PRODUCT DESCRIPTION

HT-100

Leak Detection System for Bulk and Hydrant Pipelines

The award-winning Vista HT-100 leak detection system for underground bulk pipelines and airport hydrant fueling systems combines high performance with ease of use. The HT-100 is the only U.S.-made system that can compensate for thermally induced changes in fuel volume—the most common cause of error in testing for leaks.

The Vista HT-100 is a volumetric leak detection system for testing underground bulk and hydrant fuel piping (it is certified for use on lines with a capacity of 3400 gallons or more).[1] Its high performance is due to a novel method of compensating for the thermally induced changes in fuel volume that occur during a test. In 1999, *Aviation Week & Space Technology* selected the HT-100 for one of its Annual Technology Innovation Awards.[2]

Benefits

The HT-100 offers many desirable qualities in a single easy-to-use system.

Short Test. An HT-100 test can be completed in 1 hour.

Fully Automated. The HT-100 is a fully automated system that is easily installed and operated. Once a test is initiated, a programmable logic controller governs the system operations.

On-the-Spot Results. A report is automatically generated upon completion of the test.

Owner/Operator Control. The HT-100 test can be run, and its results easily interpreted, by the owner or operator of the pipeline. Tests can be conducted with any desired frequency.

Mobile Option. The HT-100 can be permanently installed and used for on-line monitoring and testing, or it can be mounted in a van and used for tightness testing. The HT-100 system attaches to the line at a single point.

Certified Performance. The performance of the HT-100, in terms of the smallest leak that can be detected with a probability of detection (P_D) of 95% and a probability of false alarm (P_{FA}) of 5%, is 0.0021% of line capacity. If the line contains 9500 gallons, the minimum detectable leak at these probabilities is 0.2 gallons per hour. This performance is certified by an independent third party, Ken Wilcox Associates, Inc.,

1. Lines with capacities less than 3400 gallons can be tested with the LT-100, which is nearly identical to the HT-100, except that the measurement and/or storage cylinders are smaller.
2. See the article in the 10 May 1999 issue, pages 74-80.

which based its evaluation on six months of test results obtained on an operational airport hydrant pipeline containing 300,000 gallons of jet fuel and operating at a pressure of 175 psi. (The evaluation performed by KWA followed all test and reporting procedures required by ASTM and EPA.) The HT-100 has been approved for use in Florida by the Florida Department of Environmental Protection as an alternative to API standard RP 1110 (hydrostatic testing). The HT-100 evaluation is also listed with the National Work Group on Leak Detection Evaluations as being in compliance with EPA protocols.

Description

The HT-100 is a computer-controlled, fully automatic system. All data are acquired and processed electronically. As shown in the schematic diagram at right, the HT-100 sensor unit consists of (1) a measurement cylinder (Tank 1); (2) a storage cylinder (Tank 2); (3) a differential pressure sensor to measure level changes in the measurement cylinder electronically; (4) a pump for transferring fuel from the measurement cylinder or storage cylinder to the line in order to increase line pressure to a specified level; and (5) two pressure relief valves and a bypass valve for removing fuel from the line and adding it to the measurement cylinder or storage cylinder in order to decrease the pressure in the line to a specified level. When combined, the pump and the pressure relief valves can be used to maintain a constant pressure in the line at a specified level. The size of the cylinders is determined by the capacity of the largest pipeline segment that will be tested at a given site.

The storage cylinder is normally used to set or change the overall pressure in the line. (Pressure can also be set or changed with the pressure management system used to operate the line or by adding or removing fuel from a nearby tank, tanker truck, or pipeline.) The measurement cylinder is normally used to maintain constant pressure during a test and to make the volume measurements required during the test. A test can be conducted with the measurement cylinder alone if there is no need for the extra storage capacity that Tank 2 provides. The pump and pressure-relief-valve system are used to adjust and maintain a constant pressure in the line. As shown by the valves on the "ladder," the system can be operated at three pressures: a high pressure, a low pressure, and atmospheric pressure (by means of the bypass valve). The high- and low-pressure relief valves can be set to operate at any desired pressure. Finally, a pressure relief valve and an overfill alarm in each cylinder ensure safe operation of the system.

Installation

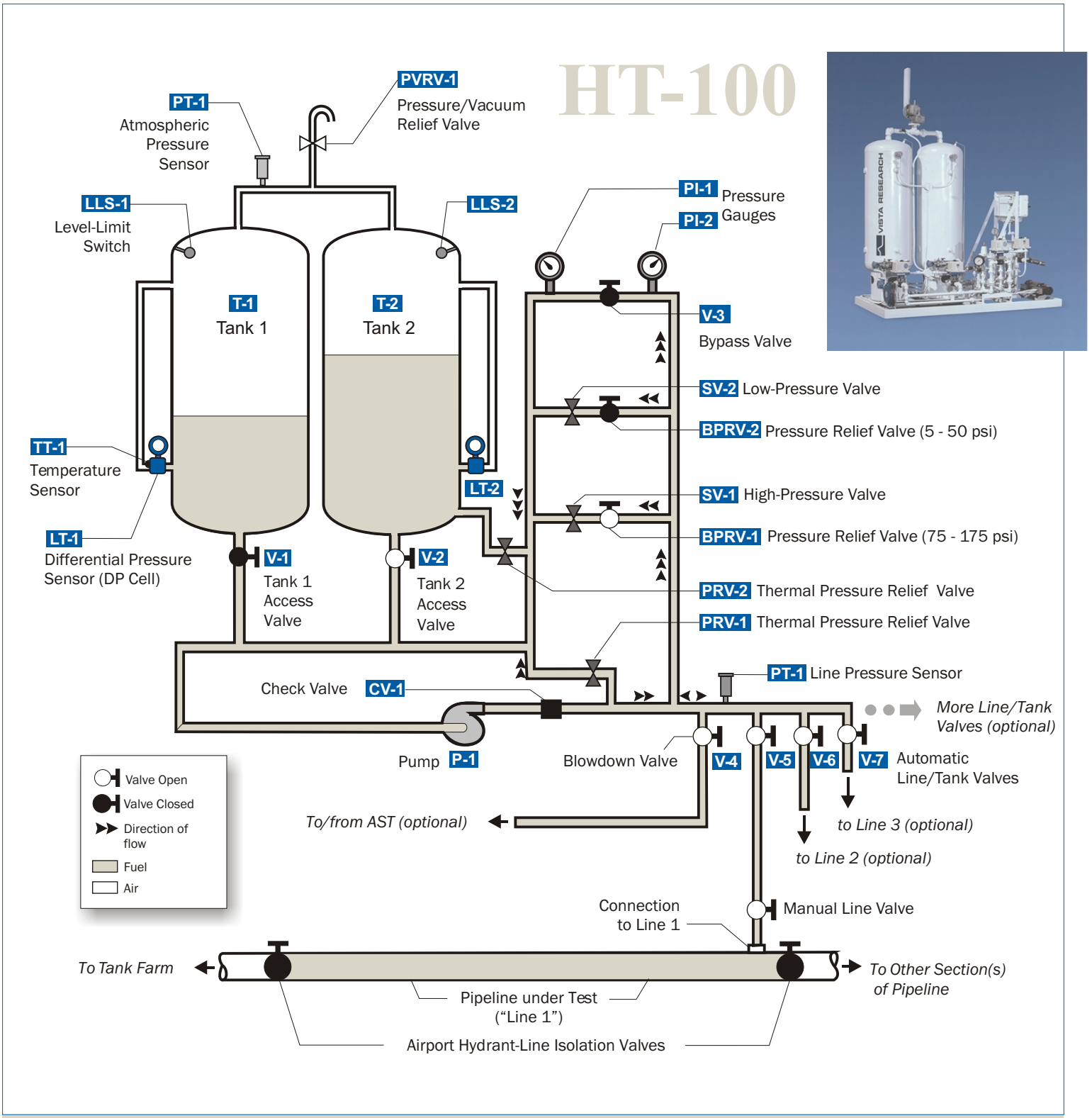
The HT-100 sensor unit is attached to the line at a single location, by means of a valve. Any convenient location along the line will do. The most common point of attachment for the HT-100 is at the fuel farm. The fuel remains in the line during a test, but all transfer operations must be suspended. The line must be completely isolated, by means of valves, from any storage tanks connected to it and from other sections of line not being tested. If the valves used to isolate the line do not seal properly, either a double block and bleed valve or valve blinds must be installed.

Test Duration

An HT-100 test can be completed in 1 hour. The minimum leak rate detectable in this 1-hour test is 0.0021% of the line volume per hour.

Temperature Compensation

The HT-100 compensates for the thermally induced volume changes in the line without using temperature sensors. The compensation removes over 99% of the thermally induced volume changes that would otherwise


HT-100
PT-1
Atmospheric Pressure Sensor
PVRV-1
Pressure/Vacuum Relief Valve
LLS-1
Level-Limit Switch
LLS-2
T-1
Tank 1
T-2
Tank 2
PI-1
PI-2
Pressure Gauges
V-3
Bypass Valve
SV-2 Low-Pressure Valve
BPRV-2 Pressure Relief Valve (5 - 50 psi)
TT-1
Temperature Sensor
LT-2
SV-1 High-Pressure Valve
LT-1
Differential Pressure Sensor (DP Cell)
V-1
Tank 1 Access Valve
V-2
Tank 2 Access Valve
BPRV-1 Pressure Relief Valve (75 - 175 psi)
PRV-2 Thermal Pressure Relief Valve
PRV-1 Thermal Pressure Relief Valve
PT-1 Line Pressure Sensor
More Line/Tank Valves (optional)
Check Valve CV-1
Pump P-1
Blowdown Valve
V-4
V-5
V-6
V-7
Automatic Line/Tank Valves
Valve Open
Valve Closed
Direction of flow
Fuel
Air
To/from AST (optional)
to Line 3 (optional)
to Line 2 (optional)
Connection to Line 1
Manual Line Valve
To Tank Farm
To Other Section(s) of Pipeline
Pipeline under Test ("Line 1")
Airport Hydrant-Line Isolation Valves

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interfere with the detection of small leaks. There are no waiting periods required for thermal stabilization.

The HT-100 compensates for the thermal expansion and contraction of the fuel within the line by measuring volume changes at two different but constant pressures. The higher of the two pressures is usually the *operating pressure* of the line. The lower one is either atmospheric (zero-gauge) pressure or some pressure above zero that is lower than the test pressure. At each pressure, the HT-100 measures the volume of fuel added to or removed from the line to maintain constant pressure and expresses the volume changes as a flow rate in gallons per hour, the quantity of regulatory interest.

At each pressure there are two types of volume changes that might occur. One volume change is due to thermal expansion and/or contraction of the liquid in the line, and the other one is the volume change due to a leak. Compensation is accomplished by differencing the volume changes measured at the high and low pressures in such a way as to address the nonlinear thermal changes in the fuel. The success of this patented compensation algorithm is based on the fact that thermally induced volume changes in the fuel are independent of pressure, while leak-induced volume changes are not. The flow rate due to a leak is larger at the higher pressure than at the lower pressure. If the lower pressure is atmospheric (zero gauge) pressure, then the output of the HT-100 is a direct measurement of the flow rate due to a leak (if one exists). Unlike a pressure test, an HT-100 test can be conducted even when the line includes surge suppressors or trapped vapor.

The HT-100 can be permanently installed on a line (or multiple lines), or it can be mounted in a truck or trailer in order to test lines at different locations.

The performance of the HT-100 can be improved even further, in terms of either a smaller detectable leak rate or a smaller probability of false alarm, when the results of two or more tests are averaged. Averaging four tests, for example, improves performance by a factor of two. The ability to average test results improves the sensitivity and robustness of the measurement and can reduce the cost of leak detection.

System Output

The temperature-compensated volume rate (in gallons per hour) is computed from the volume measurements made at the high and low pressures and is compared to a threshold to determine whether the line passes or fails the test. If the line fails the test, the estimated flow rate is also reported. The output also includes a number of data quality indices that assess the reliability of the result, including one that measures the "goodness" of each and every test. This index is a quantitative estimate (in gallons per hour) of the error in compensating for ambient, thermally induced volume changes during a given test. All the test data are collected and stored electronically for detailed analysis, review, and archiving.