

The G Systems Valve Leak Measurement System: a Case Study

Abstract

The G Systems Valve Leak Measurement System (VLMS) is a self-contained counting instrument for automated leak detection. The VLMS, a new industry standard, practices low-flow leak detection by creating bubble formation using a submerged tube in water. The VLMS provides accurate measurement of leaks that are too small for conventional flow meters to reliably detect. A simple touch-screen operator interface is provided for configuration and control of the low-flow leak detection measurement process. Bubble count, inferred flow rate, elapsed time, and camera images



are provided in real time as the test progresses. All test data including camera video can be stored to file. G Systems also offers customization services in order to interface the VLMS software directly to your database or to provide additional real-time information. The VLMS is compatible with API Standard 527, Seat Tightness of Pressure Relief Valves.

The Challenge

A leading manufacture for large valves needed a more efficient and deterministic method to detect leaks. Off the shelf flow meters are not stable at very low flow rates so valve manufacturers and service technicians rely on the decades-old, industry-accepted practice of counting bubbles formed at the end of a tube submerged in water. This requires a manufacturing line operator to count the number of bubbles that appeared in a specific amount of time in order to quantify the leak rate or verify a zero-leak

requirement. These methods are costly, tedious and prone to human error – especially in the area of low-flow leak detection.

The Solution

G Systems developed a machine vision system to implement the process of counting bubbles from the submerged tube. G Systems developed algorithms to detect and count the formed bubbles. Since a camera identifies the bubbles via automated leak detection, a video can be produced for archiving or even post witnessing the test eliminating the need for customer onsite witnessing of the process when desired. The test is performed for a predefined amount of time and the bubbles are counted during that time. Each bubble is time stamped to measure rate and even acceleration. The test information, time stamp, and bubble count data are superimposed onto the image of the video to validate the test and provide self documentation. This is critical for zero-bubble tests that require no leaks occur through a valve seat over a timed duration. Test information can be included on the display such as customer name, job number, valve type, model, seal material, etc, plus any other user-defined information. All of this information is saved to disk.

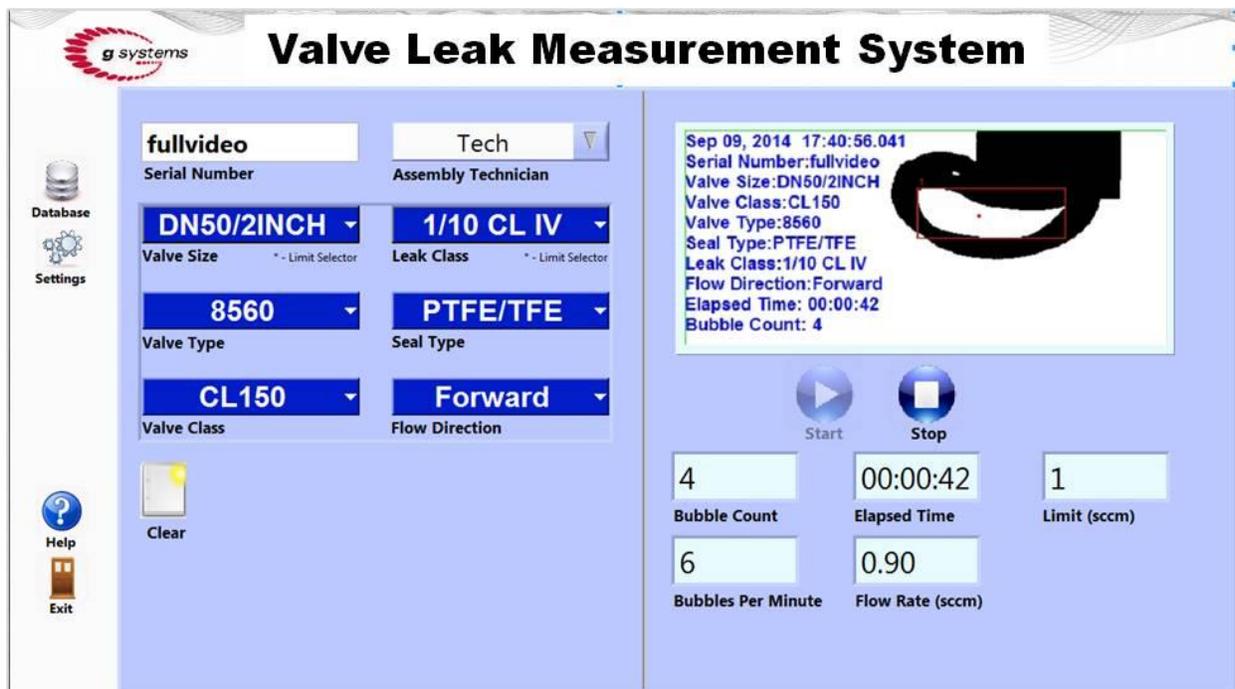


Figure 1. Example VLMS user interface

Benefits of the bubble counting system:

- Reduces operator labor and fatigue
 - eliminates need to continuously observe bubble leak jar
 - ideal for long duration tests
- Better suited than flow meters for detecting low or zero-leak conditions
- Eliminates operator bubble counting errors

- Video record of leak-test results for both zero-leak and low-leak requirements
- Automated leak detection process and data storage eliminates test documentation errors
- Fully integrates with any test fixture and data system - new or existing
- Compatible with API Standard 527, Seat Tightness of Pressure Relief Valves
- Simple touch-screen operation with pick lists for data integrity
- Instills confidence in the consistency and accuracy of the leak detection process

System Hardware

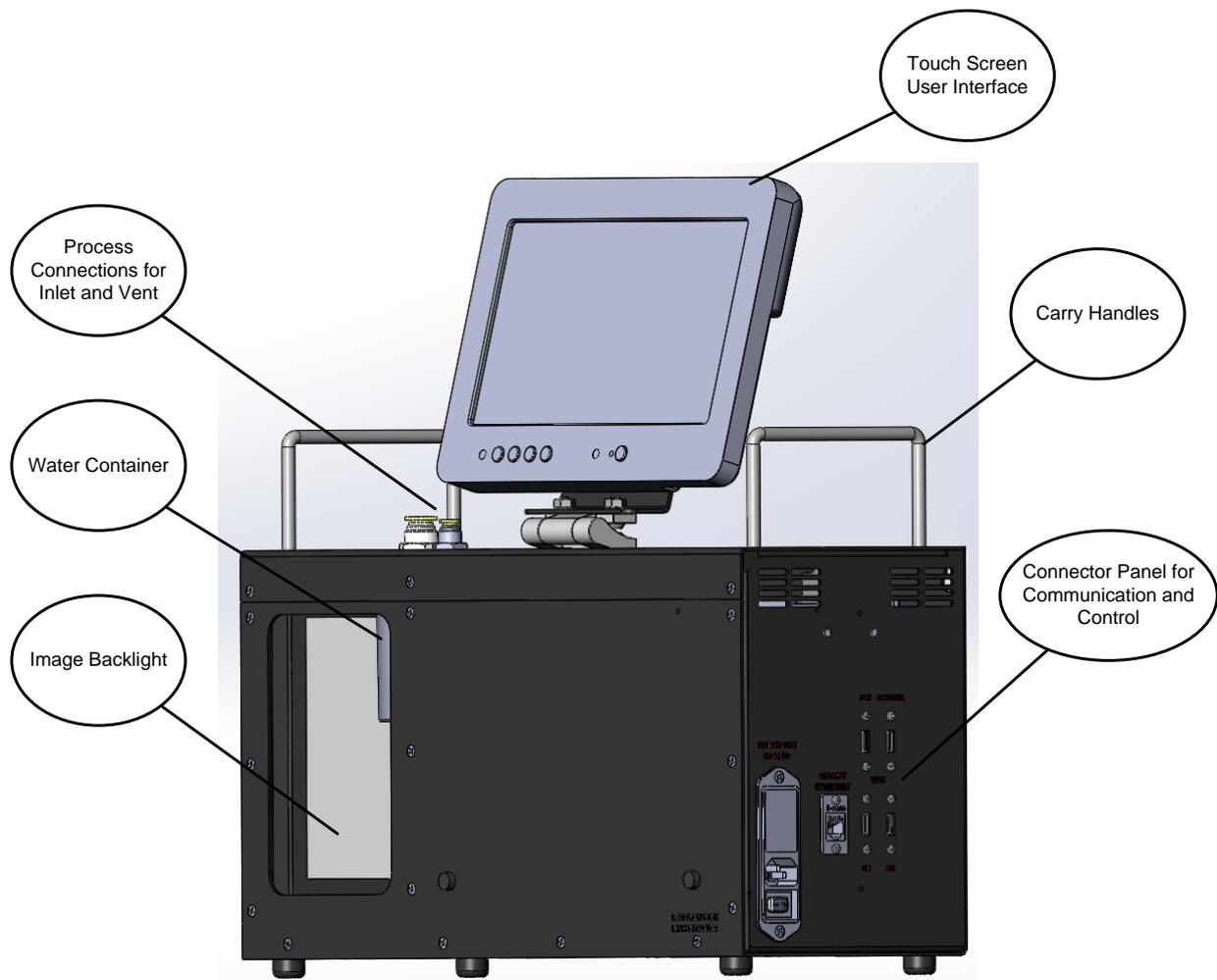


Figure 2: VLMS System Components

The G Systems LDD fully integrates with any new or existing test fixture and data system, and can be wall mounted, installed on a bench-top, or mounted directly on a machine frame. The system includes additional USB ports to connect an external keyboard/mouse (not required), a bar code scanner, or removable storage devices. The G Systems VLMS is compatible with API Standard 527, Seat Tightness of Pressure Relief Valves.

The Low Flow Rate Leak Detector system uses a simple USB 2 camera and a back light. The case provides the mounting for the jar and camera. The jar is placed in view of the camera with a back light to provide the necessary contrast to visually identify the bubbles. An industrial touch screen monitor is included for easy bench interfacing. The screen is mounted on a friction hinge which can be folded down for storage or transportation. For installations requiring full automation with a pressurization test system, the monitor can be removed to save cost. Based on the frame rate of the camera, the number of bubbles that can be reliably counted is up to 200 bubbles per minute (30 SCCM). This can be verified by watching the video frame by frame. The bubbles are time stamped to calculate formation rate and inferred flow rate. The default method of calculation is to measure the total time from the first bubble to the last bubble divided by the total number of bubbles. Another simple calculation can be performed to calculate the acceleration or deceleration of bubble formation. Deceleration would be a good indicator of the seal integrity over time.

Features

The G Systems Low-Flow-Rate Leak Detector provides features that are ideal in the following test phases:

Assembly bench station

A touch screen monitor provides the necessary user interface to enter the test unit information and execute a bubble test without a full test system. This simplifies the number of valves and sensors required at the bench. The unit information can be stored locally or be sent to a server or database.

End of line manufacturing test

Software commands can be sent to the VLMS to start a test and start counting bubbles. The rate is published to the end of line manufacturing software with TCP or serial communication.

Engineer bench station

This unit is ideal for research and development. Log files can be generated to capture the entire bubble rate profile. The unit can also be used for long term testing to determine seal integrity over a period of time.

Field in-situ testing

Valves are often required to be tested in place for leaks to recertify the seal integrity. The VLMS is portable and can easily be used as a field instrument to add reliability and integrity to the manual bubble counting process.

Key Characteristics

- Flow Range 0-200 BPM (0-30 SCCM)
- Display total bubble count/rate/volume
- Display current acceleration

- Measure forward pressure
- Store results to local, server or database
- Store video
- External software control with TCP or Serial
- Analog out, discrete out

Summary

The G Systems VLMS provides accurate, automated leak detection measurement of small leaks and is ideal for applications that must be absolutely airtight, including medical devices, pharmaceutical equipment, and oil, gas and plumbing valves. It reduces operator error and fatigue. A camera opens the doors to measurements that before were never possible including more accurate rates and acceleration. The VLMS can be used from the engineers' lab to the bench and even out in the field. The software can be customized to your company platform and requirements.