

Hydrogen Gas-Measuring Devices

It is recommended that this outline be followed as minimum criteria for examining retail motor-fuel dispensers used to measure compressed hydrogen gas. Non-retroactive requirements are followed by the applicable date in parentheses.

SAFETY NOTES

It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place 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 to the importance of taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Prior to beginning any inspection, the inspector should read and be familiar with the EPO Safety Annex - "Safety Considerations and Glossary of Safety Key Phrases." The terms and key phrases in each safety reminder of this outline are found in the glossary 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.

Asphyxiation	Lifting
Chemicals, Petroleum Products, and Hazardous Materials	Location
Clothing	Material Safety Data Sheet (MSDS)
Electrical Hazards	Nature of Product
Emergency Procedures	Personal Protection Equipment e.g., Eye Protections, Safety Shoes
Fire Extinguisher	Safety Cones/Warning Signs
First Aid Kit	Static Discharge
Grounding	Traffic
High Pressure Gas	Transportation of Equipment
Ignition Sources	

Inspectors and service persons are reminded of the importance of evaluating potential safety hazards involved when working with flammable compressed gases

Inspectors and service persons must ensure test equipment is grounded and there is adequate ventilation around power operated equipment.

This Examination Procedures Outline (EPO) for HYDROGEN dispensers is divided into two (2) sections:

32-A. Basic Dispensers, and

32-B. Remote Consoles (Key and Code lock and/or Card Reading Devices, and Receipt/ticket Printing devices).

The majority of hydrogen dispensers incorporate key/code locks, card acceptors, and receipt/ticket printers located in the basic dispenser and are discussed in EPO 32-A. However, key/code locks, card acceptors, and receipt/ticket printers may be located remotely from that dispenser. The remote equipment may have their own separate and distinct requirements for identification, indications, and type approval that are discussed in EPO 32-B.

Equipment List:

The following criteria should be considered when selecting equipment for the test.

Scale

- Intrinsic safety - scale meets Underwriters Laboratory (UL) Area Classification Class 1 Division 2 Group D (scale equipment must be located outside of classified area which is five feet from the hose fueling connection to the dispenser)
- Capacity
- Appropriate division size
- Type of power source

See Section 2.3.1. SOP 8 NIST IR 6969 for information on Scale Selection Criteria.

Mass Standards

- NIST Class F or equivalent

Test Cylinder

- Rating – must be equivalent to or greater than the service pressure marked on the device under test. CGA Type III or IV.
- Compatible fittings
- Bleed valve(s)
- Pressure gauge(s)
- Drain hose
- Means for grounding the
- (Other requirements?)

Optional Equipment:

- Cart
- Test cylinder supports (chocks)
- Weather shield/wind screen (for the weighing operation)

32-A. BASIC DISPENSERS

Introduction

A Hydrogen dispenser used to fuel vehicles shall be of the computing type and shall indicate the mass quantity, unit price, and total price of each delivery. **NOTE:** Computing type, Unit- and total-price indications are not required on devices used exclusively for fleet and/or contract sales.§ 4000 S.1.2. [3.39.]

Pre Test Inspections/Determinations:

1. Pre-Test Safety Inspection.

- Check the inspection site carefully for safety hazards and take appropriate precautions pay particular attention to the condition of the test tank high pressure fitting and hoses.
- Learn the nature of hazardous products used at or near the inspection site; obtain and read copies of Material Safety Data Sheet (MSDS).
- Know emergency procedures and the location and operation of fire extinguishers and emergency shut-off system.
- Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.
- Use personal protection equipment and clothing appropriate for the inspection site.
- Make sure there is adequate ventilation to permit fumes to dissipate before proceeding with the inspection of the dispenser.

- If the product is leaking, or inadvertently released, or exposed wiring cause hazardous testing conditions it is recommended that the testing be immediately discontinued until the unsafe conditions are corrected.
 - Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.
 - Use proper grounding procedures!
 - Use proper low resistance grounding strap with recommended minimum conductance rating and correct connections consistent with the device under test. (See the National Electrical Code or your local Occupational Safety and Health Administration (OSHA) for these requirements.)
 - Determine pressure safety limit of test tank.
 - Check station supply tank delivery pressure to determine if test tank will be suitable for testing.
 - A riser (vent stack) will be necessary when venting to atmosphere. Take extreme caution when venting.
 - Be aware of possible sources of ignition; otherwise, a compressor station with vapor recovery capability will be required.
 - Inspect equipment for leaks, exposed wiring, etc. If it appears unsafe, DO NOT TEST! Report conditions to operator and responsible authority (supervisor, fire marshal, EPA representative, etc.).
2. **Site Selection.** Select a site to locate the scale in the vicinity of the dispenser that is level and protected from wind and weather. Ensure that the scale is given a sufficient warm-up time.
3. **Determine the scale error.**
- Sufficient test weights should be available to verify the gross load to be applied during testing. The scale should be sensitive to 0.03 % or less of the total net weight of the product in the test cylinder. The value of the scale division should not exceed one-tenth of the tolerance applied to the smallest net load delivered through the device.
4. **Scale capacity.** The scale capacity must be sufficient to weigh the test cylinder, optional chocks, and cart when filled to capacity with product.
5. **Markings.** – A measuring system shall be conspicuously, legibly, and indelibly marked with the following information: § 4000 S.5. [3.39]; § 4000 G.S.1. [1.10]
- pattern approval mark (i.e., type approval number);
 - manufacturers or distributor’s name or trademark;
 - model designation or product name;
 - non-repetitive serial number;
 - accuracy class of the device as specified by the manufacturer consistent with Table T.2. Accuracy Class and Tolerances for Hydrogen Gas-Measuring Devices;
 - maximum and minimum flow rates in kilograms per unit of time;
 - maximum working pressure;
 - applicable range of ambient temperatures if other than -50°F to 120°F (-10°C to 50°C);
 - minimum measure quantity (MMQ); and
 - product limitation (such as fuel quality), if applicable.
6. **Type approval.**BPC § 12500.5.

7. **Indicating elements.**

- Readability (must be clear and easily read).§4000 G-S.5.1. [1.10]; §4000-S.1.1. [3.39]
- Return to zero (readily returnable to definite zero). §4000 S.2.1. [1.10]; §4000 UR.3.5. [3.39.]
- Unit price must be displayed on each face of a computing or money operated device.....§4000 S.2.4.1. [3.39.]; §4000 S.1.2.; U.R.3.1. [3.39.]
- Product identity (must be displayed on each face of the dispenser.)§4000 S.2.4.2. [3.39.]
- The mass division shall not exceed 0.001 kg on devices with a marked maximum flow of 30 kg./min/or less; or 0.01 kg on devices marked with a maximum flow of more than 30 kg/min.§4000 S.1.4. [3.39.]
- Power loss Indications (quantity, unit price, or sales price, etc.) shall be available for at least 15 minutes to complete any transaction.§4000 S.2.3.1. [3.39.]
- Selection of unit price shall be made prior to delivery. No change permitted during delivery.§4000 S.2.4.3. [3.39.]
- Dispenser shall have a non-resettable totalizer.§4000 S.7. [3.39.]

8. **Measuring element.**

- Directional flow valves shall be automatic in operation.§4000 S.4.2. [3.39.]

9. **Discharge line.**

- Delivery hose with automatic vent back valve shall automatically pressurize before registration of a delivery.§4000 S.3.5. [3.39.]
- Measured vapor shall not be diverted from a single discharge line during normal operation.§4000 S.4.1. [3.39.]

10. **Automatic density compensation.** Automatic density correction required for mass flow metering systems and volume-measuring devices with automatic temperature compensation.§4000 S.3.4. (a) and (b) [3.39.]

11. **Power to the scale.** Determine availability of electric power if applicable for scale.

12. **Gas Leaks.** Inspect equipment for leaks, exposed wiring, etc. If it appears unsafe, DO NOT TEST. See important safety note on page one of EPO No. 40-A-1.

13. **Scale used for testing.** Ensure scale capacity is large enough to weigh test tank when it is full of product.

14. **The value of the scale division** should not exceed 1/10 of the smallest tolerance applied to the device.§4000 S.2.3.1. [3.39] SOP 8 NIST IR 6969.

15. **Test Weights.** Have sufficient test weights to verify scale's accuracy throughout its range. Use class "F" weights and apply error weight corrections.

16. **Scale Set-up.** Ensure scale is level and free of obstruction prior to testing.

17. **Test drafts.**

The minimum test shall be one test draft at twice the declared minimum measured quantity and one test draft at approximately ten times the MMQ or 1 kg, whichever is greater. More tests may be performed over the range of normal quantities dispensed. . §4002.9 N.3. See T.3. Repeatability

The test draft shall be made at flows representative of that during normal delivery. The pressure drop between the dispenser and the proving system shall not be greater than that for normal deliveries. The control of the flow (e.g., pipework or valve(s) size, etc.) shall be such that the flow of the measuring system is maintained within the range specified by the manufacturer.

MMQ. The device shall be tested for a delivery equal to the declared minimum measured quantity §4000 N.5. [3.39.]

Normal Test. Normal tests are performed at the maximum discharge rate and at flow rates down to the rated minimum are normal tests. §4000 N.6.1. [3.39.]

18. **Repeatability Tests.** Minimum of three consecutive tests drafts of approximately the same size. Ensure variations in temperature, pressure and flow rates are reduced to the extent they do not affect result. §4002.9 N.6.1.1. [3.39.]

5. Tolerances.

5.1. **Normal and special tests.** §4002.9 T.2. [3.39]

The tolerances for hydrogen gas measuring devices are listed in §4002.9 Table T.2. Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices.

Table T.2.			
Accuracy Classes and Tolerances for Hydrogen Gas-Measuring Devices			
Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance
2.0	Hydrogen gas as a vehicle fuel	1.5 %	2.0 %
3.0 ¹		2.0 %	3.0 %
5.0 ¹		4.0 %	5.0 %
10.0 ²		5.0 %	10.0 %
¹ The tolerance values for Accuracy Classes 3.0 and 5.0 hydrogen gas-measuring devices are applicable to devices installed prior to January 1, 2020. ² The tolerance values for Accuracy Class 10.0 hydrogen gas-measuring devices are applicable to devices installed prior to January 1, 2018.			

5.2. **Range of Repeatability Test Results.** The range of test results shall not exceed 40% of the absolute value of maintenance tolerance and each result shall be within applicable tolerance. §4002.9 T.3. [3.39.]

Normal Test

1. **Computer (Indication) jump.** §4000 S.3.5. [3.39.]

- 1.1. Remove nozzle from dispenser and connect to test cylinder. (Test cylinder pressure should not be greater than 350 psi to simulate an actual delivery.)
- 1.2. Activate dispenser to deliver product
- 1.3. Verify that the dispenser delivers the initial pulse into the test cylinder (the sound of gas rushing into the test cylinder will be heard, and the weigh scale will indicate the increasing weight of the gas going into the test cylinder) before dispenser registration of amount dispensed and total price.

2. Test runs.

- 2.1. Record the weight of the empty test tank.
- 2.2. Connect nozzle to test tank. Open manual valve (if equipped).
- 2.3. Turn dispenser on; observe if there is any computer “jump”. If this condition exists, shut dispenser off.
Take appropriate enforcement action. The dispenser shall automatically show its initial zero condition. §4000 S.2.7.; UR.3.5. [3.39.]
- 2.4. Turn nozzle to “on” position and turn on dispenser. Dispense appropriate amount. Observe pressure during delivery. If it exceeds the pressure safety limits of the test tank, manually shut off the dispenser and nozzle.
 - 2.3.1. After delivery, turn nozzle to the “off” position, and disconnect nozzle for test cylinder.
- 2.4. Record the scale indication, dispenser indication, and print a receipt.
- 2.5. Check indications and computations on both sides of the dispenser for accuracy and agreement, if so equipped.§4000 G-S.5.2. [1.10]
- 2.6. Calculate the error of the dispenser. Determine the mass value of product in the test tank (weight of full tank minus weight of empty tank). Subtract this mass value of the product from the mass value indicated by the dispenser. Divide the difference by mass value of the product and multiply by 100. The result is the percent error of the dispenser.
$$\text{Mass value of product} = \text{mass value of full test tank} - \text{mass value of empty tank.}$$
$$\text{Dispenser Error} = \frac{\text{Mass Value indicated by Dispenser} - \text{Mass Value of Product}}{\text{Mass Value of Product}} * 100$$
- 2.7. Apply applicable tolerance.§4002.9 Table T.2. [3.39.]
- 2.8. Return of product to storage.§4000 UR.3.6. [3.39.]

IMPORTANT! Provisions shall be made at the site for returning product to storage or disposing of the product in a safe and timely manner during or following testing operations.

Such provisions may include return lines, or cylinders adequate in size and number to permit the return of hydrogen to the owner. §4000 UR.3.6. [3.39.]

3. Zero-Set-Back Interlock Test.

- 3.1. Remove nozzle from hanging position
- 3.2. Reset computer to zero and turn dispenser “on.”
- 3.3. Attempt to return the nozzle to its designated hanging position without engaging interlock or turning off the dispenser.§4000 S.3.6. [3.39.]
- 3.4. After placing nozzle in its designated hanging position, carefully remove it again and connect nozzle to the test tank and open the test tank valve. Attempt to dispense product by connecting nozzle to the test tank and open the test tank valve. Attempt to dispense product by turning the nozzle toward the “on” position.§4000 S.3.6. [3.39.]
- 3.5. If product flows without resetting the indications to zero, the interlock assembly is not functioning properly.

4. Provision for sealing electronic adjustable components. If the device is designed for a Category I or II sealing method, make sure you seal that portion of the device. You will have to remove the sides of the dispenser to get access. §4000 S.3.3.; Table S.3.3. [3.39]

HYDROGEN REMOTE CONSOLES

32-B. KEY/CODELOCK, CARD ACCEPTOR DEVICES, RECEIPT/TICKET PRINTERS

Some Hydrogen dispensers do not incorporate key locks, card acceptors, and receipt/ticket printers in the main console but are contained in separate or remote consoles. These remote devices have their own separate and distinct requirements for identification, indicating elements, and type approval. If the key locks, card acceptors, and receipt/ticket printers are contained in the main console, use EPO XX-A.

Pre-Test Inspection

1. **Identification.**§4000 G-S.1 [1.10]
 - 1.1. The name, initials, or trademark of the manufacturer or distributor.
 - 1.2. Model number (on identification plate attached to an exterior surface of the console/printer).
 - 1.3. Non-repetitive serial number.
 - 1.4. Software Version number if appropriate.
 - 1.5. Pattern approval mark (i.e., type approval number). §4000 S.5. (a)
2. **Type approval.**BPC Section 12500.5.
3. **Indicating elements.**
 - 3.1. Readability (must be clear and easily read).§4000 G-S.5.1 [1.10]
 - 3.2. Return to zero (readily returnable to definite zero).§4000 S.2.1 [3.39.]
4. **Digital indications.** §4000 G-S.5.2.2 (a) [1.10]
 - 4.1. All digital indications shall agree.
 - 4.2. All mathematical computations shall agree.

Tests

1. **Remote system.**
 - 1.1. Dispense product as outlined in the “Basic Dispenser” test.
 - 1.2. Compare all indications and tickets for digital and mathematical agreement.....
.....§4000 G-S.5.2.2 (a) [1.10] G-S.5 [1.10]
2. **Receipt/ticket printer.** (Price computing type only)
 - 2.1. Printed receipt/ticket must have the unit price, quantity delivered, total price, and product identity. §4000 G-S.5.2.2 (a) [1.10], §4000 S.2.6. [3.39.]
 - 2.2. Printed total quantity must agree with the indicated quantity.
..... §4000 G-S.5.2.2 (a) [1.10], §4000 S.6. [3.39.]
 - 2.3. All digital representations of like values must agree.
..... §4000 G-S.5.2.2 (a) [1.10], §4000 G-S.5.2.2 [1.10]