



# **COMPRESSED NATURAL GAS (CNG) and LIQUID NATURAL GAS (LNG)**

## **FUEL DISPENSERS**

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# CNG / NGV

## What is CNG?

CNG stands for **compressed natural gas**.

## What is NGV?

NGV stands for **natural gas vehicle**.



## CNG / NGV

**Is there a difference between compressed natural gas used as a vehicle fuel and the natural gas used to heat your home?**

**They are the same product with one big difference, the pressure involved.**

# Natural Gas Home Verses Vehicle

Home: The natural gas line coming to your home carries around **60 psi** which is reduced at the meter. The pressure at which the natural gas enters the burner of your furnace is around **¼ psi**.

Storage Cascade: The natural gas stored on site for delivery to vehicles is stored at **3600 psi**.

Vehicle: The natural gas stored in the fuel tank on in a vehicle is at **3000 psi** and is reduced to around **26 to 38 psi** when it enters the fuel injectors.



# Are Natural Gas Vehicles New Technology ?

**NOT AT ALL!**

Natural gas has been used for over 50 years to fuel vehicles. The number of natural gas vehicles worldwide exceeded 14.8 million in 2011 with Iran & Pakistan leading the way. The number of natural gas vehicles in the US is still under .25 million with most of these being busses.



## **WHO PRODUCES NATURAL GAS VEHICLES**

In all, more than 28 CNG models are in production globally by Audi, Fiat, Ford, Honda, Hyundai, Lincoln, Mercedes-Benz, Opel, Renault, Toyota and Volkswagen.

## What else is out there for motor fuel?

- **CNG: Compressed Natural Gas**

Lighter than air, large tanks, fills in three minutes

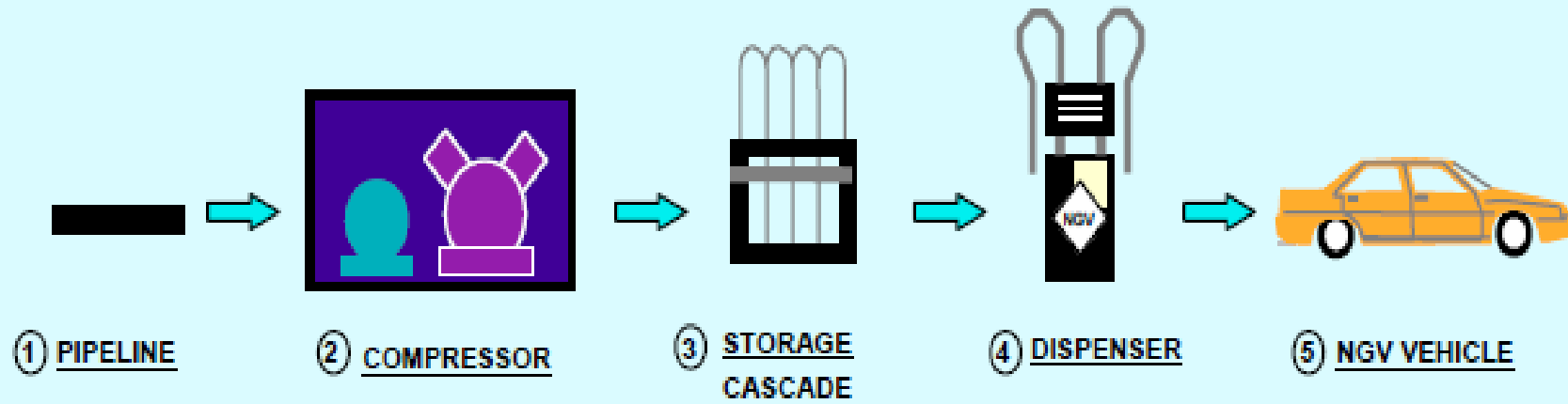
- **LNG: Liquefied Natural Gas**

Stored at  $-260^{\circ}$  F, the tank is smaller but has to be a cryogenic storage vessel

- **LPG: Liquid Petroleum Gas**

Not lighter than air, small storage tank, takes close to 20 minutes to fill

# CNG Station Layout



Gas from the distribution pipeline at pressure of 50-250 psi.

Gas is compressed in 3-4 stages to a maximum pressure of 3600 psi.

Flow rate capacity for a compressor is 200 -750 Nm<sup>3</sup>/hr.

Compressed gas is stored in three banks (high , medium and low) at the maximum pressure of 3600 psi.

Typical total volume for a storage cascade is 500-750 Nm<sup>3</sup>.

Double-hose dispenser with a filling rate of less than three minutes per vehicle.

Gas is stored in The vehicle at 3000 psi.





**Flow rate capacity for a  
compressor is**

**200 – 750 Nm<sup>3</sup> / hr.**

**Typical total volume for a storage  
cascade is**

**500 – 750 Nm<sup>3</sup>.**

# What is Nm<sup>3</sup>?

Nm<sup>3</sup> is a common unit used in industry to refer to gas emissions or exchange. It stands for Normal cubic meter. “Normal” is always dependant on the individual circumstances of each gas, pressure, and use.

What is Nm<sup>3</sup>?

To convert to Cubic Feet  
multiply Nm<sup>3</sup> X 38.04 = Cubic Feet

**“DO NOT LOOK THIS UP IN THE BACK  
OF HANDBOOK 44”**

The **compressor unit** can put out between 7680 to 28,530 cubic feet per hour.



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The **storage cascade** can store between 19,020 and 28,530 cubic feet.



The **storage cascade** can store between 19,020 and 28,530 cubic feet.



What is Nm<sup>3</sup>?

To put this in perspective.

**The average house uses 122,000 cubic feet of natural gas in a year, so the storage cascade holds around 25% of what an average house uses in a year.**



# Natural Gas Fill Valve



# Natural Gas Fill Valve





Photo courtesy of rEason  
Metrology Consulting, LLC



Photo Courtesy of Tulsa Gas Technologies, Inc.



Photo Courtesy of Tulsa Gas Technologies, Inc.







# 4 Basic Types of Tank Designs

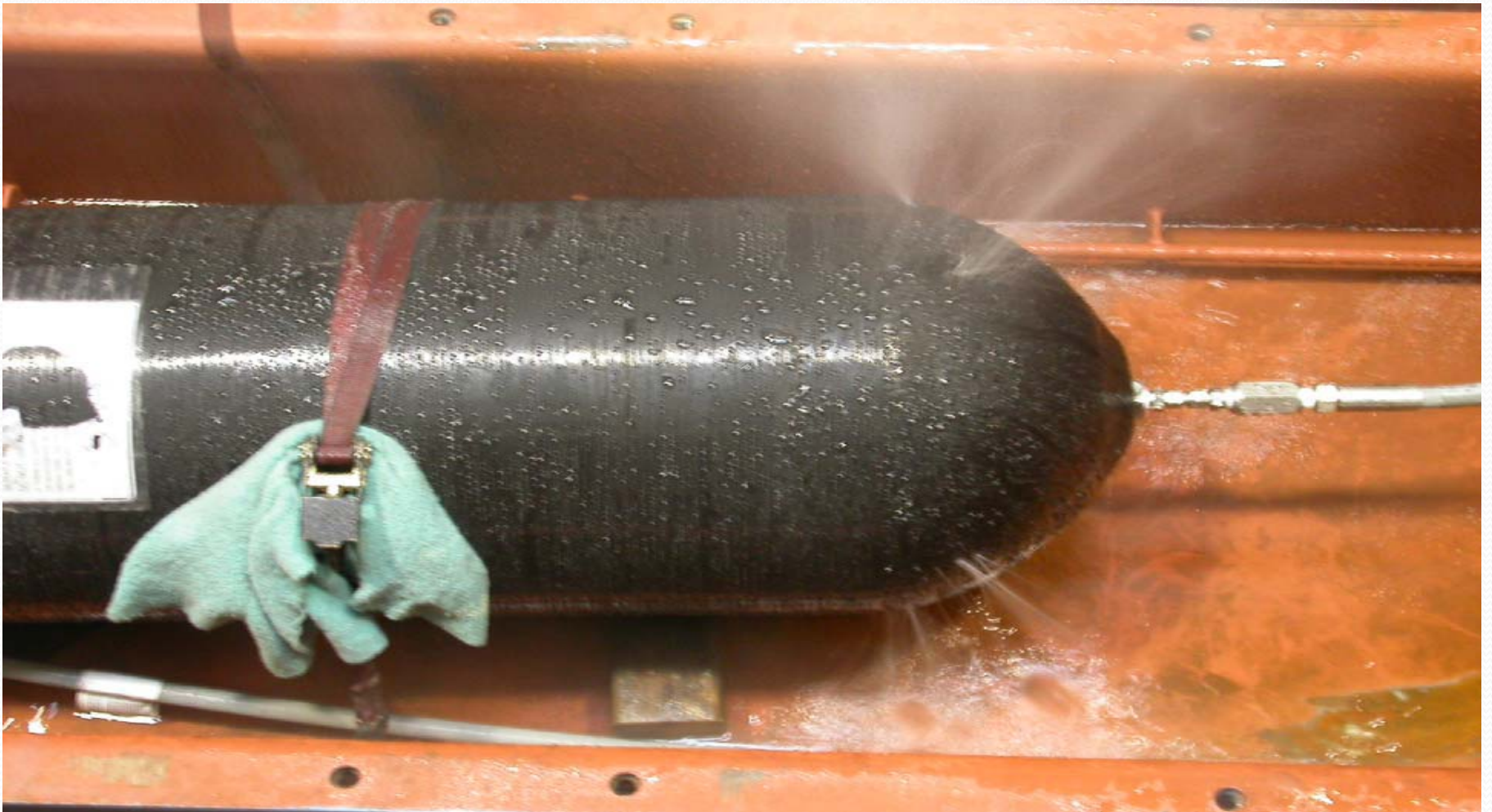
- **Type 1 - All metal (aluminum or steel)**
  - Cheap but heavy
- **Type 2 - Metal liner reinforced by composite wrap (glass or carbon fiber) around middle (“hoop wrapped”)**
  - Liner takes 50% and composite takes 50% of the stress caused by internal pressurization
  - Less heavy, but more cost



- 
- **Type 3 - Metal liner reinforced by composite wrap around entire tank (“full wrapped”)**
    - Liner takes small amount of the stress
    - Light-weight, but expensive
  - **Type 4 - Plastic gas-tight liner reinforced by composite wrap around entire tank (“full wrapped”)**
    - Entire strength of tank is composite reinforcement
    - Light-weight, but expensive

- 
- **Which design to use depends on the need to reduce weight and how much you want to pay.**
  - **All 4 designs have equivalent safety, as all must meet the same requirements and standards.**

# Tanks Must “Leak-Before-Break” Not Rupture



# DISPENSERS



# DISPENSERS





MINIMUM OCTANE RATING  
**128**

1 GASOLINE GALLON EQUIVALENT  
(1 GGE) = 5.66 POUNDS

MINIMUM METHANE  
CONTENT **88%**

FILLING  
PRESSURE



HOSE


**2**

BLUE NOZZLE  
3000 PSI FILL

VENT  
(OFF)

(ON  
FILL)





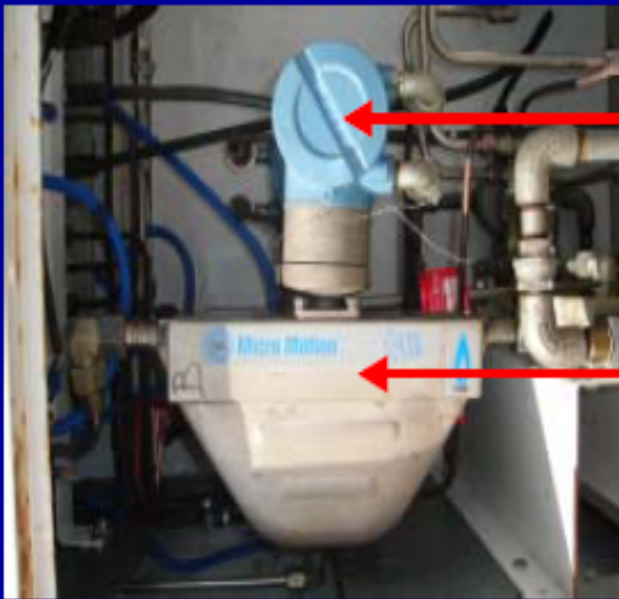
**How do these  
dispensers measure the  
natural gas being sold?**



# CNG 050 Mass Flow Meter

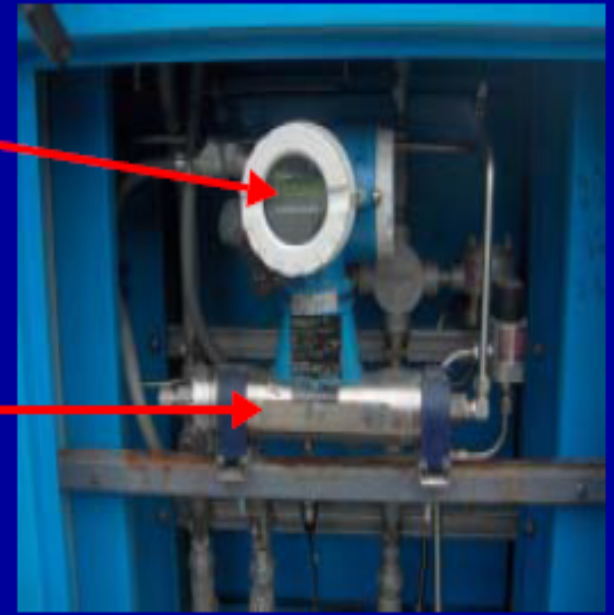


A coriolis meter consists of two primary components: the flow tube assembly (the sensor) and an electronic assembly (the transmitter). The sensor's main components are the flow tubes, a driver for oscillating the flow tubes, flow detector (displacement transducer or pickoffs) which are mounted on either side of the driver.



**Electronic assembly  
(transmitter)**

**Flow tube assembly  
(sensor)**



# Inspection of CNG Dispensers Code Application

- **The H-44 Codes that Apply:**

- 1.10. General Code

- 3.37. Mass Flow Meters

- **The NIST EPO that Applies:**

- No. 28 Compressed Natural Gas Retail Motor  
Fuel Dispensers

- (Updated 2012)*

# Code Similarities

- Many design and user requirements applicable to a retail motor fuel dispensers are the same or similar to those that apply to a CNG dispenser:
  - Zero-set back interlock
  - Diversion of product
  - Display of quantity, unit price, and total sale – for devices that compute
  - Values defined
  - Hose length
  - Steps after dispensing, etc.

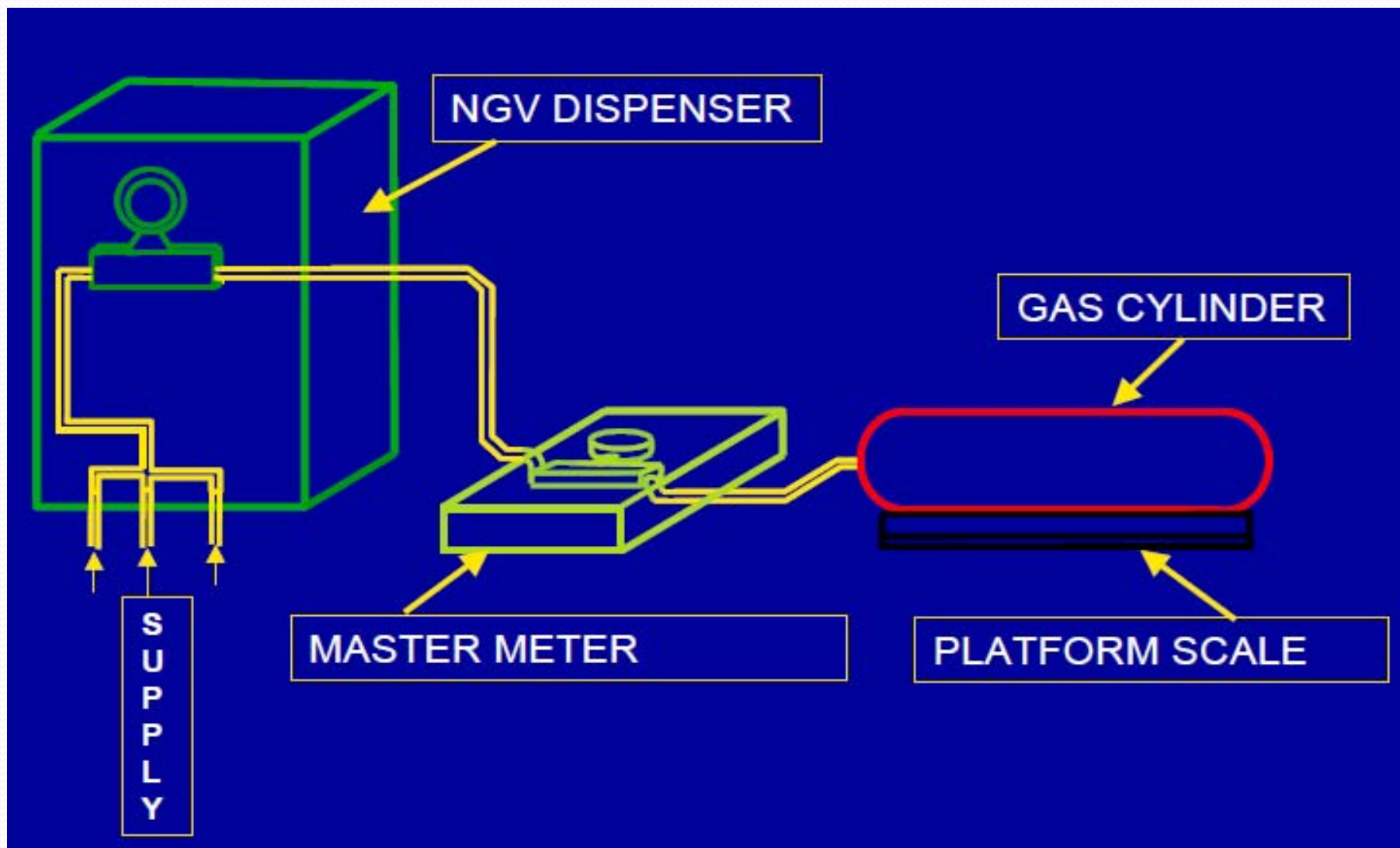
# Testing CNG Dispensers

- There are two methods to test CNG dispensers but only one is accepted by weights and measures at this time
- The first method is by using a Master Meter and the second and approved method is by Gravimetric Testing.

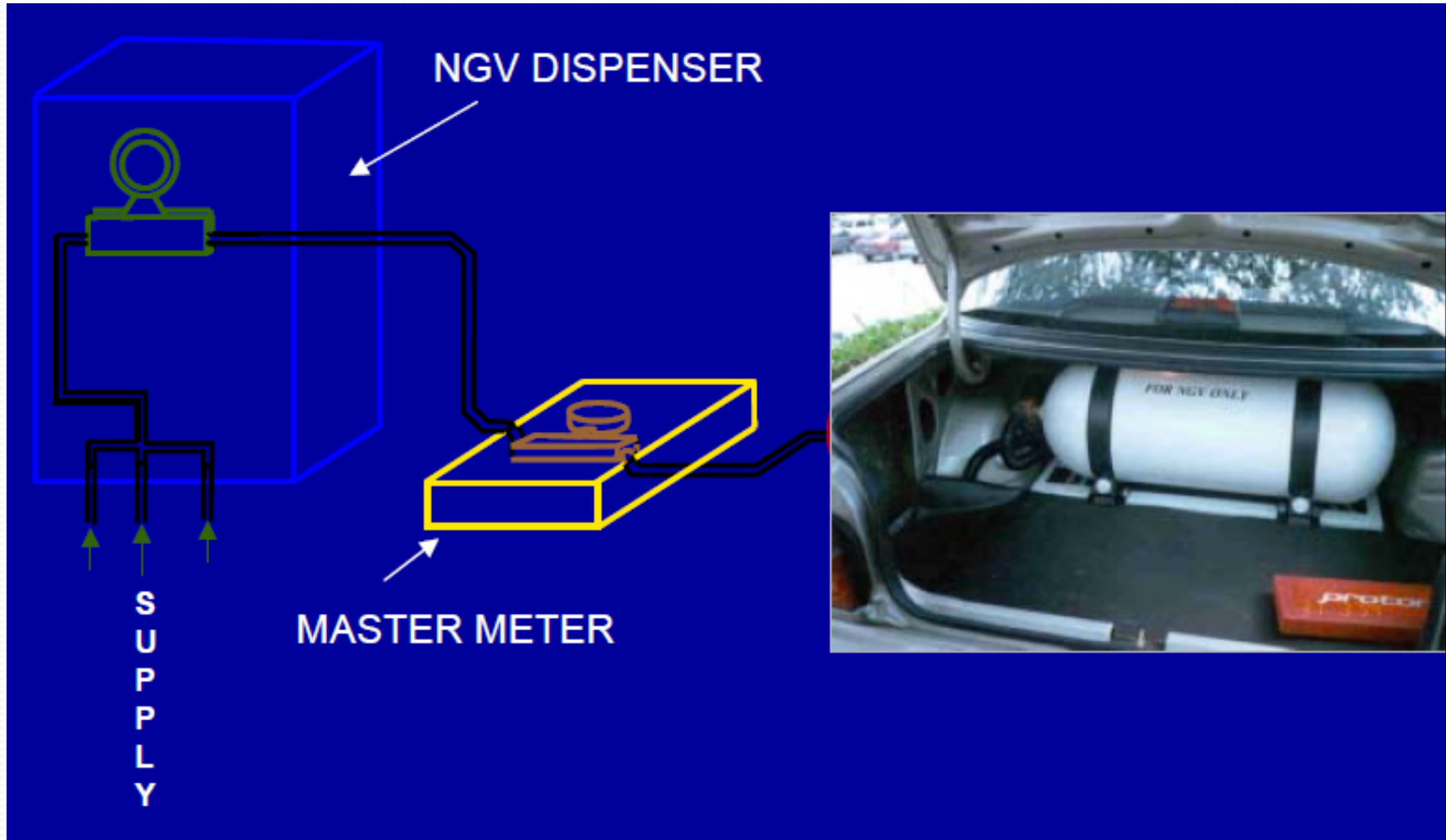
# Master Meters



# Set-up For Master Meter Calibration



# Master Meter Testing







# **SAFETY NOTES**

**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.**

# SAFETY NOTES

- Highly flammable – can be ignited by heat, flames, sparks or other sources of ignition (e.g., static electricity, etc.)  
Set up scale outside of classified area (beyond 5 feet from hose connection to dispenser)
- Ground the test tank when transferring product
- Product is under high pressure (3600 psi)

# SAFETY NOTES

- Skin may freeze if exposed to product and result in frostbite
- CNG is normally treated with an odorant
  - smell for leaks
  - Pay particular attention to the test tank under high pressure
- When released, CNG displaces oxygen – considered an asphyxiant - lighter than air

# SAFETY NOTES

- Synthetic clothing (nylon, polyester, etc.) should not be worn when working around flammable products. Avoid all possibilities of static discharge.
- Know the nature of hazardous products to be tested. Avoid breathing fumes.
- Asphyxiation; When released, CNG displaces oxygen and is considered an asphyxiate

# SAFETY NOTES

- Watch traffic flow at all times. Post safety cones/warning signs.
- Follow all emergency procedures of the location management. Know the location of fire extinguishers and emergency shut off.
- Check for safety hazards - electrical hazards, grounding.

# SAFETY NOTES

- Watch for wet/slippery areas. Wear proper footwear (non-skid).
- Have first aid kit available.
- Watch for possible ignition sources - people smoking, etc.

# SAFETY NOTES

- Open both sides of dispenser to allow fumes to dissipate before proceeding with the inspection.
- Use proper lifting techniques.
- Insure equipment is grounded.
- Be aware of the pressure and temperature of the product.



# **Equipment List**

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

**Scale**

**Mass Standards**

**Test Cylinder**





Equipment: Scale

## **Intrinsic safety –**

(scale equipment must be located outside of classified area which is **five feet** from the hose fueling connection to the dispenser)



Equipment: Scale

## **Capacity -**

The scale capacity must be sufficient to hold the total weights including the test vessel, product, cart and possibly chocks.

# Gravimetric Testing

## Suitable Scale:

Intrinsically safe: must meet Underwriters Laboratory (UL) acceptability for use in weighing Class I, Division 2 product (Volatile Liquid or gas environments )

Of sufficient capacity to weigh a full test cylinder

Appropriate division size to minimize rounding errors

The value of the scale division should not exceed  $1/10$  of the smallest tolerance applied to the device.

# Scale Indicator



# Scale Indicator Markings




# Load Cells 2 hanging S cells



# Scale S-cell markings





# Suitable Scale:

## Handbook 44

### 3.37 Mass Flow Meters

#### Table T.2.

### Accuracy Classes and Tolerances for Mass Flow Meters

Accuracy Class	Application of Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance	Special Tolerance
2.0	- Compressed natural gas as a motor-fuel	1.5%	2.0%	2.0%





## **Equipment: Mass Standards**

- **Class F weights, sufficient test weights should be available to test reference scale to the gross load to be applied during testing.**
- **Small enough for use as error weights**
- **This will include the test vessel, product, cart and possibly chocks.**

# Scale Test with Weights



# Scale Test with Weights



## Equipment: Test Cylinder

- Test cylinder should be of sufficient size to conduct all required tests.
- **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

# Equipment: Test Cylinder

## Compatible fittings

- Bleed valve
- Pressure gauge
- Drain hose
- Means for grounding the cylinder prior to connecting to dispensing equipment such as a quick connect ground strap

**Note:** Service pressure is the settled pressure at a uniform gas temperature of 21 °C (70 °F) 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.

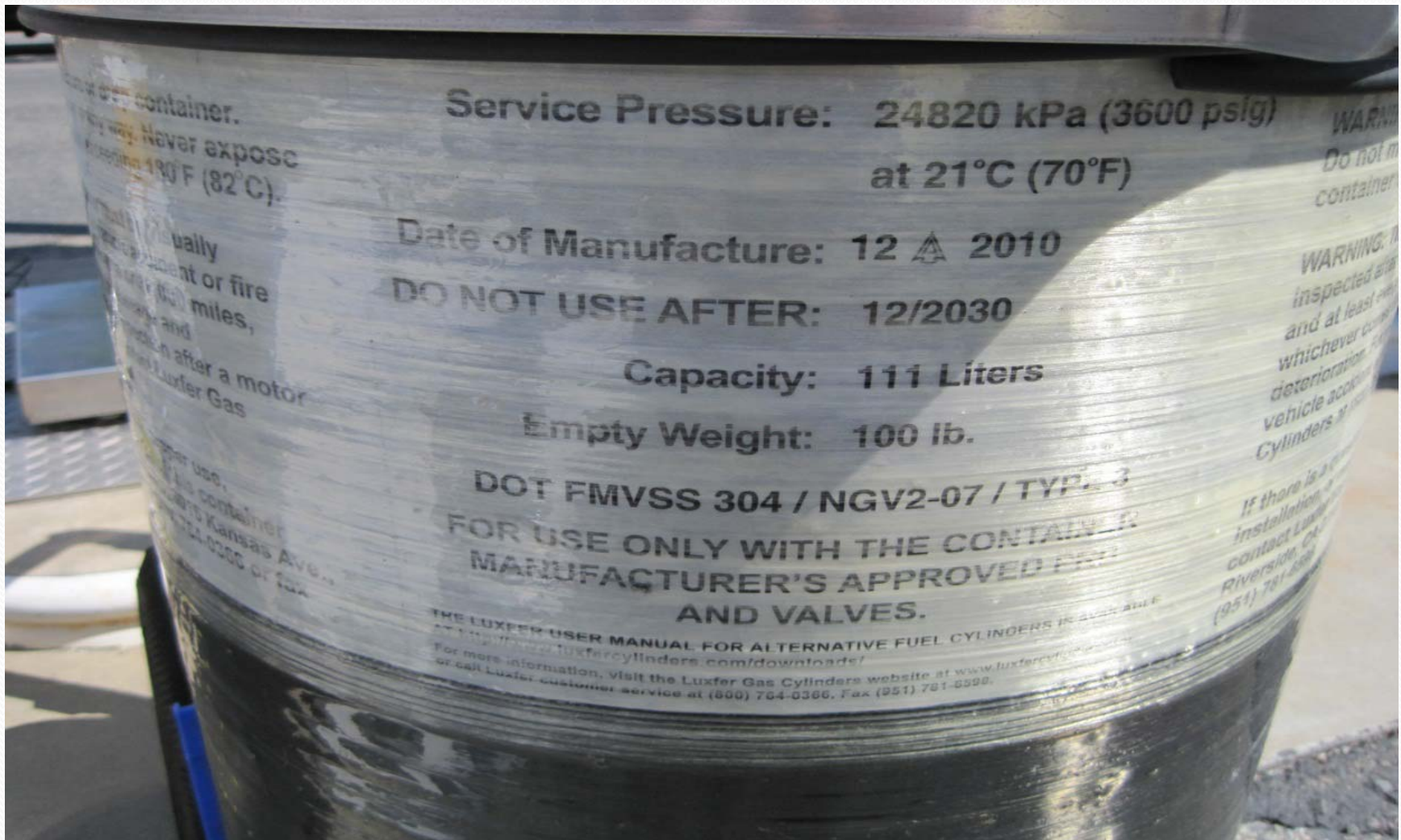
# LNG Test Cylinder



# Test Cylinders



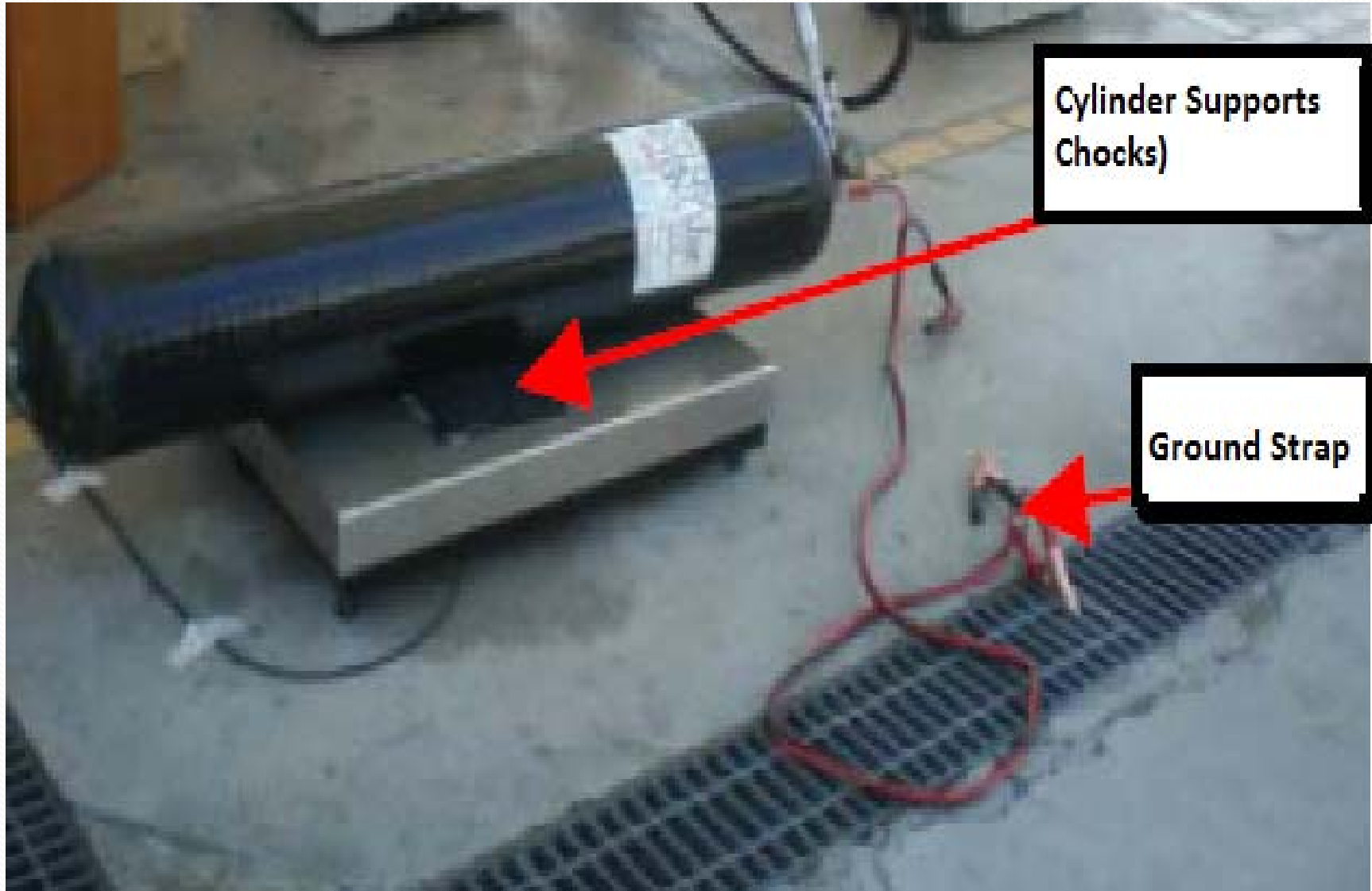
# Test Tank Label





# Optional Equipment

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



Cylinder Supports  
Chocks)

Ground Strap







# **INSPECTION:**

**Handbook 44**

**Appendix A – Fundamental Considerations**

## **4. Inspection of Commercial Equipment**

### **4.1. Inspection Versus Testing.**

## 4.1. Inspection Versus Testing

A distinction may be made between the inspection and the testing of commercial equipment that should be useful in differentiating between the two principal groups of official requirements; i.e.,

**specifications and performance requirements.**

## 4.1. Inspection Versus Testing cont:

Although the term **inspection** is frequently loosely used to include everything that the official has to do in connection with commercial equipment, it is useful to limit the scope of that term primarily to examinations made **to determine compliance with design, maintenance, and user requirements.**

## 4.1. Inspection Versus Testing cont:

The term **testing** may then be limited to those operations carried out to determine the **accuracy of value or performance of the equipment** under examination by comparison with the actual physical standards of the official.



## Appx. A 4.2. Necessity for Inspection

It is not enough merely to determine that the errors of equipment do not exceed the appropriate tolerances.

**Specification and user requirements are as important as tolerance requirements and should be enforced.**

Inspection is particularly important, and should be carried out with unusual thoroughness whenever the official examines a type of equipment not previously encountered.



## Appx. A 4.2. Necessity for Inspection cont:

This is the way the official learns whether or not the design and construction of the device conform to the **specification** requirements.

But even a device of a type with which the official is thoroughly familiar and that he has **previously** found to meet specification requirements should not be accepted entirely on faith.

## Appx. A 4.2. Necessity for Inspection cont:

Some part may have become **damaged**, or some detail of design may have been **changed** by the manufacturer, or the owner or operator may have removed an essential element or made an objectionable addition.



## Appx. A 4.2. Necessity for Inspection cont:

Such conditions may be learned only by inspection.

Some degree of inspection is therefore an essential part of the official examination of every piece of weighing or measuring equipment.

## Appx. A 4.3. Specification Requirements

- A thorough knowledge by the official of the specification requirements is a prerequisite to competent inspection of equipment.
- The inexperienced official should have his specifications before him when making an inspection, and should check the requirements one by one against the equipment itself.



## Appx. A 4.3. Specification Requirements cont:

- Otherwise some important requirement may be overlooked.
- As experience is gained, the official will become progressively less dependent on the handbook, until finally observance of faulty conditions becomes almost automatic and the time and effort required to do the inspecting are reduced to a minimum.



## Appx. A 4.3. Specification Requirements cont:

The printed specifications, however, should always be available for reference to **refresh** the official's memory or to be displayed to support his decisions, and they are an **essential** item of his kit.

Appx. A 4.3. Specification Requirements cont:

- Specification requirements for a particular class of equipment are not all to be found in the separate code for that class.
- The requirements of the General Code apply, in general, to all classes of equipment, and these must always be considered in combination with the requirements of the appropriate separate code to arrive at the total of the requirements applicable to a piece of commercial equipment.





## Appx. A

### 4.4. General Considerations

- The simpler the commercial device, the fewer are the specification requirements affecting it, and the more easily and quickly can adequate inspection be made.
- As mechanical complexity increases, however, inspection becomes increasingly important and more time consuming, because the opportunities for the existence of faulty conditions are multiplied.



Appx. A 4.4. General Considerations cont:

- It is on the relatively complex device, too, that the official must be on the alert to discover any modification that may have been made by an operator that might adversely affect the proper functioning of the device.



Appx. A 4.4. General Considerations cont:

- It is essential for the officials to familiarize themselves with the design and operating characteristics of the devices that he inspects and tests.
- Such knowledge can be obtained from the catalogs and advertising literature of device manufacturers, from trained service persons and plant engineers, from observation of the operations performed by service persons when reconditioning equipment in the field, and from a study of the devices themselves.



Appx. A 4.4. General Considerations cont:

- Inspection should include any auxiliary equipment and general conditions external to the device that may affect its performance characteristics.
- In order to prolong the life of the equipment and forestall rejection, inspection should also include observation of the general maintenance of the device and of the proper functioning of all required elements.

Appx. A 4.4. General Considerations cont:

**The official should look for  
worn or weakened mechanical parts,  
leaks in volumetric equipment,  
or elements in need of cleaning.**



## Note:

What needs checked is not limited to the Compressed Natural Gas - Fuel Dispensers. You may also need to look at a Console Controller, an Electronic Cash Register, a Point of Sale System and possibly an Electronic Payment System.

All of these devices will need to be NTEP approved and have the proper markings. Make sure you have reviewed the NTEP Certificate for the device.



**Note:**

**Be familiar with entire  
Fundamental Consideration  
and General Code Sections  
of Handbook 44.**

## Section 1.10. General Code

### G-A. Application

#### G.A.2.Code Application. –

- This General Code shall apply to all classes of devices as covered in the specific codes.
- The specific code requirements **supersede** General Code requirements in **all** cases of conflict.





Section 1.10. General Code G-A. Application cont:

### **G-A.4. Metric Equipment. –**

- Employment of the weights and measures of the metric system is lawful throughout the United States.
- These specifications, tolerances, and other requirements shall not be understood or construed as in any way prohibiting the manufacture, sale, or use of equipment designed to give results in terms of metric units.



Section 1.10. General Code G-A. Application cont:

## **G-A.5. Retroactive Requirements. –**

“Retroactive” requirements are enforceable with respect to **all** equipment.

Retroactive requirements are printed herein in upright roman type.

## **G-A.6. Nonretroactive Requirements. –**

“Nonretroactive” requirements are enforceable after the effective date for:

- (a) devices manufactured within a state after the effective date;
- (b) both new and used devices brought into a state after the effective date; and
- (c) devices used in noncommercial applications which are placed into commercial use after the effective date.

## **G-UR.1. Selection Requirements.**

### **G-UR.1.1. Suitability of Equipment. –**

Commercial equipment shall be **suitable** for the service in which it is used with respect to elements of its design, including but not limited to its weighing capacity (for weighing devices), its computing capability (for computing devices), its rate of flow (for liquid-measuring devices), the character, number, size, and location of its indicating or recording elements, and the value of its smallest unit and unit prices.



## **G-UR.1.2. Environment. –**

**Equipment shall be suitable for the environment in which it is used including, but not limited to, the effects of wind, weather, and RFI.**



## **G-UR.2.1. Installation. –**

A device shall be installed in accordance with the manufacturer's instructions, including any instructions marked on the device.

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



## **G-UR.2.1.1. Visibility of Identification. –**

Equipment shall be installed in such a manner that all required markings are readily observable.



## **G-UR.2.3. Accessibility for Inspection, Testing, and Sealing Purposes. –**

A device shall be located, or such facilities for normal access thereto shall be provided, to permit:

- (a) inspecting and testing the device;
- (b) inspecting and applying security seals to the device; and





G-UR.2.3. Accessibility for Inspection, Testing, and Sealing Purposes. –

- (c) readily bringing the testing equipment of the weights and measures official to the device by customary means and in the amount and size deemed necessary by such official for the proper conduct of the test.

Otherwise, it shall be the responsibility of the device owner or operator to supply such special facilities, including such labor as may be needed to inspect, test, and seal the device, and to transport the testing equipment to and from the device, as required by the weights and measures official. (Amended 1991)



## **G-UR.4.4. Assistance in Testing Operations. –**

If the design, construction, or location of any device is such as to require a testing procedure involving special equipment or accessories or an abnormal amount of labor, such equipment, accessories, and labor shall be supplied by the owner or operator of the device as required by the weights and measures official.

### **G-UR.3.3. Position of Equipment. –**

A device or system equipped with a primary indicating element and used in direct sales, except for prescription scales, shall be positioned so that its indications may be accurately read and the weighing or measuring operation may be observed from some **reasonable “customer” and “operator”** position.

The permissible distance between the equipment and a reasonable customer and operator position shall be determined in each case upon the basis of the individual circumstances, particularly the size and character of the indicating element.



## **G-UR.3.4. Responsibility, Money-Operated Devices. –**

Money-operated devices, other than parking meters, shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the method for the return of monies paid when the product or service cannot be obtained.



## G-UR.3.4. Responsibility, Money-Operated Devices. –

This information shall include the name, address, and phone number of the local responsible party for the device.

This requirement does not apply to devices at locations where employees are present and responsible for resolving any monetary discrepancies for the customer.

# Contact Information



# Contact and Safety Information



# Attendant Tent





# Safety Information



# Safety Information



## Safety Information



## **Appendix A – Fundamental Considerations**

### **5. Correction of Commercial Equipment**

#### **5.2. When Corrections Should Be Made. –**

If a device conforms to all legal requirements, the official “marks” or “seals” it to indicate approval. If it does not conform to all official requirements, the official is required to take action to ensure that the device is corrected within a reasonable period of time.

## **5.2. When Corrections Should Be Made. –**

Devices with performance errors that could result in serious economic injury to either party in a transaction should be prohibited from use immediately and not allowed to be returned to service until necessary corrections have been made.

The official should consider the most appropriate action, based on all available information and economic factors.



## G-UR.4.5. Security Seal. –

A security seal **shall** be appropriately affixed to any adjustment mechanism designed to be sealed.



# Marking Requirements

## S.5. Markings. –

A measuring system shall be legibly and indelibly marked with the following information:

## Marking Requirements

- (a) pattern approval mark  
(i.e., type approval number);
  
- (b) name and address of the manufacturer or his trademark and, if required by the weights and measures authority, the manufacturer's identification mark in addition to the trademark;



## Marking Requirements

(c) model identifier or product name selected by the manufacturer;

(d) nonrepetitive serial number;

## Marking Requirements

*(e) the accuracy class of the meter as specified by the manufacturer consistent with Table T.2. Accuracy Classes for Mass Flow Meter Applications Covered in NIST Handbook 44, Section 3.37 Mass Flow Meters;\**

*[\*Nonretroactive as of January 1, 1995]*

(f) maximum and minimum flow rates in pounds per unit of time;



## Marking Requirements

- (g) maximum working pressure;
- (h) applicable range of temperature if other than  $-10\text{ }^{\circ}\text{C}$  to  $+50\text{ }^{\circ}\text{C}$ ;
- (i) minimum measured quantity; and
- (j) product limitations, if applicable.



### ***S.5.1. Location of Marking Information; Retail Motor-Fuel Dispensers***

*The marking information required in General Code, paragraph G-S.1. Identification shall appear as follows:*

*(a) within 60 cm (24 in) to 150 cm (60 in) from the base of the dispenser;*

*(b) either internally and/or externally provided the information is permanent and easily read; and*



*S.5.1. Location of Marking Information; Retail Motor-Fuel  
Dispensers*

*(c) on a portion of the device that cannot be readily removed or interchanged (i.e., not on a service access panel).*

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

## S.5.2. Marking of Gasoline Volume Equivalent Conversion Factor. –

A device dispensing compressed natural gas shall have either the statement

“1 Gasoline Liter Equivalent (GLE) is Equal to **0.678 kg** of Natural Gas” or

“1 Gasoline Gallon Equivalent (GGE) is Equal to **5.660 lb** of Natural Gas”

permanently and conspicuously marked on the face of the dispenser according to the method of sale used.

(Added 1994)

## S.5.2. Marking of Gasoline Volume Equivalent Conversion Factor. –

“1 Gasoline Liter Equivalent (GLE) is Equal to **0.678 kg** of Natural Gas”

or

“1 Gasoline Gallon Equivalent (GGE) is Equal to **5.660 lb** of Natural Gas”

### **Note:**

**The Volume Equivalent Conversion Factor DGE (Diesel Gallon Equivalent) is not legal for trade.**

## **G-S.1 Identification**

All equipment, except weights and separate parts necessary to the measurement process but not having any metrological effect, shall be clearly and permanently marked for the purposes of identification with the following information:

**(a) the name, initials, or trademark of the manufacturer or distributor;**



## G-S.1 Identification cont:

### **(b) a model identifier that positively identifies the pattern or design of the device;**

*(1) The model identifier shall be prefaced by the word “Model,” “Type,” or “Pattern.” These terms may be followed by the word “Number” or an abbreviation of that word. The abbreviation for the word “Number” shall, as a minimum, **begin with the letter “N”** (e.g., No or No.). The abbreviation for the word “Model” shall be “Mod” or “Mod.” Prefix lettering may be initial capitals, all capitals, or all lower case.*

*[Nonretroactive as of January 1, 2003] Added 2000) (Amended (2001)*

## G-S.1 Identification cont:

***(c) a nonrepetitive serial number, except for equipment with no moving or electronic component parts and not-built-for-purpose, software-based devices;***

*[Nonretroactive as of January 1, 1968] (Amended 2003)*

*(1) The serial number shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the required serial number.*

*[Nonretroactive as of January 1, 1986]*

*(2) Abbreviations for the word "Serial" shall, as a minimum, begin with the letter "S," and abbreviations for the word "Number" shall, as a minimum, begin with the letter "N" (e.g., S/N, SN, Ser. No., and S. No.).*

*[Nonretroactive as of January 1, 2001]*



G-S.1 Identification cont:

***(d) the current software version or revision identifier for not-built-for-purpose, software-based devices;***

*[Nonretroactive as of January 1, 2004] (Added 2003)*

*The version or revision identifier shall be prefaced by words, an abbreviation, or a symbol, that clearly identifies the number as the **required version or revision.***

*[Nonretroactive as of January 1, 2007] (Added 2006)*



## G-S.1 Identification cont:

*Abbreviations for the word “Version” shall, as a minimum, begin with the letter “V” and may be followed by the word “Number.” Abbreviations for the word “Revision” shall, as a minimum, begin with the letter “R” and may be followed by the word “Number.” The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.).*

*[Nonretroactive as of January 1, 2007] (Added 2006)*

## G-S.1 Identification cont:

***(e) an NTEP Certificate of Conformance (CC) number or a corresponding CC Addendum Number for devices that have a CC.***

*The CC Number or a corresponding CC Addendum Number shall be prefaced by the terms “NTEP CC,” “CC,” or “Approval.” These terms may be followed by the word “Number” or an abbreviation of that word.*

*The abbreviation for the word “Number” shall, as a minimum, begin with the letter “N” (e.g., No or No.).*

*[Nonretroactive as of January 1, 2003]*



## **G-UR.2.1.1. Visibility of Identification**

Equipment shall be installed in such a manner that all required markings are readily observable.

(Added 1978)

## **G-S.1 Identification cont:**

### ***G-S.1.1. Location of Marking Information for Not-Built-For-Purpose, Software-Based Devices. –***

*For not-built-for-purpose, software-based devices either:*

- (a) The required information in G-S.1 Identification. (a), (b), (d), and (e) shall be permanently marked or continuously displayed on the device; or*
  
- (b) The Certificate of Conformance (CC) Number shall be:*
  - (1) permanently marked on the device;*
  - (2) continuously displayed; or*
  - (3) accessible through an easily recognized menu and, if necessary, a submenu. Examples of menu and submenu identification include, but are not limited to, “Help,” “System Identification,” “G-S.1. Identification,” or “Weights and Measures Identification.”*

## **G-S.1 Identification cont:**

***G-S.1.1. Location of Marking Information for Not-Built-For-Purpose, Software-Based Devices.*** – *For not-built-for-purpose, software-based devices either:*

***Note:*** *For (b), clear instructions for accessing the information required in G-S.1. (a), (b), and (d) shall be listed on the CC, including information necessary to identify that the software in the device is the same type that was evaluated.*

*[Nonretroactive as of January 1, 2004]*

*(Added 2003) (Amended 2006)*



## **G-S.1 Identification cont:**

***G-S.1.2. Remanufactured Devices and Remanufactured Main Elements.*** – All remanufactured devices and remanufactured main elements shall be clearly and permanently marked for the purposes of identification with the following information:

- (a) the name, initials, or trademark of the last remanufacturer or distributor;*
  
- (b) the remanufacturer's or distributor's model designation if different than the original model designation.*

*[Nonretroactive as of January 1, 2002]*

(Added 2001)

## **G-S.1 Identification cont:**

### ***G-S.1.2. Remanufactured Devices and Remanufactured Main Elements. –***

**Note:** Definitions for “manufactured device,” “repaired device,” and “repaired element” are also included (along with definitions for “remanufactured device” and “remanufactured element”) in Appendix D, Definitions.



## **S.1.2. Compressed Natural Gas Dispensers. –**

Except for fleet sales and other price contract sales, a compressed natural gas dispenser used to refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery.



## S.1.2. Compressed Natural Gas Dispensers. –

The dispenser shall display the mass measured for each transaction either continuously on an external or internal display accessible during the inspection and test of the dispenser, or display the quantity in mass units by using controls on the device.

(Added 1994)

## **S.1.3. Units**

### **S.1.3.1.1. Compressed Natural Gas Used as an Engine Fuel. –**

When compressed natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated in

**“gasoline liter equivalent (GLE) units” or  
“gasoline gallon equivalent (GGE) units.”**

(Also see definitions.)

(Added 1994)

# Appendix D – Definitions

**gasoline gallon equivalent (GGE).** –

Gasoline gallon equivalent

**(GGE)** means **5.660 pounds** of natural gas.[3.37]

(Added 1994)

**gasoline liter equivalent (GLE).** –

Gasoline liter equivalent

**(GLE)** means **0.678 kilograms** of natural gas.[3.37]

(Added 1994)



### **S.1.3.3. Maximum Value of Quantity-Value Divisions**

b) For dispensers of compressed natural gas used to refuel vehicles, the value of the division for the gasoline liter equivalent (GLE) shall not exceed 0.01 GLE;

the division for gasoline gallon equivalent (GGE) shall not exceed 0.001 GGE.

The maximum value of the mass division shall not exceed 0.001 kg or 0.001 lb.

## ***S.2.7. Recorded Representations, Point-of-Sale Systems***

***The sales information recorded by cash registers when interfaced with a retail motor-fuel dispenser shall contain the following information for products delivered by the dispenser:***

***(a) the total volume of the delivery;***

***(b) the unit price;***

***(c) the total computed price; and***

***(d) the product identity by name, symbol, abbreviation, or code number.***



## Security Seals

### ***G-S.8. Provision for Sealing Electronic Adjustable Components. –***

*A device shall be **designed** with provision(s) for applying a security seal that must be broken, or for using other approved means of providing security (e.g., data change audit trail available at the time of inspection), before any change that detrimentally affects the metrological integrity of the device can be made to any electronic mechanism.*

# Security Seals

## G-UR.4.5. Security Seal. –

A security seal **shall** be appropriately affixed to any adjustment mechanism designed to be sealed.

# Security Seals

## **S.3.5. Provision for Sealing. –**

Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment or interchange may be made of:

### S.3.5. Provision for Sealing

- (a) any measuring or indicating element;
- (b) any adjustable element for controlling delivery rate when such rate tends to affect the accuracy of deliveries;
- (c) the zero adjustment mechanism; and
- (d) any metrological parameter that will affect the metrological integrity of the device or system.



## **Table S.3.5. Categories of Device and Methods of Sealing**

Category 1

Category 2

Category 3

**Table S.3.5. Categories of Device and Methods of Sealing**

<b>Categories of Device</b>	<b>Methods of Sealing</b>
<i>Category 1: No remote configuration capability.</i>	<i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i>

*Nonretroactive as of January 1, 1995] (Table Added 1993) (Amended 1995, 1998, 1999, and 2006)*

**Table S.3.5. Categories of Device and Methods of Sealing**

<b>Categories of Device</b>	<b>Methods of Sealing</b>
<p><i>Category 2:</i> <i>Remote configuration capability, but access is controlled by physical hardware.</i></p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i></p>	<p><i>[The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an <b>event counter for calibration parameters and an event counter for configuration parameters</b>. The event counters may be located either at the individual measuring device or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual devices at a location. If the counters are located in the system controller rather than at the individual device, means must be provided to generate a hard copy of the information through an on-site device.]</i></p>



## **event counter**

A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device.

[2.20, 2.21, 3.30, 3.37, 5.54, 5.56(a), 5.56(b), 5.57]

(Added 1993)



**Table S.3.5. Categories of Device and Methods of Sealing**

<p><b>Categories of Device</b></p>	<p><b>Methods of Sealing</b></p>
<p><i>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</i></p> <p><i>[Nonretroactive as of January 1, 1995]</i></p> <p><i>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</i></p> <p><i>[Nonretroactive as of January 1, 2001]</i></p>	<p><i>An <b>event logger</b> is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the device or through another on-site device. The event logger shall have a capacity to retain records equal to ten times the number of sealable parameters in the device, but not more than 1000 records are required.</i></p> <p><i>(Note: Does not require 1000 changes to be stored for each parameter.)</i></p>

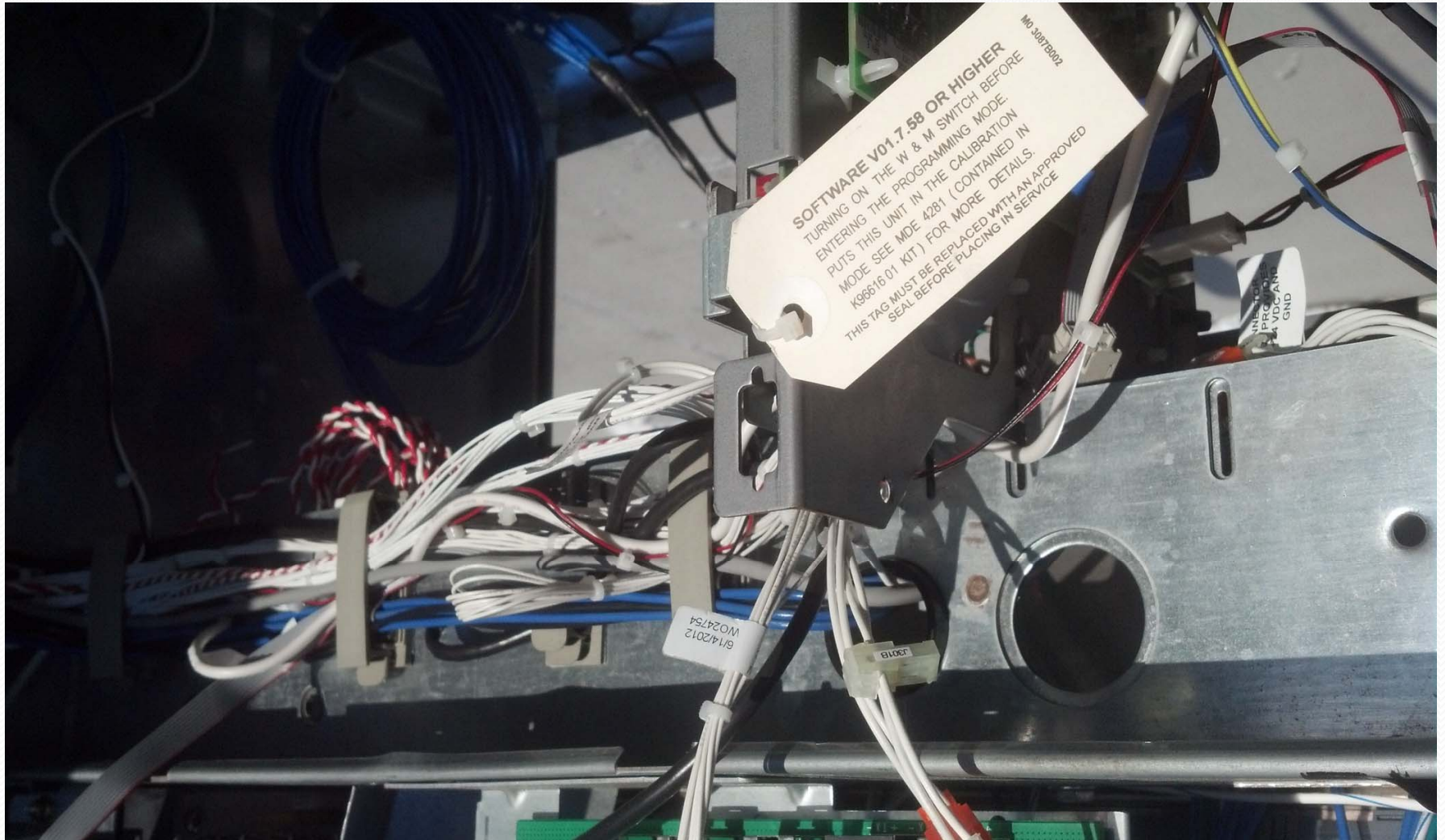
## event logger

A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter.

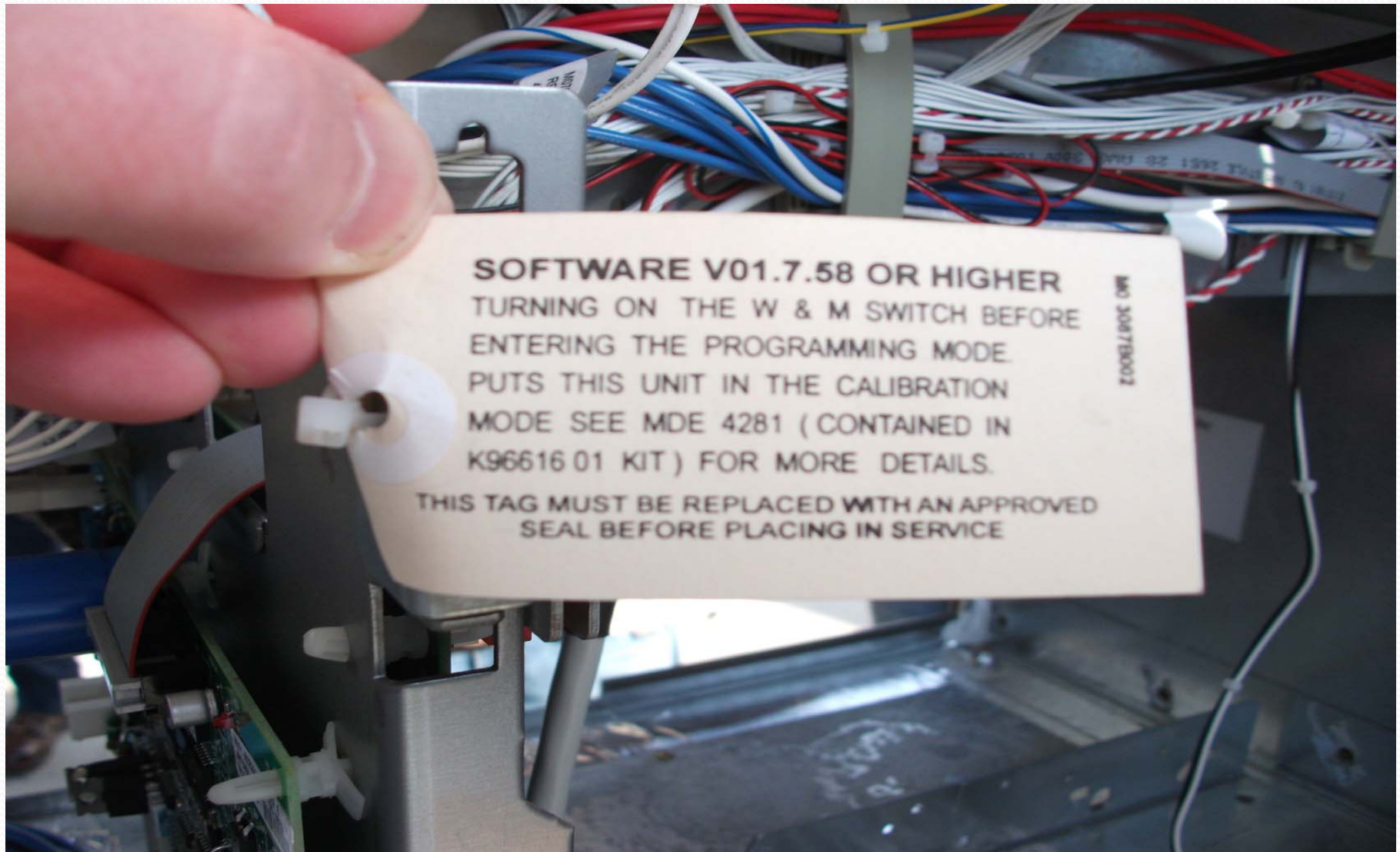
[ 2.20, 2.21, 3.30, 3.37, 5.54, 5.56 (a), 5.56 (b), 5.57 ]

(Added 1993)

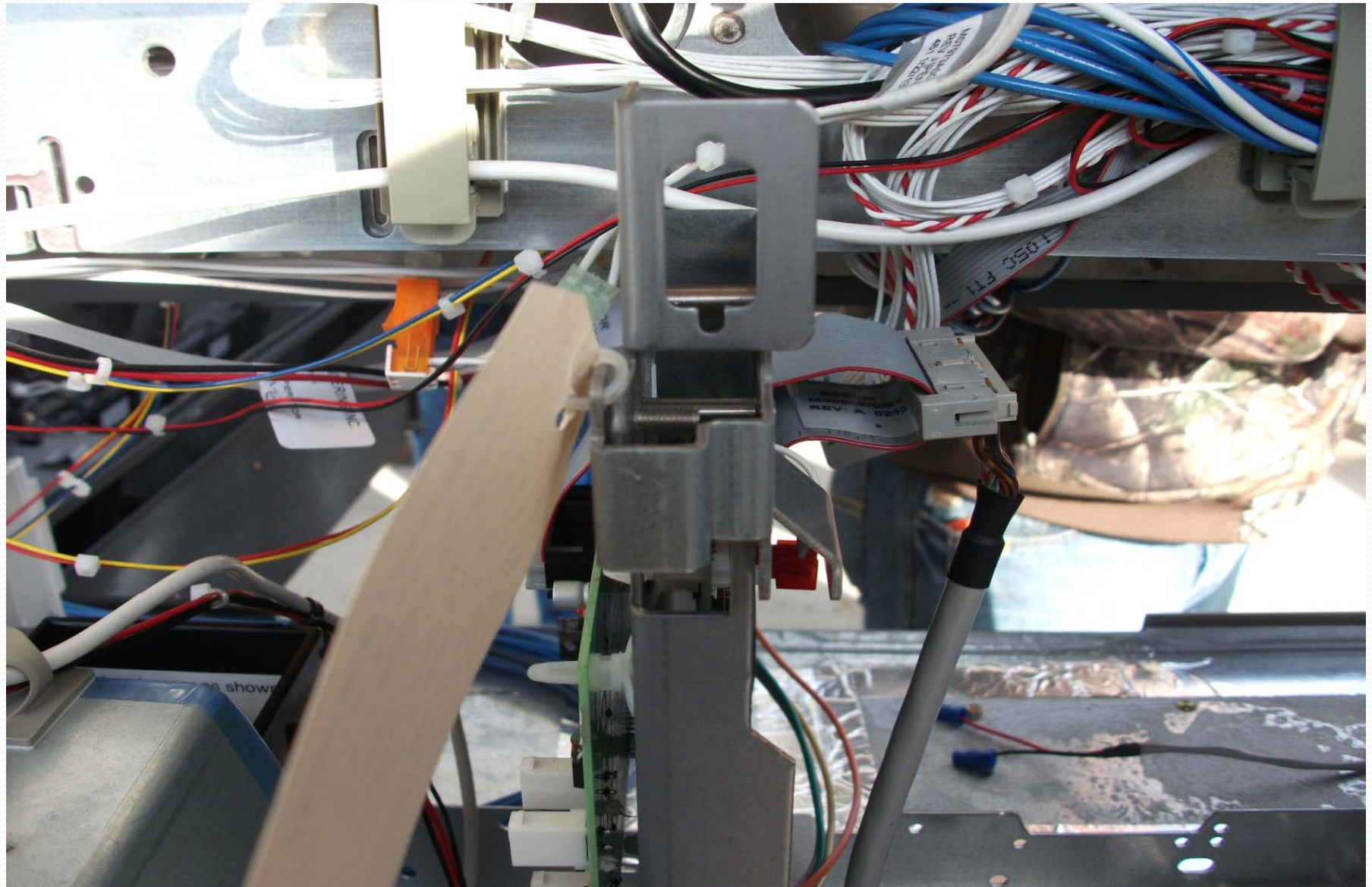
# Calibration Switch Tag



## Calibration Switch Tag



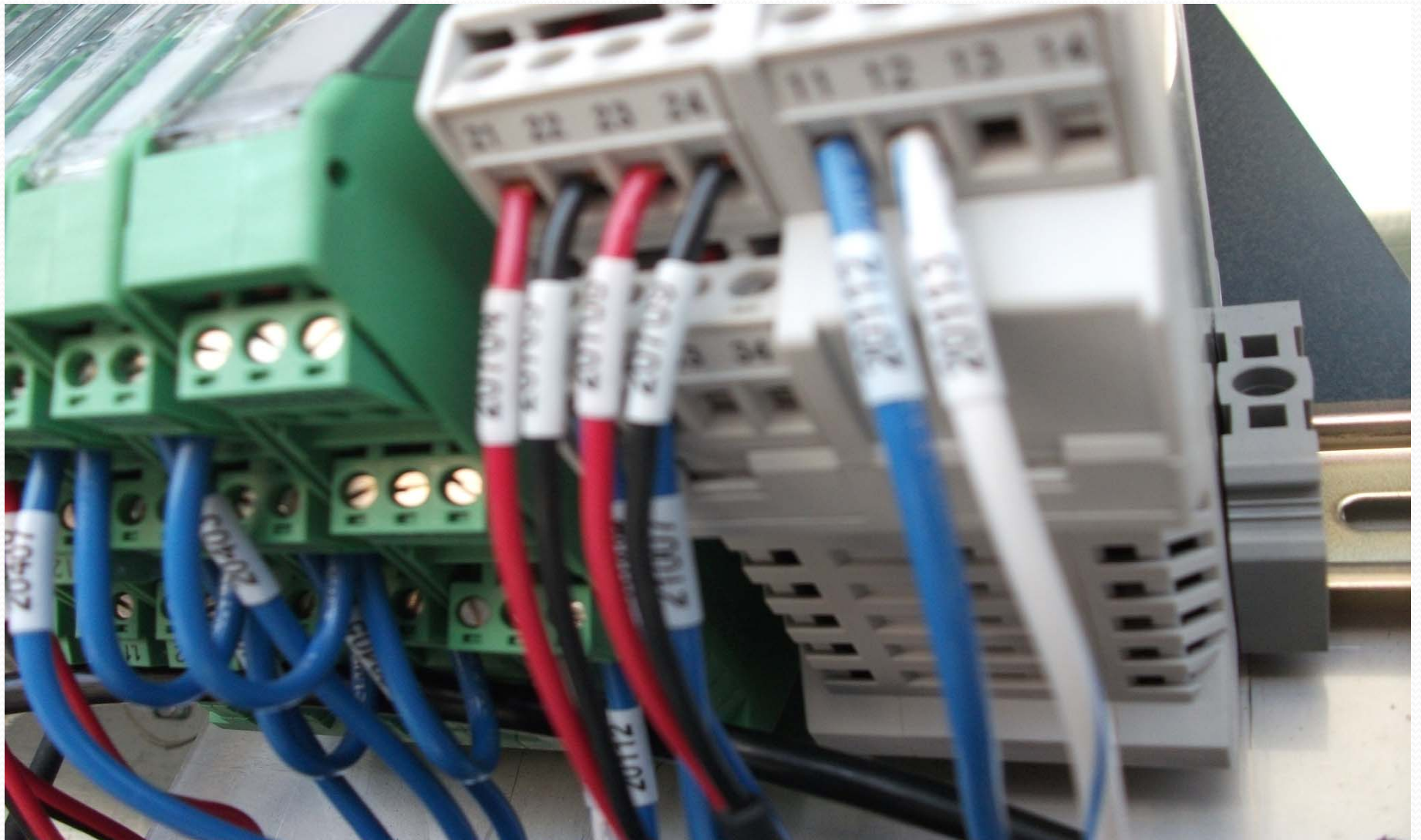
# Calibration Switch



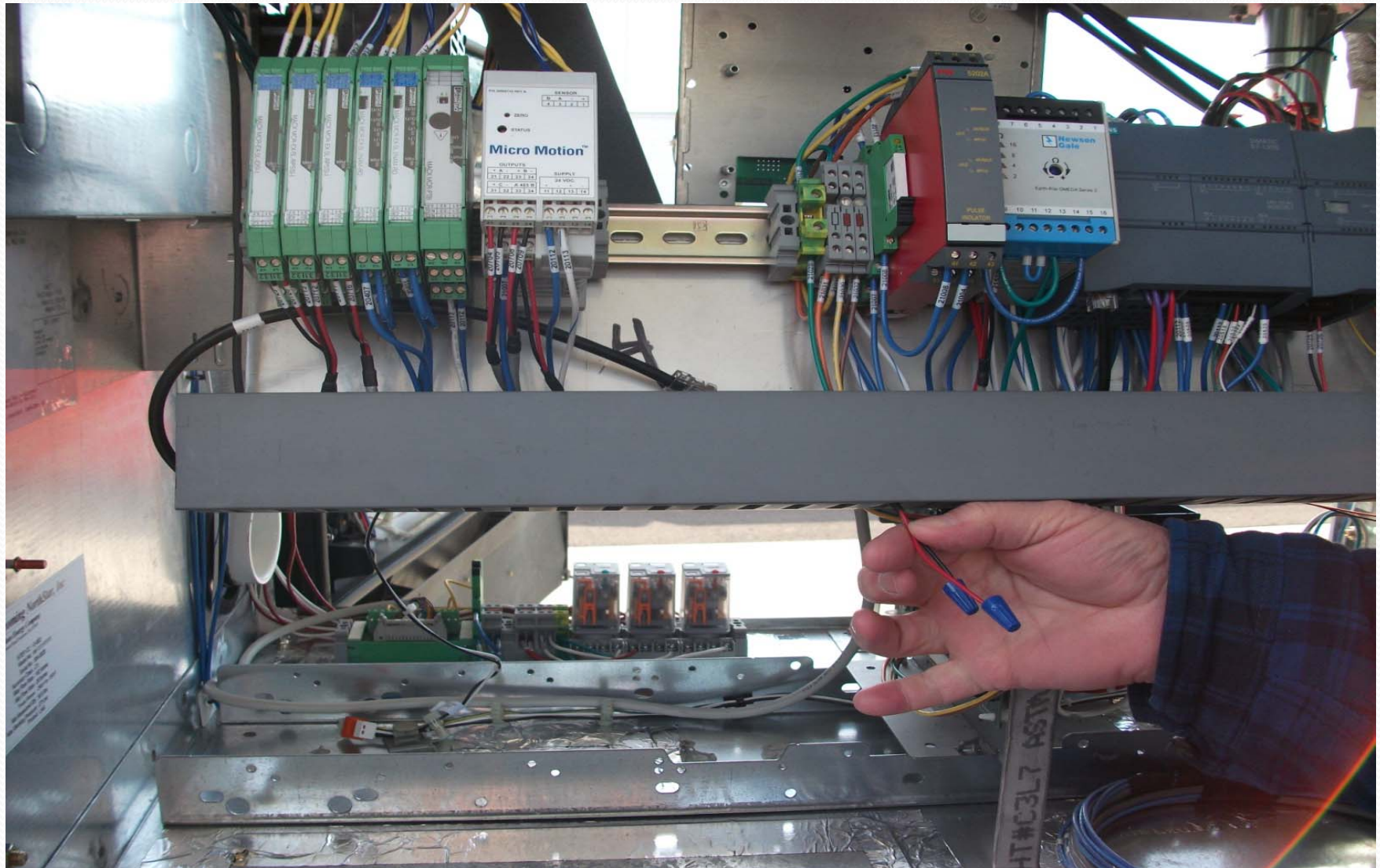
**Figure 8-1: Example of clamp and seal on transmitter**



# Micro Motion Transmitter upclose 33 & 34



# Micro Motion Transmitter Wires





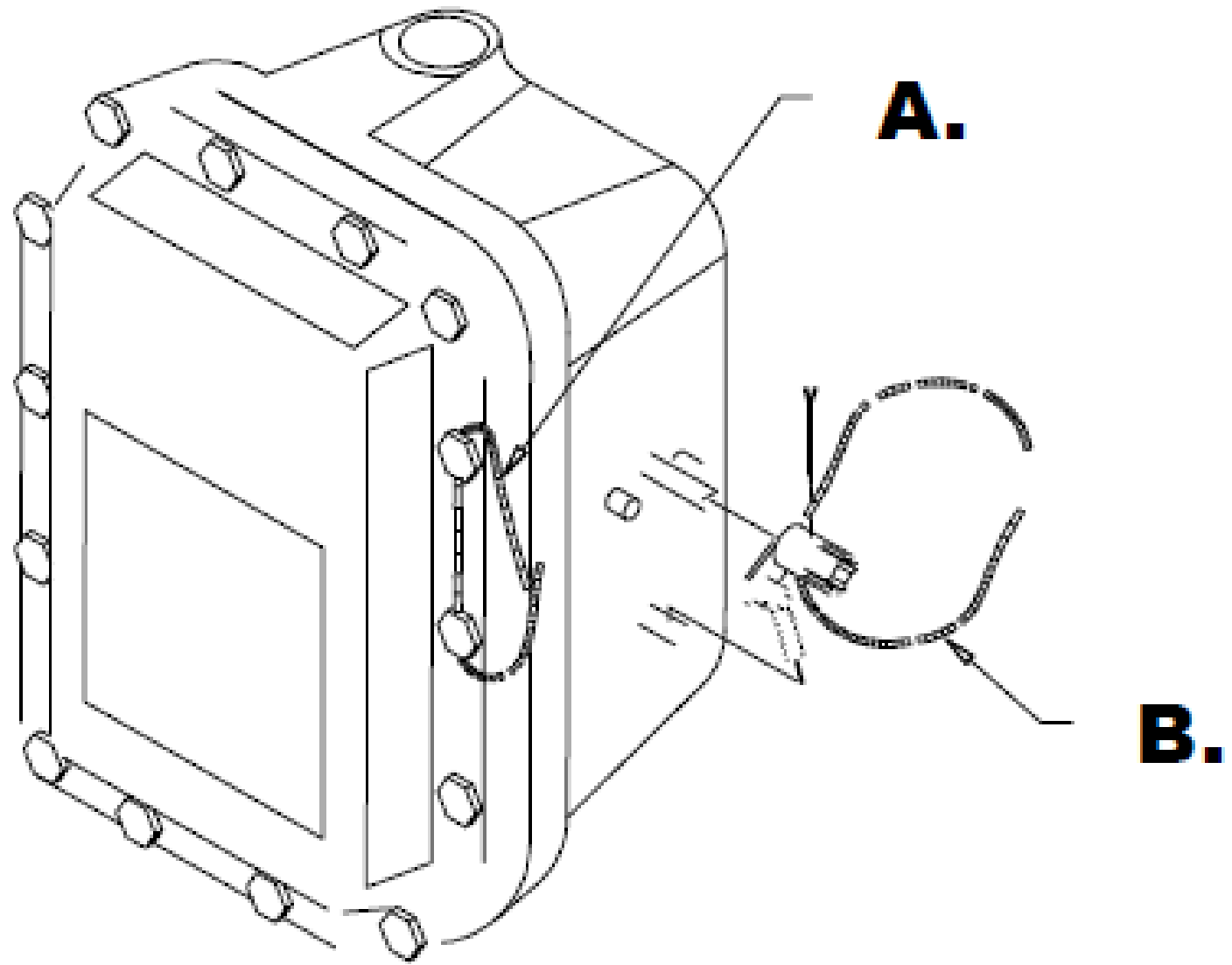
# Door Latch Security Seal



# Mater Meter Sealing

## MATER METER SEALING





# Discharge Hose

## **S.4.1. Diversion of Measured Product. –**

No means shall be provided by which any measured product can be diverted from the measuring instrument.

However, two or more delivery outlets may be permanently installed and operated simultaneously, provided that any diversion of flow to other than the intended receiving receptacle cannot be readily accomplished or is readily apparent.

Such means include physical barriers, visible valves, or indications that make it clear which outlets are in operation, and explanatory signs if deemed necessary.

(Amended 2002 and 2006)



Discharge Hose

### **S.4.3. Directional Flow Valves. –**

If a reversal of flow could result in errors that exceed the tolerance for the minimum measured quantity, a valve or valves or other effective means, automatic in operation (and equipped with a pressure limiting device, if necessary) to prevent the reversal of flow shall be properly installed in the system.

(Also see N.1. Minimum Measured Quantity.)



## **N.1. Minimum Measured Quantity. –**

The minimum measured quantity shall be specified by the manufacturer

## S.4.4. Discharge Valves

A discharge valve may be installed on a discharge line only if the system is a wet-hose type. Any other shutoff valve on the discharge side of the instrument shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

(a) by means of a tool (but not a pin) entirely separate from the device; or

(b) by means of a security seal with which the valve is sealed open.

## ***UR.1.1. Discharge Hose-Length***

*The length of the discharge hose on a retail motor-fuel device shall not exceed 4.6 m (15 ft) unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels.*

*[Nonretroactive as of January 1, 1998]*

*(Added 1997)*





## **S.3.7. Pressurizing the Discharge Hose**

The discharge hose for compressed natural gas shall automatically pressurize prior to the device beginning to register the delivery.

(Added 1993)

# Automatic Density Correction

## **S.3.6. Automatic Density Correction.**

- (a) An automatic means to determine and correct for changes in product density shall be incorporated in any mass flow metering system that is affected by changes in the density of the product being measured.

### S.3.6. Automatic Density Correction cont:

(b) Volume-measuring devices with automatic temperature compensation used to measure natural gas as a motor vehicle engine fuel shall be equipped with an automatic means to determine and correct for changes in product density due to changes in the temperature, pressure, and composition of the product.

(Amended 1994 and 1997)

# Test Overview

- Verify the appropriateness of the reference scale
- Verify that the maximum working pressure of the test cylinder will not be exceeded during tests
- Conduct test for computer jump with test tank empty (i.e., less than 200 psi)
- Conduct test drafts at 1/3rd, 2/3rd, and full capacity of the test cylinder and at maximum flow rate

## Test Overview

- Empty the test cylinder – return product to owner/operator
- Conduct test draft to full capacity of test cylinder at maximum flow rate
- Conduct repeatability test (three or more test drafts at the same flow rate and draft size under controlled conditions)

# Test Overview

- If the minimum measured quantity (MMQ) is less than the smallest test draft, conduct a test draft at the MMQ value **1,2**
- Check effectiveness of zero-set-back interlock
- Check for proper operation of the low-flow cut-off valve
- Power loss test – device memory to retain quantity and price during power loss



**1. N.4. Minimum Measured Quantity. –**

The device shall be tested for a delivery equal to the declared minimum measured quantity **when the device** is likely to be used to make deliveries on the order of the minimum measured quantity.



## **2. UR.1.2. Minimum Measured Quantity.**

(a) The minimum measured quantity shall be specified by the manufacturer.

(b) The minimum measured quantity appropriate for a transaction may be specified by the weights and measures authority. A device may have a minimum measured quantity smaller than that specified by the weights and measures authority; however, the device must perform within the performance requirements for the declared minimum measured quantity.



# Test Overview

- If the minimum measured quantity (MMQ) is less than the smallest test draft, conduct a test draft at the MMQ value **1,2**
- Check effectiveness of zero-set-back interlock
- Check for proper operation of the low-flow cut-off valve
- Power loss test – device memory to retain quantity and price during power loss

# Test Drafts Will We Conduct

## Example:

Test Tank Capacity is 111 Liters = 29.323 Gallons

Conduct test drafts at

**1/3rd, 2/3rd, and full capacity** of the test cylinder and at maximum flow rate.

1<sup>st</sup> draft 10 gallon

2<sup>nd</sup> draft 10 gallon

3<sup>rd</sup> draft to capacity



## Test Drafts Will We Conduct

- Conduct test draft to full capacity of test cylinder **at maximum flow rate**
- Conduct **repeatability test** (three or more test drafts at the same flow rate and draft size under controlled conditions)

## **PRE-TEST:**

- **Set up and calibrate scale.**
- **Insure proper grounding is in place.**

# Scale Test with Weights





# Tolerances



## T.1. Tolerances, General

(a) The tolerances apply equally to errors of underregistration and errors of overregistration.

(b) The tolerances apply to all products at all temperatures measured at any flow rate within the rated measuring range of the meter.

(Amended 1999)

## T.2. Tolerances

The tolerances for mass flow meters for specific liquids, gases, and applications are listed in **Table T.2. Accuracy Classes and Tolerances for Mass Flow Meters.**

(Amended 1994 and 1999)



**Table T.2.**  
**Accuracy Classes and Tolerances for Mass Flow Meters**

<b>Accuracy Class</b>	<b>Application or Commodity Being Measured</b>	<b>Acceptance Tolerance</b>	<b>Maintenance Tolerance</b>	<b>Special Tolerance</b>
<b>2.0</b>	<b>Compressed natural gas as a motor-fuel</b>	<b>1.5 %</b>	<b>2.0 %</b>	<b>2.0 %</b>

(Added 1994) (Amended 1999, 2001, and 2013)

## T.3. Repeatability

When multiple tests are conducted at approximately the same flow rate and draft size, the **range** of the test results for the flow rate shall not exceed **40 %** of the absolute value of the **maintenance tolerance** and the results of each test shall be within the applicable tolerance.

(Also see N.6.1.1. Repeatability Tests.)

(Amended 1992, 1994, and 2001)

## TEST:

### Totalizer

***S.7. Totalizers for Retail Motor-Fuel Devices.***  
*Retail motor-fuel dispensers shall be equipped with a nonresettable totalizer for the quantity delivered through the metering device.*

*[Nonretroactive as of January 1, 1998]*

(Added 1997)

TEST cont:

## Printed Tickets

### NOTE:

Print a ticket after every test

Printed Tickets cont:

NOTE: Print a ticket after every test

## **G-S.5.6. Recorded Representations. –**

Insofar as they are appropriate, the requirements for indicating and recording elements **shall also apply** to recorded representations.

All recorded values shall be printed digitally.

(Amended 1975)

Printed Tickets cont:

NOTE: Print a ticket after every test

## **UR.3.4. Printed Ticket. –**

The total price, the total quantity of the delivery, and the price per unit shall be printed on any ticket issued by a device of the computing type and containing any one of these values.

(Added 1993)

Printed Tickets cont:

NOTE: Print a ticket after every test

### **G-S.5.5. Money Values, Mathematical Agreement.**

Any recorded money value and any digital money-value indication on a computing-type weighing or 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.

This does not apply to auxiliary digital indications intended for the operator's use only, when these indications are obtained from existing analog customer indications that meet this requirement.

(Amended 1973)

Printed Tickets cont:

NOTE: Print a ticket after every test

## **S.2.6. Money-Value Computations. –**

A computing device shall compute the total sales price at any single-purchase unit price (i.e., excluding fleet sales, other price contract sales, and truck stop dispensers used only to refuel trucks) for which the product being measured is offered for sale at any delivery possible within either the measurement range of the device or the range of the computing elements, whichever is less.

(Added 1993)



Printed Tickets cont:

NOTE: Print a ticket after every test

### **S.2.6.1. Auxiliary Elements. –**

If a system is equipped with auxiliary indications, all indicated money value and quantity divisions of the auxiliary element shall be identical with those of the primary element.

(Added 1993)

Printed Tickets cont:

NOTE: Print a ticket after every test

## **S.2.6.2.**

### **Display of Quantity and Total Price.**

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 controls.

Printed Tickets cont:

NOTE: Print a ticket after every test

## **G-S.5.2.2. Digital Indication and Representation. –**

Digital elements shall be so designed that:

G-S.5.2.2. Digital Indication and Representation. – Digital elements shall be so designed that:

- (a) All digital values of like value in a system agree with one another.
- (b) A digital value coincides with its associated analog value to the nearest minimum graduation.

G-S.5.2.2. Digital Indication and Representation. – Digital elements shall be so designed that:

(c) A digital value “rounds off” to the nearest minimum unit that can be indicated or recorded.

*(d) A digital zero indication includes the display of a zero for all places that are displayed to the right of the decimal point and at least one place to the left. When no decimal values are displayed, a zero shall be displayed for each place of the displayed scale division.*

*[Nonretroactive as of January 1, 1986]*

(Amended 1973 and 1985)

## ***S.2.5.4. Agreement Between Indications***

*When a quantity value indicated or recorded by an auxiliary element is a derived or computed value based on data received from a retail motor-fuel dispenser, the value may differ from the quantity value displayed on the dispenser, provided the following conditions are met:*

- (a) all total money-values for an individual sale that are indicated or recorded by the system agree; and*
  
- (b) within each element the values indicated or recorded meet the formula (quantity x unit price = total sales price) to the closest cent.*

*[Nonretroactive as of January 1, 1998]*

*(Added 1997)*



## **S.1.3.4. Values Defined**

Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof.

A display of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.



## Normal Test:

### NOTE:

Take totalizer reading **before and after** every test to ensure totalizers are working properly.

Print a ticket after every delivery.



# Normal Test

## Computer Jump:

### **S.3.7. Pressurizing the Discharge Hose.**

The discharge hose for compressed natural gas shall automatically pressurize prior to the device beginning to register the delivery.

(Added 1993)

# Computer Jump Test

- Connect dispenser nozzle to test cylinder.  
(Cylinder should be empty and the pressure should not be greater than 200 psi to simulate an actual delivery.)
- Turn nozzle valve from “OFF” position to “FILL” position.

## Computer Jump Test

- Empty the discharge hose.
  - Turn nozzle valve to “OFF” position.
  - Activate the dispenser.
- Observe the dispenser indication, if computer jump occurs, take appropriate action.



# Testing Procedures

## N.3. Test Drafts. –

The minimum test shall be one test draft at the maximum flow rate of the installation and one test draft at the minimum flow rate.

More tests may be performed at these or other flow rates.

(Also see T.3. Repeatability.)

Testing Procedures cont:

## **N.6.1. Normal Tests. –**

The normal test of a meter shall be made at the maximum discharge rate developed by the installation.

Any additional tests conducted at flow rates down to and including the rated minimum discharge flow rate shall be considered normal tests.

(Added 1999)

## **N.6.1.1. Repeatability Tests. –**

Tests for repeatability should include a minimum of **three** consecutive test drafts of approximately the same size and be conducted under controlled conditions where variations in factors such as temperature, pressure, and flow rate are reduced to the extent that they will not affect the results obtained.

(Added 2001)

Testing Procedures cont:

## **N.6.2. Special Tests. –**

- “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.6.1. Normal Tests shall be considered a special test.
- Special tests of a measuring system shall be made to develop operating characteristics of the measuring systems during a split compartment delivery.
- (Also see Table T.2. Accuracy Classes and Tolerances for Mass Flow Meters.)

(Added 1999)

## N.6. Testing Procedures

### **NOTE:**

The dispenser will first be tested at  $1/3$ ,  $2/3$ , and full capacity as shown below.

These tests simulate the filling of a vehicle tank at various fill levels and different pressures associated with different fill levels.





The dispenser should be set to read in mass **not GGE** for testing.

GGE- Gasoline Gallon Equivalent

GLE- Gasoline Liter Equivalent

# TEST #1 Fill to 1/3 Capacity

- (1) Place the empty test vessel on the scale and record in box#2 (tare weight) of the test vessel.
- (2) Connect the nozzle from the dispenser to the test vessel.
- (3) At maximum flow rate fill the test vessel to 1/3 capacity for the first test draft.
- (4) Disconnect the nozzle from the test vessel.
- (5) Record the reading on the scale in box #1 (gross weight).

## TEST #1 Fill to 1/3 Capacity cont:

- (6) Subtract box #2 (tare weight) from box #1 (gross weight) and record in box #3 (net weight).
- (7) Recorded weight indicated on the dispenser in box #4.
- (8) Subtract box #4 (indicated weight) from box #3 (net weight) and record in box #5 (error in mass). (box 3 – box 4)
- (9) Figure meter error in percentage by dividing box #5 (error in mass) by box #3 (net weight) then multiplying by 100 and entering in box #6. (box 5 / box 3 x 100)
- (10) Do not empty the test vessel.

# TEST #2 Fill to 2/3 Capacity

- (1) Record the (gross weight) box #1 from TEST #1 in box #2 (tare weight) for TEST #2.
- (2) Reconnect the nozzle from the dispenser to the test vessel.
- (3) At maximum flow rate fill the test vessel to 2/3 capacity for the second test draft.
- (4) Disconnect the nozzle from the test vessel.
- (5) Record the reading on the scale in box #1 (gross weight).

## TEST #2 Fill to 2/3 Capacity cont:

- (6) Subtract box #2 (tare weight) from box #1(gross weight) and record in box #3 (net weight).
- (7) Recorded weight indicated on the dispenser in box #4.
- (8) Subtract box #4 (indicated weight) from box #3 (net weight) and record in box #5 (error in mass).
- (9) Figure meter error in percentage by dividing box #5 (error in mass) by box #3 (net weight) then multiplying by 100 and entering in box #6.
- (10) Do not empty the test vessel.

## TEST #3 Fill to Capacity

- (1) Record the (gross weight) box #1 from TEST #2 in box #2 (tare weight) for TEST #3.
- (2) Reconnect the nozzle from the dispenser to the test vessel.
- (3) At maximum flow rate fill the test vessel to full capacity for the third test draft.
- (4) Disconnect the nozzle from the test vessel.
- (5) Record the reading on the scale in box #1 (gross weight).

## TEST #3 Fill to Capacity cont:

- (6) Subtract box #2 (tare weight) from box #1 (gross weight) and record in box #3 (net weight).
- (7) Recorded weight indicated on the dispenser in box #4.
- (8) Subtract box #4 (indicated weight) from box #3 (net weight) and record in box #5 (error in mass).
- (9) Figure meter error in percentage by dividing box #5 (error in mass) by box #3 (net weight) then multiplying by 100 and entering in box #6.
- (10) The test vessel can now be emptied by returning the product to the owner/operator of the dispenser.



## **UR.3.8. Return of Product to Storage, Retail Compressed Natural Gas Dispensers**

Provisions at the site shall be made 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 this procedure.

(Added 1998)



# TEST #4 Fill to Capacity

- (1) Place the empty test vessel on the scale and record in box#2 (tare weight) of the test vessel.
- (2) Connect the nozzle from the dispenser to the test vessel.
- (3) At maximum flow rate fill the test vessel to capacity.
- (4) Disconnect the nozzle from the test vessel.
- (5) Record the reading on the scale in box #1 (gross weight).

## TEST #4 Fill to Capacity cont:

- (6) Subtract box #2 (tare weight) from box #1(gross weight) and record in box #3 (net weight).
- (7) Recorded weight indicated on the dispenser in box #4.
- (8) Subtract box #4 (indicated weight) from box #3 (net weight) and record in box #5 (error in mass).
- (9) Figure meter error in percentage by dividing box #5 (error in mass) by box #3 (net weight) then multiplying by 100 and entering in box #6.
- (10) Empty the test vessel by returning the product to the owner/operator of the dispenser.



## **NOTE:**

Do not mistake the previous testing for repeatability testing.

Although the three tests were of the same volume and flow rate they were done at different pressures due to the amount in the CNG in the tank from the previous test.



## **Next tests will be repeatability tests**

Release product then Test #5 to Full Capacity

Release product then Test #6 to Full Capacity

## N.4. Minimum Measured Quantity

The device shall be tested for a delivery equal to the declared minimum measured quantity **when the device is likely to be used** to make deliveries on the order of the minimum measured quantity.

## UR.2.3. Low-Flow Cut-Off Valve

If a metering system is equipped with a programmable or adjustable “low-flow cut-off” feature:

- (a) the low-flow cut-off value shall not be set at flow rates lower than the minimum operating flow rate specified by the manufacturer on the meter; and



UR.2.3. Low-Flow Cut-Off Valve cont:

(b) the system shall be equipped with flow control valves which prevent the flow of product and stop the indicator from registering product flow whenever the product flow rate is less than the low-flow cut-off value.

(Added 1992)

**Note:** Connect the nozzle to the empty container and dispense product slowly throttling back the valve and timing the delivery to find where the low flow cut-off valve is set.

## **S.2.4. Provisions for Power Loss**

### **S.2.4.1. Transaction Information. –**

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, or sales price) shall be determinable for at least 15 minutes at the dispenser or at the console if the console is accessible to the customer.

(Added 1993)



## S.2.4. Provisions for Power Loss

### S.2.4.2. User Information. –

The device memory shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.

(Added 1993)

**Note:** Power loss test should not be run without proper warning and supervision.

# SEALING:

## **Note:**

The device must be sealed with a wire security seal unless an approved audit trail is used for a sealing means.

Be sure to check the NTEP Certificate of Conformance for proper sealing means.

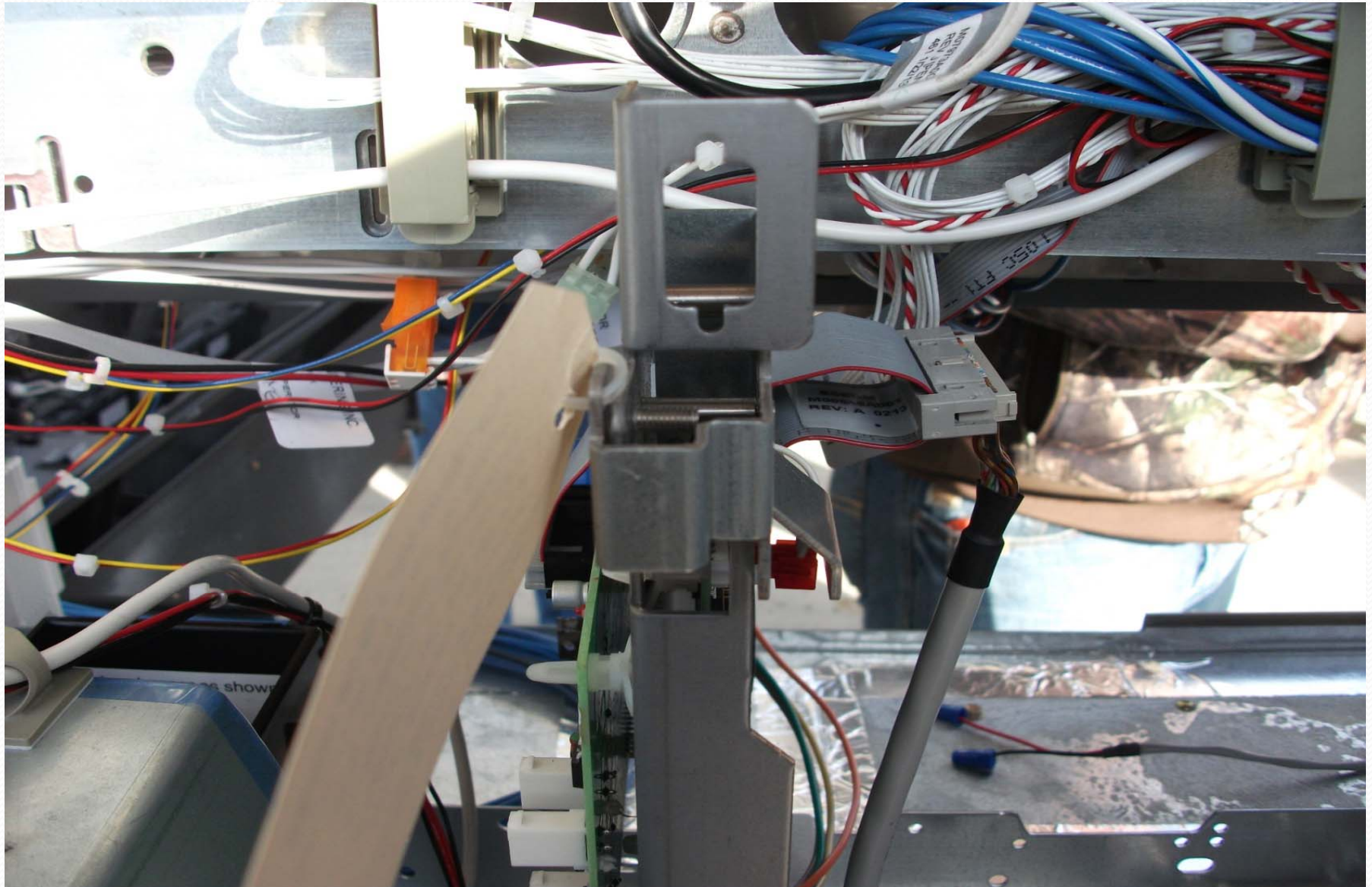
The device may have to be sealed in several locations.

# Sealing

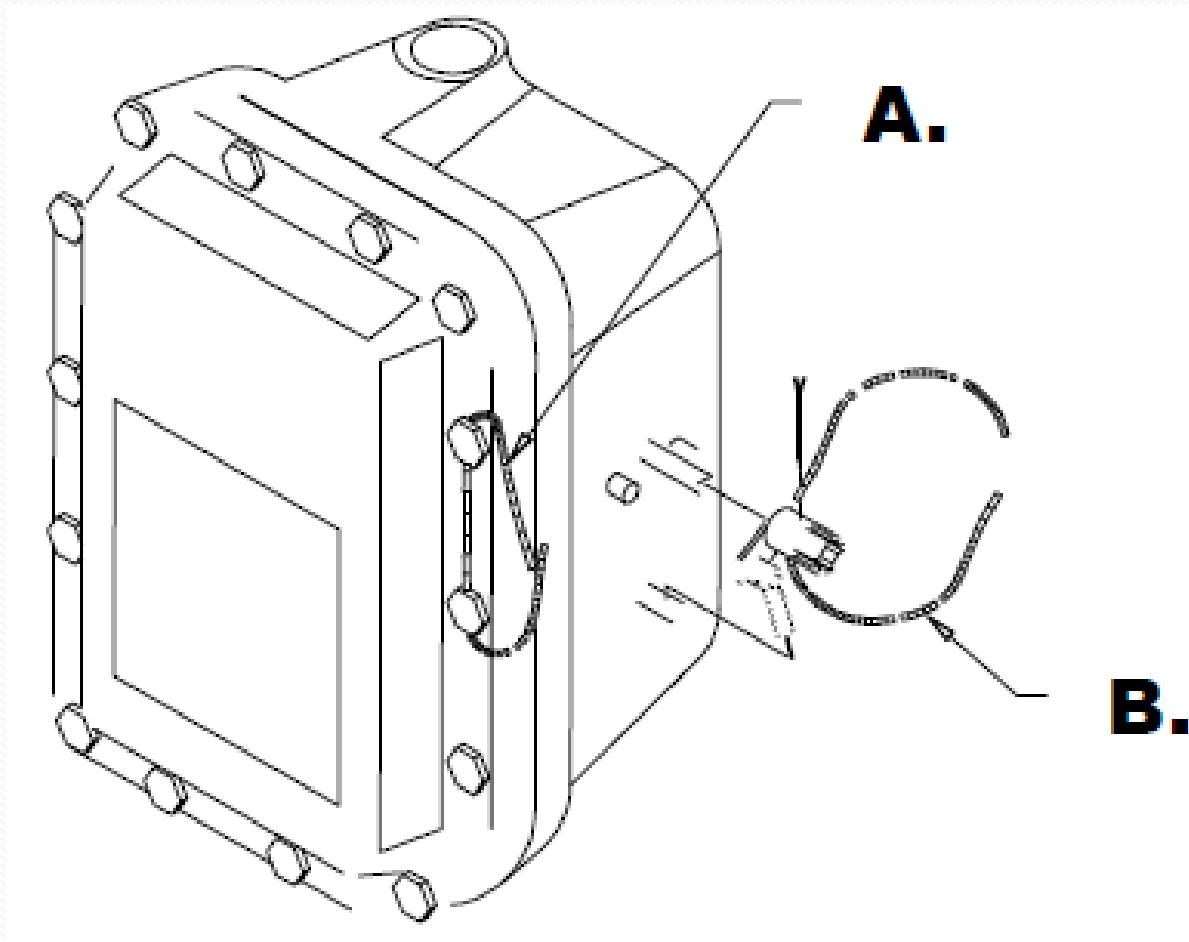
## MATER METER SEALING



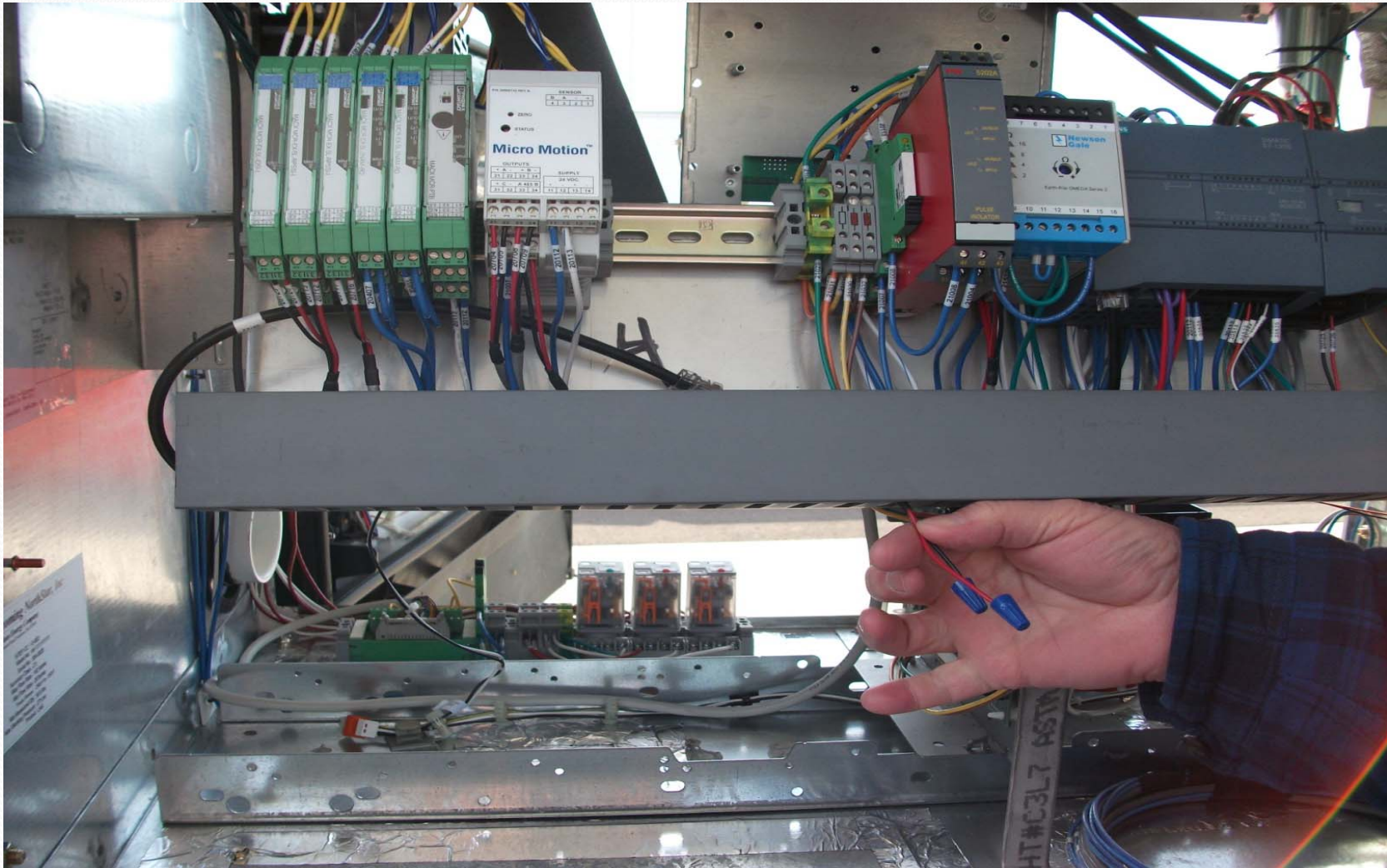
# Sealing Calibration Switch



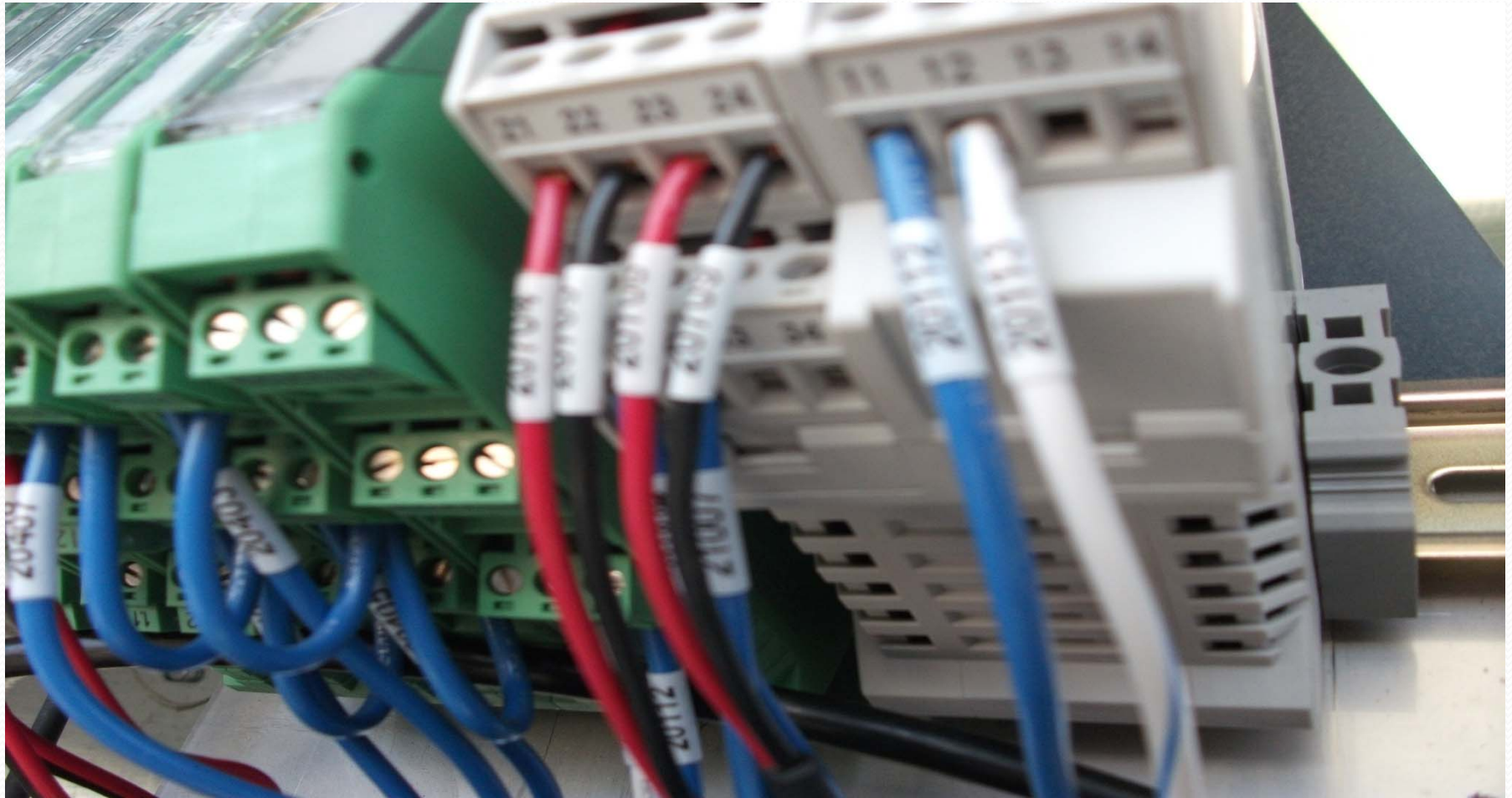
# Sealing



# Micro Motion Transmitter Wires need to be disconnected



## Micro Motion Transmitter upclose 33 & 34



**Figure 8-1: Example of clamp and seal on transmitter**





# Door Latch Security Seal



# EVALUATION

## 1) Record and evaluate test results.

### G-UR.4.1. Maintenance of Equipment. –

All equipment in service and all mechanisms and devices attached thereto or used in connection therewith shall be continuously maintained in proper operating condition throughout the period of such service.

Equipment in service at a single place of business found to be in error predominantly in a direction favorable to the device user **shall not** be considered “maintained in a proper operating condition.”

(Amended 1973 and 1991)

## EVALUATION cont:

2) Note any comments on test report.

3) Complete test report form

Include on the test report the total number of gasoline gallon equivalents of product dispensed during testing.



EVALUATION cont:

- 4) Sign the test report along with all other required signatures.
- 5) Give copies to all required parties.



**LIQUID  
NATURAL  
GAS  
DISPENSERS**

## LNG SAFETY NOTES

Insure use of proper Personal Protection Equipment (PPE) at all times when handling this product including face shield with other eye protection (safety glasses), Insulated gloves, safety work boots and nonsynthetic clothing or Nomex coveralls.

## LNG SAFETY NOTES cont:

LNG is both an odorless and colorless liquid and is very flammable after vaporization to gaseous phase.

Provide adequate ventilation to prevent inhalation of the vapors during vaporization.

Asphyxiation; when vaporization takes place the vapors displace oxygen and is considered an asphyxiant.

## LNG SAFETY NOTES cont:

- \* Use extreme care in handling due to high flammability and risk of cryogenic burns.
- \* Liquid or cold gas contact with skin or eyes could cause freezing or severe cryogenic burns



## LNG SAFETY NOTES cont:

### FIRST AID MEASURES

**Skin Contact:** Cryogenic burns remove constricting clothing. Do not thaw too rapidly. Transport to hospital immediately.

**Eye contact:** Get medical attention immediately.

**Inhalation:** Move to fresh air. Give artificial respiration if breathing has stopped. **Call 911** or a physician.

# LNG Equipment

## Test Cylinder

- Test cylinder should be of sufficient size to conduct all required tests.
- Rating - must be equivalent to or greater than the service pressure marked on the device under test.

## LNG Equipment cont:

### Test Cylinder

- The test cylinder should meet DOT, Specification 4-L, Section 178.57 provides manufacturers the requirements for the design, fabrication and certification testing of insulated, welded cylinders intended for use in the transportation and handling of non-flammable and flammable cryogenic liquids.

## LNG Equipment cont:

### Test Cylinder cont:

- Specification 4-L also references other sections of the DOT code on the issues of, sizing of relief systems, fill limits, fill density and markings for 4-L containers.
- Additional references include Sections 173.316 and 173.18 for "cryogenic liquids in cylinders" & "cargo cryogenic containers".

## LNG Equipment cont:

### Test Cylinder cont:

- Compatible fittings, Bleed valve , Pressure gauge , Drain hose and Means for grounding the cylinder prior to connecting to dispensing equipment such as a quick connect ground strap
- Optional Equipment:  
Cart , Test cylinder supports (chocks) , Weather shield/wind screen (for the weighing operation)

**(Same as CNG Slide)**

## 4.4. General Considerations

### Note:

- What needs checked is not limited to the Liquid Natural Gas - Fuel Dispensers.
- You may also need to look at a
  - \* **Console Controller**
  - \* **Electronic Cash Register**
  - \* **Point of Sale System**
  - \* **Electronic Payment System**

## 4.4. General Considerations cont:

### **Note:**

- All of these devices will need to be NTEP approved and have the proper markings.
- Make sure you have reviewed the NTEP Certificate for the device.

## **S.1. Indicating and Recording Elements.**

### **S.1.1. Indicating Elements**

#### **Liquid Natural Gas Dispensers. –**

- Except for fleet sales and other price contract sales, a liquid natural gas dispenser used to refuel vehicles shall be of the computing type and shall indicate the quantity, the unit price, and the total price of each delivery.
- The dispenser shall display the mass measured for each transaction.





S.1. Indicating and Recording Elements.

S.1.1. Indicating Elements cont:

## **Liquid Natural Gas Used as an Engine Fuel**

When liquid natural gas is dispensed as an engine fuel, the delivered quantity shall be indicated **in Mass only.**



S.1. Indicating and Recording Elements.

S.1.1. Indicating Elements cont:

## **Value of Quantity-Value Divisions**

For dispensers of liquid natural gas used to refuel vehicles.

The value of the mass division shall be as designated on the device Certificate of Conformance.

# Tolerances

**T.2. Tolerances.** – The tolerances for mass flow meters for specific liquids, gases, and applications are listed in

**Table T.2. Accuracy Classes and Tolerances for Mass Flow Meters.**

(Amended 1994 and 1999)

**T.2. Tolerance Values.** – The maintenance and acceptance tolerances for normal and special tests shall be as shown in

**Table T.2. Accuracy Classes and Tolerances for Cryogenic Liquid-Measuring Devices.**

(Amended 2003)

**Table T.2.**

**Accuracy Classes and Tolerances for Mass Flow Meters**

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance	Special Tolerance
<b>2.5</b>	<ul style="list-style-type: none"><li>- Cryogenic liquid meters</li><li>- Liquefied compressed gases other than LP Gas</li></ul>	<b>1.5 %</b>	<b>2.5 %</b>	<b>2.5 %</b>

(Added 1994) (Amended 1999, 2001, and 2013)

**Table T.2.**

**Accuracy Classes and Tolerances for Cryogenic Liquid-Measuring Devices**

Accuracy Class	Application or Commodity Being Measured	Acceptance Tolerance	Maintenance Tolerance	Special Tolerance
<b>2.5</b>	<b>Cryogenic Products; liquefied compressed gases other than carbon dioxide</b>	<b>1.5 %</b>	<b>2.5 %</b>	<b>2.5 %</b>

## Repeatability. –

When multiple tests are conducted at approximately the same flow rate and draft size, the **range** of the test results for the flow rate shall not exceed 40 % of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance.



# End of Presentation

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Some of these slides and photos are duplicated from presentations of:  
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