

Fluid power

Fluid power is the use of fluids or air under pressure to generate, control, and transmit power.

The main components of a typical basic hydraulic system are: a pump, a valve and a hydraulic cylinder. The pump converts a small amount of mechanical power into hydraulic power, the valve controls the hydraulic oil flow and the hydraulic cylinder converts the hydraulic power into a large amount of mechanical power.

Why do hydraulic systems overheat?

Heating of hydraulic fluid in operation is caused by inefficiencies. Inefficiencies result in losses of input power, which are converted to heat. A hydraulic system's heat load is equal to the total power lost (PL) through inefficiencies and can be expressed as:

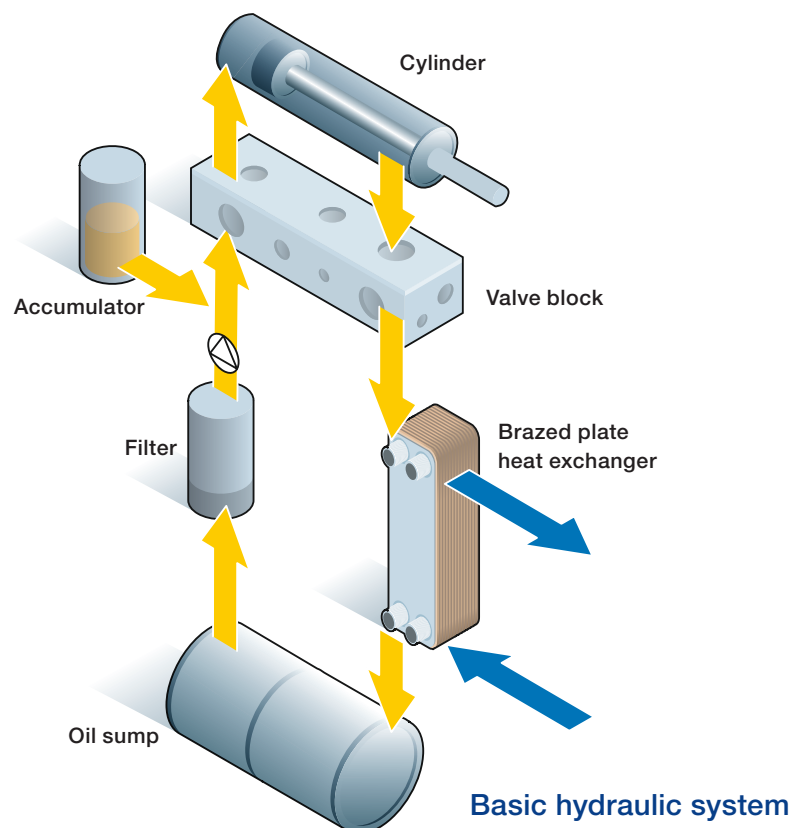
$$PL_{total} = PL_{pump} + PL_{valves} + PL_{plumbing} + PL_{actuators}$$

If the total input power lost to heat is greater than the heat dissipated, the hydraulic system will eventually overheat. Installed cooling capacity typically ranges between 25 and 40 percent

of input power, depending on the type of hydraulic system. The temperature of the hydraulic fluid should not exceed 180°F (82°C). At higher temperatures, the fluid may start to deteriorate, and the viscosity gets too low for reliable lubrication of pump and motor components. It is very important that the fluid remains clean, stays below 180°F, and contains no water (less than 150 ppm) to secure a long oil life-time.

Important facts:

- The operating temperature in most industrial applications is around 140°F (60°C)
- Operating at temperatures above 185°F (85°C) the oxidation process is accelerated.
- Oxidation stability is a chemical reaction that occurs with a combination of the oil and oxygen.
- Every 18°F (10°C) increase in temperature above 140°F (60°C) doubles the oxidation rate and cuts the life of the oil in half.



Major fluid power users

Power pack manufacturers

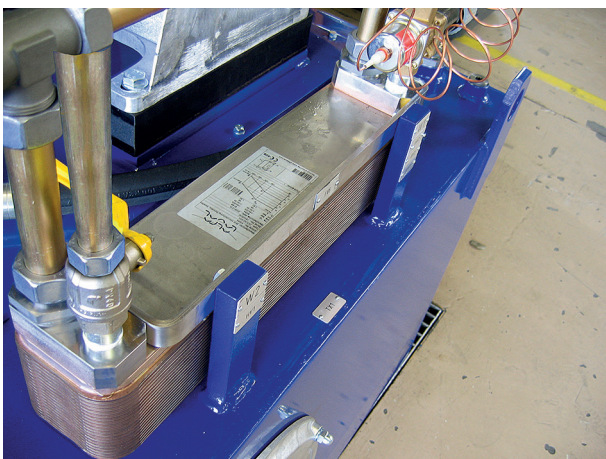
Hydraulic power packs are stand-alone devices, as opposed to a built-in power supply for hydraulic machinery. Some power packs are large, stationary units and others are more portable. They have a hydraulic reservoir, which houses the fluid, regulators that allow users to control the amount of pressure the power pack delivers to a valve, pressure supply lines and relief lines, a pump and a motor to power the pump.

Hydraulic power packs typically offer a choice of valve connections, allowing users to connect them to a control valve or valves to power a variety of machines. The power pack supplies hydraulic power through a control valve to run another machine.

Plastic industry

An injection moulding machine, also known as an injection press, is a machine for manufacturing plastic products by the injection moulding process. It consists of two main parts, an injection unit and a clamping unit. Types of injection moulding machines are classified primarily by the type of driving systems they use: hydraulic, mechanical, electric, or hybrid. Hydraulic machines, although not nearly as precise, are the predominant type in most parts of the world, with the exception of Japan.

There is also another part of the plastic machinery which is critical in terms of temperature control – the tool making the plastic component. In larger facilities the cooling water which is used to cool the tools is centrally cooled by a cooling tower or a chiller station.



Hydraulic presses

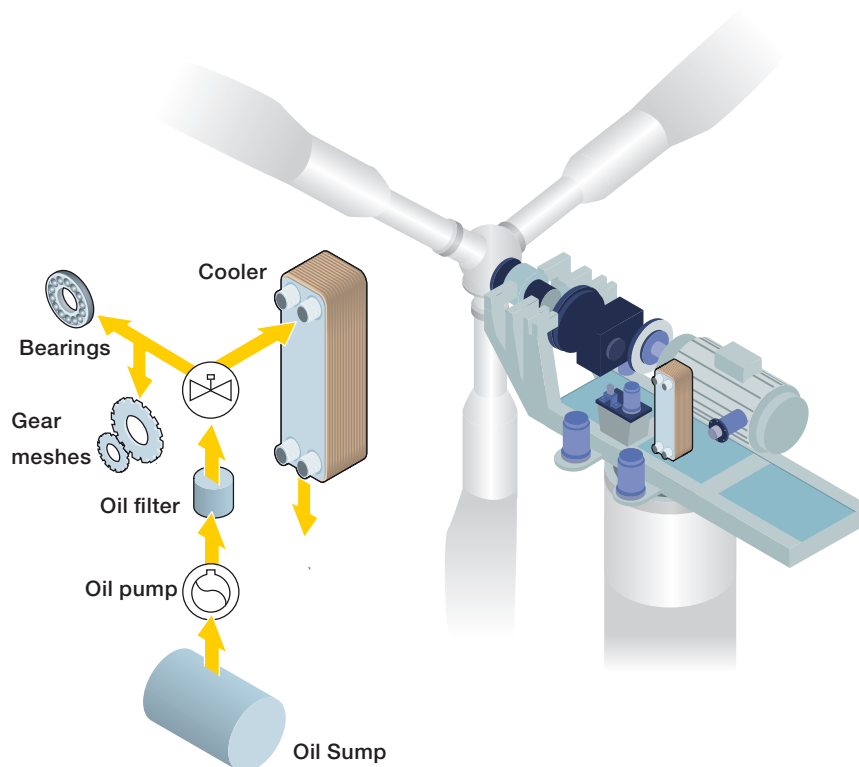
A hydraulic press is a machine using a hydraulic cylinder to generate a compressive force. It uses the hydraulic equivalent of a mechanical lever. The hydraulic press depends on Pascal's principle: the pressure throughout a closed system is constant. One part of the system is a piston acting as a pump, with a modest mechanical force acting on a small cross-sectional area; the other part is a piston with a larger area which generates a correspondingly large mechanical force. Only small-diameter tubing (which more easily resists pressure) is needed if the pump is separated from the press cylinder. A fluid, such as oil, is displaced when either piston is pushed inward. The small piston, for a given distance of movement, displaces a smaller amount of volume than the large piston, which is proportional to the ratio of areas of the heads of the pistons. Therefore, the small piston must be moved a large distance to get the large piston to move significantly. The distance the large piston will move is the distance that the small piston is moved divided by the ratio of the areas of the heads of the pistons. This is how energy, in the form of work in this case, is conserved and the Law of Conservation of Energy is satisfied. Work is force times distance, and since the force is increased on the larger piston, the distance the force is applied over must be decreased.

Hydraulic presses are commonly used for forging of metal parts.

Machines for the paper industry In the paper industry there are several machines needed for rolling and pressing paper.

Gearbox

Most modern gearboxes are used to increase torque while reducing the speed of a prime mover output shaft (e.g., a motor crankshaft). This means that the output shaft of a gearbox rotates at a slower rate than the input shaft, and this reduction in speed produces a mechanical advantage, increasing torque. A gearbox can be set up to do the opposite and provide an increase in shaft speed with a reduction of torque. Some of the simplest gearboxes merely change the physical direction of power transmission. Gearboxes have found use in a wide variety of different – often stationary – applications, such as wind turbines



Gearbox

Machine tools

A machine tool is a machine for shaping or machining metal or other rigid materials, usually by cutting, boring, grinding, shearing or other forms of deformation. Machine tools employ some sort of tool that does the cutting or shaping. All machine tools have some means of constraining the workpiece and provide a guided movement of the parts of the machine. Thus the relative movement between the workpiece and the cutting tool (which is called the toolpath) is controlled or constrained by the machine to at least some extent, rather than being entirely "offhand" or "freehand". Today machine tools are typically powered electrically or hydraulically

Marine hydraulic systems

Nowadays sea travel without hydraulics is unthinkable. Hydraulic drive systems are used to power essential operational units on ships. Titanium plate heat exchangers are perfect coolers when using seawater as the cooling medium.

There are many applications on board, such as: Winches, cranes, thrusters and propeller drives, bow and stern doors, lifts, waterjet and cargo pumps.

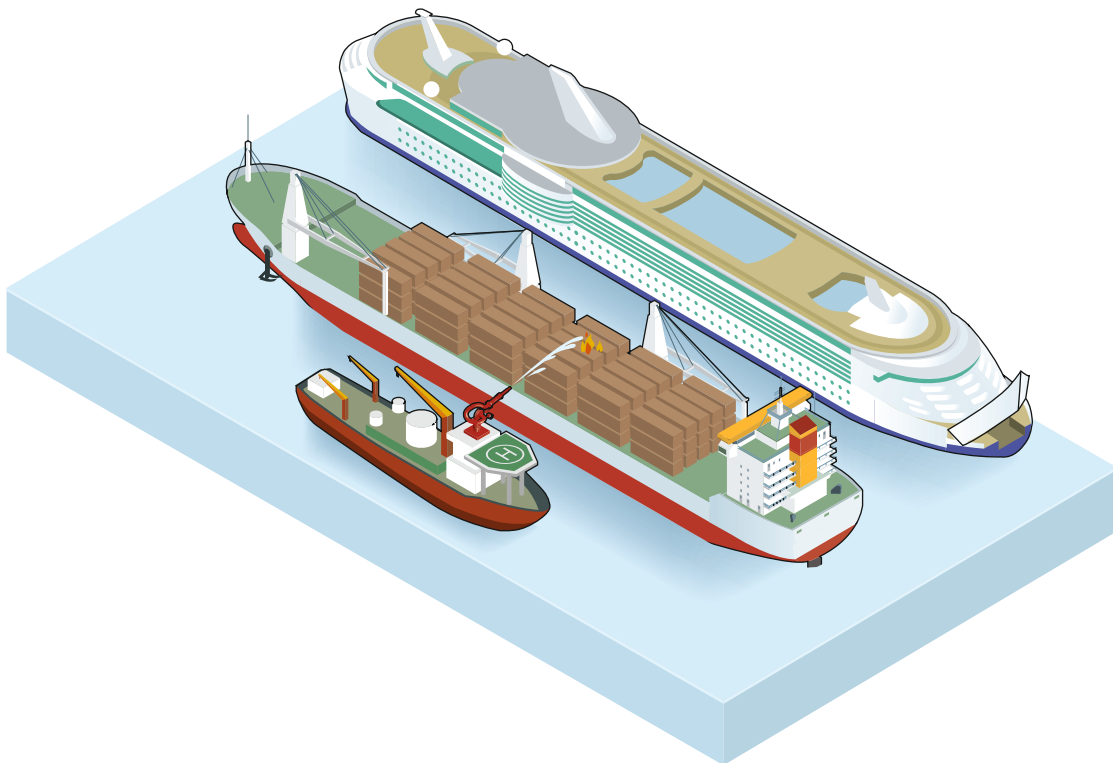
Fire fighting equipment

Conventional and FPSO offshore production platforms require fire protection, which is typically achieved by a high-pressure firewater ring main supplied by a firewater pump. Traditionally, these are conventional, vertical line-shaft pumps driven by a diesel engine via a 90° gearbox. By making an innovative hydraulic drive fire pump design a number of cost-effective improvements have been made to this key application.

Mining equipment

Heavy machinery is needed in mining for exploration and development, to remove and stockpile overburden, to break and remove rocks of various hardness and toughness, to process the ore and for reclamation efforts after the mine is closed. Bulldozers, drills, explosives and trucks are all necessary for excavating the land. Processing plants can utilize large crushers, mills, reactors, roasters and other equipment to consolidate the mineral-rich material and extract the desired compounds and metals from the ore.

Hydraulic marine application



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