



# **Examination Procedure Outlines (EPOs) for Commercial Weighing and Measuring Devices**

## **EPO No. 26**

Liquefied Petroleum Gas (LPG)

Liquid-Measuring Systems

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**EPO No. 26**  
**NIST Examination Procedure Outline (EPO) for**  
**Liquefied Petroleum Gas (LPG) Liquid-Measuring Systems**

**1. Scope.**

It is recommended that this outline be followed as minimum criteria for examining all LPG liquid-measuring systems. Nonretroactive requirements are followed by the applicable date in parentheses.

**2. Safety Notes.**

When excerpting this Examination Procedure Outline for duplication, the EPO Safety Annex (Safety Considerations and Glossary of Safety Key Phrases) should be duplicated and included with this outline.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

*Prior to beginning any inspection, the inspector should read and be familiar with the EPO Safety Annex - "Safety Considerations and Glossary of Safety Key Phrases," including the introductory section on safety found at the beginning of this annex. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of the terms and key phrases in each safety reminder of this outline are found in the glossary of the EPO Safety Annex.*

- **Bonding**
- **Clothing**
- **Electrical Hazards**
- **Emergency Procedures**
- **Eye Protection**
- **Fire Extinguisher**
- **First Aid Kit**
- **Ignition Sources**
- **Lifting**
- **Location**
- **Nature of Product**
- **Obstructions and Overhead Hazards**
- **Personal Protection Equipment**
  - e.g., Barrier Cream, Eye Protection, Gloves, Hard Hat, Safety Aprons, Safety Shoes, etc. as deemed necessary
- **Safety Cones/Warning Signs**
- **Safety Data Sheets (SDS)**
- **Static Discharge**
- **Support – for prover**

- **Traffic**
- **Transportation of Equipment**
- **Weather**

*Also:*

- **Chemicals**
- **Hazardous Materials**
- **Petroleum Products**
- **Wet/Slick Conditions**

**SAFETY REMINDER!!!**

- **Check the inspection site carefully for safety hazards and take appropriate precautions.**
- **Pay particular attention to the condition of the product storage tank and valves.**
- **Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product. Don't forget to chock the wheels of the prover.**
- **Learn the nature of hazardous products used at or near the inspection site, and obtain and read copies of SDSs.**
- **Know emergency procedures and the location and operation of fire extinguishers and emergency shut offs.**
- **Be sure that a constant supply of water is available for cooling tanks in an emergency.**
- **Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.**
- **Use caution moving around in wet, slippery areas and in climbing on prover, storage tanks, and vehicles.**
- **Use personal protection equipment and clothing appropriate for the inspection site.**
- **If leaks, spills, or exposed wiring cause hazardous testing conditions it is recommended the testing be discontinued until the unsafe conditions are corrected.**
- **Be sure a first aid kit is available and that the kit is appropriate for the type of inspection activity.**

### **3. Inspection.**

**NOTE:** Code references used throughout the document are drawn from NIST Handbook (HB) 44 General Code (Section 1.10) and Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices Code (Section 3.32). The relevant code section(s) is cited by its numerical designation and the applicable requirement(s) from that code section is identified by letter-number designation only. The code section and paragraph designation(s) are then shown immediately after the corresponding line item or task listed in the procedure. For example, NIST HB 44 General Code (Section 1.10) is designated as "1.10:" followed by the paragraph designation(s) relevant to the line item. Nonretroactive requirements are followed by the applicable date in parentheses.

### **3.1. Accessibility and Assistance in Inspecting, Testing, and Sealing.**

#### **3.1.1. The device must be readily accessible for purposes of testing.**

*Code Reference:* 1.10: G-UR.2.3., G-UR.4.4.

#### **3.1.2. Assistance shall be provided by the firm if needed.**

*Code Reference:* 1.10: G-UR.4.4.

#### **3.1.3. Testing Devices at a Central Location.**

*Code Reference:* 1.10: G-UR.4.6.(a).

### **3.2. Selection and Suitability.**

#### **3.2.1. Selection and Suitability, General.**

The device must be suitable for the service in which it is used with respect to the elements of design, including flow rate, computing capability, the details of its indicating and recording elements, and the value of its smallest unit and unit prices.

*Code Reference:* 1.10: G-UR.1.1., G-UR.1.2., 3.32: UR.1.1., UR.1.2.

#### **3.2.2. Minimum Delivery Required.**

*Code Reference:* 1.10: G-UR.1.3.

#### **3.2.3. Computing Capability.**

*Code Reference:* 3.32: S.1.5.

Computing devices used in an application when a product or grade is offered for sale at more than one unit price shall only be used for sales for which the device computes and displays the sales price for the selected transactions.

*Code Reference:* 3.32: UR.2.7.2.

Fleet sales and other price contract sales are exempt from this requirement.

*Code Reference:* 3.32: UR.2.7.2.(a).

A truck stop dispenser used exclusively for refueling trucks is exempt from this requirement provided:

- all purchases are accompanied by a recorded representation of the transaction with the required information specified in UR.2.7.2.(b)(1); and
- unless the dispenser complies with S.1.5.1. Display of Unit Price and Product Identity, the posted unit price and the unit price at which the dispenser is set to compute shall be the highest price for any transaction which may be conducted.

*Code Reference:* 3.32: UR.2.7.2.(b)(2).

A dispenser used in an application where a post-delivery discount is offered is exempt, provided the unit price on the dispenser and the recorded representation are the highest for any transaction and purchases are accompanied by a recorded representation with the required information specified in UR.2.7.2.(c)(2).

*Code Reference:* 3.32: UR.2.7.2.(c).

**3.2.4. Discharge Hose, Length, Stationary Motor-Fuel Device.**

*Code Reference:* 3.32: UR.1.2.

**3.2.5. Discharge Hose, Fill.**

*Code Reference:* 3.32: UR.2.2.

The discharge hose shall be completely filled with liquid before the “zero” condition is established prior to the start of a commercial delivery. Note also that the primary indicating elements and primary recording elements (when returnable) shall be returned to zero before each delivery.

*Code Reference:* 3.32: UR.2.2., UR.2.1.

**3.2.6. Environment.**

The device shall be suitable for use in the environment in which it is installed and used.

*Code Reference:* 1.10: G-UR.1.2.

**3.2.7. Permanence.**

*Code Reference:* 1.10: G-S.3.

**3.3. Installation.****3.3.1. Installation Shall Not Facilitate Fraud.**

*Code Reference:* 1.10: G-S.2.

**3.3.2. Diversion of Measured Product.**

Examine discharge lines and valves to ensure the system is installed such that measured liquid cannot be diverted. (See also “Discharge Lines and Valves.”)

*Code Reference:* 1.10: G-S.2., 3.32: S.3.1.

**3.3.3. Installed in Accordance with Manufacturer’s Instructions.**

*Code Reference:* 1.10: G-UR.2.1.

A device installed in a fixed location shall be installed so that neither its operation nor its performance will be adversely affected by any characteristic of the foundation, supports, or any other detail of the installation.

*Code Reference:* 1.10: G-UR.2.1.

**3.3.4. Discharge Rate.**

A device shall be installed such that the actual maximum discharge rate will not exceed the marked maximum discharge rate. Automatic means for regulating the flow shall be incorporated into the system if necessary.

*Code Reference:* 3.32: UR.1.1.

**3.3.5. No Obstruction Between Indicating and Recording Elements.**

The device shall be installed so that there is no obstruction between a primary indicating element or recording element and the measuring element. Otherwise, there shall be convenient and permanently installed means for direct oral or visual communication between an individual located at the primary element and an individual located at the measuring element.

*Code Reference:* 1.10: G-UR.2.2.

**3.3.5.1. Visibility of Markings.**

*Code Reference:* 1.10: G-UR.2.1.1.

**3.3.5.2. Position of Equipment.**

A device or system equipped with a primary indicating element and used in direct sales shall be positioned so that its indications may be accurately read and the measuring operation may be observed from some reasonable “customer” and “operator” position. The positioning shall be determined on a case-by-case basis, considering the individual circumstances, including the size and character of the indicating element.

*Code Reference:* 1.10: G-UR.3.3.

**3.4. Use.****3.4.1. Facilitation of Fraud.**

*Code Reference:* 1.10: G-S.2.

**3.4.2. Method of Operation.**

The device and any associated equipment are to be operated and maintained as intended by the manufacturer.

*Code Reference:* 1.10: G-UR.3.1., G-UR.4.1.

**3.4.3. Operation of Associated and Nonassociated Equipment.**

*Code Reference:* 1.10: G-UR.3.2.

**3.4.4. Return of Indicating and Recording Elements to Zero.**

The primary indicating elements and primary recording elements (when returnable) shall be returned to zero before each delivery.

*Code Reference:* 3.32: UR.2.1.

Electronic stationary retail motor-fuel dispensers. On/off mechanism and zero-set-back interlock engaged after delivery and the dispenser nozzle returned to its designed hanging position.

*Code Reference:* 3.32: S.2.5.2. (1/1/17), UR.2.1.

**3.4.5. Computing Capability, Stationary Retail Computing-Type Devices Installed After 1/1/17.**

*Code Reference:* 3.32: UR.2.7.2.

**3.4.6. Recorded Representation of the Sale Provided the Customer.**

*Code Reference:* 3.32: UR.2.6.

- Vehicle-mounted metering systems shall be equipped with a means to record all sales where product is delivered through the meter and shall comply with G-S.5.6. Recorded Representations.
- A copy of the recorded representation issue by the device shall be left with the customer at the time of delivery unless otherwise specified by the customer.

**3.4.7. Ticket in Printing Device.**

*Code Reference:* 3.32: UR.2.5.

**3.4.8. Use of Automatic Temperature Compensation (ATC).**

*Code Reference:* 3.32: S.2.8.

**3.5. Maintenance.****3.5.1. Maintained in Proper Operating Condition.**

The device and any associated equipment are to be maintained in proper operating condition.

*Code Reference:* 1.10: G-UR.4.1.

**3.5.2. Abnormal Performance.**

*Code Reference:* 1.10: G-UR.4.2.

**3.5.3. Errors Not in Favor of the Device Owner.**

*Code Reference:* 1.10: G-UR.4.1.

Adjustments not used to compensate for worn or faulty parts and made to bring errors as close to zero value as practicable.

*Code Reference:* 1.10: G-UR.4.3.

**3.6. Indicating and Recording Elements.****3.6.1. Design.**

*Code Reference:* 3.32: S.1.1.1., S.2.4.

**3.6.2. Units.**

*Code Reference:* 3.32: S.1.1.2.

**3.6.2.1. Value of Smallest Unit.**

- Shall not exceed 0.5 L (1 pint) on retail devices.  
*Code Reference:* 3.32: S.1.1.3.(a).
- Shall not exceed 5 L (1 gal) on wholesale devices.  
*Code Reference:* 3.32: S.1.1.3.(b).

**3.6.3. Readability.**

*Code Reference:* 1.10: G-S.5., G-S.6. (1/1/77), G-S.7., 3.32: S.1.2., S.1.3.

- Indicating and recording elements must be clear, definite, and easily read.  
*Code Reference:* 1.10: G-S.5., 3.32: S.1.2., S.1.3.
- Required markings shall be distinct, easily readable, and of a permanent nature.  
*Code Reference:* 1.10: G-S.6. (1/1/77), G-S.7.

**3.6.4. Values of Intervals.**

Values of the graduated intervals must be uniform throughout the series of indicating elements or, if equipped, recording elements.

*Code Reference:* 1.10: G-S.5.3.

For devices indicating or recording in more than one unit, the values must be appropriately identified.

**Code Reference:** 1.10: G-S.5.3.1.

### **3.6.5. Indication of Delivery, Retail Devices.**

**Code Reference:** 3.32: S.1.4.1. (portions Nonretroactive 2006).

### **3.6.6. Computing-Type Devices.**

#### **3.6.6.1. Money-Value Computations.**

**Code Reference:** 3.32: S.1.5.2.

#### **3.6.6.2. Money-Value Divisions.**

- Analog.  
**Code Reference:** 3.32: S.1.5.2.1.
- Digital.  
**Code Reference:** 3.32: S.1.5.2.2.
- Auxiliary indications.  
**Code Reference:** 3.32: S.1.5.2.3. (1/1/85).

#### **3.6.6.3. Unit Price and Product Identity.**

Display of unit price and product identity, stationary retail devices only.

**Code Reference:** 3.32: S.1.5.1. (portions Nonretroactive 2016), UR.2.7.1. (1/1/17)

### **3.6.7. Advancement and Return to Zero of Indicating and Recording Elements.**

It shall not be possible to advance primary indicating and recording elements except by mechanical operation of the device.

**Code Reference:** 3.32: S.1.1.4.

Indicating and recording elements may only be advanced to zero by the mechanical operation of the device, UNLESS:

**Code Reference:** 3.32: S.1.1.4.

- a. Advancement cannot be stopped until zero is reached, OR
- b. The indicating elements are automatically obscured until the elements reach a correct zero position.

#### **3.6.7.1. Return to Zero, Retail Devices.**

**Code Reference:** 3.32: S.1.4.2.

Primary indicating and primary recording elements, when these are returnable to zero, shall be returned to zero immediately before each delivery is begun and after the pump has been activated and the product to be measured has been supplied to the measuring system.

**Code Reference:** 3.32: UR.2.1.

A ticket shall not be inserted into the ticket printer until indications that are resettable to zero have been returned to zero as described above.

**Code Reference:** 3.32: UR.2.1., UR.2.5.

### **3.6.8. Recorded Representations.**

#### **3.6.8.1. General.**

*Code Reference:* 1.10: G-S.5.6., 3.32: S.1.1.6.

#### **3.6.8.2. Vehicle-Mounted Systems Shall Be Equipped with a Primary Recording Element.**

*Code Reference:* 3.32: S.1.1.1., UR.2.5., UR.2.6.

#### **3.6.8.3. Point-of-Sale Systems.**

*Code Reference:* 3.32: S.1.5.4.

#### **3.6.8.4. Post-Delivery Discounts.**

*Code Reference:* 3.32: S.1.5.5.

#### **3.6.8.5. Travel of Indicator, Wholesale Devices.**

*Code Reference:* 3.32: S.1.6.1.

### **3.7. Provision for Sealing.**

#### **3.7.1. Sealing, General.**

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:

- any measuring or indicating element;
- any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries; and
- any metrological parameter that will affect the metrological integrity of the device or system.

*Code Reference:* 1.10: G-S.8. (1/1/90), 3.32: S.2.2., Table S.2.2. (1/1/95), S.2.8.2.

#### **3.7.2. A metrologically-significant software change is a sealable event.**

*Code Reference:* 1.10: G-S.9.

#### **3.7.3. Physical Means of Security.**

For devices designed with a physical means of security, check for:

##### **3.7.3.1. Accessibility of the Adjusting Mechanism.**

When applicable, the adjusting mechanism shall be readily accessible for the purpose of affixing a security seal.

*Code Reference:* 3.32: S.2.2.

The device shall be installed and located such that access is provided to permit inspecting and applying security seals.

*Code Reference:* 1.10: G-UR.2.3.

**3.7.3.2. Presence of Security Seals.** Check for the presence of security seals on the device. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Document missing seals on the official report and apply new seals as needed.

*Code Reference:* 1.10: G-UR.4.5., 3.32: S.2.2.

### **3.7.4. Provisions for Sealing ATC (for systems equipped with ATC).**

*Code Reference:* 3.32: S.2.8.2.

### **3.7.5. Audit Trails, General.**

#### **3.7.5.1. Audit Trails, Format.**

For devices using an audit trail(s) as a means of security, the audit trail(s) shall use the format set forth in Table S.2.2. Categories of Device and Methods of Sealing.

*Code Reference:* 1.10: G-S.8. (1/1/90), 3.32: S.2.2., Table S.2.2. (1/1/95).

#### **3.7.5.2. Audit Trail Information – Review and Document.**

If the system is equipped with an audit trail, note the event counter settings on the report form for future reference. If equipped with an event logger, a printed copy of the information shall be available on demand through the device or through another on-site device at the time of the inspection. Print a copy of the event log and attach it to the report form for future reference. Note that on some systems an electronic copy of the event log may also be available; however, the system must still be able to provide a hard copy. Examine these records for any signs of misuse of adjustments.

*Code Reference:* 1.10: G-S.8. (1/1/90), 3.32: S.2.2., Table S.2.2. (1/1/95).

#### **3.7.5.3. Event Logger.**

If security is provided using an event logger, the event logger shall include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter.

The event logger information shall be available on demand at the time of inspection through the device or through another on-site device. In addition to providing a printed copy of the information, the information may be made available electronically.

The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)

*Code Reference:* 3.32: S.2.2., Table S.2.2. (1/1/95).

### **3.7.6. Single Provision for Sealing Multiple Elements.**

For multiple measuring elements with a single provision for sealing, a change to the adjustment of any measuring element must be individually identified.

*Code Reference:* 1.10: G-S.8.1. (1/1/10).

### **3.7.7. Parameters Accessed Via Removable Digital Storage.**

For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device\*, such as a secure digital (SD) card, USB flash drive, etc., security shall be provided for those parameters using either: (1) an event logger in the device; or (2) a physical seal that must be broken in order to remove the digital storage device from the device (or system).

\* This applies only to removable digital storage devices that must remain in the device or system for it to be operational.

*Code Reference:* 1.10: G-S.8.2., 3.32: S.2.2., Table S.2.2. (1/1/95).

### 3.8. Marking.

#### 3.8.1. General.

*Code Reference:* 1.10: G-S.1.

**3.8.1.1. Clear and Permanent Marking.** Equipment shall be clearly and permanently marked for the purposes of identification.

*Code Reference:* 1.10: G-S.1.

**3.8.1.2. Visibility of G-S.1. Marking Information.** The required information shall be located so that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device. However, the use of a dispenser key or tool to access internal G-S.1. marking information is permitted for retail liquid-measuring devices.

*Code Reference:* 1.10: G-S.1., 3.32: S.4.3. (1/1/03).

#### 3.8.2. Identification.

*Code Reference:* 1.10: G-S.1.

**3.8.2.1. Name, Initials, or Trademark of Manufacturer or Distributor.**

*Code Reference:* 1.10: G-S.1.(a) Retroactive.

**3.8.2.2. Model Designation.**

*Code Reference:* 1.10: G-S.1.(b).

**3.8.2.2.1. Model Identifier Prefix and Acceptable Abbreviations for “Model” and “Number.”**

*Code Reference:* 1.10: G-S.1.(b)(1) (1/1/03).

**3.8.2.3. Nonrepetitive Serial Number.**

*Code Reference:* 1.10: G-S.1.(c) (1/1/68).

**3.8.2.3.1. Serial Number Identifier Prefix.**

*Code Reference:* 1.10: G-S.1.(c)(1) (1/1/86).

**3.8.2.3.2. Acceptable Abbreviations for “Serial” and “Number”.**

*Code Reference:* 1.10: G-S.1.(c)(2) (1/1/01).

#### 3.8.3. Software Version or Revision Identifier.

**3.8.3.1. Software Version or Revision Identifier for Not-Built-For-Purpose Software-Based Devices.**

*Code Reference:* 1.10: G-S.1.(d) (1/1/04).

**3.8.3.2. Software Version or Revision Identifier for All Software-Based Devices.**

*Code Reference:* 1.10: G-S.1.(d) (1/1/22).

**3.8.3.3. Software Version or Revision Identifier Preface.**

*Code Reference:* 1.10: G-S.1.(d)(1)(i) (1/1/07).

**3.8.3.4. Software Version or Revision Identifier is continuously displayed or accessible via the display.**

*Code Reference:* 1.10: G-S.1.(d)(1)(ii) (1/1/22).

**3.8.3.5. Abbreviations for “Version.”**

*Code Reference:* 1.10: G-S.1.(d)(2) (1/1/07).

**3.8.4. NTEP CC Number.**

*Code Reference:* 1.10: G-S.1.(e) (1/1/03).

**3.8.4.1. NTEP CC Number Identifier.**

*Code Reference:* 1.10: G-S.1.(e)(1) (1/1/03).

**3.8.5. Location of G-S.1. Information, Not-Built-For Purpose, Software-Based Devices.**

*Code Reference:* 1.10: G-S.1.1. (1/1/04).

**3.8.6. Location of Marking Information, Retail Motor-Fuel Dispensers.**

*Code Reference:* 3.32: S.4.3. (1/1/03).

- Between 24 inches and 60 inches from the base of the dispenser.
- Externally or internally marked, permanent, and easily read.
- On a portion of the device that cannot be readily removed.
- The use of a dispenser key or tool to access internal marking information is permitted for retail motor-fuel dispensers.

**3.8.7. Devices or Main Elements Remanufactured as of January 1, 2002.**

*Code Reference:* 1.10: G-S.1.2. (1/1/02).

**3.8.7.1. Name and ID of Remanufacturer or Distributor.**

*Code Reference:* 1.10: G-S.1.(a) (1/1/02).

**3.8.7.2. Model Number if different from the original number.**

*Code Reference:* 1.10: G-S.1.(b) (1/1/02).

**3.8.8. Values Identified.**

*Code Reference:* 1.10: G-S.5.2.4.

If graduations, indications, or recorded representations are intended to have specific values, these values shall be adequately defined and markings positioned as close as practicable to the values being identified.

**3.8.9. Permanence of Indications and Markings.**

*Code Reference:* 1.10: G-S.5.2.5.

Graduations, indications, or recorded representations and their defining figures, words, and symbols shall be of such character that they will not tend easily to become obliterated or illegible.

**3.8.10. Marking, Operational Controls.**

All switches, lights, displays, pushbuttons, and other operational controls and features must be clearly and definitely identified.

*Code Reference:* 1.10: G-S.6. (1/1/77).

**3.8.11. Visibility of Required Markings After Installation.**

*Code Reference:* 1.10: G-UR.2.1.1.

**3.8.12. Money-Operated Devices, Responsibility.**

*Code Reference:* 1.10: G-UR.3.4.

**3.8.13. Limitation of Use.**

Any limitation on a device's use shall be clearly and permanently marked on any device intended to measure accurately:

*Code Reference:* 3.32: S.4.1.

- only products having particular properties,
- only under specific installation conditions, or
- only when used in conjunction with specific accessory equipment.

**3.8.14. Discharge Rates.**

*Code Reference:* 3.32: S.4.2.

**3.8.14.1. A meter shall be marked to show its designed minimum and maximum discharge rates.**

**3.8.14.2. The minimum discharge rate shall not exceed 20 % of the maximum discharge rate.**

**3.8.15. For Devices Equipped with ATC Systems, Markings.**

Primary indicating elements, recording elements, and recorded representations shall be marked to show the volume has been adjusted to the volume at 15 °C or 60 °F.

*Code Reference:* 3.32: S.4.4.

**3.9. Measuring Elements.****3.9.1. Air/Vapor Elimination.**

*Code Reference:* 3.32: S.2.1., S.2.4.

**3.9.1.1. Effective, automatic means to eliminate air/vapor shall be provided.**

**3.9.1.2. Verify air/vapor eliminator vent lines are made of appropriate, non-collapsible material.**

**3.9.2. Security Seals.****3.9.2.1. General.**

*Code Reference:* 1.10: G-S.8. (1/1/90), G-S.9., G-UR.4.5., 3.32: S.2.2., Table S.2.2. (1/1/95).

Security seal on adjusting mechanism. Check for the presence of security seals on the device. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Document missing seals on the official report and apply new ones as needed.

*Code Reference:* 1.10: G-UR.4.5.

### **3.9.3. Directional Flow Valves.**

A measuring system shall be equipped with a valve or other effective, automatic means to prevent reversal of flow of the product. Valve must be installed in or adjacent to the measuring element.

*Code Reference:* 3.32: S.2.3.

Zero-Set-Back Interlock, Electronic Stationary Meters (Other than Electronic Stationary Retail Motor-Fuel Dispensers) and Electronic Vehicle-Mounted Meters. See also the “Test” portion of the EPO.

*Code Reference:* 3.32: S.2.5.1. (1/1/21).

### **3.9.4. Zero-Set-Back Interlock, Electronic Stationary Retail Motor-Fuel Devices.**

*Code Reference:* 3.32: S.2.5.2. (1/1/17).

On/off mechanism and zero-set-back interlock engaged after delivery and the dispenser nozzle returned to its designed hanging position. See Test portion of the EPO for more details.

*Code Reference:* 3.32: S.2.5.2.(a) (1/1/17), S.2.5.2.(b) (1/1/17).

On a system with more than one dispenser supplied by a single pump, product cannot be delivered by other dispensers supplied by the same pump until the indicating elements on those other dispensers are in a correct zero position.

*Code Reference:* 3.32: S.2.5.2.(c) (1/1/17).

### **3.9.5. Provision for Thermometer Well.**

For test purposes, means shall be provided (e.g., thermometer well) to determine the temperature of the liquid.

The thermometer well shall be located either in the:

- a. Liquid chamber of the meter; or
- b. Meter inlet or discharge line immediately adjacent to the meter.

*Code Reference:* 3.32: S.2.7.

## **3.10. Discharge Lines and Valves.**

### **3.10.1. Directional Flow Valves. (see 3.9. Measuring Elements above).**

*Code Reference:* 3.32: S.2.3.

### **3.10.2. Maintenance of Liquid State.**

*Code Reference:* 3.32: S.2.4.

### **3.10.3. Diversion of Measured Liquid.**

*Code Reference:* 3.32: S.3.1.

### **3.10.4. Diversion, General.**

Examine the discharge line and valves to ensure measured liquid cannot be diverted from the measuring chamber or discharge line.

*Code Reference:* 3.32: S.3.1.

Two or more outlets may be installed only if automatic means are provided to ensure:

*Code Reference:* 3.32: S.3.1.

- a. Liquid can only flow from one outlet at a time; and
- b. The direction of flow for which the mechanism may be set at any time is definitely and conspicuously indicated.

Outlets for emptying a portion of the system for repair and maintenance are permitted. Effective means shall be provided to prevent the passage of liquid through such an outlet during normal device operation and to indicate clearly and unmistakably when the valve controls are set so as to permit the passage of liquid through such an outlet.

*Code Reference:* 3.32: S.3.1.

### **3.10.5. Facilitation of Fraud.**

Examine the system and any associated equipment to ensure the assembly, installation, and construction do not facilitate fraud.

*Code Reference:* 1.10: G-S.2.

### **3.10.6. Leaks.**

#### **3.10.6.1. No leaks should exist in the system on the outlet side of the meter.**

*Code Reference:* 1.10: G-UR.4.1., 3.32: S.3.1.

**Note:** If leaks are detected on the inlet side of the meter, a notation should be made on the inspection report and the firm should be made aware of the location of the leak for purposes of safety.

### **3.10.7. Discharge Hose.**

**3.10.7.1. Hose Fill/Zero Start.** The hose shall be filled with liquid before the zero condition is established.

*Code Reference:* 3.32: UR.2.1., UR.2.2.

**3.10.7.2. Shut-off Valve, Wet-Hose Type.** The delivery hose of a retail device shall be of the wet-hose type with a shut-off valve at its outlet end.

*Code Reference:* 3.32: S.3.2.

**3.10.7.3. Length, Stationary Motor-Fuel Device.**

*Code Reference:* 3.32: UR.1.2.

The length of the discharge hose shall not exceed 5.5 m (18 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to the receiving vessels.

An unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.

The hose length is measured from the outside of the housing of the device to the inlet end of the discharge nozzle.

#### **3.10.8. Vapor-Return Line.**

*Code Reference:* 3.32: UR.2.3.

### **3.11. Automatic Temperature Compensation (ATC) Systems.**

#### **3.11.1. Automatic Temperature Compensation.**

A device may be equipped with an automatic means for adjusting the indication and registration of the measured volume to the volume of product at 15 °C (60 °F).

*Code Reference:* 3.32: S.2.8.

#### **3.11.2. Provisions for Deactivating ATC.**

Provisions for Deactivating ATC. Provision shall be made to deactivate the automatic temperature compensating system so that the meter may indicate and record, if equipped to record, in terms of the uncompensated volume.

*Code Reference:* 3.32: S.2.8.1.

#### **3.11.3. Provisions for Sealing ATC.**

For devices and systems in which the ATC system can be disconnected and/or adjusted by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. (See this reference in the Inspection portion of this EPO.)

*Code Reference:* 1.10: G-S.8.2., 3.32: S.2.2.

For other devices, adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that an ATC system cannot be disconnected and no adjustment may be made to the system.

*Code Reference:* 3.32: S.2.2., S.2.8.2., Table S.2.2. (1/1/95).

#### **3.11.4. Temperature Determination, Thermometer Well.**

A thermometer well shall be provided for determination of the temperature of the liquid.

*Code Reference:* 3.32: S.2.7.

#### **3.11.5. Temperature Compensated Volume, Markings.**

Primary indicating and recording elements on devices equipped with automatic temperature compensating systems shall be marked to show that the volume delivered has been adjusted to 15 °C (60 °F).

*Code Reference:* 3.32: S.4.4.

#### **3.11.6. Use of Automatic Temperature Compensator (ATC).**

*Code Reference:* 3.32: UR.2.4.

When to be used. ATCs shall be connected and operable at all times. ATCs may not be removed or replaced with a non-ATCs device without permission of weights and measures authority.

*Code Reference:* 3.32: UR.2.4.1.

**3.11.7. Temperature Compensated Sales, Reference Temperature and Corrections.**

For sales of LPG in the liquid state in which the quantity is determined by an approved measuring system equipped with an ATC or by weight converted to liters or gallons or by a calibrated container, the sale shall be in terms of liters corrected to 15 °C or gallons corrected to 60 °F.

*Code Reference:* 3.32: UR.2.4.2.

**3.11.8. Invoices.**

Invoices shall be marked to show volume delivered has been adjusted to reference temperature.

*Code Reference:* 3.32: UR.2.4.3.

**3.11.9. ATC Design and Location Within Applicable Tolerances.**

Means for determining the temperature of measured liquid in an ATC system shall be so designed and located that in any “usual and customary use” of the system, the resulting indications and/or recorded representations are within applicable tolerances.

*Code Reference:* 3.32: UR.2.4.4.

**3.12. Facilitation of Fraud.**

Examine the system and any associated equipment to ensure the assembly, installation, and construction do not facilitate fraud.

*Code Reference:* 1.10: G-S.2.

**3.13. Automatic Timeout.**

*Code Reference:* 3.32: S.2.6.

**3.13.1. Electronic Stationary (Other than Stationary Retail Motor-Fuel Dispensers).**

For individual deliveries, if there is no product flow for three minutes the transaction must be completed before additional product flow is allowed.

*Code Reference:* 3.32: S.2.6.1. (1/1/21).

The three-minute timeout shall be a sealable feature on an indicator.

*Code Reference:* 3.32: S.2.6.1. (1/1/21).

**3.13.2. Pay-at-Pump Retail Motor-Fuel Devices.**

After authorization, the device must de-authorize in three minutes if not activated and reauthorization of the device must be performed before product can be dispensed.

*Code Reference:* 3.32: S.2.6.2. (1/1/22).

If the time limit to deauthorize the device is programmable, it shall not accept an entry greater than three minutes.

*Code Reference:* 3.32: S.2.6.2. (1/1/22).

**3.13.3. Electronic Vehicle-Mounted Meters.**

For individual deliveries, if there is no product flow for five minutes the transaction must be completed before additional product flow is allowed.

*Code Reference:* 3.32: S.2.6.3.

The five-minute timeout shall be a sealable feature on an indicator.

*Code Reference:* 3.32: S.2.6.3.

### 3.14. Totalizers.

#### 3.14.1. Totalizers, General. Verify Proper Operation.

**Code Reference:** 1.10: G-UR.4.1., G-UR.4.2.

**3.14.2. Totalizers, Retail Motor-Fuel Dispensers.** – Verify device is equipped with a non-resettable totalizer for the quantity delivered through the metering device

**Code Reference:** 3.32: S.1.5.7. (1/1/17).

## 4. Pretest Determinations.

**NOTE:** Code references used throughout the document are drawn from NIST HB 44 General Code (Section 1.10) and Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices Code (Section 3.32). The relevant code section(s) is cited by its numerical designation and the applicable requirement(s) from that code section is identified by letter-number designation only. The code section and paragraph designation(s) are then shown immediately after the corresponding line item or task listed in the procedure. For example, NIST HB 44 General Code (Section 1.10) is designated as “1.10:” followed by the paragraph designation(s) relevant to the line item. Nonretroactive requirements are followed by the applicable date in parentheses.

### 4.1. Test Methods.

This EPO was designed around the use of volumetric, neck-type test standards. However, this does not preclude the use of other test methods and apparatus that have been approved by the Director as described in NIST Handbook 44, Appendix A, Section 3. Testing Apparatus. If other test standards and apparatus are used, corresponding adjustments to the test procedures described in this EPO may be needed to reflect the use of that equipment.

**Code Reference:** 1.10: G-N.3., Appendix A. Fundamental Considerations Section 3. Testing Apparatus.

### 4.2. Test Draft Size.

**Code Reference:** 3.32: N.3.

#### 4.2.1. Minimum Test.

Test drafts shall be equal to at least the amount delivered by the device in 1 minute at its normal discharge rate.

**Code Reference:** 3.32: N.3.1.

#### 4.2.2. Transfer Standard Meter Test.

For tests conducted using a calibrated transfer standard, the minimum quantity for any test draft shall be equal to or greater than the amount delivered in one minute at the flow rate being tested.

**Code Reference:** 3.32: N.3.2.

### 4.3. Prover Design and Condition.

Ensure prover is of appropriate capacity and has a valid calibration certificate and its security seals are intact.

**Code Reference:** NIST HB 105-4 *Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures, 4. Specifications and Tolerances for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers*, 2016.

Evaluation of the prover and associated valves, piping, surfaces, gauges, etc., are addressed during calibration to the requirements of NIST Handbook 105-4 by the laboratory metrologist.

Appropriate care in routine maintenance to ensure: (1) safe and suitable cleaning prior to the time of their use for measurement(s) so as to not alter proper drainage, the determination of volume, and (2) to include proper storage, handling/use, and transportation, to avoid damage or prevent contamination. Inspect prover exterior, all fittings and connections, and for signs of interior surface dents, product residue, rust, moisture, or other foreign material.

Prover sight glass must be clean and fittings must not leak.

#### **4.4. Thermometers.**

##### **4.4.1. Thermometers may be of the partial immersion or digital type.**

(See NIST HB 105-6 *Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures*, 6. *Specifications and Tolerances for Thermometers*, 1997, for additional information).

##### **4.4.2. Accuracy.**

Thermometers shall be matched.

- a.  $\pm 0.5$  °C, have a range of at least 0 °C to 50 °C, and be divided in increments of no greater than 0.5 °C for liquid-in-glass thermometers and 0.1 °C for digital thermometers; or
- b.  $\pm 1$  °F, have a range of at least 0 °F to 120 °F, and be divided in increments of no greater than 1 °F for liquid-in-glass thermometers and 0.1 °F for digital thermometers.

#### **4.5. Tolerances.**

##### **4.5.1. Acceptance/Maintenance Tolerances.**

*Code Reference:* 1.10: G-T.1, G-T.2.

##### **4.5.2. Application.**

*Code Reference:* 1.10: G-T.3., 3.32: T.1.

##### **4.5.3. Intermediate Values.**

*Code Reference:* 1.10: G-T.4.

##### **4.5.4. Tolerances on Tests When Type 2 Transfer Standards are Used.**

When Type 2 transfer standards are used to conduct accuracy tests, adjust the tolerances as described in G-T.5. Tolerances on Tests When Type 2 Transfer Standards Are Used.

*Code Reference:* 1.10: G-T.5.

##### **4.5.5. Basic Values.**

*Code Reference:* 3.32: T.2., Table T.2.

##### **4.5.6. Repeatability.**

*Code Reference:* 3.32: T.3.

##### **4.5.7. Automatic Temperature-Compensating Systems.**

*Code Reference:* 3.32: T.4.

#### 4.6. Test Liquid.

Verify the test liquid is the same as that to be commercially measured or is a liquid with the same general physical characteristics.

*Code Reference:* 3.32: N.1.

#### **SAFETY REMINDER!!!**

- **Wear appropriate personal protection equipment such as static-resistant, nonskid safety shoes (to avoid potential ignition source and to prevent possible injury from slipping on slick surfaces), protective clothing, eye protection (to prevent injury from product), and a hard hat (to prevent injury from overhangs and projections on the prover and at the test site).**
- **Use proper bonding procedures! Be sure the prover is equipped with an explosion-proof motor.**
- **Carefully inspect the electrical supply lines for the test equipment for wear or damage; correct potentially hazardous conditions before use, protect lines from damage during use.**
- **Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.**
- **Remove fire extinguisher(s) from storage receptacle and set out for easy access.**
- **Use proper lifting techniques to lift and move equipment!**
- **Be aware of vehicular and pedestrian traffic in the area.**
- **Device operator should be present at all times during test – the operator (not the inspector) should operate the device under test.**
- **Never leave equipment unattended while it is in operation.**

#### 5. Test Notes.

**NOTE:** Code references used throughout the document are drawn from NIST Handbook 44 (HB 44) General Code (Section 1.10) and Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices Code (Section 3.32). The relevant code section(s) is cited by its numerical designation and the applicable requirement(s) from that code section is identified by letter-number designation only. The code section and paragraph designation(s) are then shown immediately after the corresponding line item or task listed in the procedure. For example, NIST Handbook 44 (HB 44) General Code (Section 1.10) is designated as “1.10:” followed by the paragraph designation(s) relevant to the line item. Nonretroactive requirements are followed by the applicable date in parentheses.

##### 5.1. Totalizers.

*Code Reference:* 1.10: G-UR.4.1., G-UR.4.2., 3.32: S.1.5.7. (1/1/17).

To determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts. Provide this information to the device owner to account for the product dispensed and returned to the device owner’s tank during official tests.

Mark any delivery tickets or recorded representations as appropriate to indicate they were generated as part of an official test and to deter the potential for their misuse. Return all delivery tickets or recorded representations used during the test to the device owner at the end of the test.

##### 5.2. Test Equipment Setup and Leveling.

### 5.2.1. Test Equipment Setup.

- Before reading the indication on the prover, set up and level the prover and ensure valves and return pumping mechanisms are functional.
- Ensure the ground surface on which the standard or trailer rests is firm and stable and is adequate to safely bear the weight of the test apparatus when the standard is full of product.
- Ensure the test equipment is properly bonded.
- Prior to dispensing product into the prover, verify that all valves in the proving system are closed and that the prover pumping mechanism is functional.

### 5.2.2. Leveling the Prover.

- Check for the proper operation of the level indicators on the prover.
- Prior to dispensing product into the prover, level the prover by repositioning the prover by moving or adjusting it until the prover is level according to the level indicating means provided on the prover (and as verified by the calibration laboratory).
- After filling the prover with product and before reading the indications on the prover, re-check the level of the prover to ensure the weight of the product has not affected the level condition. Re-level the prover as necessary.

## 5.3. Wet Prover.

**Code Reference:** NIST HB 105-4 *Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures, 4. Specifications and Tolerances for Liquefied Petroleum Gas and Anhydrous Ammonia Liquid Volumetric Provers*, 2016.

Conduct a “wet run” to wet the prover (fill to nominal capacity) for **each meter** tested by filling the prover to capacity and emptying it following proper drain procedures. This includes allowing a 30-second drain period each time the prover is emptied.

## 5.4. Evaporation and Volume Change.

**Code Reference:** 3.32: N.2.

Exercise care so the product temperature in the prover is the same as or as close as practical to that at the meter. Take care to minimize changes in volume of the test liquid due to temperature changes and evaporation losses.

## 5.5. Temperature Corrections.

**Code Reference:** 3.32: N.5.

Corrections shall be made for any changes in volume resulting from the differences in liquid temperatures between the time of passage through the meter and time of volumetric determination in the prover. When adjustments are necessary, appropriate petroleum measurement tables shall be used.

Temperature readings are to be taken to the nearest 0.25 °C or 0.5 °F or for digital thermometers, to the nearest increment. Take the temperature of the test liquid in the prover immediately following each accuracy test. For provers equipped with more than one thermometer, the temperature of the test liquid is the mathematical average of the individual readings.

A thermometer placed in the thermowell adjacent to the meter is to be used to determine meter temperature. Meter temperature is to be taken during each delivery when meter indications reach quantities equal to 1/3- and 2/3 of the capacity of the prover and the two values averaged.

**5.6. Read and Record Results Immediately.**

Read and record the indications on the prover immediately after delivery.

**5.7. Eye Level and Reading the Meniscus.**

When reading the indications on the prover, position yourself so that the bottom of the meniscus is at eye level and observe the reading on the gauge scale opposite the bottom of the meniscus.

- If the level of the liquid is not exactly at the zero line, the value shown on the scale will be recorded as “plus” if above the zero line and “minus” if below the zero line.
- If the reading is between graduations, “round off” the results to the nearest graduation.
- If the reading is exactly in the middle of two graduations, read and report the results to one-half the graduation or follow your jurisdiction’s policy for reporting such a result.

**5.8. Confirm Results.**

If the result of any test is at, near, or exceeds the applicable tolerance limit, repeat that test to confirm the results and to help ensure you did not inadvertently introduce error into the test process. If necessary, conduct a “Repeatability Test” as described under the “Test” section of this EPO.

**5.9. Drain Procedures.**

Bottom drain provers require a 30-second drain (or as specified otherwise on the calibration report or marked on the prover) after the main flow ceases.

**5.10. Return to Zero.**

The primary indicating elements and the primary recording elements (when these are returnable to zero) shall be returned to zero immediately before each delivery and after the pump has been activated and product to be measured has been supplied to the measuring system.

*Code Reference:* 3.32: UR.2.1.

**5.11. Recorded Representations.**

- a. Vehicle-mounted systems shall be equipped with a means to record all sales where product is delivered through the meter and shall comply with G-S.5.6. Recorded Representations.  
*Code Reference:* 1.10: G-S.5.6., 3.32: S.1.1.1., UR.2.6.
- b. For any recorded representation created by a computing-type device that includes the total computed price, verify the recorded representation also includes the total volume of the delivery and appropriate fraction and the corresponding price per unit of the quantity.  
*Code Reference:* 3.32: S.1.1.6.
- c. A copy of the ticket issued by the device shall be left with the customer or as otherwise specified by the customer.  
*Code Reference:* 3.32: UR.2.6.
- d. Verify that any options for obtaining a recorded representation are appropriate. On systems equipped with a means to issue a recorded representation, the recorded representation shall be made available to the customer in hard copy form unless otherwise specified by the customer. The customer may be given the option of not receiving the recorded representation. If the system is equipped with the capability of issuing an electronic recorded representation, the customer may also be given the option of receiving the recorded representation electronically (e.g., via cell phone, computer, etc.) in lieu of or in addition to a hard copy.  
*Code Reference:* 1.10: G-S.5.6.

- e. A ticket shall not be inserted into a device equipped with a ticket printer until immediately before a delivery is begun and until indications which are returnable to zero have been returned to zero as described above.

**Code Reference:** 3.32: UR.2.1., UR.2.5.

- f. In no case shall a ticket be in the device when the vehicle is in motion on a public street, highway, or thoroughfare.

**Code Reference:** 3.32: UR.2.5.

#### 5.12. Steps After Each Test Draft.

- a. Print a ticket/receipt if the device is so equipped and verify required information is provided and correctly recorded and that it complies with the provisions of G-S.5.6. Recorded Representations.

**Code Reference:** 1.10: G-S.5.2.2., G-S.5.6.

- b. Stationary Retail Devices, Recorded Representations on Point-of-Sale Systems and Cash/Card Activated Devices, General.

**Code Reference:** 3.32: S.1.5.4., UR.2.7.2. (1/1/17).

For transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash, verify that required information is printed on the receipt.

- c. Stationary Retail Devices, Recorded Representations, Post-Delivery Discounts.

**Code Reference:** 3.32: S.1.5.5., UR.2.7.2. (1/1/17).

For transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash and which involve a post-delivery discount, verify required information is on the recorded representation and that the recorded representation is available to the customer through a built-in or separate recording element that is part of the system.

- d. Computing-Type Devices.

For printed tickets which display the total sale price, verify the total quantity of the delivery and the unit price is also printed on the ticket.

**Code Reference:** 3.32: S.1.1.6.

Check price computations on all indications (including consoles) and on recorded representations.

**Code Reference:** 3.32: S.1.5.2., N.4.3.2.

- Digital equipment.

**Code Reference:** 1.10: G-S.5.5., 3.32: S.1.5.2.2.

- Analog Equipment.

**Code Reference:** 3.32: S.1.5.2.

- e. Check for agreement of values among indications and recorded representations.

**Code Reference:** 1.10: G-S.5.2.2., 3.32: S.1.1.5., S.1.5.3.

- f. Stationary Retail Devices - Check for agreement of quantity values between indicated and recorded representations.

**Code Reference:** 3.32: S.1.5.3. (1/1/16).

**5.13. Use of Adjustments.**

Verify that adjustments are used only to correct for conditions that these elements are designed to control and that adjustments are made to bring performance errors as close to zero value as possible. Verify equipment is properly maintained and errors are not predominantly in favor of the device user.

**Code Reference:** 1.10: G-UR.4.1., G-UR.4.2., G-UR.4.3.

**5.14. Normal Tests, General.**

Normal tests are conducted at the maximum discharge flow rate that can be developed under the conditions of the installation. Additional tests conducted at flow rates down to and included one-half of the sum of the maximum discharge flow rate and the rated minimum discharge flow rate shall be considered “normal tests.”

For example:

Rated minimum discharge flow rate = 20 gpm

Maximum flow rate developed in the installation = 60 gpm

The sum of the:

(rated minimum discharge flow rate) + (maximum discharge flow rate developed in the installation)

= 20 gpm + 60 gpm

= 80 gpm

One half of this sum:

$80 \text{ gpm} \div 2 \text{ gpm} = 40 \text{ gpm}$

In this example, any tests conducted on the example retail motor-fuel dispenser at flow rates down to and including 40 gpm are considered “normal” tests.

**Code Reference:** 3.32: N.4.1.

**5.15. Special Tests, General.**

Special” tests shall be made to develop the operating characteristics of a device and any special elements and accessories attached to or associated with the device. Any test except as set forth in N.4.1. Normal Tests shall be considered a special test.

**Code Reference:** 3.32: N.4.2.

Since flow rates can vary during testing based on conditions in the fueling system, it is recommended that tests be conducted at a flow rate slightly above the targeted values referenced in N.4.2. Special Tests. This avoids the possibility that the flow rate used during testing might drop below the targeted flow rate and helps ensure tests are not conducted at flow rates outside of the metering system’s designed operating limits.

**Code Reference:** 3.32: N.4.2.

**5.15.1. Motor-Fuel Devices, Flow Rate for Special Tests.**

For motor-fuel devices conduct the special test at the slower of the following rates:

- 20 L (5 gal) per minute; or
- The minimum discharge rate marked on the device.

**Code Reference:** 3.32: N.4.2.1.

**5.15.2. Other Retail Devices, Flow Rate for Special Tests.**

For retail devices other than retail motor-fuel devices, the special test shall be conducted at the greater of the following rates:

- The minimum discharge rate that can be developed under the conditions of the installation; or
- The minimum discharge rate marked on the device.

*Code Reference:* 3.32: N.4.2.2.

**5.15.3. Wholesale Devices, Flow Rate for Special Tests.**

For wholesale devices, special tests shall include a test at or slightly above the minimum discharge rate marked on the device. In no case shall the test be performed at a flow rate less than the minimum discharge rate marked on the device.

*Code Reference:* 3.32: N.4.2.3.

**6. Test.**

**NOTE:** Code references used throughout the document are drawn from NIST HB 44 General Code (Section 1.10) and Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices Code (Section 3.32). The relevant code section(s) is cited by its numerical designation and the applicable requirement(s) from that code section is identified by letter-number designation only. The code section and paragraph designation(s) are then shown immediately after the corresponding line item or task listed in the procedure. For example, NIST HB 44 General Code (Section 1.10) is designated as “1.10:” followed by the paragraph designation(s) relevant to the line item. Nonretroactive requirements are followed by the applicable date in parentheses.

**6.1. Accuracy Tests - Overview****6.1.1. Non-Temperature Compensated Meters****6.1.1.1. Normal Test – Full Flow, Normal Tolerance.**

*Code Reference:* 3.32: N.4.1., T.1., T.2., Table T.2.

**6.1.1.2. Special Test – Slow Flow, Special Tolerance.**

*Code Reference:* 3.32: N.4.2., T.1., T.2., Table T.2.

**6.1.1.3. Proceed to “All Meters.” (see Section 6.4.1. below).****6.1.2. Automatic Temperature-Compensated (ATC) Meters.****6.1.2.1. Normal Test – ATC Activated - Full Flow, Normal Tolerance.**

Compare the compensated volume indicated or recorded by the metering system to the delivered volume indicated in the prover corrected to 15 °C (60 °F).

*Code Reference:* 3.32: N.4.1., N.4.1.1., T.1., T.2., Table T.2., T.4.

**6.1.2.2. Normal Test – ATC Deactivated - Full Flow, Normal Tolerance.**

Compare the uncompensated volume indicated or recorded by the metering system to the delivered volume indicated in the prover.

*Code Reference:* 3.32: N.4.1., N.4.1.1., T.1., T.2., Table T.2., T.4.

**6.1.2.3. Compare Compensated and Uncompensated Values.**

Compare the meter errors determined with and without the temperature compensated system activated. For systems that indicate or record both compensated and uncompensated volume for every delivery, the tests in 6.1.2.1. Normal Test - ATC Activated and 6.1.2.2. Normal Test – ATC Deactivated may be performed using a single test run using the compensated and uncompensated values indicated and/or recorded by the metering system.

*Code Reference:* 3.32: N.4.1., N.4.1.1., T.1., T.2., Table T.2., T.4.

**6.1.2.4. Special Test – ATC Deactivated - Slow Flow, Special Tolerance.**

*Code Reference:* 3.32: N.4.2., T.1., T.2., Table T.2.

**6.1.2.5. Proceed to “All Meters.” (see Section 6.4.1. below).****6.2. Non-Temperature-Compensated Meters.****6.2.1. General.**

*Code Reference:* 3.32: N.4.4., N.5., T.3.

- Read the temperature of the product at the meter at one-third and two-thirds prover capacity.
- If the result of any test is at, near, or outside the applicable tolerance, repeat that test to confirm the results.
- If necessary, conduct a repeatability test. See “Repeatability Test” below.

**6.2.2. Normal Test.**

- Test Conducted at Full Flow.
- Normal Tolerances Apply.

*Code Reference:* 3.32: N.2., N.4.1., N.5., T.1., T.2., Table T.2.

- a. Conduct a test at the full flow rate.
- b. Adjust the volume indicated at the prover to reflect changes in the product temperature between the meter and the prover. That is, adjust the volume indicated at the prover to the volume at the temperature taken at the meter.
- c. Calculate the difference between the volume indicated by the meter and the adjusted prover volume. This difference is the meter error.
- d. Express the meter error as a percent.
- e. The result of this test shall not exceed the normal tolerance values of:
  - 0.6 % for acceptance tolerance, or
  - 1.0 % for maintenance tolerance.

**6.2.3. Special Test.**

- Test Conducted at “Slow” Flow Rates as Specified in N.4.2.
- Special Test Tolerances Apply.

*Code Reference:* 3.32: N.2., N.4.2., N.5., T.1., T.2., Table T.2.

- a. Conduct a test with the ATC deactivated at “slow” flow rates as follows:
  - Motor-fuel devices.

*Code Reference:* 3.32: N.4.2.1.

- Other retail devices.  
*Code Reference:* 3.32: N.4.2.2.
- Wholesale devices.  
*Code Reference:* 3.32: N.4.2.3.
- b. Adjust the volume indicated at the prover to reflect changes in the product temperature between the meter and the prover. That is, adjust the volume indicated at the prover to the volume at the temperature taken at the meter.
- c. Calculate the difference between the volume indicated by the meter and the adjusted prover volume. This difference is the meter error.
- d. Express the meter error as a percent.
- e. The result of this test shall not exceed the special test tolerance of 1.0 %.

### 6.3. Automatic Temperature-Compensated (ATC) Meters.

#### 6.3.1. General.

*Code Reference:* 3.32: N.4.4., N.5., T.3.

- For tests conducted with the ATC deactivated, read the temperature of the product at the meter at one-third and two-thirds prover capacity.
- If the result of any test is at, near, or outside the applicable tolerance, repeat that test to confirm the results.
- If necessary, conduct a repeatability test. See “Repeatability Test” below.

#### 6.3.2. Normal Test – ATC Activated.

- Test Conducted at Full Flow.
- Normal Tolerances Apply.

*Code Reference:* 3.32: N.2., N.4.1., N.4.1.1., N.5., T.1., T.2., Table T.2.

- a. Conduct a test at the full flow rate with the temperature compensator activated.
- b. Adjust the volume indicated at the prover to the volume at 15 °C (60 °F).
- c. Calculate the difference between the volume indicated by the meter and the adjusted prover volume. This difference is the meter error.
- d. Express the meter error as a percent.
- e. The result of this test shall not exceed the normal tolerance values of:
  - 0.6 % for acceptance tolerance, or
  - 1.0 % for maintenance tolerance.

#### 6.3.3. Normal Test – ATC Deactivated.

- Test Conducted at Full Flow.
- Normal Tolerances Apply.

*Code Reference:* 3.32: N.2., N.4.1.1., N.5., T.1., T.2., Table T.2., T.4.

- a. Conduct a test at the full flow rate with the ATC deactivated.
- b. The flow rate and size of this draft shall be approximately the same as the test conducted in Step 1 Normal Test ATC Activated above.

- c. Adjust the volume indicated at the prover to reflect changes in the product temperature between the meter and the prover. That is, adjust the volume indicated at the prover to the volume at the temperature taken at the meter.
- d. Calculate the difference between the volume indicated by the meter and the adjusted prover volume. This difference is the meter error.
- e. Express the meter error as a percent.
- f. The result of this test shall not exceed the normal tolerance values of:
  - 0.6 % for acceptance tolerance, or
  - 1.0 % for maintenance tolerance.

#### **6.3.4. Compare Compensated and Uncompensated Values.**

- a. Calculate the difference between the meter error (expressed as a percent) determined with the ATC activated (Step 1) and the meter error (expressed as a percent) determined with the ATC deactivated (Step 2).

For systems that indicate or record both compensated and uncompensated volume for every delivery, the tests in 1. Normal Test - Temperature Compensated Activated and 2. Normal Test–Temperature Compensator Deactivated may be performed using a single test run and comparing the compensated and uncompensated values indicated and/or recorded by the metering system.

**Code Reference:** 3.32: N.4.1.1., T.4.

- b. The difference between the results with the ATC activated and the ATC deactivated shall not exceed:
  - 1 % for mechanical ATC systems.
  - 0.5 % for electronic ATC systems.

**Code Reference:** 3.32: T.4.

#### **6.3.5. Special Test – ATC Deactivated.**

- Test Conducted at “Slow” Flow Rates as Specified in N.4.2.
- Special Test Tolerances Apply.

**Code Reference:** 3.32: N.2., N.4.2.1., N.5., T.1., T.2., Table T.2.

- a. Conduct a test with the ATC deactivated at “slow” flow rates as follows:
  - Motor-fuel devices.  
**Code Reference:** 3.32: N.4.2.1.
  - Other retail devices.  
**Code Reference:** 3.32: N.4.2.2.
  - Wholesale devices.  
**Code Reference:** 3.32: N.4.2.3.
- b. Adjust the volume indicated at the prover to reflect changes in the product temperature between the meter and the prover. That is, adjust the volume indicated at the prover to the volume at the temperature taken at the meter.
- c. Calculate the difference between the volume indicated by the meter and the adjusted prover volume. This difference is the meter error.
- d. Express the meter error as a percent.

- e. The result of this test shall not exceed the special test tolerance of 1.0 %.

#### **6.4. Reactivate the temperature compensator and, as appropriate, apply security seals.**

##### **6.4.1. All Meters.**

###### **6.4.1.1. Repeatability Test.**

If necessary, conduct a repeatability test.

*Code Reference:* 3.32: N.2., N.4.4., T.3.

A repeatability test should include a minimum of three consecutive test drafts and be of approximately the same draft size.

Tests should be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent they will not affect the results of the tests.

Repeatability tests shall be conducted at flow rates within the minimum and maximum discharge rates marked on the device.

For devices equipped with an automatic temperature compensating (ATC) system, the results shall be based on the uncompensated (gross) volume. That is, with the ATC deactivated.

###### **6.4.1.2. Money-Value Computations and Recorded Representations.**

As described in “Test Notes” under “Steps After Each Test Draft”:

For computing devices, check money-value computations and mathematical agreement on all indications, including consoles and recorded representations.

Print a ticket/receipt (if the device is so equipped) and verify all required information is provided and correctly recorded.

###### **6.4.1.3. Testing with Nonassociated Equipment.**

Conduct tests as deemed necessary to determine nonassociated equipment and influences such as radio frequency interference (RFI) do not adversely affect the performance of a device.

*Code Reference:* 1.10: G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.

Radio Frequency Interference (RFI) Test (Electronic Equipment Only). This testing is typically done during the inspection of a new installation. It is conducted subsequently only if a problem is suspected.

###### **6.4.1.4. Zero-Set-Back Interlock.**

Check the effectiveness of the zero-set-back interlock.

*Code Reference:* 3.32: S.2.5.

###### **6.4.1.4.1. Zero-Set-Back Interlock, Electronic Stationary Meters (Other than Electronic Stationary Retail Motor-Fuel Dispensers) and Electronic Vehicle-Mounted Meters.**

*Code Reference:* 3.32: S.2.5.1. (1/1/21).

A device shall be so constructed that after an individual delivery has been completed by moving the starting, an automatic interlock system shall engage to prevent a subsequent delivery until the indicating elements and, if equipped, recording elements have been returned to their correct zero position.

**6.4.1.4.2. Zero-Set-Back Interlock, Electronic Stationary Retail Motor-Fuel Devices.**

**Code Reference:** 3.32: S.2.5.2. (1/1/17).

Engaging the Interlock. The device shall be constructed such that after an individual delivery has been completed by moving the starting lever to any position that shuts off the device, an interlock shall automatically engage to prevent a subsequent delivery until the indicating and any recording elements have been returned to their zero positions.

**Code Reference:** 3.32: S.2.5.2.(a) (1/1/17).

Return to Hanging Position. The discharge nozzle cannot be returned to its designed hanging position (that is, any position where the tip of the nozzle is placed in its designed receptacle and the lock can be inserted) until the starting lever is in its designed shut-off position and the zero-set-back interlock has been engaged.

**Code Reference:** 3.32: S.2.5.2.(b) (1/1/17).

Multiple Dispensers Supplied by a Single Pump. On a system with more than one dispenser supplied by a single pump, activate one dispenser and verify that product cannot be delivered by other dispensers supplied by the same pump until the indicating elements on those other dispensers are in a correct zero position.

**Code Reference:** 3.32: S.2.5.2.(c) (1/1/17).

**6.4.1.5. Power Loss Test, Stationary Retail Devices.**

Ensure that information (such as the quantity and unit price, or total sales price) needed to complete transactions in progress at the time of a power loss can be determined for at least 15 minutes at the dispenser or customer-accessible console or at another on-site device and that user information is retained in device memory.

It is not typically necessary nor is it recommended to repeat this test for every inspection; however, this does not preclude the test from being conducted when deemed necessary by the regulatory authority or service person to ensure continued compliance with this requirement. As a minimum, this test should be conducted on the examination of a system or device that is put into service for the first time to verify proper installation and set-up. It may also be warranted in response to specific complaints where the test would be relevant. NIST recommends that, prior to conducting a test to verify compliance with these requirements, you check with your supervisor to verify your jurisdiction's or organization's policy regarding this test.

**Code Reference:** 3.32: S.1.5.6. (1/1/17).

**7. Post-Test Tasks.**

**NOTE:** Code references used throughout the document are drawn from NIST Handbook 44 (HB 44) General Code (Section 1.10) and Liquefied Petroleum Gas and Anhydrous Ammonia Liquid-Measuring Devices Code (Section 3.32). The relevant code section(s) is cited by its numerical designation and the applicable requirement(s) from that code section is identified by letter-number designation only. The code section and paragraph designation(s) are then shown immediately after the corresponding line item or task listed in the procedure. For example, NIST Handbook 44 (HB 44) General Code (Section 1.10) is designated as "1.10:" followed by the paragraph designation(s) relevant to the line item. Nonretroactive requirements are followed by the applicable date in parentheses.

**7.1. Security Means.**

Adequate provision shall be made for applying a physical security seal and/ or providing other approved means of security such as a data change audit trail.

**Code Reference:** 1.10: G-S.8. (1/1/90), G-S.8.1. (1/1/10), 3.32: S.2.2., Table S.2.2. (1/1/95), S.2.8.2.

For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices.

**Code Reference:** 1.10: G-S.8.2., 3.32: S.2.2.

For multiple measuring elements with a single provision for sealing, a change to the adjustment of any measuring element must be individually identified.

**Code Reference:** 1.10: G-S.8.1. (1/1/10).

A metrologically-significant software change is a sealable event.

**Code Reference:** 1.10: G-S.9.

**7.1.1. Audit Trail Information.** If the system is equipped with an audit trail, note the event counter settings on the report form for future reference. If equipped with an event logger, print a copy of the event log and attach it to the report form for future reference. Note that on some systems an electronic copy of the event log may also be available; however, the system must still be able to provide a hard copy. Examine these records for any signs of misuse of adjustments.

**Code Reference:** 1.10: G-S.8. (1/1/90), 3.32: S.2.2., Table S.2.2. (1/1/95).

**7.1.2. Security Seals.** Check for the presence of security seals on the device. Document missing seals on the official report and apply new ones as needed.

**Code Reference:** 1.10: G-UR.4.5., 3.32: S.2.2.

## **7.2. Record the Total Quantity.**

Note the final totalizer reading and record the number of gallons of product dispensed during the test on the official test report. Verify totalizers are working correctly.

**Code Reference:** 1.10: G-UR.4.1., G-UR.4.2., 3.32: S.1.5.7. (1/1/17).

Mark any delivery tickets or recorded representations as appropriate to indicate they were generated as part of an official test and to deter the potential for their misuse. Return all delivery tickets or recorded representations used during the test to the device owner at the end of the test.

## **7.3. Review/Analyze Results.**

After all equipment at a location has been tested, review the results to determine compliance with requirements for equipment maintenance and use of adjustments.

**Code Reference:** 1.10: G-UR.4.1., G-UR.4.3.

## **7.4. Affix Tags and Seals.**

Affix tags and seals as appropriate to designate the disposition of the device.

## **7.5. Record Compliance Action and Explain Results.**

Record the compliance action and disposition of the device on the report and explain the results to the device owner.

As needed, remind the device owner of their responsibility to maintain the equipment, correct abnormal performance, and use adjustments properly.

**Code Reference:** 1.10: G-UR.4.1., G-UR.4.2., G-UR.4.3.