Parker Hannifin Plc
Product Training

Reservoirs

Level 1

List of Figures

Contents

1.0 Introduction
Level One training has been devised as a 'self teach' module for persons who have no, or very little prior knowledge of the subject matter. The aim is for a person to work through the information provided at their own pace and in their own time. When they have completed the module and feel confident that they have increased their knowledge they can complete a test that accompanies the module. Successful completion of the module test permits progress onto Level Two.

1.1 What is a hydraulic reservoir?
A hydraulic reservoir, (often referred to as a hydraulic tank or just tank), is a container which is connected via hoses and pipe-work to the hydraulic circuit of a machine or devise which uses hydraulic oil to perform some useful function. You may believe that the function of a hydraulic reservoir is only to hold the system fluid. Besides acting as a fluid container however, a reservoir also serves to cool the fluid, it allows contamination returning from any system component to settle and it enables trapped air in the fluid to dissipate. The reservoir can also be used to house heaters and other fluid conditioning devises.

For industrial applications, the amount of space available for a reservoir is not normally a problem and greater care can be taken with its design. With this in mind, the reservoir can be built to optimise and improve system efficiency. Industrial reservoirs are usually free standing and rectangular in shape. They can be built with a dished or flat tank bottom, have flat tops with or without mounting plates, and can be fitted with inspection covers in easily accessible positions. Suction and return ports can be placed in the most ideal positions, separated by internal baffle plates in order to reduce the amount of turbulence created by oil returning into the reservoir.

In a mobile application however, space is always at a premium with weight being the other major factor in deciding the size, design and layout of the reservoir. Sometimes in a mobile system the vehicle chassis or main-frame may be designed to utilise a sealed hollow section which contains the hydraulic fluid. Although not always an ideal option many systems use this type of reservoir without any problems.

2.0 How a reservoir works
Air pressure acting on the surface of the oil forces it to flow through the suction line into the pump inlet. The end of the suction line is situated clear of the bottom of the reservoir and may sometimes have a suction strainer on its end. Oil then goes out into the hydraulic system before returning to the reservoir via the return line. With fluid returning to the reservoir, a baffle plate blocks the returning fluid from flowing directly to the suction line. With the baffle in place and the flow blocked, a quiet area is formed allowing contamination to settle and the air bubbles to rise to the surface. Fluid baffling is a very important part of a reservoir's operation; for this reason all lines that return fluid to the reservoir should be located below fluid level and positioned as far away as possible from the suction line. On a mobile system extra baffles may be needed due to the movement of the machine. The ends of return tubes are generally cut at an angle so as to increase the area available for the fluid to exit and slow its velocity quicker. Figure 2.1 shows a typical reservoir layout.

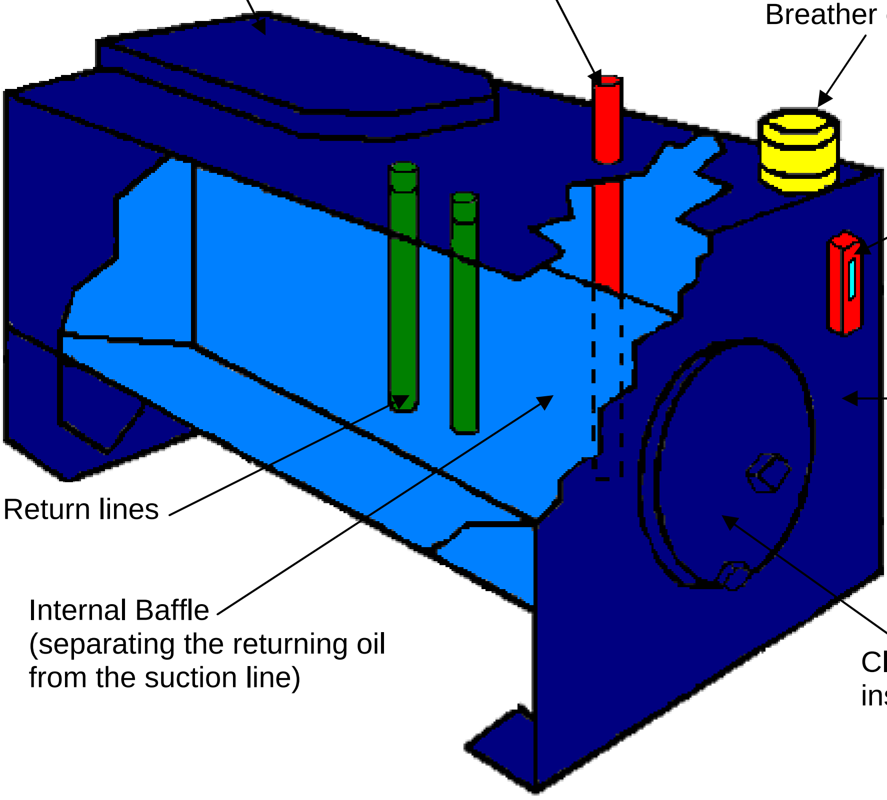

Figure 2.1 Typical layout of an oil reservoir

3.0 Reservoir construction

3.1 Reservoir body

Most reservoir body constructions are made from steel. Typically the fabrication is designed in such a manner that mounting holes, bosses and feet are included as part of the body. Other materials used in the construction of bodies include stainless steel and plastics.

3.2 Filler / breather cap

Whether an industrial or mobile application, the type of environment that a reservoir works in has the potential to add to the contamination level of the hydraulic fluid. The operation of a vented hydraulic system depends on air entering the reservoir through the breather cap and pushing the fluid into the pump. As the actuators in the system are filled and discharged, the tank inhales and exhales air through the breather cap. Any dirt that is not caught in the breather drops into the fluid.

Breathers are very rarely maintained and because of this lack of maintenance the filter medium can become blocked. As a result the cap is often removed or damaged. The reservoir is now open to the environment and draws contaminated air into the system. Dirt particulate is not the only consideration however. Water vapour is also a contaminant. While the system is running this not too much of a problem but when the system is shut down the trapped vapour condenses on the walls of the reservoir. This can lead to the formation of rust, which eventually falls into the fluid. Apart from the fact that damage will be caused to the system by the contaminated oil, dirt causes sludge to build up on the tank walls and inhibits the transfer and dissipation of heat. A clean hydraulic system will run cooler than a dirty system.

Many industrial and mobile systems use control valves, which have spool clearances of around 3-6 microns. In systems of this kind, controlled reservoir filling methods, in the form of sealed quick couplers, need to be employed along with good system filling filtration. It should be noted however, that this method of reservoir filling is best adopted for all hydraulic systems irrespective of what system components are used.

3.2 Fluid level gauge

The fluid level gauge can be located in any position so long as it is in a position that can be read easily. A gauge that is hard to read will not be read at all. Sometimes the level gauge will have a thermometer incorporated in the design. Temperature is always a concern in hydraulic systems, especially in mobile applications. Generally mobile systems use lower capacity tanks and temperatures can rise at an alarming rate if the system is running to its full potential.

3.3 Baffles

Baffles come in various designs and make up. Whatever the design may be the function is the same; to reduce turbulence caused by the returning oil, to dissipate air bubbles contained in the returning oil, to give the returning oil a chance to cool before being taken back into the system again, and to allow any contamination particles to fall to the bottom of the reservoir and not be taken back into the system.

Some baffles are manufactured with small holes in them that allows the hot oil to mix more easily with the cooler oil already in the tank. With mobile applications the reservoir could be working at various angles and this should be taken in to account when designing the baffle layout. Photo 3.1 shows a typical application for a piece of mobile equipment. Note the gradient that the unit is working on.

Figure 3.1 showing the diverse working angles of a mobile machine, which entails good reservoir design and internal layout

3.5 Return lines
Return lines should always be as far away from the suction line as possible, and on the opposite side of the baffle. Return lines should exit below the oil level so that oil disturbance and the generation of air bubbles is kept to a minimum. Many systems nowadays make use of a return line filter which is usually mounted directly on to the reservoir or line mounted close to the reservoir. All major return lines will pass oil through this filter before it enters the reservoir.

3.6 Inspection cover
The inspection cover is fitted, so that, if ever there is a need to clean out the reservoir, access can be gained through the cover. On some modern mobile plastic reservoirs inspection covers are not designed into the reservoir and so the tank has to be removed and flushed if cleaning is required. Figure 3.2 shows a typical plastic style reservoir with a return filter fitted opposite to the filler / breather cap.

Figure 3.2 - A modern plastic reservoir without inspection covers

Figure 3.3 – An industrial power unit with large well-spaced reservoir
Note the inspection covers on the front of the unit allowing cleaning and inspection of internals

4.0 Reservoir Identification

4.1 Schematic Drawings
Hydraulic components are identified on schematic drawings by internationally recognised symbols. The symbol used for a hydraulic reservoir is shown at the foot of every page in this module. Figure 4.1 shows how a hydraulic reservoir is represented on a typical section of a hydraulic schematic diagram. Despite the fact that three reservoir symbols are shown, in reality only one reservoir exists. It is common practice to draw the reservoir symbol at the ends of main return lines rather than draw many extra lines all the way back to a single reservoir symbol.

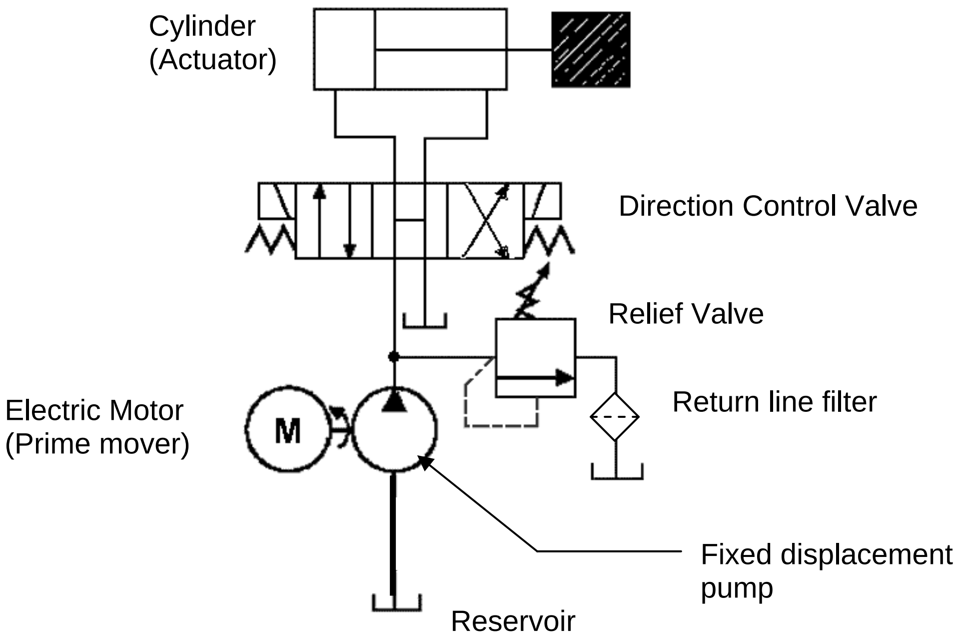

Figure 4.1 Schematic diagram showing how a reservoir is represented symbolically.

4.2 Alternative reservoir symbols
The vast majority of hydraulic reservoirs are none pressurised. In other words, the oil inside is subject to atmospheric pressure. Some reservoirs however are ‘pressurised’. The two systems have different symbols which identify the type of system in use. These are shown in figures 4.2 and 4.3.

Fig 4.2 Symbol for a vented reservoir

Fig 4.3 Symbol for a pressurized reservoir

Return lines are also shown in two configurations, some are terminated below the oil level some are terminated above. On some drawings this is very easy to miss. Figures 4.4, 4.5, 4.6 and 4.7 show the different arrangements.

Fig 4.4 and 4.5 Return lines terminating above fluid level

Fig 4.6 and 4.7 Return line terminating below fluid level

Summary points

- Baffles divide and break up the flow of oil so that air bubbles can escape
- Hydraulic tanks are not stable they inhale and exhale, due to system demands
- Return and suction lines should be as far apart as possible
- Breather caps should be maintained on a regular basis
- Sludge build up in a tank prevents the dissipation of heat
- Dirty systems always run hotter than clean systems
- Due to tighter valve tolerances industrial systems are usually fitted with spin on type breathers
- Water vapour in the atmosphere can cause rust to form on the inside of a tank, contaminating the system
- Plastic tanks are rarely designed with an inspection plate
- Level gauges sometimes incorporate a thermometer
- Reservoirs for mobile machinery are generally smaller than industrial typs due to space and weight constraints