Specialized test procedure—Truck-mounted gravity-supplied meters and gravity-/pump-supplied meters

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Application

This procedure applies specifically to truck-mounted gravity-supplied meters and to truck-mounted gravity-/pump-supplied meters.

Purpose

To outline the special installation requirements applicable to this type of measuring system and the specialized testing equipment required along with the procedure for using this equipment in order to simulate gravity-supplied measuring systems.

Equipment required

- Centrifugal pump with a capacity of at least 500 lpm
- Appropriate open neck local standard (generally 1500 L or larger for 3-4” meters)
- Adapter for the outlet of the gravity-supplied meter with reliable vacuum/pressure gauge with 2 kPa increments or finer
- Jumper hoses of sufficient length to go from the gravity-supplied meter adapter to the pump and from the pump to the local standard bottom loading stub

Legislative references

- R:262 – In-service limits of error
- R:263 – Repeatability requirements
- R:266(2) – Accuracy requirements
- R:275 – Vacuum breaker
- R:287 – Discharge hose type for gravity-supplied meters

Installation requirements

Gravity-supplied metering installations

Air elimination on truck-mounted gravity-supplied metering installations requires special attention. This is because there is no back pressure to assist in venting air out of the air eliminator (AE). The manifold and lines from the tanks to the manifold are typically dry at the start of a transaction. When the system is flooded, pockets of air can be trapped in the manifold and the manifold valves. This air can then be released when maximum flow is achieved. In such a case, the air will normally be measured causing measurement error.

Referring to the manifold vent line in the standard installation drawing, it can be seen that it is plumbed to the top of the AE to allow air to escape while the manifold is being flooded. Once the AE's retention chamber is flooded, the vent line is closed by a float and check valve. In these installations, it is important to make sure the bottom of the retention chamber is maintained at the same level as the top of the manifold in order to prevent the float from rising prematurely and blocking the venting of the manifold. In the drawing, this additional height (referred to as H1) is obtained by adding a riser to the AE mount. Another option would be to plumb the manifold vent line to the vapour space at the top of a compartment or into a spit tank vented to atmosphere. In this case, a check valve must be installed in the vent line to prevent air from being drawn back into the meter during operation.

Another special consideration for gravity-supplied metering installations is that the measuring assembly must remain full of liquid upon emptying a compartment. This requirement is found in regulations 287 and 282(2). The liquid level that remains in the measuring assembly is considered as the transfer point. This is achieved by venting the AE to the discharge side of the meter through a siphon breaking line. This arrangement allows air to enter the AE once the hose as emptied thereby breaking the hose siphon and preventing additional liquid from being withdrawn through the meter.

A vacuum breaker must be installed at the outlet of the meter to prevent the liquid pressure in the meter to fall below atmospheric pressure. This requirement, found in regulation 275, also allows the dry discharge line to drain to the underground tank when the auto shut off valve is operated or a quick-acting valve is closed when partial compartments are delivered. It must be installed just downstream of the quick-acting valve or automatic flow control valve so that it is able to sense the main flow stream just ahead of the dry hose connection.

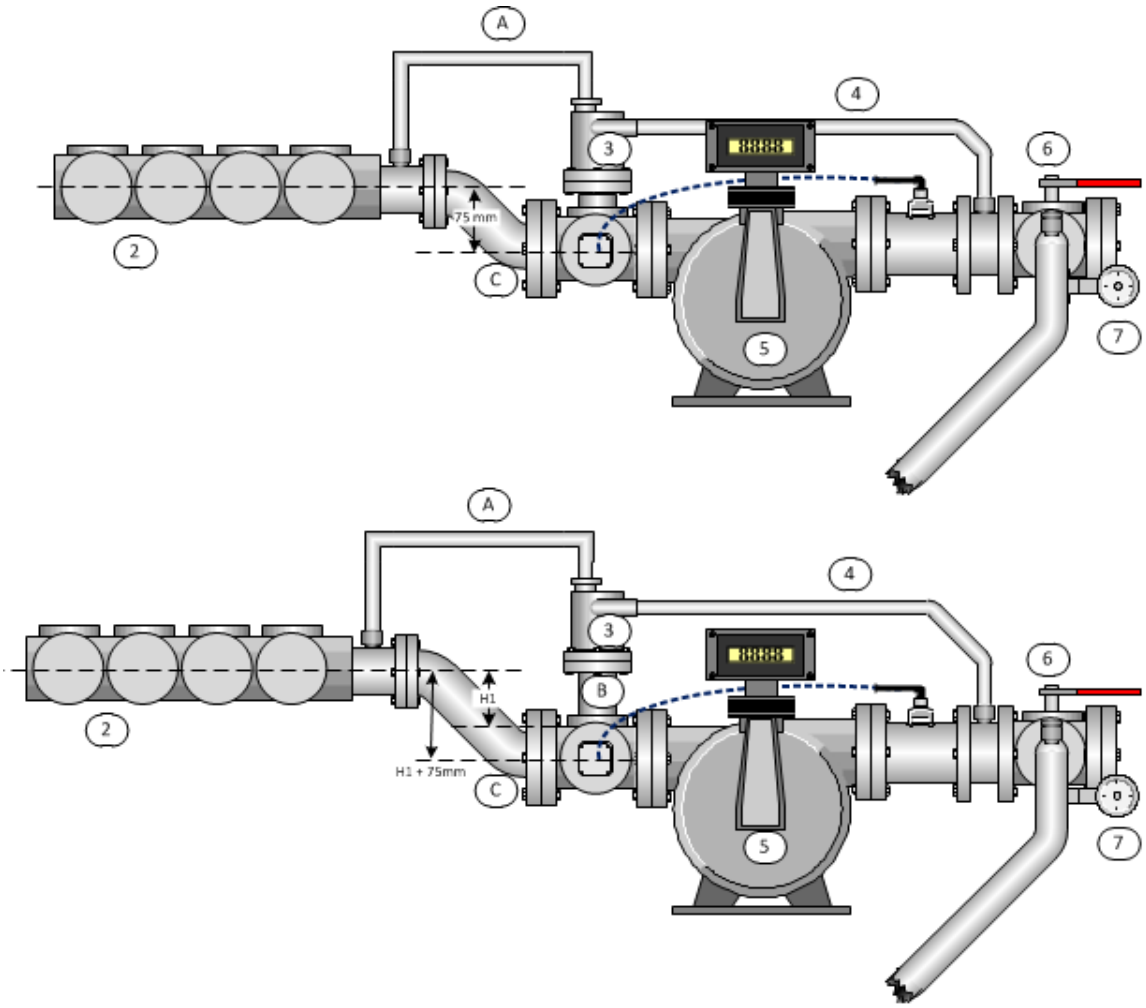

Figure 1: Air eliminator riser

Key for figures 1, 2 and 3:

1. tank truck
2. manifold
3. air/vapour eliminator
4. vent line
5. meter (device under test)
6. 3-port/2-way valve
7. pressure/vacuum gauge
8. centrifugal pump
9. prover standard

A. manifold vent
B. riser
C. drop on delivery line
D. N/A
E. prover return line
F. prover fill line
G. vented spit tank
H. hose reel
I. delivery nozzle

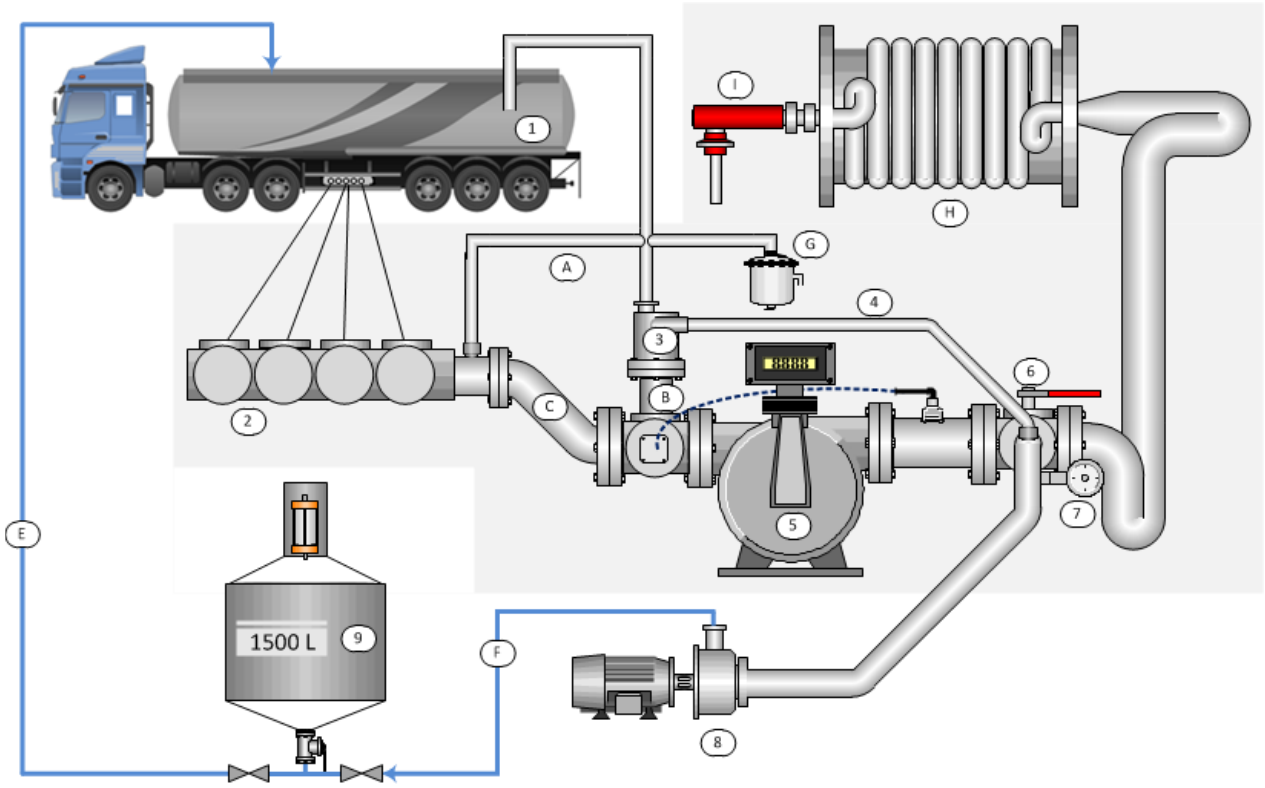

Figure 2: Gravity-supplied metering installation

Gravity- and pump-supplied metering installations

The installation is much the same as for meters supplied by gravity only, except that a 3-port/2-way valve (a valve with one inlet and two isolated outlets) must be installed to divert the flow to the pump-supplied hose reel while at the same time isolating the gravity outlet. The vent line of the AE is plumbed as before to the outlet side of the gravity-supplied meter and also to a spit tank vented to atmosphere or to the vapour space of a compartment in the tank truck.

The outlets may only be selected one at a time and in no case may the product be partially delivered by both outlets. This is commonly referred to as a break-before-make valve. Electronic solenoid control valves may also be used to accomplish this switching. In all cases, the inspector must ensure product cannot be misdirected.

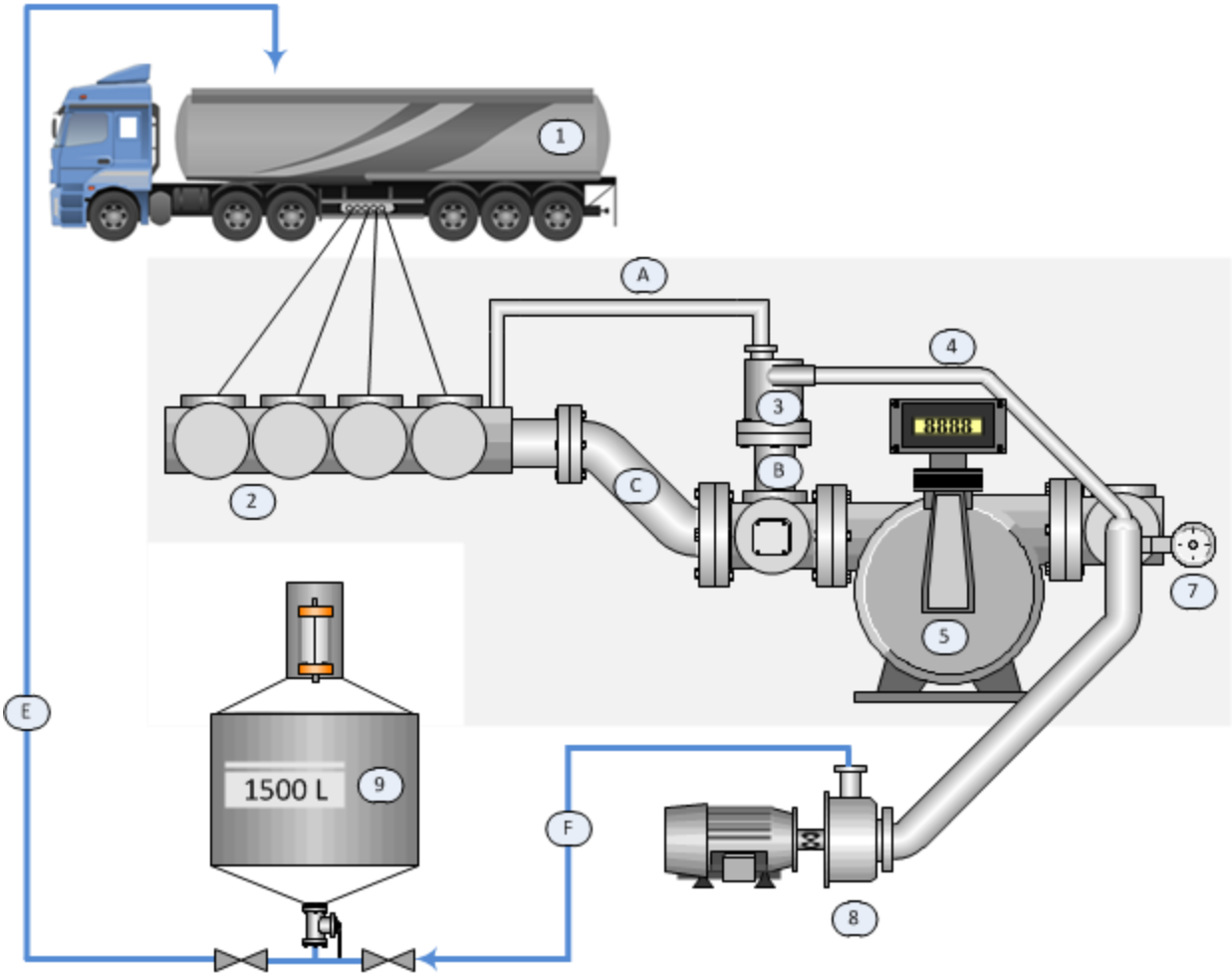

Figure 3: Gravity- and pump-supplied metering installation

Specialized equipment and general set-up

- Centrifugal pump with a capacity of at least 500 lpm
- Appropriate local standard (generally 1500 L or larger for 3-4” meters)
- Adapter for the outlet of the gravity-supplied meter with reliable vacuum/pressure gauge with 2 kPa increments or finer
- Jumper hoses of sufficient length to go from the gravity-supplied meter adapter to the pump and from the pump to the local standard bottom loading stub

The set-up will be somewhat location dependent. The prover and pump must be located so as to allow for easy access to control the flow rate and monitor flow pressures. The tank truck manifold is plumbed to the centrifugal pump and on to the prover bottom loading stub. Additional plumbing is made from the prover outlet back to the tank truck. This return line may also need to be equipped with a pump (not shown) in order to drain the prover between test runs.

Procedure

The test attempts to simulate a gravity drop using a centrifugal pump to supply the product. To accomplish this, once the pump is turned on, the operator must adjust the flow rate using the bottom loading stub valve until the vacuum gauge reads just above zero gauge pressure. This allows for maximum flow rate under the influence of gravity. This pressure must be monitored and maintained throughout the testing procedure. At no time should the gauge be reading a negative pressure or vacuum during a test run.

In order to maintain the proper pressure, the local standard must be installed next to the tank truck and the meter, allowing the operator to monitor the vacuum/pressure gauge installed at the outlet of the gravity-supplied meter. A proper installation as described above typically has a maximum flow rate of about 600 lpm due to the installation of a vacuum breaker at the outlet of the meter. The operator monitors the pressure and adjusts the flow control valve to keep the pressure as close to zero gauge pressure without allowing it to drop into a vacuum situation.

If a vacuum is allowed to form, air will enter the system via the vacuum breaker thereby breaking the vacuum and preventing a siphon from forming. This will ensure that product does not continue to pass through the meter due to the effect of suction, which is not representative of gravity flow. If the vacuum breaker opens due to low pressure in the line, the flow rate will slow until the pressure returns and the vacuum breaker closes. The operator facilitates this by adjusting the flow rate manually and monitoring the vacuum/pressure gauge.

The hose from the gravity-supplied meter should slope down to the pump inlet without high or low spots which can trap air and slope up from the pump outlet to the bottom loading stub of the local standard or prover.

The slow flow test is performed by closing the bottom loading stub valve on the prover until the desired flow rate is achieved. The increased pressure reading on the gauge is then noted. The prover inlet valve is controlled manually to maintain the pressure and thereby keep the flow rate constant for the duration of the test.

A product depletion test (STP-08) is performed in much the same way as for a pump-supplied vehicle-mounted measuring system. After the performance tests are complete, a full local standard is partially emptied into an empty compartment of the tank truck. The test is then started from this partially filled compartment and allowed to continue until the meter comes to a stop from lack of product. The operator then switches to a full compartment to complete the test. This test is performed with the most viscous product and by using the empty compartment furthest away from the gravity-supplied meter.

For tank trucks intended for use with both gravity- and pump-supplied delivery through the same meter, it is not required to test the accuracy of the measuring system by both means of delivery; however, an out of product test is required for both means of delivery.

Interpretation of results

All results must be within the applicable limits of error for the delivery.

Revisions

The purpose of revision 2 was to clarify procedural requirements and update the applicable figures.

The purpose of revision 1 was to add device type 55.10 and 55.11 of device types identified in the title line.