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Fixed Foam Eductor Series System

GENERAL SYSTEM NOTES

A bladder tank concentrate controller may be used for small open head foam/water deluge systems. A more economical choice would be the use of an eductor system with an atmospheric storage tank. This system is less expensive than the bladder tank system and easier to install on small deluge systems.

The eductors are designed to produce a strong venturi effect (vacuum) as a given flow range of water passes through the eductor. The venturi effect causes the concentrate from the concentrate storage tank to be educted into the flow of water. The foam concentrate is stored in an atmospheric pressure container unlike the bladder tank. The container can be located at an elevation lower than the eductor (see eductor technical data sheets for more specific information).

The eductors require a minimum of 35% pressure loss across the device in order to produce the proper venturi effect. To illustrate this, assume your eductor has 50 PSI at the inlet. The maximum outlet pressure of the eductor would be 32.5 PSI. **NOTE:** The system must be designed to provide a pressure loss as close to the maximum outlet pressure as possible without producing less than 35% pressure loss across the device.

The fixed foam eductor systems can be designed in two different ways depending on the application and system requirements. In the first design, one eductor may be selected to operate one or more heads. Multiple eductors may be added in series to operate individual systems of one or more heads.

FIXED FOAM EDUCTOR SERIES NOTES:

1. The discharge devices must be spaced properly with an equal amount of piping for each branch after the outlet of the eductor.
2. Foam storage tank shall be placed at a distance of no more than 15 equivalent feet from the foam inlet of the eductor.
3. The system must be designed to meet the requirements of the authority having jurisdiction and NFPA 11- Standard for Low Expansion Foam, NFPA 13- Standard for The Installation of Sprinkler Systems, NFPA 16- Standard for the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems. The piping supply to the inlet of the eductor shall be sized according to the NPT inlet on the eductor.
4. When using an alcohol resistant type foam concentrate, Viking recommends that the piping size from foam concentrate container to the eductor be increased one pipe size and that the final placement of the foam concentrate container be located at an elevation above the eductor.

SYSTEM DESIGN EXAMPLE:

1. **Define the system requirements**
 The example, shown in Figure 1, has an operating area of 400 sq. ft. It is required that the system provide a minimum density of 0.2 gpm/sq.ft. for a 10 minute duration. The Hydrocarbon fuel requires 3% AFFF foam concentrate. The available water supply pressure at the inlet of the eductor is 90 PSI at a flow of 90 gpm.
2. **Choose the system design desired**
 In this example we chose two eductors in series to operate the four heads (2 heads per eductor). Notice the choice was arbitrary and that two eductors in parallel could have been used to operate all four heads of the system. The eductor and the discharge device are the limiting factors in your system design. If the desired system design is not feasible, it will be evident in the following calculations. This will require you to return to this section and alter your design.



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3. **Calculate the estimate foam concentrate supply**

The foam concentrate supply can be calculated from the following formula.

$$EFC = D \times A \times C \times Du \times 1.15$$

EFC	=	estimated foam concentrate supply
D	=	required density (gpm/sq.ft.)
A	=	area of operation (ft ²)
C	=	% of foam concentrate
Du	=	duration of foam water solution (min.)
1.15	=	15% overage factor

For this example:

EFC	=	.2 (gpm/sq.ft) x 400 (ft ²) x 3% x 10 (min.) x 1.15
EFC	=	27.6 gallons of foam concentrate

Notice: This does not include any extra foam for the system operation test. **Viking and NFPA recommend that these systems be proof tested in order to verify system design.** This test would require an actual flow test to ensure proper proportioning and flows of the system. Actual test foam amount should equal a 1 minute flow test of device with foam concentrate.

4. **Calculate the minimum discharge flows**

This is calculated by multiplying the sprinkler head square foot coverage by its required density. In this example each discharge device operates 100 sq. ft. with a density of .2 gpm/sq.ft. This would result in a flow of minimum 20 gpm per head and 80 gpm for the entire system. A system demand calculation to establish friction loss in the system piping is required as well as a system supply calculation, which will establish the actual supply flow past the eductor which will indicate the actual foam usage and foam concentrate system requirement.

5. **Selection of the eductor(s) and discharge device(s)**

For this example we choose a Model FE-60 Foam Eductor. The K factor for the Model FE-60 is 4.55 with 3% AFFF foam. The eductor will flow 43.2 gpm at 90 PSI inlet pressure. This is established by multiplying the square root of the available pressure by the K factor of the eductor.

The sum of the K-factors of all discharge devices (Kd-total), that the eductor is operating, must be equal to or greater than the K-factor of the eductor (Ke). Notice that each eductor is operating two heads. Therefore, the K-factor for each discharge device 4.55 (Ke) x 1.6 2 (heads) = 3.64.

K factor of Eductor		Factor for Friction Loss of system Piping		No. of discharge outlets		Sum of K factors of all discharge devices
4.55	x	1.6	/	2	=	3.64

The Viking 1/2" orifice sprinklers with a K factor of 5.5 should be selected since the device has a Kd equal to 3.64 .



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6. Verify the feasibility of the design

The flow through each sprinkler will be 22.2 gpm's which is determined by dividing the flow rate through the eductor at 90 PSI plus half the concentrate flow rate. This is established as follows:

Flow through eductor	=	K of eductor	=	Multiplied by the Square root of P
43.16		4.55 x		the Square root of 90psi
+				
Flow of Foam Concentrate = water flow	=		multiplied by	design concentration
1.29		43.16	x	.03%
<hr style="width: 20%; margin-left: 0;"/>				
44.45		total flow through eductor		

Flow through each sprinkler is established by dividing total flow by number of discharge sprinklers. 44.45 divided by 2 (sprinklers) = 22.2 gallons per sprinkler

The pressure required at the sprinkler outlet is 16.29 psi. This is established by dividing Sprinkler flow by the sprinkler K factor and squaring the quotient.

$$(22.2 \text{ gpm} \div 5.5 \text{ K factor})^2 = 16.29 \text{ PSI}$$

The available pressure left for friction loss of system piping is the required sprinkler head starting pressure subtracted by the pressure available at the discharge outlet of the eductor. The eductor will require a 35% pressure loss across the device. In our example of 90 psi available, the available pressure at the discharge outlet of the eductor will be 58.5 psi. The available pressure for friction loss in the system piping is 42.21 PSI. The ultimate design would be if the friction loss in the piping were to equal 42.21 PSI. The friction loss pressure should be balanced to the resulting pressure between the eductor outlet and the sprinkler discharge outlet. When the friction loss pressure is less than the resulting pressure between the eductor and the sprinkler discharge outlet the eductor will proportion foam at a richer concentration than the design concentration, meaning the foam concentrate will not last the duration. If the friction loss pressure is higher than the resulting pressure between the eductor and the sprinkler discharge outlet, the eductor will proportion at a concentration less than the design concentration, meaning that the foam water solution being discharged may not be of ample strength to control the fire.

7. Perform Final Hydraulic Calculations

The flow rate of the foam water solution is 44.5 gpm at the outlet of each eductor and 89 gpm in the single pipe feeding the discharge devices. The inlet pressure to the eductor is 90 PSI and the outlet pressure of the eductor should be designed for 58.5 PSI. The discharge device pressure is 16.3 PSI. Remember that most if not all of this remaining pressure between the outlet of the eductor and the discharge device must be built into the piping loss of the system so that the eductor has a 35% loss across its inlet and outlet. Be careful in your calculations to notice the joining of the flows after the eductor and the split of the flows to each of the branches feeding the discharge devices.

VIKING[®] **TECHNICAL DATA** **FIXED FOAM EDUCTOR SERIES SYSTEM**

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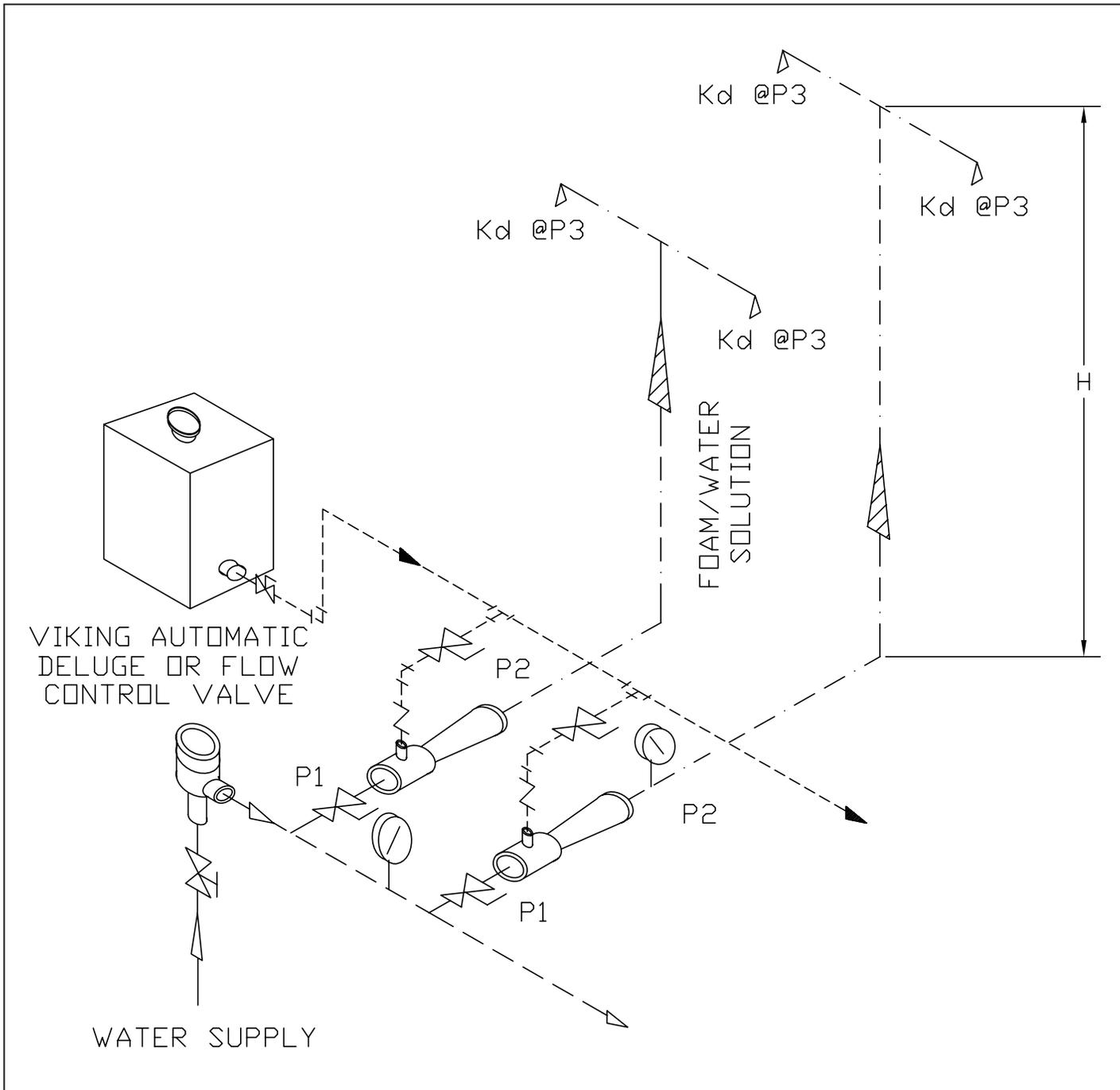


Figure 1