

## National Type Evaluation Program Checklists and Test Procedures for Hydrogen Gas-Measuring Devices

### 1. Indicating Elements, Recording Elements, and Recorded Representations

#### Code Reference: S.1.1. Indicating Elements

- 1.1. A device shall be equipped with a primary indicating element that continuously displays measurement results relative to quantity and total price.  Yes  No  N/A
- 1.2. Is the device equipped with a primary recording element?  Yes  No  N/A

#### Code Reference: S.1.2. Vehicle Fuel Dispensers

- 1.3. Dispensers used to fuel vehicles shall be of the computing type and shall indicate the mass, the unit price, and the total price of each delivery.  Yes  No  N/A

#### Code Reference: S.1.1. Indicating Elements, S.2. Operating Requirements

Primary indicating and recording elements may advance only as a result of the operation of the device. However, means shall be provided for readily returning the device to zero. Once the zeroing operation has begun, it shall not be possible to return primary indicating elements or primary recording elements beyond the correct zero position. It shall not be possible to indicate a value other than the latest measurement, or “zeros” when the zeroing operation has been completed.

- 1.4. Indicating and recording elements shall advance only by the operation of the device (except for clearing the device to zero).  Yes  No  N/A
- 1.5. During the reset operation, it shall not be possible to return primary indicating elements or primary recording elements to any value other than zero.  Yes  No  N/A
- 1.6. During the reset operation, it shall not be possible to indicate a value other than the latest measurement, or “zeros” when the zeroing operation has been completed.  Yes  No  N/A

#### Code Reference: G-S.5.1. Indicating and Recording Elements - General

Indicating elements must be appropriately designed and adequate in amount. Specifically, a device must have sufficient display capacity to indicate the quantities and total prices, if it applies in the normal encountered specific application. Electronic devices shall either have sufficient display capacity to indicate the normal quantities and money values or automatically stop the delivery before exceeding the display capacity of either the quantity or total price. This consideration may apply when evaluating a system that may be used in either a truck stop or an automobile service station.

- 1.7. An electronic digital indicating element shall either:
- 1.7.1. Have adequate display capacity for the application, **OR**  Yes  No  N/A
- 1.7.2. Automatically stop the delivery before exceeding the maximum quantity or maximum total price that can be indicated.  Yes  No  N/A

#### Code Reference: G-S.7. Lettering

- 1.8. All required markings and instructions shall be distinct and easily readable and shall be of such character that they will not tend to become obliterated or illegible.  Yes  No  N/A

#### Code Reference: G-S.5.2.4. and S.1.3.4. Values Defined

- 1.9. Values shall be adequately defined by a sufficient number of figures, words, or combinations to include a zero display for all displayed digits to the right of the decimal mark and at least one to the left.  Yes  No  N/A

**Code Reference: G-S.5.2.2; Digital Indication and Representation; S.2.4.4. Agreement Between Indications**

Basic operating requirements for devices are that:

- All digital values of like value in a system shall agree.
- Digital values shall round off to the nearest digital division that can be indicated or recorded.
- When a digital zero display is provided, the zero indication shall consist of at least one digit to the left and all digits to the right of the decimal point.

For those systems consisting of a console and dispensers and equipped with pre-set quantity, the dispenser must deliver at least the pre-set quantity; it cannot deliver less. For example, if the console sends only the money equivalent of the pre-set volume to the dispenser, the dispenser shall deliver at least the pre-set quantity. It may not stop at the first quantity amount that will result in mathematical agreement with the money value equivalent of the pre-set quantity if the quantity indication is less than the pre-set quantity. Similarly, if a money value is pre-set, the dispenser is not properly designed if it always stops at the lowest quantity value that provides mathematical agreement with the pre-set money value.

Tests for agreement of digital values shall be performed in the post pay, prepay money, and pre-set quantity modes. Agreement should be checked at several unit prices including the maximum unit price and with the dispenser operating at its maximum flow rate.

- 1.10. Digital quantity indications must agree.  Yes  No  N/A
- 1.11. Manual quantity entries in invoice billing systems must be identified as such.  Yes  No  N/A
- 1.12. When delivery from a computing device is based upon a **pre-set quantity**, the quantity indicated on the dispenser and any auxiliary device must be equal to or greater than the pre-set quantity at the conclusion of the transaction.  Yes  No  N/A

**Code Reference: G-S.5.5. Money Values, Mathematical Agreement**

- 1.13. All total sale money value indications in a computing system are primary indications and must agree.  Yes  No  N/A
- 1.14. Any recorded money-value and any digital money-value indication on a computing – type measuring device used in retail trade shall be in mathematical agreement with its associated quantity representation or indication to the nearest 1 cent of money value. (e.g., within each element, the values indicated or recorded must meet the formula)  Yes  No  N/A
- 1.15. The **printed ticket** and dispenser money values shall be in mathematical agreement to the nearest cent.  Yes  No  N/A
- 1.16. The quantity, unit price, and total price indications on the **console** shall be in mathematical agreement with the dispenser and printed ticket.  Yes  No  N/A
- 1.17. The following applies when a quantity value indicated or recorded by an **auxiliary element** such as a console, ticket printer, or remote customer display, is a derived or computed value based on data received from a retail vehicle fuel dispenser.
- 1.17.1. The quantity values indicated or recorded on a console, electronic cash register, or other auxiliary indicating or recording element may differ, however:
- 1.17.1.1. All indicated or recorded total money values for an individual sale shall agree, **AND**  Yes  No  N/A
- 1.17.1.2. The indicated or recorded quantity, unit price, and total sales price values shall be in mathematical agreement.  Yes  No  N/A
- [Quantity x Unit price = Total sales price] to the closest cent.  
 Examples: \$4.5549 rounds to \$4.55  
 \$4.5551 rounds to \$4.56  
 \$4.5550 rounds to either \$4.55 or \$4.56

**Code Reference: S.2.5.1. Auxiliary Elements**

Money value divisions on auxiliary elements such as remote consoles and printers shall be the same as on the primary element. Any recorded money value and any digital money value

indication on a primary indicator must agree mathematically with its associated quantity (volume) representation or indication.

**Formula: Unit Price x Indicated quantity = Total Sale**

1.18. Check mathematical agreement of all primary indications (e.g., dispenser, console, printer) under the following conditions:

- |   |                              |                             |                              |
|---|------------------------------|-----------------------------|------------------------------|
| 1.18.1. At various flow rates, including maximum and minimum.   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| 1.18.2. Closing and reopening the nozzle outlet valve several times during delivery. Check mathematical agreement each time flow is halted.             | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| 1.18.3. At several unit prices including the low prices and the maximum pricing capability of the computer and when operating at the maximum flow rate. | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |
| 1.18.4. Turn the dispenser off during delivery with nozzle outlet valve open.   | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> N/A |

**Code Reference: G-S.5.1. Indicating and Recording Elements/General**

**Discount Pricing**

*NIST Handbook 44* requires that, when a product or grade is offered for sale at more than one unit price through a computing device, the selection of the unit price shall be made prior to delivery using controls on the device or other customer-activated controls.

Should the customer elect to use another method of payment following completion of delivery, the console may be used to recalculate the total price — provided the dispenser complies with all applicable *NIST Handbook 44* requirements. For example, the customer selects the credit card unit price on the dispenser and dispenses product at that unit price. However, the customer discovers that he forgot his credit card and decides to pay cash. In this case, the console might be used to calculate the total price at the cash unit price. In keeping with the intent of National Conference on Weights and Measures action in 1989 to require dispensers to calculate at all unit prices for which a product is offered for sale, it is anticipated that the console would be required to recalculate the new total price using the formula (quantity x unit price = total price). A receipt providing the total quantity, unit price, total computed price, and product identity shall be available through a built-in or separate recording element for all transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash (Code Reference S.2.6. Recorded Representations, Point of Sale Systems) as the transaction was completed. The recorded and displayed total quantity on the receipt and dispenser, respectively, shall agree.

**Selectable Unit Price Capability**

Selectable unit price capability is a design feature that permits the customer to select the unit price for a particular transaction at the time of sale. A dispenser may then allow the unit price for a delivery to be selected from two or more unit prices.

If the customer selects the unit price at the dispenser (e.g., cash or credit price), the selection may be made at any time prior to the start of product flow. The dispenser operating "control" may be activated when the selection is made. A system shall not permit a change to the unit price during delivery of product.

*Note: The term "control" generically refers to the handle, flapper, start button, on/off switch, or other mechanism used to activate or deactivate the dispenser.*

**Code Reference: S.2.5.2. Display of Quantity and Total Price**

After a transaction is completed, the unit price displayed at the dispenser may be changed to a base unit price. However, the quantity and total price must be displayed on the face of the dispenser for at least 5 minutes or until the next transaction is initiated. Any display of quantity, unit price, and total price that does not mathematically agree occurs between transactions. This is permitted (in response to demands of device users) because the displayed values between "transactions" are not "significant" relative to the actual delivery process (transaction.)

The displayed unit price may revert to the base unit price immediately after the completion of a transaction, defined as the time the delivery has been terminated and payment has been settled. The payment may be automatic if the delivery is to a pre-paid amount. If the sale is prepaid, the delivery is considered terminated after the "control" is in the off position or after the nozzle has been returned to the designed hanging position. This will allow the customer adequate time to observe that the prepaid amount has been reached. If the delivery stops short or overruns a prepaid amount, settling the payment means that money is either refunded or collected from the customer and the transaction is "cashed out" by the console operator.

In the case of invoice billing systems, such as card-lock or key-lock systems which compute the total sale price, it is considered not appropriate for the displayed unit price to revert to the base unit price immediately following a transaction. Because a receipt for the transaction may not be available, the customer must be allowed an adequate period of time following the delivery to record the transaction information. The transaction unit price must be displayed for at least 30 seconds, and the total price and the quantity must be displayed for at least 5 minutes following the completion of the delivery or the start of the next transaction. The delivery is considered complete after the "control" is off or the nozzle has been returned to its designed hanging position.

**Code Reference: S.2.4.1. Unit Price and S.2.4.3. Selection of Unit Price**

- 1.19. The selected unit price must be made clearly evident on the dispenser.  Yes  No  N/A
- 1.20. A dispenser may be equipped with means for selecting more than one unit price, provided that the selected unit price cannot be changed after the initial flow begins.  Yes  No  N/A

**Code Reference: S.2.5.2. Display of Quantity and Total Price**

- 1.21. The selected unit price displayed at the dispenser prior to the delivery of product must be continuously displayed at the conclusion of the delivery, after automatic termination by the dispenser or after manual termination by the customer using the controls at the device, until the start of the next transaction by whichever occurs first:
- 1.21.1 Customer initiation of the delivery using the controls at the device, **OR**  Yes  No  N/A
- 1.21.2 "Authorization/Approval" by the console operator.  Yes  No  N/A
- 1.22. When a delivery is completed, the total price and quantity for that transaction shall be displayed on the face of the dispenser for at least 5 minutes or until the next transaction is initiated by using controls on the device or other user-activated (e.g., customer-activated) controls.  Yes  No  N/A
- 1.23. In a system where a base unit price is automatically displayed on the dispenser after the completion of a transaction (e.g., product is dispensed and payment is settled), the dispenser may display the values for quantity, unit price, and total price that do not result in a mathematically correct equation. That is provided when the total price value displayed is divided by the quantity value displayed, the result is a unit price that is "posted" for a particular kind of transaction.  Yes  No  N/A

**Credit Card- or Debit Card-Activated Retail Vehicle Fuel Dispenser**

On card-activated retail vehicle fuel dispensers, the customer authorizes the dispenser by inserting the card or swiping the card through a slot. On credit card transactions, the customer is typically billed through the same methods as have been used for credit transactions handled through a station attendant. On debit card transactions, payment is made directly from the purchaser's account by electronic funds transfer.

- 1.24. A receipt must be available to the customer at the completion of the transaction. The issuance of the receipt may be initiated at the option of the customer.  Yes  No  N/A
- 1.25. The customer receipt must contain the following information:
- 1.24.1. The identity (codes may be used) of the product purchased, the quantity purchased, the unit price, and the total price.  Yes  No  N/A
- 1.26. **Cash Value Card** - A cash value card that is initially encoded with the purchase price, authorizing a customer to purchase products up to the current cash value of the card. The value of the card is decreased in amounts equal to individual transactions.  Yes  No  N/A
- Means shall be provided to the customer to determine the initial cash value of the card and the remaining cash value prior to and after each transaction.
- 1.27. **Invoice Billing** - Invoice billing is a process in which customers are billed for one or more transactions at the end of a billing period.
- 1.27.1. The date, quantity, unit price, and total price shall be recorded and shall agree with the indications on the dispenser.  Yes  No  N/A
- 1.27.2. All displayed transaction information must be shown for at least 30 seconds after completing a delivery or starting the next transaction. The delivery is  Yes  No  N/A

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considered complete after the "control" is off or after the nozzle has been returned to its designed hanging position.

**Code Reference: S.1.3.1. Primary Elements/Units**

- 1.28. A hydrogen gas-measuring device shall indicate, and record if the device is equipped to record, its deliveries in kilograms or decimal multiples or submultiples of the kilogram.  Yes  No  N/A

**Code Reference: S.1.3.2. Numerical Value of Quantity-Divisions and S.1.3.3. Maximum Value of Quantity-Value Divisions**

- 1.29. The value of the scale division for the indicating and recording element must be in values of 1, 2, or 5 and uniform throughout the series. The maximum value of the quantity-value division shall not be greater than 0.5 % of the minimum measured quantity.  Yes  No  N/A

**Code Reference: S.1.4. Value of Smallest Unit**

- 1.30. The value of the quantity division shall not exceed the equivalent of 0.001 kg on devices with a marked maximum flow rate of 30 kg/min or less.  Yes  No  N/A
- 1.31. The value of the quantity division shall not exceed the equivalent of 0.01 kg on devices with a marked maximum flow rate greater than 30 kg/min.  Yes  No  N/A

**Code Reference: S.2.7.; Indication of Delivery and S.3.5. Pressurizing the Discharge Hose**

- 1.32. Retail devices shall automatically show their initial zero condition and amount delivered up to the nominal capacity of the device. The measurement, indication of delivered quantity, and the indication of total sales price shall be inhibited until the fueling position reaches conditions necessary to ensure the delivery starts at zero.  Yes  No  N/A

**Test Method:**

1. Remove nozzle from dispenser and connect to test cylinder. Test cylinder initial pressure should not be greater than 2.5 MPa (360 psig) and should not be less than 2 MPa (290 psi) to simulate an actual delivery.
2. Turn nozzle valve from "OFF" to "FILL" position.
3. Empty discharge hose.
4. Turn nozzle valve to "OFF" position
5. Activate dispenser.
6. Dispenser indications shall not advance.

Yes  No  N/A

**Code Reference: S.2.3. Provisions for Power Loss and S.2.3.1. Transaction Information**

Even if power fails during a delivery, it is still necessary to correctly complete all transactions in progress at the time of the power failure. Quantity and total sales price information shall be recallable for at least 15 minutes after the power failure. The information may be recalled at the dispenser or at the console if the console indications are accessible to the customer. Operator information, such as fuel and money value totals, shall be retained in memory during a power failure. The operator information is not required to be recallable during the power failure, but shall be recallable after power is restored. Test to determine if the indications are accurate when the delivery is continued after a power failure.

*Note: For remote controllers (e.g., cash register, console, etc.) which have the capability to retain information pertaining to a transaction (e.g., stacked completed sales.) If the information cannot be recalled at the dispenser following a power outage, means (e.g., uninterruptible power supply or other means) must be provided to enable the transaction information to be recalled and verified for at least 15 minutes following a power outage.*

**Code Reference: S.2.3.2. User Information**

**Comment [ 1 ]:** This test method is a work in progress based on Field Evaluation and Permanence Tests for Mass Flow Meters (Section I.) and requires further input from industry on various methods employed by hydrogen dispensers to comply with 2.3.5.

- 1.33. The quantity and total sales price shall be recallable for 15 minutes after the power failure.  Yes  No  N/A
- 1.34. The quantity and total sales price values shall be correct if the power fails between deliveries.  Yes  No  N/A
- 1.35. The quantity and total sales price values shall be correct if the delivery is continued after a power failure.  Yes  No  N/A
- 1.36. The operator's information shall be retained in memory during a power failure.  Yes  No  N/A
- 1.37. Remote controllers which stack completed sales must have a means to enable the transaction information to be recalled and verified for at least 15 minutes.  Yes  No  N/A

**Code Reference: S.2.1. Return to Zero**

The primary indicating and recording elements of a retail device shall readily return to a definite zero indication. Key-lock and other self-operated devices must have a zero-return indicating element, but they are not required to have the recording element return to zero. These devices may be equipped with cumulative recording elements. The primary indicating and recording elements shall not go beyond their correct zero position.

- 1.38. Does the device have a primary recording element?  Yes  No  N/A
- 1.39. The indicating and recording elements of a retail device shall be readily returnable to a definite zero indication.  Yes  No  N/A
- 1.40. Key-lock and self-operated devices shall have an indicating element that return to zero.  Yes  No  N/A
- 1.41. Does the device have:
- 1.41.1. A cumulative indicating element?  Yes  No  N/A
- 1.41.2. A cumulative recording element?  Yes  No  N/A
- 1.42. Primary indicating and recording elements shall not go beyond their correct zero position.  Yes  No  N/A

**Code Reference: S.2.4. Display of Unit Price and Product Identity**

A computing or money-operated device shall have a means on the face of the device for displaying the unit price at which it is set to compute or deliver and for posting the product identity. When a product is offered for sale at more than one unit price from a device, then all of the unit prices at which that product is offered for sale shall be displayed or shall be capable of being displayed on the dispenser using controls available to the customer prior to the delivery of the product. The unit price shall be expressed as a decimal value in dollars.

**Code Reference: S.2.4.1. Unit Price, S.2.4.2. Product Identity, and S.2.4.3. Selection of Unit Price**

- 1.43. Means shall be provided to display the unit price on each face of the device.  Yes  No  N/A
- 1.44. Means shall be provided to post on each side of the device the identity of the dispensed product.  Yes  No  N/A
- 1.45. When a product is offered for sale at more than one unit price from a device, then all of the unit prices at which that product is offered for sale:
- 1.45.1. Shall be displayed prior to the delivery of the product, **OR**  Yes  No  N/A
- 1.45.2. Shall be capable of being displayed on the dispenser using controls available to the customer.  Yes  No  N/A
- 1.45.3. A system shall not permit a change to the unit price during delivery of product.  Yes  No  N/A

*Note: It is not necessary to simultaneously display all of the unit prices, provided the dispenser complies with HB 44 section S.2.4.1.*

*The unit prices for each product and price level may be:*

- a. *Displayed simultaneously for all products,*

- b. *Displayed simultaneously for each product separately, OR*  
 c. *Displayed individually in a unit-price display only if controls permit the customer to sequence the display through the unit prices for each and every product.*

1.46. The unit price shall be expressed in dollars and decimals of dollars using a dollar sign. A common fraction shall not appear in the unit price, (e.g., \$4.29 not \$4 29/100).  Yes  No  N/A

**Code Reference: S.2.5.2. Display of Quantity and Total Price**

1.47. When a delivery is completed on a computing device, the total price and quantity for that transaction shall be displayed on the face of the dispenser for at least 5 minutes or until the next transaction is initiated by using controls on the device or other customer-activated controls.  Yes  No  N/A

*Note: The displayed unit price may revert to a base unit price immediately after the completion of a transaction, defined as the time the delivery has been terminated and payment has been settled. Any display of quantity, unit price, and total price that does not mathematically agree occurs between transactions and is permitted (in response to demands of device users) because the displayed values between "transactions" are not "significant" relative to the actual delivery process (transaction.)*

## 2. Computing

**Code Reference: S.2.5. Money-Value Computations**

A hydrogen gas dispenser used to fuel vehicles shall be capable of computing total sale prices for all unit prices and for all deliveries within the range of measurement or computing capacity.

2.1. A retail computing device shall compute total sale prices for all quantities and unit prices within the range of its quantity and computing capacities.  Yes  No  N/A

**Code Reference: S.2.4.4. Agreement between Indications**

2.2. All quantity, unit price, and total price indications shall agree.  Yes  No  N/A

**Code Reference: S.2.5.1. Auxiliary Elements**

2.3. All indicated money value divisions and quantity value divisions on auxiliary elements shall be identical with those of the primary element.  Yes  No  N/A

## 3. Recorded Representations, Point of Sale Systems, and Printed Receipt

A printed receipt shall be available through a built-in or separate recording element for transactions conducted with point-of-sale systems or devices activated by debit cards, credit cards, and/or cash. The printed receipt shall contain the following information for products delivered by the dispenser.

**Code Reference: S.2.6. Recorded Representations, Point of Sale Systems**

- 3.1. A printed receipt shall be available for devices activated by debit cards, credit cards, and/or cash. The printed receipt:  Yes  No  N/A
- 3.1.1. Shall contain the total mass of the delivery;  Yes  No  N/A
  - 3.1.2. Shall contain the unit price;  Yes  No  N/A
  - 3.1.3. Shall contain the total computed price; and,  Yes  No  N/A
  - 3.1.4. Shall contain the product identity by name, symbol, abbreviation, or code number.  Yes  No  N/A

**Code Reference: S.6. Printer**

3.2. Printed information must agree with the indications on the dispenser.  Yes  No  N/A

3.2.1. Printed values shall be clearly defined.  Yes  No  N/A

**Code Reference: S.6.1. Printed Receipt**

- 3.3. Any delivered, printed quantity
- 3.3.1. Shall include an identification number, and;  Yes  No  N/A
- 3.3.2. Shall include the time and date, and;  Yes  No  N/A
- 3.3.3. Shall include the name of the seller.  Yes  No  N/A

**4. Design of Measuring Elements and Measuring Systems**

**Code Reference: S.3.1. Maximum and Minimum Flow-Rates**

- 4.1. The ratio of the maximum to minimum flow-rates for devices measuring gases shall be 10:1 or greater.  Yes  No  N/A

**Code Reference: S.3.2. Adjustment Means**

- 4.2. Means shall be provided to change the ratio between the indicated quantity and the quantity of gas measured by the assembly.  Yes  No  N/A
- 4.2.1. A bypass on the measuring assembly shall not be used for these means.  Yes  No  N/A

**Code Reference: S.3.2.1. Discontinuous Adjustment Means**

- 4.2.2. When the adjusting means changes the ratio between the indicated quantity and the quantity of measured gas in a discontinuous manner, the consecutive values of the ratio shall not differ by more than 0.1%.  Yes  No  N/A

**Code Reference: S.3.3. Provision for Sealing**

Measuring elements shall be designed with adequate provisions to prevent changes from being made to the measuring element or the flow rate control (if the flow rate control affects the accuracy of deliveries) without evidence of the change being made. These provisions can be an approved means of security (e.g., data change audit trail) or physically applying a security seal which must be broken before adjustments can be made. When applicable, the adjusting mechanism shall be readily accessible for the purposes of affixing a security seal.

- 4.3. A measuring element shall have provisions for either:
- 4.3.1. Applying a physical security seal, **OR**  Yes  No  N/A
- 4.3.2. An approved means of security (e.g., data change audit trail) so that no changes may be made to its adjustable components.  Yes  No  N/A
- 4.4. Any adjustable element controlling the delivery rate shall provide for sealing or other approved means of security (e.g., data audit trail) if the flow rate affects the accuracy of deliveries.  Yes  No  N/A
- 4.5. When applicable, the adjusting mechanism shall be readily accessible for the purposes of affixing a security seal.  Yes  No  N/A
- 4.6. Audit trails shall use the format set forth in the Common and General Code Criteria section of this checklist (Code Reference G-S.8 LMD-23) and in Appendix A, Philosophy for Sealing.  Yes  No  N/A
- 4.7. Retail vehicle fuel dispensers with remote configuration capabilities shall be sealed according to Table S.3.3. of NIST HB 44 Section 3.39 Hydrogen Gas-Measuring Devices – Tentative Code and according to Appendix A, Philosophy for Sealing.  Yes  No  N/A

**Code Reference: S.3.4. Automatic Density Correction**

- 4.8. An automatic means to determine and correct for changes in product density due to changes in temperature, pressure, and composition, shall be incorporated in any hydrogen gas-measuring system that is affected by changes in the density of the  Yes  No  N/A

product being measured.

**Code Reference: S.3.6. Zero-Set-Back Interlock, Retail Vehicle Fuel Devices**

The zero-set-back interlock on a dispenser is critical to prevent fraudulent practices. A retail vehicle fuel device shall have an effective automatic interlock such that once the dispenser shuts off, it cannot be restarted without resetting the indicating element to zero. This requirement also applies to the recording element if one is present. The dispenser shall be designed so that the starting lever must be in the shut-off position and the interlock engaged before the discharge nozzle can be returned to its designed hanging position. If a single pump supplies more than one dispenser, then each dispenser shall have an automatic control valve that prevents product from being delivered by a dispenser until its indications have been set to zero.

- 4.9. After the device is turned off by moving the lever that stops the flow, a subsequent delivery shall be prevented until the indicators (and recording element if present) have returned to their correct zero positions.  Yes  No  N/A
- 4.10. The starting lever shall be in shut off position and zero-set-back interlock engaged before the nozzle can 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.  Yes  No  N/A
- 4.11. If more than one dispenser is connected to a single source, an automatic control valve shall prevent fuel from being delivered until the indicating elements have been returned to their correct zero position and engaged.  Yes  No  N/A
- 4.12. The use of the interlock shall be effective under all conditions when any control on the console, except a system emergency shut-off, is operating and after any momentary power failure.  Yes  No  N/A

## 5. Discharge Lines and Valves

**Code Reference: S.4.1. Diversion of Measured Product**

- 5.1. No means shall be provided by which any measured product can be diverted from the measuring device.  Yes  No  N/A

**Code Reference: S.4.2. Directional Flow Valves**

- 5.2. Valves intended to prevent the reversal of flow shall be automatic in operation.  Yes  No  N/A

**Code Reference: S.4.3. Other Valves**

- 5.3. Check valves and closing mechanisms that are not used to define the measured quantity shall have relief valves (if necessary) to dissipate any abnormally high pressure that may arise in the measuring assembly.  Yes  No  N/A

## 6. Markings

**Code Reference: S.5. Marking Requirements**

- 6.1. A measuring system shall be conspicuously, legibly, and indelibly marked with:
- 6.1.1. Pattern approval mark (e.g., type approval number);  Yes  No  N/A
- 6.1.2. Name and address of the manufacturer or his trademark and, required by the weights and measures authority, the manufacturer's identification mark in addition to the trademark;  Yes  No  N/A
- 6.1.3. Model designation or product name selected by the manufacturer;  Yes  No  N/A
- 6.1.4. Non-repetitive serial number;  Yes  No  N/A
- 6.1.5. Accuracy class of the meter as specified by the manufacturer consistent with  Yes  No  N/A

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Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices;

- |  |   |
|--|---|
| 6.1.6. Maximum and minimum flow rates in kilograms per unit of time; | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 6.1.7. Maximum working pressure;                                     | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 6.1.8. Applicable temperature range if other than - 10 °C to +50 °C; | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 6.1.9. Minimum measured quantity (MMQ.);                             | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 6.1.10. Product limitations (such as fuel quality) if applicable.    | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

**Code Reference: S.5.1. Location of Marking Information; Retail Vehicle Fuel Dispensers**

6.2. The marking information required in the General Code, Paragraph G-S.1. Identification shall appear as follows:

- |   |   |
|---|---|
| 6.2.1. Within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser,   | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 6.2.2. Either internally and/or externally provided the information is permanent and easily read and accessible, <b>AND</b> | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 6.2.3. On a portion of the device that cannot be readily removed or interchanged (e.g., not on a service access panel.).    | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

*Note: The use of a dispenser key or tool to access internal marking information is permitted for retail hydrogen-measuring devices.*

**7. Totalizers****Code Reference: S.7. Totalizers for Retail Vehicle Fuel Dispensers**

- |   |   |
|---|---|
| 7.1. Vehicle fuel dispensers shall be equipped with a non-resettable totalizer for the quantity delivered through each separate measuring device. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
|---|---|

**8. Minimum Measured Quantity****Code Reference: S.8. MMQ**

8.1. The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

- |   |   |
|---|---|
| 8.1.1. An MMQ not exceeding 0.5 kg for measuring systems with maximum flow rate less than or equal to 4 kg/min, <b>OR</b>             | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |
| 8.1.2. An MMQ not exceeding 1.0 kg for measuring systems with maximum flow rate greater than 4 kg/min but not greater than 12 kg/min. | <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A |

**9. Card-Activated Hydrogen Gas-Measuring Devices****Code Reference: G-S.2. Facilitation of Fraud**

There is great concern regarding the potential for accidental or intentional fraud when card-activated systems are used in service stations, especially because bank-card-activated systems give direct access to bank accounts. The following criteria and test procedures apply to card-activated retail vehicle fuel dispensers.

A card-activated system shall authorize the dispensing of product for not more than three minutes of the time between authorization and "control" on at the dispenser. It shall properly record transactions on the appropriate card account.

When a card-activated system is subjected to power loss of greater than 10 seconds, the dispenser shall deauthorize. Because systems may be installed with separate power lines to the console, card reader, and dispenser, the different parts of the system should be tested with power failures to evaluate the potential for accidental or intentional errors. The appropriate device response depends upon when the power loss occurs during the delivery sequence.

*Note: The term "control" generically refers to the handle, flapper, start button, on/off switch, or other mechanism used to activate or deactivate the dispenser.*

- 9.1. The dispenser must de-authorize in not more than three minutes if the pump "control" is not turned on.  Yes  No  N/A
- 9.2. If the time limit to deactivate a dispenser is programmable, it shall not accept an entry greater than three minutes.  Yes  No  N/A
- 9.3. When a power loss greater than 10 seconds occurs after the pump "control" is on, the dispenser must de-authorize.  Yes  No  N/A
- 9.4. When there is a loss of power, but the dispenser "control" is not on, the dispenser must de-authorize in not more than three minutes.  Yes  No  N/A

## 10. Test Methods for Card-Activated Retail Vehicle Fuel Dispensers

- 10.1. Authorize the dispenser and, with the pump "control" on, interrupt power to any part (or all) of the system. The pump should de-authorize immediately.  Yes  No  N/A
- 10.1.1. Authorize with a card and turn the "control" on. Power down briefly, then restore power. Try to dispense product; the dispenser must not dispense because the power failure should have de-authorized the dispenser.  Yes  No  N/A
- 10.2. Authorize the dispenser using a card (leaving control off); wait more than three minutes, and try to start the dispenser. It should not start because the authorization should have timed out.  Yes  No  N/A
- 10.2.1. Authorize with a card, but do not turn the "control" on. Power down for more than three minutes, and then restore power. Try to dispense product; the dispenser should have "timed-out" and not dispense.  Yes  No  N/A
- 10.2.2. Authorize and dispense with card #1. Allow the system to time out and de-authorize (if it does). Do not turn off the "control." Authorize and dispense with card #2. The transactions shall be properly recorded for each card.  Yes  No  N/A
- 10.2.3. Authorize with card #1. Turn the "control" on, then off. Authorize with card #2. Dispense product and complete the delivery. Check the printed receipt to verify that the delivery has been properly charged to card #2  Yes  No  N/A
- 10.2.4. Turn the dispenser "control" on, and use a card to authorize the dispenser. Turn the "control" off. After a period of 15 seconds, turn the "control" on. Try to deliver product; the dispenser must not dispense.  Yes  No  N/A
- 10.2.5. Authorize with card #1 (do not turn the "control" on) and interrupt power for at least 10 seconds. This should de-authorize the dispenser. Resupply power; turn the "control" on; try to dispense. The dispenser shall not deliver product.  Yes  No  N/A
- 10.2.6. Authorize with card #1 (turn the "control" on) and interrupt power for at least 10 seconds. This should de-authorize the dispenser. Resupply power; turn the "control" on; try to dispense. The dispenser shall not deliver product.  Yes  No  N/A
- Note: This test is not required if the device under test complies with paragraph 10.1.*
- 10.2.7. Authorize a dispenser with card #1, but do not turn the dispenser "control" on. Try to authorize the same dispenser with card #2; it should not be accepted until after the 3 minute time-out.  Yes  No  N/A
- 10.3. Attempt to override or confuse the card system by varying the length of time the card is in the slot, (e.g., vary the "swipe" times) and pushing all other keys on the keypad during each step of the authorization process.  Yes  No  N/A

## 11. Cash Activated Hydrogen Gas-Measuring Devices

The following criteria and test procedures apply to cash-activated retail vehicle fuel dispensers. Tests using various denominations of bills accepted by the cash acceptor should be performed.

Certificates of Conformance will cover the use of the cash acceptor option at both attended and unattended stations. Cash Acceptors which are used at unattended locations must meet the marking requirements of paragraph G-UR.3.4.

Responsibility, Money-Operated Devices shall be clearly and conspicuously displayed on the device or immediately adjacent to the device information detailing the return of monies paid when the product cannot be obtained.

Even if power is interrupted during a delivery, it is still necessary to correctly complete all transactions in progress at the time of the power interruption. In the event of a power loss, the information needed to complete any transaction in progress at the time of the power loss (such as the quantity and unit price, sales price, or amount of money already inserted into the cash acceptor) shall be determinable for at least 15 minutes at the dispenser or at the console or journal printer if the console or journal printer is accessible to the customer.

All portions of the transaction must be accounted for in order to complete the transaction. This information includes the following: (1) the total amount of money that was inserted into the device prior to the power interruption, (2) the amount of product already dispensed (which should be available from the dispenser and which must comply with the requirements of S.2.3. Provision for Power Loss, (3) and any bill that has been inserted but has not yet been recognized by the cash acceptor.

*Note: For bills that have not yet been drawn into the cash acceptor to the point that the bill is no longer visible, it is assumed that the information on the bill denomination can be obtained from visual examination.*

Various methods may be used to recall specific portions of the transaction depending on how the basic system operates. For example, systems that can print a record of the amount fed into the machine as each bill is fed into the device maintain an ongoing record of bills recognized by the system. Other systems may not print a receipt until the end of the transaction, so the information is recalled on a journal printer accessible to the customer or can be recalled on the cash acceptor display.

Check to see what happens when the power is interrupted at different points of the transaction. Note what occurs at the points where power is interrupted, what information is provided to the customer on the receipt, audibly and visually in the form of instructions or error messages. Because systems may be installed with separate power lines to the console, card reader, and dispenser may be installed, tests should be run with power interruptions to different parts of the system to evaluate the potential for accidental or intentional errors. The appropriate device response depends upon when the power loss occurs during the delivery sequence.

#### Code Reference: S.2.3. Provisions for Power Loss

- 11.1. Systems with Battery Back-up or Uninterruptible Power Supply or Equivalent - Some systems are equipped with a battery back-up or an uninterruptible power supply (or equivalent) which allows a transaction to continue in the event of a power loss. For such systems, the transaction in progress at the time of a power interrupt must continue as if no power interruption had occurred (or comply with the requirements for systems not equipped with a battery back-up.) That is, all bills (including bills being fed into the device at the time of the power loss) must be correctly accounted for, and the quantity and total sale amounts must be mathematically correct. Check these systems by interrupting power at several points in the transaction to ensure that all information (total price, quantity, mathematical agreement, and total dollar amount inserted by the customer) is accounted for correctly.  Yes  No  N/A
- All Other Systems:** To check the operation of systems not equipped with a battery backup, uninterruptible power supply, or equivalent, interrupt power as described below. As noted earlier, if separate power lines supply different components in the system, interrupt power to different parts of the system.
- 11.2. When one or more bills has been accepted and registered by the device, but product has not yet been dispensed, at least one of the following criteria must be met to ensure that this information can be recalled in the event of a power interruption:
- 11.2.1. The denomination of the bill must be printed by the printer on the device as the device recognizes the bill. (The printed receipt must be available to the customer.)  Yes  No  N/A
- 11.2.2. The denomination of each bill must be printed by a journal or other printer accessible to the customer as each bill is recognized by the device.  Yes  No  N/A
- 11.2.3. The running total display must be capable of being recalled for at least 15 minutes.  Yes  No  N/A
- 11.2.4. Means provided to enable the customer to retrieve the money inserted into the  Yes  No  N/A

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device (e.g., a button which can be used during a power interruption to eject the money inserted by the customer.)

- 11.2.5. Other means used to provide a visual or printed record of the total amount of money accepted by the device.  Yes  No  N/A
- 11.3. There is a brief period of time during which a bill has been accepted by the cash acceptor but has not yet been recognized by the device. The following criteria must be met to ensure that this information can be recalled in the event of a power failure.  Yes  No  N/A
- 11.3.1. Means provided to enable the attendant or customer to retrieve the bill (for example, a button which can be used during a power interruption to eject the bill or if the cash acceptor box can be removed by the attendant and the bill retrieved.)  Yes  No  N/A

*Note: There may be a space of time in which a bill can be caught partially in and out of the cash acceptor during a power interruption. In such a case, if the denomination of the bill is visible to the customer and attendant, this is sufficient to provide information about the bill being fed into the device at the time of the power interruption. The cash acceptor must comply with the other applicable items noted above.*

It is expected that the retail vehicle fuel dispenser will comply with paragraph S.2.3. Provision for Power Loss; and the information on the product already dispensed can be recalled through this portion of the system.

- 11.4. Power should be interrupted at different points in the transaction to determine that all transaction information can be recalled in the event of a power interruption including combinations of the following:
- 11.4.1. After one bill has been inserted.  Yes  No  N/A
- 11.4.2. After several bills have been inserted  Yes  No  N/A
- 11.4.3. While a bill is being inserted.  Yes  No  N/A
- 11.4.4. After a bill has been inserted but not yet recognized.  Yes  No  N/A
- 11.4.5. After a bill(s) has been inserted and recognized, but the on/off control is still in the "off" position.  Yes  No  N/A
- 11.4.6. After a bill(s) has been inserted and recognized, the on/off control is in the "on" position, but no product has been dispensed.  Yes  No  N/A
- 11.4.7. After a bill(s) has been inserted and recognized, the on/off control is in the "on" position, and product is being dispensed.  Yes  No  N/A

**Code Reference: G-S.5.1. Indicating and Recording Elements, General**

- 11.5. A running display showing the amount of money fed into the machine must be provided. It is not necessary for this information to be displayed once the customer initiates delivery.  Yes  No  N/A

**Code Reference: S.2.6. Record Representation, Point of Sale Systems**

- 11.6. A printed receipt must be available to the customer from the device at the completion of the transaction. The issuance of the receipt may be initiated at the option of the customer.  Yes  No  N/A
- 11.6.1. The customer receipt must contain the following information:
- 11.6.1.1. The identity (codes may be used) of the product purchased, the quantity purchased, the unit price, and the total price.  Yes  No  N/A
- Because the customer must be provided with the option of receiving a receipt, at unattended devices the system must not accept cash if sufficient paper is not available to complete the transaction.

- 11.7. The cash acceptor must not initiate a cash transaction if either of the following conditions is true:

- 11.7.1. No paper is in the receipt printer of the cash acceptor.  Yes  No  N/A
- 11.7.2. Insufficient paper is available to complete a transaction  Yes  No  N/A

**Code Reference: G-S.6. Marking Operational Controls, Indications, and Features**

- 11.8. Instructions must be marked on the device to inform the customer how to operate the cash acceptor.  Yes  No  N/A

**Code Reference: G-S.2. Facilitation of Fraud**

- 11.9. Means must be provided for the customer to cancel the transaction at any point.
  - 11.9.1. The customer has inserted cash, but has not yet dispensed product. If the customer cancels the transaction by pressing the cancel key (or equivalent key(s)) or by lowering the on/off control, the device must either:
    - 11.9.1.1. Be equipped with means for the customer to retrieve the cash inserted from the device, **AND** Automatically issue a printed receipt indicating the amount tendered and the amount returned,  Yes  No  N/A
    - OR**
    - 11.9.1.2. Display instructions (such as "sale terminated, see attendant," "sale terminated, get receipt" or similar wording) for the customer to see the attendant, **AND** Automatically issue a printed receipt showing the amount of cash inserted by the customer, a statement indicating that the sale was terminated, and instructions for the customer to see the attendant.  Yes  No  N/A
  - 11.9.2. The customer has inserted cash and has started dispensing product. If the customer cancels or discontinues the transaction by pressing the cancel key (or equivalent key(s)) or lowering the on/off control before reaching the total money inserted into the device, the device must:
    - 11.9.2.1. Display instructions for the customer to obtain the receipt and to see the attendant.  Yes  No  N/A
    - 11.9.2.2. Automatically issue a printed receipt showing the amount of cash inserted, the amount dispensed, the balance due to the customer, a statement indicating that the sale was terminated, and instructions for the customer to see the attendant.  Yes  No  N/A

*Note: It is acceptable for different messages to be used. This depends upon whether the transaction is terminated by use of the cancel key, (e.g., "sale terminated, get receipt" or "sale terminated, see attendant") or by lowering the on/off "control" (e.g., "change due, see attendant").*