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Examination Procedure Outline for

Compressed Natural Gas (CNG)
Retail Motor-Fuel Dispensers

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

SAFETY NOTES

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

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. The inspector should read and be familiar with the introductory section on safety found at the beginning of this publication. As a minimum, the following safety precautions should be noted and followed during the inspection. Definitions of each reminder are found in the "Glossary of Safety Key Phrases" at the back of this publication.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors or servicepersons be aware of all safety regulations and policies in place at the inspection site and 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.

Asphyxiation

Chemicals, Petroleum Products, and Hazardous Materials

Clothing

Electrical Hazards

Emergency Procedures

Eye Protection

Fire Extinguisher

First Aid Kit

Grounding

High Pressure Gas

Ignition Source

Lifting

Location

Material Safety Data Sheet (MSDS)

Nature of Product

Personal Protection Equipment

Safety Shoes

Safety Cones/Warning Signs

Static Discharge

Traffic

Transportation of Equipment

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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 hose connection to dispenser)
- capacity
- appropriate division size
- type of power source

See the Appendix to EPO 28 for information on Scale Selection Criteria and Verifying Scale Accuracy.

Mass Standards
- Class F

Test Cylinder
- rating - must be equivalent to or greater than the service pressure marked on the device under test as required by the ANSI/IAS NGV 4.1/CSA 12.5 "NGV Dispensing Systems," Standard for Natural Gas Vehicle Dispensing Systems
- compatible fittings
- bleed valve
- pressure gauge
- drain hose

Note: Service pressure is the settled pressure at a uniform gas temperature of 21 ºC (70 ºF) and full gas content. It is the pressure for which the equipment has been constructed under normal conditions. This is different from the maximum working pressure.

Optional Equipment:
- quick connect ground strap
- cart
- test cylinder supports (chocks)
- weather shield/wind screen (for the weighing operation)

H-44 General Code and
Mass Flow Metering Devices
Code References

Pretest Determinations:

1. Select a site in the vicinity of the dispenser that is level and protected from wind and weather to locate the scale. Ensure that the scale is given a sufficient warm-up time.

2. 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 percent 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 device.

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Pretest Determinations (cont.):

3. Scale capacity must be sufficient to weigh the test cylinder, optional chocks, and cart when filled to capacity with product.

4. Tolerances.
   Applicable requirements ..... G-T., T.1.
   Applicable tolerances in NIST Handbook 44.
   Basic values..... T.2.
   Applicable tolerances for CNG application.

Inspection:

Safety First !!!

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 location and operation of fire extinguisher 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 product is leaking (most CNG contains an odorant), 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.[1]

[1]See the National Electrical Code or your local Occupational Safety and Health Administration (OSHA) for these requirements.

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Inspection (cont.):

1. General considerations.
   - Selection ..... G-UR.1.1.
     - Equipment suitable for service
   - Installation ..... G-UR.2.1., G-UR.2.2., UR.2.1.
     - Installed in accordance with manufacturer's instructions does not adversely affect operation nor impede communications between indicator/recorder
   - Position ..... G-UR.3.3.
     - During direct sales, indications are readable from a reasonable customer and operator position.
   - Accessibility ..... G-UR.2.3.
     - Located or such facilities provided for access to permit inspection, testing, and sealing
   - Assistance ..... G-UR.4.4.
     - If required, operator to provide assistance in testing.
   - Use and maintenance ..... G-UR.3.1., G-UR.4.1.
     - Proper operation and maintenance of equipment

2. Marking ..... G-S.1., S.5., G-UR.2.1.1.
   - Visible markings of the following information:
     - Pattern approval mark.
     - Name and address of manufacturer.
     - Model designation.
     - Model prefix ..... (1/1/03)
     - Nonrepetitive serial number.
     - Serial number prefix ..... (1/1/01)
     - Accuracy class ..... (1/1/95)
     - Maximum and minimum flow rates (quantity/unit time).
     - Maximum working pressure.
     - Applicable temperature range (if other than -10 °C to 50 °C).
     - Minimum measured quantity.
     - Product limitations, if applicable.
     - Remanufacturer information as appropriate
       - Name and ID of manufacturer ..... (1/1/02)
       - Model number if different from original model number ..... (1/1/02)
     - Gasoline volume equivalent conversion factor S.5.1

3. Indicating and recording elements.
   - Design ..... G-S.5.1., S.1.1.
     - Shall have clear accurate indicator
   - Computing type[2] ..... S.1.2.
     - Mass display for inspection and testing
     - (pound displayed ÷ 5.660 = Gasoline Gallon Equivalent (GGE) displayed or
     - kilograms displayed ÷ 0.678 = Gasoline Liter Equivalent (GLE) displayed)
   - Units ..... S.1.3.1.1.
     - Quantity indications in GLE or GGE

[2]Indicates an exception to this requirement for dispensers used exclusively for fleet sales, other price contract sales and truck refueling.

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Inspection (cont.):

- Readability ..... G-S.5., G-S.6. (1/1/77), G-S.7.
  - Appropriate and accurate indicator and recorder
  - Clear and identified operational controls and indicator
  - Lettering is clear and tends not to become obliterated.
- Values of intervals..... G-S.5.3.
  - Values of graduated intervals shall be uniform.
- Maximum value of quantity-value divisions..... S.1.3.3.(b)
  - Value of GLE is not greater than 0.01 GLE.
  - Value of GGE is not greater than 0.001 GGE.
  - Mass division shall not be greater than 0.001 kg or 0.001 lb.
- Auxiliary indications..... S.2.6.1.
  - All money value and quantity divisions are identical to those of the primary element.
- Unit price and product identity..... S.2.5.1., S.2.5.2., S.2.5.3., UR.3.1.
  - Display on each side.
  - Post information in direct sale[2].
  - Selection of unit price[2]
- Advancement and return to zero..... S.2.1., S.2.2., S.2.8., UR.3.7.
- Return indication to zero.
  - Does not return beyond zero position.
  - Reset not operable during delivery.
  - Return primary indicator to zero prior to delivery.
- Provision for sealing..... S.8., G-UR.4.5., S.3.5.
  - Metrological integrity protected by means of security.
  - Affix a seal to adjustment mechanisms.
- Recorded representations, point of sale systems ..... S.2.7.
  - Interface with cash register shall record :
    - Total volume
    - Unit price
    - Total computed price
    - Product identity

4. Measuring elements.
   - Means of security on adjusting mechanism..... S.8., G-UR.4.5., S.3.5.
     Adequate security or sealing for:
     - Measurement element.
     - Adjustable elements that affect accuracy
     - Zero adjustment mechanism.
   - Directional flow valves ..... S.4.3.
     - Prevent flow reversal if it adversely affects device.

5. Discharge hose ..... S.4.1., S.4.4., UR.1.1.
   - No means of product diversion from measuring element.
   - It is apparent if there are two or more delivery outlets.

[2]Indicates an exception to this requirement for dispensers used exclusively for fleet sales, other price contract sales and truck refueling.

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Inspection (cont.):

Discharge valve may be installed on wet-hose type.
Other shutoffs are automatic or semiautomatic predetermined stop type or operable by a separate tool or sealed open by means of security.
Length UR.1.1. (1/1/98)
Pressurizing the discharge hose..... S.3.7.
Discharge hose shall automatically pressurize prior to registration of delivery.

6. Automatic Density Correction..... S.3.6.

Test Notes:

Wear appropriate personal protection equipment such as nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, and eye protection to prevent injury from discharged product or propelled objects.

Be certain the scale is intrinsically safe!
Scale meets Underwriters Laboratory (UL)
Area Classification Class 1 Division 2 Group D
(Equipment location is outside of classified area which is five feet from hose connection to dispenser).

Do not leave an activated dispenser unattended!

Ground test tank and scale properly during return of product.

1. Connect grounding cables to equipment.

2. Determine the tare weight of the test tank and record.
   Repeat this process prior to each delivery.

3. To determine proper operation of totalizer, observe and record the totalizer indications before and after all test drafts ..... S.7.

4. After each test draft:
   a. Print ticket if device is so equipped..... G-S.5.6., UR.3.4.
      All recorded values shall be digital.
      Total-price, quantity, and unit price must be on the receipt.
   b. Check price computations on all indicators (including consoles) and on recorded representations..... G-S.5.5.
      Mathematical agreement of associated quantity or indication to the nearest one cent
   c. Check all indicated and recorded values for proper comparability ..... G-S.5.2.2., S.2.5.4..(a), S.2.5.4.(b)
      Check design of digital indication to determine that:
      Like values agree.
      Values coincide with analog value to nearest minimum graduation.

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Test Notes (cont.):

Value rounds off to nearest minimum unit.
Digital zero display all places to the right, and at least one place to the left of the decimal point.

Tests:

Ground test tank and scale properly during return of product.

Use proper lifting techniques when lifting test tank!

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 product return area.

1. Normal test ..... S.3.7.,N.4., N.6.1, T.2., T.3.
   Computer jump:
   Remove nozzle from dispenser and connect to test cylinder. (Test cylinder pressure should not be greater than 200 psi to simulate an actual delivery.)
   Turn nozzle valve from "OFF" position to "FILL" position.
   Empty discharge hose.
   Turn nozzle valve to "OFF" position.
   Activate dispenser.
   Observe dispenser indications, if computer jump occurs take appropriate action.

NOTE: A test cylinder is not necessary for the computer jump test on dispensers equipped with an autovent system. To test, turn dispenser on and observe the indication display for computer jump when the dispenser shuts off.

Minimum test drafts are as follows:
Place empty test cylinder on the scale.
Access mass display of the dispenser.
Tare weight of the test cylinder, chocks, and stand.
Connect the nozzle to the test cylinder.
Fill the test cylinder to 1/3 capacity full at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error ..... T.2.
Leave product in test cylinder.

Tests (cont.):

Tare the weight of the test cylinder, chocks and stand.

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Connect the nozzle to the test cylinder.
Begin the fill operation with product in the cylinder; fill cylinder to 2/3 capacity at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error ..... T.2.
Tare the weight of the test cylinder, chocks, and stand.
Connect the nozzle to the test cylinder.
Begin the fill operation with product in the cylinder; fill cylinder to capacity at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error ..... T.2.
Return product to owner/operator of dispenser ..... UR.3.8.
Place empty test cylinder on scale (scale may be supported by chocks and stand.)
Tare the weight of the test cylinder, chocks, and stand.
Connect the nozzle to the test cylinder.
Fill test cylinder to capacity at maximum flow rate.

Stop delivery manually if delivery hose pressure exceeds allowable safety limits.

Disconnect the nozzle from the test cylinder.
Compare mass display to scale indication.
Determine dispenser error ..... T.2.
Return product to owner/operator of dispenser.
Repeating previous tests ..... T.3.(a)
Applicable tolerance for multiple tests at the same flow rate
Return product to owner/operator of dispenser.
If the meter minimum measured quantity (MMQ) is less than the smallest test draft, conduct a test at the MMQ value..... N.4.

NOTE: If 300 divisions (d) or 2.27 kilograms (5 pounds) is greater than 1/3 of the test cylinder capacity, then the test cylinder should be emptied to accommodate a delivery of at least 300 d or 2.27 kilograms (5 pounds) otherwise a larger tank is necessary.

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Tests (cont.):

2. Check effectiveness of zero-setback interlock ..... S.3.8., UR3.6., UR.3.7.
   No subsequent delivery until indicating and recording element returned to zero.
   After delivery is complete the dispenser starting lever (mechanism) is shutoff, interlock engaged, and discharge nozzle is in the designed hanging position. (Note: This does not apply to nozzle control.)

   Remove nozzle from hanging position.

   Reset computer to zero and turn on dispenser.

   Attempt to return the nozzle to its designed hanging position, carefully remove nozzle and connect it to the test tank and open valve. Move the dispenser starting lever (mechanism) to "ON" position and attempt to dispense product. (Note: This does not apply to nozzle control.)

   Product should not flow without resetting the indications to zero.

3. Check operation of low-flow cut-off valve ..... UR.2.3.
   Valve shall not be set lower than the minimum flow rate.
   Valve stops registration when flow is below the low-flow cut-off value.

   Connect nozzle to empty test tank and dispense product. Slowly throttle down on the valve on the test tank to the minimum attainable flow rate. Product delivery should not occur below the mass flow meter minimum flow rate.

4 Power loss test ..... S.2.4.1., S.2.4.2.
   Transaction in progress at power loss, information shall be retainable for 15 minutes.
   Device memory shall retain quantity of product and sales price during power loss.

5. Security seal--apply wire security seal to secure adjusting mechanism (if applicable) ..... G-UR.4.5., S.3.5.

   Note on the official report the number of gasoline gallon equivalents of product dispensed during the test.

   After all equipment at a location has been tested, review results to determine compliance with equipment maintenance and use of adjustments..... G-UR.4.1., G-UR.4.3.

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Appendix to EPO No. 28

Compressed Natural Gas (CNG) Retail Motor-Fuel Dispensers

Scale Selection Criteria[3]:

The size of the division relative to the net load has a significant effect on the accuracy to which a meter can be tested. It will also affect the size of the test draft required to evaluate the meter. To keep the "rounding error" (caused by reading a scale to the nearest scale division) to an acceptably small level for a single weighing, the value of the scale division should not exceed one-tenth of the tolerance applied to the CNG dispenser. (For example, if applying the acceptance tolerance of ±1.5 percent to a 50 kg or 100 lb test draft, the scale division should be no greater than 70 g or 0.15 lb; applying the maintenance tolerance of ±2.0 percent the scale division should be no greater than 90 g or 0.20 lb.) The rounding error occurs in both the gross and tare weights, so it could represent as much as two-tenths of the tolerance**. Either a high-resolution scale is needed, error weights should be used, or a larger test draft selected. A combination of these approaches may be used. If the size of the test draft must be small due to the available test cylinder(s) then a scale must be selected with an appropriate division size. If the scale available for testing has a relatively large division size then the size of the test draft must be increased accordingly.**

For example, if a CNG dispenser is to be tested using a scale with a 5 g or 0.01 lb division, error weights should be used to increase readability to the nearest 0.5 g or 0.001 lb for the gross and tare weights. Each weight value is, thus, ±0.5 g or ±0.001 lb or to the nearest 0.5 g or 0.001 lb, but since there are two weighings, gross and tare, the potential for total rounding error is 1 g or 0.002 lb. The acceptance tolerance for a CNG mass flow meter is ±1.5 percent. To limit the error for each weighing to one-tenth of the tolerance, the minimum test draft must be equal to:

$$\frac{(1.0\ g \times 10)}{(0.015)} = 666.67 g = 0.67\ kg \quad \text{or} \quad \frac{(0.002\ lb \times 10)}{(0.015)} = 1.333\ lb$$

Thus, if a scale with 0.5 g or 0.001 lb divisions is used, or a scale with 5 g or 0.01 lb divisions and error weights to 0.5 g or 0.001 lb is used and a tolerance of ±1.5 percent is applied, the minimum test draft is recommended to be at least 0.67 kg or 1.34 lb. Other considerations may apply when determining minimum test draft size such as average customer delivery and meter size. (See also EPO discussion concerning determination of minimum test draft size.)

Verifying Scale Accuracy:

The Fundamental Considerations of Handbook 44, state it is necessary to limit the total error in a standard used without corrections to less than one-third of the tolerance of the device under test. For example, if applying the acceptance tolerance of ±1.5 percent to a CNG meter, this means the scale must be accurate to at least 0.5 percent. Consequently, it is necessary to thoroughly test the scale, verify that its results repeat very well, correct for any errors determined during the scale test, and use the scale properly. This takes considerable time and care under field conditions. For devices with larger applicable tolerances (large test drafts), the requirements for the test may not be as stringent.

[3]The scale selection criteria and minimum test draft size for mass flow meter technology are discussed in the 1987 Report on the Specifications and Tolerances Committee Agenda Item 330-2.