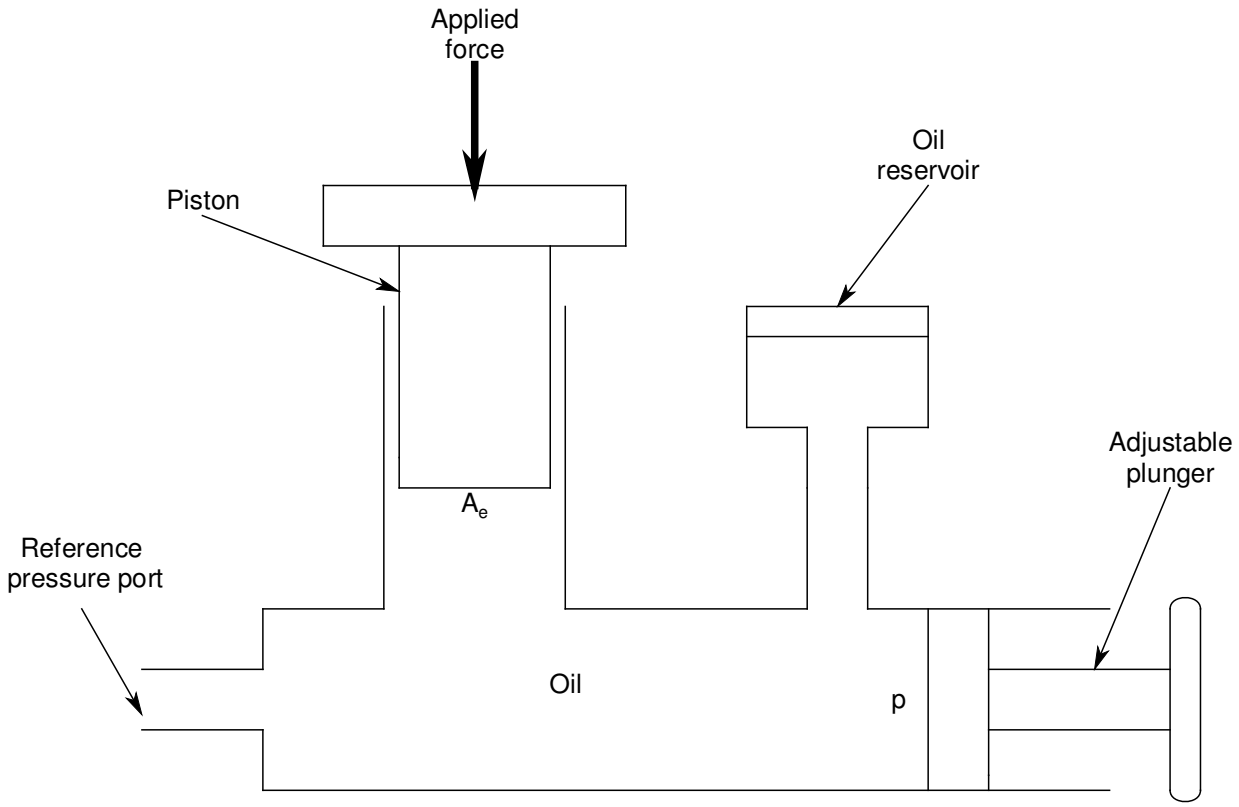
DEAD WEIGHT TESTER

The dead weight tester is used as a laboratory standard for the calibration of pressure-measuring devices over the pressure range from 70 to $7X10^7$MPa. This device determines pressure directly through the fundamental definition of a force per unit area.



Principle: A deadweight tester consists of an internal chamber filled with a liquid, and a close fitting piston and cylinder. Chamber pressure is produced by the compression of the liquid, usually oil, by the adjustable plunger. This pressure acts on the end of the carefully machined piston. A static equilibrium will exist when the external pressure exerted by the piston on the fluid balances with the chamber pressure. This external pressure is created by a downward force acting over the equivalent area A_e of the piston. The weight of the piston plus the additional weight of calibrated masses are used to produce this external force, F. At static equilibrium the piston will float, and the chamber pressure can be deduced as $p = \frac{F}{A_e} + \sum errors$. A pressure gauge is calibrated by connecting to the reference port and comparing with the chamber pressure.

The instrument uncertainty in the chamber pressure reading using a deadweight tester can be as low as 0.05-0.01% of the reading. Sources of errors include air buoyancy effects, variations in local gravity, uncertainty in the known mass of the piston and added masses, shear effects, thermal expansion of the piston area, and elastic deformation of the piston.