Design Guidelines for Levitronix Pump System

Priming – Gravity Feed

The Levitronix Pump is a Centrifugal Pump and therefore not “self-priming”. The most effective setup for priming the Levitronix Pump is the gravity feed. In order to ensure that liquid fully fills the pump head, ensure that the pump is be placed below the tank, the tank fitting for the suction line should be below the liquid level, and the suction line should follow a smooth path downward to the pump so that there are no air traps. The following figures illustrate what defines a proper gravity feed.

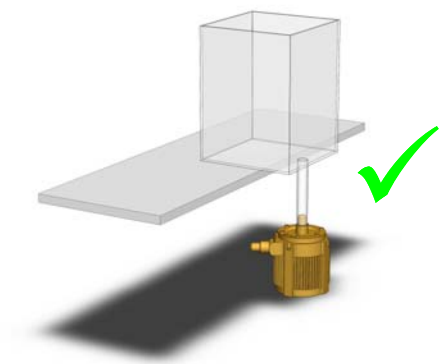

Figure 1: Short, straight tubing from the bottom of the tank to the inlet of the pump. Pump inlet vertically up and outlet to the side. Pump is below the tank.

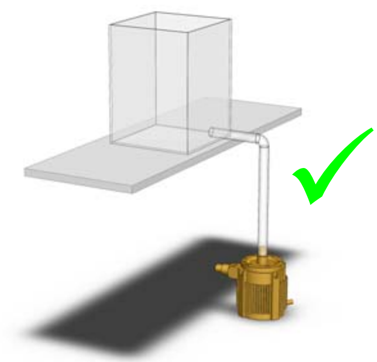

Figure 2: Short, L-bend tubing from the bottom side of the tank with the fitting below the liquid level. Pump inlet vertically up and outlet to the side. Pump is below the tank.

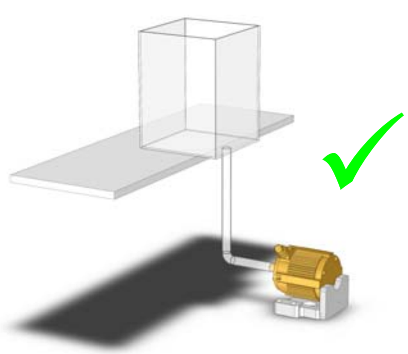

Figure 3: Short, L-bend tubing from the bottom of the tank to the inlet of the pump. Pump oriented sideways and below the tank.

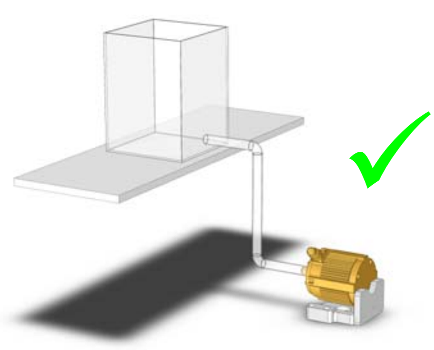

Figure 4: Short, S-bend tubing from the bottom side of the tank to the inlet of the pump. Pump oriented sideways and below the tank.

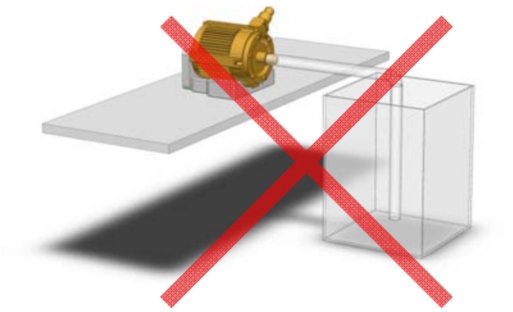

Figure 5: Tubing coming from the top of the tank to the inlet of the pump. Pump oriented sideways and above the tank.

Figure 6: Tubing coming from the top of the tank to the inlet of the pump. Pump oriented vertically and below the tank.

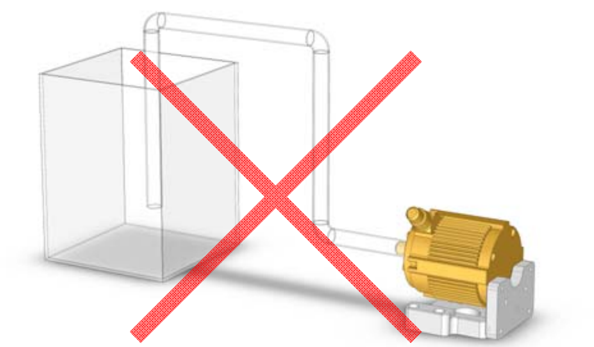

Figure 7: Tubing coming from the top of the tank to the inlet of the pump. Pump oriented sideways and below the tank.

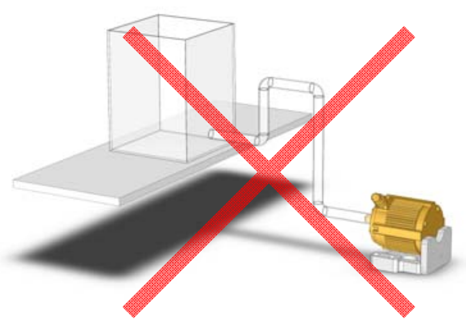

Figure 8: Tubing coming from the bottom side of the tank to the inlet of the pump. Pump oriented sideways and below the tank. Air trap located in center of suction line.

Smooth Fitting Transitions throughout the loop

When using reducer fittings, use reducers that have smooth transitions and not jumps or edges. When pairing fittings; use fittings that have the same inner diameter. This will eliminate potential sources of shear (stress) to sensitive fluids.

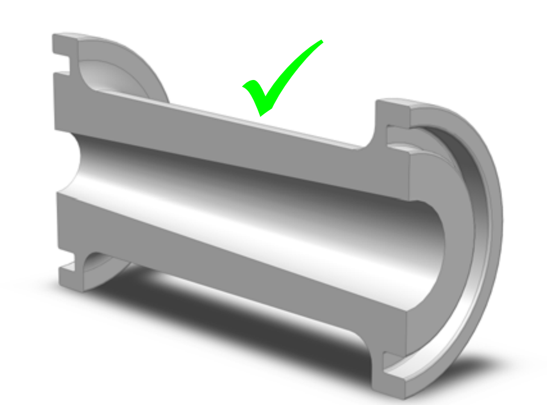

Figure 9: 3/8" ID to 1/4" ID reducer with smooth transition.

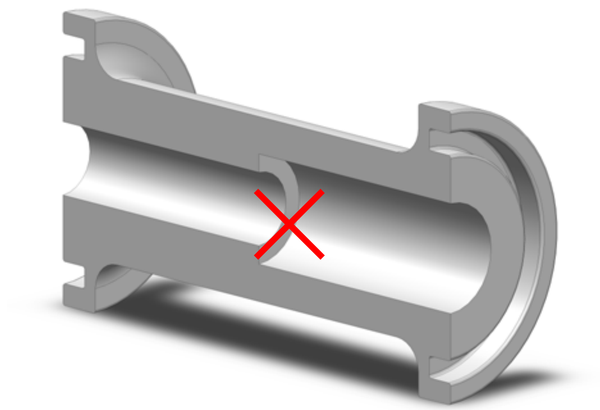

Figure 10: 3/8" ID to 1/4" ID reducer with jump for transition. The jump is a source of shear stress.

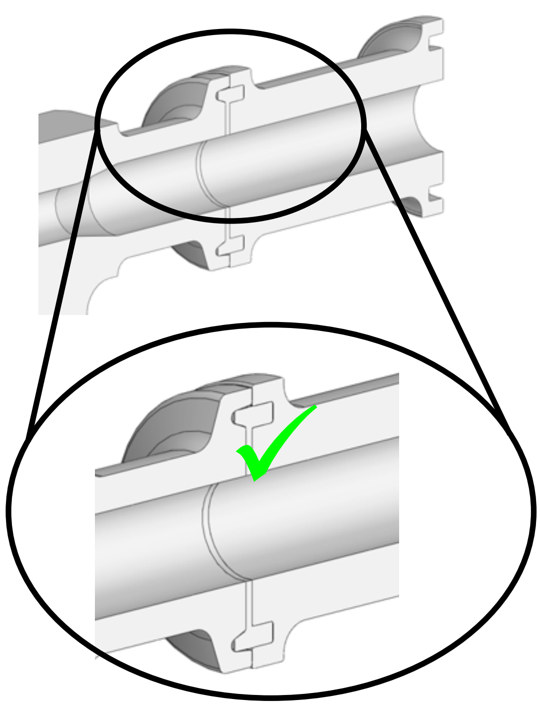

Figure 11: Two fittings with same IDs for smooth transition.

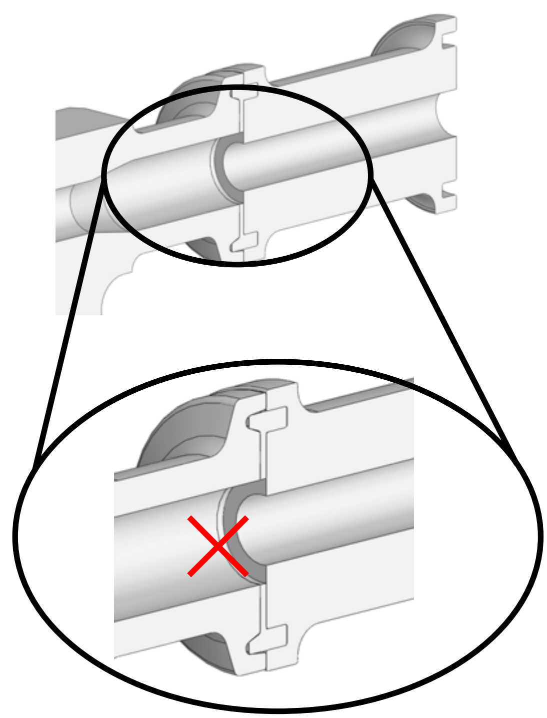

Figure 12: Two fittings with differing IDs for uneven transition. The edge is a source of shear stress.

Tubing ID on Suction Line

The ID of the tubing, whether it is on the suction line or the discharge line, greatly affects the pressure loss in that tubing. The smaller the ID of the tubing, the greater the pressure loss there will be. It is good practice to keep the tubing ID as large as possible to avoid high pressure loss, especially on the suction line, as it avoids absolute pressure levels below atmosphere and therefore stress to sensitive liquids.

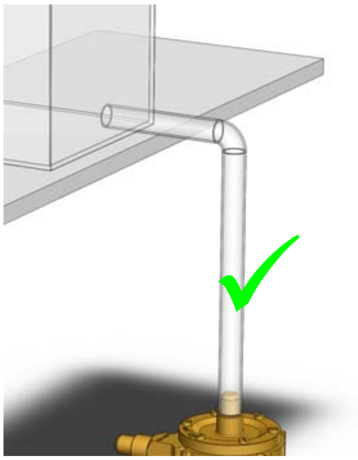

Figure 13: ½" ID tubing on the suction line

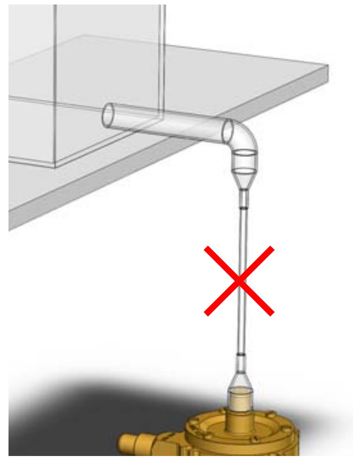

Figure 14: ¼" ID tubing on the suction line

Tubing Hardness on Suction Line

Avoid soft or thin walled tubing on the suction line as the tubing might collapse due to the negative absolute pressure as shown in *Figure 16*. Use a harder material and thicker walls to prevent collapsing of the tubing.

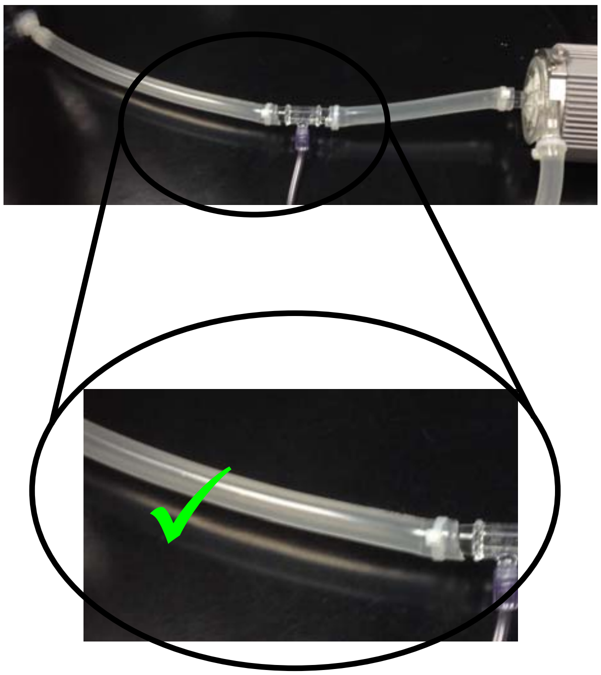

Figure 15: Harder tubing on the suction line to prevent collapse

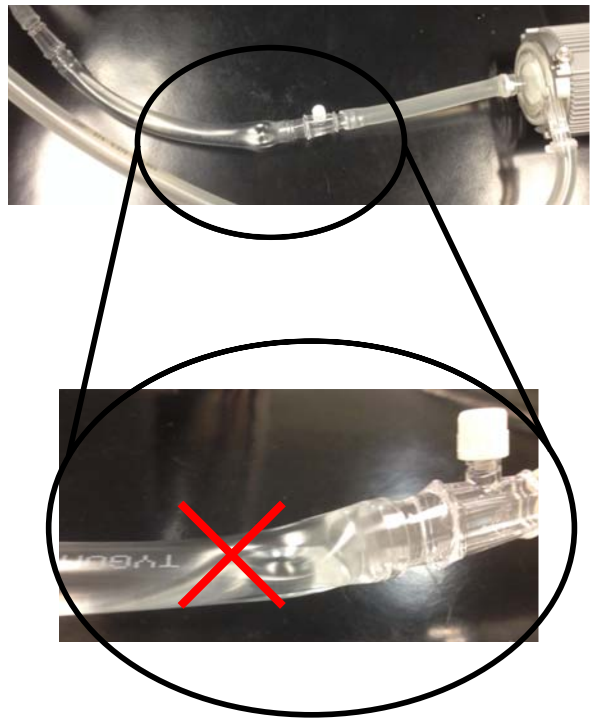

Figure 16: Soft tubing on suction line collapsing

Suction Line vs. Discharge Line Design

Avoid placing sources of high pressure, such as filters or long sections of tubing, on the suction line. Instead place these sources of pressure on the discharge line.

Definition of Suction Line:	Section between tank outlet and pump inlet
Definition of Discharge Line:	Section between pump outlet and tank inlet/return

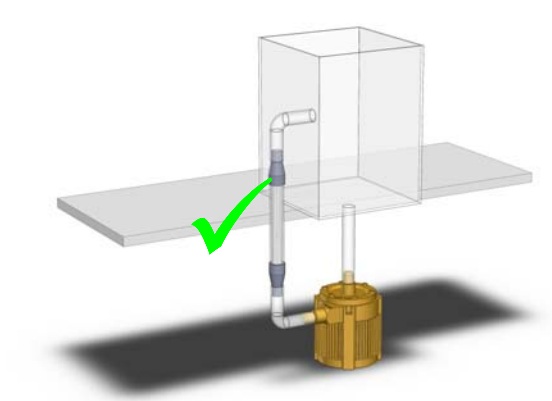

Figure 17: Filter on the discharge line

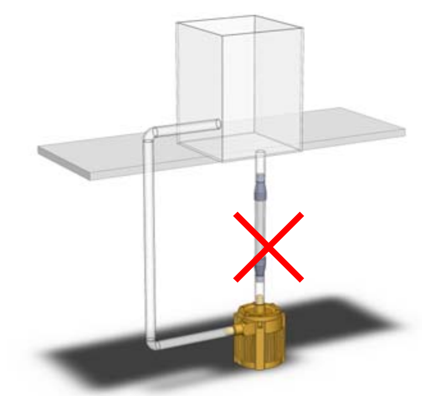

Figure 18: Filter on the suction line

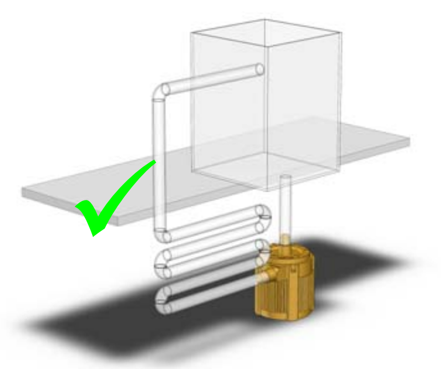

Figure 19: Long tubing on the discharge line

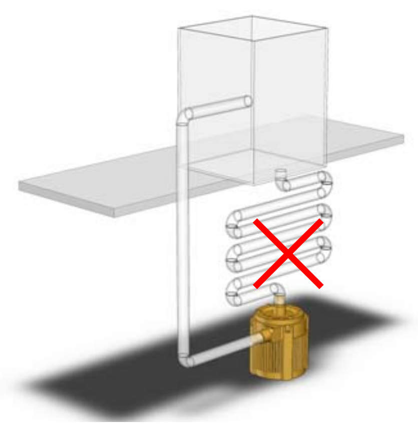

Figure 20: Long tubing on the suction line

Kinking in tubing

Avoid sharp bends, <u>especially with soft tubing in the suction line</u> as this will cause the tubing to kink. Kinking will be a large source of pressure loss and shear stress to sensitive liquids.

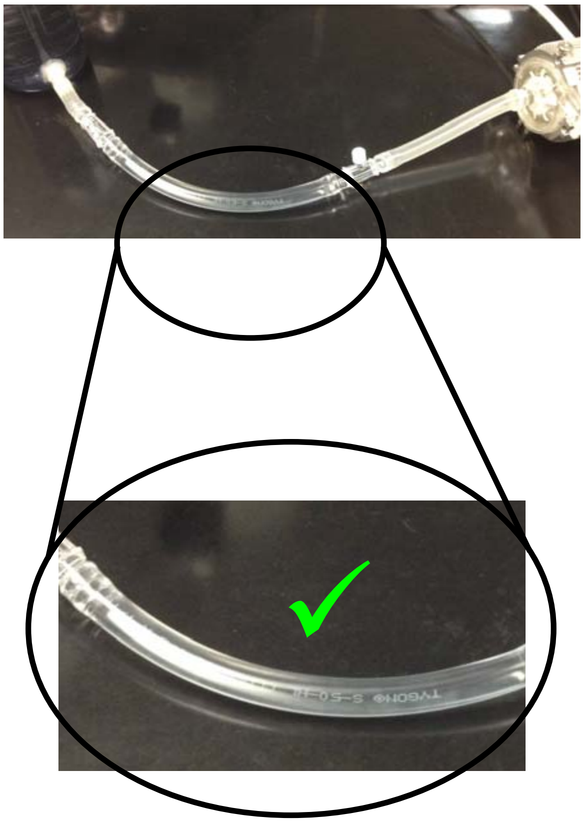

Figure 21: Lessen the bending of the tubing to prevent kinking

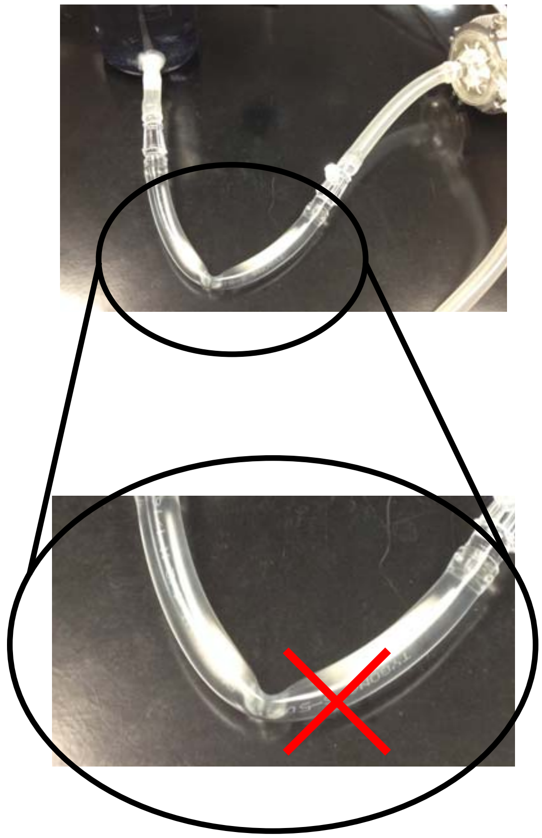

Figure 22: Too much in the bend on the tubing causing kinking

Tubing ID and length effect on pressure loss

The pressure loss of the tubing is mostly determined by the ID of the tubing as well as the tubing length. The ID has a much larger impact on the pressure loss than the length however.

Change in…	Length (ft)	ID (in)	Flow Rate (L/min)	Pressure Loss (mbar)
"Reference"	10	3/8	5	**66**
Length	20	3/8	5	**132**
ID	10	3/16	5	**1815**

Table 1: Pressure loss based on ID and length of tubing

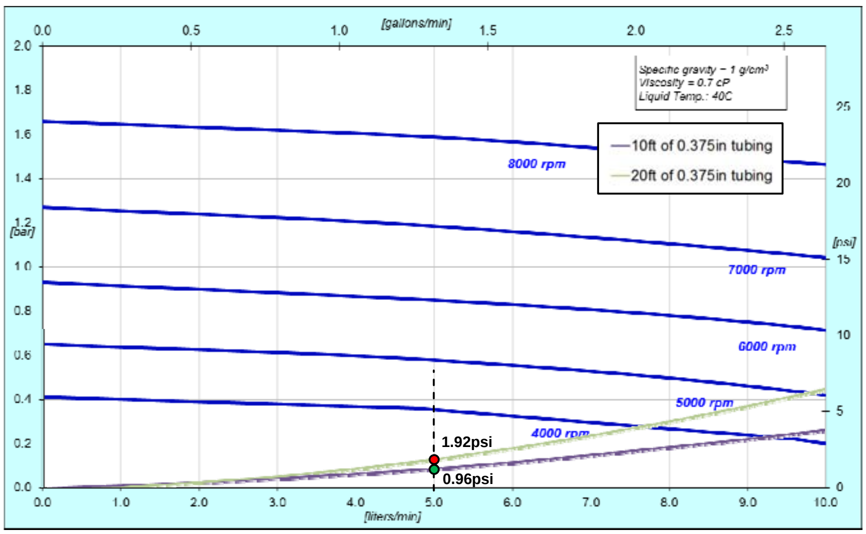

Figure 23: Pressure/Flow curves with load curve change for double tubing length

As shown in *Figure 23*, at 5L/min and 10ft of tubing the pressure is 0.96psi while at 20ft of tubing the pressure is 1.92psi.

By increasing the tubing length by twice the original size, the pressure is also increased by a factor of 2.

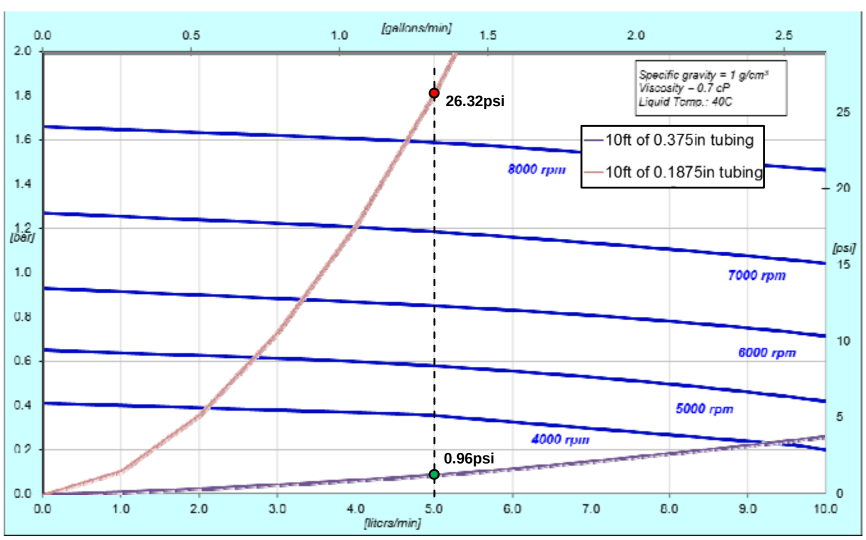

Figure 24: Pressure/Flow curves with load curve change for half the tubing ID

As shown in *Figure 24*, at 5L/min and 3/8" ID tubing the pressure is 0.96psi while at 3/16" ID tubing the pressure is 26.32psi.

By decreasing the tubing ID to 1/2 of the original size, the pressure increased by a factor of 27.5.

Design Guideline for Levitronix Clamp-on Sensor

Clamp-on Flow Sensor Placement

The clamp-on flow sensor can be placed on either the suction or discharge line. Make sure that the clamp-on is placed on a straight section of tubing with the minimum straight tubing before and after the clamp-on as shown in Table 2. Whenever the clamp-on is placed on a section of tubing, rezero the flow meter to ensure accuracy.

Clamp-on	Straight run before clamp-on	Straight run after clamp-on
Standard	30x tubing ID	12x tubing ID
LFSC-12 with 3/8" ID tubing	11.25in / 285mm	4.5in / 115mm
LFSC-22 with 3/4" ID tubing	22.5in / 570mm	9in / 230mm

Tabe 2: Length of straight tubing needed before and after clamp-on

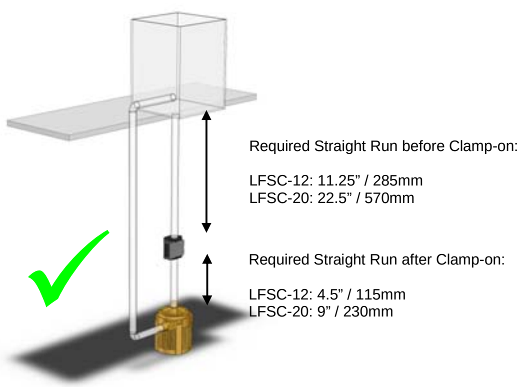

Figure 25: Clamp-on on the suction line

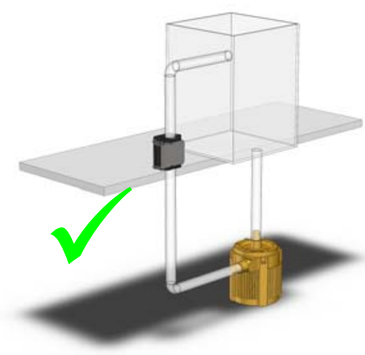

Figure 26: Clamp-on on the discharge line

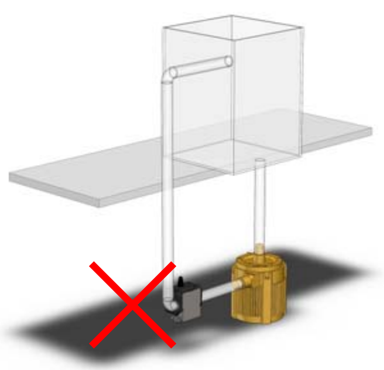

Figure 27: Not enough straight run after clamp-on

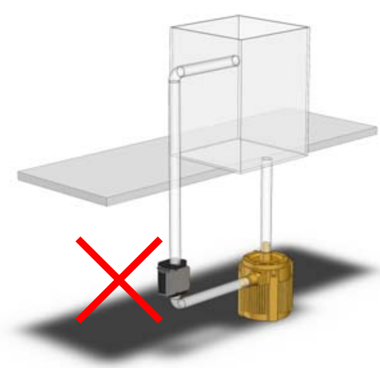

Figure 28: Not enough straight run before clamp-on

Figure 29: Bubbles trapped in top of curved tubing

Clamp-on Flow Sensor Re-zero

After set up of the sensor, re-zeroing of the flow meter is recommended.

In the following cases a re-zero is recommended:

- 30 minutes after power-on of a cool converter and sensor
- Change of fluid properties (fluid temperature, fluid viscosity, fluid density)
- Change of liquid type
- Clamp-on of the sensor to a new tubing
- Change of the hydraulic loop

Zero Adjust Procedure:

1. Assure that the sensor is completely filled with fluid and is free of bubbles. Stable liquid properties should be assured by flushing the circuit with the final liquid until temperature and viscosity becomes stable. After this zero flow shall be realized.
2. Push the “ZERO ADJ” button on the converter, see Figure 28, for about 3 seconds.
3. During adjustment “0ADJ” appears on the converter display (about 2s with blinking). The duration of zeroing is about 6-15 seconds.

Figure 30: Rezero on Levitronix converter