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Estimating Pressure Loss for High Pressure Sprayers

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Pressure losses in hoses and fittings can have a significant impact on high-pressure sprayer performance by reducing the flow rate through the orifice disc at the spray gun. Altering the flow rate changes the rate of chemical being applied.

Estimating pressure losses through hoses and fittings is essential for proper pump and application rate adjustment. Four factors that must be considered are:

1) **Flow rate in gallons per minute (GPM) delivered through the orifice disc.** Flow rate is controlled by the orifice size and operating pressure (pressure at the disc, not pump pressure). As fluid flow and velocity through the hose increases, pressure loss due to hose sidewall friction increases. Flow rate for specific orifice discs at various operating pressures available in manufacturer's catalogs.

2) **Inside diameter of the hose**. As hose diameter decreases, fluid velocities required to provide specific kilowatts increase, resulting in increased pressure loss. Thus smaller diameter hoses have higher-pressure losses than larger hoses at equal flow rates. If more than one size hose is used on the same sprayer, the pressure losses for each hose size must be estimated separately and then totaled to determine total pump operating pressure.

3) **Hose length**. Pressure losses increase with increased hose length. Therefore, longer hoses have higher-pressure losses. The nomograph used in this Fact Sheet is for 50-foot lengths; pressure losses can easily be calculated for other hose lengths by using multiples of the 50-foot base length.

4) **Number of couplings and fittings between the pump and the spray gun.** Couplings and fittings create turbulence and restrictions in flow that results in pressure losses.

The flow rate (GPM), orifice disc size,and inside diameter of hose must be known to estimate the pressure loss. The nomograph (Figure 1) is used to estimate pressure loss for a 50-foot length of hose. The pressure loss can then be converted to the actual length of hose being used. Notice that the nomograph has non-uniform dimensions on both flow rate and pressure loss scales. Steps 1-6 are used to estimate total pressure losses for a hose and nozzle assembly using Figure 1.

Step 1. Flow rates in gallons per minute are shown down the left scale of the nomograph. Mark the flow rate for the size of orifice disc being used.

Step 2. The center scale represents hose inside diameters. Select the hose size being used and mark that size on the scale. Pressure loss for different hose sizes must be calculated separately.

Step 3. Draw a straight line through the marks for flow rate and hose diameter to the scale for pressure loss. Read the pressure loss off this scale for 50 feet of hose at the specified flow rate and hose size.

Step 4. Divide the actual length of hose used by 50 and multiply the pressure loss by the number of 50-foot sections to obtain the actual pressure loss for the entire hose. Remember, this pressure loss is for only one hose size. If different size hoses are combined, the pressure loss must be calculated separately for each hose length. Repeat steps 1-4 for each hose size.

NOTE: If different hose sizes are used, add the pressure losses for all the sizes to get the total pressure loss for the entire hose assembly.

Step 5. Add 4 psi pressure loss for each set of couplings or fittings between the pump and the spray gun. If the hose is rolled on a reel or spool, add 10 psi for the coiled effect (centrifugal flow forces) to the hose pressure loss to obtain the total pressure loss.

Step 6. Combine pressure losses from steps 4 and 5 to determine the total pressure loss. Add this estimated total pressure loss to the desired operating pressure at the orifice to obtain the pump pressure. Set the pump pressure at this level.

This pump pressure is for the conditions specified (orifice disc flow, hose size(s), number of fittings, and spool or reel effect). If any of these conditions change, the pressure loss must be calculated again. The nomograph is for smooth wall hose only. Hoses with a rougher interior will have higher pressure losses and this nomograph will not accurately predict that loss.

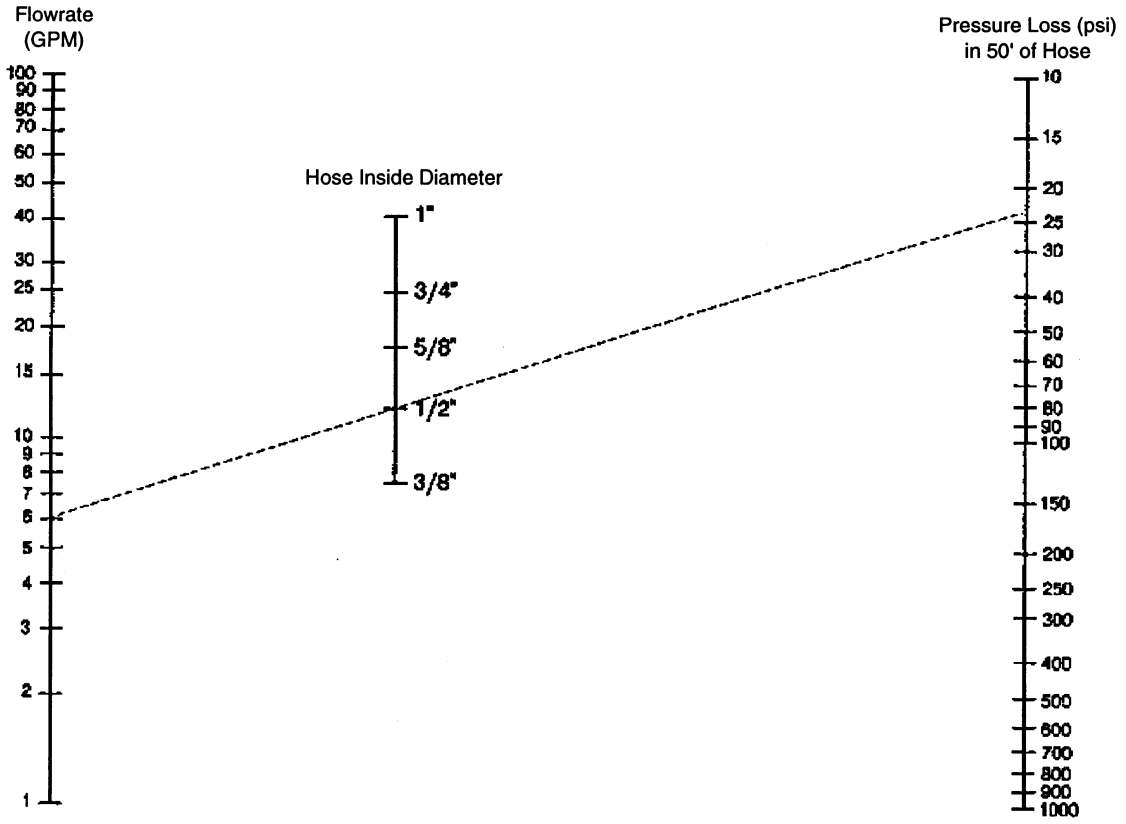

Figure 1. Hose Pressure Loss Nomograph. Dashed line is for example problem.

The following example illustrates the pressure loss computation process.

Conditions:

1) Desired flow rate of approximately 6 GPM.
2) Delavan size 10 or Spraying Systems D-10 orifice disc.
3) 200 feet of $^1/_2$" hose.
4) 2 couplings between the pump and gun.
5) The hose is mounted on a reel or spool.

Step 1. The manufacturer's catalogs show the disc has a capacity of 6 GPM when operating at 200 psi. Mark the left scale at 6 GPM.

Step 2. Mark the center scale for $^1/_2$ I. D. hose.

Step 3. Draw a straight line through the flow rate and hose diameter marks to the pressure loss scale. The pressure loss for 50 feet of hose is about 24psi.

Step 4. Estimate the pressure loss for 200 feet of hose.
200 ft. = 4 sections
50 ft
24 psi x 4 = 96 psi

Step 5. Add 4 psi for each fitting x 2 fittings = 8 psi.
96 psi + 8 psi = 104 psi
Add 10 psi for the pressure loss due to the reel'
104 psi + 10 psi = 114 psi

Step 6. Calculate the pump pressure.
114 psi + 200 psi = 314 psi
Set the pump pressure gauge at about 315 psi.

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