TECHNICAL DATA

# LOW PRESSURE FIXED FOAM EDUCTOR SYSTEM (MULTIPLE)

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## SYSTEM NOTES AND SYMBOLS

A bladder tank and concentrate controller may be used for small open head foam/water deluge systems, but the cost may be prohibitive. Another choice for small, open head foam/water deluge systems, would be the use of an eductor system with an atmospheric foam storage tank. The eductor is better suited to this type of system, since it is less expensive, and easier to install on small deluge systems, than the bladder tank system would be.

Eductors are designed so that when a specific flow range of water passes through the eductor, a strong venturi effect takes place, which causes foam concentrate to be drawn into the eductor. The foam concentrate is stored in an atmospheric pressure container that can be located at an elevation lower than the eductor (see eductor tech data sheets for specific information). Because of this strong venturi effect, there is a very high pressure drop across the device, which results in an eductor discharge pressure at least 35 % lower than its inlet pressure. This means that if the eductor has a 100 psi inlet pressure, the maximum outlet pressure of the device will be 65 psi, in order for the eductor to function properly. Therefore, eductor systems have always required a high water supply inlet pressure for economical system design. Viking eductors can operate with as little as 50 psi inlet pressure, and as much as 200 psi inlet pressure.

The Example in Figure 1 indicates a small four head system covering approximately 400 $ft^2$ of operating area. It will require a .2 gpm/$ft^2$. density, and a 10 minute duration, using 3% AFFF foam for a hydrocarbon fuel. The water pressure available is 90 psi at the eductor. The 90 psi inlet pressure will affect the selection process of the eductor, as it limits the amount of flow which can pass through the eductor, and still maintain a minimum 35% drop in pressure across the eductor. Therefore, the system design may require one larger eductor, or multiples of smaller eductors, in order to provide the necessary amount of foam/water solution to the discharge devices. For this example (Figure 1), multiple smaller eductors will be selected. NOTE: Larger size eductors would provide a greater density at the same inlet pressure as the smaller size eductors.

### 1. Calculate the Estimated Foam Concentrate Supply.

The estimated foam concentrate supply for Figure 1 can be calculated in the same fashion as for larger systems, by using the following formula; **EFC** = total system **(De**) x **(A)** x **(C)** x **(D)** x **(1.15)**, so the estimated amount of foam would be:

EFC = (.2 gpm/$ft^2$ x 400 $ft^2$) x 3% x 10 minutes x 1.15 (15% overage factor)
EFC = 80 gpm x .03 x 10 x 1.15
EFC = 27.6 Gallons of foam concentrate for a 10 minute system foam supply

Where:

**A** = Area of operation
**EFC** = Estimated Foam Concentrate Supply
**C** = % of Foam Concentrate
**D** = Duration in Minutes
**De** = Density
**Q** = Total Discharge Flow for each Eductor ($Q = K\sqrt{P}$)

This does not include any foam for a system test. **NFPA and Viking recommend that these systems be proof tested in order to verify system design.** This would mean an actual flow test of the system to insure that the proper percentage of foam/water solution, as well as calculated system flows are achieved, and at an eductor discharge pressure which cannot exceed 65% of its inlet pressure.

### 2. Calculate the Discharge Device flows or Kd.

This is done in the same fashion as for any hydraulically calculated system, by multiplying the sprinkler head square foot coverage by the required density. In this case, this would mean 100 $ft^2$ x .2 density, or 20 gpm per head x 4 heads, for a total flow of 80 gpm minimum, times 1.15, for a 15 percent overage factor. This would result in a maximum flow of 92 gpm of foam/water solution for this particular system.

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### 3. Select the Eductor/Discharge Device (Sprinkler).

**Kd(total)** must be equal to, or greater than **Ke(**1.6). If a model FE60 eductor is selected, it has a K-factor of 4.55 with 3% foam, so (4.55) x (1.6) = 7.28. Therefore, 7.28/4 heads = 1.82 or greater, is the approximate K-factor for each of the 4 heads on this system. This means that in order to use the FE60 eductor, the system has to use 3/8 inch orifice sprinklers, or larger. Viking 3/8 inch orifice sprinklers have a K-factor of 2.7 and would require an operating pressure of 54.86 psi ($P = (20/2.7)^2$) in order to provide a .2 density over 100 square feet of operating area. This operating pressure nearly equals the available outlet pressure for the eductor. (Remember that the outlet pressure of the eductor must not be more than 65% of the eductor inlet pressure. 90 psi x .65= 58.5 psi, or the maximum eductor outlet pressure to design the system. This results in too little pressure remaining, (approximately. 3.6 psi) to design the piping system with, so the K-factor must change, if we want to maintain the maximum 100 $ft^2$ spacing.

Viking 1/2” orifice sprinklers have a K-factor of 5.5, so 7.28/5.5 = 1.3 heads, or possibly two 1/2” orifice heads can be supplied from one FE60 eductor at the available pressure. The starting pressure for a 1/2” Viking sprinkler at a .2 density over 100 square feet, is 13.22 psi ($P = (20/5.5)^2$), well above the listed minimum pressure of 7 psi. The Viking FE60 eductor, at an inlet pressure of 90 psi, can flow 43.2 gpm, which should be enough to satisfy the 20 gpm per head for 2 heads, or 40 gpm, as shown in Figure 1.

### 4. Perform Finished Hydraulic Calculations.

Now it is simply a matter of performing the finished hydraulic calculations to size the piping from the sprinkler heads (discharge devices) back to the eductor. **Remember that the outlet pressure of the eductor is only 65 percent maximum of inlet pressure so .65 x 90 = 58 psi available to design the system, including any elevation loss.** Subtracting the end head starting pressure from the eductor’s available pressure (58 psi available at outlet of eductor, minus the 13.22 end head starting pressure for the 1/2” orifice sprinkler, = 44.78 psi left to run calculations). This still leaves the designer with enough pressure to allow for the piping friction loss and elevation height pressure loss, **(H)**.

**NOTE**: The system piping must be sized in order to use up as much of the 44.78 psi as possible, or there will be too much of a pressure imbalance. The pressure imbalance will then affect the flow range of the eductor, resulting in a rich foam/water solution. Once the finished calculations have been completed, the actual amount of foam concentrate can be calculated by multiplying the Actual Calculated system Flow **(ACF)** x **(C)** x **(D)**.

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**H** = Pressure Loss due to Height (PE)
**Kd** = K Factor for Discharge Devices such as Sprinklers, hose stations, small monitor nozzles
**Kd (Total)** = Ke (1.6) The sum of the (Total) Discharge Device K-Factors must be equal to or greater than 1.6 times the K-Factor of the Eductor.
**Ke** = K Factor for Foam Eductors. (See Technical data sheet for individual K-Factors).
**P1** = Inlet Pressure to the Viking Eductor.
**P2** = Outlet Pressure = P1(.65) This is the outlet pressure of the Viking Eductor.
**P3** = Pressure @ Discharge Device – Flow Pressure at the Discharge Device.
**PL** = Pressure Loss in piping due to flow (friction loss)

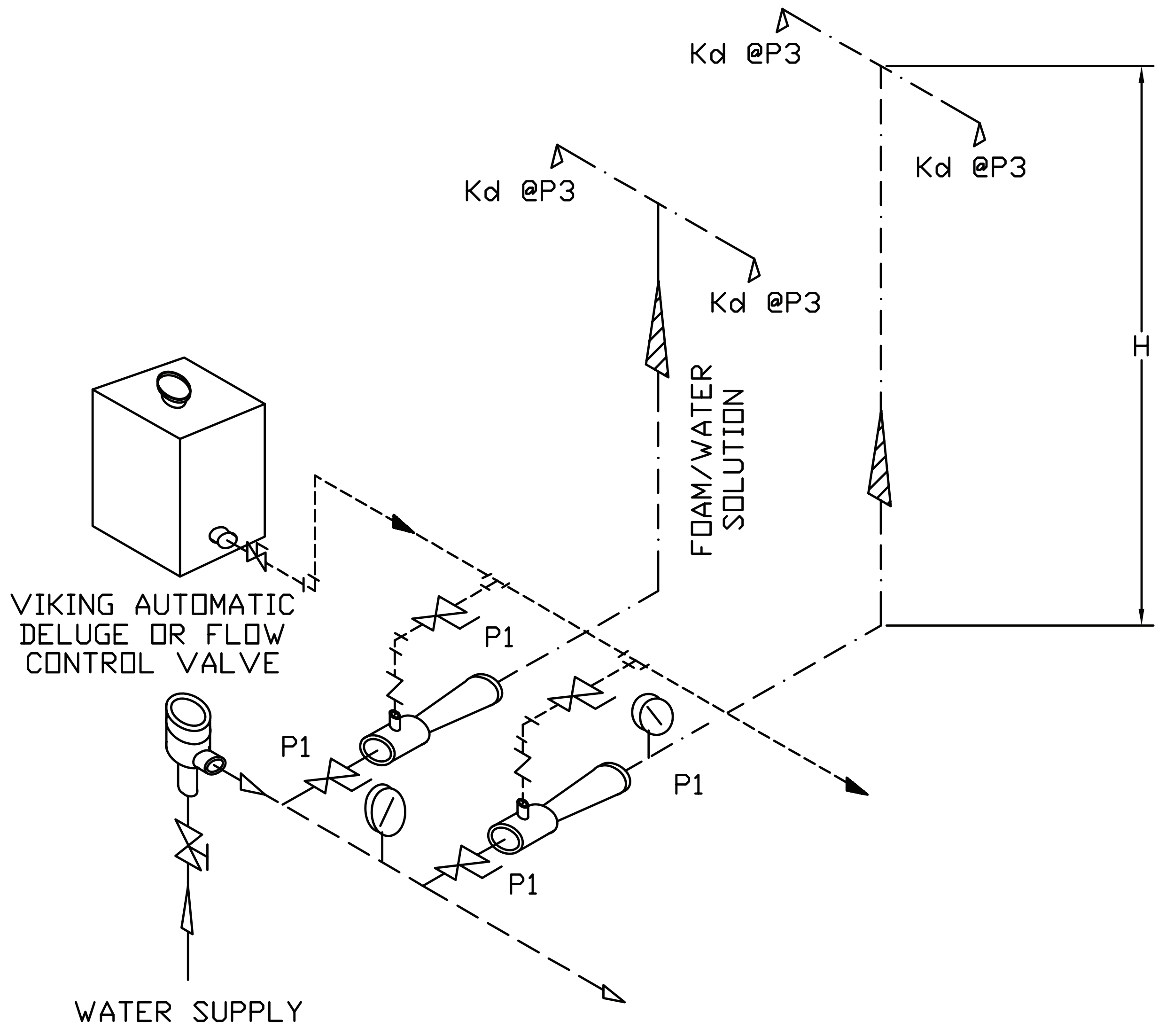


**FIGURE 1 - LOW PRESSURE (50-90 PSI) FIXED EDUCTOR**

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