CHAPTER 4

PRELIMINARIES TO THE FIELD EXAMINATION

CHAPTER OBJECTIVES

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

1. Identify test equipment used in field examinations of vehicle-tank meters.

2. Describe the selection and setup of a large-capacity prover.

3. Describe the steps in performing a test measurement using a large-capacity prover.

4. Understand the use of official report forms used by your jurisdiction for examinations of vehicle-tank meters.

5. Describe safety procedures for testing vehicle-tank meters in the field.

INTRODUCTION

Before you conduct a field examination of any weighing or measuring device, a number of tasks must be performed to assure that the examination will be performed efficiently, accurately, and safely.

- You must know where and what you are going to be examining.
- You must notify the operator and make arrangements for access to the device(s) and needed assistance that will not cause an unreasonable disruption of the business.
- You must select the proper test equipment.
- You must determine what examination procedures are appropriate and any special circumstances that might require special procedures.
- You must be prepared when you arrive at the test site to conduct the examination as expeditiously as possible without compromising the accuracy or equity of the examination.

The first of these items -- where and what to examine -- may be determined primarily by your supervisors, who are generally responsible for planning the overall program of weights and measures enforcement for your jurisdiction. The schedules they develop will be based upon a number of factors, including the economic impact of particular devices in the marketplace, complaints from the public, the compliance history of particular types of devices or particular operators, and so on. The time of year may also be a factor in some cases. For example, most jurisdictions schedule examinations of vehicle-tank meters that are used by retail home heating oil services for the summer months, so as not to disrupt service during the

heating season. Additionally, advance scheduling is generally required for vehicle-tank meters since those devices are moved from location to location during normal use and may not be available at the company's main facility. Your instructor will explain how assignments are made in your jurisdiction, and you will learn and practice these and other administrative procedures in the course of your field training.

Similarly, notifying operators and scheduling examination times are administrative procedures that vary widely from jurisdiction to jurisdiction. However, it is likely that as an inspector you will have at least some role in preliminary dealings with device operators, since it is essential that you develop a cooperative relationship with them from the outset; this is usually initiated through personal contact. The importance of establishing this cooperative relationship can not be emphasized enough, since cooperation will make your work more effective and will reduce any burden on the device owner to a minimum. Again, you will learn and practice these procedures thoroughly in the course of your field training.

This chapter will focus on several other aspects of the other pre-examination tasks listed above, specifically your test equipment, report forms, and safety procedures.

TEST EQUIPMENT

The essential items of equipment required for field examinations of vehicle-tank meters include:

- Safety gear, including a fire extinguisher, prover grounding cable, first aid kit, and any special gear, such as goggles, gloves, etc. required for a specific job.
- An accurate watch, with a second hand or a digital display that indicates seconds, or a stopwatch.
- A 5-gallon metal bucket with a bail or handle and sufficiently sturdy to permit pouring its contents without spilling.
- A copy of NIST Handbook 44 and other codes applicable in your jurisdiction.
- Copies of the NIST Examination Procedure Outlines (EPO's) for gravity-discharge and power-operated vehicle-tank meters, as well as checklists, worksheets, etc. used by your jurisdiction.
- Official examination report forms.
- Security seals, inspection stickers, tags, and other marking devices used by your jurisdiction.
- A field standard prover of the type, construction, and capacity required for the test liquid and the metering system being examined and which is certified as correct.

Safety equipment and report forms will be described in detail later in this chapter. The use of Handbook 44, EPO's, seals and marking devices, bucket, and watch will be discussed in later chapters, when we turn to examination procedures. Our discussion here will, therefore, begin with the last -- and largest, if not most important -- item on the list, the prover.

Field Standard Provers

All liquid-measuring devices are tested in the field under conditions that approximate as nearly as possible the normal operating conditions of the device. In the case of vehicle-tank meters, this generally means that test liquid is delivered from the truck tank, through the meter and discharge line, into a container of known capacity. The difference between the quantity actually delivered and the quantity indicated on the register is the test error, and this provides the basis for determining the system's compliance or non-compliance with performance requirements. The "container of known capacity" employed in the test is the prover.

The prover (formally referred to as a "field standard prover" because it is employed as a test standard in the field) is itself a precision measuring device, which must be tested and certified as accurate and correct periodically, like the devices it is used to test. In fact, the performance requirements for provers, as for all field standards, are considerably more stringent than those that apply to the commercial devices that are tested. As a general rule, the standard must perform within tolerances that are no greater than one-third of the tolerances that apply to the device under test.

To assure this degree of accuracy, provers must be certified by a State metrologist or by a licensed testing laboratory. Standard provers maintained by weights and measures jurisdictions are used for almost all examinations, although the official use of a prover owned and maintained by a device operator may be permitted under special circumstances, provided that the prover is certified by the appropriate State authority. Such a situation might arise if the jurisdiction desired to examine a particular device but could not provide an appropriate prover. Specific requirements for provers are established in NIST Handbook 105-3, "Specifications and Tolerances for Graduated Neck Type Volumetric Field Standards."

Provers are constructed of metal (usually low carbon or stainless steel), with their interior surfaces treated by galvanizing, plating, coating with an epoxy resin, or some other means to resist corrosion from the test liquid(s) they are used to measure. They are available in a variety of sizes, ranging from 20 gal to 1 500 gal capacity (provers used for testing vehicle-tank meters generally fall within the range of 50 gal to 200 gal capacity). The size required for a particular test depends upon the rated capacity of the meter being tested: the prover must have a capacity equal to or greater than the quantity of product that is delivered by the system in one minute, operating at its maximum discharge rate. Additionally, the test draft shall not be less than 50 gal (180 L). The reason for this requirement will be discussed presently.

Figure 4-1 illustrates the essential features of a typical prover.

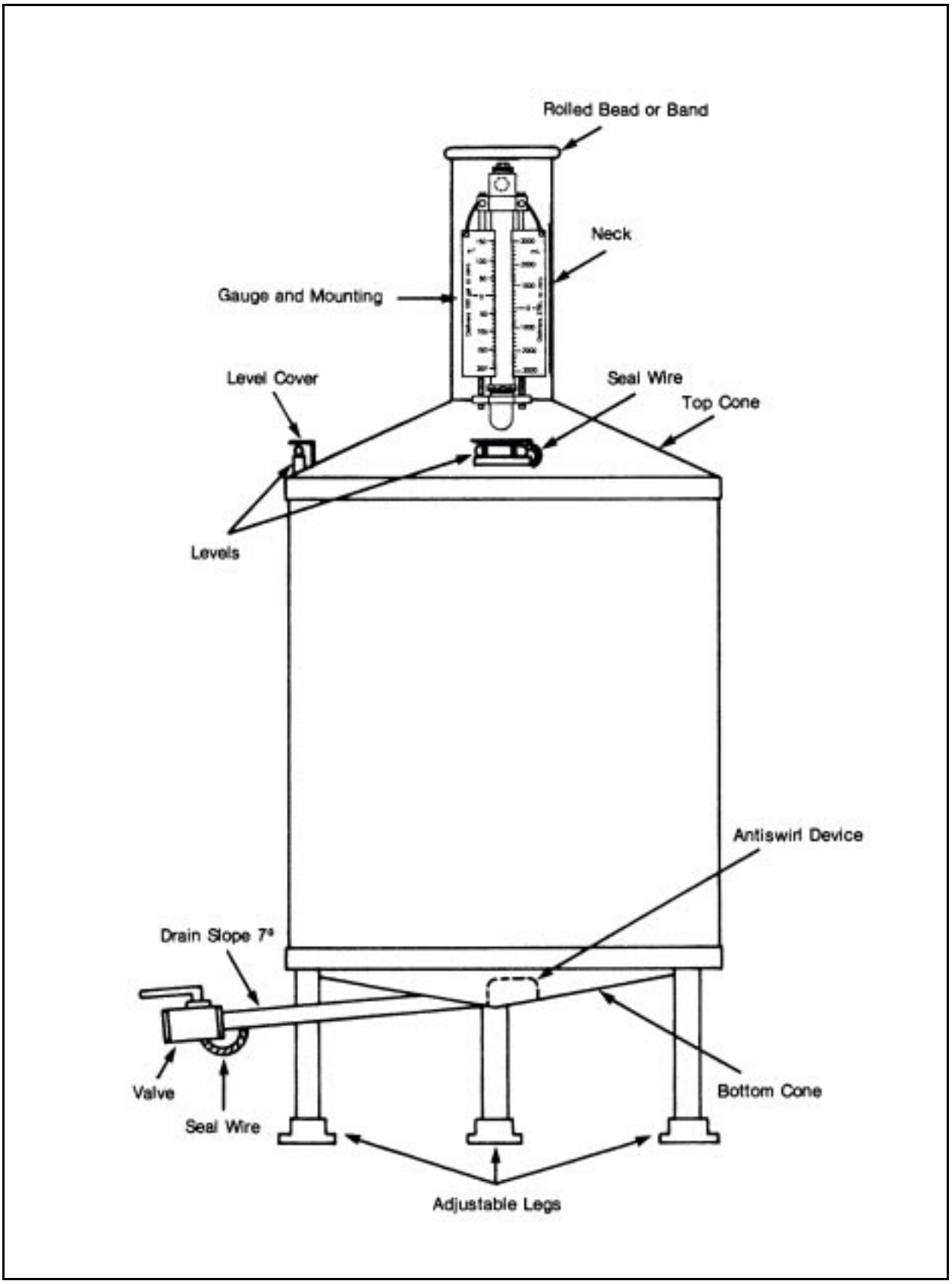

Figure 4-1. Typical Field Standard Prover

Test liquid is delivered through an opening at the top of the elongated neck of the prover (though some larger capacities of provers may be filled from the bottom) and falls to the bottom of the container, filling the drain pipe, where its flow is checked by a valve. The level inside the container rises as the delivery continues. When it reaches the neck, the liquid also rises in a glass gauge tube, which penetrates the container through an opening in the top cone. When delivery is halted, the level of the liquid in this tube is used to indicate the quantity contained on a scale plate that is securely attached to the prover.

Before we look more closely at this gauge, we should notice two other features of the prover depicted in Figure 4-1. The first is that it is equipped with adjustable legs and levels. Leveling the device from front to back and side to side is essential to an accurate indication, since the liquid level in the gauge tube will be directly affected. For example, if the prover were tilted forward slightly (toward you as you view it), the level inside the tube would rise slightly. The level indication should also be verified after the prover is filled with product since the weight of the product might affect the level condition of the prover when full as compared with the prover empty. Second, all elements of the prover whose deliberate or accidental alteration could affect the accuracy of the measurement are protected by security seals. For example, the length of the drain pipe affects the capacity of the prover, since each inch of pipe holds several cubic inches of liquid. Sealing the end of the pipe to the drain valve makes it impossible to alter or replace the pipe without removing or mutilating the seal. Similarly, the mounting brackets for the levels must be parallel to the top and bottom of the prover, and to the graduations on the gauge. Because they are adjustable, these too are sealed. The seals are applied at the time the prover is certified and should not be removed except for recalibration or recertification. Checking all security seals before the start of an official test will assure both you and the operator regarding the correct condition of the prover.

Figure 4-2 is an enlarged view of the prover gauge. The gauge may be equipped with two scales, one employing U.S. inch-pound units (cubic inches), the other metric units (milliliters). Each scale plate is independently adjustable, so each is independently sealed. Graduation lines and numbers are engraved on the plates, along with the nominal capacity of the prover, in the units of the appropriate system (here 100 gallons and 378 liters). The notation on the gauge plate ("Delivers 100 gal. to zero" "Delivers 378 L to zero") indicates that when the level of the liquid is exactly adjacent to the graduation marked 0 (zero), the prover will deliver its nominal capacity (details on reading the prover gauge are covered later in this chapter). Deviations from the nominal capacity are read on the diverging scales above and below the zero line, in divisions of 10 cu in or 200 mL (the value of these divisions varies with the capacity of the prover).

The scale plate of this prover indicates that it delivers 100 gallons (378 L) to zero. This is not the same as saying that it contains its nominal capacity. In fact, a prover that is calibrated "to deliver" will contain somewhat more than its nominal capacity when filled to the zero line. The reason for this method of calibration is that liquid tends to cling to the sides of a container. Even after thorough draining, a film of liquid will adhere to the sides of a container, and this clingage can be significant in a precision measuring device (clingage in a 100-gallon steel prover could amount to several cubic inches of liquid). If the standard can be wiped completely dry before it is used again, clingage is not a problem. But field examinations require successive test drafts, and it would be impractical to dry the inside of the prover thoroughly after each one. Calibration "to deliver" compensates for the clingage. However, because the prover is calibrated to contain more liquid than its nominal capacity, whenever it is dry (before the first official test draft) it must be filled with test liquid and then drained correctly, so that clingage will be present when the first test measurement is made. To assure the correct amount of clingage, a specified drain time must be carefully observed. We will discuss this procedure shortly.

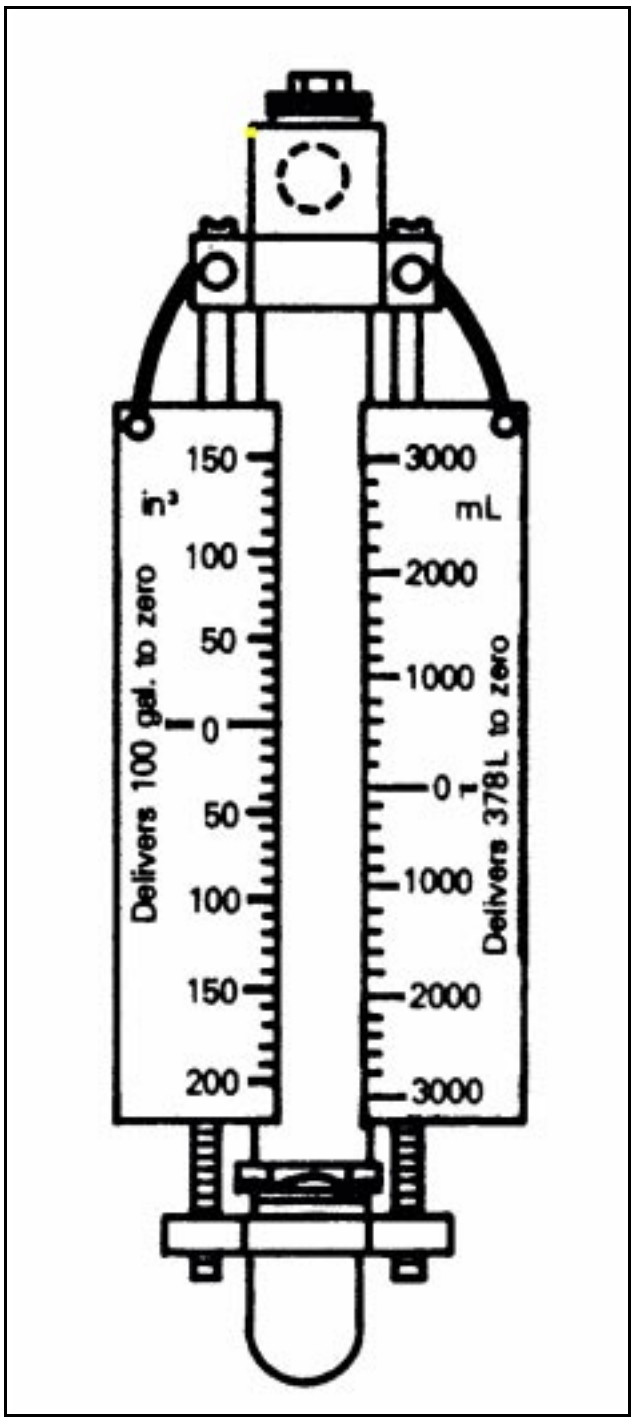

Figure 4-2. Prover Gauge

Large-capacity provers like those used for testing vehicle-tank meters are often mounted on trailers or flat-bed trucks. This makes it possible to transport them to the site of a field examination. However, provers used to test gravity-discharge systems must be positioned at a level below the tank truck, either in a pit or below a platform onto which the vehicle can be driven. Gravity-discharge test pits are generally permanent installations. So the operator must transport his or her trucks to the jurisdiction's test site for examination. Figure 4-3 illustrates testing from a pit.

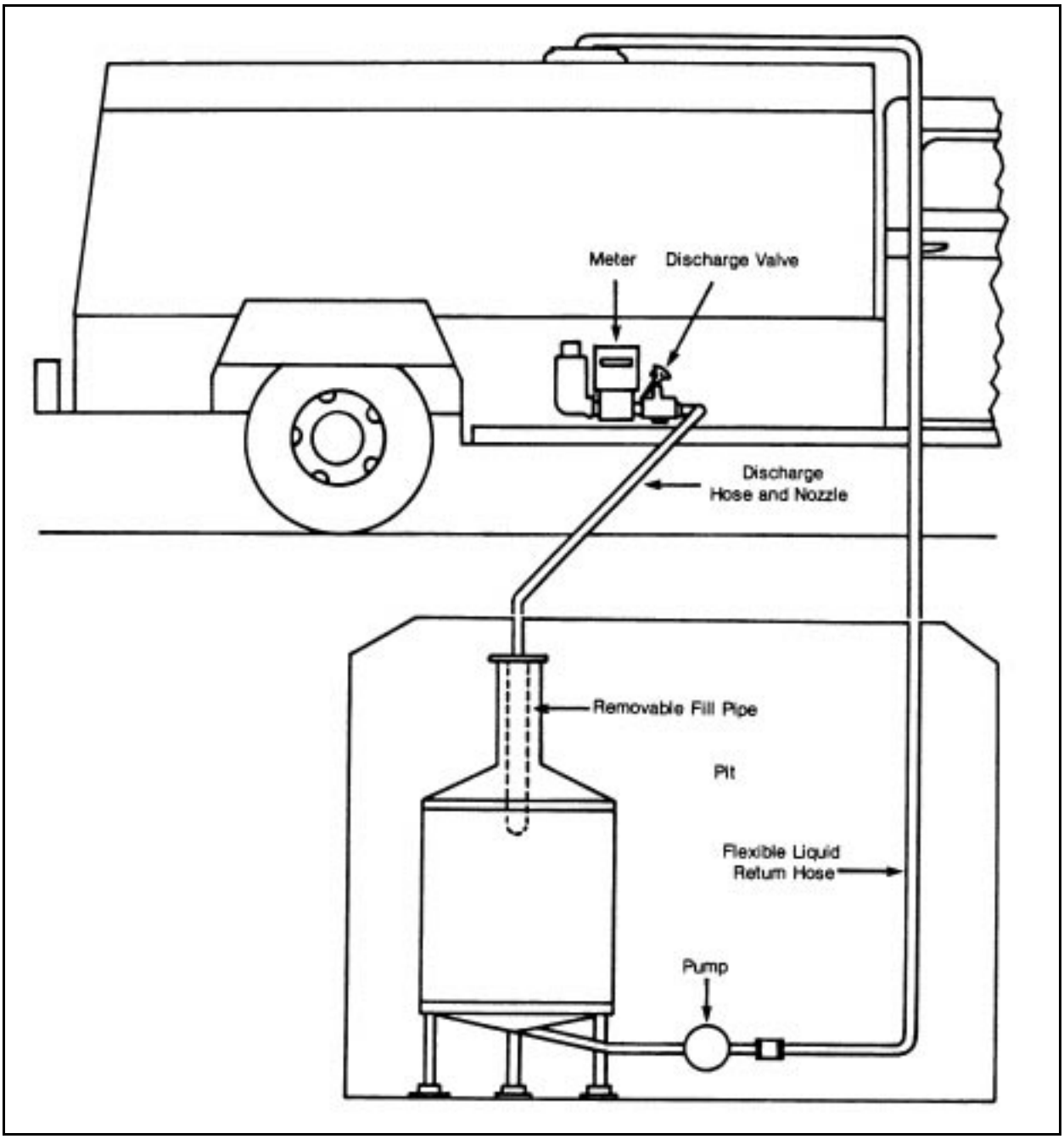

Figure 4-3. Gravity-Discharge Test Pit

Notice that a return line leads from the bottom of the prover back to the vehicle tank fill opening. This permits product to be returned directly to the truck at the conclusion of a test draft. You can also see that a pump installed in the return line is necessary to lift the product from the pit. In fact, this configuration is virtually identical to that typically used for power-operated systems (as shown in Figure 4-4), with product delivered through the meter and discharge hose to the top of the prover and returned at the conclusion of the test to the top of the vehicle tank with the aid of a pump.

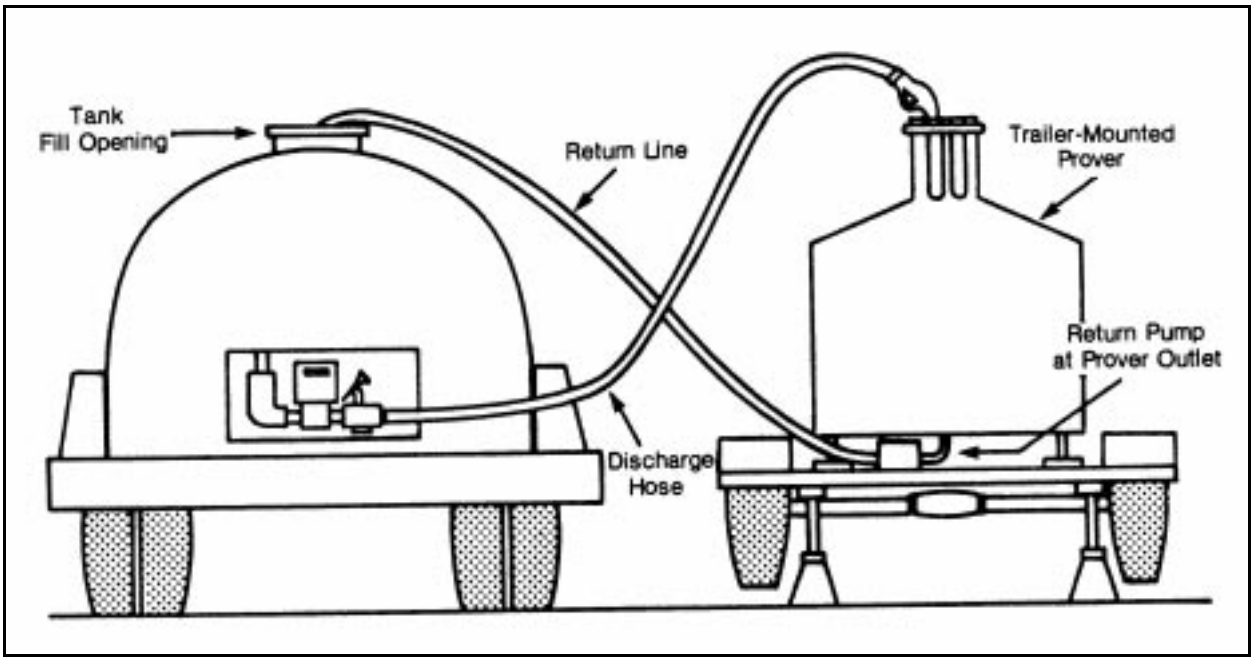

Figure 4-4. Typical Prover Configuration for Power-Operated Systems

Figure 4-5 shows a standard prover mounted on a trailer. Note that jacks are used both to level the device and to lift its weight off the trailer wheels. These are required to assure that uneven tire inflation or unbalanced suspension does not cause the prover to lose its level condition as the weight of the contents increases during a test delivery. This prover is also equipped with a ladder, which provides access for the inspector to the top of the prover, which may be 7 or 8 feet above ground level. The grounding lug furnishes a ready means of attaching a grounding cable to the prover -- an essential safety feature, as you will learn later in this chapter. These features are standard on large-capacity vehicle-mounted provers.

This example also illustrates a number of additional features that may be incorporated in the design of provers used for testing vehicle-tank meters. Several factors determine whether these features are necessary, including the size of the prover and the characteristics of the liquid product that is measured. Your instructor will describe the specific features of provers used in your jurisdiction.

The prover shown is equipped for vapor recovery. This will be necessary if the product produces toxic, polluting, corrosive, or combustive vapors, and State laws may also require vapor recovery for other products as well. The system shown here operates in a manner similar to the air eliminator in the metering system: the rising liquid level inside the container during delivery forces vapor above it through a relief valve and into a vent line, which leads back to the vehicle tank.

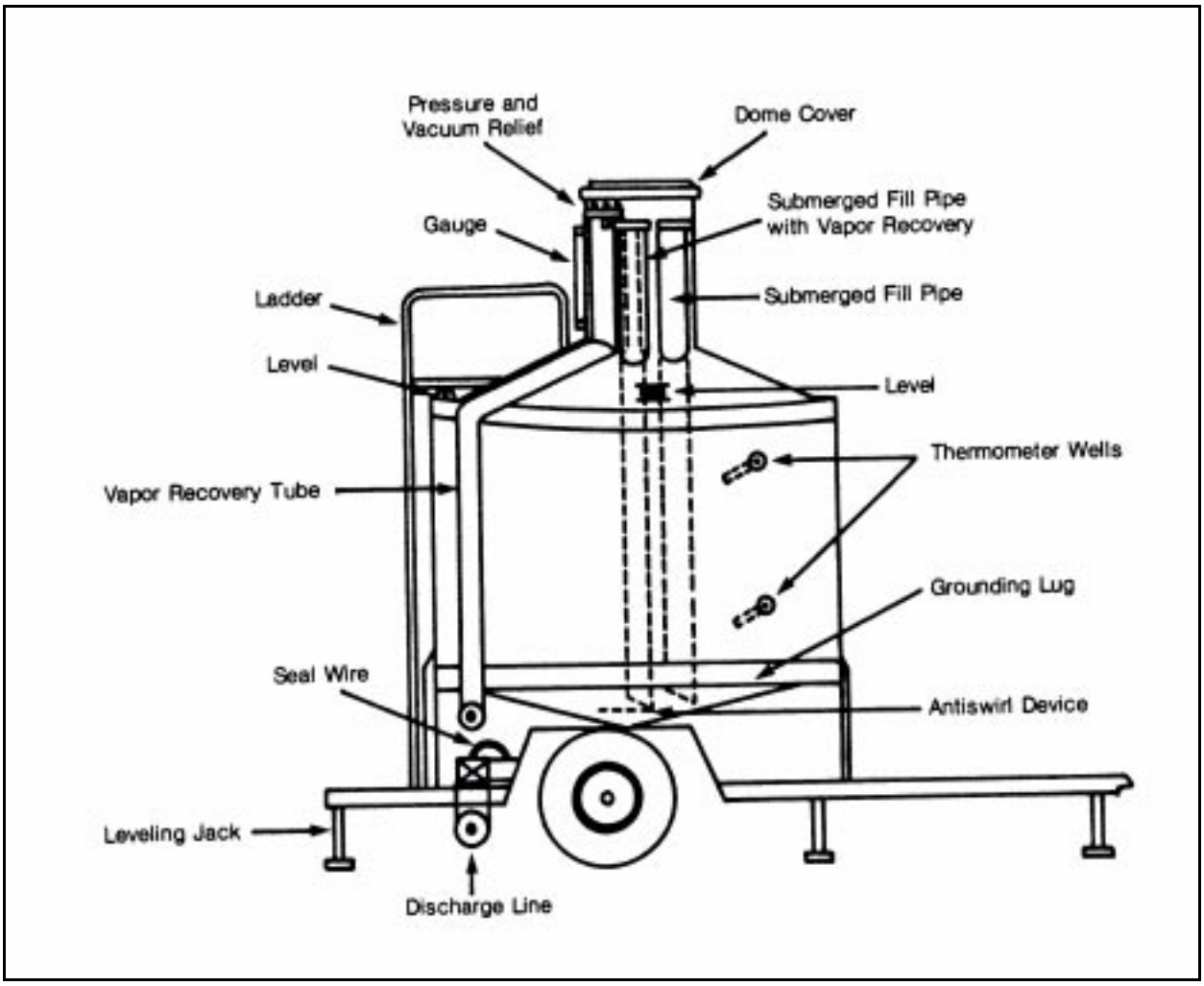

Figure 4-5. Trailer-Mounted Standard Prover Equipped for Vapor Recovery

The submerged fill pipe is used to reduce foaming and churning of product. Since it occupies space inside the container, a submerged fill pipe must be either permanently fixed in its position when the prover is calibrated or, if removable, must be securely positioned and protected by a security seal.

An antiswirl device in the prover drain performs the same function as the baffle plates in the vehicle tank, preventing the formation of a vortex which could draw air from the container into the discharge line. This is essential for the effective operation of the return pump, which may not be capable of lifting product back to the vehicle tank if large quantities of air or vapor are present in the return line.

Finally, you will notice that this prover is equipped with thermometer wells. These provide a means of inserting a thermometer to monitor or record the temperature of the product inside the prover. At least one thermometer well is required (in accordance with NIST Handbook 105-3) for provers with nominal capacities of 250 gal (1,000 L) or more and for all provers that are closed to the atmosphere, like the example shown, for vapor containment or recovery purposes.

Because liquids are subject to changes in density -- and, therefore, in the volume they occupy -- with changes in temperature, provers are calibrated to deliver their nominal capacity at a standard temperature, usually 60 °F. If the temperature of a given quantity of product in the prover is higher than this standard temperature, it will occupy more volume than it would at the reference temperature; conversely, it will occupy less volume if its temperature is lower. Under some conditions the temperature of the product may affect the accuracy of the measurement to a significant degree. We will take a closer look at the topic of temperature correction as it relates to performance tests of vehicle-tank meters in Chapter 6.

One other type of prover is used for testing vehicle-tank meters, called a double-neck or wet-bottom prover. From the example shown in Figure 4-6 you can easily see the reason for the first of these names. This prover has a neck at the bottom that corresponds to its upper neck, and both are similarly equipped with liquid level gauges. The lower gauge is used to establish an accurate zero reading before each test draft. As the prover is being emptied, the inspector watches the bottom gauge for the appearance of the top surface of the liquid. When it appears at the top of the gauge tube, the prover outlet valve is closed, halting the emptying of the prover for the appropriate drain time. Then the inspector opens the valve slightly, permitting product at the bottom of the prover to drain until the level in the lower gauge tube coincides with the zero mark on the scale plate. At this point, the outlet valve is closed again and the prover is ready to receive another draft.

Now you can see why this type of prover is referred to as a wet-bottom prover, especially if you think of the distinction between wet-hose and dry-hose metering systems that we discussed in Chapter 2. In contrast to a dry-bottom prover -- all the examples we looked at earlier are dry bottom -- in which the drain line is emptied of liquid before each draft, a wet-bottom prover retains some product in its lower neck between drafts, and is therefore "wet."

It might seem at first that wet-bottom provers are more accurate than dry-bottom provers, because the user controls the drainage while monitoring the bottom gauge. In fact this is not the case: the accuracy of both wet- and dry-bottom provers depends primarily upon observing the correct drain time for the prover. The second gauge on a bottom-fill prover is simply used to establish a zero fill point relative to the zero line in the top gauge.

Wet-bottom provers do have two advantages. The first is that the liquid retained in the lower neck prevents air from being returned to the vehicle tank. The other advantage of the wet-bottom prover is that it does not require leveling, since the capacity of the prover is established between the two gauges, which lie in the same vertical plane and thus will be affected in the same way by any out-of-level condition. Leveling the prover is a time-consuming procedure, and so this feature will make the use of the prover more efficient, especially if it must be moved from one location to another.

On the other hand, the draining procedure for wet-bottom provers involves more steps than does the relatively simple procedure for a dry-bottom prover, and this factor may offset the quick setup, especially when a number of tank trucks are tested at a single location. (In this situation the prover is only leveled once, but drained several times for each truck tested.)

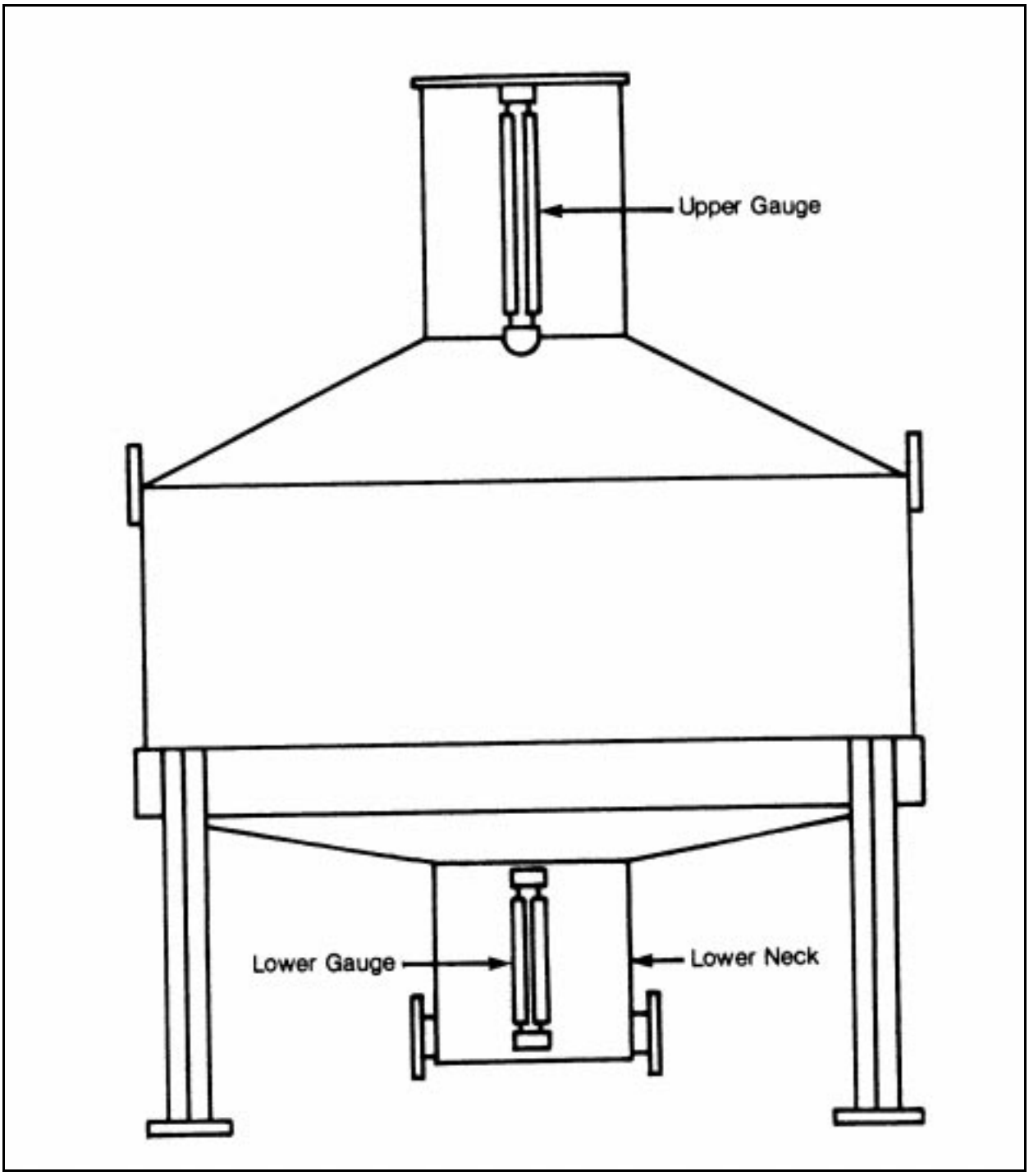

Figure 4-6. Double-Neck or Wet-Bottom Prover

Setting Up the Prover

You will learn and practice specific setup procedures for the provers used by your jurisdiction in the course of your field training. However, a general outline of the steps in setting up will help you understand the test procedures we will be discussing in Chapter 6.

1. Position the prover in a suitable location. It must be positioned where individual trucks can be brought to the prover to be tested, rather than moving the prover to the trucks. At the same time, its location should interfere as little as possible with normal business activities.

   In addition, a stable footing is required for leveling. It is preferable that the prover stand on pavement rather than on asphalt or on bare ground (unless the ground is sufficiently compacted to keep the prover from settling, or its feet from digging into the earth as it is being filled).

2. Check the security seals on the prover. This will assure you and the owner of the metering equipment that the prover has not been altered, or damaged in any way that could affect its accuracy.

3. Level the prover. This is especially important for dry-bottom provers. Spirit levels are required to be permanently installed on all provers, and must be used; leveling "by eye" is not adequate. The prover must be leveled both front-to-back and side-to-side. If it is mounted on a truck or trailer, jacks must be used to level the bed and prover together. (The prover must never be allowed to sit on the vehicle tires, even if it appears to be level when empty.)

   Always chock the trailer or vehicle on which the prover is mounted to be sure it does not roll away should the prover shift during testing. Check to be sure that the chocks are still secure when the prover is full of product.

4. Connect the prover return pump to an adequate power supply. Care should be taken that the line does not cross a high-traffic area (this may be another factor in choosing a location to set up).

5. Position the truck to be tested. The operator of the truck or an employee of the operator provided as an assistant should always move the truck and operate the system during the test. Unfamiliarity with the equipment on the part of the inspector or inadequate maintenance could result in accidental damage to the equipment. The correct location will depend on the type of system (gravity- or power-operated) and the specific installation (the meter and hose connections may be on the side of the truck or in the back, etc.). In any case, the truck should be close enough to the prover to minimize the length of hoses required to deliver, to return the product, and to enable the inspector to observe the meter indications during the testing procedure. Chocks should be placed under the vehicle's wheels to prevent any movement.

6. Ground the prover. This is an essential safety measure, especially when the test liquid is volatile or flammable. The prover can be grounded to the truck chassis or to some other suitable ground. Check to make sure that the grounding cable is in good condition

and that the grounding lug on the prover and the place where the cable is attached at the other end provide bare metal surfaces, free of corrosion or dirt.

7. Connect the discharge line from the truck to the prover inlet and the prover return line to the truck fill opening. This must be done in a manner that meets safety and air quality requirements (some products require vapor recovery equipment, etc.). If the discharge nozzle can not be coupled directly to an adapter on the prover, it must be held in place during the delivery portion of the test. Under no circumstances should the discharge line simply be fed into the top of the prover, since its presence inside the container will affect the volumetric capacity of the prover. If the truck is filled through openings that are too large to be adapted to the return line, the assistant must hold the end of the return line while product is being pumped back into the tank to prevent spillage.

8. Wet the prover. This involves filling the prover to its nominal capacity with test liquid and then draining it, observing the correct drain time. The procedure is thus identical to that employed for a test draft (described below), except that the prover is filled to its own nominal capacity, rather than to the point at which the truck register indicates delivery of that amount. And, of course, results are not official, since the dry prover will require an amount greater than its nominal capacity to fill it. Subsequent drafts will keep the prover wet, so this procedure need not be repeated unless testing is halted for a period long enough to allow the clingage to evaporate.

Test Drafts

An official test of a vehicle-tank meter requires several test drafts. In Chapter 6 you will study the purpose of each of these and how to interpret their results. For the moment, however, let's look at the basic steps involved in drawing a test draft, reading the gauge, and returning the draft, just as we did above for the setup procedure. We will assume that the prover has been set up correctly in advance.

1. Check the truck manifold valves. Only the valve for the compartment that is going to be used to deliver product for the test should be open.

2. Check the prover outlet valve. It should be closed. If it is not, the prover must be re-wet.

3. Deliver product to the prover until the register on the truck indicates the nominal capacity of the prover. If you are testing a gravity-discharge system, the delivery will be regulated by the main control valve. This should be done by the assistant provided by the operator. If the system is power-operated, the assistant will first engage the pump to the vehicle engine. The inspector then regulates the delivery from the discharge nozzle valve.

   An attempt should always be made to halt the delivery when the index of the indicator (the end of the pointer) coincides with some part of the graduation that represents the exact nominal capacity of the prover. At the same time, excessive throttling should be

avoided, since this would not occur under normal operating conditions, and might affect the performance of the meter. If the delivery is slightly "long", you may have to correct the prover reading. For example, if the register stopped at the reading shown in Figure 4-7, you would note that the delivery was long by about 1/8th of a graduated interval (measured from the center of one graduation to the center of the next). Since one such interval on this wheel equals 0.1 gal (23.1 cu in), you would need to correct for slightly less than 3 cubic inches (23.1/8 = 2.89 cu in). To make the correction, you would subtract that amount from the prover reading; this would correct the reading to make it roughly equivalent to what would be expected of an indicated delivery of exactly the nominal capacity of the prover. Of course, there is some degree of uncertainty in such readings, and it is preferable to continue the delivery until the meter reaches the next graduated interval. However, this need not be a great concern if, as in the example just described, it is relatively small in comparison to the tolerance (never less than 25 cu in for a vehicle-tank meter). If the results of the test are quite close to the applicable tolerance, you will repeat the test for confirmation in any case (some useful guidelines for repeating tests are described in Chapter 6).

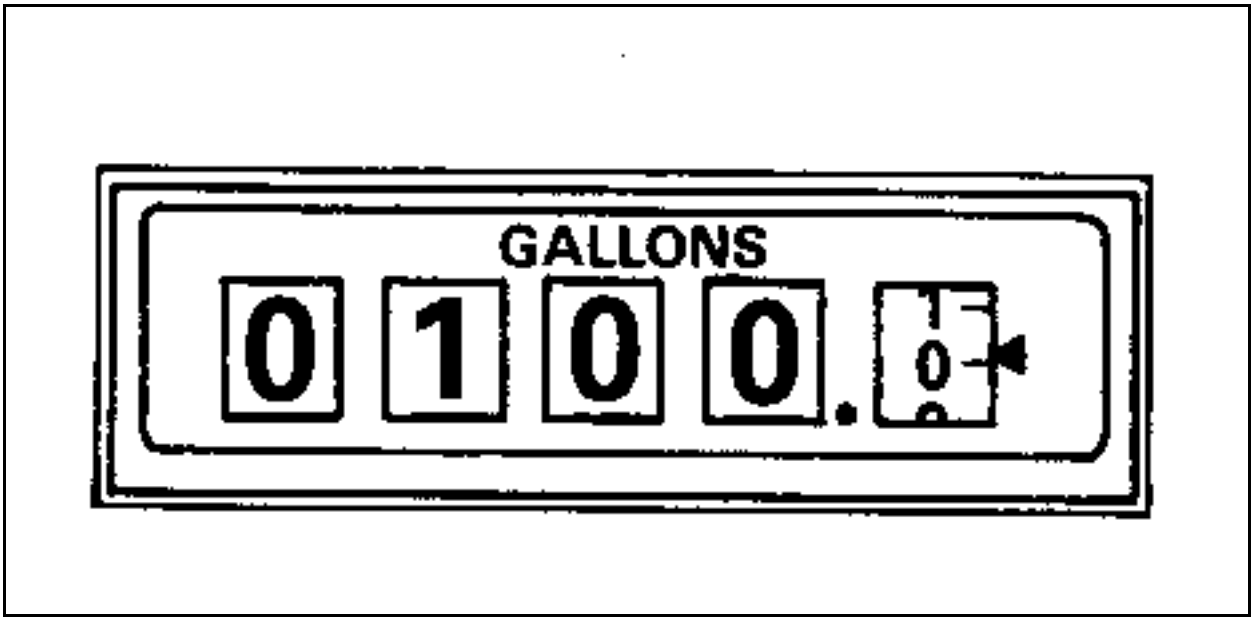

Figure 4-7. A "Long" Test Draft

4. Read the prover. If the product is one that tends to foam (like no. 2 fuel oil or diesel fuel) you will have to wait until the level inside the gauge tube stabilizes and the bubbles subside. This will usually not take more than a minute.

In tests of gravity-discharge systems, you should take care to assure that the metering system discharge hose has sufficient time to drain into the prover before a reading is taken. If necessary, the hose should be detached from the meter outlet and held in a nearly upright position above the opening of the prover.

When satisfied that the prover is ready to be read, position yourself so that the top surface of the liquid is at eye level. This liquid surface will be your indicator. Unless

the test liquid is opaque, you should be able to see the slight concavity in the surface that is known as the meniscus (see Figure 4-8). When reading the gauge, you should always

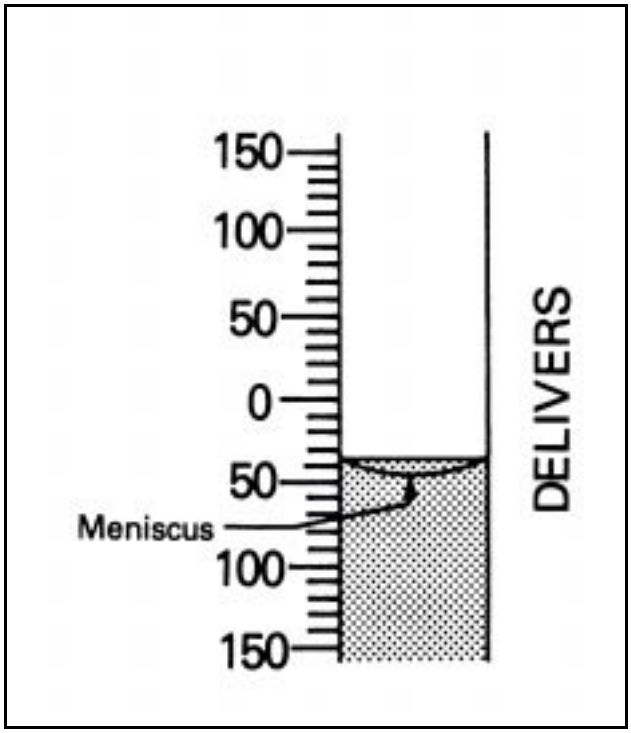

Figure 4-8. Reading the Prover Gauge

record the value of the graduation that is nearest the level you are using as an index (e.g., the bottom of the meniscus for a transparent liqiuid).

This value is the difference, in cubic inches, between the quantity actually delivered and the quantity indicated and, thus, represents the meter error for that draft.

If the index appears to be exactly between two graduations, record the even value. For example, if the bottom of the meniscus in Figure 4-8 is between the graduations representing -40 and -50 cu in, you would read the error as -40 since -40 is the even value.

You should also record the temperature of the liquid inside the prover at this time if your test procedures require temperature correction. We will discuss the use and interpretation of temperature readings in Chapter 6.

5. Return the test liquid to the vehicle tank. This is accomplished by opening the prover outlet valve and activating the return pump. The assistant provided by the operator should stand atop the vehicle and hold the end of the return line securely at the fill opening. This will prevent the end of the line from jumping out of the opening when

the flexible line is pressurized (or de-pressurized) or as a result of accidental movement of the line below.

In order to assure the accuracy of the prover for the next test draft, the correct drain procedure must be followed. A drain time is specified by the manufacturer of the prover (for many provers it is 30 seconds). The specified drain time, along with other important information regarding the construction, use, and physical properties of the prover, is required to be permanently marked on some conspicuous surface. It is usually etched or embossed on an identification plate.

The drain time is the period allowed after the cessation of flow of the product from the prover (after the discharge from the prover outlet has ceased to be a continuous stream, and has broken into a trickle) for draining residual liquid sufficient to establish a "wet" condition. At the end of the drain time, the liquid remaining inside the prover is the amount of clingage for which the prover was calibrated. It is trapped inside the prover by closing the outlet valve.

When using a dry-bottom prover, the inspector monitors flow in a sight glass installed in the discharge line, usually on the discharge side of the outlet valve. The sight glass usually contains a ball or some such device to show that liquid is flowing. The drain time begins when the inspector observes that flow has ceased and only a trickle of liquid is moving through the drain pipe. At the end of the specified time, the outlet valve is closed, and the prover is ready for the next draft.

The drain procedure for a wet-bottom prover involves several more steps. Flow is halted by the inspector when the top surface of the test liquid first appears in the top of the lower gauge tube. The drain time thus begins with the closure of the outlet valve. At the conclusion of the drain time, the valve is opened again, but only for long enough to lower the level in the gauge tube to the zero line. When the outlet valve is closed again, the prover is ready for another delivery.

It is essential that the specified drain time be observed as precisely as practicable, since this period was used to calibrate the prover to deliver its nominal capacity. Allowing either more or less time for drainage will affect the accuracy of the prover. A watch that indicates seconds or a stopwatch should always be used to monitor the drain time.

6. Empty the return line. When the prover outlet valve is closed at the end of the drain procedure, the return line will still be full of liquid. If another draft is going to be drawn from the same tank this is of no concern, since the quantity of product in the return hose has no effect on the capacity of the prover. However, after the last test draft for a particular vehicle has been measured, the return line must be emptied into the vehicle tank. The return pump, whose function is to lift product back to the tank, may not be capable of returning the liquid as the return line fills with air.

   A check valve, located at the prover end of the return line, prevents product from falling back into the prover during the drain period. This same check valve also serves to trap the product inside the return hose, so that the inspector can disconnect it at the prover end if necessary and, with the help of the assistant, lift the entire return hose to a height sufficient for gravity to drain its contents into the tank.

REPORT FORMS

Every official action you take as an inspector must be recorded, and reports of that activity are used in different ways depending on the activity. For the examination of vehicle-tank meters, you will need to keep records of:

- the meter examined,
- the findings in that examination,
- the decision on acceptability of the meter, and
- action taken as a result of that decision.

The NIST Handbook 130 Uniform Weights and Measures Law which has been adopted by the National Conference on Weights and Measures and by most States requires that adequate records be maintained; but only infrequently, if at all, do these statutes describe the details of the records.

A good report form should include the following elements:

- Be complete enough and in a suitable form so that it is the primary record; that is, it should not be necessary for someone to copy the report information onto other records.

- Provide a detailed record of the work performed by the inspector.

  In the case of examination of vehicle-tank meters, it should contain space for all the information you will gather when you follow the Examination Procedure Outline.

- Give the owner or operator of the device a clear understanding of the compliance or noncompliance of his or her equipment and the official action taken as a result of the test.

- Serve as a guide to the repairperson in the service of a rejected device.

- Provide an historical record of individual devices and establishments, with necessary data from which statistics may be derived.

- Be a simple design, easy to use, and easy to understand.

Every jurisdiction has different report forms and systems unique to that jurisdiction. Your instructor will explain the use of the report forms used in your jurisdiction.

The sample report form shown in Figure 4-9 was selected from among a number of standard forms currently in use in jurisdictions around the country that have the features described above.

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DIVISION OF STANDARDS AND CONSUMER SERVICES
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LARGE-VOLUME PETROLEUM MEASURING DEVICE INSPECTION REPORT

PMD NO _____ COUNTY _____ DATE _____
NAME OF BUSINESS _____
ADDRESS _____
_____
MAKE OF METER _____ SERIAL NO _____
MODEL NO _____ MARKED DISCHARGE RATE. MAX _____ MIN _____
ATC _____ METER APPLICATION _____ N.M. PERMIT NO _____

PRODUCT _____ CORRECTED API GRAVITY _____
TOLERANCE APPLIED MAINTENANCE _____ ACCEPTANCE _____
SEALS INTACT: REGISTER _____ COMPENSATOR _____ STANDARD SIZE _____
TOTALIZER READING BEGINNING _____ ENDING _____

TEST TYPE _____ FLOW RATE _____ COMPENSATED / UNCOMP PROD / AVG TEMP _____ / _____ VOL REDUCTION FACTOR _____ x PROVER READING _____ _____ - CORRECTED PROVER READING _____ METER READING _____ _____ NET METER ERROR _____ _____	TEST TYPE _____ FLOW RATE _____ COMPENSATED / UNCOMP PROD / AVG TEMP _____ / _____ VOL REDUCTION FACTOR _____ x PROVER READING _____ _____ - CORRECTED PROVER READING _____ METER READING _____ _____ NET METER ERROR _____ _____	TEST TYPE _____ FLOW RATE _____ COMPENSATED / UNCOMP PROD / AVG TEMP _____ / _____ VOL REDUCTION FACTOR _____ x PROVER READING _____ _____ - CORRECTED PROVER READING _____ METER READING _____ _____ NET METER ERROR _____ _____
TEST TYPE _____ FLOW RATE _____ COMPENSATED / UNCOMP PROD / AVG TEMP _____ / _____ VOL REDUCTION FACTOR _____ x PROVER READING _____ _____ - CORRECTED PROVER READING _____ METER READING _____ _____ NET METER ERROR _____ _____	TEST TYPE _____ FLOW RATE _____ COMPENSATED / UNCOMP PROD / AVG TEMP _____ / _____ VOL REDUCTION FACTOR _____ x PROVER READING _____ _____ - CORRECTED PROVER READING _____ METER READING _____ _____ NET METER ERROR _____ _____	TEST TYPE _____ FLOW RATE _____ COMPENSATED / UNCOMP PROD / AVG TEMP _____ / _____ VOL REDUCTION FACTOR _____ x PROVER READING _____ _____ - CORRECTED PROVER READING _____ METER READING _____ _____ NET METER ERROR _____ _____

THIS DEVICE IS: APPROVED _____ ADJUSTED _____ REJECTED _____ NSNLFT _____

	AS FOUND:	AS SEALED:		
GEAR RATIOS (A/B) (R/S)	_____	_____	SUPPLEMENTAL I.R.	_____
CALIBRATOR SETTING	_____	_____	OUT OF ORDER	_____
TOP ADJUSTOR SETTING	_____	_____	NOTICE OF VIOLATION	_____
COMPENSATOR SETTING	_____	_____	MEMORANDUM	_____

REMARKS _____
THE PRODUCT USED FOR TESTING OF THIS DEVICE WAS PROPERLY RETURNED TO STORAGE

_____ REPORT ACKNOWLEDGED

_____ INSPECTOR

Figure 4-9. Typical Report Form

SAFETY

During your field training, your instructor will spend a good deal of time talking about safety, demonstrating correct safety procedures, and having you practice them. The topic of safety on the job can never be over-stressed, especially when the job involves working with different equipment, different substances, and under different conditions every day, as yours does.

Several manufacturers of vehicle-tank meters include with their informational literature a list of specific product applications for which different models are best suited. One such list of generic products that are commonly transported in tank trucks has more than 800 entries. Needless to say, a great many of these substances are classified as hazardous. Some are volatile, some caustic, some highly flammable, some highly toxic, and some are dangerous in more than one way.

Of course, a weights and measures examination does not involve direct inspection of the product, or any handling of it. Substances, hazardous or not, are intended to remain contained within the system. However, the system will incorporate your test equipment, and some product will be moved. Under these conditions there is always some risk of leaks. Given the variety of situations that could arise -- even though none are likely to -- the inspector's most important safety equipment is his or her knowledge. You must:

- Know the physical and chemical properties of the substance you are dealing with.
- Know how the equipment used to meter the product and your own test equipment works, how it may malfunction, and how it should be operated in the event of an emergency.
- Know what to expect under a variety of different conditions so that you can anticipate dangerous situations before they develop and be prepared for them if they do.

In addition, and perhaps most important, you must know the limits of safe operation. If you are ever in doubt, you should contact your supervisor before you begin a procedure, and you should not proceed until you are confident that you can do so safely. It is always better and more efficient in the long run to be cautious than to risk injury to yourself and others or damage to property.

Your jurisdiction will have established safety guidelines and procedures. These should be studied carefully and followed to the letter, both in training exercises and in the field. The following list includes some very basic and general safety practices.

- Do not smoke or permit smoking, flame, or sparks in your work area. (Your work area comprises the space covered by the tank truck and prover, and immediately adjacent areas.)
- As you inspect the device, and throughout the examination procedure, look carefully for leaks. Report any found immediately to the operator or supervisor, and do not proceed until the source is discovered and corrected. If necessary, require that the device be taken out of service until the leak is repaired.

- Do not leave equipment unattended while in operation. You or your assistant must always be within an arm's reach of controls, and the level of product in the prover should be monitored to prevent overfill and spillage in the event that the meter is severely underregistering. If supply or return lines are not coupled at their discharge ends, they must be held in place continuously.

- Avoid inhaling fumes or vapor. Make sure that adequate provision has been made for vapor recovery if required.

- Eliminate all possible sources of electric discharge (sparks) within the work area including static electricity. Do not wear clothing that produces static (like a nylon windbreaker). Do wear rubber-soled shoes (which will also provide secure footing on wet or slippery surfaces). Report any exposed wiring on the vehicle to the operator or a supervisor, and do not proceed until the condition has been repaired.

- Always ground the prover, and make sure that the prover pump electrical supply line is in good condition and that it is protected from damage while in use.

- Beware of vehicular and pedestrian traffic around your work area. If necessary, set up barriers. Be especially careful when trucks must back into position near the prover.

- Always chock the trailer or vehicle on which the prover is mounted to be sure it does not roll away should the prover shift during testing. Check to be sure that the chocks are still secure when the prover is full of product.

- If the liquid dispensed by the metering system is highly toxic or volatile, make arrangements to test the device using a substitute test liquid that has the same general properties as the product, but is less hazardous.

This list of general precautions is not intended to replace specific safety procedures established by your jurisdiction. Your instructor will provide you with copies of these procedures and review them with you thoroughly. Do not hesitate to discuss any questions or concerns you have regarding safety with your instructor.

SUMMARY

Several important tasks must be performed before you begin an official field examination to assure that procedures on-site can be conducted efficiently, accurately, and safely. After the location is selected, suitable arrangements must be made with the owner or operator of the device(s) regarding access and assistance. The inspector must then select appropriate test equipment, and must be thoroughly familiar in particular with procedures for setting up and operating the field standard prover that will be used. Report forms are designed to facilitate the recording of essential field examination data in a form that can be clearly understood and used by the inspector, the device operator, repairpersons, and weights and measures administrators. The topic of safety on the job can not be overstressed. Field examinations should not be hazardous if proper precautions are employed, and if the inspector has a confident knowledge of the substance being measured and its properties, the equipment to be used both to measure and deliver it, and the range of circumstances that could give rise to an emergency situation.