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Re: Lifts in Vacuum Return Lines

It is important to avoid lifts in vacuum return lines whenever possible. Under no circumstances should lift fittings be used in lieu of an auxiliary accumulator tank in the return main at the inlet to the vacuum heating pump receiver. However, when there is no practical way to avoid a lift, the inherent disadvantages may be minimized by the proper selection and careful installation of the required lift fittings.

Basic Principles

The operating principles of a lift are illustrated in Figure 1 below. Condensate flows by gravity in the vacuum return line and accumulates in the well of the lift fitting where is seals off the base of vertical lift pipe. This water seal interrupts the flow of air in the return (since you can't draw a vacuum past a section of pipe that is sealed with water) line decreasing the vacuum in the return line. This creates a pressure differential between the lower and upper sections of the return line. The pressure differential creates the motive force needed to raise or "lift" the condensate from the lower to upper section of the return line. Once the condensate is lifted to the upper section, it is prevented from dropping back by the upper loop.

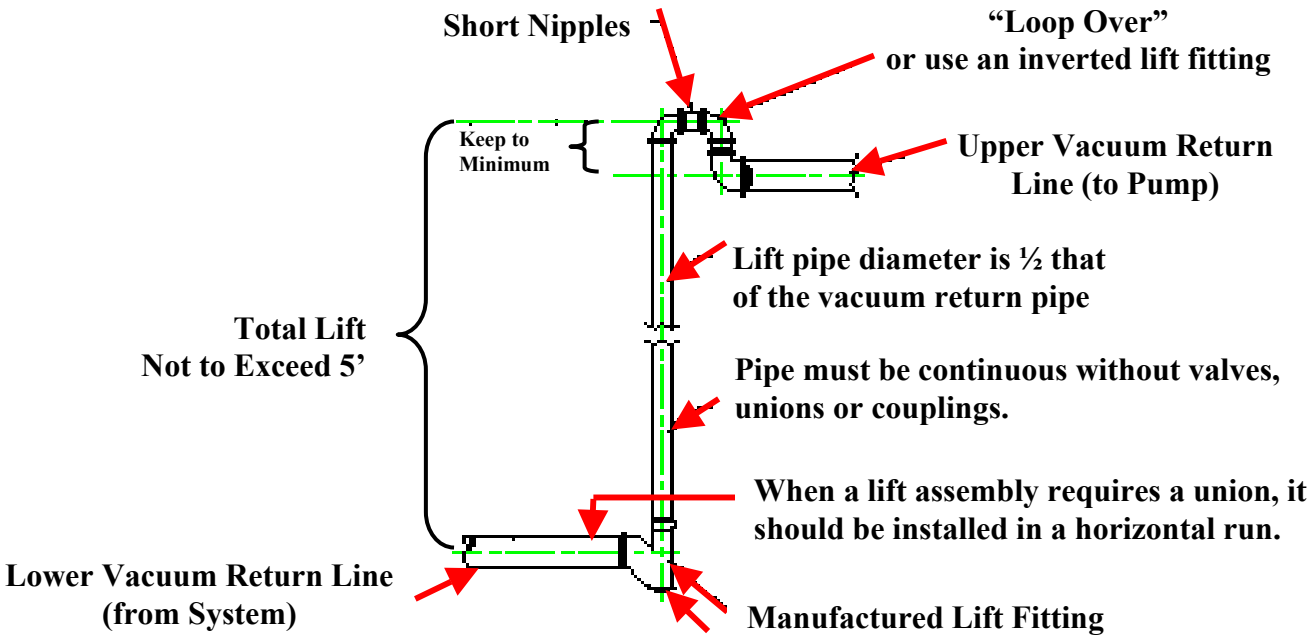

Figure 1
Single-Step Lift

In operation, the lift works with a pulsating action alternately lifting slugs of condensate and air. The action occurs rapidly enough to mix the condensate and air.

At the start of the lift action, a pressure differential of about ½ psig (or 1'Hg) is required to lift the water for each foot of vertical rise. As the alternating lift cycle proceeds, the condensate and air become mixed; the density of the mixture is less than water alone. As a result, the pressure differential needed is reduced to about 60 percent of the values mentioned above. However, the pressure loss in the lift should be calculated upon the basis of a solid column of water.

Single-Step Lift

Figure 1 illustrates a single-step lift that will meet typical lift requirements. Note that in place of the "loopover" at the top of the lift, a manufactured lift fitting may be used if preferred. Based on practical experience:

- The rise of a single-step lift should not exceed five feet.
- The diameter of the lift pipe should be ½ the diameter of the vacuum return pipe
- The lift pipe must be a continuous piece of pipe without valves, unions or couplings.

To estimate the vacuum that can be maintained in the lower vacuum return line, deduct the lift from the vacuum maintained in the upper return line. For example if the lift is 5 feet and 10" Hg of vacuum is maintained in the upper return line, then only 5" of vacuum can be maintained in the lower return line. Five feet of lift corresponds to approximately 5" Hg (a 5 foot rise equates to 2.16 psig or approximately 5" Hg of vacuum, with rounding, based on two formulas: 1) 1" Hg equals .5 psig and 2) 1 psig equals 2.31 feet of head).

Step Lift

Figure 2 illustrates a two-step lift that may be used to handle a lift greater than five feet but not exceeding eight feet. By breaking the lift into two equal sections, the lift takes place in the first section and then in the second section, so that the effect is cumulative. Therefore, the loss in vacuum for an eight-foot, two-step lift is approximately the same as a five-foot, single-step lift. However, the two-step lift is not as efficient as the single-step lift due to additional friction losses. The guideline for the diameter of the two sections of rise is the same as in the single-step rise — 1/2 the diameter of vacuum return line.

If lift exceeds eight feet, then additional steps of equal distance should be created. The length of the horizontal, return piping that connects the pipe of step 1 to the pipe of step 2 depends on the diameter of the vacuum return pipe as summarized in the table below.

Diameter of Vacuum Return Pipe	**Length of Vacuum Return Pipe Connecting Step 1 and Step 2 (see "A" in Figure 2)**
1"	7"
1 ¼"	8"
1 ½"	9"
2"	10"
2 ½"	14
3"	15"
4"	18"
5"	21"
6"	24"

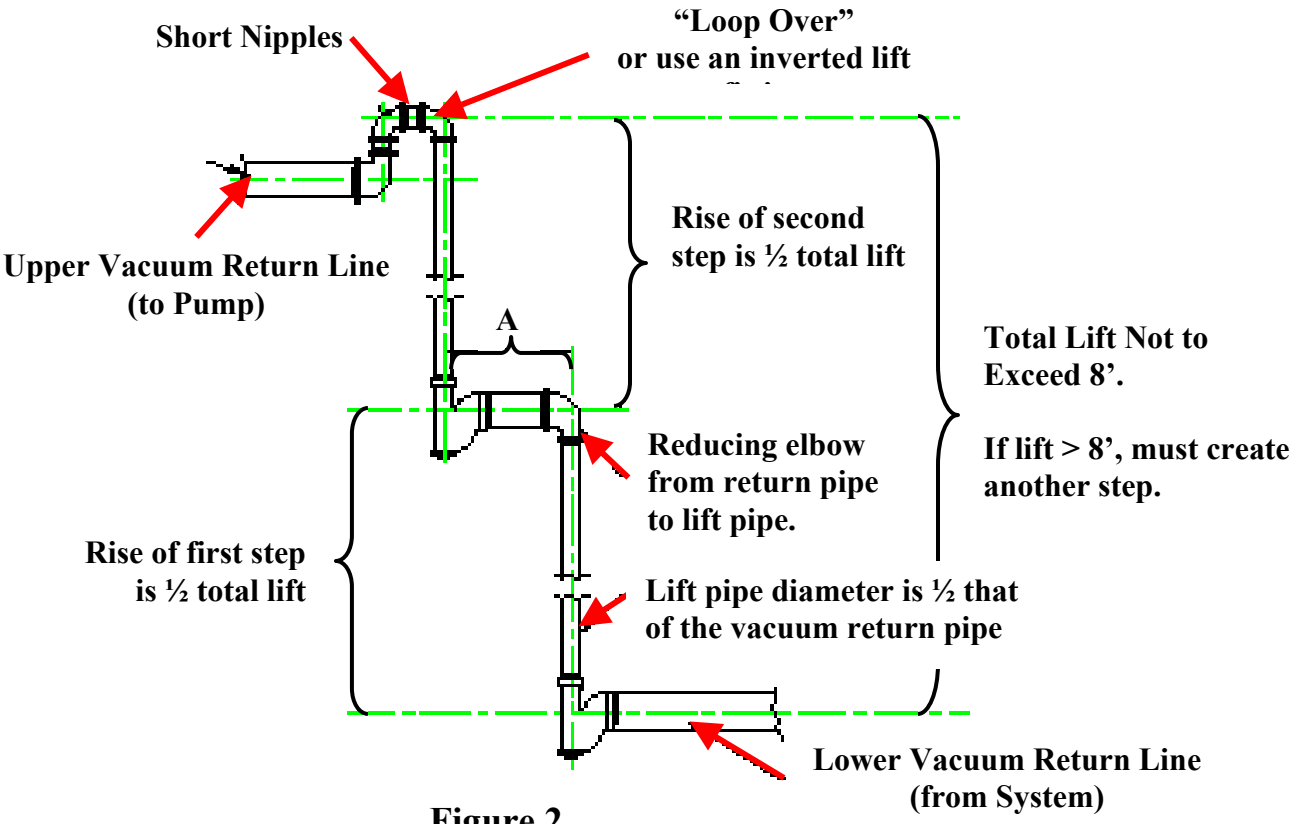

Figure 2
Step Lift

Lift Fittings

Lift fittings made by manufacturers who specialize in steam system products are preferable because the fittings can be installed with a minimum cost of labor. However, such fittings may not be readily available when needed. If not available, satisfactory lift connections can be made from standard pipe fittings. Figure 3 illustrates the proper design and dimensions for building lift connections. The design and dimensions should be followed closely.

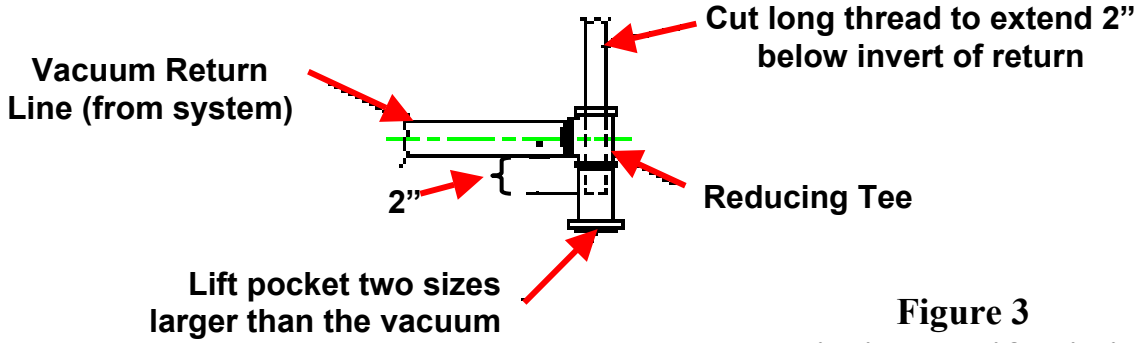

Figure 3
Building a Lift Fitting

**Disclaimer: The purpose of this article is to explain the general principles of lifts in vacuum return lines. The discussion and diagrams in this article are typical representations and not intended to be used for a job specific installation, operation or maintenance drawings. Job specific drawings should be made by professionals, licensed and registered as required, familiar with the equipment and the job site conditions and in accordance with specific manufacturer's installation manuals. Installation must be performed by professionals, licensed and registered as required, familiar with local, state, and federal codes, rules and regulations governing the installation and operation of the equipment and the intended use in the overall system.*

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