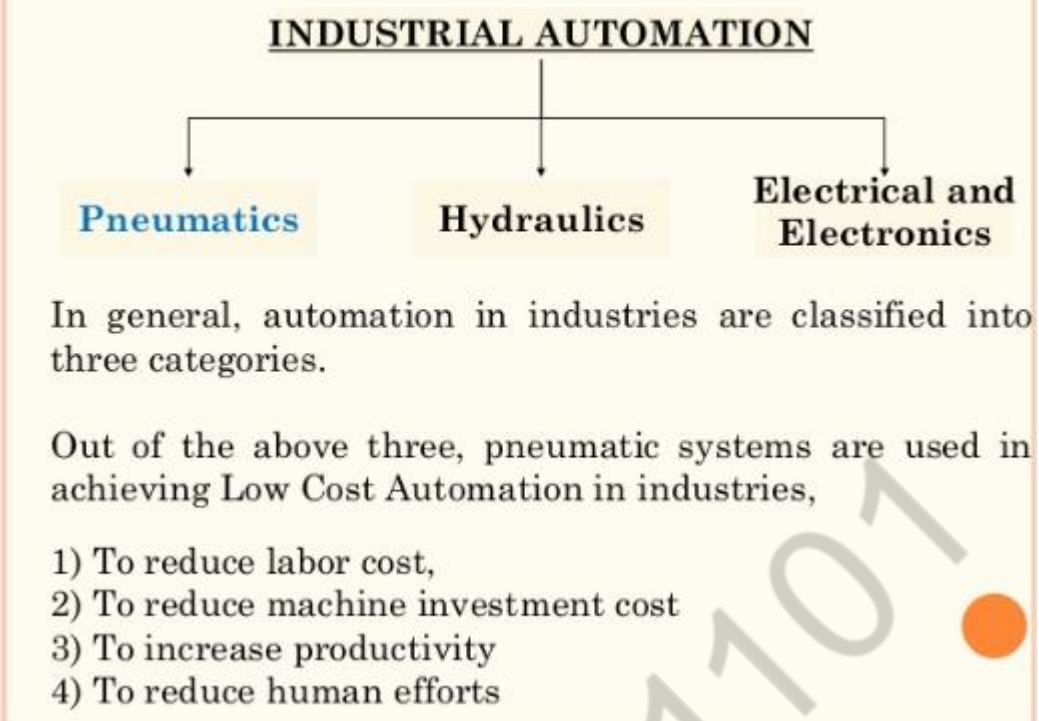
2.i)Explain the applications of hydraulic and pneumatic systems for low cost automation with suitable examples. (Apr/May2005)

Applications of hydraulic systems as follows

Examples of equipment that 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 will work most efficiently if the hydraulic fluid used has zero compressibility

Applications of Pneumatic systems as follows

Processing industries, such as chemical, petrochemical, food processing, textiles, paper, etc. Used in the brake system of automobiles, railway coaches, wagons and printing presses.



ii) Write a note on power packs. (Apr/May2005)

Power pack consists of pump, electric motor, reservoir, and associated valving assembled to one unit to supply pressurized fluid. They are relatively small in size and provide functions of pressure, direction and flow control within the basic package.

3.i)Briefly explain the maintenance requirements for hydraulic power packs. (May/June2006)

Hydraulic power packs need regular maintenance to extend their life and to allow safe operation. Maintenance includes checking the tubing for dents, cracks or other problems, changing the hydraulic fluid and checking the reservoir for rust or corrosion.

ii) Explain the principle of low cost automation. (May/June2006)

The main aim of Low Cost Automation is to increase Productivity and quality of products and reduce the cost of production, and not reduce labor. Even the lower level technologies can be made highly productive by automation at low cost and in simple form.

4.i)What are the factors considered during the installation of pneumatic systems. (Nov/Dec2007)

The various factors to be considered during the installation of pneumatic systems are given below:

1. ***Installation of FRL unit***—installed upstream from the other components.
2. ***Installation of cylinder***—properly mounted and perfectly aligned, it should be ensured that the cylinders are properly lubricated.
3. ***Installation of pipelines***—adequate filter between the main and the circuit to be ensured, water trap is to be fitted at the end of each branch line, piping should be sloped away from the compressor.
4. ***Installation of compressor***—compressor intake should be from the outside air, open end of intake pipeline screened to prevent rain and dirt entering.

ii) List out various operating problems associated with pumps, valves and various faults, possible causes and suitable remedy for each problem (April/May2008)

Ref Question no 1 (Apr/May2005)

5. Discuss any eight common problems and their remedies in pneumatic circuits. (Nov/Dec2009)

Trouble/Fault	Probable causes	Remedial actions
I. COMPRESSORS		
1. Unusual noise	Leaking cylinder valve	Adjust and stop leakage
	Loose belt in compressor wheel, motor pulley	Adjust the belt as recommended
	Motor with excessive end play in shaft	Adjust the end play
	Carbon on top of the piston	De-carbonise
	Leaking, broken or worn out constant speed unloader parts	Adjust or replace
	Valve seats worn	Recondition valve seat
	Worn or scored connecting rod, piston pin or crank pin bearings	Recondition the connecting rod, replace or condition gudgeon pin and crank pin bearings
	Defective ball bearings on crank shaft or on motor shaft	Replace bearings
	Loose motor fan	Tighten the motor fan
	Cylinders or pistons scratched, worn or scored	Rebore cylinder and replace piston
2. Inadequate performance	Dirt in suction filter	Clean filtering plate and filter disc. Do not use gasoline for danger of explosion
	Defective sealing of cylinder head	Mount fresh packing of the cylinder head
	Valve interference through dislocated valve seat and valve guide	Exchange valve insert plate
	Worn out pistons and piston rings as well as worn out cylinder	Exchange piston with rings and also the cylinder if necessary
	Piston rings broken or not sealed	Replace piston rings as per manufacturer's instructions
	End gap not staggered in grooves	Stagger the end gaps, make the rings free in the grooves
	Rough, scratched or excessive	Replace

Trouble/Fault	Probable causes	Remedial actions
II. FILTERS		
1. Excessive pressure drop through filter	Dirty filter element	Replace filter element
	Filter is undersized	Consult manufacturer's flow charts; consider both body, size and port sizes when specifying
2. Contaminants carried through the filter	Elements omitted during servicing	Replace missing elements
	Elements not tightened enough	Tighten elements to prevent bypass
	Broken elements	Replace broken elements
	Element too coarse	Replace with finer graded elements
	Broken end cap from increased pressure drop caused by dirt build-up on entry side	Install standard particle filter ahead of the coalescing filter
3. Moisture in downstream air	Sump of filter bowl has collected too much water and water is re-entering the system	Drain bowl or install automatic drain
	Installation is wrong	Correct installation
	Location is incorrect : filter too close to the after cooler or too high in the plant ceiling	Relocate filter or install a dryer
	Body size is too large, causing low velocity and inefficient operation	Consult manufacturer's data
	Dew point of air is too high	Install a dryer
4. Plastic bowl crazed and breaking	Incompatible chemicals in contact with the plastic	Unless exact cause can be identified, substitute with metal bowls
	Excessive temperatures,	Unless damaging agent can be
III. REGULATORS		
1. Regulator cannot reach high set point	Pressure gauges are inaccurate	Ensure that gauge calibration is a regular maintenance function
	Insufficient upstream pressure	Measure and compare inlet pressure with outlet pressure
	Incorrect control spring range	Check model number for type used and replace

Trouble/Fault	Probable causes	Remedial actions
	Leakage in downstream circuit	Check fittings, valves, cylinders and regulators, correct as required
	Incorrect adjusting technique	To achieve reduced pressure, turn handle counter-clockwise below desire set point, then clockwise back up
2. Set point pressure becomes too high	External loads imposing a higher pressure	Use pressure relief valves, circuit changes or a venting regulator
	Leakage from inlet side : worn out poppet seal, seat or balancing seal	Check for leakage and replace parts as necessary
	Non-venting regulator can aggrevate pressure increase from other causes	Replace with venting regulator
3. Air often escaping from vent hole	External loads imposing a higher pressure	Use pressure relief valves, circuit changes or a ventilating regulator
	Leakage from inlet side : worn out poppet seal, seat, or balancing seal	Check for leakage and replace parts as necessary
4. Pressure too low when air is flowing	Incorrect adjusting technique	To achieve reduced pressure, turn handle counter-clockwise below the desired set point then clockwise back up
	Setting altered through vibration	Re-position adjustments and use locking features to secure position
	Leakage in downstream system	Check connections, component seals and correct as required
	Flow requirement is too high for regulator rating and/or plumbing	Install a larger regulator and/or larger plumbing

6. i)What are the factors considered during the installation of pneumatic systems. (Nov/Dec2011)

Cost

When the SS body disposable cylinder was developed, many people questioned the viability of a non-repairable product. This product has not only succeeded, it has also revolutionized the market. Because of its low cost and ease of replacement, many organizations opted to replace many traditional steel, aluminum and brass body cylinders that could be repaired. While these pneumatic cylinders are the most cost-effective choice and easiest to use, they do have limitations that make them less-than-ideal for certain applications.

Space

Some applications require short cylinders, not allowing for the entire cylinder body to be much longer than its stroke. For these applications, compact or “pancake” cylinders available with round bodies or shaped aluminum extrusions are ideal. These cylinders use thin heads, caps and pistons. Short bearing surfaces keep cylinder length to a minimum. Because of their size, these pneumatic cylinders typically don’t resist side loads well and are not available in long stroke lengths. They are often used in clamping applications were space is at a premium.

Side Load

Cylinders are designed to provide force on one axis. However, many applications experience forces that act on multiple axes, and cylinders must be able to operate at full capacity while resisting these lateral forces. The most common force attributed to pneumatic cylinder failure is side load. Side load consists of a force applied to the cylinder that is perpendicular to the active axis.

Certain types of cylinders are able to better withstand side load because they have longer bearing surfaces for the rod, longer pistons or a greater distance between pistons and the end of the rod bearing surfaces. Tie rod cylinders and the aluminum extruded version of square body pneumatic cylinders are more robust and better suited to resist side load. They can be built with stop tubes, which aid them in overcoming side load by increasing the distance between pistons and rod bearings surfaces, but add to overall cylinder length.

If you are looking to compensate for side load with lighter-duty cylinders, add guides parallel to the rod, which will absorb side load forces and allow for use in these applications.

Serviceability

Many lower cost cylinders available today are not built to be repaired. The crimped body disposable cylinder cannot be serviced, but low cost and versatility mean that it is easier to simply replace them rather than repair them. The ability to repair a cylinder and put it back into service quickly, however, is a great advantage in high-use MRO facilities. Hard cylinder components typically last through several seal changes, meaning that the ability to repair a cylinder can provide long-term benefits.

Cycles

The number and type of cycles that cylinders experience are critical factors in determining the appropriate cylinders to use in your applications. High-cycle systems can wear out cylinder seals prematurely; as a result, high-cycle seals have been developed to extend cylinder life. Additionally, cylinders that reach the end of their strokes in normal system cycles experience reductions in life cycle resulting from continual piston impact absorption by these cylinders. To remedy this problem, cylinders are offered with cushions and bumpers to reduce force and extend cylinder life.

Durability

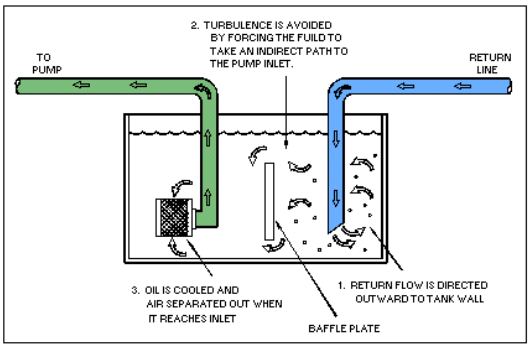
As the performance of aluminum and plastic cylinders have improved, people are opting to convert their steel pneumatic cylinders to ones made of these new materials. There are still applications, however, that demand the durability and serviceability that steel body cylinders provide. In heavy-duty applications such as those found in steel mills and foundries, long life provided by steel cylinders far outweighs any weight or cost savings found in lighter-duty materials. It is always best to process cautiously when deciding whether to replace steel with lighter-duty materials which many not always provide expected product life or serviceability in critical applications.

Application

The environment in which cylinders operate may require specific types of cylinders. Some pneumatic systems run on lubricated air, which consists of in-line components that add oil mist to compressed air. This oil lubricates seals in valves and cylinders and reduces wear on elastomeric seals as they rub against cylinder walls or rods. Today, many cylinders and seals are matched to the type of compressed air that will be used in their respective systems.

7. Expalin the installation procedure for various hydraulic systems and its maintenance procedure. (May/June2013)

Lack of maintenance of hydraulic systems is the leading cause of component and system failure yet most maintenance personnel don't understand proper maintenance techniques of a hydraulic system. The basic foundation to perform proper maintenance on a hydraulic system has two areas of concern. The first area is Preventive Maintenance which is key to the success of any maintenance program whether in hydraulics or any equipment which we need reliability. The second area is corrective maintenance, which in many cases can cause additional hydraulic component failure when it is not performed to standard.



Preventive Maintenance

Preventive Maintenance of a hydraulic system is very basic and simple and if followed properly can eliminate most hydraulic component failure. Preventive Maintenance is a discipline and must be followed as such in order to obtain results. We must view a PM program as a performance oriented and not activity oriented. Many organizations have good PM procedures but do not require maintenance personnel to follow them or hold them accountable for the proper execution of these procedures. In order to develop a preventive maintenance program for your system you must follow these steps:

A list of Preventive Maintenance Task for a Hydraulic System could be:

1. Change the (could be the return or pressure filter) hydraulic filter.

2. Obtain a hydraulic fluid sample.

3. Filter hydraulic fluid.

4. Check hydraulic actuators.

5. Clean the inside of a hydraulic reservoir.

6. Clean the outside of a hydraulic reservoir.

7. Check and record hydraulic pressures.

8. Check and record pump flow.

9. Check hydraulic hoses, tubing and fittings.

10. Check and record voltage reading to proportional or servo valves.

11. Check and record vacuum on the suction side of the pump.

12. Check and record amperage on the main pump motor.

13. Check machine cycle time and record.

Preventive Maintenance is the core support that a hydraulic system must have in order to maximize component and life and reduce system failure. Preventive Maintenance procedures that are properly written and followed properly will allow equipment to operate to its full potential and life cycle. Preventive Maintenance allows a maintenance department to control a hydraulic system rather than the system controlling the maintenance department. We must control a hydraulic system by telling it when we will perform maintenance on it and how much money we will spend on the maintenance for the system. Most companies allow the hydraulic system to control the maintenance on them, at a much higher cost.