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# Hydraulics

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# Preface

This field manual (FM) serves as a guide for personnel who operate and maintain military equipment using hydraulic-powered control systems. It includes general information covering basic hydraulics and describes the properties and characteristics of fluids and several types of pumps, motors, valves, and controls. This manual also deals with piping, tubing, and hoses used to convey fluid under pressure. It describes the functions and types of reservoirs, strainers, filters, and accumulators. It discusses the purposes and types of seals and packings used in fluid power systems.

The contents of this manual are applicable to both nuclear and nonnuclear warfare.

The Appendix contains an English to metric measurement conversion chart.

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Unless otherwise stated, masculine nouns and pronouns do not refer exclusively to men.

## CHAPTER 1

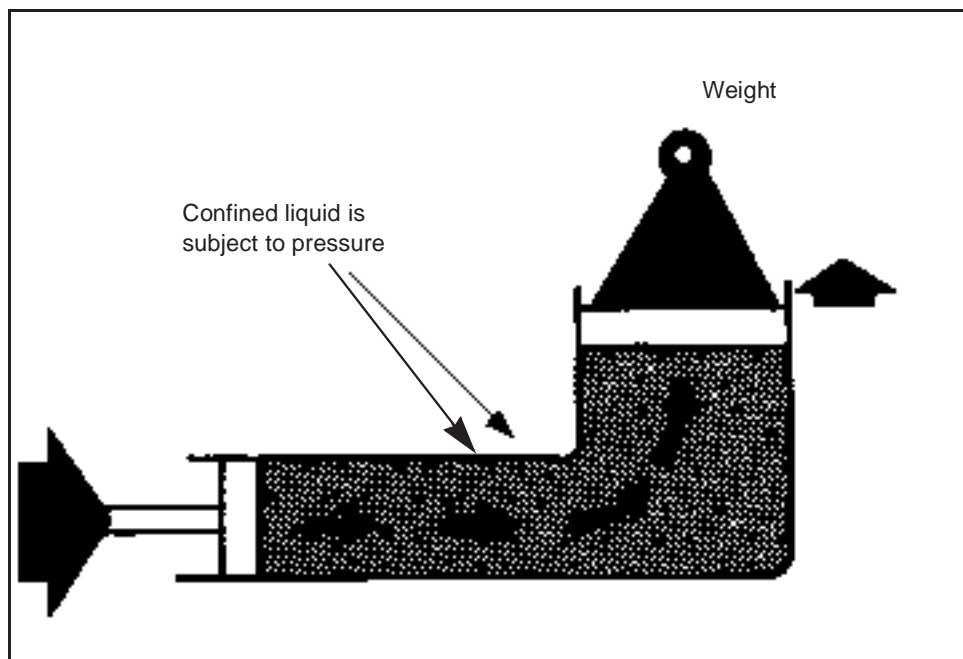
# Hydraulic Basics

*Hydraulics is the science of transmitting force and/or motion through the medium of a confined liquid. In a hydraulic device, power is transmitted by pushing on a confined liquid. Figure 1-1 shows a simple hydraulic device. The transfer of energy takes place because a quantity of liquid is subject to pressure. To operate liquid-powered systems, the operator should have a knowledge of the basic nature of liquids. This chapter covers the properties of liquids and how they act under different conditions.*

**1-1. Pressure and Force.** Pressure is force exerted against a specific area (force per unit area) expressed in pounds per square inch (psi). Pressure can cause an expansion, or resistance to compression, of a fluid that is being squeezed. A fluid is any liquid or gas (vapor). Force is anything that tends to produce or modify (push or pull) motion and is expressed in pounds.

a. *Pressure.* An example of pressure is the air (gas) that fills an automobile tire. As a tire is inflated, more air is squeezed into it than it can hold. The air inside a tire resists the squeezing by pushing outward on the casing of the tire. The outward push of the air is pressure. Equal pressure throughout a confined area is a characteristic of any pressurized fluid. For example, in an inflated tire, the outward push of the air is uniform throughout. If it were not, a tire would be pushed into odd shapes because of its elasticity.

There is a major difference between a gas and a liquid. Liquids are slightly compressible (Figure 1-2, page 1-2). When a confined liquid is pushed on, pressure builds up. The pressure is still transmitted equally throughout the container. The fluid's behavior makes it possible to transmit a push through pipes, around corners, and up and down. A hydraulic system uses a liquid



**Figure 1-1. Basic hydraulic device**