

Pressures in a Well 101

There are a number of pressures that are involved in well operation and drilling, including:

- Hydrostatic pressure (HSP): is the pressure in the bottom of the well due to the weight of a column of fluid. It's calculated based on true vertical depth..
- Fluid pressure: is the pressure of the fluid (gas, water, or oil) usually measured at surface by a pressure gauge under static or flowing conditions. Fluid pressure measured at the bottom of the well under static conditions would be the hydrostatic pressure. Often the fluid pressure can be expressed as a pressure gradient i.e., pressure per foot of depth.
- Surface Pressure (casing pressure): is the surface pressure measured at the ground level of the casing. When a workover or drilling rig is working on a well, the surface casing pressure is maintained at zero pressure. The blowout preventer equipment is merely safety equipment installed on the casing and used in the event surface pressure unexpectedly occurs during the drilling or workover work.
- Bottomhole pressure (BHP): is the pressure at the bottom of the well. It's calculated by adding the applied surface pressure to the hydrostatic pressure.. When the well is in a static condition, the bottomhole pressure is equal to the hydrostatic pressure. When the well is circulating, the bottomhole pressure increases due to the applied surface pressure needed to overcome friction pressures in the piping. The bottomhole pressure during circulation can be calculated from the mud weight, and is a sum of the applicable pressures in the well.
- Formation Pressure: is the pressure in the formation at a certain depth. Normally, formation pressure at a certain depth is equal to the hydrostatic pressure of a column of sea water calculated at the same depth. Occasionally, certain formations can be abnormally pressured and higher than a corresponding column of sea water. Conversely, certain formations can be lower than a corresponding column of sea water as in a depleted oil or gas formation or in a gas storage operation.
- Formation Pressure and Bottomhole Pressure: In well control, the primary concern is that static bottomhole pressure (hydrostatic pressure) due to the column of fluid exceed the formation pressure. As long as the hydrostatic pressure exceeds the formation pressure the well will remain killed and not flow. Correspondingly, when attempting to kill a well, the goal is to pump and maintain sufficient drilling fluid (mud) in the well to overcome the formation pressure.
- Fracture pressure: is the point when the bottomhole pressure exceeds the strength of the rock and characterized by an actual fracture of the rock. Fractures are small cracks in the rock that allow more rapid fluid transport through the rock formation. The greater the density of the rock, the higher the fracture pressure needed.
- Relief Well Pressure Considerations: One of the considerations when drilling a relief well (or any well) is the density of the drilling mud used in the drilling operation. Formation pressures increase with depth, thus in general, deeper wells require higher mud weights to overcome the higher formation pressures. However, if the mud weight is too high, the drilling operation could cause the surrounding rock to fracture and some drilling mud would be lost to the surrounding formation. Optimal drilling mud density is determined prior to the drilling of the well and then monitored for effectiveness during the drilling process to optimize drilling rates while overcoming the formation pressures.