



Automatic Sprinklers: Dry Pipe Differential Principle

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Learning Objective: The student shall be able to explain the “differential principle” as it pertains to dry pipe sprinkler systems.

Dry pipe sprinkler systems commonly are used where the ambient temperature of the space they are protecting is expected to be less than 40 °F (4.4 °C). The sprinkler pipe is filled with compressed air or nitrogen that is released when a sprinkler opens and allows the dry pipe valve to open, filling the overhead pipes with water.

What keeps water from entering the sprinkler pipes prematurely? The dry pipe valve is designed so that the pressure from the compressed air or nitrogen keeps the valve closed until it is needed.

Look at the interior of the valve assembly in the photograph. The waterway at the bottom is smaller than the air chamber above the clapper valve. This design enables it to enjoy the mechanical advantage of the “differential principle.” The larger surface area under relatively low air pressure is able to hold back the water pressure from the smaller orifice.

In most dry pipe valves, this differential principle operates on a ratio of about 1:6; one unit of air pressure will resist six units of water pressure. If, for example, the incoming water pressure were 60 psi (4.1 bar), the differential principle created by the larger surface area would allow as little as 10 psi (0.7 bar) air pressure to keep the valve closed. Some “low-differential” dry pipe valves operate with an air to water pressure ratio of 1:1.2.

While the minimum air pressure will keep the dry pipe valve closed during normal conditions, most sprinkler fitters will put an additional 20 psi (1.4 bar) air pressure on the system to prevent inadvertent valve operation in the event of a small air leak. National Fire Protection Association (NFPA) 13, *Standard for the Installation of Automatic Sprinkler Systems*, provides guidance on minimum air pressure that must be maintained.

Another important feature of this dry pipe valve is the latching device pictured in the upper left hand corner. This attachment is designed to hold the heavy dry pipe valve in the open position once it operates so that it does not interfere with water flowing to control a fire.

For additional information, refer to NFPA 13, *Standard for the Installation of Automatic Sprinkler Systems*.



This open dry pipe valve housing illustrates the size difference between the incoming waterway and the upper valve surface.

