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# ACTUATORS AND FILTERS

# HYDRAULIC ACTUATORS

- **A hydraulic actuating cylinder transforms energy in the form of fluid pressure into mechanical force, or action to perform work.**
- **It is used to impart powered linear motion to some movable object or mechanism.**
- **A typical actuating cylinder consists of a cylinder housing, one or more pistons and piston rods, and some seals.**
- **Actuating cylinders are of two major types: single action and double action.**

# Types of Actuator

## 1. LINEAR ACTUATORS

1.1 Single Acting

1.2 Double Acting

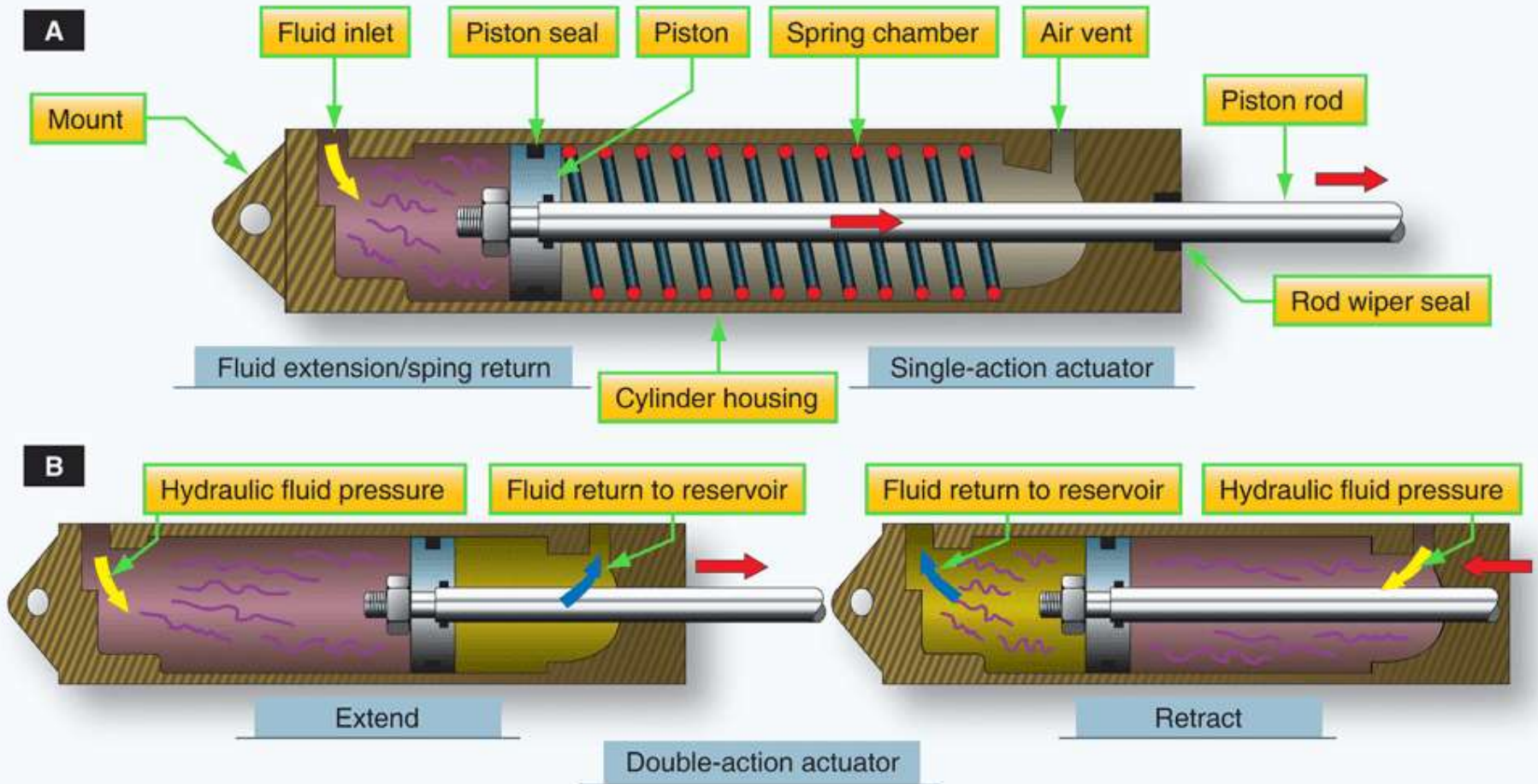
## 1. ROTARY ACTUATORS

# 1.1 Single Acting Linear Actuator

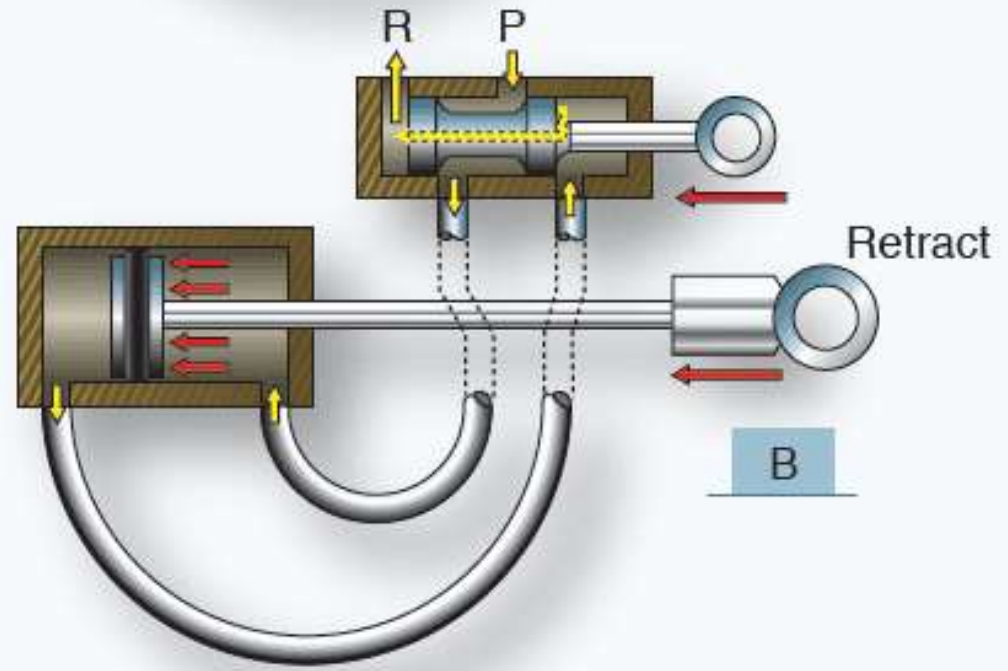
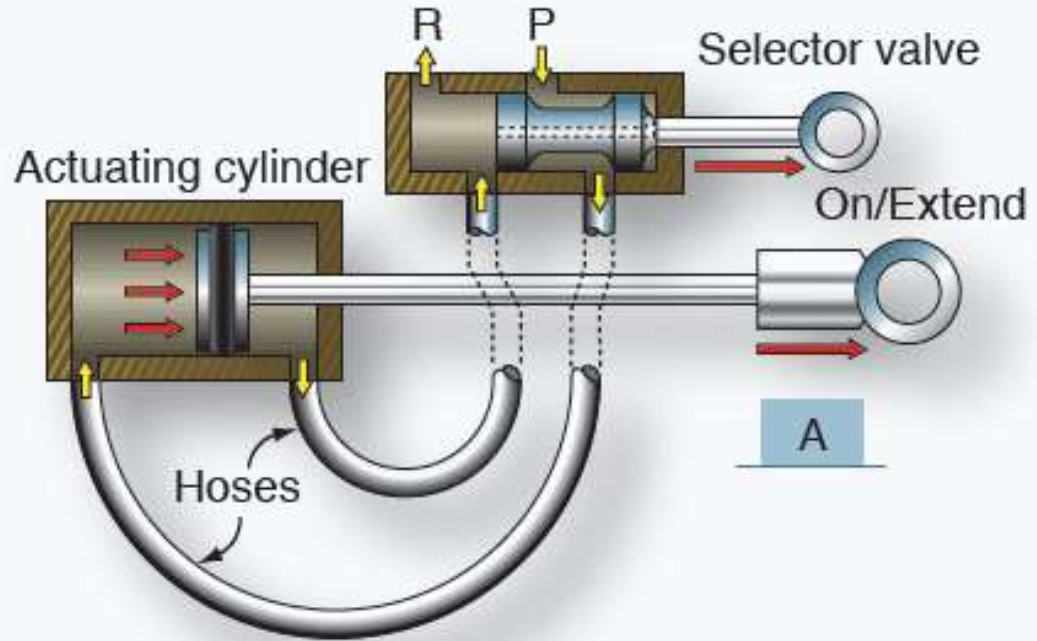
- Fluid under pressure enters the port at the left and pushes against the face of the piston, forcing the piston to the right.
- As the piston moves, air is forced out of the spring chamber through the vent hole, compressing the spring.
- When pressure on the fluid is released to the point it exerts less force than is present in the compressed spring, the spring pushes the piston toward the left.
- As the piston moves to the left, fluid is forced out of the fluid port. At the same time, the moving piston pulls air into the spring chamber through the vent hole.
- A three way control valve is normally used for controlling the
- operation of a single-action actuating cylinder.

## 2.2 Double Acting Actuator

- The operation of a double-action actuating cylinder is usually controlled by a four-way selector valve.
- When the selector valve is placed in the ON or
- EXTEND position, fluid is admitted under pressure to the left-hand chamber of the actuating cylinder.
- *This results in the piston being forced toward the right. As the piston moves toward the right, it pushes return* .
- fluid out of the right-hand chamber and through the selector valve to the reservoir. When the selector valve is placed in its RETRACT position.
- *fluid pressure enters the right chamber, forcing the piston toward the left. As the piston moves toward the left, it pushes return fluid out of the left chamber and through the selector valve to the reservoir.*



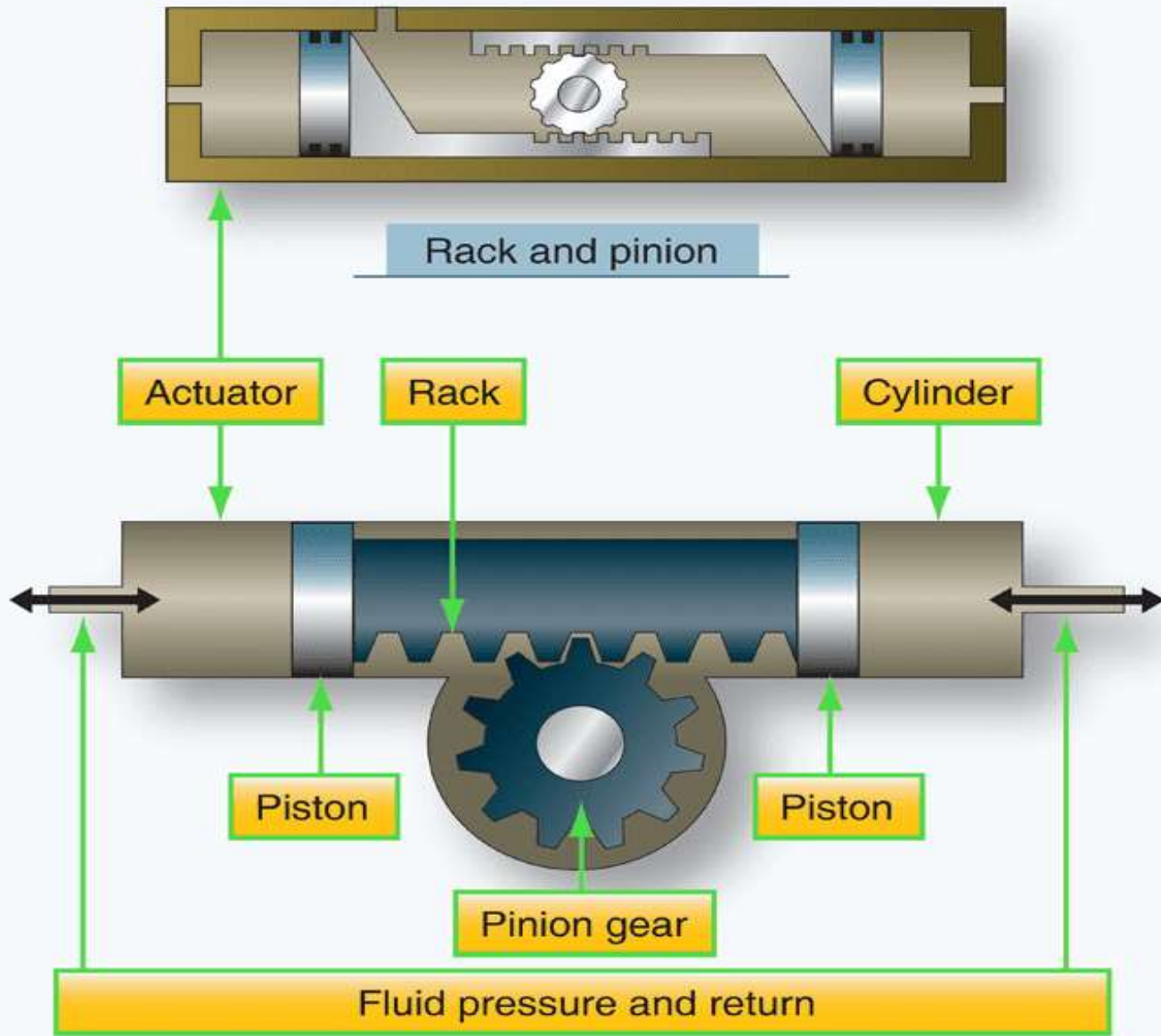
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## **2. ROTARY ACTUATORS**

- **Rotary actuators can mount right at the part without taking up the long stroke lengths required of cylinders.**
- **Rotary actuators are not limited to the 90° pivot arc typical of cylinders; they can achieve arc lengths of 180°, 360°, or even 720° or more, depending on the configuration.**
- **An often used type of rotary actuator is the rack and pinion actuator used for many nose wheel steering mechanisms.**
- **One side of the piston receive fluid pressure while the other side is connected to the return. When the piston moves, it rotates the pinion.**



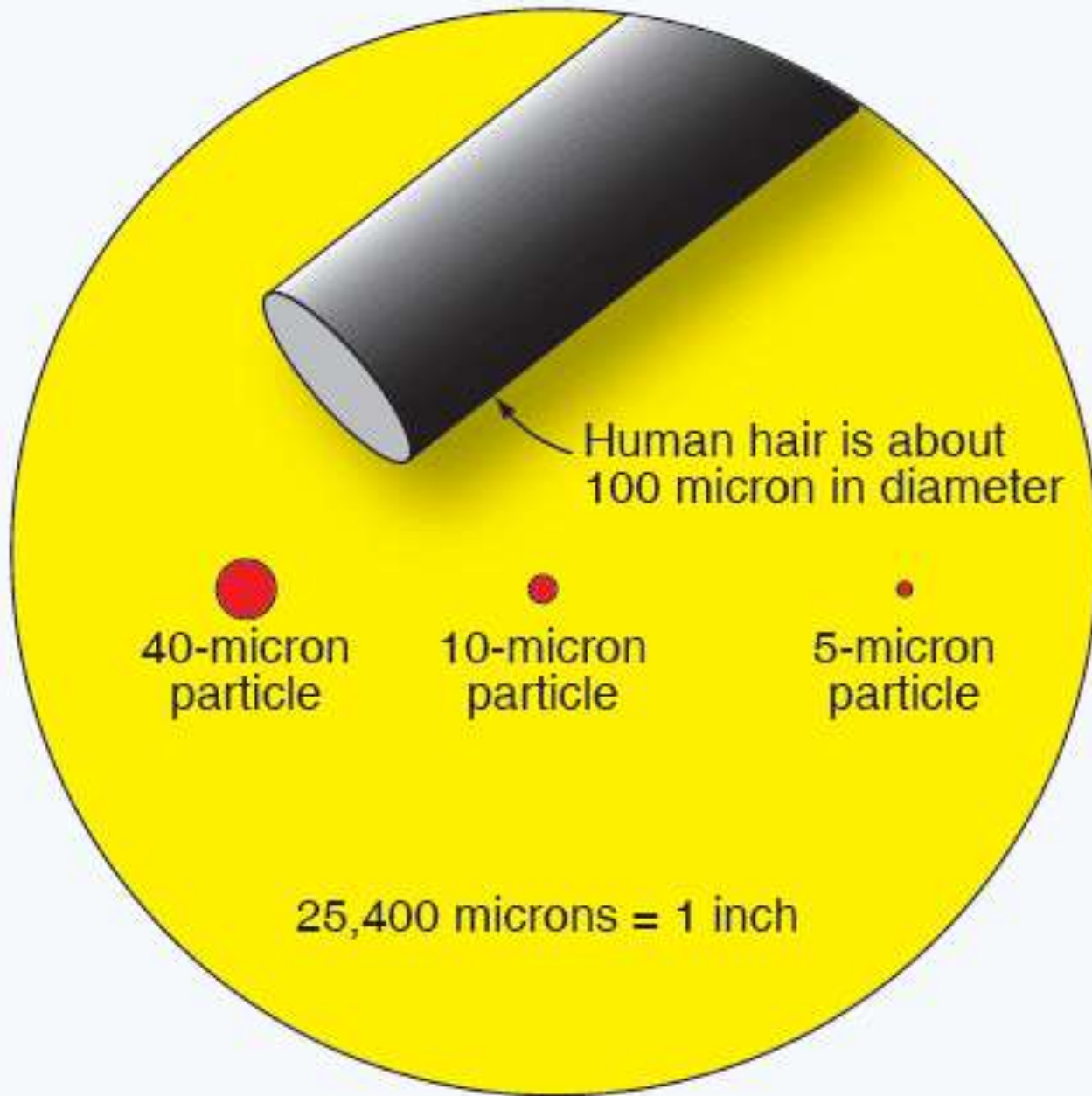
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**FILTERS**

# FILTERS

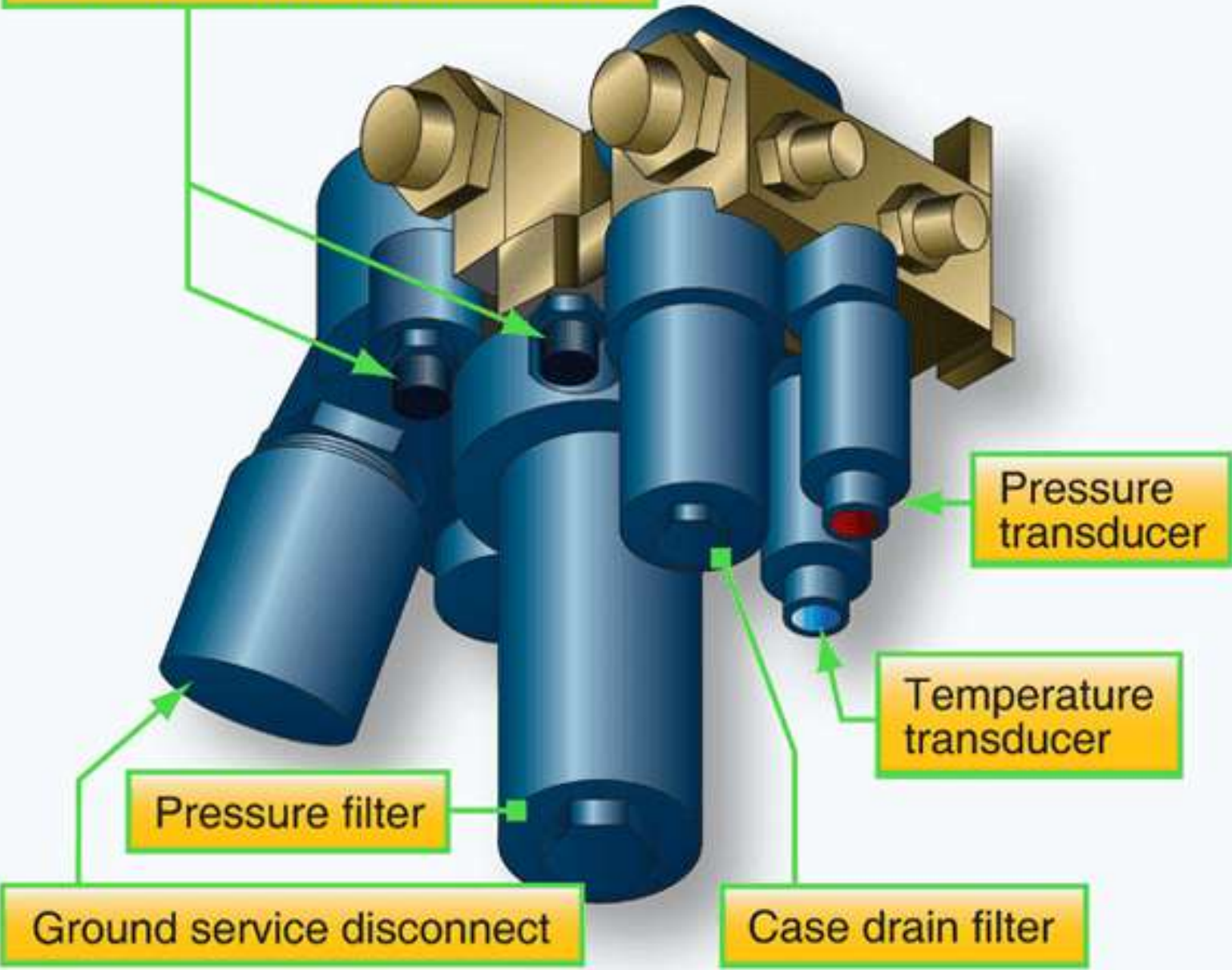
- A filter is a screening or straining device used to clean the hydraulic fluid, preventing foreign particles and contaminating substances from remaining in the system.
- The hydraulic fluid holds in suspension tiny particles of metal that are deposited during the normal wear of selector valves, pumps, and other system components. Such minute particles of metal may damage the units and parts through which they pass if they are not removed by a filter.
- Filters may be located within the reservoir, in the pressure line, in the return line, or in any other location



# Construction

- **The head assembly is secured to the aircraft structure and connecting lines.**
- **Within the head, there is a bypass valve that routes the hydraulic fluid directly from the inlet to the outlet port if the filter element becomes clogged with foreign matter.**
- **The bowl is the housing that holds the element to the filter head and is removed when element removal is required.**

Differential pressure indicators



Pressure transducer

Temperature transducer

Pressure filter

Ground service disconnect

Case drain filter

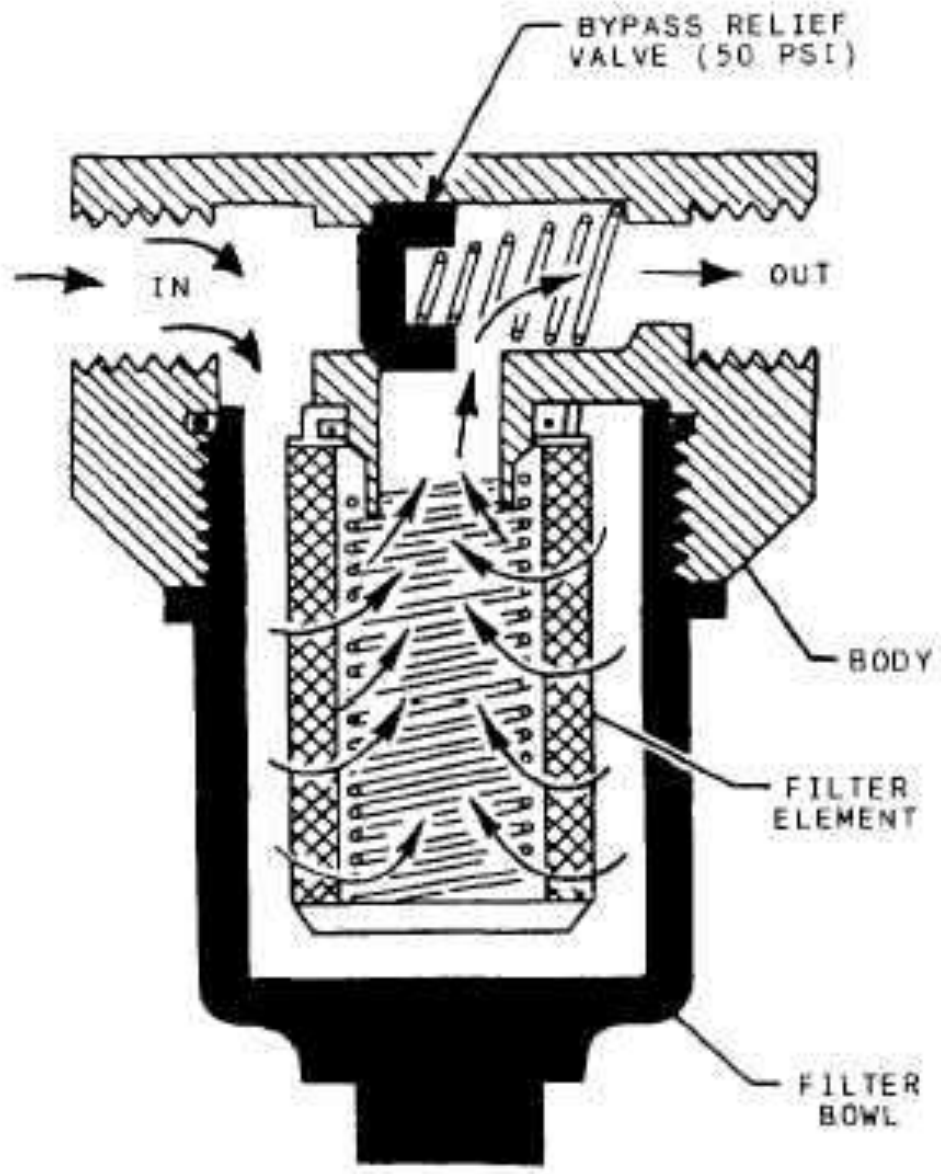


Head  
Assembly

Filter  
Element

Bowl





# Types of the Filters

- **Micron**
- **Porous metal and**
- **Magnetic filter**

# 1.MICRON TYPE FILTERS

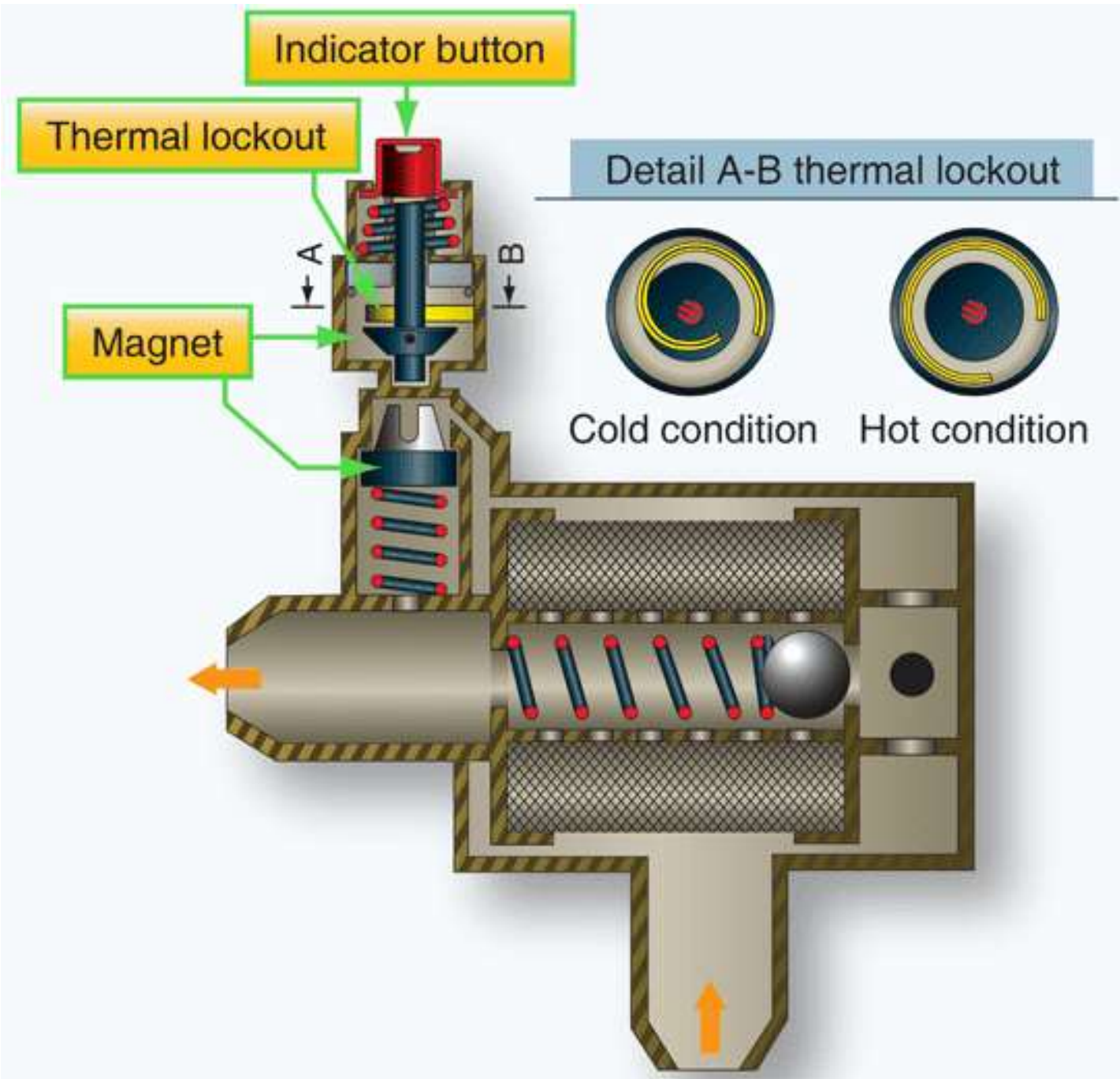
- A typical micron type filter assembly utilizes an element made of specially treated paper that is formed in vertical convolutions (wrinkles).
- An internal spring holds the elements in shape.
- The micron element is designed to prevent the passage of solids greater than 10 microns (0.000394 inch) in size.
- In the event that the filter element becomes clogged, the spring-loaded relief valve in the filter head bypasses the fluid after a differential pressure of *50 psi has been built up*.

# MAINTENANCE OF FILTERS

- **The element should be inspected very closely to ensure that it is completely undamaged**
- **Filters using the micron type element should have the element replaced periodically according to applicable instructions.**
- **When replacing filter elements, be sure that there is no pressure on the filter bowl. Protective clothing and a face shield must be used to prevent fluid from contacting the eye.**
- **After the filter element has been replaced, the system must be pressure tested to ensure that the sealing element in the filter assembly is intact.**
- **In the event of a major component failure, such as a pump, consideration must be given to replacing the system filter elements, as well as the failed component.**

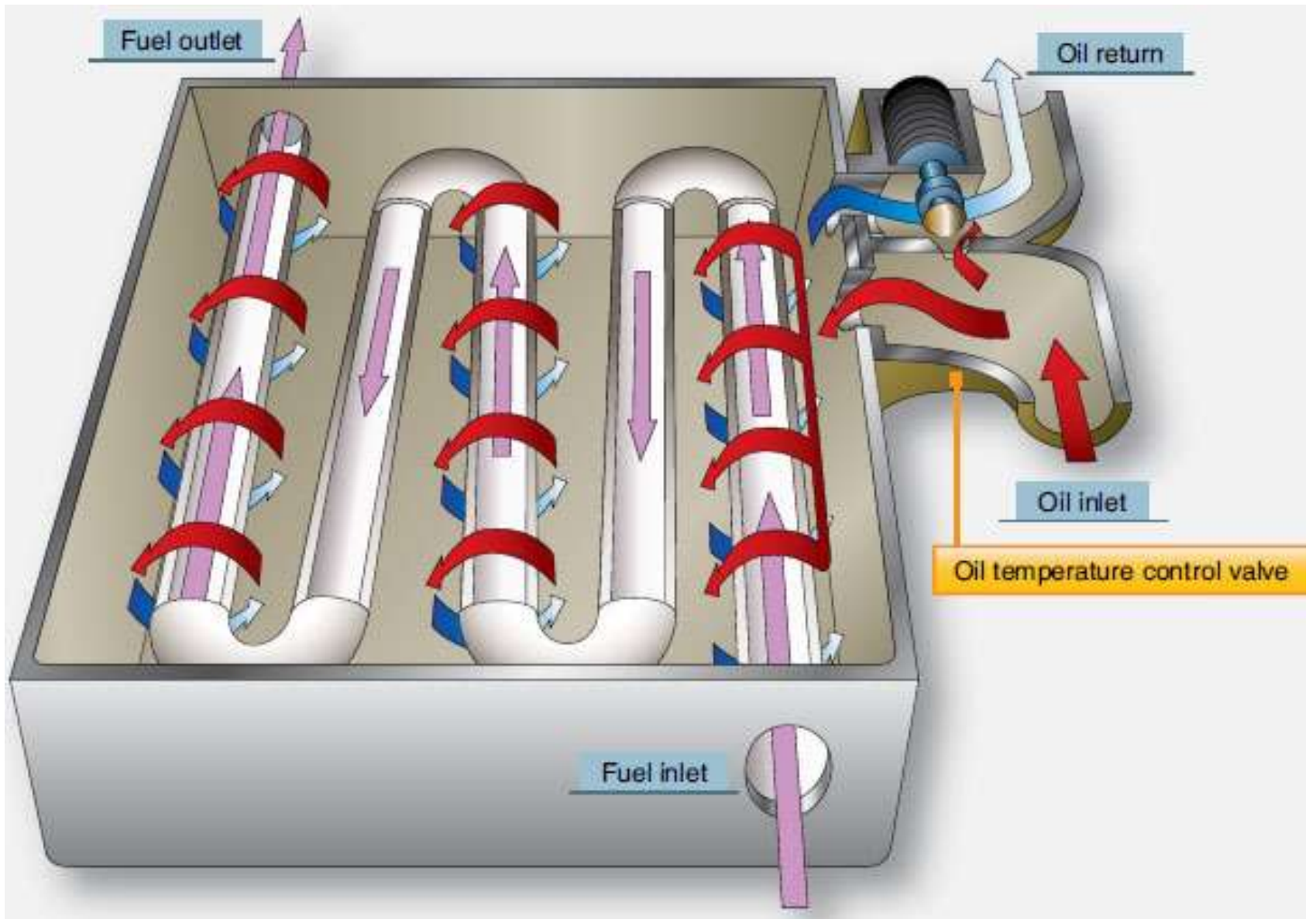
# **FILTER BYPASS VALVE**

- **Filter modules are often equipped with a bypass relief valve.**
- **The bypass relief valve opens if the filter clogs, permitting continued hydraulic flow and operation of aircraft systems.**
- **Dirty oil is preferred over no flow at all.**
- **Ball valve opens when the filter becomes clogged and the pressure over the filter increases.**



# HEAT EXCHANGERS

- **Transport type aircraft use heat exchangers in their hydraulic power supply system to cool the hydraulic fluid from the hydraulic pumps.**
- **This extends the service life of the fluid and the hydraulic pumps.**
- **They are located in the fuel tanks of the aircraft.**
- **The heat exchangers use aluminum finned tubes to transfer heat from the fluid to the fuel.**
- **The fuel in the tanks that contain the heat exchangers must be maintained at a specific level to ensure adequate cooling.**





# HYDRAULIC INDICATING AND WARNING

# HYDRAULIC INDICATING AND WARNING

- **There are just a few hydraulic system indications on the flight deck. Typically, electro-hydraulic transducers are mounted in the system in key locations so that hydraulic pressure and temperature can be displayed on a gauge or LCD screen.**
  1. **Fluid pressure**
  2. **Fluid temperature**
  3. **fluid quantity**
  4. **Reservoir pressurization air pressure**

# Pressure Sensor Location

- Pressure sensor used at Filter so that it shows the Filter Clogging.
- Downstream of the pump so that low pressure indication.
- Typically a lamp will illuminate, flash or change color on the flight deck when a pressure sensor sends an electric or electronic signal that a low pressure condition exists.

# INTERFACE WITH OTHER SYSTEMS

- **Many aircraft systems use hydraulic power such as landing gear extension and retraction, flight controls, and auto pilot.**
- **In most cases, the operational logic for these advanced systems are controlled by computer.**
- **To integrate the mechanical power of the hydraulic system, hydraulic system parameters and status condition must be input into the controlling computer.**
- **In the absence of any malfunction, the computer controller activates the correct hydraulic system components when needed.**

- **Vital systems control logic can also dictate operation in alternate modes should the hydraulic system parameters be out of the normal operating range.**
- **For example, if the hydraulic pump used for normal operations is not maintaining acceptable system pressure, logic circuits reconfigure the operational mode from 'normal' to an alternate mode that utilizes the back up hydraulic pump.**
- **Hydraulic system parameters that are captured in analog format are converted to digital format for use in the control system logic.**



**Nearly three percent  
of the ice in Antarctic  
glaciers is penguin  
urine.**







# धन्यवाद

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