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The presence of negative numbers in a hydraulic calculation can be confusing, even alarming. Negative pressures as *available* or *safety* pressures are always a concern. However, the presence of negative numbers as *required* pressures are completely normal in situations involving fire pumps or elevated supplies.

Demand-based[i] calculations accumulate pressures and flows from a remote point in the system and then display the total requirements at the source. Pressure losses due to friction, elevation, fittings and valves are counted as positive values, INCREASING the required pressure. A fire pump or an elevated supply must therefore be treated as a DEDUCTION to the required pressure.

Consider this example. A city main has 45 PSI Static and 38 PSI Residual flowing 1230 GPM. Calculations show a required pressure and flow at the fire pump (discharge side) of 48 PSI at 1025 GPM. Working from the source, 1025 GPM is available at 40 PSI. This is reduced to 39 PSI by friction losses in the pipe and fittings between the source and the fire pump. The pump boosts the pressure by 60 PSI to a total of 99 PSI. On the discharge side of the fire pump, we have 99 PSI available, but only 48 PSI required, leaving a surplus pressure of 51 PSI.

That should make sense, but we had to look at the portion of the system from the source to the discharge side of the pump in the reverse direction (as compared to the normal flow of information for Demand-based calculations). The normal flow of information in the calculation report is moving toward the source, so the pressure generated by the pump is treated as a negative number. When that boost exceeds the pressure required, the required pressure at the pump suction is a negative value. **That does not mean we have a vacuum in the main**. It means that the pump is generating more pressure than is required at the discharge side of the pump (for that calculation).

Looking at the sample scenario using the demand-based approach, the sprinkler system requires 48 PSI at 1025 GPM at the discharge side of the fire pump. Subtracting the 60 PSI boost leaves –12 PSI required (48 – 60 = negative 12) at the suction side of the pump. Add 1 PSI for losses in the piping to the source and we have negative 11 (-11) PSI *required* at the source. The source has 40 PSI *available*, so the *SURPLUS* pressure is 51 PSI (*available* less *required* = *surplus*).

In this example, the only negative numbers were *required* pressures. As long as the Safety Pressure is a positive number, there should be no concern. The safety pressure reported will always show the true pressure difference between the *Available* Source Pressure and the *Required* System Pressure at the source. As was shown above, these values do not represent a vacuum in the pipes.

As you can see, a negative *required* pressure represents the **theoretical** situation in which the pressure required to operate the system at a specific location is less than 0 PSI. These values can only occur in a demand-based calculation. **The only negative values to be concerned about are *available* pressures and *safety* pressures.**

If you have additional questions, please contact the SprinkCad Technical Support team at 800-495-5541.

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[i] **Demand-based** calculations start at a sprinkler head or other flowing node at a minimum *required* pressure and flow. Results are given at a source point where the total *required* pressure and flow is compared to the *available* pressure. **Supply-based** calculations start at a source point using the *available* pressure at the source and demonstrate the actual flows and pressures expected from a particular system with certain heads in operation. Results are interpreted based on whether all sprinklers flow amounts equal to or exceeding the minimum.