NIST | OFFICE OF WEIGHTS AND MEASURES

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

EPO No. 21

Retail Motor-Fuel Dispensers Single, Dual, and Multi-Product (Except Blenders)

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Table of Contents

EPO No. 21
NIST Examination Procedure Outline (EPO) for
Retail Motor-Fuel Dispensers Single, Dual, and Multi-Product (Except Blenders)

1. Scope.

It is recommended this outline be followed as minimum criteria for examining conventional, single and dual product, power-operated retail dispensers – "gasoline pumps," analog or digital, and consoles. This outline may also be used for multi-product dispensers that share a single hose, but not including those that dispense blended products which are addressed in EPO No. 22 Retail Motor-Fuel Dispensers Blended Products. Nonretroactive requirements are followed by the applicable date in parentheses.

2. Safety Notes.

When excerpting this Examination Procedure Outline for duplication, the NIST 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 and servicepersons be aware of all safety regulations and policies in effect at the inspection site and to practice their employer's safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons of the importance in 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 NIST EPO Safety Annex - "Safety Considerations and Glossary of Safety Key Phrases." The terms and key phrases in each safety reminder of this outline are found in the glossary of the EPO Safety Annex. The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to the device. As a minimum, the following safety precautions should be noted and followed during the inspection.

- **Bonding**
- **Chemicals, Petroleum Products, and Other Hazardous Materials**
- **Clothing**
- **Electrical Hazards**
- **Emergency Action Plan/Procedures**
- **Eye Protection**
- **Fire Extinguisher**
- **First Aid Kit**
- **Grounding**
- **Ignition Sources**
- **Lifting**
- **Location**
- **Nature of Product**
- **Obstructions**
- **Personal Protection Equipment**

  - e.g., Safety Shoes, Non-Synthetic Clothing (avoid sources of static discharge), Safety Vests, Safety Aprons, Gloves, Safety Glasses, Barrier Cream, etc., if deemed necessary
- **Safety Cones/Warning Signs/Other Types of Barriers**
- **Safety Data Sheets (SDSs)**
- **Static Discharge**
- **Switch Loading**
- **Traffic**
- **Transportation of Equipment**
- **Weather**
- **Wet/Slick Conditions**

SAFETY REMINDER!!!

- **Check the inspection site carefully for safety hazards and take appropriate precautions.**
- **Learn the nature of hazardous products at, or near, the inspection site.**
- **Obtain and read copies of SDSs.**
- **Know the emergency procedures and location and operation of fire extinguishers and emergency shut offs.**
- **Post safety cones/warning signs/other types of barriers and be aware of vehicular and pedestrian traffic patterns.**
- **Use caution when moving in wet, slippery areas.**
- **Open both sides of the dispenser to allow fumes to dissipate before proceeding with the inspection of the dispenser.**
- **If leaks, spills, or exposed wiring cause hazardous testing conditions, it is recommended that the testing be discontinued until the unsafe conditions are corrected.**
- **Use personal protective equipment appropriate for the inspection site.**
- **Be sure that 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 HB 44 General Code (Section 1.10) and Liquid-Measuring Devices Code (Section 3.30). 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. Device Location and Normal Access.

The device must be readily accessible for purposes of inspection, testing, and sealing.

Code Reference: 1.10: G-UR.2.3.

3.1.2. Assistance in Testing Procedure.
Assistance in testing shall be provided by the firm if needed.
Code Reference: 1.10: G-UR.4.4.

3.2. Selection and Suitability.

3.2.1. Selection and suitability, general.
Code Reference: 1.10: G-UR.1.1., G-UR.1.2., G-UR.1.3.

3.2.2. Minimum delivery required.
Code Reference: 1.10: G-UR.1.3.

3.2.3. Computing capability.
Code Reference: 3.30: S.1.6.5.(a), UR.3.3.

3.2.4. Delivery hose, length.
Code Reference: 3.30: UR.1.1.

3.2.5. Environment.

3.2.5.1. The device shall be suitable for the environment in which it is installed and used.
Code Reference: 1.10: G-UR.1.2.

3.2.6. 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.
Code Reference: 3.30: UR.2.4.

3.3.3. Installed in accordance with the manufacturer's instructions.
Code Reference: 1.10: G-UR.2.1.

3.3.4. Maximum discharge rate does not exceed the rated maximum discharge rate.
Code Reference: 3.30: UR.2.2.

3.3.5. No obstruction between indicating and recording elements.
Code Reference: 1.10: G-UR.2.2.

3.3.6. Visibility of markings.
Code Reference: 1.10: G-UR.2.1.1.

3.3.7. Position of Equipment.
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.

3.4.2.1. The device and any associated equipment are to be operated and maintained as intended by the device 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.
Code Reference: 3.30: UR.3.1.

3.4.5. Computing capability.
Code Reference: 3.30: UR.3.3.

3.4.6. Steps after dispensing.

3.4.6.1. On/Off mechanism and zero-set-back interlock engaged after delivery and the dispenser nozzle returned to its designed hanging position.
Code Reference: 3.30: UR.3.5.

3.5. Maintenance.

3.5.1. Maintained in proper operating condition.
Code Reference: 1.10: G-UR.4.1., G-UR.4.2.

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.

3.5.4. Use of Adjustments.

3.5.4.1. 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., 3.30: UR.4.1.

3.6. Indicating and Recording Elements.

3.6.1. Design.
Code Reference: 3.30: S.1.1.

3.6.2. Units.
Code Reference: 3.30: S.1.2.1., S.1.2.3.(a), S.1.2.3.(c).

3.6.3. Readability.
Code Reference: 1.10: G-S.5., G-S.6. (1/1/77), G-S.7., 3.30: S.1.4., S.1.5.

Indicating and recording elements must be clear, definite, and easily read.
Code Reference: 1.10: G-S.5., 3.30: S.1.4., S.1.5.

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.
Code Reference: 1.10: G-S.5.3., G-S.5.3.1.

3.6.5. Indication of delivery.
Code Reference: 3.30: S.1.6.1. (portions Nonretroactive 1/1/06).

3.6.6. Computing-Type Devices.

3.6.6.1. Money-Value Computations.
Code Reference: 3.30: S.1.6.5.

3.6.6.2. Money-Value Divisions.

- Analog.
  Code Reference: 3.30: S.1.6.5.1.
- Digital.
  Code Reference: 3.30: S.1.6.5.2.
- Auxiliary Indications.
  Code Reference: 3.30: S.1.6.5.3. (1/1/85).

3.6.7. Unit Price and Product Identity.
Code Reference: 3.30: S.1.6.4.1.(a), S.1.6.4.2., UR.3.2., UR.3.3.

3.6.8. Multiple Unit Price Dispensers.
Code Reference: 3.30: S.1.6.4.1.(b)(1) (1/1/91), S.1.6.4.1.(b)(2), S.1.6.5.(a) (1/1/91), S.1.6.5.4.(a) (1/1/91), S.1.6.5.4.(b), UR.3.3.

3.6.9. Quantity and Total Price Display – except aviation refueling.
Code Reference: 3.30: S.1.6.5.5. (1/1/94).

3.6.10. Quantity and Total Price Display – aviation refueling.
Code Reference: 3.30: S.1.6.5.6. (1/1/08).

3.6.11. Advancement and Return to Zero.
Code Reference: 3.30: S.1.3., S.1.6.3., UR.3.1.

3.6.12. Recorded Representations.

3.6.12.1. General.

Code Reference: 1.10: G-S.5.6.

3.6.12.2. Values of total price, total volume, unit price, and dispenser designation are recorded on a recorded representation containing any one of these.

Code Reference: 1.10: G-S.5.6., 3.30: UR.3.4. (portions Nonretroactive 1/1/21).

3.6.12.3. Aviation Refueling Systems.

Code Reference: 3.30: S.1.6.5.6.(d) (1/1/08).

3.6.12.4. Point of Sale Systems.

Code Reference: 3.30: S.1.6.7.(a-d) (1/1/86), S.1.6.7.(e) (1/1/21).

3.6.12.5. Post-Delivery Discounts.

Code Reference: 3.30: S.1.6.8.(a-d), S.1.6.8.(e) (1/1/21), UR.3.3.

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), 3.30: S.2.2., Table S.2.2. (1/1/95).

A metrologically-significant software change is a sealable event.

Code Reference: 1.10: G-S.9.

3.7.2. Physical Means of Security.

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

3.7.2.1. Accessibility of the Adjusting Mechanism.

When applicable, the adjusting mechanism shall be readily accessible for the purpose of affixing a security seal. 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., 3.30: S.2.2.

3.7.2.2. 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., 3.30: S.2.2.

3.7.3. Audit Trails, General.

3.7.3.1. 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 Devices and Methods of Sealing.

Code Reference: 1.10: G-S.8. (1/1/90), 3.30: S.2.2., Table S.2.2. (1/1/95).

3.7.3.2. 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, the event logger information shall be available at the time of inspection either as a printed copy or in electronic format. Obtain a copy of the event log and attach it to or file it with the inspection report for future reference. Examine these records for any signs of misuse of adjustments.

Code Reference: 1.10: G-S.8. (1/1/90), 3.30: S.2.2., Table S.2.2. (1/1/95).

3.7.3.3. 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 at the time of inspection either as a printed copy or in electronic format. The information may be printed by the device, printed by another on-site device, or transmitted 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: 3.30: S.2.2., Table S.2.2. (1/1/95).

3.7.4. 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).

3.7.5. 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., 3.30: S.2.2., Table S.2.2. (1/1/95).

3.8. Marking.

3.8.1. General.

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., 3.30: S.4.4.2. (1/1/03).

3.8.2. Name or identification of the manufacturer.

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

3.8.3. Model designation.

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

3.8.3.1. Model designation identifier and abbreviations.

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

3.8.4. Nonrepetitive serial number.

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

3.8.4.1. Serial number identifier and abbreviations.

Code Reference: 1.10: G-S.1.(c)(1) (1/1/86), G-S.1.(c)(2) (1/1/01).

3.8.5. Software version or revision identifier, software-based devices.

3.8.5.1. Software version or revision identifier for not-built-for-purpose software-based devices.

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

3.8.5.2. Software version or revision identifier for all software-based devices.

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

3.8.5.3. Software version or revision identifier preface.

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

3.8.5.4. 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).

3.8.5.5. Abbreviations for "version."

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

3.8.6. NTEP CC Number.

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

3.8.6.1. NTEP CC Number identifier.

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

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

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

3.8.8. Location of Marking Information for Retail Dispensers.

- Between 60 cm (24 in) and 150 cm (60 in) from the base of the dispenser (for a system in a dispenser).

  Code Reference: 3.30: S.4.4.2.(a) (1/1/03).
- Externally or internally marked, permanent, and easily read.

  Code Reference: 3.30: S.4.4.2.(b) (1/1/03).
- On a portion of the device that cannot be readily removed.

  Code Reference: 3.30: S.4.4.2.(c) (1/1/03).
- The use of a dispenser key or tool to access internal marking information is permitted for retail liquid-measuring devices.

  Code Reference: 3.30: S.4.4.2.

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

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

3.8.9.1. Name and ID of remanufacturer or distributor.

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

3.8.9.2. Model number if different from the original number.

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

3.8.10. 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.

3.8.11. 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.

3.8.12. Marking, Operational Controls.

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

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

3.8.13. Visibility of required markings after installation.
Code Reference: 1.10: G-UR.2.1.1.

3.8.14. Money-Operated Devices, Responsibility.
Code Reference: 1.10: G-UR.3.4.

3.8.15. Limitation on Use.
Code Reference: 3.30: S.4.1.

3.8.16. Discharge Rates.
Code Reference: 3.30: S.4.4.1. (1/1/85).

3.9. Measuring Elements.

3.9.1. Air/Vapor Elimination.
Code Reference: 3.30: S.2.1.
Effective, automatic means to eliminate air/vapor shall be provided.
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., 3.30: S.2.2., Table S.2.2. (1/1/95).

3.9.2.2. 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.

3.9.3.1. Valves intended to prevent the reversal of flow shall be automatic in operation.
Code Reference: 3.30: S.2.3.

3.9.4. Zero-Set-Back Interlock for Retail Devices.
Code Reference: 3.30: S.2.5.

The device shall be equipped with a zero-set-back interlock such that, after a delivery is completed, the interlock shall prevent subsequent deliveries until indicating and recording elements have been returned to their zero position.
Code Reference: 3.30: S.2.5.(a).

The discharge nozzle cannot be returned to its designed hanging position until the starting lever is in its designed shut-off position.
Code Reference: 3.30: S.2.5.(b).

Multiple Dispensers Supplied by a Single Pump. Dispensers are equipped with an automatic control valve that prevents any product from being delivered until indications on the device are in a correct zero position once any other dispenser in the system is activated.
Code Reference: 3.30: S.2.5.(c).

3.10. Discharge Hose, Retail.

3.10.1. General.

Code Reference: 3.30: S.3.1., S.3.2., S.3.3., S.3.5., S.3.6., S.3.7.

3.10.2. Directional flow valves.

Code Reference: 3.30: S.2.3.

(See Measuring Elements above.)

3.10.3. Diversion, General.

3.10.3.1. Examine the discharge line and valves to ensure that measured liquid cannot be diverted from the measuring chamber of the meter or its discharge line.

Code Reference: 3.30: S.3.1.

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

Code Reference: 3.30: 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 clearly and conspicuously indicated.

3.10.3.3. Outlets for purging and draining the measuring system or for recirculating (if recirculating is required to maintain the product in a deliverable state) shall be permitted only when the system is measuring:

- Food products
- Agri-chemicals
- Biodiesel
- Biodiesel blends

3.10.3.4. Effective, automatic means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the measuring system and to inhibit meter indications (or advancement of indications) and recorded representations while the outlet is in operation.

Code Reference: 3.30: S.3.1.

3.10.3.5. Exceptions to S.3.1. Diversion of Measured Liquid.

Code Reference: 3.30: S.3.1., S.3.2.

The provisions of S.3.1. Diversion of Measured Liquid shall not apply to truck refueling devices when diversion of flow to other than the receiving vehicle:

- cannot be readily accomplished; and
- the diversion is readily apparent.

Allowable deterrents to prevent diversion include, but are not limited to:

- Physical barriers to adjacent driveways.
- Visible valves to show the direction of flow.

- Lighting systems to indicate which outlets are in operation.
- Explanatory signs.

Code Reference: 3.30: S.3.2., UR.2.4.

3.10.4. Leaks.

3.10.4.1. No leaks should exist in the system on the outlet side of the meter.

Code Reference: 1.10: G-UR.4.1., 3.30: 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.

3.10.5. 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. Discharge Hose.

3.10.6.1. Pump Discharge Unit, Wet-Hose Type. A pump discharge unit equipped with a flexible host shall be of the wet-hose type.

Code Reference: 3.30: S.3.3., UR.3.1.

3.10.6.2. Reinforcement. A discharge hose shall be adequately reinforced so that the performance of the device is not affected by the expansion or contraction of the line.

Code Reference: 3.30: S.3.5.

3.10.6.3. Discharge Valve.

A discharge valve may only be installed in the discharge line if the device is of the wet-hose type.

Code Reference: 3.30: S.3.6.

Any other shutoff valve on the discharge line shall be of the automatic or semi-automatic, predetermined stop-type or shall be operable only by means of a tool separate from the device or the mutilation of a physical security seal.

Code Reference: 3.30: S.3.6.

3.10.6.4. Anti-Drain Means.

Code Reference: 3.30: S.3.7.

3.10.6.5. Length-General.

Code Reference: 3.30: UR.1.1.1.

Hose length is measured from the housing or outlet of the discharge line to the inlet of the discharge nozzle.

Code Reference: 3.30: UR.1.1.1.(a).

The hose shall be measured with the hose fully extended.

Code Reference: 3.30: UR.1.1.1.(b).

No longer than 5.5. m (18 ft) unless it can be demonstrated that a longer hose is essential.

Code Reference: 3.30: UR.1.1.1.(c).

An unnecessarily remote location of the device from the fueling point is not a justification for an abnormally long hose.

Code Reference: 3.30: UR.1.1.1.

3.10.6.6. Length and Protection – Marinas and Airports.

Code Reference: 3.30: UR.1.1.2.

The length shall be as short as practicable and shall not exceed 15 m (50 ft) unless it is demonstrated that a longer hose is essential.

Code Reference: 3.30: UR.1.1.2.1.

Hoses exceeding 8 m (26 ft) shall be adequately protected from weather and other environmental factors such as vehicle traffic when not in use.

Code Reference: 3.30: UR.1.1.2.2.

3.10.6.7. Hose Fill/Zero Start. The primary indicating element and recording element (if so equipped) shall be returned to zero before a delivery.

Code Reference: 3.30: UR.3.1.

3.11. Facilitation of Fraud.

3.11.1. Facilitation of Fraud, General.

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.

3.11.2. Automatic Timeout for Pay-at-Pump Retail Devices.

After authorization, the device must de-authorize in three minutes if not activated. If the time limit to deauthorize the device is programmable, it shall not accept an entry greater than three minutes.

Code Reference: 3.30: S.1.6.10. (1/1/17).

3.11.3. Security for Retail Motor-Fuel Devices (RMFDs).

Any RMFD capable of conducting customer-initiated electronic financial transactions must be secured to substantially restrict the ability of unauthorized persons to manipulate it to obtain payment information that could be used to commit fraud. Examples of ways in which such restrictions may be accomplished include, but are not limited to:

- A physical lock, locking device, or a physical securing device that will restrict access to the electronic transaction compartment of the RMFD. OR
- Electronic alarming or disabling of the equipment if unauthorized access is attempted. OR
- Advanced payment acceptance technologies that increase protections against the theft of payment information itself or do not allow access to such information in a form that may be used to commit fraud. OR
- Another security solution that has been approved by the local or state weights and measures jurisdiction with authority.

See paragraph UR.4.2. Security for Retail Motor-Fuel Devices (RMFDs) for additional details.

Code Reference: 3.30: UR.4.2.

3.12. Totalizers.

The device shall be equipped with a nonresettable totalizer.

Code Reference: 3.30: S.5. (1/1/95).

4. Pretest Determinations.

NOTE: Code references used throughout the document are drawn from NIST HB 44 General Code (Section 1.10) and Liquid-Measuring Devices Code (Section 3.30). 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, Section 3. Testing Apparatus.

4.2. Test Draft Size.

Code Reference: 3.30: N.3.4., N.3.5.3.

4.3. Test Measure or Prover Design and Condition.

- Ensure the test measure or prover is of appropriate capacity and has a valid calibration certificate and its security seals are intact.
- Inspect test measure's or prover's interior surface for dents, product clingage, rust, water, or other foreign material.
- Test measure or prover sight glass must be clean and fittings must not leak.

4.4. Tolerances.

4.4.1. Acceptance/Maintenance Tolerances.

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

4.4.2. Application.

Code Reference: 1.10: G-T.3., 3.30: T.1.

4.4.3. Intermediate Values.

Code Reference: 1.10: G-T.4.

4.4.4. 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.

4.4.5. Basic Values.

Code Reference: 3.30: T.2., Table T.2.

4.4.6. Repeatability.

Code Reference: 3.30: T.3.

4.5. Special Test Tolerances.

Special tests are recommended as part of the minimum test procedures for retail motor-fuel dispensers. However, the "Special Test Tolerances" shown in Table T.2. do not apply to these special tests. Instead, the applicable "Acceptance" or "Maintenance" tolerance shown in Table T.2. is to be applied.

Code Reference: 3.30: T.2., Table T.2. Footnote 1.

4.6. Test Liquid.

Code Reference: 3.30: N.1.1.

Verify that the test liquid is the same as that to be commercially measured or is a liquid with the same general physical characteristics. Note the product used during the test on the official report.

4.7. Product Storage Identification.

Code Reference: 3.30: UR.2.5.

5. Test Notes.

NOTE: Code references used throughout the document are drawn from NIST Handbook 44 General Code (Section 1.10) and Liquid-Measuring Devices Code (Section 3.30). 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.

SAFETY REMINDER!!!

- **Wear appropriate personal protection equipment such as petroleum-resistant, nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, and eye protection to prevent injury from splashed product.**
- **Use proper lifting and carrying techniques when lifting and/or moving a test measure!!!**
- **Do not leave an activated dispenser unattended!**
- **Properly apply methods for grounding and bonding the test measure or prover (single/multiple unit(s) when either a portable cart-, truck bed/skid-, or trailer-mounted) and only use a metal funnel when returning product to storage.**

5.1. Totalizers.

To determine the 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 product storage during official tests.

Code Reference: 1.10: G-UR.4.1., G-UR.4.2., 3.30: S.5. (1/1/95).

5.2. Test Equipment Setup and Leveling.

5.2.1. Test Equipment Setup.

Before reading the indications on the test measure or prover, set up and level the test measure or prover.

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.

Properly apply methods for grounding and bonding the test equipment.

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.

5.2.1.1. Leveling Hand-Held Test Measures.

a. Suspend the test measure by the bail handle so that it hangs vertically; or
b. Plumb the neck of the test measure by placing a precision digital electronic or spirit level vertically against the neck on at least two locations 90 degrees apart around the circumference of the neck, adjusting the orientation of the standard until the neck is as close to vertical as possible.

5.2.1.2. Leveling Provers.

a. Check for proper operation of the level indicators on the prover.
b. Prior to dispensing product into the prover, reposition 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).
c. 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 Test Measure or Prover.

If the test measure or prover is dry, it must be prepared for use by first "wetting" it. To wet the test measure or prover, fill it to capacity and empty it following proper drain procedures.

Code Reference: NIST Handbook 105-3.

5.4. Evaporation and Volume Change.

Exercise care so the product temperature in the test measure or 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.

Code Reference: 3.30: N.2.

5.5. Read and Record Results Immediately.

Read and record the indications on the test measure or prover immediately after delivery.

5.6. Eye Level and Reading the Meniscus.

When reading the indications on the test measure or 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.

5.7. 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.

5.8. Drain Procedures.

Handheld test measures require a 30-second (+ 5 s) pour followed by a 10-second drain, with the measure held at a 10- to 15-degree angle from vertical.

Code Reference: 3.30: N.4.4.1.

Bottom drain provers require a 30-second drain after the main flow ceases.

Code Reference: 3.30: N.4.4.2.

See NIST HB 105-3, *Specifications and Tolerances for Reference Standards and Field Standard Weights and Measures, 3. Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards,* 2010, Section 7. Test Methods and References.

5.9. Automatic Timeout for Pay-at-Pump Retail Devices.

For pay-at-pump retail devices, once the device has been authorized, it must de-authorize within three minutes if the device has not been activated. To verify this operation, first authorize the dispenser. Next, without dispensing product, wait three minutes and then attempt to dispense product. The system must not dispense product.

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

Code Reference: 3.30: S.1.6.10. (1/1/17).

5.10. Recorded Representations, Options.

Verify any options for obtaining a recorded representation are appropriate:

- For systems required by the Liquid-Measuring Devices Code 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 receipt (e.g., via cell phone, computer, etc.), the customer may also be given the option of receiving the recorded representation electronically in lieu of or in addition to a hard copy.

Code Reference: 1.10: G.S.5.6.

5.11. Steps After Each Test Draft.

a. Check Recorded Representations. 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.5.6., G-S.5.6.1., 3.30: UR.3.4.

b. Aviation Refueling Systems. For aviation refueling systems, verify that a receipt is available and it includes, at a minimum, the total price, quantity, and unit price.

Code Reference: 3.30: S.1.6.5.6.(d) (1/1/08).

c. Point-of-Sale Systems and Card/Cash Activated Systems, General. 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.

Code Reference: 3.30: S.1.6.7.(a-d) (1/1/86), S.1.6.7.(e) (1/1/21), UR.3.3.

d. Post-Delivery Discounts. For transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash, verify that required information is on the receipt and that a receipt is provided in applications where post-delivery discounts are offered.

Code Reference: 3.30: S.1.6.8.(a-d), S.1.6.8.(e) (1/1/21), UR.3.3.

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

Code Reference: 3.30: S.1.6.5.(a) (1/1/91).

- Digital equipment.

  Code Reference: 1.10: G-S.5.5.
- Analog Equipment.

  Code Reference: 3.30: S.1.6.5.(b), Table 1., N.4.3.2.

f. Check for agreement of values among indications and recorded representations.

Code Reference: 1.10: G-S.5.2.2., 3.30: S.1.6.6.(a)(1), S.1.6.6.(a)(2) (1/1/88), S.1.6.6.(b).

5.12. Display of Quantity and Total Price After Delivery.

Verify that, after a delivery is completed, the quantity and total price are displayed for at least 5 minutes or until the next transaction is initiated by a customer.

Code Reference: 3.30: S.1.6.5.5. (1/1/94), S.1.6.5.6. (1/1/08) (aviation refueling).

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 that equipment is properly maintained and that 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. Multiple Linearization Factors.

For a measuring system capable of being programmed with multiple linearization factors, it is necessary to verify all enabled linearization factors. When any device is adjusted, it is the user's/owner's responsibility to ensure errors are within tolerance and any adjustments which are made are made to bring performance errors as close as practicable to zero value. Verify all enabled linearization factors are appropriate. This verification can be done through physical testing at each of the points where a factor has been enabled or through a combination of physical testing and empirical analysis.

Code Reference: 1.10: G-UR.4.1., G-UR.4.2., G-UR.4.3., 3.30: N.4.5., UR.4.1.

5.15. 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 including 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 = 12 gpm
Maximum flow rate developed in the installation = 50 gpm

The sum of the:
(rated minimum discharge flow rate) + (maximum discharge flow rate developed in the installation)

= 12 gpm + 50 gpm
= 62 gpm

One half of this sum:

62 gpm ÷ 2 gpm = 31 gpm

In this example, any tests conducted on the example retail motor-fuel dispenser at flow rates down to and including 31 gpm are considered "normal" tests.

Code Reference: 3.30: N.4.1.

5.16. 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: 3.30: N.4.2.

Since flow rates can vary during testing based on conditions at the fueling site, 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: 3.30: N.4.2.

For RMFDs and retail dispensers of diesel exhaust fluid (DEF) NOT marked with a minimum flow rate conduct the special test at the slower of the following rates:

- 19 L (5 gal) per minute; or
- The minimum discharge rate at which the device will deliver when equipped with an automatic discharge nozzle set at its slowest setting (when the device is equipped with such a mechanism).

  Code Reference: 3.30: N.4.2.2.(a).

For RMFDs and retail dispensers of diesel exhaust fluid (DEF) marked with a minimum flow rate, conduct the special test at or near the minimum flow rate.

Code Reference: 3.30: N.4.2.2.(b).

SAFETY REMINDER!!!

- **Use proper lifting and carrying techniques when lifting and/or moving a test measure!!!**
- **Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.**
- **Be aware of vehicular and pedestrian traffic when moving between dispenser and storage tanks.**
- **Avoid switch loading! Test devices dispensing low-vapor pressure products (e.g., diesel fuel and kerosene) before testing devices dispensing high-vapor pressure products (e.g., gasoline and ethanol blends up to E85) with the same test measure or prover. Additional precautions may be necessary with other high-vapor pressure products.**

6. Test.

NOTE: Code references used throughout the document are drawn from NIST HB 44 General Code (Section 1.10) and Liquid-Measuring Devices Code (Section 3.30). 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. Normal Test – Full Flow, Basic Tolerance.

Code Reference: 3.30: N.4.1., T.2., Table T.2.

For this and subsequent Normal Tests, verify the maximum discharge rate of the installation does not exceed the marked maximum.

Code Reference: 3.30: S.4.4.1. (1/1/85), UR.2.2.

For this and subsequent tests, verify other conditions of use do not exceed marked or manufacturer-specified limitations.

Code Reference: 1.10: G-UR.3., 3.30: S.4.1.

At the beginning of the first delivery, check for suppressed values.

Code Reference: 3.30: S.1.6.1. (1/1/06).

For this and subsequent tests, re-check the level of the test measure or prover once it is full of liquid and before reading the indication to ensure the weight of the product has not affected the level condition.

If the result of this test is at, near, or exceeds the tolerance limit, repeat the test.

Code Reference: 3.30: T.1., T.2.

If necessary, conduct a "Repeatability Test" as outlined in Step 6.3. below.

6.1.1. Petroleum Product Sampling.[1]

NIST HB 158 *Field Sampling Procedures for Fuel and Motor Oil Quality Testing: A Handbook for Use by Fuel and Oil Quality Regulatory Officials* Section VI. Sampling Procedure for Taking Fuel Samples at Retail Fueling Locations provides more details on how samples are taken, safety, and sampling equipment, for products stored at or near atmospheric pressure.

6.2. Special Test - Slow Flow, Basic Tolerance.

Code Reference: 3.30: N.4.2, N.4.2.2., T.2., Table T.2.

For this and subsequent tests, re-check the level of the test measure or prover once it is full of liquid and before reading the indication to ensure the weight of the product has not affected the level condition.

If the result of this test is at, near, or exceeds the tolerance limit, repeat the test.

If necessary, conduct a "Repeatability Test" as outlined in Step 6.3. below.

6.3. Repeatability Test.

Code Reference: 3.30: N.2., N.3.4., N.4.6., T.3.

If necessary, conduct a repeatability test.

- 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 flow rates marked on the device.
- For devices with no marked minimum and maximum flow rates, the "minimum discharge rates" shall be as specified in "N.4.2.2. Retail Motor-Fuel Devices and DEF Devices" and the "maximum discharge rates" shall be the maximum discharge rate developed under the conditions of the installation.

6.4. Money-Value Computations and Recorded Representations.

Check money-value computations and mathematical agreement on all indicators, including consoles, and recorded representations.

Code Reference: 1.10: G-S.5.5., 3.30: S.1.6.5.

Print a ticket if the device is so equipped and check price computations as outlined in "Test Notes."

Code Reference: 1.10: G-S.5.2.2., 3.30: S.1.6.6.(a), S.1.6.6.(b) (1/1/88).

6.5. Testing with Nonassociated Equipment.

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

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.

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

[1] When taking gasoline samples from single hose multi-product dispensers, the samples should be collected either immediately following an observed sale of the particular grade or product to be sampled, or after sufficient product has been purged from the hose to ensure the sample is representative of the grade or product being sampled. Guidelines for taking samples for octane verification are found in NIST Handbook 130 *Uniform Laws and Regulations in the Areas of Legal Metrology and Fuel Quality*, Part VI. NCWM Policy, Interpretations and Guidelines, Section 2.6.16. Minimum Fuel Flush for Octane Verification and are stated as follows: **"A minimum of 1.2 L (0.3 gallon) of motor fuel shall be flushed from a dispenser before taking a sample for octane verification. The flush shall be returned to the storage tank containing the lowest octane."**

6.6. Anti-Drain Test.

Check the effectiveness of the anti-drain means.

Code Reference: 3.30: S.3.7.

6.7. Zero-Set-Back Interlock.

Code Reference: 3.30: S.2.5.

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

Code Reference: 3.30: S.2.5.(a), S.2.5.(b).

On equipment with remote pumping systems, activate one dispenser and check all others operated by the same pump to make certain they will not operate without activating the individual starting levers.

Code Reference: 3.30: S.2.5.(c).

6.8. Power Loss Test.

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.

Code Reference: 3.30: S.1.6.2.1. (1/1/83), S.1.6.2.2. (1/1/83).

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 or organization policy regarding this test.

7. Post-Test Tasks.

NOTE: Code references used throughout the document are drawn from NIST Handbook 44 General Code (Section 1.10) and Liquid-Measuring Devices Code (Section 3.30). 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), 3.30: S.2.2., Table S.2.2. (1/1/95).

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., 3.30: 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), 3.30: 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 seals as needed.

Code Reference: 1.10: G-UR.4.5., 3.30: S.2.2.

7.2. Record Total Quantity. Note the final totalizer reading and record the total quantity of product dispensed during the test on the official test report. Verify that the totalizers are working correctly.

Code Reference: 1.10: G-UR.4.1., G-UR.4.2., 3.30: S.5. (1/1/95).

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.

SAFETY REMINDER!!!

- **Avoid switch loading! Test devices dispensing low-vapor pressure products (e.g., diesel fuel and kerosene) before testing devices dispensing high-vapor pressure products (e.g., gasoline and ethanol blends up to E85) with the same test measure or prover. Additional precautions may be necessary with other high-vapor pressure products.**
- **Take precautions to isolate equipment when transporting it to avoid exposure to hazardous fumes.**

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