Module: 4.4
Dynamic Measuring Systems - General

Overview and Scope

This module sets the standards for basic inspection and testing of dynamic liquid measuring systems, i.e. those that measure the liquid while flowing through the system as opposed to static systems that measure the liquid while at rest. The module is geared toward general measurement concepts related to device technology, operations, and general inspection requirements and test procedures for these devices.

Prerequisites

4.1 Safety Considerations

Learning Objectives

1 Technologies Used in Dynamic Liquid Measuring Systems

A weights and measures inspector should understand the method of operation and the primary technologies used in typical Dynamic Liquid Measuring Systems. To demonstrate this the inspector can:

1.1 Describe the various technologies used to deliver liquid product to the measuring element, including the functions of manifolds, pumps, check valves, and vapor elimination systems.

1.2 Describe the difference between dry hose and wet hose systems.

1.3 Recognize typical measurement technologies used in these systems, such as positive displacement, turbine, mass flow, and magnetic flow meters.

1.4 Recognize typical registration technologies used in these systems, such as mechanical registers and electronic registers.

1.5 Describe the function of temperature compensation devices.

1.6 Identify the metrological components of a measuring system (measuring element, pulser or signal generator, register, operator controls and printer).

1.7 Restate that these systems may be made up of measuring elements/modules and indicator elements/modules.

1.8 Recognize that device performance will vary with flow rate, influences such as product viscosity, temperature, supply voltage, etc, and disturbances such as flow interruption, EMI/RFI, etc.

2 System Markings and Operations

A weights and measures inspector should understand the various marking requirements applicable to a measuring system and demonstrate ability to operate a measuring system. To demonstrate this the inspector can:

2.1 Recognize and interpret required identification markings on a measuring system or element (from various Specification paragraphs in the General and LMD codes).

2.2 Recognize and interpret required markings on the controls, indications and features of a system in this category.

2.3 Operate the following functions/operations on a measuring system.

2.3.1 Zero reset.

2.3.2 Activation controls to start flow.

2.3.3 Flow control valves (at nozzle or outlet).

2.3.4 Ticket printing controls.

2.4 Recognize and interpret the measurement information displayed on a system.

2.5 Demonstrate ability to estimate the actual flow rate of a system using the system indications.

3 Technical Requirements

A weights and measures inspector should understand the various technical requirements applicable to a dynamic liquid measuring system. To demonstrate this the inspector can:

3.1 Apply the rules regarding the following measuring system features/indications and identify where to find them in HB44.

3.1.1 Marking Requirements.

3.1.2 Size of minimum increment of volume indications.

3.1.3 Return to proper zero indication on reset.

3.1.4 Maximum and minimum flow rates for the system.

3.1.5 Maximum and minimum indications of delivery.

3.1.6 Agreement of indications within a system.

3.1.7 Mathematical agreement on computing devices - general.

3.1.8 Vapor elimination devices.

3.1.9 Categories of Sealing, appropriate seals and audit trails.

3.1.10 Flow control and check valves for dry hose systems.

3.1.11 Flow control and check valves for wet hose systems.

3.1.12 Discharge lines and valves.

3.2 Apply the rules for matching measuring elements to indicating elements (modules).

4 User Requirements

A weights and measures inspector should understand the various user requirements applicable to a measuring system. To demonstrate this the inspector can:

4.1 Assess suitability of the device and various components for the intended use.

4.2 Assess whether device is installed correctly.

4.3 Assess whether a device is being used correctly.

4.4 Assess whether the device is being properly maintained (electrical issues, leaks, etc.).

5 Basic Test Procedures

A weights and measures inspector should be able to apply the appropriate performance tests to a measuring system and evaluate compliance the applicable tolerances and performance standards. To demonstrate this the inspector can:

5.1 Determine the appropriate Accuracy Class for the application of the system.

5.2 Use test measures appropriately and care for them when not in use.

5.3 Determine minimum test drafts required for testing a given measuring system.

5.4 Determine what products should be used in the test of a system.

5.5 Describe the difference between normal and special tests and be able to apply the appropriate test tolerance for each test.

5.6 Select appropriate test drafts for normal tests of a given measuring system, perform the appropriate normal tests, and evaluate the test results for compliance with applicable tolerances.

5.7 Select appropriate test drafts and flow rates for a (Normal) Repeatability Test for a given measuring system, perform the test, and evaluate the test results for compliance with applicable tolerances and agreement requirements.

5.8 Select appropriate test drafts for special tests for a given measuring system, perform the appropriate special tests, and evaluate the test results for compliance with applicable tolerances.

5.9 Conduct appropriate performance tests to evaluate that required devices within the system are working correctly and are functioning within tolerance (air elimination, check valves, zero reset, etc).

5.10 Describe the difference between "delivery error" and "meter error," and, given appropriate test data, determine the correct values for either type of error expressed either in volume units or in percent.

5.11 Perform necessary calculations to correct observed prover volume to actual prover volume at the prover temperature (or at the prover temperature and pressure for closed systems). Also correct the corrected prover volume at the prover temperature to volume at another temperature (i.e. average meter temperature for gross calculations or reference temperature for net).

Contributors:

Initial Draft (Ross Andersen, New York);11/4/2013 Added Influences (Ross Andersen); 7/7/2014 Fix to User Requirements; 5/1/2015 added prover calculations