Firehouse.com WEEKLY DRILL

# DRILL # 32: FACTS ABOUT WATER

**Introduction**

The most basic material used by the fire service is that of water. Understanding water supply and how we move the water to be used efficiently should not be a mystery to anyone in the fire service.

One of the first things we need to understand is that water cannot be compressed, which is why we can pump it so easily and conveniently. On the other hand, water does come with weight attached to it, which has a huge effect on our operations. Water weighs about 62½ pounds per cubic foot. Each cubic foot holds about 7½ gallons of water, which makes a gallon of water weigh approximately 8.3 pounds. To give us some idea as to what this means to us, think of it this way: a 50-foot length of 1¾" hose filled with water will weigh 54 pounds, a 2" hose filled with water will weigh 68 pounds, and a 2½" hose filled with water will weigh 106 pounds.

Keep in mind, as we raise the level of water in a container, the pressure at the bottom will have pressure applied to it. At the surface of the water, the pressure will be "0" and for every foot added in height, a pressure of .434 pounds per square inch will be applied. Remember, we are talking about a cubic foot of water or length x width x height (12" x 12" x 12"); therefore a cubic inch of water stacked up 12 inches high will have a pressure of .434 psi at the bottom [12 x 12 = 144: 62.5 ÷ 144 = .434].

Another principle we need to keep in mind is that of atmospheric pressure, which is the amount of pressure the air is exerting on the earth's surface (about 14.7 psi). This would require 33.9 feet of water to equal this 14.7 psi [33.9 x .434 = 14.7]. You may ask why this is important to know. The answer is simply because atmospheric pressure will either assist the firefighter in moving water or hinder the operation.

Remember, pumps on fire engines don't suck water, they push water and increase the pressure behind it. If we need to draft water, this atmospheric pressure would be assisting us to a certain point. There are some things that have to occur before this water will rise up into the pump, namely, removing all the air in the pump and intake hose, which in turn creates a vacuum. Once this air has been removed, the atmospheric air pressure pushing on the water's surface will push the water up the intake hose and eventually into the pump, where the pump will then increase the pressure and discharge it through the desired outlet.


But wait! Remember, we said atmospheric pressure can also have a negative effect on our operation. Take this same scenario where we are in a position that will require us to draft, however, we are not able to get water into the pump. Frantically, the pump operator runs around the rig checking all the intake and discharge valves, assuring there is no air getting into the pump. Everything is the way it is supposed to be, yet still no water is getting to the pump. The problem is the elevation of the pump above the water's surface. In theory, we should lift water 33.9 feet; however, being realistic it will be hard to draft once the elevation exceeds about 28 feet.

We can expect to encounter problems as well with the weight of water and the pressure it will exert when pumping into the fire department connection of a standpipe system. Pumps are designed to operate at maximum efficiency at 250 psi. Based on this alone, and not taking into account any friction loss, we would not be able to operate on the 58th floor of a high-rise building as the water would never reach us. Why? At 10 feet per floor, we would be 580 feet above the pump. With the weight of water being .434 psi per foot and being pumped at 250 psi, it would not have the pressure behind it to reach the 58th floor [580' x .434psi = 251.72psi].

***–Prepared by Russell Merrick***