HYDRANT DISCHARGE FORMULA

To obtain the flow from hydrant outlets use the same formula as given for smooth bore nozzles but use the factor "C" equal to 0.90. Every Fire Department should check the flow from their hydrants. This can be done simply and easily using only a cap with a pressure gauge attached. Merely place the gauge on one outlet, open the hydrant and read the gauge. Remove another cap, open the hydrant and read the gauge again and obtain the gallons per minute using the above method or from the discharge table for hydrant outlets. Obtain the maximum amount of water available from the discharge table for hydrant outlets. Then to obtain the maximum amount of water available from the hydrant in gallons per minute with a residual of 10 lbs. (which is the lowest you should draw down the pressure on the hydrant) use the following formula.

$$A = \frac{Bx\sqrt{P1-10}}{\sqrt{P1-P2}}$$

Where A = Gallons per minute available at 10 lbs. residual.

B = Gallons per minute obtained.

P1 = Static pressure on hydrant with no water flowing.

P2 = Residual pressure on hydrant with water flowing.

DISCHARGE TABLE FOR HYDRANT OUTLETS

Outlet Pressure (lbs.)	Outlet Diameter (inches)				Outlet Pressure (lbs.)	Outlet Diameter (inches)			
	2.5	3	4	4.5		2.5	3	4	4.5
	U.S. Gallons per Minute					U.S. Gallons per Minute			
1	170	240	430	540	16	670	970	1720	2180
2	240	340	610	770	17	690	1000	1770	2240
3	290	420	740	940	18	710	1030	1820	2310
4	340	480	860	1090	19	730	1050	1870	2370
5	380	540	960	1220	20	750	1080	1920	2430
6	410	590	1050	1340	22	790	1130	2020	2550
7	440	640	1140	1440	24	820	1180	2110	2660
8	480	680	1220	1540	26	860	1230	2190	2770
9	500	730	1290	1640	28	890	1280	2280	2880
10	530	760	1360	1730	30	920	1320	2350	2980
11	560	800	1430	1810	32	950	1370	2430	3080
12	580	840	1490	1890	34	980	1410	2510	3170
13	610	870	1550	1960	36	1010	1450	2580	3260
14	630	900	1610	2040	38	1040	1490	2650	3350
15	650	940	1660	2110	40	1060	1530	2720	3440

DEFINITIONS

Static Pressure – The word "static" means at rest or without motion. Pressure on water may be produced by an elevated water supply, by atmospheric pressure, or by a force pump. If the water is not moving, the pressure exerted is static. In water distribution systems there is always some flow in the pipes because of normal domestic or industrial needs. A true static pressure is, therefore, seldom found in municipal water systems. From a practical viewpoint, however, the pressure normally found in a water system before water flows from a hydrant, is considered to be static pressure. A water flow definition of static pressure could be as follows: "Static pressure is stored potential energy that is available to force water through pipe, fittings, fire hose, and adapters."

Residual Pressure – The word "residual" means a remainder, or that which is left. As an example, during a fire flow test, the term residual represents the pressure which is left in a distribution system within the vicinity of one or more flowing hydrants. Residual pressure in a water distribution system will vary depending upon the amount of water that may be flowing from one or more hydrants and upon water consumption demands. One point that must be remembered is that residual pressure must be identified at the location where the reading is taken. A water flow definition of residual pressure could be as follows: "Residual pressure is that part of the total available pressure that is not used to overcome friction or gravity while forcing water through pipe, fittings, fire hose, and adapters."

Flow Pressure – The rate of flow or velocity of the water coming from a discharge opening produces a force which is called flow pressure or velocity pressure. Since a stream of water emerging from a discharge opening is not encased within a tube, it exerts pressure in a forward direction but does not exert a sideways pressure. The forward velocity or flow pressure can be measured by using a Pitot tube and gauge. If the size of opening is known, the flow pressure can be used to calculate the quantity of water flowing in gallons per minute (gpm). A water definition of flow pressure can be as follows: "Flow pressure is the forward velocity pressure at a discharge opening while water is flowing." An example of flow pressure is one in which the forward velocity of a water stream exerts a pressure that can be read on a gauge.

Normal Operating Pressure – Normal operating pressure is that pressure which flowing water exerts against the wall of a conduit; i.e. pipe, fire hose, appliances, valves, fittings, etc. The difference between static and normal operating pressure is the friction loss caused by the water flowing through these conduits. As soon as water starts to flow, static pressure no longer exists. The demands for water sometimes change during fireground operations, so therefore, normal operating pressures will change also. A piezometer gauge is used to determine this type of pressure. A water flow definition of it would be as follows: "Normal operating pressure is that pressure which flowing water exerts against the wall of the conduit through which it flows in a distribution system."

Friction Loss – If an opening is made in a closed system of piping or fire hose, a difference in pressure will exist between the internal pressure and the atmospheric pressure outside the pipe or hose. This difference in pressure causes the water to flow toward the lesser pressure. Water flowing through pipe or fire hose meets certain resistances or friction which must be overcome by pressure. This loss of pressure is usually called friction loss or loss because of friction. The only pressure available to overcome this resistance is the total pressure. A fire stream definition of friction loss could be as follows: "Friction loss is that part of total pressure that is lost while forcing water through pipe, fittings, fire hose, and appliances." The differences in pressure on a hose line between a nozzle and a pumper is a good example of friction loss.