

## **USING A TURBINE FLOWMETER SYSTEM IN CRYOGENIC CUSTODY TRANSFER APPLICATIONS**

### Introduction

The effective use of a Cryogenic Flowmetering System to obtain accurate flow measurements requires a number of basic considerations be satisfied. These include the following:

1. The meter system must be suitable for intended use.
2. The meter system must be installed in accordance with manufacturer and government metering code.
3. The meter system must be operated within its design limits.
4. The manufacturer's and Government's Metering Codes recommended transfer procedure must be followed.

This application note is intended to develop some of these basic requirements into a series of guidelines you can use in selecting and applying a Hoffer Cryogenic Flowmetering System.

### Suitability for Use

The most basic requirement is that the meter system must be suitable for your intended use. This usually requires the system to be rugged, durable, and have a stable accuracy in its work environment.

The meter manufacturer should be advised if the system will be located indoors or outdoors so that a suitable enclosure may be selected. The equipment mounted out of doors must be able to withstand the expected seasonal temperature limits.

Government metering codes require billing for commercial deliveries to be done to an accuracy of +/-1.5%.

The units of billing may be one of the following units of measure:

1. Compensated Volume (Equivalent Gallons at the Normal Boiling Point)
2. Equivalent Amount of Gas (Cubic Feet of 70°F and 14.696 PSIA)
3. Pounds

Systems which compensate for expansion of the liquid as it warms are required for most installations. These systems are termed "Temperature Compensated" and automatically correct the measured volume to provide for indication and billing in the required units of measure. Compensated systems are recommended by Hoffer Flow Controls for all cryogenic applications involving customer billing.

The codes require the entire compensated system to be installed and in serviceable condition at all times during use.

Volumetric metering systems may only be used where the saturated pressure of the liquid source is kept below 20 PSIG by a suitable relief valve. Otherwise compensated factors will need to be supplied are based on the liquid temperature. Most applications will therefore require temperature compensation.

The meter system must be such that the amount of the minimum delivery can be metered to an accuracy of +/-1.5% or better.

The United States (and most other countries), has a procedure whereby flowmeter manufacturers may have a system "Type Approved". This is a test where the meter system's accuracy and suitability for use is verified by the National Bureau of Standards. Hoffer Flow Controls participates in this program to assure its customers of the suitability of our products.

### Installation

The flowmeter system must be installed in accordance with the detailed requirements applicable to the equipment selected and in accordance with the government metering code. Consult with the User's Manual for specific requirements.

Most manufacturers' recommendations include:

1. Use the recommended straight pipe run into the meter.
2. Use the recommended straight pipe run out of the meter.
3. Flow control valves should be located downstream.
4. No upstream flow disturbances should exist.
5. Strainers should be used where required.
6. Access for maintenance is required.
7. Provisions for meter cool-down are required.
8. Safety release valves should be used wherever liquid may be trapped by manual and automatic closing valves.
9. Do not locate the flowmeter pickup near electrical devices which may cause interference.
10. Consider spare parts and test equipment if you will be maintaining your system.

The government metering code requirements include:

1. No diversion of liquid from the outlet of the meter system to the point of discharge is allowed.
2. A check valve is required downstream of the meter.
3. No vapor return line from the customer tank is required.

### Operation within the Selected Design Limits

A Flowmetering system has several design limitations associated with it. These are defined at the time the equipment is initially selected. The following limitations must be observed during use:

1. All meter designs, and the meter code, require the fluid to be in a liquid state while passing through the meter with adequate pressure on it to prevent cavitation.
2. The flow measurement range of the meter system must equal or exceed that required by the application.
3. The temperature compensation limits of the equipment must equal or exceed that which will be encountered in use.
4. The maximum working pressure of the meter system must not be exceeded.
5. The fluid being measured must be the same as that for which the meter system is intended for compensated systems.

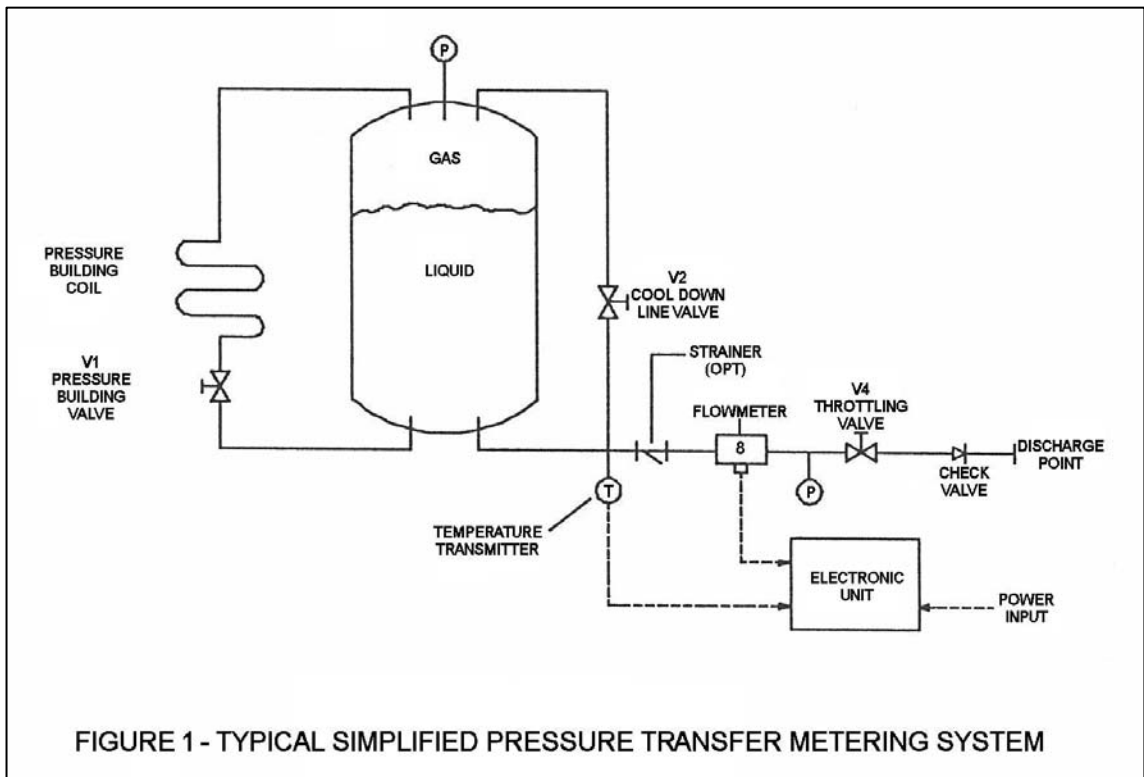
## Transfer Procedure

A typical transfer of liquid for a commercial sale could be described as follows for the case of a pressure transfer method. A figure of the typical system is shown in Figure 1.

1. Open the pressure building coil, valve, V1, to raise the pressure of the liquid vessel to at least 25 to 50 PSIG over its saturated vapor pressure. (The pressure it has stabilized at overnight.)
2. Cooldown the piping up to the meter system using the meter cooldown line valve, V2. Monitor any special indicator the meter system may have to indicate when cooldown is complete.
3. Purge the delivery hose using the expected procedure.
4. Clear the delivery total on the meter system.
5. Slowly open the discharge valve, V3, to commence the delivery. Throttle the flow rate using the downstream discharge valve, V3, to keep the flow rate within the rated range of the flowmeter while also maintaining adequate back pressure on the meter to prevent cavitation.

Note: A pressure indicator located downstream of the meter may help the operator maintain the adequate back pressure. The meter system will grossly over-register if cavitation develops during a transfer. In many cases, the operator can feel this cavitation as vibration in the line around the meter. (In some cases, an audible noise may also signal cavitation.)

6. Close the discharge valve, V3, when the delivery is complete.
7. Record the delivery amount.
8. Allow one to three minutes for the delivery hose to drain into the customer's tank.



## Conclusion

A successful application of a cryogenic meter system will result with the correct equipment so long as you follow a suitable operating procedure.