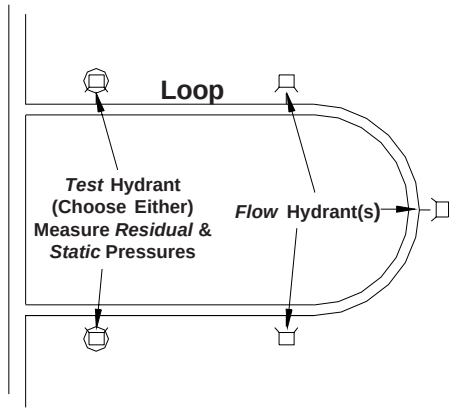
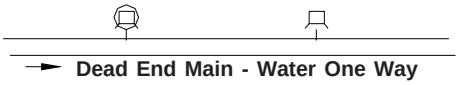
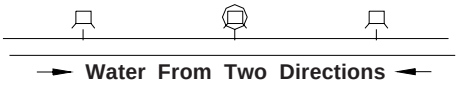
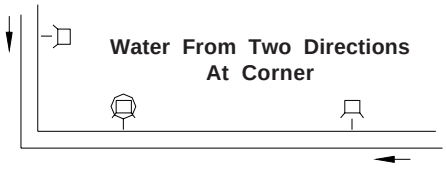
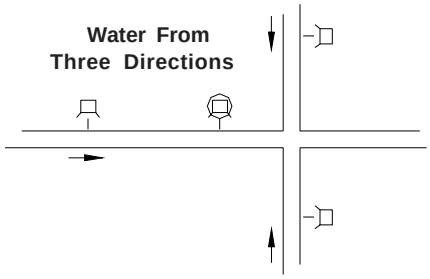
NOTE: The Hydrant in the circle is the test Hydrant. *Residual* and *Static* pressures are measured here.











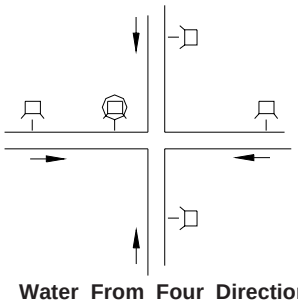


Figure 1

FLOW TEST PROCEDURES

When testing the available water supply, the number of hydrants to be opened will depend upon an estimate of the flow that may be available in the area; a very strong probable flow requires several hydrants to be opened for a more accurate test. Enough hydrants should be opened to drop the ***Static*** pressure by at least 10 psi (70 kPa); however, if more accurate results are required, the pressure drop should be the ***(Residual*** pressure) as close as possible to 20 psi (138 kPa). The flow available at 20 psi (138 kPa) can be determined by dropping the ***Residual*** pressure to exactly 20 psi (138 kPa) or can be determined at any ***Residual*** pressure by graphical analysis, or by formula calculations.

Another problem that might be encountered is that water mains may contain such low pressures that no flow pressure will register on the pitot gauge. If this is the case, straight stream nozzles with smaller than 2-1/2" (65 mm) orifices must be placed on the hydrant outlet to increase the flow velocity to a point where the velocity pressure is measurable. It must be noted that these straight stream nozzles will require an adjustment in the water flow calculation that must include the smaller diameter of the nozzle tip and its respective coefficient of friction.

Flow test are sometimes conducted in areas very close to the base of an elevated water storage tank or stand pipe and the results in flows that are quite large in gallons per minute (L/min). It should be realized that such large flows can only be sustained as long as there is sufficient water in the elevated tank or stand pipe. It is advisable to make an additional flow test with the tank or stand pipe shut off. The flow obtained from this second test is the quantity available when the tank or stand pipe has been depleted.

The ***Residual*** pressure and the ***Static*** pressure during a flow test should be taken from a fire hydrant that is located as close as possible to the location requiring the test results. This hydrant is commonly called the "***Test***" hydrant. The "***Flow***" hydrants are those where pitot reading are taken to find their individual flows, then added together to find the total flow during the test.

Six arrangements by which fire hydrants in an area can be selected for a flow test are shown on the left side of this page. The illustration (Figure 1) shows the location of the ***Test*** hydrants relative to the ***Flow*** hydrants with different hydrant and water main configurations. In general, when flowing a single hydrant, the ***Test*** hydrant should be between the ***Flow*** hydrant and the water supply source. That is, the ***Flow*** hydrant should be down stream from the ***Test*** hydrant. When flowing multiple hydrants, the ***Test*** hydrant should be centrally located relative to the ***Flow*** hydrant.

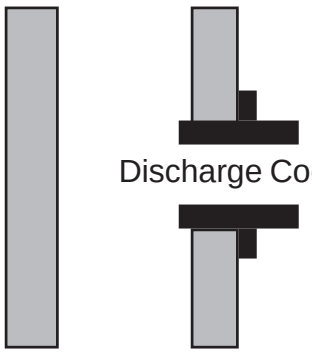
HYDRANT FLUSHING

Flushing a hydrant removes any accumulated sediment in the barrel and the valve. It is recommended that each hydrant in the system be flushed annually along with the regular inspection and maintenance. In all cases, the annual inspection and maintenance must be done before flushing.

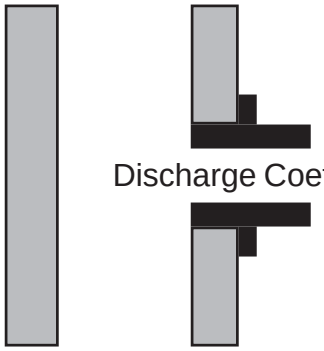
1- Contact the appropriate Water Department personal and inform them that a test is about to take place.
2- Prepare to flush hydrant. Decide if you will need a diffuser to prevent washout around the hydrant or to protect landscaping or other areas.
   a- Akron Brass HKD-25, 2-1/2" diffuser for attaching directly to hydrant nozzle.
   b- Akron Brass ST-25, 2-1/2" Street-T diffuser or the Akron Brass ST-45, 4-1/2" Street-T diffuser

   Attach diffuser to hydrant or length of hose for the Street-T diffuser.
3- Open the hydrant very slowly until it's fully open.
4- Let water flow for a minimum of 3 minutes or until water is clear. Flush only one hydrant at a time.
5- Shut the hydrant down, again very slowly.
6- Prepare to flow test, before replacing cap(s).

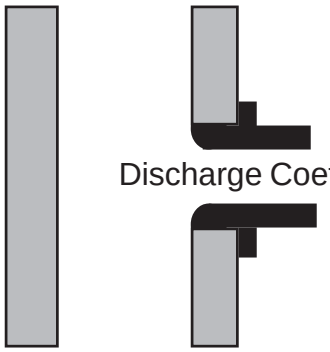
Shown are three types of hydrant discharges or outlets and their respective discharge coefficients.



Discharge Coefficient = .70



Discharge Coefficient = .80



Discharge Coefficient = .90

Figure 2

Nozzles have discharge coefficients. Some common ones are listed:

Akron Brass HK-25	**0.84**
Short Playpipe	**0.96**
Smooth Bore Nozzle, General	**0.96-0.98**
Underwriter Playpipe	**0.97**
Deluge or Monitor Nozzle	**0.99**
Short Shut-Off Nozzle	**0.90**
Standard 1/2" Sprinkler Head	**0.75**

SETUP & FLOW

1- Decide which hydrant will be the ***Test*** hydrant and which will be your ***Flow*** hydrant. The ***Test*** hydrant will be used to measure both ***Static*** and ***Residual*** pressures. It should be closer to a feed main than the ***Flow*** hydrant.

2- Decide how many ***Flow*** hydrants to use. As a general rule of thumb, you should flow enough hydrants at the same time so that the ***Residual*** pressure drops at least 10% from the ***Static*** pressure but never allow the ***Test*** hydrant to go below 20 psi (138 kPa).

3- Contact the appropriate Water Department personal and inform them that a test is about to take place.

4- Locate and perform the following on the Test hydrant:
   a- Flush hydrant. (See FLUSHING HYDRANTS section)
   b- Install Akron Brass cap gauge with petcock open to allow air to escape.
   c- Open hydrant slowly and fully and after you have a steady stream of water from the petcock, close it.
   d- Read and record the ***Static*** pressure.

5- Locate and perform the following on the ***Flow*** hydrant.

6- Record the inside diameter of the nozzle which will be flowed; generally one of the 2-1/2" nozzles. Insert your hand into the nozzle opening and feel the entrance shoulder to determine the nozzle coefficient. (See Figure 2)

7- Flush hydrant. (See FLUSHING HYDRANTS section)

8- Install Akron Brass Hydrant Flow Test Kit on the nozzle and or have your Akron Brass Hand Held Pitot ready to get your pitot reading. You will only have this hydrant open long enough to get your Pitot reading and Residual reading for the ***Test*** hydrant. Record all readings.

COMPUTING HYDRANT FLOW:

The easiest way to determine how much water is flowing from the hydrant outlet(s) is to refer to prepared tables for nozzle discharge. These tables have been computed by using a formula for gallons per minute (L/min) flow, when the flow pressure is known.

THE FORMULA MAY BE STATED AS FOLLOWS:

Flow rate is equal to a constant, multiplied by the coefficient of discharge, multiplied by the diameter of the orifice-squared, by the square root of the pressure.

THE FORMULA IS WRITTEN AS FOLLOWS:

GPM $Q_r = 29.83 \times C_d \times D^2 \times \sqrt{P_p}$

L/min $Q_r = 0.0667766 \times C_d \times D^2 \times \sqrt{P_p}$

$$Q_f = Q_r \left[\frac{P_s - 20}{P_s - P_r} \right]^{0.54}$$

WHERE:

29.83 or (0.0667766) are constants.

"C_d" is the friction loss coefficient ***(usually 0.90 for a smooth 2-1/2" opening)***

"D" is the actual diameter (measured) of the hydrant or nozzle in inches (mm)

"P_p" is the ***Pitot*** pressure reading in PSI (kPa)

"Q_f" is the ***Fire Flow*** in GPM (L/min) **(Total System Flow)**

"Q_r" is the ***Fire Flow*** in GPM (L/min) **(Individual Hydrant Flow)**

"P_s" is the ***Static*** pressure in PSI (kPa)

"P_r" is the ***Residual*** pressure in PSI (kPa)

DISCHARGE TABLE FOR CIRCULAR OUTLETS* (US)
Outlet Pressure Measured by Pitot Gauge

HK-25 Outlet Pressure in psi	OUTLET DIAMETER IN INCHES											
	2-3/8"	2-1/2"	2-5/8"	2-3/4"	2-7/8"	3"	3-1/8"	3-7/8"	4"(*)	4-3/8"(*)	4-1/2"(*)	4-5/8"(*)
	U.S. Gallons per Minute											
1	150	160	180	200	220	240	260	400	430	510	540	580
2	210	220	260	290	310	340	370	570	610	720	770	810
3	260	280	320	350	380	420	450	700	740	890	940	990
4	300	320	370	410	440	480	530	810	860	1030	1090	1150
5	340	350	410	450	500	540	590	900	960	1150	1220	1290
6	370	390	450	500	540	590	640	990	1050	1260	1340	1410
7	400	420	490	540	590	640	690	1070	1140	1360	1440	1520
8	430	450	520	570	630	680	740	1140	1220	1450	1540	1620
9	450	480	550	610	670	730	790	1210	1290	1540	1640	1720
10	480	500	580	640	700	760	830	1280	1360	1630	1730	1820
11	500	520	610	670	730	800	870	1340	1430	1710	1810	1910
12	520	550	640	700	770	840	910	1400	1490	1780	1890	1990
13	550	570	670	730	800	870	950	1450	1550	1850	1960	2070
14	570	590	690	760	830	900	980	1510	1610	1920	2040	2150
15	590	610	720	790	860	940	1020	1560	1660	1990	2110	2220
16	610	630	740	810	890	970	1050	1620	1720	2060	2180	2300
17	620	650	760	840	910	1000	1080	1660	1770	2120	2240	2370
18	640	670	780	860	940	1030	1110	1710	1820	2180	2310	2440
19	660	690	810	890	960	1050	1140	1760	1870	2240	2370	2510
20	680	700	830	910	990	1080	1170	1800	1920	2290	2430	2570
22	710	740	870	950	1040	1130	1230	1890	2020	2400	2550	2700
24	740	770	910	1000	1090	1180	1290	1970	2110	2510	2660	2810
26	770	800	940	1040	1130	1230	1340	2050	2190	2620	2770	2930
28	800	830	980	1070	1170	1280	1390	2130	2280	2720	2880	3040
30	830	860	1010	1110	1210	1320	1430	2210	2350	2820	2980	3150
32	860	890	1050	1150	1260	1370	1480	2280	2430	2910	3080	3250
34	880	920	1080	1180	1290	1410	1530	2350	2510	3000	3170	3350
36	910	950	1110	1220	1330	1450	1580	2420	2580	3080	3260	3440
38	930	970	1140	1250	1370	1490	1620	2480	2650	3170	3350	3540
40	960	1000	1170	1290	1400	1530	1660	2550	2720	3250	3440	3630

*** Computed with Coefficient C =.90, to nearest 10 gallons per minute.**
Table from "IFSTA" International Fire Service Training Association, Fourth Edition.

CORRECTION FACTORS FOR LARGE DIAMETER OUTLETS	
VELOCITY PRESSURE	FACTOR
2 psi (13.8 kPa)	0.97
3 psi (20.7 kPa)	0.92
4 psi (27.6 kPa)	0.89
5 psi (34.5 kPa)	0.86
6 psi (41.4 kPa)	0.84
7 psi (48.3 kPa) or over	0.83

(*) The stream from a large hydrant outlet 4 to 4-1/2 inches contains voids (i.e., the entire stream of water is not solid), and for this reason the standard flow formulas alone will not give accurate results for flows using these larger steamer outlets. Generally, the 2-1/2 inch outlets should be used. When a large outlet is used the standard formula answer must be multiplied by the factor in the adjacent table to get a fairly accurate flow result.

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DISCHARGE TABLE FOR CIRCULAR OUTLETS* (US)
Outlet Pressure Measured by Pitot Gauge

HK-25 Outlet Pressure in kPa	OUTLET DIAMETER IN MM											
	60	64	67	70	73	76	79	98	102(*)	111(*)	114(*)	117(*)
	Liters per Minute											
5	484	550	603	658	716	776	839	1291	1398	1656	1746	1840
10	684	778	853	931	1012	1098	1186	1825	1977	2341	2470	2602
15	838	953	1045	1140	1240	1344	1453	2235	2422	2868	3025	3186
20	968	1101	1206	1317	1432	1552	1677	2581	2796	3312	3493	3679
25	1082	1231	1348	1472	1601	1736	1875	2886	3126	3702	3905	4113
30	1185	1348	1478	1613	1754	1901	2054	3161	3425	4056	4278	4506
35	1280	1456	1596	1742	1894	2054	2219	3415	3699	4381	4620	4867
40	1368	1557	1706	1862	2026	2195	2372	3650	3954	4683	4940	5203
45	1451	1651	1810	1975	2148	2328	2516	3871	4194	4967	5239	5519
50	1530	1741	1907	2082	2264	2455	2652	4081	4421	5236	5523	5817
55	1604	1826	2001	2184	2375	2574	2781	4281	4637	5492	5792	6101
60	1676	1907	2090	2281	2481	2689	2905	4471	4843	5736	6050	6373
65	1744	1985	2175	2374	2582	2799	3024	4653	5041	5970	6293	6633
70	1810	2060	2257	2463	2679	2904	3138	4829	5231	6195	6535	6883
75	1873	2132	2336	2550	2773	3006	3248	4999	5415	6413	6764	7125
80	1935	2202	2413	2634	2864	3105	3355	5162	5593	6623	6986	7358
85	1994	2270	2487	2715	2952	3200	3458	5321	5765	6827	7201	7589
90	2053	2335	2559	2794	3038	3293	3558	5476	5932	7025	7410	7805
95	2109	2399	2629	2870	3121	3383	3656	5625	6094	7217	7612	8019
100	2164	2462	2698	2945	3203	3471	3751	5772	6253	7405	7810	8227
105	2217	2522	2764	3017	3282	3557	3843	5914	6407	7589	8003	8430
110	2269	2582	2860	3089	3359	3640	3933	6054	6558	7766	8192	8628
115	2320	2640	2893	3158	3434	3722	4022	6190	6705	7940	8376	8822
120	2370	2697	2955	3225	3508	3803	4109	6323	6849	8112	8556	9012
125	2419	2752	3016	3292	3581	3881	4193	6453	6990	8279	8732	9198
130	2467	2807	3076	3358	3652	3958	4277	6581	7129	8443	8905	9380
135	2514	2860	3135	3422	3721	4033	4358	6706	7265	8604	9075	9559
140	2560	2913	3192	3484	3789	4107	4438	6829	7398	8761	9241	9734
145	2605	2964	3249	3546	3856	4180	4516	6950	7529	8917	9405	9907
150	2650	3015	3304	3607	3922	4251	4594	7069	7658	9069	9569	10076

*** Computed with Coefficient C =.90, to nearest 10 gallons per minute.**
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