

LPG Liquid-Measuring Devices Part 2: Inspection

NIST Weights and
Measures Division

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Inspection - Overview

- General Considerations
- Indicating/Recording Elements
- Measuring Elements
- Marking
- Piping

Inspection

- Determine compliance with specs & other requirements (design, installation, operation)
- Not limited to visual examination.....may need to verify through test or other determination
- Extent & emphasis of inspection depends on:
 - familiarity with the device
 - age of device
 - whether or not device NTEP approved
 - whether or not complaint was received

Indicating and Recording Elements - Analog vs. Digital Types

- **analog type.** A system of indication or recording in which values are presented as a series of graduations in combination with an indicator, or in which the most sensitive element of an indicating system moves continuously during the operation of the device.
- **digital type.** A system of indication or recording of the selector type or one that advances intermittently in which all values are presented digitally, or in numbers. In a digital indicating or recording element, or in digital representation, there are no graduations.

General Considerations – Selection

- Design and construction of device ensure accuracy and operation as intended
- Device must be suitable for application
 - Volume Indications of sufficient capacity
 - Flow rate
 - Price computing capability is adequate
 - Environment in which it is used
- Minimum delivery no less than 10 divisions for analog devices
- Minimum delivery no less than 100 divisions for other devices
 - For example, 100 d on a 0.1 gal device is 10 gallons
- H44 Code References: G-S.3., G-UR.1.1., G-UR.1.2., G-UR.1.3.

General – Use and Maintenance

- Equipment operated in manner indicated by construction or instructions on equipment
 - Some features may require instructions/markings
 - Product/payment selectors, self-pay devices (key, card, cash)
- Owner required to maintain equipment in proper operating condition
- Owner cannot take advantage of tolerances
 - Equipment cannot be in error predominantly in a direction favorable to owner (e.g., in “minus” direction)
 - Also need to consider past history
 - Some jurisdictions have specific policies to address this

General – Installation

- Installed according to manufacturer's instructions
 - Maximum discharge rate not in excess of rated maximum
- Performance not affected by installation
- Installed such that markings are readily observable
- No obstruction between primary elements and device
- Installation rigid and secure
- Device and associated equipment and installation do not facilitate fraud

H44 Code References: G-S.2., G-UR.2.1., G-UR.2.2., UR.1.1.

General – Accessibility & Assistance

● Access

- Access to meters, printers, consoles, associated equipment
- Access to apply security seals & check audit trail info
- Access to device with your test equipment
- Access to electricity & product return
- Transportation to remote locations
- Devices brought to central location

● Assistance

- Operator for metering system
 - Avoid liability for damage
- Some steps such as positioning prover may require 2 people

General Considerations – Testing Devices at Central Location

- Devices which are routinely transported for the purpose of use (e.g., vehicle-mounted devices and devices used in multiple locations)
- Official may require devices to be brought to a central location for testing
 - Dealer or owner shall provide transportation of the devices to and from the test location.

H44 Code References: G-UR.4.6.(a)

Indicating and Recording Elements

- Design (S.1.1.)
 - Device equipped with primary indicator
 - Device may be equipped with primary recording element
- Ticket Printer (UR.2.6.)
 - Applies only in **vehicle-mounted** applications
 - Became retroactive 1/1/94
 - applies to new **and** existing installations
 - Requires ticket printer
 - Printer used for all sales
 - Ticket must be left with customer

Indicating and Recording Elements - Design

- Value of Smallest Unit (S.1.1.3.)
 - Shall not exceed:
 - One pint on retail
 - Note: 1 pint = 0.125 gallon
 - One gallon on wholesale
 - Minimizes effects of rounding on delivery size
 - On analog device, smallest unit = smallest graduation on right-hand wheel
 - On a digital device, the smallest unit is the smallest change in quantity that can be indicated

H44 Code References: S.1.1.3.

Indicating and Recording Elements - Readability

- General (G-S.5.1.)
 - Elements appropriate in design & adequate in amount
 - Easy to read & understand in any condition of normal service
- Graduations, Indications, Recorded Representations (G-S.5.2.)
 - Graduations and units uniform in size
 - Subordinate values appropriately designated
 - Values defined by words, symbols (e.g., gallons, liters, \$)
 - Graduations and defining figures not easily obliterated

H44 Code Reference: G-S.5.

Indicating and Recording Elements

S.1.2. Graduations.

S.1.2.1. Length.

S.1.2.2. Width.

S.1.2.3. Clear Interval
Between Graduations.

→ Not practical to check in field

S.1.3. Indicators.

S.1.3.1. Symmetry.

S.1.3.2. Length.

S.1.3.3. Width.

S.1.3.4. Clearance.

S.1.3.5. Parallax.

H44 Code Reference: S.1.2, S.1.3

Indicating and Recording Elements - Readability

- Position of Equipment (G-UR.3.3.)
 - Must be such that weighing or measuring operation can be observed . . .
 - From some **reasonable** customer position and
 - From some **reasonable** operator position
 - Use your judgment...put yourself in the customer's and operator's positions

Indicating and Recording Elements – Unit Price and Product Identity

- Unit price and product identity (S.1.5.1.)
 - Stationary retail computing devices only
 - Means to display on device:
 - unit price
 - identity of product on each side
 - blend or grade (if able to dispense more than one grade or blend being dispensed)

Indicating & Recording Elements – Advancement and Return to Zero

- Prevents manipulation prior to reaching zero
- Advancement only by mechanical operation of device
- But can be cleared by advancing only if:
 - Once started, cannot stop until zero is reached or
 - For indicating elements, elements are obscured until zero is reached
 - e.g., shutters, analog, blanking, etc.
- Primary indicating elements and recording elements, when these are returnable to zero, shall be returned to zero before each delivery.

H44 Code Reference: S.1.1.4., S.1.4.1., S.1.4.2., S.1.6.1.

Indicating and Recording Elements – Provision for Sealing

- Provision for Sealing, Electronic (G-S.8., 1/1/90)
 - Requires device to be designed with provision to apply security seal
 - Physical seal or other approved means (e.g., audit trail)
 - Seal protects against metrological changes
- Security Seal (G-UR.4.5.)
 - Security seal must be affixed to adjustment mechanism designed to be sealed

Measuring Elements – Vapor Elimination

- Vapor Elimination (S.2.1.)
 - Device shall be equipped with an effective vapor eliminator or other effective means to prevent the passage of vapor through the meter
- Maintenance of Liquid State (S.2.4.)
 - Device shall be so designed and installed that the product being measured will remain in a liquid state during the passage through the meter

Measuring Elements – Security Seals

- Provision for Sealing (S.2.2.)
 - Provision for approved means of security on:
 - Measurement element
 - Adjustable element for controlling delivery rates when rates affect accuracy
 - Adjusting mechanism readily accessible
 - Audit trails as specified in LMD Code Table S.2.2.
- Automatic Temperature Compensator (ATC) (S.2.6.2.)
 - Provision made for sealing ATC to prevent deactivation

Provision for Sealing – Table S.2.2. (1/1/95)

- Category 1:
 - No remote configuration
 - **Sealing:**
 - Physical seal or two event counters
- Category 2:
 - Remote configuration, but access controlled by hardware
 - Only for devices manufactured prior to 1/1/05
 - **Sealing:**
 - Physical seal on hardware or two event counters
 - Clear indication when in calibration mode
 - If counters are at system controller, means to generate hard copy of information through on-site device (1/1/96)

Provision for Sealing – Table S.2.2. (1/1/95)

- **Category 3:**
 - Remote configuration, access unlimited or controlled through software switch
 - **Sealing:**
 - Event logger required
 - Clear indication when in calibration mode (1/1/01)
 - Printed copy of information available through device or another on-site device
- **Note:** As of 2005, all devices with remote configuration must meet Category 3.

Measuring Elements

- Thermometer well (S.2.5.)
 - Means shall be provided to determine the temperature of the liquid either:
 - in the liquid chamber of the meter, or
 - in the meter inlet or discharge line and immediately adjacent to the meter.
- Automatic temperature compensation (S.2.6., UR.2.4.)
 - Device may be equipped with automatic temperature compensator (S.2.6.)
 - NIST Handbook 130 requires ATC on meters with greater than 20 gpm rated maximum
 - Provision must be provided for deactivating (S.2.6.1.)
 - Compensator in use and activated at all times (UR.2.4.)
 - May only be deactivated with permission from W&M

Marking

- Devices marked clearly and permanently
 - Riveted metal badge or pressure-sensitive material
- Markings required:
 - Mfg/distributor name
 - Model
 - Preface identifying model number (NR 1/1/03)
 - Serial number (NR 1/1/68) (except software-based devices)
 - Software version, on not-built-for purpose software-based (1/1/04)
 - Preface identifying serial number (NR 1/1/86)
 - NTEP Certificate of Conformance Number, if applicable (NR 1/1/03)
 - Remanufacturer information on remanufactured devices (1/1/02)

H44 Code References: G-S.1., G-S.1.1. (1/1/04), G-S.1.2. (1/1/02), G-UR.2.1.1., G-UR.3.4.

Marking

- G-S.6. Marking Operational Controls, Indications, Features (NR 1/1/77)
 - Controls, features clearly identified
 - Pictograms acceptable
- G-S.7. Lettering
 - Required markings distinct & easy to read
 - Not easily obliterated

Marking

- **Limitation of Use** (S.4.1.)
 - If device designed to operate with only specific liquids, must be marked accordingly
- **Discharge Rate** (S.4.2.)
 - Minimum and maximum flow rates must be marked
 - Minimum not greater than 5 gpm for stationary retail
 - Minimum not greater than 20% of maximum for all other devices
- **Temperature Compensated** (S.4.3.)
 - Device with ATC must be marked to show indications are corrected to 60 degrees F
 - Printed indications must also be marked

Piping – Discharge Line and Valves

- Directional Flow Valve (S-2.3.)
 - Valve or other automatic means provided to prevent reversal of flow
- Diversion of Measured Liquid (S.3.1.)
 - No means for diverting measured liquid
 - Two delivery outlets permitted, provided:
 - Liquid can only flow from one outlet at a time, and
 - Direction of flow clearly indicated
 - Manually-controlled outlet for service permitted, but must have provision for sealing

Piping – Discharge Line and Valves

- Delivery hose (S.3.2.)
 - “Wet-hose” type, full of product at all times
 - Shut off at outlet end
- Length of Discharge Hose (UR.1.2.)
 - No greater than 18 ft for stationary retail devices
 - Exceptions made if need can be demonstrated
- Condition of Discharge Hose (UR.2.2.)
 - Must be completely filled with liquid before “zero”
- Facilitation of fraud (G-S.2)
 - Equipment of design so as not to facilitate fraud

Piping – Discharge Line and Valves

- Vapor Return Line (UR.2.3.)
 - No vapor return line permitted between metering system and receiving tank during metered delivery
 - Vapor in the receiving tank belongs to customer
 - Spray fill tank design enables efficient delivery
 - Promotes condensation and reduces pressure
 - Used in testing -- allows vapor initially in prover to be pushed back into system tank
 - If vapor in prover were to remain, pressure from incoming liquid would cause condensation
 - Necessary for testing; not possible to determine amount of product resulting from vapor condensation
 - Reduces pressure

Part 1: Inspection - Summary

- **Indicating/Recording Elements**

- Design
- Readability
- Ticket Printer (Vehicle-Mounted)
- Unit Price & Product Identity
- Advancement & Return to Zero
- Provision for Sealing

- **Measuring Elements**

- Vapor Elimination
- Security Seals
- Thermometer Well
- Automatic Temperature Compensation

Part 1: Inspection - Summary (cont.)

- **Marking**
- **Piping**
 - Discharge Line & Valves
 - Facilitation of Fraud
- **General Considerations**
 - Selection
 - Use & Maintenance
 - Installation
 - Accessibility
 - Assistance
 - Testing Devices at a Central Location