Bulk Liquid Stock Control at Retail Outlets

API RECOMMENDED PRACTICE 1621
FIFTH EDITION, MAY 1993

REAFFIRMED, MAY 2012

AMERICAN PETROLEUM INSTITUTE

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Downstream Segment

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FOREWORD

This recommended practice contains procedures and methods designed to control and identify product losses through use of a suitable inventory control accounting system. Employees should be trained in the procedures in this recommended practice and be required to follow them. Use of these procedures will enable the operator to identify trends and significant changes in inventory variations that may indicate the presence of controllable losses. Suitable corrective actions may then be taken to reduce product losses.

On September 23, 1988, the U.S. Environmental Protection Agency (EPA) issued its *Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)*. These standards, which will be found in 40 *Code of Federal Regulations* Part 280, were published in Volume 53 of the *Federal Register* at pages 37194–37212. Furthermore, legislation and regulations on all aspects of UST management are under active development at state and local levels. These levels may have requirements other than those specified in the EPA *Technical Standards,* and the appropriate government agencies should be consulted about regulations that apply in the geographic area of interest before any action suggested by this recommended practice is taken. When used in this document, the term *implementing agency* means EPA or the designated state or local agency responsible for carrying out an approved UST program.

This recommended practice is based upon the experience of knowledgeable members of the petroleum industry. In some respects it may be more stringent than the requirements imposed by the EPA *Technical Standards*. However, the recommended practice does not attempt to cover all of the subjects covered by the EPA *Technical Standards*. Furthermore, while substantial effort has been made to ensure that none of the recommendations contravene the requirements of the EPA *Technical Standards,* API is not undertaking to interpret the EPA *Technical Standards* and cannot guarantee that its recommendations are completely in accord with them, nor is any representation made that these recommendations conform with any requirements imposed by state and local agencies.

This recommended practice supersedes and replaces API Recommended Practice 1621, fourth edition, December 1987. The EPA *Technical Standards* provide that Recommended Practice 1621 can be used as a guide to comply with EPA's standards for inventory control. According to EPA, an owner or operator conforms with this provision of the EPA *Technical Standards* if he or she uses the 1987 edition, which was in force when the EPA *Technical Standards* became final. However, an owner or operator who uses this new edition will also be meeting the requirements of the 1987 edition and EPA encourages the use of the most recent version.

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Suggested revisions are invited and should be submitted to the director of the Manufacturing, Distribution and Marketing Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

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Bulk Liquid Stock Control At Retail Outlets

SECTION 1—GENERAL

1.1 Introduction

1.1.1 The primary application of this recommended practice is in connection with the underground storage of motor fuels and used oil at retail and commercial facilities. This recommended practice does not apply to inground (that is, where a part of the tank is aboveground) or aboveground bulk storage systems. Hereafter, the use of the term *tank* refers to an underground petroleum storage tank. Any merchandising operation in which a commodity is handled in bulk is susceptible to stock or inventory losses. This problem becomes even more critical at retail outlets selling motor fuels since the principal bulk commodity handled is volatile. Thus, special care must be exercised to control product losses to (a) provide a safe environment for the operator, employees, customers, and neighbors; (b) minimize air and water pollution; and (c) maximize profits.

1.1.2 The negative effect of product losses on profits needs no explanation. However, the operator should understand that he or she, as well as the owner of the underground storage and dispensing equipment, may be subject to financial penalties imposed by government agencies if product leakage causes contamination. He or she may also be liable for personal injuries and property damage resulting from hazardous conditions caused by product leakage as a result of his or her negligence. Most states have regulations that contain penalties for noncompliance.

1.2 Purpose

The purpose of this recommended practice is to assist the operator in controlling bulk stock losses, thereby achieving a high level of safety and pollution control while maximizing profits. This recommended practice describes and explains practices and procedures needed to achieve good bulk stock control. This control is achieved through the daily preparation and review of inventory control records. Achieving good control of bulk stock allows the operator to quantify product losses and quickly recognize the presence of leaks or equipment problems.

1.3 Federal Requirements

The U.S. Environmental Protection Agency (EPA) accepts inventory control in conjunction with tank tightness testing as an approved method of release detection until December 22, 1998, or 10 years after a new tank has been installed or an existing tank has been upgraded, whichever comes later. The EPA requires that any suspected release be reported within 24 hours to the authority having jurisdiction. *Authority having jurisdiction* refers to one or more federal, state, or local government agencies or individuals responsible for approving equipment, installations, and procedures associated with underground storage tank systems. When using inventory control as a method of release detection, variances exceeding 1 percent of product throughput plus 130 gallons for two consecutive months must be reported to the authority having jurisdiction. In addition, the tank tightness test must be capable of detecting a 0.1 gallon per hour leak rate with a 95 percent probability of detection and a 5 percent probability of false alarm.

An alternate method of release detection accepted by the EPA is the use of an automatic tank gauging (ATG) system. The ATG must be capable of detecting a release equivalent to 0.2 gallons per hour with a 95 percent probability of detection and a 5 percent probability of false alarm during a monthly test. In addition to providing a tank testing feature, some ATG systems may be able to perform automatic inventory control. The scope of this recommended practice does not include additional discussion of ATG systems.

The EPA also allows manual tank gauging (MTG) as an alternate method of leak detection for tanks of 2000 gallons capacity or less (refer to 5.2). MTG can be used for tanks containing motor fuels, used oil, and petroleum distillates. However the EPA exempts certain tanks from the UST regulations, including heating oil tanks used for consumptive use on the premises where stored. Some state regulations, however, do not exempt such tanks.

State and local agencies may have more stringent standards and should be consulted.

1.4 Referenced Publications

The most recent editions of the following standards, codes, and specifications are cited in this recommended practice.

API

RP 1615	*Installation of Underground Petroleum Storage Systems*
RP 1628	*A Guide to the Assessment and Remediation of Underground Petroleum Releases*
RP 1631	*Interior Lining of Underground Storage Tanks*
RP 1637	*Using the API Color-Symbol System to Mark Equipment and Vehicles for Product Identifi-*

cation at Service Stations and Distribution Terminals

EPA[1]

Straight Talk on Tanks

Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (40 *Code of Federal Regulations* Part 280)

NFPA[2]

77 Static Electricity

SECTION 2—ACCOUNTING SYSTEMS

2.1 Requirements

2.1.1 The necessity of establishing and using an adequate accounting system, not only for inventory but for the business in general, cannot be stressed enough. Even a very simple system may be adequate to control inventory of bulk liquid stock, but it is of the utmost importance that it be used every day.

2.1.2 As a minimum, the system should clearly show the following information for each grade or type of bulk liquid product for each day of operation:

a. A record of all bulk liquid receipts (that is, delivery invoices).
b. A record of all bulk liquid sales (obtained from the fuel dispensers).
c. A record of bulk liquid used other than that sold.
d. A daily reconciliation between sales, use, receipts, and inventory-on-hand.

2.2 Implementation

2.2.1 Many different accounting systems are available. Most oil suppliers will advise their operators as to the proper accounting procedures to be used, including sources and use of suitable accounting forms. A sample daily gasoline inventory record is contained in Appendix A.

2.2.2 Once the operator has adopted a system, he or she must use it conscientiously and according to the instructions. In some cases, the circumstances of an individual operation may be such that after a reasonable period of use, the system can be simplified without impairing its purpose, or augmented to provide additional useful information. No matter how it is modified, the system must be used daily to be of full value.

SECTION 3—PRODUCT LOSSES

3.1 Sources of Losses

For the purpose of this discussion, losses are divided into two categories: (a) those that are unavoidable because of the nature of the business and the characteristics of the product, and (b) those that can be controlled and reduced by following appropriate stock control procedures.

3.2 Unavoidable Losses

3.2.1 DESCRIPTION OF NORMAL LOSSES

3.2.1.1 Any business involving the handling of bulk merchandise is subject to unavoidable stock losses. The operator of a retail gasoline outlet is even more subject to unavoidable stock loss because of the volatile nature of the liquid product he or she handles. A portion of the product in the storage tanks will vaporize and occupy the empty portion of the tank as a vapor-air mixture. When the product is received, an equivalent volume of vapor-air mixture is forced out through the vents by the incoming product. Where vapor emission control equipment is in use, the vapor-air mixture is returned to the tank truck making the delivery.

3.2.1.2 Regardless of whether the storage system is or is not equipped with vapor emission control equipment, vapor-air mixture is seldom, if ever, expelled from underground tanks except during deliveries. The only other times when this condition could occur are when the vapor-air mixture expands as a result of an increase in temperature or when the barometric pressure changes.

3.2.1.3 The temperature of the ground around underground tanks does not vary appreciably from day to day. Even if underground product temperatures increase, vapor-air mixture normally will not be expelled from the vent because increased space is created whenever product is pumped from the tank during a sale to a customer. As a result, air is drawn into the tank rather than vapor-air mixture being forced out.

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[1]Environmental Protection Agency, The *Code of Federal Regulations* is available from the U.S. Government Printing Office, Washington, D.C. 20402; *Straight Talk on Tanks* is available from the National Technical Information Services, Department of Commerce, Springfield, Virginia 22161.
[2]National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.

3.2.1.4 It is reasonable to conclude that vapor losses other than those that occur when deliveries are made to the underground tanks are so small that they could not be detected by ordinary gauging methods.

3.2.1.5 Differences in temperature between the product being delivered and the product already in the tank will cause a temperature change after delivery. If the temperature of the stored product drops, the volume will decrease, resulting in a shrinkage loss. Conversely, a rise in temperature results in product expansion.

3.2.1.6 It is virtually impossible to calibrate the meters of gasoline dispensers to achieve and maintain 100 percent accuracy. The National Conference on Weights and Measures has established the legal tolerance level of gasoline dispensing meters at 6 cubic inches per 5 gallon measure (±0.52 percent). Since meter calibration variances involve overages as well as underages, customers, on balance, receive full measure. A procedure for testing the accuracy of gasoline dispensing meters is described in Appendix B. All dispensing meters should be checked regularly to reduce meter inaccuracies.

3.2.1.7 In addition to these normal losses, the operator should recognize that an apparent reduction of inventory will occur when a new outlet is opened or tanks and lines are repaired at an existing outlet and the dispensing pumps are then placed in operation. This is caused by the withdrawal of product from the tank necessary to fill the lines. The operator should gauge the tanks and, if necessary, make an adjustment to his or her records. Neither the line fill nor the unavailable product in the tank below the suction stub should be considered lost since the product remains at the outlet and can be reclaimed or accredited as necessary.

3.2.2 MAGNITUDE OF NORMAL LOSSES

3.2.2.1 The variances that have been discussed cannot be controlled by the operator; they are inherent in the retail outlet operation and in the characteristics of the product handled. Data from a U.S. Department of the Treasury survey of regional differences between the volume of gasoline received and the volume dispensed at retail outlets showed that average geographic variances were within the range of +0.27 percent to -0.40 percent. In the aggregate, these variances are small enough to fall within the limits of good business operating overhead and should be considered as such by the operator.

3.2.2.2 It is apparent from 3.2.1 that a single or absolute figure cannot be developed to characterize the unavoidable losses of gasoline at specific retail outlets due to shrinkage, vaporization, meter calibration, and other causes. An operator should expect small variations in his or her inventory. However, per tank variances generally should not exceed 0.5 percent of product throughput (volume of product dispensed) over a one month period, or five gallons of every 1,000 gallons of monthly throughput. Monthly variances can be calculated from daily inventory control reconciliation data (see Section 4). The calculation requires that daily reconciliations be conducted to determine daily variances (shortages or overages). When these variances are added together for the month, a cumulative shortage or overage can be determined. If variances exceed 0.5 percent of throughput, a system leak may exist. Daily reconciliations should also be used to detect sudden, unexplained changes from the established pattern or small daily losses. Any tank operator whose losses exceed 0.5 percent of throughput over extended periods of time should carefully examine his operating practices. In addition, the operator should be observant of trends; continual or predominant gains or losses may indicate a problem that requires additional investigation.

Note: The EPA requires that any suspected release be reported to the authority having jurisdiction within 24 hours. When using inventory control as a method of release detection, variances exceeding 1 percent of product throughput plus 130 gallons for two consecutive months must be reported to the authority having jurisdiction (refer to the *Technical Standards* for underground storage tanks). Based on industry research,[3] the inventory control procedure is capable of detecting a release equivalent to 0.5 percent of product throughput over a one month period with a 100 percent probability of detecting the leak and a 30 percent probability of false alarm. Regardless of the high false alarm rate, API recommends that variances exceeding 0.5 percent of throughput be investigated. State and local agencies may have more stringent standards than the EPA, and should be consulted.

3.3 Controllable Losses

3.3.1 DESCRIPTION OF CONTROLLABLE LOSSES

The largest stock losses in a service station operation occur from practices and conditions that are within the operator's control. These include leaks, spills, theft, and product used on the premises. The larger the operation and the more persons employed, the more critical it becomes to adhere rigidly to established procedures for good stock control if the business is to be successful.

3.3.2 LEAKAGE

3.3.2.1 Leaks can occur in dispensing equipment, underground piping, or tanks. Losses from these sources can be reduced by proper product accountability, by regular inspection of the visible parts of the product handling system, and by the prompt recognition of symptoms that indicate leaks in the underground portion.

3.3.2.2 The dispensing equipment should be inspected at least once a week. If possible, this inspection should be made

[1] *Review and Analysis of Existing and Proposed Underground Storage Tank Inventory Control Procedures,* by Radian Corporation for API, June 5, 1987.

while the equipment is operating. Although the operator may tighten a leaking connection, he or she should not attempt to correct a condition requiring extensive repair. Under no circumstances should electrical connections be broken or disconnected. If repairs or adjustments are required, the operator should immediately notify those responsible for maintenance of the equipment. See API Recommended Practices 1615 and 1631 for further information on storage system repair.

3.3.2.3 Evidence of leakage from underground equipment can be gathered from inventory control records and from abnormal operation of pumping equipment. Some of the more obvious symptoms of such leaks are the following:

a. Loss of product in a tank during periods when product is not dispensed. This symptom sometimes indicates a leaking tank, but might also indicate an unaccounted-for withdrawal, theft, or extreme temperature change.
b. An unaccountable increase in water in an underground tank. This symptom may be caused by a leak in the tank if the ground surrounding it is saturated. This symptom also may be caused by a leaking gauge or fill cap, and these should be examined and made watertight, if necessary, before concluding that the tank is at fault.
c. Increasing differences between the amount of product received and dispensed. This symptom may indicate a meter calibration problem, theft, or a leak in tanks or piping.
d. Large differences appearing consistently between the amounts invoiced and the gauged values after deliveries where fill boxes are located remotely from the tanks. This symptom may indicate a leak in the remote fill line. In such event, the line should be tested.
e. A hesitation in the delivery from a suction pump. This symptom may indicate a leak in the suction piping, although such hesitation may also be caused by a leaking foot valve or, in warm weather, by vapor lock. Should this occur, the inventory control records may indicate whether the cause is mechanical or whether the product is actually being lost.
f. A slow flow in the delivery from a dispenser nozzle. This symptom may indicate a leak in the pressure piping when a mechanical leak detection device is present on the submersible pump discharge line.
g. Gasoline odor in spaces belowground or in confined areas adjacent to the station. This symptom may be evidence of underground leaks in the tank or piping.

3.3.2.4 Should the operator observe any of the symptoms described in 3.3.2.3, he or she should immediately notify those responsible for maintaining the equipment. The operator should not attempt to correct the condition, as the operation may involve some hazard and may require special equipment.

3.3.2.5 If gasoline odors are detected in an off-property location or if there is evidence of leakage at the outlet, the local fire department and the owner(s) of the underground storage and dispensing equipment should be notified immediately.

3.3.2.6. Should the operator observe any of the symptoms described in 3.3.2.3 (f.) or 3.3.2.5, or should any other release detection device indicate the presence of a possible release, the authority having jurisdiction should be consulted immediately about any requirements concerning notification, site assessment, or corrective action. Additional investigatory steps are described in API Publication 1628. In these circumstances, the federal UST regulations require that the state or local implementing agency be notified within 24 hours (or within the time specified by the implementing agency).

3.3.3 SPILLAGE

3.3.3.1 Spillage losses can occur during receipt of product if the truck hose connections are not properly made either at the truck or at the fill box or are disconnected prior to properly draining the hose. These connections should be observed by the operator at the beginning and completion of the delivery and corrected if necessary.

3.3.3.2 Care should be exercised to avoid overfilling the underground storage tanks. The procedures for receipt of product in 4.3 will prevent spillage from this source.

3.3.4 THEFT

Although loss through theft is not common, it must be considered. The accounting system must provide for periodic checks of purchases, sales, and inventories. If excessive variations of inventory are revealed by such checks, outlet facilities and operating procedures should be scrutinized closely. If this examination does not indicate the cause of the variation, the possibility of theft must be explored. The stock inventory control system should be designed to take into consideration the fact that the normal causes for loss may be utilized to cover up fraudulent operations. Therefore, to prevent loss by theft, the operator must maintain a constant and careful watch over the operation of the system and immediately investigate any abnormal losses. Product delivery points should be adequately identified and secured. See API Recommended Practice 1637 for specific recommendations.

3.3.5 PRODUCT USED ON PREMISES

A careful record should be kept of all product dispensed for use on the premises or for the personal use of the operator and his or her employees. Such withdrawals must be properly accounted for if the stock control record is to show a true picture of inventory and losses. Losses cannot be ascer-

tained with any degree of accuracy without good gauging procedures and properly adjusted dispensing meters. The procedures for meter checking (see Appendix B), and proper use of the gauge stick (see Appendix C) are designed to assist the operator in accurately accounting for his or her bulk liquid stock.

SECTION 4—PROCEDURES FOR REDUCTION OF CONTROLLABLE LOSSES

4.1 Introduction

The procedures in this section are recommended for use in maintaining an accurate inventory of bulk liquid product. It is recognized that the frequency of these procedures will vary when applied to the wide range of retail outlet operations dispensing motor fuel; however, adherence to the basic principle of maintaining a sound inventory control system will minimize losses and provide early detection of losses in excess of normal unavoidable losses.

4.2 Daily Procedures

Perform the following procedures at opening or closing of business:

a. Read all totalizing meters. If the outlet is operating on shifts, the incoming and outgoing shift supervisors should perform this duty together. If this is not practical, the incoming supervisor should make meter readings his or her first duty and should check any readings left by the supervisor of the previous shift. If the outlet is closed at night, compare the opening reading with the previous closing reading.
b. Gauge all tanks as specified in Appendix C.

Note: a and b should be performed during a time period when no input or removal of the tank's contents has occurred.

c. Check all tanks for water as specified in Appendix D. Compare the current reading with the previous reading and make necessary adjustments for any variation. An undetected change in the amount of water in the tank would change the level of the product and produce an erroneous reading.
d. Reconcile meter and tank readings by product system on a daily basis, maintaining records in such a manner that trends over a period of time are easily discerned (see Appendix A).

Reconciliations (see 3.2.2) over longer periods will provide greater inventory control accuracy and leak detection capability. In addition, daily inventory records should be checked each day for unusual fluctuations or trends.

4.3 Procedure for Receipt of Product

4.3.1 Perform the following procedures before and after delivery:

a. Although a few minutes might be saved by gauging only those tanks involved with the anticipated receipt of product, it is recommended that all tanks be gauged. This will not only reveal any mistakes that might occur such as dumping into wrong tanks, but will ensure accuracy when tanks are interconnected (that is, syphoned together) or when environmental considerations require a pressure/vacuum (P/V) valve on the vents. (See Appendix C for special precautions when P/V valves are present.)
b. All tanks should be gauged immediately prior to delivery and after delivery has been completed. Note that sales during deliveries will need to be reconciled. Should variations be experienced with interconnected tanks, a second gauge should be taken at least one-half hour later when the product level has equalized. A record should be kept of all gauges, but the last (and more accurate) gauge (in the case of interconnected tanks or when a P/V valve is present on the vents) should be used for inventory purposes.
c. All tanks should be checked for water before and after delivery. No supplier intentionally delivers water, but bulk plant operations and procedures sometimes result in water reaching the vehicle tanks without the knowledge of the loader. An increase in the water level will result in an erroneous calculation of the amount received unless the water is detected and the records adjusted accordingly.
d. All fill and gauge caps should be reinstalled, making sure that caps and gaskets are in good condition. The delivery truck operator will make his or her own hook-ups.

CAUTION: Due to many recent changes in storage and dispensing facilities necessitated by environmental protection considerations, the outlet operator must take particular care to ensure that he or she thoroughly understands the particular system. It should be recognized that a pressure or vacuum may exist under certain conditions, in which case necessary precautions should be observed (see Appendix C). Most oil suppliers will advise their retailers concerning such precautions when requested.

4.3.2 Perform the following procedures after delivery:

a. Make adjustments for variation in water level, if any.
b. Make adjustments for transactions during delivery, if any.
c. Calculate the amount of product received and compare with the amount shown on the invoice. If the invoice shows both net volume delivered (temperature adjusted) and gross

volume, then the calculated amount should be compared with the gross.
d. Make sure fill and gauge caps are tight and locked.

4.3.3 Perform the following procedures during night deliveries when the station is closed:

a. Calculate the difference between the closing gauges and the opening gauges of those tanks that were filled and compare with the amount shown on the invoice.
b. Check the tanks for water at the opening of business following the delivery and make necessary adjustments for any variation in water level from the previous day.
c. Make sure fill and gauge caps are tight and locked.

4.4. Special Circumstances

Tanks should be checked for water after a thaw or heavy rain to detect water that may enter the tank through leaking fill or gauge caps.

SECTION 5—MANUAL TANK GAUGING

5.1 Description

Manual Tank Gauging (MTG) is a release detection procedure in which the level of the contents of the tank are compared before and after a specified period of tank inactivity. This method requires that the tank be inactive during the test period (see Appendix E).

5.2 Federal Requirements

MTG is useful for tanks of 2000 gallons capacity or less. In EPA's *Straight Talk on Tanks*, the agency, in effect, amended the UST regulations [40 *Code of Federal Regulations* Parts 280.43 (b) (4)] to allow tanks up to 1000 gallons (as opposed to 550 gallons capacity in the regulations) in capacity to use MTG as a sole method of leak detection. This requires using longer test durations and the applicable weekly and monthly variations that are reproduced in Appendix E. Tanks from 1001 to 2000 gallons can only use MTG when it is combined with tank tightness testing. MTG in conjunction with tank tightness testing can only be used until December 22, 1998, or 10 years after a new tank has been installed or an existing tank has been upgraded, whichever comes later. After this time, the tank must be upgraded and a monthly monitoring method must be installed as identified in the federal UST regulations. State and local agencies may require more stringent standards and should be consulted. Refer to EPA reference documents listed in 1.4.

5.3 Conditions for Use

MTG can be employed if the following conditions are met:

a. The nominal tank capacity is 2000 gallons or less.
b. Measurements are made at the beginning and ending of a 36-hour period (or longer with respect to using MTG as a sole method of leak detection for 551 to 1000 gallon tanks; see Appendix E) during which no input or removal of the tank's contents has occurred. (At a minimum each measurement should consist of the average of the readings resulting from two independent insertions of the measuring device; see Appendix E).
c. Measuring devices are capable of measuring within $^1/_8$ of an inch over the full range of the tank's depth.
d. Any variation exceeding the monthly or weekly standard is reported as a suspected leak. (See Appendix E.)

5.4 Form and Procedure

The Record and Reconciliation Form (Appendix E) may be used for MTG.

APPENDIX A—SAMPLE RECONCILIATION FORMS

INVENTORY CONTROL PROGRAM
DAILY RECONCILIATION FORM

DATE: _____

LOCATION: _____

	BOOK INVENTORY		REGULAR LEADED	REGULAR UNLEADED	PREMIUM UNLEADED	DIESEL
1.	Closing 1	+				
2.	2	+				
3.	3	+				
4.	4	+				
5.	5	+				
6.	6	+				
7.	7	+				
8.	8	+				
9.	9	+				
10.	10	+				
11.	Total Meters	=				
12.	Meters Out	+				
13.	Meters In	–				
14.	Dispenser Cal Test Gals.	–				
15.	Total Closing Meters	=				
16.	Opening Meters	–				
17.	Today's Sales	=				

	Physical Inventory	REGULAR LEADED		REGULAR UNLEADED		PREMIUM UNLEADED		DIESEL	
		IN.	GAL.	IN.	GAL.	IN.	GAL.	IN.	GAL.
18.	Tank 1 Total								
19.	Tank 1 Water								
20.	Tank 1 Net	X		X		X		X	
21.	Tank 2 Total								
22.	Tank 2 Water								
23.	Tank 2 Net	X		X		X		X	
24.	Physical Inventory								

	TANK RECONCILLIATION (Gallons)		REGULAR LEADED	REGULAR UNLEADED	PREMIUM UNLEADED	DIESEL
25.	Opening Physical Inventory					
26.	Today's Sales	–				
27.	Product Receipts	+				
28.	Inventory Balance	=				
29.	Physical Inventory	–				
30.	Tanks Over (IF -)	=				
31.	Tanks Shorts (IF +)	=				

SEE INSTRUCTIONS ON REVERSE SIDE

INSTRUCTIONS FOR THE INVENTORY CONTROL PROGRAM DAILY RECONCILIATION FORM

At the end of each day, a tank reconciliation should be performed as follows:

Note: Enter all values as gallons unless indicated otherwise.

Book Inventory

1. Read all dispenser meters to determine closing for each hose and enter on lines 1-10 under the appropriate product column. Add all meter readings from hoses selling the same product (lines 1-10) to determine total meters (line 11).
2. Enter any dispenser meter readings from old meters removed on line 12.
3. If newly installed dispenser meter readings are other than zero enter on line 13.
4. On line 14, enter any product used to conduct a dispenser calibration test, if the product is returned to the storage tank. Add line 12 to line 11 and subtract lines 13 and 14 from the sum. Enter the result on line 15.
5. Enter today's opening meters (previous day's closing meters) on line 16 and subtract from today's total closing meters (line 15). Enter the result on lines 17 and 26.

Physical Inventory

1. Carefully gauge each tank and enter inches of product in each of the appropriate product columns on lines 18 and 21. See Appendix C for gauging procedures.
2. Enter inches of water in each tank in the appropriate product column on lines 19 and 22.
3. Convert all inches to gallons using the tank conversion chart supplied with the tank and record gallons next to the inches figures on the appropriate lines. (See C.1.3.)
4. Subtract line 19 from 18 and line 22 from 21 and enter the results on lines 20 and 23, respectively.
5. If a single product is stored in two tanks that are interconnected (that is, product flows freely between two tanks) add lines 20 and 23 and enter the result on lines 24 and 29.
6. If a product is stored in a single tank, enter the result on line 20 and on line 29.

Tank Reconciliation

1. Enter physical inventory from previous day (line 29 of previous day's form) on line 25.
2. Enter today's product receipts received on line 27.
3. Subtract line 26 from line 25 and add line 27 to the result to determine inventory balance (line 28).
4. Subtract line 29 from line 28. If the result is negative, enter it on line 30. If the result is positive, enter it on line 31.
5. Enter values on line 30 and/or 31 on the Inventory Control Program Monthly Reconciliation Worksheet.

INVENTORY CONTROL PROGRAM
MONTHLY RECONCILIATION WORKSHEET

DATE: _____

LOCATION: _____

		DAILY OVERAGE/SHORTAGE (GALLONS)			
LINE	DAY	REGULAR LEADED	REGULAR UNLEADED	PREMIUM UNLEADED	DIESEL
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				
	21				
	22				
	23				
	24				
	25				
	26				
	27				
	28				
	29				
	30				
	31				
1	CUM OVER TOTAL				
2	% THRU				
3	CUM SHORTAGE TOTAL				
4	% THRU				

SEE INSTRUCTIONS ON REVERSE SIDE

INSTRUCTIONS FOR THE INVENTORY CONTROL PROGRAM MONTHLY RECONCILIATION WORKSHEET

1. Enter daily overage or shortage for each product from the tanks over and tanks short lines (lines 30 and 31) of the Inventory Control Program Daily Reconciliation Form for each operating day of the month.
2. Enter daily overages and shortages from 31 operating days (or one continuous month), then add all overages and shortages and enter those values on line 1 if the sum is negative or line 3 if the sum is positive.
3. Calculate total throughput for the month for each product. Calculate the percentage of each total *cumulative* overage or shortage of the total throughput for each product and enter the value on line 2 or 4 as appropriate.

If these values exceed 0.5 percent of monthly throughput for a product, a potential leak may exist and should be investigated. See API Recommended Practice 1628 for response procedures.

Note: The EPA requires that any suspected release be reported within 24 hours to the authority having jurisdiction when the cumulative sum of monthly overages and shortages exceeds 1 percent of product throughput plus 130 gallons for two consecutive months. State and local agencies may require more stringent standards and should be consulted.

APPENDIX B—PROCEDURE FOR TESTING ACCURACY OF GASOLINE-DISPENSING METERS

B.1 Equipment

B.1.1 The only special equipment required is a proving can of 5-gallon capacity. The upper portion of this can consists of a neck approximately 4 inches in diameter having a sight glass with an adjacent scale graduated in cubic inches above and below a zero point. The scale indicates the number of cubic inches delivered by the meter greater or less than the amount indicated on the dispenser dial.

B.1.2 If local regulations require the station operator to periodically check the dispensing units, the local bureau of weights and measures should be consulted concerning the size and type of proving can to be used. Otherwise, a suitable can may be purchased from a reliable automotive equipment supplier. Each can should be checked for accuracy periodically or as may be required by local regulations.

B.2 Procedure

Follow these steps to test the accuracy of gasoline-dispensing meters:

a. Wet the can by filling it with product to its full capacity, then return the product to the storage tank.

WARNING: When product is transferred, electrical continuity must be provided between the can and the dispensing nozzle and between the can and the underground storage tank to ensure dissipation of potential static electrical charges (refer to NFPA 77).

b. With the dispenser nozzle fully open (maximum filling rate), refill the can with exactly 5 gallons (or its rated capacity if a different size can is used) as indicated by the dispenser.

c. Read on the graduated scale the number of cubic inches delivered greater or less than the quantity shown on the dispenser, and record the difference.

d. Return the product in the can to the appropriate product storage tank.

e. Refill the can as in step b, but with the nozzle partly closed to limit flow to approximately 5 gallons per minute.

f. Repeat steps c and d.

g. If the quantity delivered in steps b or e varies by more than 6 cubic inches above or below the zero point (for a 5-gallon can), adjustment by a qualified pump mechanic should be arranged. The operator should not attempt to adjust the meter himself.

h. Note in the inventory record the changed meter readings caused by the delivery of the product used for the test, noting also whether the product was returned to storage or used for other purposes.

i. Keep records of calibrations to assist in reconciling inventory variations.

APPENDIX C — GAUGING PROCEDURE FOR UNDERGROUND HORIZONTAL TANKS

C.1 Equipment

C.1.1 A gauge stick made of varnished hardwood (maple) or other nonsparking material should be used. The stick should be long enough to reach the bottom of the tank (usually 6 feet to 10 feet), and should be about 1 inch wide by $^3/_4$ inch thick. The stick should not be warped. One side of the stick should be marked in inches with $^1/_8$ inch subdivisions; the zero marking should be at the bottom or tip of the stick. If the stick is used for gauging gasoline or other volatile product, the side adjacent to the graduated side should be horizontally grooved every $^1/_8$ inch in order to retard creepage.

C.1.2 The gauge stick is used in conjunction with a calibration chart or charts furnished by the tank supplier. The chart shows the number of gallons for each inch on the gauge stick. Each chart is calculated for a tank of particular dimensions and capacity, and the chart used must be the proper one for the tank being gauged.

C.1.3 Precaution is necessary when gauging tanks with pressure/vacuum (P/V) valves installed on the vent line. Some state or local areas may require that P/V valves be installed on vent lines (see Figure C-1). The use of P/V valves on vents may tend to alter the pressure within the tank. This may result in erroneous gauge readings if the tank is gauged manually at the fill opening. In this situation, one of the following alternatives should be used:

a. The tank is gauged through an alternate tank opening (that is, where a fill tube is not present).
b. An automatic tank gauge system is used to perform inventory control.
c. The problem is investigated further by a qualified person.

If precautions are not taken, depending on the size of the tank and where the liquid level is at the time of gauging, significant miscalculations in inventory records may occur each time the tank is gauged.

Figure C-1 provides a schematic of a typical Stage II vapor balance system with the addition of a P/V valve. As noted, a flow-actuated vapor valve is located in the nozzle (or in the hose on older equipment) that closes when the nozzle is not in use. In addition, the P/V valve is normally closed and is only designed to open when a pressure or vacuum in the tank exceeds the preset level of the P/V valve.

A slight pressure or vacuum can occur in the tank as a result of a warmer product being delivered to a cooler tank or due to cooler Stage II vapors being returned to a warmer tank and vice versa. This pressure is too slight to trigger the P/V valve to open and therefore cannot relieve itself because the system is *closed* by the vapor valve at the nozzle (as shown in Figure C-1).

When the tank is gauged through the fill opening, during a situation as described in the prior paragraph, the ullage pressure *in the fill tube* will immediately vent to normal atmospheric pressure. This results in a differential pressure between the fill tube and the tank itself. The pressure must equalize through a $+^1/_4$-inch hole in the fill tube as shown in Figure C-1. It may take several minutes for the tank to equalize several thousand gallons of vapors (under slight pressure or vacuum) to normal atmospheric pressure. In a situation where several tanks are manifolded together (as may occur with Stage II vapor recovery balance systems), more time would be required for equalization as the total volume of vapors to be equalized would include the sum of the vapors present in all the tanks. For more information on Stage II systems refer to API Recommended Practice 1615.

C.2 Procedure

Use the following procedure to obtain gauge readings:

a. API recommends that an average of two gauge readings be made that are within $^1/_4$ inch of each other. A third gauge reading should be taken if the first two do not fall within $^1/_4$ inch of each other.
b. Slowly insert the gauge stick through the gauge hole of the tank until the tip touches the tank bottom. The stick should be inserted at the same point in the gauge hole each time a gauge is taken and should be held in a vertical position. Be sure that the stick does not rest on a projection of the tank bottom.
c. Withdraw the stick quickly to avoid creepage of the product and read the product cut on the graduated scale to the nearest $^1/_8$ inch. When gasoline or another volatile product is gauged, the reading adjacent to the cut on the grooved portion of the stick should be taken as the gauge.
d. Clean the stick at the cut by wiping with a cloth and repeat the procedure.
e. Record both readings and average the two measurements. The average reading should be used to calculate the product volume in the tank.

Note: The accuracy of these measurements can be increased significantly by the use of product-finding paste. Information on the use of paste may be obtained from any petroleum equipment supplier.

C.3 Use of Tank Calibration Chart

After gauging the tank, select the correct calibration chart. Read the chart directly for all readings that are whole inches (tolerance plus or minus $^1/_{16}$ inch). For readings of at least $^1/_8$ inch over or under a whole inch, proceed as follows:

a. Read the chart for the exact inch readings above and below the actual stick-gauge reading. For example, if stick gauge reads 46-$^1/_4$ inches, read the chart at 46 inches and 47 inches.

b. Subtract the gallonage shown on the scale at the two readings. For example, for a 1000 gallon tank (diameter 64 inches, length 72 inches):

Chart reading at 47 inches	789 gallons
Chart reading at 46 inches	771 gallons
Difference	18 gallons

c. Multiply the difference by the fraction of an inch in the actual stick-gauge reading. For example:

$$18 \text{ gallons} \times {}^1/_4 = 4.5 \text{ gallons}$$

d. Add the gallonage shown on the chart for the lower whole inch gauge and the gallons calculated in step c. For example:

Gallons at 46 inches	771 gallons
Gallons at $^1/_4$ inch	4.5 gallons
Sum	775.5 gallons

e. The tank gauge reading of 46-$^1/_4$ inches represents 775.5 gallons of product in a 1000 gallon tank (diameter 64 inches, length 72 inches).

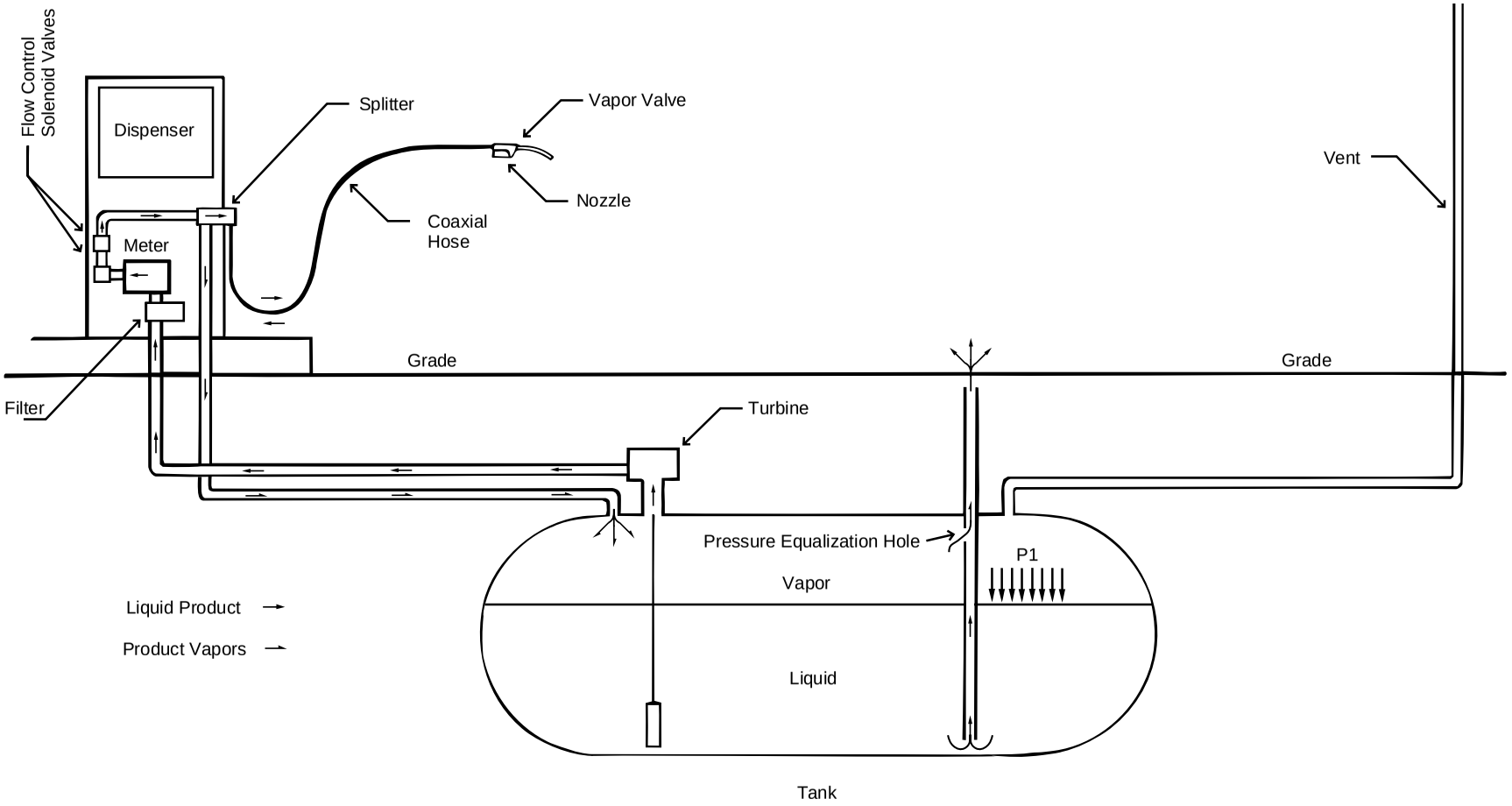
f. If a water gauge (see Appendix D) has been taken, the quantity of water contained in the tank is determined by the same procedures. The total volume (gallons) of water should be subtracted from the total volume (gallons) of liquid in the tank (as determined in step d) to determine the net gallons of product contained.

Note: Underground tanks are fabricated as production items. The tank manufacturer supplies charts intended to be used for all tanks of the same nominal dimensions and capacities. Depending on the fabricating method, these tanks are likely to vary by a fraction of an inch in diameter or length. Therefore, the charts cannot be considered as absolutely accurate, although the amount of inaccuracy is usually too minute to be of consequence.

Some long tanks are equipped with a gauge well at each end. These are installed for use if the tank settles unevenly with one end lower than the other. It is not necessary under ordinary circumstances to gauge through both wells. It would be advisable, however, to check occasionally to determine that the product is approximately at the same level in both gauge wells.

If the gauge well is in the center of the tank, settlement will not affect the accuracy of the gauge. If settlement occurs, however, the water will collect at the lower end and a water gauge taken at the center may not indicate the true condition.

The manufacturer's instructions should be followed and augmented as necessary with this recommended practice when automatic tank gauging systems are used to perform inventory control. To verify the accuracy of automatic tank gauging systems, tanks equipped with such devices should be periodically stick-gauged in accordance with this appendix.


Flow Control
Solenoid Valves
Dispenser
Splitter
Vapor Valve
Nozzle
Coaxial
Hose
Vent
Meter
Grade
Grade
Filter
Turbine
Pressure Equalization Hole
P1
Vapor
Liquid Product
Product Vapors
Liquid
Tank

APPENDIX D—WATER-GAUGING PROCEDURE

D.1 Checking for Water

A water-finding paste, which is unaffected by gasoline but will change color in water, is used to check for water at the bottom of storage tanks. Information on satisfactory paste may be obtained from the supplier. It is used as follows:

a. Coat the end of a gauge stick on the graduated side with a light, even film of the paste for approximately 3 inches.
b. Slowly insert the stick through the gauge hole until the stick reaches the bottom of the tank. Be sure that the stick is kept in a vertical position and that it does not rest on an obstruction or other projection on the tank bottom. Wait 1 to 2 seconds and slowly remove the stick.
c. Withdraw the stick and read the water cut (as noted by the change in the color of the paste) on the graduated scale to the nearest $^1/_8$ inch.
d. If the test shows 1 inch (or more) of water, make arrangements for the water's immediate removal and notify the product supplier. If the test shows water levels of 2 inches or more, the product should not be delivered until the water has been removed.
e. Refer to Appendix C for information on converting the gauge readings from inches to gallons of water. This conversion is required for proper inventory reconciliation.

For a more accurate measurement, API recommends an average of two gauge readings that fall within $^1/_4$ inch of each other. (See C.2).

Note: Occasionally, a submerged and/or suction pump will deliver water with the product, but no water will show when the tank is checked. This usually indicates that the tank is not level and the water has accumulated at the low end away from the gauge well. Similarly, a suction pump may dispense water with the product when there is an underground suction line leak and a high water table. Such a condition must be checked and corrected immediately. Some long tanks are equipped with a gauge well at each end and water may be found only under the lower end. A tank equipped with only a center gauge well may not show accumulated water if the tank is not level.

D.2 Acceptable Procedures For Removal of Water Accumulation

When water in the tank exceeds 1 inch, it should be removed. Removal may be accomplished with a low volume pump, using a length of 1-inch steel pipe inserted in the fill riser or gauge riser, whichever is at the lowest end of the tank. A small, hand operated rotary pump, air operated pump, or explosion-proof electric pump works well. The bottom of the suction pipe should be cut off square with a notch as shown in Figure D-1.

Note: Prior to performing these procedures, the authority having jurisdiction should be consulted concerning regulations pertaining to emission control and disposal and handling of the liquids generated.

If desired, the following procedures may be considered:

D.2.1 The water may be pumped from the tank to an approved container for transport to a recycling facility or an approved disposal site. The authority having jurisdiction should be consulted. In addition, refer to the EPA declaratory ruling concerning recycling of gasoline water mixtures.

Note: In a letter dated March 19, 1986, the U.S. EPA Office of Solid Waste, in response to a petition for a declaratory ruling and advisory opinion concerning 40 *Code of Federal Regulations* Part 261.33 (c); recycling of gasoline/water mixtures, writes, "gasoline/water mixture is considered a mixture which contains a commercial chemical product (CCP). CCPs that are reclaimed are not considered 'solid wastes' (i.e., it's not 'discarded' because it's normally a fuel and not being abandoned). Since hazardous waste is a subset of solid waste, this mixture is not defined as a hazardous waste (i.e., it must be a solid waste before it can be a hazardous waste). . . . Since the fuel oil-water mixture is not a solid and hazardous waste, this mixture is not subject to Federal regulation under the Resource Conservation and Recovery Act. This mixture may still be subject to state law and to the transportation rules promulgated by the Department of Transportation."

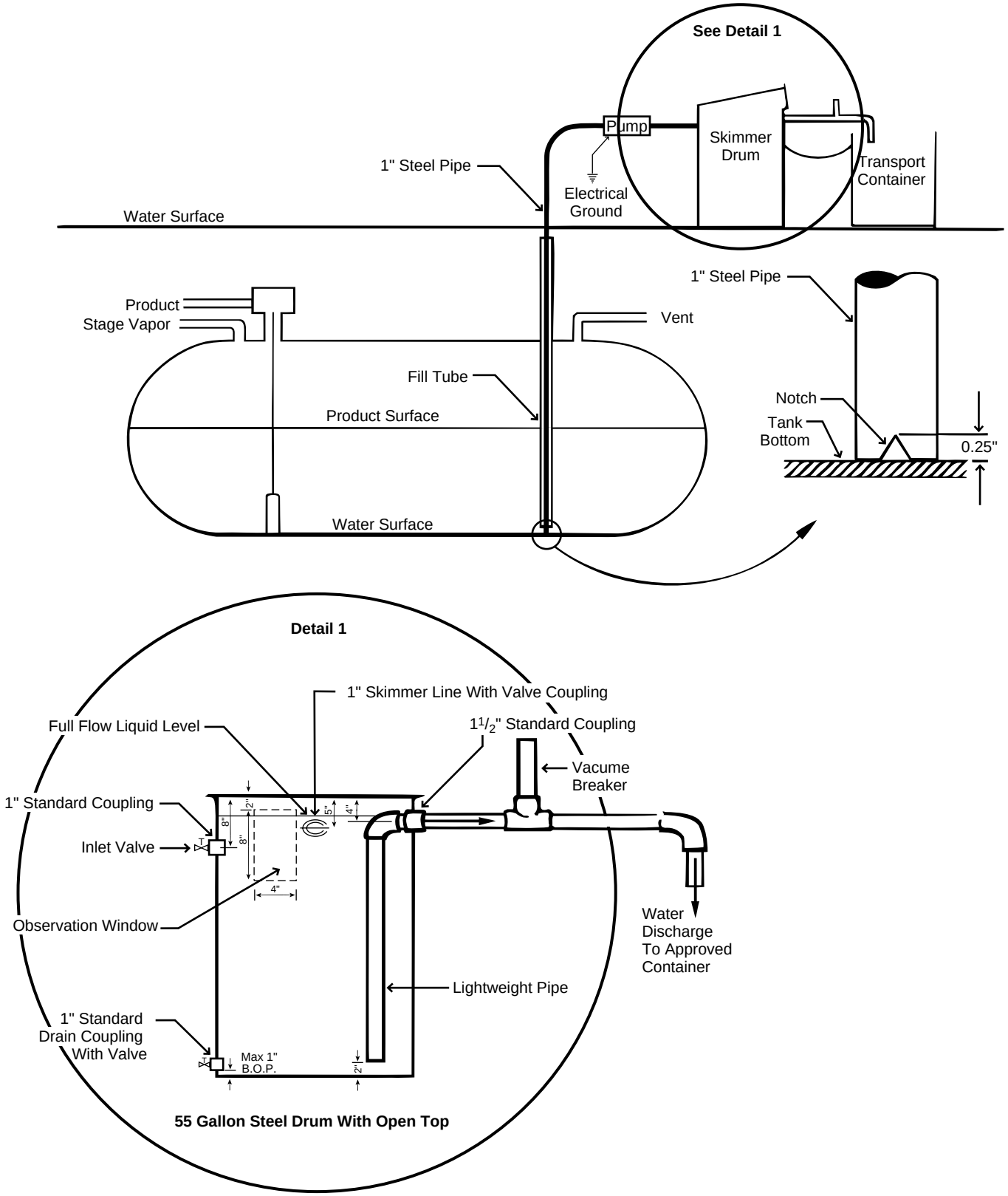
WARNING: Prior to starting the water removal process, electrical continuity must be provided between the pump, tank, and container in addition to a positive ground to ensure dissipation of potential static electric charges.

D.2.2 The water may be pumped from the tank, with the suction pipe at the bottom of the tank, into a 55 gallon steel drum. The drum can be converted for use as an oil skimmer as indicated in Figure D-1. The following procedures may be used when using the oil skimmer as detailed in Figure D-1:

a. Connect the water removal pump discharge hose to the inlet connection on the 55 gallon skimmer drum.
b. Fill the skimmer with water prior to starting the water removal process.
c. Prior to starting the water removal process, electrical continuity must be provided between the pump, tank, and drum, in addition to a positive ground (refer to NFPA 77).
d. Connect water discharge to a state or federally approved container that will be used to haul the contaminated water to an authorized recycling location or disposal site. Refer to federal, state and local regulations.
e. Start pumping the water from the tank. Adjust the inlet valve for a maximum pump flow rate of 5 gallons per minute. Reduce the flow if necessary to avoid overflowing the drum and to obtain better oil/water separation.
f. During the pumping operations, separated gasoline in the skimmer drum should not be allowed to exceed 2 inches in depth. Skim the gasoline into an approved container for return to the underground storage tank. Note that the container must be electrically grounded as identified in Item c above. The skimmer drum may be equipped with a 1 inch skimming line and valve placed through the side of the drum wall at 5 inches (centerline of the 1-inch pipe) below the top of the drum (see Figure D-1).
g. Upon completion of the water removal operation, all

product should be skimmed off the surface of the skimmer drum into an approved container and returned to the underground storage tank. The water phase in the drum should be transferred to an approved container for hauling to a recycling facility or to an approved disposal site. Check with the authority having jurisdiction for regulations pertaining to the removal, disposal and designation of a recyclable product. Again, refer to the EPA declaratory ruling concerning recycling of gasoline-water mixtures.

CAUTION: An open-top drum is recommended to observe operation and facilitate skimming. The drum top should be in place during normal pumping operations since flammable liquid/vapor may be on the surface of the separator drum. Therefore, ensure that all safety precautions are taken when performing this operation.



Note: Quick Disconnects May Be Installed At All External Pipe/Hose Connections

Figure 2 – Water Removal Procedure Using an Oil Skimmer

APPENDIX E—MANUAL TANK GAUGING RECORD RECONCILIATION FORM

MANUAL TANK GAUGING RECORD RECONCILIATION FORM

LOCATION: _____ TANK NO.: _____

ADDRESS: _____ CONTENTS: _____

_____ DATE: _____

	STICK READINGS (Inches)						
	DATE/TIME	1ST	2ND	SUM	AVERAGE	TANK CONVERSION (Gallons)	WEEKLY VARIATION (Gallons) (Test End Less Test Start)
WEEK 1 TEST START							
TEST END							
WEEK 2 TEST START							
TEST END							
WEEK 3 TEST START							
TEST END							
WEEK 4 TEST START							
TEST END							

TOTAL MONTHLY VARIATION (Add Weeks 1 Through 4) _____

MONTHLY AVERAGE VARIATION (Total/4) _____

Note:
1. Tank test must be done weekly; no product may be put in/removed during the test period. (See chart below for the required test period.)
2. The stick reading measurements must be an average of two stick readings (see C.2) to be considered valid for the test start and end.
3. See chart below for allowable monthly and weekly variations.

	ALLOWABLE VARIATION (Gallons)		
TANK SIZE (Gallons)	WEEKLY VARIATION	MONTHLY VARIATION	TEST PERIOD
If Manual Tank Gauging is the ONLY leak detection method used:			
550 or Less	10 Gallons	5 Gallons	36 Hours
551–1000[a] (When Largest Tank Is 64" x 73")	9 Gallons	4 Gallons	44 Hours
1000[a] (If Tank is 48" x 128")	12 Gallons	6 Gallons	58 Hours
If Manual Tank Gauging is combined with Tank Tightness Testing:			
551–1000	13 Gallons	7 Gallons	36 Hours
1001–2000	26 Gallons	13 Gallons	36 Hours

Does this week's variation exceed weekly allowable above? _____

Does variation of monthly average exceed monthly allowable shown? _____
(A "Yes" answer to either question should be reported as a suspected leak.)

[a]Refer to EPA reference document in 1.4 entitled *Straight Talk on Tanks*.

INSTRUCTIONS FOR THE MANUAL TANK GAUGING RECONCILIATION FORM

1. The tank should be gauged at the beginning and end of the test period.
2. No product can be added or removed from the tank during the test period.
3. The level of product must be measured at the start of the test period and again at the end using a gauge stick capable of measuring $^1/_8$-inch increments.
4. The EPA requires that the measurements must be an average of two stick readings to be considered valid. API recommendations for a more accurate measurement calls for an average of two readings that are within $^1/_4$ inch of each other. Refer to C.2.

Note: If the tank has received product less than 6 to 8 hours prior to the test start, erroneous results may be observed.

5. The test must be conducted once a week and averaged monthly.
6. The records must be maintained for a minimum of one year.
7. Variations in excess of the allowable variations should be reported to the implementing agency.

ATTENTION: The EPA requires that any suspected release be reported within 24 hours to the authority having jurisdiction when the cumulative sum of monthly overages and shortages exceeds 1 percent of product throughput plus 130 gallons for two consecutive months. State and local agencies may require more stringent standards and should be consulted.

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