FST 205 Study Guide Part 2 of 2

Important note: Please make sure that you have reviewed part 1 in addition to part 2.

**Pressure calculations**

To calculate friction loss in **Single Hoselines** use the modern friction loss formula:

**Equation 10:** \( FL = CQ^2L \)

Where:
- \( FL \) = friction loss
- \( C \) = friction loss coefficient for the hose diameter used
- \( Q \) = rate of flow in hundreds of gallons per minute
- \( L \) = hose length in hundreds of feet

For values of \( C \), you may use IFSTA’s measurements or refer to the NOVA manual section 5.10.2:

<table>
<thead>
<tr>
<th>Hose Diameter (inches)</th>
<th>Friction Loss Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ¾</td>
<td>15.5</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>2 ½</td>
<td>2</td>
</tr>
<tr>
<td>3 with 2 ½ couplings</td>
<td>1 (rounded)</td>
</tr>
<tr>
<td>3 1/2</td>
<td>0.34</td>
</tr>
<tr>
<td>4</td>
<td>0.2</td>
</tr>
</tbody>
</table>

Example: Calculate the friction loss in 300 feet of 2 ½ inch hose flowing 250 gpm.

\[
FL = CQ^2L \\
FL = 2 \times \left( \frac{250}{100} \right)^2 \times \frac{300}{100} \\
FL = 2 \times 6.25 \times 3 = 37.5 \approx 38 \text{ psi}
\]
To calculate the friction loss in multiple hoselines a different set of coefficients is used, otherwise the process is identical.

<table>
<thead>
<tr>
<th>Examples Friction Loss coefficients for some Parallel or Siamese Hoselines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of hoses and their diameters</td>
</tr>
<tr>
<td>Two 2 ½ inch</td>
</tr>
<tr>
<td>Three 2 ½ inch</td>
</tr>
<tr>
<td>Two 3 inch with 2 ½ inch couplings</td>
</tr>
<tr>
<td>One 3 inch with 2 ½ couplings and one 2 ½ inch</td>
</tr>
</tbody>
</table>

**Elevation Loss (or Gain)**

Although more accurately the pressure loss due to gravity is 0.433 psi/foot, it is acceptable to round to 0.5 psi/foot when performing fireground calculations. This yields

**Equation 12:** \( EP = 0.5 \times H \)

Where:

- \( EP \) = Elevation pressure (loss or gain) in psi
- 0.5 = The rounded value for pressure loss (or gain) due to gravity, constant
- \( H \) = Height in feet

Equation 12 may be rewritten as \( EP = H / 2 \), however there are many ways to estimate the pressure loss (or gain) in multistory buildings. For consistency with the NOVA manual use the rule of thumb: 5 psi for every 10 feet. This is expressed mathematically as:

**Equation 13:** \( EP = 5 \text{ psi} \times \frac{\# \text{ of feet}}{10} \)

In addition to hoses and gravity, appliances, ladder pipes and essentially any other device that water has to flow through will cause some friction loss. For consistency with the NOVA manual, use 5 psi for the loss due to small appliances and 15 psi for appliances flowing more than 350 gpm. 10 psi may be used to estimate the loss due to ladder pipes.
The purpose of calculating loss due to fiction and elevation is to determine pump discharge pressure. In most cases you should not exceed 250 psi as a pump discharge pressure. If you are unable to achieve the required flow and are approaching 250 psi, parallel hoselines (or a larger diameter hose) may be needed to operate effectively.

**Equation 14:** \( P_{DP} = NP + TPL \)

Where:
- \( P_{DP} \) = pump discharge pressure
- \( NP \) = nozzle pressure
- \( TPL \) = total pressure loss (appliance, friction and elevation)

When pumping a configuration that involves parallel hoselines of different lengths or sizes, generally the higher \( P_{DP} \) will need to be used (and if possible, gate back the line with the lower FL to achieve approximately the correct pressure).

**Supplying Sprinkler and Standpipe Systems**

Essentially the same as supplying handlines, but in order to determine flow, you may need additional information about the sprinklers. You can usually disregard the friction loss inside of fixed pipes, but especially in standpipe systems elevation loss must be considered. Friction loss should be calculated in any hose used to supply the sprinkler or standpipe system and any attack hose connected to a standpipe system. Each jurisdiction has a different recommended initial pressure guideline for standpipe systems, however an important note is that you have standing orders to charge the system.

The most common orifice size in automatic sprinklers is ½ inch, and generally, the approximate discharge pressure is 15-20 psi. To calculate flow from a sprinkler:

**Equation 15:** \( Q_S = K \times \sqrt{P} \)

Where:
- \( Q_S \) = Flow in GPM
- \( P \) = The discharge pressure at the sprinkler in PSI
- \( K \) = The discharge coefficient (for ½ inch sprinklers \( K = 5.5 \))

The total flow from a sprinkler system is:

**Equation 16:** \( Q_T = F \times Q_S \)

Where:
- \( Q_T \) = Total flow in GPM
- \( F \) = Number of sprinklers flowing
- \( Q_S \) = Flow for an individual sprinkler (can be calculated from Eqn 15)

We could combine those formulas to simplify:

\[ Q_T = F \times K \times \sqrt{P} \]
This concludes the review guide for FST 205. Remember that you are responsible to all of the material addressed by the NFA Hydraulics curriculum, and while no information has been intentionally left out of this guide, just because it’s not in here doesn’t mean that it couldn’t appear on the exam.

I want to reiterate that this is not a hydraulics manual, but rather a study guide. You should use your department’s SOP/SOG (usually the NoVa manual) as a basis for your fireground decision making. If you need a copy of the NoVa manual, please contact your training officer.

Make sure to do all of the review problems from the end of the chapters, and let me know if you have any questions. There aren’t any trick questions, but you will need to have an understanding of hydraulics to do well. Be safe and good luck.

Let me know if you have questions:

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