

Chapter 6

Inspection

Objectives

Upon completion of this chapter, you should be able to:

1. Describe the components of an official field examination.
2. Understand the function of the National Type Evaluation Program (NTEP) and the use of NTEP evaluations in preparing to inspect a specific LPG liquid-measuring device.
3. Identify the elements of an LPG liquid-measuring system that are subject to inspection in the course of an official field examination.
4. Understand the specifications and other requirements set forth in NIST Handbook 44 that are relevant to the inspection of LPG liquid-measuring systems.
5. Describe specific procedures for inspecting LPG liquid-measuring systems in the field.

Introduction

The knowledge you have acquired about the design and operation of these sophisticated liquid-measuring devices should make it obvious that systematic procedures must be employed for inspecting and testing them. Given the complexity of the LPG liquid-measuring system and the number of components that must function correctly to provide accurate measurement, a haphazard approach would at best be inefficient, thereby diminishing the overall effectiveness of the program. At worst, a haphazard approach could lead to overlooking or misinterpreting significant data, thereby invalidating the examination. In this chapter and those that follow you will receive a thorough introduction to examination procedures that employ a systematic approach to inspection and testing in the field.

The purpose of an official weights and measures examination is to determine whether or not the device being examined meets requirements that are established by law or regulations. Thus, legal requirements form the basis of all examination procedures, and a thorough knowledge of applicable codes and administrative policies is as important a part of your job as knowing how to set up and use an LPG prover or how to conduct a slow-flow test.

These examination procedures are based on NIST Handbook 44, “*Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.*” The requirements that apply to Liquefied Petroleum Gas (LPG) liquid-measuring devices are included in Sections 1.10. “General Code,” and 3.32. “LPG and Anhydrous Ammonia Liquid-Measuring Devices Code” of the handbook. These codes will be referenced throughout the following discussions. Some jurisdictions

have amended portions of these codes or adopted additional requirements through State and/or local laws and regulations. Your instructor or supervisor will point out specific differences between Handbook 44 and any regulations in force in your jurisdiction.

Codes provide the basis for field procedures, but they are presented in a way that suits their primary function as legal documents, and as a result they are often not organized for easy use in the field. Specific requirements that govern a particular component or feature of the metering system -- like the zero-set-back mechanism -- sometimes appear at separate places in the codes, and some requirements are applicable to more than one element of the system. In recognition of the need for a more systematic organization of requirements, one that is suited to efficient field procedures, the National Institute of Standards and Technology (NIST) Weights and Measures Division developed Examination Procedure Outlines (EPO's) for many weighing and measuring devices, including LPG liquid-measuring systems. These EPO's are included in NIST Handbook 112, "*Examination Procedure Outlines for Commercial Weighing and Measuring Devices.*"

Figure 6-1 is the "Inspection" portion of the EPO for LPG liquid-measuring devices. As you can see, the EPO provides a systematic organization, referencing the applicable paragraphs of the Handbook 44 codes for each of the major functional components of the metering system that are involved in measuring and indicating deliveries. A subsequent portion of the EPO presents a step-by-step procedure for conducting performance tests on the device while it is in operation. Because of its systematic organization, the EPO can be used as a checklist to ensure that all of the steps in the examination have been performed.

Note that the EPO also contains safety notes and key safety phrases to remind you to evaluate each installation for potential safety hazards. The importance of evaluating and recognizing potential safety hazards in an installation and the importance of establishing a safety program are emphasized in the "Safety Considerations" section of NIST Handbook 112; this section is included in Appendix A of this manual. The key safety phrases used throughout this and other EPO's are defined in the "Glossary of Safety Key Phrases" in Handbook 112; this section is also included in Appendix A. These two sections should be included in any EPO excerpted from NIST Handbook 112.

The EPO is intended as an outline of what should be considered to be the minimum inspection and test conducted on any measuring device. When you encounter a device that has features that are "new" to you, or you are conducting non-routine examinations (e.g., responding to complaints, or when there is reason to suspect that the device is being used improperly or to facilitate fraud), additional tests and other examination procedures are likely to be needed.

Two EPO's are provided for LPG liquid-measuring devices: one is intended specifically for motor-fuel devices, the second is intended for use with all other devices such as vehicle mounted systems. Both EPO's are reproduced in Appendix A of this manual. These EPO's should be updated periodically to incorporate changes in Handbook 44 or in the codes or policies of your jurisdiction.

EPO No. 27

**Examination Procedure Outline for
Liquefied Petroleum Gas
Liquid-Measuring Devices**

It is recommended that this outline be followed for all LP gas liquid meters except motor-fuel dispensers.

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.

- * Clothing
 - * Electrical Hazard
 - * Emergency Procedures
 - * Eye Protection
 - * Fire Extinguisher
 - * First Aid Kit
 - * Grounding
 - * Ignition Sources
 - * Lifting
 - * Location
 - * Material Safety Data Sheets (MSDS)
 - * Nature of Product
 - * Personal Protection Equipment
e.g., Safety Shoes, Safety Aprons, Respirators,
Gloves, Barrier Cream, etc. if deemed necessary,
Hard Hat – for protection from overhead hazards
 - * Safety Cones/Warning Signs
 - * Static Discharge
 - * Support – for prover
 - * Switch Loading
 - * Traffic
 - * Transportation of Equipment
- also: Wet/Slick Conditions
Chemicals, Petroleum Products, and Hazardous Materials
Obstructions and Overhead Hazards

FIGURE 6-1a. Inspection Portion of Examination Procedure Outline No. 27

Inspection:

Safety First !!!

Check the inspection site carefully for safety hazards and take appropriate precautions. Pay particular attention to the condition of the product storage tank and valves.

Check to be certain that the ground surface of the inspection site is sufficiently strong and rigid to support the prover when it is filled with product. Don't forget to chock the wheels of the prover.

Learn the nature of hazardous products used at or near the inspection site. Obtain and read copies of MSDS.

Know emergency procedures (particularly for this location) and the location and operation of fire extinguisher and emergency shut-offs.

Be sure that a constant supply of water is available for cooling tanks in an emergency.

Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns.

Use caution moving around in wet, slippery areas and in climbing on prover, storage tanks, and vehicles.

Use personal protection equipment and clothing appropriate for the inspection site.

If exposed wiring or other factors cause hazardous testing conditions, it is recommended that the testing be 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.

FIGURE 6-1b. Inspection Portion of Examination Procedure Outline No. 27

| H-44 General Code and LPG and AA Liquid-Measuring Devices Code References | |
|--|--|
| 1. General considerations. | |
| Selection | G-S.3., G-UR.1.1., G-UR.1.2., G-UR.1.3. |
| Use and maintenance | G-UR.3.1., G-UR.4.1., G-UR.4.2. |
| Installation | G-UR.2.1., G-UR.2.2., UR.1.1., G-S.2. |
| Accessibility | G-UR.2.3. |
| Assistance | G-UR.4.4. |
| Testing devices at a central location | G-UR.4.6.(a) |
| 2. Indicating and recording elements. | |
| Design | S.1.1. |
| Readability | G-S.5., G-UR.3.3., S.1.2., S.1.3. |
| Ticket Printer (vehicle-mounted systems) | UR.2.6. |
| Unit price and product identity | S.1.5.1. |
| Advancement and return to zero | S.1.1.4., S.1.4.1., S.1.4.2., UR.2.1., S.1.6.1. |
| Provision for sealing | G-S.8. (1/1/90), G-UR.4.5. |
| 3. Measuring elements. | |
| Vapor elimination | S.2.1., S.2.4. |
| Security seals | G-UR.4.5., S.2.2., S.2.6.2. |
| Thermometer well | S.2.5. |
| Automatic temperature compensation | S.2.6., S.2.6.1., UR.2.4. |
| 4. Marking requirements. | G-S.1., G-S.6.(1/1/77), G-S.7., S.4. |
| 5. Piping. | |
| Discharge line and valves | S-2.3., S.3., UR.2.2., UR.2.3. |
| Facilitation of fraud | G-S.2. |

FIGURE 6-1c. Inspection Portion of Examination Procedure Outline No. 27

An official field examination consists of four components:

- The Inspection, to determine compliance with specifications and other requirements;
- Pre-test Determinations, to assure correct application of tolerances and other test factors;
- The Test, to determine compliance with performance requirements; and
- The Evaluation of Inspection and Test results followed by approval or rejection of the device.

This division is based upon distinctions that are observed in Handbook 44 and in the EPO's. Note that the terms "inspection," "test," "evaluation," and "examination" are used to refer to specific, different activities (the examination comprising the other three). These distinctions will become clear as we discuss the separate components in detail.

Inspection

The first part of the EPO is devoted to the Inspection (see Figure 6-1). In the Inspection portion of an official examination, you will determine whether the metering system is in conformance with specifications and other technical requirements pertaining to design, installation, and operation. The extent and emphasis of your inspection will depend on a number of factors relating to the specific device being examined and the circumstances under which it is being examined. The most important of these factors are:

- your familiarity with the device,
- the age of the device,
- whether or not the device has received a Certificate of Conformance (CC) under the National Type Evaluation Program, and
- whether or not a complaint has been received.

Naturally, your previous experience with the particular device will have an impact upon the inspection process. If you are checking a particular make or design of meter for the first time, you may want to perform an extensive inspection that includes a careful check of all applicable requirements in Handbook 44, including those concerned with design and installation. If you are checking a device that you are familiar with, one that has been in service for some time, you may not need to spend as much time on design and installation requirements; however, you will want to look for such things as fraudulent use or abuse, or inappropriate applications of the equipment.

The age of the device -- when it was manufactured and when it was put into commercial service -- is important because a number of requirements in Handbook 44 are nonretroactive as of a certain date. As a result, you will find that newer equipment may be required to meet requirements different than those specified for older equipment.

Type Evaluation

In some cases, the devices you will be examining will be of a type that has been evaluated under the National Type Evaluation Program (NTEP). NTEP is a program managed by the National Conference on Weights and Measures (NCWM) for determining conformance of a weighing or measuring device "type" or "model" with the relevant provisions of Handbook 44. Manufacturers submit models or prototypes of their devices for evaluation under NTEP. Many weights and measures jurisdictions now require NTEP Certificates of Conformance (CCs) for all commercial

weighing and measuring devices installed after a specified date. An authorized NTEP laboratory conducts the evaluation. When a device is found to meet all applicable requirements, NTEP issues a CC for the device. The CC provides details of the evaluation results and device characteristics necessary for use in commerce.

Before testing a new type of device, you should determine whether a model of the device has been type evaluated. If it has, you should review the CC to determine which features have been evaluated. Copies of NTEP CCs are available to help you determine whether a particular device has been evaluated. Copies of those CCs are available on the NTEP web site at *www.ncwm.net*. You can also obtain a copy of the CC from the manufacturer of the device or from your State's Weights & Measures agency. Your instructor will tell you how to use an NTEP CC to determine whether or not a specific device is covered by the CC.

During the type evaluation process extensive tests are performed in a laboratory setting to determine whether a particular device model meets all applicable requirements in Handbook 44. Some of these tests would be very difficult or impossible to conduct in the field. Consequently, the fact that a device has received a CC can make your job easier. This is because during a routine field examination you may not have to examine extensively certain design criteria on a device that has received type approval. But remember that type evaluation means that a sample of that particular model of the device has been tested, not that each device of that type has been tested. Therefore, devices must be thoroughly inspected and tested when placed in service, and you should still review all applicable requirements when inspecting a new device.

Measuring devices are designed with specific applications in mind. Some are designed for a narrow range of applications, whereas others have a multitude of features to satisfy many different applications. Not all features are suitable for all applications. A CC will state the intended application of a device type. If you encounter a new device or a feature on a device in an unusual application, it should be thoroughly tested to determine its appropriateness and to assure that it does not facilitate fraud.

Another factor that affects the nature and extent of your inspection is the existence of a complaint about a particular device or the practices of a device owner or operator. You may want to perform a more rigorous inspection than usual if your office has received complaints about a device or business.

As you will see in the detailed discussion that follows, most Inspection determinations are made on the basis of a careful visual check and the inspector's experience and knowledge of the device. This does not mean, however, that the Inspection may be approached casually or that compliance with any requirement can be taken for granted just because the device has received type approval. It is not uncommon to discover items of non-conformance in a number of areas covered by the Inspection, especially when the equipment is old or has not been properly maintained. Furthermore, it is possible that modifications intended to facilitate fraud will show up in the course of a careful inspection rather than in the results of performance tests.

You should also keep in mind that your inspection is never limited to visual means. It is your responsibility to decide what is necessary to adequately determine the compliance status of the

device. If you have reason to believe that a correct determination requires additional testing, either in the field or under more controlled conditions, you should consult your supervisor. The decision to conduct further testing will be based on the probability that a suspected violation will be confirmed against the cost of additional testing to the firm and the jurisdiction.

Inspection

The remaining sections of this chapter will present the Inspection for LPG liquid-measuring devices. Each of the items included in the EPO's will be discussed in detail. However, in the interest of establishing a basic framework for field procedures, we will begin with the General Considerations and Marking sections of the EPO. Differences between the EPO for motor-fuel devices and the EPO for all other LPG liquid-measuring devices are slight; they will be pointed out and explained as we proceed.

General Considerations

The items under this heading refer, for the most part, to requirements and specifications from the General Code that are necessarily broad and comprehensive in nature. They may also relate to items covered specifically elsewhere in the Inspection or Test portions of the examination. These general considerations are important and should be considered throughout the examination.

Accessibility

All elements of the metering system that are subject to inspection and testing must be accessible to you and any test equipment used in the test.

For LPG liquid-measuring systems, these elements include:

- all indicating and recording elements (the register, ticket printer, totalizers, etc.)
- the automatic temperature compensator, if the system is equipped with one

Note: Handbook 44 does not require an LPG meter to be equipped with automatic temperature compensation; however, if your jurisdiction has adopted the Uniform Method of Sale of Commodities Regulation in NIST Handbook 130, refer to Section 2.21. Liquefied Petroleum Gas. This section, which went into effect on January 1, 1987, requires all metered sales from devices that deliver more than 20 gallons a minute to be automatically temperature compensated.

2.21. Liquefied Petroleum Gas. - All liquefied petroleum gases, including but not limited to propane, butane, and mixtures thereof, shall be kept, offered, exposed for sale, or sold by the pound, metered cubic foot of vapor (defined as 1 cu ft at 60 °F), or the gallon (defined as 231 cu in at 60 °F). All metered sales by the gallon, except those using meters with a maximum rated capacity of 20 gallons per minute or less,

shall be accomplished by use of a meter and device that automatically compensates for temperature. (Added 1986)

- the meter and vapor eliminator, including vent lines from the vapor eliminator and the meter identification plate, which contains several items of important and required information
- all piping between the storage tank and the discharge nozzle, and all automatic and manual control elements

Section G.-UR.2.3. in the General Code states that it is the responsibility of the owner or operator of a weighing and measuring device to make all equipment accessible for testing by weights and measures officials.

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
- (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)

Figure 6.2. General Code, Paragraph G-UR.2.3.

Because LPG liquid-measuring systems are designed for use in direct sales, there is generally no problem with accessibility. However, if, for example, the meter is installed in a locked cabinet, the operator must provide a key. Or if the meter or piping is obscured by housings or cabinetry, the operator must make these elements accessible.

Assistance

Several steps in the examination procedures require two people to perform them safely and properly. For example, assistance is usually needed to position a vehicle-mounted system adjacent to the prover. It is also standard procedure (as well as a matter of policy in many jurisdictions) to have the vehicle driver operate the metering system, while the inspector operates the test equipment. This minimizes any liability for damage that occurs during the examination, and it is usually a more efficient procedure, since the driver will be more familiar with the system's controls, adaptors, etc.

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.

Figure 6.3. General Code, Paragraph G-UR.4.4.

Where safety is concerned and assistance is necessary to complete any task, you must not attempt to perform procedures alone. The General Code requires that assistance be provided by the owner or operator of a device whenever necessary. It is obviously important that the owner or operator be notified of the need for assistance in advance to allow for the necessary arrangements to be made. Your jurisdiction may have specific procedures regarding arrangements for assistance. If so, your supervisor will explain them to you.

In some jurisdictions, such as large cities and rural areas, central test locations are designated in appropriate sites so that test equipment and other resources can be utilized more efficiently. Firms in these jurisdictions are notified to bring vehicle-mounted meters to the test locations on a certain date between certain time periods for testing. In 1994 paragraph G-UR.4.6. "Testing Devices at a Central Location" was added to Handbook 44 to ensure that jurisdictions have the authority to require device owners to transport devices to a specific site for testing.

G-UR.4.6. Testing Devices at a Central Location. -

- (a) When devices in commercial service require special test facilities, or must be removed from service for testing, or are routinely transported for the purpose of use (e.g., vehicle-mounted devices and devices used in multiple locations), the official with statutory authority may require that the devices be brought to a central location for testing. The dealer or owner of these devices shall provide transportation of the devices to and from the test location.

(Added 1994)

Figure 6.4. Excerpt from General Code Paragraph G-UR.4.6.

Selection

LPG liquid-measuring systems are available in a variety of designs and configurations to meet the needs of specific applications. A number of usage factors are considered by the owner of the device in selecting the correct equipment. For example, a dispensing system intended for use primarily for making retail deliveries of LPG to motor vehicles should be designed to deliver at a lower maximum discharge rate because the receiving tanks and piping are relatively small. A metering system installed at an LPG terminal, on the other hand, and used for wholesale deliveries to LPG tank trucks, will require a larger meter to provide the higher discharge rates needed for efficient delivery.

In 1995 paragraph G-UR.1.3. “Liquid-Measuring Devices” was added to Handbook 44 to provide additional guidance to device owners and users on selecting the appropriate equipment for making product deliveries by establishing restrictions on the minimum delivery that can be made from a measuring device.

G-UR.1.3. Liquid-Measuring Devices. - To be suitable for its application, the minimum delivery for liquid-measuring devices shall be no less than 100 divisions, except that the minimum delivery for retail analog devices shall be no less than 10 divisions. Maximum division values and tolerances are stated in the specific codes.
(Added 1995)

Figure 6.5. General Code Paragraph G-UR.1.3.

Using equipment that is unsuitable for its application is generally more costly in the long run since components will wear more rapidly and are more likely to malfunction when used under conditions other than those for which they were designed. But where measuring devices are concerned, the use of unsuitable equipment can also affect accuracy; for example, when a system is operated at discharge rates outside the range recommended by the manufacturer. These examples represent just a few of the reasons that the selection of suitable equipment is required by the General Code.

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.
(Amended 1974)

Figure 6.6. General Code, Paragraph G-UR.1.1.

Several of the specifications covered elsewhere in the Inspection relate to the suitability of the device in regard to particular elements or features, but it is important to make a general assessment of the suitability of the equipment at the beginning of the examination. Specific information, including maximum and minimum discharge rates and use limitations, are required to be marked permanently on the device (see the section in this chapter on “Marking” for details). The operating manual and/or installation instructions that come with the meter from the manufacturer or distributor usually include a discussion of appropriate applications and will also mention specific applications that are not appropriate. If you are unfamiliar with the device, you should check these sources. If they are not available or do not provide enough information to make a determination as to the suitability of the equipment, a local distributor, manufacturer’s representative, or authorized service agency can usually answer any question you have. Of course, you may have to rely upon the operator of the equipment to describe to you how it is actually used. If you have any additional questions or concerns contact your supervisor.

Installation

Even a metering system that is suitable for its application may not perform accurately and consistently if it has not been installed properly. For example, the use of piping or connectors with dimensions other than those specified by the manufacturer can affect various operating characteristics of the system, and these, as you know, can in turn affect the accuracy of measurements. Proper installation of LPG metering devices also involves important considerations of safety and security. As a means of assuring that the system performs as it was designed to, the General Code requires that the manufacturer's instructions be followed in installing the meter and accessory equipment. It is also essential that equipment be installed in such a manner that all required markings can be readily observed.

It is neither practical nor, generally speaking, necessary to check each item in the manufacturer's instructions as part of a routine field examination. You should at least, however, determine by a visual inspection whether the meter and register are properly installed. As you proceed through the examination, results from inspecting and testing particular elements of the system may lead you to the conclusion that a substandard condition or performance is ultimately the result of improper installation.

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 so installed 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.
(Added 1978)

Figure 6.7. General Code, Paragraphs G-UR.2.1. & G-UR.2.1.1.

Two other specifications relating to installation are referenced in the EPO's. G.UR.2.2. from the General Code, requires that there be no visual obstruction between the measuring element (the meter, in the case of an LPG liquid-measuring device) and a primary indicating element (the register).

G-UR.2.2. Installation of Indicating or Recording Element. - A device shall be so installed that there is no obstruction between a primary indicating or recording element and the weighing or measuring element; otherwise there shall be convenient and permanently installed means for direct communication, oral or visual, between an individual located at a primary indicating or recording element and an individual located at the weighing or measuring element. [See also G-UR.3.3.]

Figure 6.8. General Code, Paragraph G-UR.2.2.

The purpose of this requirement is to minimize facilitation of fraud by prohibiting an installation in which it is not possible for a person who is monitoring the register -- whether the operator, a customer, or you as the inspector -- to monitor the meter and dispensing elements at the same time,

either directly or by direct communication with another individual. Conformance with this requirement is obviously necessary for a device to be examined.

For example, if the register for a delivery station at an LPG terminal is located inside a service building, a window permitting simultaneous monitoring of the register and the meter would be adequate to meet the requirement, as would an intercom system connecting the service building with the delivery station. Either will provide assurance that product is being delivered to the purchaser (or your test prover) and not diverted to some other delivery vessel and that controls are not being manipulated in such a way as to affect the measurement.

The second requirement is contained in UR.1.1. “Discharge Rate” in the LPG & AA/LMD Code. It prohibits any installation that allows the metering system to be operated at a discharge rate that exceeds its rated maximum.

UR.1.1. Discharge Rate. - A device shall be so installed that the actual maximum discharge rate will not exceed the rated maximum discharge rate. If necessary, means for flow regulation shall be incorporated in the installation, in which case this shall be fully effective and automatic in operation.

Figure 6.9. LPG & AA/LMD Code, Paragraph UR.1.1.

In many systems, the maximum discharge rate that can be developed is effectively limited by such factors as the inside diameter of the piping and the design of the pump (provided, of course, that the system has been installed in accordance with the manufacturer’s specifications). However, in some systems additional means of controlling flow rate are necessary. This is often accomplished by a pilot-operated control valve, which is actuated either mechanically or electrically in response to a rate-of-flow sensor located on the discharge side of the meter. The operation of such a device need not concern you, except that it must be automatic; that is, it shuts off flow of product when the calibrated flow rate is exceeded, without requiring any action on the part of the operator. A system incorporating a flow rate indicator or gauge and a manual throttling valve as a means of preventing excessive discharge rates will not meet this requirement since these means would not be automatic. (Such mechanisms are, however, appropriate for controlling flow rate within the rated range and are not prohibited when used for that purpose.)

Use and Maintenance

A measuring device can be expected to perform accurately and reliably only if it is used and maintained properly. Two User Requirements in the General Code establish correct use and maintenance as requirements.

G-UR.3.1. Method of Operation. - Equipment shall be operated only in the manner that is obviously indicated by its construction or that is indicated by instructions on the equipment.

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, 1991)

Figure 6.10. General Code, Paragraphs G-UR.3.1. & G-UR.4.1.

Obviously it will be impossible to determine whether equipment is being used properly in commercial service in the course of a field examination. You may, however, question the operator about how the device is normally used and provide information on the user requirement quoted above. This should certainly be done if complaints have been received. It is often possible to detect certain types of misuse or inadequate maintenance from the physical condition of the equipment at the time of the inspection. Look for evidence such as excessive dirt or grease, leaks, dents, premature wear, or frequent need for adjustment. Broken or cracked glass over the register should be cited since it may affect the readability of indications.

Maintenance of Equipment - Accuracy

The provision of G-UR.4.1. regarding equipment at a single location with errors predominately in favor of the owner is intended to discourage firms from taking advantage of tolerances. Measuring devices are required to be adjusted as close as possible to a zero error condition, not to applicable tolerances. If the owner of a number of LPG tank trucks, for example, makes it a practice to adjust the metering equipment as close as possible to tolerances in a direction favorable to the owner rather than to zero error, the cumulative effect can be a significant financial advantage for the firm and significant losses for consumers even though each device performs within tolerances that permit only a small degree of error. The system of tolerances can only be effective if it can be assumed that for a large number of devices that perform within tolerances, some have errors slightly in favor of their owners, others slightly in favor of customers, so that the cumulative effect is truly insignificant.

Under this requirement, you can reject all metering devices operated from a single location even though none of them individually performs outside applicable tolerances (to provide flexibility in applying G-UR.4.1. the phrase “near the tolerance limit” was removed from the requirement in 1991). Your supervisor can provide your jurisdiction’s policy on applying this requirement.

The owner or operator who is taking advantage of tolerances will likely not admit to this illegal practice, and it is extremely unlikely that written instructions regarding such adjustments will exist, so the evidence will generally be entirely based upon your test results. If a check of records for past inspections reveals that a firm’s equipment is usually in this condition, the pattern observed could constitute strong evidence that abuse is occurring. Such factors as the number of meters operated from the same location, the time that has passed since the last examination, and the compliance

history of the owner or operator should be taken into account whenever possible. If you have questions seek guidance from your supervisor.

Marking

Under G.S.7. Lettering in the General Code, Handbook 44 specifies that required markings be made in such a manner that they would not tend to become obliterated. All required markings, whether included in this section of the EPO or elsewhere, must also be legible and easily readable.

G-S.7. Lettering. - All required markings and instructions shall be distinct and easily readable and shall be of such character that they will not tend to become obliterated or illegible.

Figure 6.11. General Code, Paragraph G-S.7.

To assure that a source of authoritative technical information is available for all equipment in commercial service, the General Code specifies that each device be marked with the manufacturer's name, the model designation, and, if it has been put in service since 1968 and is a built-for-purpose device, a nonrepetitive serial number. Devices manufactured or placed into service after certain dates are required to have additional identification information such as terms clearly designating the model and serial number. Likewise, some devices covered under an NTEP CC are also required to have information relative to the CC Number.

Some weighing and measuring systems use equipment that was not built specifically for use in a weighing or measuring application. For example, a metering system may consist of a conventional meter interfaced with a generic computer (central processing unit and monitor) and running on software that was developed for use in a weighing or measuring application. This same generic computer could be used with other (non-weights and measures) software in non-weighing and measuring applications. Because the generic computer hardware was not built specifically for use in weighing and measuring applications, it is referred to as a "not built-for-purpose" device.

In 2003, Paragraph G-S.1. was modified to require that not-built-for purpose software-based devices be marked with the current software version designation. Paragraph G-S.1.1. specifies the location of the marking information for not-built-for purpose software-based devices.

The most authoritative source of technical information about an LPG liquid-measuring system is the manufacturer. Because technical information is often needed by the operator of the device, by service persons, and by weights and measures officials, the name of the manufacturer must be readily available. But the company name alone is often not enough to identify the device for the purpose of obtaining specific information. Most manufacturers of LPG meters, for example, make more than one model of meter. Furthermore, design changes and new features are sometimes incorporated into existing models.

As a result, the only way of positively identifying a particular piece of metering equipment is by using a system of nonrepetitive serial numbers. Many manufacturers imprint or etch this

information on a thin metal plate, which is then affixed to one of the surfaces of the meter body. Figure 6-13 illustrates the type of information that is found on the meter identification plate.

In accordance with paragraph G-S.1., identifying information must be permanently marked. This means that it must not be removable or alterable, unless provision is made that removal or alteration will be readily evident. Thus, an identification plate should be attached to a component in some way that prevents its removal without mutilating it; this will prevent the plate from being replaced or transferred to another device.

To prevent alteration of the imprinted information, some manufacturers use a plate made of pressure-sensitive material that will clearly show any attempt to erase original markings or alter them in any way. To avoid accidental obliteration of the markings, the device owner should make sure that when the device is installed the plate is located on a surface that is visible or readily accessible (as required), but not exposed to frequent abrasion during the course of normal operation.

Remanufactured devices and remanufactured main elements are required to be marked with the remanufacturer's name and the remanufacturer's model designation (if it is different than the original manufacturer's model designation). In 2003, requirements and associated definitions (as outlined in Figure 6-14) were added to the General Code to specify marking requirements for remanufactured equipment. Definitions for "repaired device" and "repaired element" were also added to help in clarifying the difference between "remanufactured" and "repaired" equipment.

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;
- (b) a model designation that positively identifies the pattern or design of the device;
 - 1. *The model designation shall be prefaced by the term "Model," "Type," or "Pattern." These terms may be followed by the term "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)
- (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, and 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]

(d) the current software version designation for not built-for-purpose, software-based devices;
[Nonretroactive as of January 1, 2004]
(Added 2003)

(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 term "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]

The required information shall be so located that it is readily observable without the necessity of the disassembly of a part requiring the use of any means separate from the device.
(Amended 1985, 1991, 1999, 2000, 2001, and 2003)

Figure 6.12. General Code, Paragraph G-S-1.

G-S.1.1. Location of Marking Information for Not Built-For-Purpose, Software-Based Devices. -
For not built-for-purpose, software-based devices, the following shall apply:

(a) the manufacturer or distributor and the model designation shall be continuously displayed or marked on the device (see note below), or

(b) the Certificate of Conformance (CC) Number shall be continuously displayed or marked on the device (see note below), or

(c) all required information in G-S.1. Identification. (a), (b), (c), (e), and (h) shall be continuously displayed. Alternatively, a clearly identified "view only" System Identification, G-S.1. Identification, or Weights and Measures Identification shall be accessible through the "Help" menu. Required information includes that information necessary to identify that the software in the device is the same type that was evaluated.

Note: Clear instructions for accessing the remaining required G-S.1. information shall be listed on the CC. Required information includes that 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)

Definition:

built-for-purpose device. Any main device or element which was manufactured with the intent that it be used as, or part of, a weighing or measuring device or system. [1.10]

(Added 2003)

Figure 6.13. General Code, Paragraph G-S-1.1. Location of Marking Information, Not Built-for-Purpose Devices and Associated Definitions

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)

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.

Definitions:

element. A portion of a weighing or measuring device or system which performs a specific function and can be separated, evaluated separately, and is subject to specified full or partial error limits.
(Added 2002)

manufactured device. Any commercial weighing or measuring device shipped as new from the original equipment manufacturer.[1.10]
(Amended 2001)

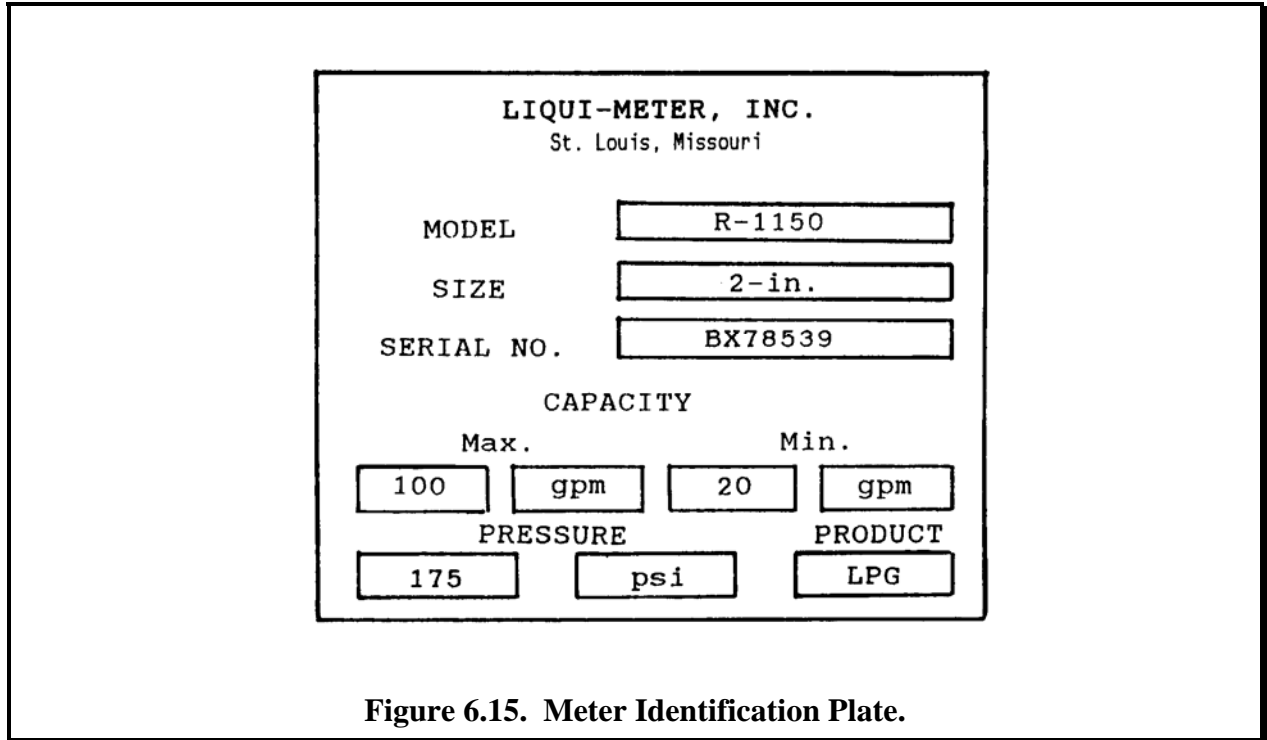
remanufactured device. A device that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new device of the same type.[1.10]
(Added 2001)

remanufactured element. An element that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new element of the same type.[1.10]
(Added 2001)

repaired device. A device to which work is performed that brings the device back into proper operating condition.[1.10]
(Added 2001)

repaired element. An element to which work is performed that brings the element back into proper operating condition. [1.10]
(Added 2001)

Figure 6.14. General Code, Paragraph G-S-1.2. Remanufactured Equipment and Definitions



The General Code also includes one additional requirement that relates directly to the marking of operating controls and other features of the device.

G-S.6. Marking, Operational Controls, Indications, and Features. - All operational controls, indications, and features, including switches, lights, displays, push buttons, and other means, shall be clearly and definitely identified. The use of approved pictograms or symbols shall be acceptable. [Nonretroactive as of January 1, 1977.]
(Amended 1978, 1995)

Figure 6.16. General Code, Paragraph G-S.6.

In addition to these general marking requirements, several specific marking requirements are included in subsection S.4. of the LPG & AA/LMD Code.

S.4. Marking Requirements.

S.4.1. Limitation of Use. - If a device is intended to measure accurately only products having particular properties, or to measure accurately only under specific installation or operating conditions, or to measure accurately only when used in conjunction with specific accessory equipment, these limitations shall be clearly and permanently stated on the device.

S.4.2. Discharge Rates. - A device shall be marked to show its designed maximum and minimum discharge rates. The marked minimum discharge rate shall not exceed:

- (a) 20 L (5 gal) per minute for stationary retail devices, or
 - (b) 20 % of the marked maximum discharge rate for other retail devices and for wholesale devices.
- (Amended 1987)

Note: See example in Section 3.30. Liquid-Measuring Devices Code, Paragraph S.4.4.1. (Added 2003)

S.4.3. Temperature Compensation. - If a device is equipped with an automatic temperature compensator, the primary indicating elements, recording elements, and recorded representation shall be clearly and conspicuously marked to show that the volume delivered has been adjusted to the volume at 15 °C (60 °F).

Figure 6.17. LPG & AA/LMD Code, Subsection S.4.

Limitations of use will be specific to the equipment installed. Since the internal components of LPG meters are made of special materials, the marking may indicate that the device is only suitable for metering LPG liquid. The meter may also be marked to indicate a specified range of pump discharge rates and/or the maximum working pressure and/or a range of ambient temperatures for which it is designed to operate.

In addition, the meter must be marked to show its maximum and minimum discharge rates. The requirement for the marked minimum discharge rates included in paragraph S.4.2. -- 20 L (5 gpm) for stationary retail devices and 20 percent of the marked maximum discharge rate for all other devices -- constitutes an additional design requirement (see the following section on design requirements) and is intended to assure that the system is capable of accurate measurement and registration at relatively low flow rates that may be required for its application and use. An example of how paragraph S.4.2. applies to the minimum and maximum discharge rates is included in Liquid-Measuring Devices Code Paragraph S.4.4.1. as noted in Figure 6-17.

Marked limitations of use and discharge rates will normally be included on the main identification plate located on the meter assembly (see Figure 6-13), although they may be imprinted on a separate plate.

The required markings for a system equipped with an automatic temperature compensator include “clear and conspicuous” indications on the register, ticket printer (if the system has one), and also on any printed ticket that the indicated or recorded amount has been corrected to reflect the volume of product at its reference standard temperature 15 °C (60 °F).

At an early stage in your inspection you should check all required markings and record them, either on the official report form or in your own field notes. Requirements for marking are included in Handbook 44 because the information is often useful, and sometimes critical, in determining conformance of the device with other requirements and tolerances. You will need to refer to at least some of this information as your examination proceeds and should also have it recorded for future reference.

Indicating and Recording Elements

The remainder of the Inspection deals directly with the operating components of the system: indicating and recording elements, measuring elements, and piping and control elements. According to Handbook 44, an indicating element is “an element incorporated in a weighing or measuring device by means of which its performance relative to quantity or money value is “read” from the device itself. . . .” A recording element makes a permanent record of such a “reading.”

Design

Any indicating or recording element that is used as the basis for determining the price of a commercial transaction is called a primary element. All commercial measuring devices, including LPG liquid-measuring devices, must be equipped with at least a primary indicating element.

S.1.1.1. General. - A device shall be equipped with a primary indicating element and may also be equipped with a primary recording element.

[Note: Vehicle-mounted metering systems shall be equipped with a primary recording element as required by paragraph UR.2.6.]

Figure 6.18. LPG & AA/LMD Code, Paragraph S.1.1.1.

UR.2.6. Ticket Printer; Customer Ticket. - Vehicle-mounted metering systems shall be equipped with a ticket printer. The ticket printer shall be used for all sales; a copy of the ticket issued by the device shall be left with the customer at the time of delivery.
(Added 1992)

Figure 6.19. LPG & AA/LMD Code, Paragraph UR.2.6.

Most LPG liquid-measuring devices have only one primary indicating element, the register; but they may have more than one. Consider the example in which an LPG terminal has indicators both at the delivery stations and in a service building, and the indicators in the building are used as the basis for determining the price of a delivery of product. If an employee prepares an invoice on the basis of those indications while the attendant and/or customer monitor the delivery on the indicator at the

delivery station, both sets of indicators would be considered primary indicating elements. Similarly, totalizers are only considered primary indicating elements if they are actually used as the basis for computing a price for the product delivered. For example, when cumulative totals are used to determine the amount of product sold from a consignment of product. Totalizer readings may also be used as primary indicating elements to prepare periodic billings for key- or card-acceptor systems, where individual customers are assigned individual totalizers and are invoiced periodically (often once a month) for all purchases of product during the billing period. (During the delivery itself, the consumer usually monitors a register that is reset to zero before each delivery; the totalizer readings are used by the operator in preparing invoices.) UR.2.6. Ticket Printer; Customer Ticket. - Vehicle-mounted metering systems shall be equipped with a ticket printer. The ticket printer shall be used for all sales; a copy of the ticket issued by the device shall be left with the customer at the time of delivery. (Added 1992)LPG stationary liquid-measuring systems are not required to have a primary recording element. However, as shown in Figure 6-17, Handbook 44 does require vehicle-mounted metering systems to be equipped with a ticket printer and a copy of the ticket issued by the printer must be left with the customer.

Many LPG liquid-measuring devices are equipped with ticket printers because they reduce the operator's effort and are consistently accurate, whereas hand-printed invoices take time to prepare and are sometimes inaccurate due to errors in transcription or computation made by the operator. Again, some systems may be equipped with more than one primary recording element (for example, a remote invoice printer that is used to prepare billings, while the customer receives a receipt printed at the delivery station).

As you begin your inspection of indicating and recording elements identify all elements in the system that meet the general definition and check each for conformance with specific design requirements. Two of these specific requirements relate to the units that an LPG liquid-measuring system must use to indicate quantities delivered.

S.1.1.2. Units. - A device shall indicate, and record if the device is equipped to record, its deliveries in terms of gallons, quarts, pints, or binary-submultiple or decimal subdivisions of the gallon.

(Amended 1987)

S.1.1.3. Value of Smallest Unit. - The value of the smallest unit of indicated delivery, and recorded delivery if the device is equipped to record, shall not exceed the equivalent of:

(a) 0.5 L (1 pt) on retail devices, or

(b) 6 L (1 gal) on wholesale devices.

(Amended 1987)

Figure 6.20. LPG & AA/LMD Code, Paragraphs S.1.1.2. and S.1.1.3.

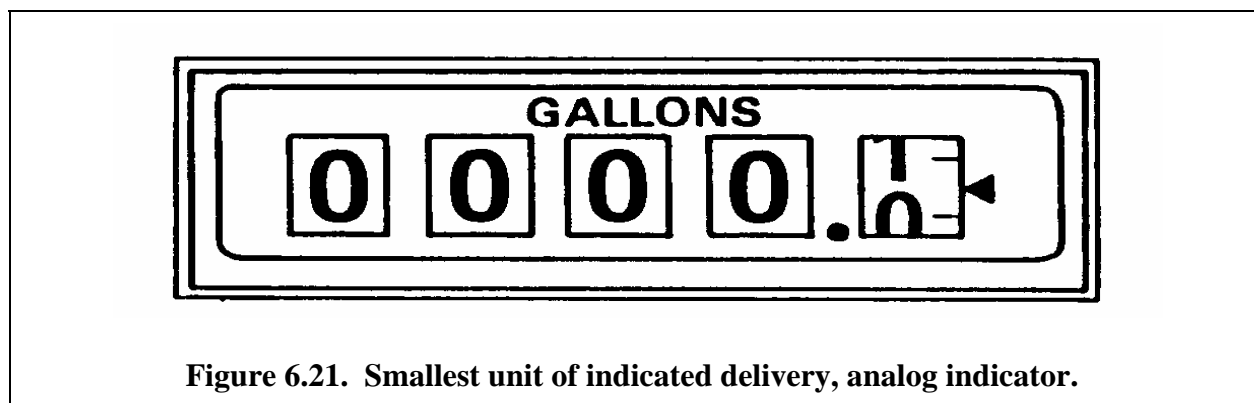
The first of these requirements is intended to prevent the confusion that would certainly arise in the marketplace if units other than those customarily used for sales of liquid products in the U.S. inch-

pound system were employed by some operators. Thus, for example, deliveries may not be indicated in barrels or cubic inches.

The requirement for the value of the smallest unit indicated or recorded minimizes the effects of rounding up to the next higher value and reflects the fact that this effect will be proportionally greater for what are usually relatively smaller sales to retail customers.

For example, if wholesale consumers are charged for 401 gallons of LPG when they only receive 400.4 gallons, the effect due to rounding up will be about 0.1 percent. On the other hand, if retail consumers have to pay for 41 gallons when they only receive 40.4 gallons, the effect due to rounding would be more than 1 percent, that is, about 10 times greater even though the amount rounded is exactly the same. Reducing the smallest unit of delivery to 1 pint (0.125 gallon) would mean that the retail customer would pay for 40.5 gallons, and the effect due to rounding would only be about 0.25 percent.

The value of the smallest unit of indicated delivery for an analog indicator is the value of the smallest graduated interval on the quantity indication, as illustrated in Figure 6-19.



In the case of an analog register, the smallest unit indicated is the value of the smallest graduated interval. In this example, the smallest graduation is indicated in 0.1 gallon (0.8 pint). For a digital device, the value of the smallest unit will be the smallest quantity increment, that is the smallest change in quantity that can be indicated. For example, if a digital indicator reads 20.0 gallon and the next value indicated as delivery continues is 20.1 gallon, the next 20.2 gallon, and so on, the smallest quantity increment is 0.1 gallon.

The value of the smallest unit can be determined for an analog device by observing the right-hand quantity wheel. To determine the smallest unit for a digital indicator, on the other hand, you may have to observe the device in operation. Conformance with this design requirement may be determined, therefore, during the Test portion of the examination, when the device is actually placed in operation. (Note that any device that indicates quantities of 0.1 gallon or less will automatically meet this requirement, since 1 pint = 0.125 gallon.)

Paragraph S.1.1.4. includes a requirement relating to advancement and return of indicating and recording elements to zero. We will discuss it in detail shortly, along with several other

requirements relating to the same function. Similarly, S.1.1.5., which deals with indicated and recorded money values, will also be discussed in a later section.

One further requirement is included in S.1.1.6. “Printed Ticket.” It relates to a printed ticket, and it simply states that any printed ticket produced by a computing type device must display, in addition to the computed price, the total quantity of the delivery in liters or gallons, and fractional subdivisions of the liter or gallon, and the price per liter or gallon.

S.1.1.6. Printed Ticket. - Any printed ticket issued by a device of the computing type on which there is printed the total computed price, shall have printed clearly thereon the total volume of the delivery in terms of liters or gallons, and the appropriate decimal fraction of the liter or gallon, and the corresponding price per liter or gallon.
(Added 1979; Amended 1987)

Figure 6.22. LPG & AA/LMD Code, Paragraph S.1.1.6.

A number of requirements specifying the dimensions, character, and other design features of graduations and indicators (here used to refer to the pointer which is used in conjunction with graduations) are included in subsections S.1.2. and S.1.3. of the LPG & AA/LMD Code. Most of these relate to analog registers only (since digital devices have neither graduations nor indicators). It is neither practicable nor necessary to check a device for conformance with each of these specifications in the course of a routine field examination, especially if you are familiar with the device being examined or have determined that it is covered by an NTEP Certificate of Conformance.

Readability

The specifications just mentioned are included in the LPG & AA/LMD Code in order to assure that LPG liquid-measuring devices will be readable. To minimize errors and the possibility of misrepresentation, the customer and the operator of the device must be able to read and understand the information displayed by primary indicating and recording elements. A number of requirements in the General Code (especially subsection G-S.5.) also deal with the subject of readability and provide useful guidance for a routine inspection procedure. The first of these simply states the requirement of readability for all primary indicating elements and recorded representations.

G-S.5.1. General. - All weighing and measuring devices shall be provided with indicating or recording elements appropriate in design and adequate in amount. Primary indications and recorded representations shall be clear, definite, accurate, and easily read under any conditions of normal operation of the device.

Figure 6.23. General Code, Paragraph G-S.5.1.

Another paragraph of the General Code further defines readability, this time in concrete terms, specifying a position from which indications must be readable.

G-UR.3.3. Position of Equipment. - A device equipped with a primary indicating element and used in direct sales, except for prescription scales, shall be so positioned 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 position shall be determined in each case upon the basis of the individual circumstances, particularly the size and character of the indicating element.
(Amended 1974 and 1998)

Figure 6.24. General Code, Paragraph G-UR.3.3.

Though the requirement here is addressed explicitly to the position of measuring equipment, it provides a practical guideline for readability: some reasonable “customer” and “operator” position. As you inspect the register or other primary indicating element, place yourself physically in the position from which a customer would normally monitor delivery. Would a customer in this position, one who may not be as familiar as you are with the device, be able to read and understand the indications? Likewise, place yourself physically in the position from which an operator would normally monitor delivery and ask the same questions. If you determine that the customer and/or operator would not be able to read and understand the indications, is it because the indications are somehow obscured, either by their position or by dirt, grease, or scratched or broken glass? Or is it the size, character, or some other design feature that makes them unreadable? If the latter, you may wish to check the specifications set forth in the LPG & AA/LMD Code, especially subsections S.1.2. and S.1.3. to determine the specific item of nonconformance.

Unit Price and Product Identity

Even if a computing-type device displays accurately and clearly the quantity delivered and the total price, the customer cannot make value comparisons or verify the total price unless the product is clearly identified and the unit price is displayed. The LPG & AA/LMD Code requires that this information be displayed conspicuously on certain types of retail devices.

S.1.5. For Stationary Retail Devices Only.

S.1.5.1. Display of Unit Price and Product Identity. - In a device of the computing type, means shall be provided for displaying on each face of the device the unit price at which the device is set to compute or to deliver, as the case may be, and there shall be conspicuously displayed on each side of the device the identity of the product that is being dispensed. If a device is so designed as to dispense more than one grade, brand, blend, or mixture of product, the identity of the grade, brand, blend, or mixture being dispensed shall also be displayed on each face of the device.

Figure 6.25. LPG & AA/LMD Code, Paragraph S.1.5.1.

It is not sufficient for the operator simply to post a sign somewhere on the premises stating the price and the product; the unit price and product identity must be marked on the device itself. Note that this requirement is intended to apply to stationary retail LPG motor-fuel devices (and is nearly

identical to a requirement in the Liquid-Measuring Devices Code that applies to motor-fuel dispensers). It does not apply to retail computing-type devices on truck-mounted systems.

Nor does this requirement apply to non-computing registers since the unit price is not set in the mechanism; the delivery information registered by a non-computing device (quantity dispensed) will be the same regardless of the unit price.

Advancement and Return to Zero

Primary indicating elements installed in LPG liquid-measuring systems that are used for retail sales are required to have a means for resetting them to zero before the beginning of each delivery. The same requirement is applicable to recording elements on retail LPG motor-fuel devices.

Wholesale devices may be equipped with return-to-zero mechanisms, or they may employ cumulative indicators and recorded representations, in which case the amount delivered is calculated by subtracting the value indicated before any product is dispensed from the value indicated at the conclusion of the delivery.

On retail devices, the primary indicating element (and primary recording element on a stationary retail motor-fuel device) must be readily returnable to a definite zero. Paragraph S.1.4.2. also requires that means be provided to prevent turning the elements past zero to display any other amount. This requirement is usually met by a mechanical indicating or recording element whose design incorporates a positive stop in the reset mechanism. In electronic elements, the indicator is designed to stop at zero.

A separate requirement is intended to prevent a resettable indicating or recording device from being manipulated in such a way as to display any value during the resetting process before the elements reach zero. Most mechanical registers are equipped with shutters that are actuated automatically when the reset control begins. These shutters obscure the value wheels while they are turning and are retracted, again automatically, when the indicator has reached the zero stop.

Most electronic registers blank out the display completely during the reset process, displaying the figure “8” for all digits momentarily just before zeros appear. (This is a segment check of the display; since the figure “8” includes all the independently activated display segments that are used to display the other numerals, this test assures that all display segments are operative.)

S.1.4. For Retail Devices Only.

S.1.4.1. Indication of Delivery. - A retail device shall be constructed to show automatically its initial zero condition and the amounts delivered up to the nominal capacity of the device.

S.1.4.2. Return to Zero. -

- (a) Primary indicating elements shall be readily returnable to a definite zero indication.
- (b) Primary recording elements on a stationary retail device shall be readily returnable to a definite zero indication if the device is equipped to record.
- (c) Means shall be provided to prevent the return of primary indicating elements, and of primary recording elements if these are returnable to zero, beyond their correct zero position.

(Amended 1990)

Figure 6.26. LPG & AA/LMD Code, Paragraphs S.1.4.1. and S.1.4.2.

S.1.1.4. Advancement of Indicating and Recording Elements. - Primary indicating and recording elements shall be susceptible of advancement only by the mechanical operation of the device. However, a device may be cleared by advancing its elements to zero, but only if:

- (a) the advancing movement, once started, cannot be stopped until zero is reached, or
- (b) in the case of indicating elements only, such elements are automatically obscured until the elements reach the correct zero position.

Figure 6.27. LPG & AA/LMD Code, Paragraph S.1.1.4.

Indicating and recording elements that are returnable to zero are intended to display delivery information for a single delivery only; if the elements are not returned to zero before the commencement of a given delivery, the quantities displayed will obviously not accurately reflect that delivery. Handbook 44 includes a user requirement that specifies that returnable elements must be reset between deliveries.

UR.2.1. Return of Indication and Recording Elements to Zero. - The primary indicating elements (visual), and the primary recording elements when these are returnable to zero, shall be returned to zero before each delivery.

Figure 6.28. LPG & AA/LMD Code, para. UR.2.1.

Though you will be able to make some observations about how the operator uses the equipment during your testing procedures, obviously you will not be able to determine whether the operator has and will conform with this user requirement by any routine inspection procedure. However, you

may inform the operator of the requirement, and should certainly do so if complaints have been received from customers. If repeated complaints are received, contact your supervisor for guidance.

You can also inspect the device for conformance with other requirements relating to advancement and return to zero. Observe the register and/or other primary indicating element from a “customer” position while your assistant operates the reset mechanism. You should not be able to read any value on the elements until they reach zero, and the zero indication, when displayed, should be exact. You can check the reset on a ticket printer by printing a ticket when the register has been reset to zero. The printed representation should also be clearly zero.

Measuring Elements

After this discussion of the numerous and detailed specifications relating to the indicating and recording elements of an LPG liquid-measuring system, it may seem surprising to you that Handbook 44 has no specifications for the design of the meter itself, except that provision be made for sealing it. Of course, the entire metering system is required to perform accurately within close tolerances, and this performance, which you will test in the course of your examination, depends to a large degree upon the condition of the meter. However, the design and operation of the type of positive-displacement meter that is usually incorporated in LPG metering systems is relatively simple from a mechanical point of view, and both are very effective and very reliable.

Although there are no specific requirements for the meter, Handbook 44 does specify several aspects of the design of auxiliary components of the measuring system: the vapor eliminator, thermometer wells, and the automatic temperature compensator (if the system is equipped with one). In addition, several requirements relate to provisions for sealing.

Vapor Elimination

Paragraphs S.2.1. and S.2.4. of the LPG & AA/LMD Code deal with the subject of vapor elimination. To provide accurate measurement, an LPG liquid-measuring system must be equipped with a vapor elimination device capable of preventing vapor from passing through the meter. A differential pressure valve assists in vapor elimination by maintaining an operating pressure inside the meter that is sufficient to prevent the liquid product from vaporizing. These two components, when installed, maintained, and operated correctly, normally provide effective means of vapor elimination.

S.2.1. Vapor Elimination. - A device shall be equipped with an effective vapor eliminator or other effective means to prevent the passage of vapor through the meter.

S.2.4. Maintenance of Liquid State. - A device shall be so designed and installed that the product being measured will remain in a liquid state during the passage through the meter.

Figure 6.29. LPG & AA/LMD Code, Paragraphs S.2.1. and S.2.4.

You can observe at this point whether the system you are examining is equipped with a vapor eliminator and differential pressure valve. However, you will not be able to determine whether their

operation is effective until you actually test the performance of the system and analyze the results. We will discuss these procedures in Chapter 7.

Thermometer Well

As you have learned, LPG has a relatively high coefficient of expansion. In order to obtain accurate test results, it must be possible, therefore, to adjust the prover reading to reflect any change in liquid volume resulting from differences in ambient temperature. To do this, it is necessary to observe and record the temperature of product at the meter. Handbook 44 requires that a thermometer well be provided to facilitate accurate testing.

S.2.5. Thermometer Well. - For test purposes, means shall be provided to determine the temperature of the liquid either:

(a) in the liquid chamber of the meter, or

(b) in the meter inlet or discharge line and immediately adjacent to the meter.

(Amended 1987)

Figure 6.30. LPG & AA/LMD Code, Paragraph S.2.5.

The thermometer well should have a removable cover, which should be closed when the well is not in use to prevent dirt, grease, and other foreign material from falling into the well and inhibiting heat transfer to or from the thermometer when it is inserted. Locate the meter thermometer well and check to see that it is in suitable condition for use.

S.2.6.1. Provision for Deactivating. - On a device equipped with an automatic temperature compensating mechanism that will indicate or record only in terms of liters compensated to 15 °C or gallons compensated to 60 °F, provision shall be made to facilitate the deactivation of the automatic temperature compensating mechanism so that the meter may indicate, and record if it is equipped to record, in terms of the uncompensated volume.

(Amended 1972)

UR.2.4.1. Use of Automatic Temperature Compensators. - If a device is equipped with an automatic temperature compensator, this shall be connected, operable, and in use at all times. Such automatic temperature compensator may not be removed, nor may a compensated device be replaced with an uncompensated device, without the written approval of the weights and measures authority having jurisdiction over the device.

Figure 6.31. LPG & AA/LMD Code, Paragraphs S.2.6.1. and UR.2.4.1.

Automatic Temperature Compensation

LPG liquid-meter systems equipped with automatic temperature compensators must also have a means for deactivating the compensator for test purposes or adjustment. If the compensator cannot be deactivated, it will be impossible to isolate the cause of inaccurate measurement through volumetric testing.

At the same time, the ability of the temperature compensator to be deactivated must not provide a means of facilitating fraud (e.g., the user is not permitted to sell compensated product during the winter and uncompensated product in the summer). While requiring that provision be made for deactivating temperature compensators for test purposes, paragraph UR.2.4.1. explicitly prohibits the deactivation, overriding, or removal of a temperature compensator without permission of the weights and measures jurisdiction. These requirements are found in paragraphs S.2.6.1. and UR.2.4.1. of the LPG & AA/LMD Code.

You should check the security seal on a temperature compensator to determine that it has not been tampered with since the last examination by your jurisdiction (see the next section on “Security Seals”). If the seal is broken, you should ask for an explanation. You will be deactivating the compensator for performance tests later in the course of your examination and can determine at that time whether the deactivation mechanism meets the requirement.

Security Seals

Some means of adjusting or recalibrating the measuring and registration elements of a metering system is necessary. Without such a mechanism, expensive components would have to be replaced as soon as they were no longer capable of meeting close tolerance performance tests, and the cost of this replacement would be passed on to the consumers of metered products. However, any adjusting mechanism will tend to facilitate fraud unless some means is available to assure that it cannot be manipulated by the operator to affect the measurement or registration of the device.

The most effective means of providing this assurance is a security seal, which prevents any movement of an adjusting mechanism without leaving clear and tangible evidence of such tampering. For this reason, Handbook 44 requires that all adjustable elements that may affect measurement or registration be designed with provision for the installation of security seals.

Electronic Adjustable Components

For devices equipped with electronic adjustable components, other approved means of providing security are recognized by General Code paragraph G-S.8.; this paragraph is nonretroactive as of January 1, 1990. This paragraph requires that a device be designed with provision(s) for applying a security seal that must be broken before any change that detrimentally affects the metrological integrity of the device can be made to any adjustment mechanism. As an alternative to a physical security seal, the device may be equipped with other approved means such as a data change audit trail that is available at the time of inspection.

| |
|---|
| S.2.2. Provision for Sealing. - Adequate provision shall be made for applying security seals |
|---|

in such a manner that no adjustment may be made of:

- (a) any measurement element, and
- (b) any adjustable element for controlling delivery rate, when such rate tends to affect the accuracy of deliveries.

When applicable the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

Figure 6.32. LPG & AA/LMD Code, Paragraph S.2.2.

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.*

[Nonretroactive as of January 1, 1990.]

A device may be fitted with an automatic or a semi-automatic calibration mechanism. This mechanism shall be incorporated inside the device. After sealing, neither the mechanism nor the calibration process shall facilitate fraud.

(Added 1985) (Amended 1989, 1993)

Figure 6.33. General Code, Paragraph G-S.8.

An audit trail must be consistent with the minimum form of audit trail specified in the Liquid-Measuring Devices Code paragraph S.2.2. and Table S.2.2. to be considered an approved means of sealing. Paragraph S.2.6.2. in the LPG & AA/LMD Code extends this requirement specifically to automatic temperature compensators.

S.2.2. Provision for Sealing.

(c) Audit trails shall use the format set forth in Table S.2.2.

[Nonretroactive and enforceable as of January 1, 1995.]

(Amended 1991, 1993, and 1995)

Figure 6.34. Liquid-Measuring Devices Code, Paragraph S.2.2.

S.2.6.2. Provision for Sealing. - Provision shall be made for applying security seals in such a manner that an automatic temperature-compensating system cannot be disconnected and that no adjustment may be made to the system.

Figure 6.35. LPG & AA/LMD Code, Paragraph S.2.6.2.

Finally, the General Code includes a use requirement that security seals must be installed and maintained on any adjustable element that can be sealed.

| |
|--|
| <p>G-UR.4.5. Security Seal. - A security seal shall be appropriately affixed to any adjustment mechanism designed to be sealed.</p> |
|--|

Figure 6.36. General Code, Paragraph G-UR.4.5.

In addition to the adjustment mechanisms for the meter and register and for an automatic temperature compensator, if the system is equipped with one, each of the components of the meter “stack” should be sealed to the next lower component, so that access can not be gained to a mechanism through the opening at top or bottom by which it is connected to another component.

You should check all existing seals to determine that they are properly installed and intact. If any are missing or damaged, ask the operator for an explanation. You should record the location and condition of all seals in place at the conclusion of your examination, so that they may be checked at the next regular inspection. Where applicable, you should record information provided by the audit trail for the device; for example, the numbers shown on the event counters. Procedures for installing security seals are presented, along with other post-test tasks, in Chapter 8.

| Table S.2.2. Categories of Device and Methods of Sealing | |
|--|--|
| Categories of Device | Method of Sealing |
| <p><i>Category 1: No remote configuration capability.</i></p> | <p><i>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</i></p> |
| <p><i>[Category 2 applies only to devices manufactured prior to January 1, 2005. Devices with remote configuration capability manufactured after that date must meet the sealing requirements outlined in Category 3. Devices without remote configuration capability manufactured after that date will be required to meet the minimum criteria outlined in Category 1.]</i></p> <p><i>Category 2: 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.</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 event counter for calibration parameters and an event counter for configuration parameters. 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> <p><i>[*Nonretroactive as of January 1, 1996]</i></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>Nonretroactive as of January 1, 2005, all devices with remote configuration capability must comply with the sealing requirements of Category 3.</i></p> | <p><i>An event logger 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. (Note: Does not require 1000 changes to be stored for each parameter.)</i></p> |

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

Figure 6-37. Liquid-Measuring Devices Code, Table S.2.2.

Piping and Discharge Lines

Proper design, installation, and maintenance of the piping and discharge lines are essential to the accuracy of an LPG liquid-measuring system. Any significant restriction of flow upstream of the meter can result in excessive vaporization of product; restriction downstream of the meter can cause increased slippage of product through meter clearances and can also produce excessive working pressure that can accelerate meter wear. Restriction can be caused by a clogged strainer or valves, improper matching of piping dimensions to manufacturer's specifications, improper installation that produces steep pitches in the piping, etc. The responsibility of the owner or operator of an LPG liquid-measuring system to install the equipment correctly and maintain it properly are established in the paragraphs of the General Code that we discussed above, under General Considerations, especially paragraphs G-UR.2.1. (installation) and G-UR.4.1. (maintenance).

It is more likely that evidence of improper installation or maintenance will appear from performance tests than from a visual inspection. However, as you inspect the entire length of the system piping you should be attentive to anything that appears unusual. For example, if your experience with similar equipment suggests to you that the size of the piping between the storage tank and the meter inlet is too small, and if performance tests suggest that the system is overregistering due to excess vaporization, you can check the manufacturer's specifications to confirm your suspicion.

It is especially important to determine that the equipment, as installed and operated, does not tend to facilitate fraud. It is not necessary to prove or even have evidence that the operator is actually using the equipment to perpetrate fraud, only that the design or installation could be used fraudulently. The assurance that the potential for abuse of weighing and measuring equipment has been minimized is essential both for consumer confidence and equity in the marketplace. The General Code includes a broad requirement relating to facilitation of fraud.

| |
|---|
| <p>G-S.2. Facilitation of Fraud. - All equipment and all mechanisms and devices attached thereto or used in connection therewith shall be so constructed, assembled, and installed for use such that they do not facilitate the perpetration of fraud.</p> |
|---|

Figure 6.38. General Code, Paragraph G-S.2.

One design feature that could readily facilitate fraud is the installation of more than one outlet on the discharge side of the meter. Multiple discharge outlets could provide a means for diverting metered liquid to some destination other than the purchaser's receiving container during the course of a delivery and thereby facilitate fraud. On the other hand, more than one discharge hose is sometimes necessary for efficient delivery. The LPG & AA/LMD Code addresses both the issue of diversion of metered product and that of multiple discharge outlets directly.

S.3.1. Diversion of Measured Liquid. - No means shall be provided by which any measured liquid can be diverted from the measuring chamber of the meter or the discharge line therefrom. However, two or more delivery outlets may be permanently installed if means are provided to insure that:

- (a) liquid can flow from only one such outlet at one time, and
- (b) the direction of flow for which the mechanism may be set at any time is definitely and conspicuously indicated.

In addition, a manually controlled outlet that may be opened for the purpose of emptying a portion of the system to allow for repair and maintenance operations shall be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the device and to indicate clearly and unmistakably when the valve controls are so set as to permit passage of liquid through such outlet.

(Amended 1975)

Figure 6.39. LPG & AA/LMD Code, Paragraph S.3.1.

Multiple discharge hoses are sometimes necessitated by the physical layout of the installation; for example, when access to fill openings of different types of vehicles can only be gained from different hose positions. According to the requirements of S.3.1., multiple discharge lines may be installed for such use, but only with certain safeguards to minimize the potential for abuse.

Specifically, means must be provided to assure that delivery can only be made from one outlet at any given time and to indicate clearly which outlet is operative. Adequate means could include a discharge manifold equipped with triple-port valves that automatically obstruct flow through any line other than that selected by the operator and visible flow indicators, such as in-line sight gauges, in each of the discharge lines.

Many systems are also equipped with one or more service outlets that can be used to evacuate the system components that are ahead of the valve. Such outlets are generally installed upstream of the meter to permit the meter, vapor eliminator, differential pressure valve, etc. to be removed without evacuating the entire system. An outlet located before the meter could not readily facilitate fraud since any product diverted through it will not yet have passed through the meter. If the valve is located after the meter, however, it should be of a design that prevents simultaneous discharge through the normal discharge line and should be clearly marked (for example, with a painted line on the movable valve operator that lines up with a similar marking on the fixed body of the valve when the outlet is closed).

You should, if possible, inspect the entire length of the piping, from the storage tank to the discharge nozzle, although this may not be practicable at an LPG terminal or in an installation where the piping is very extensive. At a minimum, you should carefully inspect the discharge line (that is, all piping after the meter). All outlets or valves other than those that are standard for the device should be identified and their function explained to you by the operator. If multiple discharge outlets are installed, they must conform with the requirements of S.3.1. (see above), even if the operator tells

you that they are never used. You should make notes of any such non-standard equipment, to which you can refer if complaints are received about the device or at a future examination.

S.2.3. Directional Flow Valves. - A measuring system shall be equipped with a valve or other effective means, automatic in operation and installed in or adjacent to the measuring element, to prevent reversal of flow of the product being measured.
(Amended 1982)

Figure 6.40. LPG & AA/LMD Code, Paragraph S.2.3.

Metered product that has passed into the discharge line has, in effect, already been sold to a customer and must not be allowed to flow back through the meter. The system must, therefore, be equipped with some automatic means of preventing reversal of flow. One such means is a type of valve referred to as a “check valve,” which permits liquid to flow only in one direction. A check valve may be installed at the meter outlet to prevent reversal of flow.

You will not be able to determine whether the system conforms with this requirement by visual inspection. Observation of the system in operation during performance tests may indicate whether the valve is functioning properly. Several specifications apply to the discharge hose. One of these pertains to all LPG liquid-measuring systems and requires that the hose be filled with liquid product before registered delivery begins. Another requirement similarly deals with the condition of the discharge hose, but applies only to retail devices.

UR.2.2. Condition of Fill of Discharge Hose. - The discharge hose shall be completely filled with liquid before the “zero” condition is established prior to the start of a commercial delivery, whether this condition is established by resetting the primary indicating elements to zero indication or by recording the indications of the primary indicating elements. (Also see UR.2.1.)

S.3.2. Delivery Hose. - The delivery hose of a retail device shall be of the wet-hose type with a shutoff valve at its outlet end.

Figure 6.41. LPG & AA/LMD Code, Paragraphs UR.2.2 and S.3.2.

The effect of these two separate requirements is the same -- to assure that the discharge hose is filled with product at the time when the measurement of a delivery begins, and thus that the purchaser always receives the full quantity of product that has passed through the meter. Paragraph S.3.2. prescribes the design of the discharge hose; to maintain a "wet-hose" condition between deliveries a valve must be installed at the discharge nozzle to prevent draining the hose. Recall from Chapter 3 that a "wet-hose type" devices is one designed to be operated with the discharge hose full of product at all times. Paragraph UR.2.2. states that the hose must be full of liquid prior to the start of a delivery. Like other use requirements established in Handbook 44, it applies to every delivery made by the system.

You should inspect any retail device to determine if it conforms with the requirement of a shutoff valve at the discharge nozzle. The wet condition of the hose at the beginning of a delivery may be

checked when the system is placed in operation during the Test portion of the examination (see Chapter 7).

The length of the discharge hose on a stationary LPG motor-fuel device should be no greater than necessary to reach the inlet of the receiving vehicle. This requirement is intended to minimize the risk of damage to the hose resulting from its being run over by vehicles moving into or out of the delivery area, and to reduce the effects of ambient temperature on product inside the hose between deliveries. The LPG & AA/LMD Code specifies a maximum length for the discharge hose, but permits exceptions in individual cases where the need for a longer hose can be clearly demonstrated.

UR.1.2. Length of Discharge Hose. - The length of the discharge hose on a stationary motor-fuel device shall not exceed 5.5 m (18 ft), measured from the outside of the housing of the device to the inlet end of the discharge nozzle, unless it can be demonstrated that a longer hose is essential to permit deliveries to be made to receiving vehicles or vessels. Unnecessarily remote location of a device shall not be accepted as justification for an abnormally long hose.
(Amended 1991)

Figure 6.42. LPG & AA/LMD Code, Paragraph UR.1.2.

UR.2.3. Vapor-Return Line. - During any metered delivery of liquefied petroleum gas from a supplier's tank to a receiving container, there shall be no vapor-return line from the receiving container to the supplier's tank:

- (a) in the case of any receiving container to which normal deliveries can be made without the use of such vapor-return line, or
- (b) in the case of any new receiving container when the ambient temperature is below 90 °F.

Figure 6.43. LPG & AA/LMD Code, Paragraph UR.2.3.

Measure the length of the discharge hose on any stationary motor-fuel device. If it exceeds 18 feet in length, measured from the dispenser chassis to the inlet of the discharge nozzle, you will have to determine from talking to the device owner whether there is justification for the additional length.

Vapor Return Line

One final requirement relates to the piping of all LPG liquid-measuring systems. It states that a vapor-return line may not be used during a commercial delivery of LPG except under special circumstances.

The intent of this use requirement is to assure that all metered product remains in the possession of the purchaser, including product vapor inside the receiving tank or vessel. As was mentioned in Chapter 5, a vapor return line is not necessary for efficient delivery of product under most operating conditions. However, when ambient temperature is relatively high (above 90 °F), elevated pressure

inside the receiving vessel may make delivery difficult or impossible. To provide for this situation, and because some older receiving tanks are not equipped with a spray fill design, paragraph UR.2.3. permits the use of a vapor return line under these special circumstances.

Additional Inspection Procedures

We covered all the items included in the Inspection portion of the EPO's for LPG liquid-measuring devices and motor-fuel devices. As mentioned at the beginning of the chapter, the EPO's outline what should be considered a minimum inspection. You should become familiar with all the requirements and specifications in Handbook 44, as well as additional requirements in force in your jurisdiction, so that you can conduct a more extensive Inspection when circumstances dictate.

Summary

The Inspection is the first of four components of an official field examination of an LPG liquid-measuring system. Its purpose is to determine whether the system being examined conforms with legal specifications and other requirements relating to design, installation, maintenance, and operation. An Inspection should be a systematic procedure for making separate determinations regarding functional components of the system and also for evaluating a number of general requirements and considerations. Such an Inspection is outlined in the Examination Procedure Outlines (EPO's) developed by the National Institute of Standards and Technology. The EPO's outline a minimum inspection procedure. The extent of inspection that is appropriate for any given system depends upon the inspector's familiarity with the equipment, the age of the equipment, the existence of complaints, and whether the specific make and model have been evaluated under the National Type Evaluation Program (NTEP). In addition to checking specifications regarding the design, installation, and use of indicating and recording elements, measuring elements, and piping, the inspector also must determine whether required markings are present and readable, whether the equipment is suitable for its commercial application, and whether any aspect of the installation could facilitate fraud.

Terms to Know:

built-for-purpose device. Any main device or element which was manufactured with the intent that it be used as, or part of, a weighing or measuring device or system. [1.10]

element. A portion of a weighing or measuring device or system which performs a specific function and can be separated, evaluated separately, and is subject to specified full or partial error limits.

manufactured device. Any commercial weighing or measuring device shipped as new from the original equipment manufacturer.[1.10]

remanufactured device. A device that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new device of the same type.[1.10]

remanufactured element. An element that is disassembled, checked for wear, parts replaced or fixed, reassembled and made to operate like a new element of the same type.[1.10]

repaired device. A device to which work is performed that brings the device back into proper operating condition.[1.10]

repaired element. An element to which work is performed that brings the element back into proper operating condition. [1.10]