November 2002
RG-399

Vapor Recovery Test Procedures Handbook

Field Operations Division

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Vapor Recovery Test Procedures Handbook

Prepared by
Field Operations Division

RG-399
November 2002

Authorization for use or reproduction of any original material contained in this publication—that is, not obtained from other sources—is freely granted. The commission would appreciate acknowledgment.

Copies of this publication are available for public use through the Texas State Library, other state depository libraries, and the TCEQ Library, in compliance with state depository law. For more information on TCEQ publications call 512/239-0028 or visit our Web site at:

http://www.tceq.state.tx.us/publications

Published and distributed
by the
Texas Commission on Environmental Quality
PO Box 13087
Austin TX 78711-3087

CONTENTS

FORMS

TABLES

FIGURES

Introduction

Vapor Recovery Testing in Texas

Efficient operation of vapor recovery systems is critical to the improvement of air quality across the state. This Handbook outlines procedures which must be followed in order to ensure accurate and consistent test results.

Background for Test Methods

All Stage II Vapor Recovery systems undergo two types of testing: Certification and Performance.

Certification Tests: Tests conducted at a model system to determine the actual VOC emission recovery efficiency of a vapor recovery system. This suite of tests are very intensive and result in the issuance of values for numerous operational parameters of a system. Such parameters include (but are not limited to) 1) Pressure Decay Parameters, 2) Piping/Nozzle back-pressure limits, 3) Maximum Gasoline Flow Rate, 4) Manifolding configuration, and for bootless nozzle assist systems, a Vapor Volume to Liquid Volume ratio based on flow. Successful completion of the above tests, as well as others, may result in the certification of a vapor recovery system and/or system components. Certifications issued by the California Air Resources Board (CARB) are known as Executive Orders.

Performance Tests: These are tests conducted on systems that have been installed per the requirements of an approved certification program. By successfully completing the appropriate tests immediately after installation and by the appropriate testing schedule thereafter, individual vapor recovery systems demonstrate an efficiency comparable to that of the original, certified system. The TCEQ considers an individual system to be of acceptable efficiency only if the performance tests result in values that demonstrate an efficiency equal or greater to those determined in the Certification Testing phase.

Texas requires that all systems meet the applicable performance testing standards as found in the respective test procedures of the “Vapor Recovery Test Procedures Handbook” as well as in the original system certification. The TCEQ reserves the right to invalidate any test results which are achieved through improper or incomplete application of these test procedures.

Suite of Performance Tests Required in Texas

TXP-101 Vapor Space Manifold Each certification describes the allowable manifolding scheme for a given installation. This test verifies that the vapor space of all tanks and vapor return piping are in agreement with the requirements given in the certification. This test is required of all systems and must be successfully completed at least once every 36 months.

TXP-102 Pressure Decay Determines leak tightness, an absolutely critical parameter for all systems. The CARB test procedures TP-201.3 (UST systems) and TP-201.3a (AST systems) are 5 inch water column, for 5 minute tests. TXP-102 requires pressurizing the system to two (2) inches water column. This 1) allows systems to be tested with P/V valves in place, 2) Results in fewer VOC emissions during the test, and 3) more closely approximates the actual in-use characteristics of the system. TXP-102 must be successfully completed at least once every 12 months.

TXP-103	**Dynamic Back-Pressure**	Verifies pipe sloping and tests for vapor space obstructions. TXP-103 is required of all systems and must be successfully completed at least once every 36 months.
TXP-104	**Flow Rate Determination**	Verifies gasoline dispensing rate does not exceed the criteria given in the system certification. Required of all systems that do not utilize correctly operating flow rate limiter devices. If applicable, TXP-104 must be successfully completed at least once every 12 months.
TXP-105	**Liquid Removal Device**	This test is used to determine the effectiveness of the liquid removal device for systems in which they are required (i.e., high-hang dispensers for balance systems, Amoco V1 assist system, etc). This test may also be conducted when a liquid blockage problem exists for a system whose underground piping has successfully passed the requisite dynamic back-pressure test criteria. If applicable, TXP-105 must be successfully completed at least once every 12 months.
TXP-106	**V/L Ratio**	This is a critical test for bootless assist systems. This procedure requires the use of an approved vapor volume meter, however, other measuring devices approved by the Executive Director may be used in conjunction with alternative methods. **Note: Regardless of which method is used, procedure 7.4 of TXP-106, regarding the introduction of fuel to the vapor return line(s), must be followed**. If another approved method is used, results should be submitted using the form provided in TXP-106 (**Form 106-2**). TXP-106, or equivalent, must be successfully completed at least once every 12 months.
TXP-107	**Healy Booted Nozzle**	A test specific to the Healy booted assist system used to determine if the correct vacuum limits are met when booted Healy Systems are operating. It is an alternative to the 'hypodermic needle' test method for determining boot operational pressure. TXP-107 must be successfully completed at least once every 12 months for all Healy systems incorporating a booted nozzle.

PROPER TESTING AND REPORTING

Proper testing and reporting of systems in Texas currently involves three steps:

1) All required system performance tests must be conducted and successfully completed within 30 days of completion of system installation and once in every 12 month period (36 months for TXP-103) thereafter. A 10 working day pre-test notification to the appropriate TCEQ Regional office or local air pollution program is required prior to conducting the tests. Use a copy of the 'Stage II Vapor Recovery Pre-Test Notification Form' (TCEQ-10501) for this reporting (TCEQ Regional Office mailing addresses are found on page 2 of the form). If circumstances require that a planned test must be rescheduled, call the regional office or the local air pollution program office with jurisdiction as soon as possible and follow-up by submitting a revised Pre-Test Notification.

2) The appropriate tests for each vapor recovery system must be conducted and successfully completed. If multiple tests are attempted and a failing result is achieved for at least one, the system may be retested for any test(s) which failed no later than 30 days from the original test date. After 30 days, all originally attempted tests must again be conducted.

3) Recording and Reporting of the test results must be performed using the format specified by each test procedure. All test results, regardless of their outcome, must be submitted to the appropriate Regional Office of the TCEQ or local air pollution program within 10 working days after each test is conducted. Attach to the completed 'Vapor Recovery Test Procedure Cover Sheet' copies of all test result forms from each applicable test.

   Note that 30 Texas Administrative Code §115.246 requires that copies of all test results must be kept as part of on-site record keeping.

Copies of the Stage II Vapor Recovery Pre-Test Notification and Vapor Recovery Test Result Cover Sheet can be found on the following four pages. TCEQ mailing addresses and contact information are listed on page 2 of each form.

Stage II Vapor Recovery Pre-Test Notification

(NOTICE: Written notification must be received by TCEQ 10 working days in advance of the test. See reverse side for addresses.)

Notification Type and Test Purpose:

Notification Type (Check one): ☐ Original ☐ Revised ☐ Rescheduled ☐ Canceled

If revised, rescheduled or canceled, what was the original notification date?: ____________ Original test date?:____________

Test Purpose: ☐ Compliance ☐ Problem Resolution ☐ Other (Explain):____

If compliance, What type? ☐ Startup ☐ Annual ☐ Major Modification

Test(s) will begin on (date): __________________________ at (time): ____________________________

Test(s) of the Vapor Recovery System are to be conducted at the following location:

Facility Name: ____

Facility Address: ____

Facility City: ____

Facility Zip Code: ____________________________

Facility PST ID#: ____________________________

Directions to Facility (if needed): ____

____

Facility Vapor Recovery System Information:

Number of Gasoline Storage Tanks at the Facility: _____ ASTs _____ USTs Total number of gasoline nozzles: _____

Type of Stage I System: ☐ Coaxial ☐ Two Point

Type of Stage II System: ☐ Balance ☐ Booted Assist ☐ Bootless Assist CARB Executive Order: _______________

Test(s) to be Conducted at the Facility:

_____ TXP-101.1 Vapor Space Manifold _____ TXP-104.1 Flow Rate Determination _____ TXP-107.1 Healy Booted Nozzle

_____ TXP-102.1 Pressure Decay _____ TXP 105.1 Liquid Removal Device _____ CARB TP-201.5 A/L Ratio

_____ TXP-103.1 Dynamic Back-Pressure _____ TXP-106.1 V/L Ratio

_____ Other (Explain): ____

Facility Contact Information:

Facility Contact Name: ______________________________________ Facility Phone: ______________________________

Facility Owner Name: ______________________________________ Owner Phone: ______________________________

Testing Contractor Information:

Test Company Name: ____ Phone: _____________________

Test Company Address: ____

Test Company City: ______________________________________ State: ___________ Zip Code: ___________________

Tester Name: ____

Phone or Pager Number at Which Person Conducting Test Can be Contacted: ____

Submitted By:

____

Printed Name Signature Date Signed

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

List of Contacts for Stage II Vapor Recovery Testing Information

Submit Test Notifications to the Regional Office with Jurisdiction

TCEQ Regional Office	Jurisdiction	Mailing Address	Phone and Fax Numbers
Region 4 - Dallas / Fort Worth	Counties: Collin, Dallas, Denton, Tarrant	TCEQ Attn: PST/Stage II Team 2301 Gravel Dr. Fort Worth, TX 76118-6951	Phone: (817) 588-5800 Fax: (817) 588-5703
Region 6 - El Paso	County: El Paso	TCEQ Attn: PST/Stage II Team 401 E. Franklin Ave., Ste. 560 El Paso, TX 79901-1206	Phone: (915) 834-4949 Fax: (915) 834-4940
Region 10 - Beaumont	Counties: Hardin, Jefferson, Orange	TCEQ Attn: PST/Stage II Team 3870 Eastex Fwy. Beaumont, TX 77703-1892	Phone: (409) 898-3838 Fax: (409) 892-2119
Region 12 - Houston	Counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller	TCEQ Attn: PST/Stage II Team 5425 Polk Ave., Ste. H Houston, TX 77023-1486	Phone: (713) 767-3642 Fax: (713) 767-3646

**** This portion of the form is provided for informational purposes only. Please do not submit this page with a Stage II Vapor Recovery Pre-Test Notification. ****

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Vapor Recovery Test Result Cover Sheet

(NOTICE: Submit Test Results to the appropriate TCEQ regional office, and local program with jurisdiction, within10 working days of test completion. See reverse side for addresses.)

Tests of the Vapor Recovery System were conducted at the following location:

Facility Name: ______________________________ Facility ID Number: ____________________

Facility Address: ____

Facility City: ________________________ State: ______ Zip Code: ____________________

Facility Phone: (______) _______ - _________________

Owner Name: ________________________ Phone Number: (______) _______ - _________________

Vapor Recovery System Installed:

System	UST or AST	Type of System[1]	Executive Order or Certification Number	Test Purpose[2]
Stage I			N/A	N/A
Stage II				

[1] Coaxial or Two-point for Stage I, Balance or Assist for Stage II.
[2] Test Purposes are: CI=Initial Compliance, CA=Annual Compliance, CM=After Major Modification, or 5Y=Five Year.

The Following Tests were Conducted at the Facility:

Test Procedure Number	Test Procedure Name	Date Tested	Name of Person(s) Conducting Test	Pass or Fail
TXP-101	Vapor Space Manifold			
TXP-102	Pressure Decay			
TXP-103	Dynamic Backpressure			
TXP-104	Flow Rate Determination			
TXP-105	Liquid Removal Device			
TXP-106	V/L Ratio			
TP 201.5	CARB A/L Ratio			
TXP-107	Healy Booted Nozzle			
Other: ____________________				

The tester arrived on-site at _____:______ (AM or PM) and departed at _____:_______ (AM or PM).

There are a total of ______ pages containing test results attached to this cover sheet.

I certify that the above tests, the results of which are attached to this cover sheet, were conducted in accordance with the test procedures as outlined in the Vapor Recovery Test Procedures Handbook, and that the results submitted here are true and correct to the best of my knowledge.

Signature of Test Contractor Responsible Party: ______________________________ Date: _____/_____/__________

Test Company Name: ______________________________ Phone Number: (______) _______ - _________________

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

List of Contacts for Stage II Vapor Recovery Testing Information

Submit Test Notifications to the Regional Office with Jurisdiction

TCEQ Regional Office	Jurisdiction	Mailing Address	Phone and Fax Numbers
Region 4 - Dallas / Fort Worth	Counties: Collin, Dallas, Denton, Tarrant	TCEQ Attn: PST/Stage II Team 2301 Gravel Dr. Fort Worth, TX 76118-6951	Phone: (817) 469-6750 Fax: (817) 795-2519
Region 6 - El Paso	County: El Paso	TCEQ Attn: PST/Stage II Team 401 E. Franklin Ave., Ste. 560 El Paso, TX 79901-1206	Phone: (915) 834-4949 Fax: (915) 834-4940
Region 10 - Beaumont	Counties: Hardin, Jefferson, Orange	TCEQ Attn: PST/Stage II Team 3870 Eastex Fwy., Ste. 110 Beaumont, TX 77703-1892	Phone: (409) 898-3838 Fax: (409) 892-2119
Region 12 - Houston	Counties: Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller	TCEQ Attn: PST/Stage II Team 5425 Polk Ave., Ste. H Houston, TX 77023-1486	Phone: (713) 767-3642 Fax: (713) 767-3646

**** This portion of the form is provided for informational purposes only. Please do not submit this page with a Stage II Vapor Recovery Pre-Test Notification. ****

TXP-101:
Determination of Vapor Space Manifolding of Vapor Recovery Systems at Gasoline Dispensing Facilities

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, "Control of Volatile Organic Compounds." To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is used to determine the actual as-built manifolding of all vapor space associated with petroleum storage tank(s) and piping at a gasoline dispensing facility (GDF). This test serves two important purposes:

(1)To verify by test that the piping manifolding scheme meets the requirements given in the initial system certification, and ;

(2)To facilitate the execution of required performance tests related to pressure decay and dynamic back-pressure.

This test procedure is applicable to all installations of balance and assist systems at GDFs utilizing Underground Storage Tank Systems (USTs) or Aboveground Storage Tank Systems (ASTs).

Note: This test may be run concurrently with the pressure decay test (TXP-102) and/or the Dynamic Back-Pressure Test (TXP-103) when either of these two tests are conducted. Regardless of wether this test is run concurrently with either TXP-102 or TXP-103, report the manifolding portion of the test on the forms (**Form 101-1** and **Form 101-2**) for this procedure.

2 PRINCIPLE AND SUMMARY OF THE TEST PROCEDURE

The purpose of this test procedure is to determine actual vapor space manifolding at GDFs. By flowing dry nitrogen through each vapor recovery nozzle (for balance systems), or riser at each dispenser (for assist systems), and through each vent line, then subsequently depressing each Stage I vapor connection dry break to locate flowing nitrogen, it is possible to determine the basic vapor-space manifolding configuration.

3 BIASES AND INTERFERENCES

It may be necessary to cap off the storage tank vent riser prior to conducting the test. If capping of the vent risers is determined to be necessary, the installation of a pressure relief valve set to relieve pressures greater than 1 psi must be installed on the storage tank vent riser prior to conducting the test. Ordinarily, the existing P/V valves should permit the system to be pressurized appropriately.

4 SENSITIVITY, RANGE, AND PRECISION

Not applicable.

5 EQUIPMENT

5.1 Nitrogen Pressure Drop Test Unit

See **Figure 101-1**.

Use a fill pipe known to be compatible with all vapor recovery nozzles and equipped with a pressure tap, or a test fitting which connects to a standard test port or vapor recovery riser.

Use a high pressure nitrogen cylinder rated at 2500 psig and equipped with a compatible two-stage pressure regulator. Use commercial grade nitrogen. Note that the nitrogen cylinder must be properly grounded (for safety reasons) prior to flowing nitrogen into any portion of the vapor space.

5.2 Rotameters(s)

Use a calibrated rotameter capable of accurately measuring nitrogen flow rates of 40, 60, 80, and 100 CFH and equipped with a flow control valve.

5.3 Pressure gauge(s)

For the nitrogen pressure drop test unit (**Figure 101-1**), use two Magnehelic differential pressure gauges, or equivalent, with appropriate ranges, and equipped with toggle valves connected to the high pressure inlets.

For all procedures, appropriate gauge ranges are:

0.0 to 2.0 inches Water Column (WC)
0.0 to 5.0 inches WC

5.4 Hand Pump

Use a gasoline compatible hand pump to drain condensate pots (where applicable).

6 CALIBRATION PROCEDURE

6.1 Verify that there are no leaks in the test apparatus (see **Figure 101-1**). This may be done by plugging the nozzle end of the auto fill pipe, opening the nitrogen cylinder and toggling valves on the magnehelic gauges. Then adjust the flow meter control valve until a pressure of 50 percent of full scale is indicated on the high range pressure gauge. Close the nitrogen cylinder valve and toggle valves. A pressure decay of 0.2 inches WC in five (5) minutes is considered acceptable.

7 PRE-TEST PROTOCOL

7.1 Check Facility Operating Mode

7.1.1 Assemble the apparatus as shown in **Figure 101-1**.

7.1.2 For installations utilizing condensate pots, drain the pots prior to testing if gasoline in the pots will result in a liquid blockage of the vapor path.

7.1.3 Remove the dust cover from the Stage I vapor connection dry break valve(s). Prop open the Stage I vapor connection dry break of the appropriate storage tank system prior to flowing nitrogen for the test. The dry break must be propped open in such a manner that no damage is done to the poppet valve or seal. As an alternative, only depress the poppet valve when actually ready to determine the presence of nitrogen flowing into the storage tank.

7.1.4 Use appropriate safety precautions at every stage of testing. At a minimum, verify that no ignition sources are present near the Stage I dry break while it is propped open, or while liquid gasoline is present.

8 TEST PROCEDURE

8.1 All Systems

8.1.1 For balance systems, insert the vapor recovery nozzle into the fill pipe of the nitrogen pressure drop test assembly, assuring that the fill pipe/nozzle interface is sealed tightly. Insure that the riser shut-off valve on the test equipment is closed.

For assist systems, cap off the fill pipe of the nitrogen pressure drop test assembly and connect the assembly to the vapor recovery test port or riser in the dispenser.

8.1.2 Close both toggle valves and connect the nitrogen supply.

8.1.3 Open the nitrogen supply, set the delivery pressure to 3-5 psig, and use the flowmeter control valve to adjust the flow rate to 100 CFH.

8.1.4 Verify that nitrogen is flowing from the dispenser through the vapor return piping to the appropriate Stage I dry break via the gasoline product tank. Determine if vapor is flowing through each of the other storage tanks Stage I poppet valves in succession. Record the presence or lack of nitrogen flow on the data sheet shown in **Form 101-1a**.

8.1.5 Repeat steps 8.1.1 through 8.1.4 for each dispenser or vapor return riser at the facility.

8.1.6 Repeat steps 8.1.1 through 8.1.4 for each atmospheric vent pipe from each storage tank. If each vent pipe is not equipped with a tap or quick-connect, this test will require that the P/V valves be removed. If desired, this test may be conducted during the back-pressure test so that removal of the P/V valves is minimized.

9 QUALITY ASSURANCE/QUALITY CONTROL

This section reserved for future specifications.

10 RECORDING DATA

Form 101-1a and **Form 101-1b** are the field data sheets for use with this procedure.

Form 101-1a:

This sheet is used to record the data collected during the test. Attach additional sheets as needed.

Form 101-1b:

Sketch the layout of the facility. The sketch must at a minimum include:

1) Location and number of each storage tank, its type (UST or AST), the product and grade of product it contains, and its number (e.g. Tank #2, UST, Premium),

2) Location and number of each dispensing nozzle,

3) Location of buildings, streets, and other major structures,

4) An arrow to depict North, and

5) A depiction of all vapor return and vent lines, including manifolds.

The facility sketch must be drawn so as to accurately depict the relative position of the tanks, pumps, buildings, etc. at the facility. Appropriate scale must be used to allow the entire facility to be drawn on one page.

11 CALCULATING RESULTS

No calculations required, just accurately determine vapor path from dispenser to storage tank(s), and from storage tanks through atmospheric vent(s). Vapor flow through the system must be consistent with certification requirements for successful completion of this test.

12 REPORTING RESULTS

Report all results on **Form 101-1a**.

13 ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, may only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to the applicable test procedure.

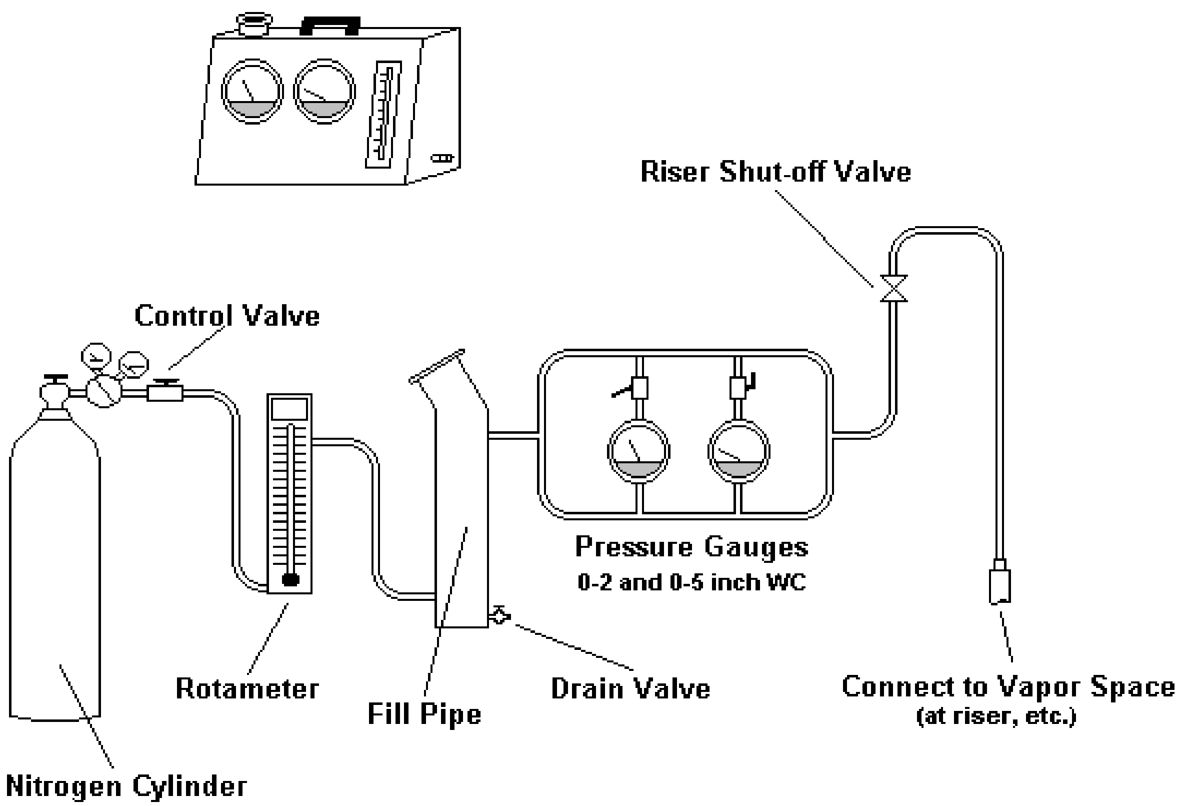
14 REFERENCES

None.

15 FIGURES

Figure 101-1 and Forms 101-1a and 101-1b are attached.

Figure 101-1:
Nitrogen Pressure Test Assembly



Form 101-1a:
Vapor Space Manifolding Test Report Form

Test Date: ___/___/______
Page ___ of ___

Facility Name: ________________________________ Facility ID Number: _______________________

Vent Number	System Manifold: ☐ Above-ground ☐ Below-ground				
	Storage Tank(s) to Which Vent is Connected or Manifolded				
	Tank#____ RU MU SU*	Tank#____ RU MU SU*	Tank#____ RU MU SU*	Tank#____ RU MU SU*	Tank#____ RU MU SU*

Nozzle Number	Product Grade	Storage Tank(s) to Which Vapor Return is Connected or Manifolded				
		Tank#____ RU MU SU*	Tank#____ RU MU SU*	Tank#____ RU MU SU*	Tank#____ RU MU SU*	Tank#____ RU MU SU*

* Circle Product Grade: RU = Regular Unleaded, MU = Midgrade or Plus, SU = Super Unleaded

Form 101-1b:
Facility Layout

Test Date: ___/___/______
Page ___ of ___

Facility Name: ________________________________ Facility ID Number: ______________________

Facility Layout: Include the location and number of all tanks, nozzles, and dispensers as well as basic vapor piping layout and manifolding scheme. Also denote the relative position of all buildings and adjacent street name(s), an arrow pointing north, and a scale.

TXP-102:
Determination of Static Pressure Performance (Pressure Decay) of Vapor Recovery Systems at Gasoline Dispensing Facilities

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, “Control of Volatile Organic Compounds.” To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is applicable to all underground storage tank (UST) and above ground storage tank (AST) systems.

Excessive leaks in the vapor recovery system will increase the quantity of fugitive hydrocarbon emissions and lower the overall efficiencies of both the Stage I and Stage II vapor recovery systems. This test procedure is used to quantify the vapor tightness of any vapor recovery system installed at a gasoline dispensing facility (GDF).

The compliance standard of static pressure performance for a system is initially determined during the certification phase of a model system. This test procedure is used to determine compliance with the static pressure performance standard of a vapor recovery system after the system is installed at a GDF.

2 PRINCIPLE AND SUMMARY OF THE TEST PROCEDURE

The entire vapor recovery system is pressurized, with nitrogen, to two (2.0) inches water column (WC). The system is then allowed to decay and the pressure after five (5) minutes is compared with an allowable value. The allowable five-minute final pressure is based on the system ullage and pressure decay equations. For the purpose of compliance determination, this test must only be conducted after all back-filling, paving, and installation of all Stage I and Stage II components, including P/V valves, has been completed.

3 BIASES AND INTERFERENCES

3.1 Nitrogen Flow Rates

Introduction of nitrogen into the system at flow rates exceeding five (5) CFM (300 CFH) may bias the results toward non-compliance. This requires the use of a flow meter together with the nitrogen pressure gauge when delivering the nitrogen into the vapor space.

3.2 Considerations for Assist Systems

3.2.1 For vacuum-assist Stage II systems which utilize an incinerator, the processor or collection device must be isolated and the vapor system/incinerator connection capped. If this is not done, leakage at this point may erroneously indicate a system component leak.

3.2.2 For vacuum-assist systems which locate the vacuum producing device in-line, between the Stage II vapor riser and the storage tank, the following shall apply:

3.2.2.1 A valve must be installed at the vacuum producing device. When closed, this valve must isolate the vapor passage downstream of the vacuum producing device.

3.2.2.2 The storage tank side of the vacuum producing device must be tested in accordance with these procedures. Compliance must be determined by comparing the final five-minute pressure with the allowable minimum five-minute final pressure from the first column (1-6 affected nozzles) in **Table 102-2** or use the corresponding equation in section 9.2.

3.2.2.3 The upstream vapor passage (nozzle to vacuum producing device) must also be tested.

4 SENSITIVITY, RANGE, AND PRECISION

4.1 Pressure Gauges/Measuring Devices

4.1.1 If mechanical pressure gauges are employed, the full-scale range of the pressure gauges must be 0.0-2.0, and 0.0-5.0 inches of water column. Maximum incremental graduations of the pressure gauges must be two hundredths (0.02) inch water column for the 0-2 inch gauge, and one-tenth (0.10) of an inch water column for the 0-5 inch gauge. The minimum accuracy of the gauges must be two percent of full scale. The minimum diameter of the pressure gauge face must be four (4) inches.

4.1.2 If an electronic pressure measuring device is used, the full-scale range of the device must not exceed 0-10 inches of water column. Maximum graduations must be one hundredths (0.01) inch water column. The minimum accuracy of this device must be 0.5 percent of full-scale.

4.2 Ullage Requirements

4.2.1 The minimum ullage must be the greater of 25 percent of the manifolded tank capacity or 500 gallons (300 in the case of ASTs), while the maximum total manifolded ullage must not exceed 25,000 gallons (See **Figure 102-1**).

4.3 Nitrogen feed rates

4.3.1 The minimum and maximum nitrogen feed-rates, into the system, must be one (1) and five (5) cubic feet per minute (CFM), respectively. These requirements permit a rapid equilibrium of nitrogen and gasoline vaporization in the ullage space in the minimum amount of time. Loading the vapor space too quickly will result in potential growth/shrinkage problems that will bias the test.

5 EQUIPMENT

5.1 Nitrogen

5.1.1 Use commercial grade nitrogen in a high pressure cylinder (rated at 2500 psig), equipped with a two-stage pressure regulator and a one psig pressure release valve.

5.2 Pressure Measuring Device

5.2.1 Use 0-5 and 0-2 inches water column pressure gauges connected in parallel, a 0.0-5.0 inches water column manometer or an electronic (0-10" WC) pressure measuring device to monitor the pressure decay in the vapor recovery system. The pressure measuring device, will at a minimum, be readable to the nearest two hundredths of an inch (0.02 for the 0-2" WC gauge, or 0.1" WC for the 0-5" gauge) water column.

5.3 Connector Assemblies

5.3.1 "T" Connector Assembly. If the test is to be conducted through the vapor riser under a dispenser, configure the test assembly as shown in **Figure 102-2**.

5.3.2 Vapor Coupler Integrity Assembly. Assemble OPW 633-A and 633-B adapters, or equivalent, as shown in **Figure 102-3**. If the test is to be conducted at the storage tank Stage I vapor coupler, this assembly must be used prior to conducting the pressure decay test in order to verify the pressure integrity of the vapor poppet. The internal volume of this assembly must not exceed 0.1 cubic feet.

5.3.3 Vapor Coupler Test Assembly. Use a compatible OPW 634-B cap, or equivalent, equipped with a center probe to open the poppet, a pressure measuring device to monitor the pressure decay, and a connection for the introduction of the nitrogen into the system. See **Figure 102-4**.

5.4 Detectors and other Meters

5.4.1 Flowmeter. Use a Dwyer® flow meter, Model RMC-104, or equivalent, to determine the required pressure setting of the delivery pressure gauge on the nitrogen supply pressure regulator. This pressure must be set such that the nitrogen flow rate is between the 1.0 and 5.0 CFM (60-300 CFH). This flow meter should be connected in line between the pressure regulator and the fitting through which nitrogen is introduced into the vapor space. A Nitrogen Test Kit as shown in **Figure 102-7** would be an example of a proper configuration.

5.4.2 Combustible Gas Detector. A Bacharach Instrument Company®, Model 0023-7356, or equivalent, may be used to verify the pressure integrity of system components during this test. A spray bottle with soapy water may also serve to locate leaks.

5.4.4 Stopwatch. Use a stopwatch accurate to within 0.2 seconds.

5.4.5 Plastic bags. A leak free plastic bag of at least 2 gallons with a wall thickness suitable to easily contain 1 inch water column more pressure than the rated cracking pressure of the installed P/V valve(s) without rupturing must be used. This bag is to be leak tight, and will be used to encase the vent P/V valves during the P/V cracking pressure portion of this test. A plastic bag will be required for each P/V valve.

6 Calibration Procedure

6.1 Pressure Measuring Devices

6.1.1 The pressure gauge must be calibrated using either a reference gauge or incline manometer. Calibration must be performed at 20, 50 and 80 percent of full scale. Accuracy of the gauge must be within two percent at each of these calibration points. Calibration must be conducted at a minimum weekly, with records of all calibration maintained indefinitely. Calibration records must be available for inspection during each test. **Form 102-2** is provided as an example calibration table.

6.2 Determination of Pressure/Flow Rate Range

6.2.1 Use the flow meter to determine the nitrogen regulator delivery pressures which correspond to nitrogen flow rates of 1.0 and 5.0 CFM. These pressures define the allowable range of delivery pressures acceptable for this test procedure. Also record which regulator delivery pressure setting, and the corresponding nitrogen flow rate, will be used during the test for use in section 8 of this test method.

6.3 Determination of Ullage and Manifolding Status of the Vapor Recovery System

6.3.1 Measure the gallons of gasoline present in each underground storage tank and determine the actual capacity of each storage tank from facility records. Calculate the ullage space for each tank by subtracting the fuel volume (gallons) present from the actual tank capacity (gallons). Record the ullage for each tank in the appropriate columns of the data sheet in **Form 102-1**. Determine the vapor space manifolding status via Test Procedure TXP-101. Determine the total ullage of the manifolded vapor space by adding the ullage of each manifolded tank. Record this value in the appropriate location in the data form for this procedure, **Form 102-1**.

6.3.2 The minimum ullage (including all manifolded tanks) during the test must be 25 percent of the tank capacity or 500 gallons (300 in the case of ASTs), whichever is greater. The total ullage must not exceed 25,000 gallons.

6.4 Determination of Approximate Time Required to Pressurize the System to 2 inches water column

6.4.1 Utilize the total ullage volume to be tested obtained in 6.3.1 above together with the appropriate equation of Section 9.3 to calculate the time required to pressure the system to 2 inches water column. The method to determine time-to-pressurize is designed to assist the tester by providing a rough gauge of system tightness. Generally, taking more than two times the calculated time to pressurize indicates that there are leaks in the vapor space that will result in the actual pressure decay test failing. This will allow the tester to minimize the quantity of nitrogen introduced into those systems which cannot comply with the pressure decay standards due to leaks in the system.

7 PRE-TEST PROTOCOL

7.1 Check Facility Operating Mode

7.1.1 Safety Considerations. General safety precautions apply in addition to the following:

7.7.1.1 Only nitrogen must be used to pressurize the system. The nitrogen delivery vessel must be suitably electrically grounded to prevent static electricity sparks when flowing nitrogen into the vapor recovery vapor space of the GDF.

7.1.1.2 A one (1) psig relief valve must be installed to prevent the possible over pressurizing of the storage tank.

7.1.2 No product flow preceding or during testing. Product dispensing must not take place during, or for the 30 minutes preceding the test, nor shall there be any bulk deliveries into or out of the storage tank(s) being tested within three (3) hours prior to the test or during the test. Record the date and time of the most recent gasoline delivery on the data sheet for this test procedure. It is recommended that the waiting period be used to check for and repair obvious vapor leaks.

7.1.3 Verify ullage. The minimum ullage during the test must be 25 percent of the (combined) tank capacity or 500 gallons (300 in the case of ASTs), which ever is greater. The total ullage must not exceed 25,000 gallons.

7.1.4 Dust Caps. Dust caps from all fillports and Stage I vapor couplers must be removed prior to testing. This is necessary to insure the vapor tightness of the drop tube(s) and the Stage I poppet valve(s).

7.1.5 Lubrication. Only aerosol or pump-spray lubricants may be used on vapor recovery system components. The use of heavy oil, grease, liquid silicone, etc. is prohibited. If a component will not pass the applicable test with an aerosol or pump-spray lubricant, then that component is considered faulty and must be repaired or replaced. This prohibition does not apply to threaded connections.

7.1.6 If an installed containment box is equipped with a drain valve, the valve assembly may be cleaned and lubricated prior to the test. This test must, however, be conducted with the drain valve installed and the manhole cover removed. In the case of AST systems, the vault containment box must be removed.

7.1.7 Verify that the liquid level in each storage tank is at least four (4) inches above the highest opening at the bottom of the submerged drop tube, and that the top of the drop tube opening is within six (6) inches or less of the tank bottom.

7.2 Determination of proper Pressure/Vacuum (P/V) valve operation

7.2.1 For each P/V valve installed in the system with a rated cracking pressure of at least 2.5 inches water column, the following shall apply:

7.2.1.1 Install a plastic bag on each vent riser in such a manner as to completely encase each P/V valve, and be secure around the vent riser at a location at least 4 inches below the P/V valve connection. The plastic bag must be attached to the riser in such a manner as to be leak tight. If the P/V valve cannot be seen from the ground, the system may be tested without the bag (see Section 8.1.1.1.1).

7.2.1.2 The actual test of the P/V valve will be accomplished in Section 8 below.

7.3 Location of test considerations

7.3.1 The following shall apply when testing at the dispenser:

7.3.1.1 Install the “T” connector (see **Figure 102-2**) to the vapor riser inside the dispenser. For those systems utilizing a vapor valve, such as some assist systems, the “T” connector assembly may be connected to the vapor riser inside the dispenser. Connect the nitrogen supply (do not use air or any gas other than nitrogen) and pressure measuring device to the “T” connecter.

7.3.1.2 Due to the excessive back-pressure that may be created in the vapor return line at nitrogen flow rates ranging between 1.0 and 5.0 CFM, it may, in most cases, be necessary to connect the pressure measuring device to another vapor recovery riser, vapor coupler adapter, functional element of the submersible pump, or a quick-connect tap on the vent line in order to obtain the exact pressure at which the P/V valve cracks.

7.3.2 The test may not be conducted at the Stage I vapor coupler if the Stage I system utilizes a coaxial Stage I vapor coupler. If this is the case, the test must be conducted from a dispenser riser.

7.3.3 The following shall apply when testing the Stage I Vapor Coupling of a two-point Stage I system:

7.3.3.1 Connect the Vapor Coupler Integrity Assembly to the Stage I vapor coupler.

7.3.3.2 Connect the Vapor Coupler Test Assembly.

7.3.3.4 Carefully pressurize the internal volume of the assembly to one (1.0) inch water column.

7.3.3.5 Start the stopwatch. Record the pressure after one minute.

7.3.3.6 If the pressure after one minute is less than 0.2 inches water column, the leak rate through the Stage I vapor coupling poppet precludes conducting the static leak test at this location. If the pressure after one minute is greater than or equal to 0.2 inches water column, the pressure decay test may be conducted at this location. This criteria assures a maximum leak rate through the vapor coupler poppet of less than 0.0002 cubic feet per minute.

7.3.3.7 Disconnect the Vapor Coupler Integrity Assembly from the Stage I vapor coupler. If the requirements of subsection 7.3.3.6 were met, install the Vapor Coupler Test Assembly to the Stage I vapor coupler.

7.3.3.8 The integrity of the Stage I vapor coupler may also be confirmed by using leak detection solution following step 8.2.3. If the vapor coupler is found to be faulty using this method, it must be replaced, the system must be repressurized, and the integrity of the new vapor coupler must be confirmed with leak detection solution.

7.4 Verify that the pressure test device is leak tight

7.4.1 Check the test equipment using leak detection solution or a combustible gas detector to verify that all test equipment is leak tight.

8 TEST PROCEDURE

8.1 Pressurize the system

8.1.1 Open the nitrogen gas supply valve and set the regulator delivery pressure within the allowable range determined in Section 6.4, and start the stopwatch. Record the number of seconds needed for the system to reach 2.0 inches WC in **Form 102-1**. Continue to pressurize the vapor system to be tested as follows:

8.1.1.1 In the case of systems utilizing P/V valves rated to crack at no less than 2.5 inches WC the following shall apply:

8.1.1.1.1 The system must be pressurized until the (each) P/V valve cracks inflating the bag. If the P/V valve cannot be seen from **any** point on the ground, its cracking pressure may be determined in two ways:

8.1.1.1.1.1 1) The cracking pressure may be taken from the electronic or mechanical gauge provided that the testing equipment is configured in such a way to eliminate back-pressure on the gauge (as described in Section 7.3.1.2), or

8.1.1.1.1.2 2) The test may be performed by two people, with one person observing the P/V valve and the other observing the electronic or mechanical pressure gauge.

8.1.1.1.2 The actual cracking pressure as well as the manufacturers listed cracking pressure must be recorded in **Form 102-1** for each P/V valve. A P/V valve that fails to crack within the manufacturers stated cracking pressure limits must be considered faulty and must be replaced in order to continue the test. After replacement, retest the system. Use of the proper plastic bag should permit each P/V valve to be tested successfully.

8.1.1.1.3 After cracking all valves under pressure, close and disconnect the nitrogen supply and remove the bags from all P/V valves. The pressure of the system must then be allowed to drop back below the cracking pressure until a stable pressure of 2.1 inches water column or better is achieved. If a non-stable pressure condition occurs, flow nitrogen at the pressure and flow rate previously established until the pressure stabilizes at least 2.1 inches water column. It is critical to maintain the nitrogen flow until the pressure stabilizes, indicating temperature and vapor pressure stabilization in the tank(s).

8.1.2 If the time required to achieve the initial pressure of two inches water column exceeds twice the time computed in Section 6.4 above, consider searching the system for leaks prior to continuing, as it is an indication that there are sufficient leaks present to cause the test to fail.

8.2 Timing the Pressure Decay

8.2.1 If the requirements of section 8.1.2 are met, close and disconnect the nitrogen supply (if that has not already been completed) and remove the bags from the tank atmospheric vent P/V valves. Start the stopwatch when the pressure has decreased to the initial starting pressure of two (2.0) inches water column. This action (achieving 2.0 inches water column and the start of the stopwatch) begins the test.

8.2.2 At one minute intervals during the test, beginning at the initiation of the test as determined in 8.2.1 above, record the system pressure in **Form 102-1**. After five minutes, record the final system pressure. For balance systems, see **Table 102-1** (or the appropriate equation in section 9.1) or for assist systems, see **Table 102-2** (or the appropriate equation in section 9.2), and for all AST systems, see **Table 102-1** (1-6 nozzle column) or equation 9.1.1.1 to determine the acceptability of the final (five minute) system pressure results. For intermediate values of ullage in either **Table 102-1** or **Table 102-2**, linear interpolation may be employed. Compliance is determined by comparing the final 5 minute value to the appropriate tabular or calculated value for the system.

8.2.3 If the system failed to meet the criteria indicated in 8.2.2 above, repressurize the system and check all accessible vapor connections using leak detector solution or a combustible gas detector. If vapor leaks in the system are encountered they must be repaired prior to continuing the test. Potential sources of leaks include nozzle check valves, pressure/vacuum relief valves, tank monitor connections, containment box drain valve assemblies, and plumbing connections. Repeat section 8.1 and following until the system meets the criteria set out in section 8.2.2.

8.3 Completing the Test

8.3.1 If the test was performed through one or more Stage I poppets, remove the testing adapter and verify the tightness of the poppet(s) with leak detection solution or a combustible gas detector.

8.3.2 After successfully completing section 8.2 and 8.3.1 above, relieve the remaining system pressure (in a safe manner), remove the test assembly and reconnect the appropriate components.

8.3.3 If the vapor recovery system utilizes individual vapor return lines (vapor space for all grades are not manifolded), repeat the leak test for each separate subsystem.

8.4 Testing Healy Systems Utilizing a Central Vacuum Device

Note: This test requires the use of additional vacuum and pressure gauges. Use a gauge capable of accurately measuring vacuums in the range of 0-100" WC., The gauge~~s~~ must be calibrated weekly against a standard, and records of calibration must be maintained indefinitely.

Refer to **Figure 102-5** “Healy Vapor Return Leak Tightness Schematic” attached, or to the Figure 5-A of the same name in Executive Order G-70-70 AC.

Note: For Healy Assist systems, the portion of the vapor system downstream from the Multi-Jet or Mini-Jet (including storage tanks, Stage I risers, and atmospheric vents) must be tested utilizing the test procedures outlined in 8.1-8.3 above, and final pressure compared with equations in 9.1 or 9.2. Test the portion of the Healy system between the Multi-Jet/Mini-Jet and nozzles utilizing the procedures outlined as follows:

8.4.1 Connect 0-100" WC vacuum gauge at 1/4" plug location for vacuum test (see Dwg. 9001-111 at 1"Tee in vapor inlet line and end of 2" underground vapor return).

8.4.2 Turn on Multi-Jet/Mini-Jet by turning on any dispenser--hang nozzle to maintain Multi-Jet/Mini-Jet vacuum (all nozzles must be closed and remain closed throughout the test).

8.4.3 Observe the 0-100" WC gauge.

8.4.4 When the vacuum level becomes stable, close the 1" ball valve in the vapor inlet line and the 1/4" ball valve in the syphon line and observe 0-100" WC gauge with all nozzles closed. If a stable vacuum level is not achieved, or if the stable vacumm level is less than the required value listed in the system certification, turn off the Multi-Jet/Mini-Jet and check for problems before continuing. Potential problems include: high nozzle to Multi-Jet/Mini-Jet ratio, clogged or dirty screens, or faulty check valves.

8.4.5 Note the initial, stable vacuum level and start the stopwatch. Record the vacuum level at one minute intervals for five minutes.

8.4.6 Calculate the change in vacuum level by subtracting the final vacuum from the initial vacuum. Record this as the “change in vacuum” (ΔV) in the appropriate portion of **Form 102-1**. Estimate the total length of 2 inch diameter vapor return piping between the dispensers and the Multi-Jet/Mini-Jet. Use the following equation to calculate the “allowable vacuum change” or $A\Delta V$ and record the result:

$$A\Delta V = 800 / N$$

Where: $A\Delta V$ = allowable vacuum change.

N = the estimated length of vapor return piping in feet.

Note: if the GDF utilizes three inch diameter vapor piping, multiply the $A\Delta V$ by 0.5. This is based on an allowable leak rate of 0.08 gallons per minute.

If the observed change in vacuum (△V) is greater than the allowable change in vacuum (A△V), the vapor recovery system fails to meet the compliance standard. Make necessary repairs and repeat the test. If △V is less than A△V, then proceed to 8.4.7.

8.4.7 If the vapor recovery system utilizes more than one Multi-Jet/Mini-Jet subsystem, then repeat the test for each Multi-Jet/Mini-Jet.

> **NOTE: FOLLOWING THE TEST, MAKE SURE BOTH 1" BALL VALVE AND 1/4" BALL VALVE ARE OPEN FOR NORMAL SERVICE STATION OPERATION.**

9 CALCULATIONS

9.1 Critical Pressure Values for Balance Systems (and all systems with ASTs)

9.1.1 The allowable five minute final pressure, with an initial pressure of two inches of water column, must be calculated as follows:

9.1.1.1 $P_f = 2e^{-760.490/V}$ when $1 \leq N \leq 6$
9.1.1.2 $P_f = 2e^{-792.196/V}$ when $7 \leq N \leq 12$
9.1.1.3 $P_f = 2e^{-824.023/V}$ when $13 \leq N \leq 18$
9.1.1.4 $P_f = 2e^{-855.974/V}$ when $19 \leq N \leq 24$
9.1.1.5 $P_f = 2e^{-888.047/V}$ when $N \geq 24$

Where: N = The number of affected nozzles, i.e., the number of nozzles connected to the vapor space being tested. For manifolded systems, N equals the total number of nozzles whose vapor space is connected.

P_f = The minimum allowable five minute final pressure, inches water column.

V = The total ullage affected by the test, gallons.

e = A dimensionless constant, equal to 2.718.

2 = The initial starting pressure, inches water column.

9.2 Critical Pressure Values for Vacuum Assist Systems

9.2.1 The allowable five minute final pressure, with an initial pressure of two inches of water column, must be calculated as follows:

9.2.1.1 $P_f = 2e^{-500.887/V}$ when $1 \leq N \leq 6$
9.2.1.2 $P_f = 2e^{-531.614/V}$ when $7 \leq N \leq 12$
9.2.1.3 $P_f = 2e^{-562.455/V}$ when $13 \leq N \leq 18$
9.2.1.4 $P_f = 2e^{-593.412/V}$ when $19 \leq N \leq 24$
9.2.1.5 $P_f = 2e^{-624.483/V}$ when $N \geq 24$

Where: N = The number of affected nozzles, i.e., the number of nozzles connected to the vapor space being tested. For manifolded systems, N equals the total number of nozzles whose vapor space is connected.

P_f = The minimum allowable five minute final pressure, inches water column.

V = The total ullage affected by the test, gallons.

e = A dimensionless constant, equal to 2.718.

2 = The initial starting pressure, inches water column.

9.3 Minimum Time Required to Pressurize the System Ullage

9.3.1 The theoretical time required to pressurize the system ullage to two inches water column must be calculated as follows:

9.3.1.1

$$t1 = (V/(1522*F))*60$$

Where: t1 = The theoretical time required to pressurize the ullage to two inch water column, seconds.

V= The total ullage affected by the test, gallons.

F= The nitrogen flow rate into the system, CFM.

1522= Conversion factor for pressure and gallons.

10 RECORDING DATA

Record all information related to the test on **Form 102-1**.

11 REPORTING RESULTS

Report test results according to the information on **Form 102-1**.

12 ALTERNATIVE TEST PROCEDURES

12.1 Special Test Procedure Requests

Test procedures, other than specified above, must only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to this test procedure.

13 REFERENCES

California Air Resources Board, 1992. Draft TP-201.3 Determination of Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities. Workshop Drafts: Certification and Test Procedure for Vapor Recovery Systems., pp TP-201.3 1-TP-201.3 12.

14 FIGURES AND TABLES

Figures 102-1 through 102-6, Forms 102-1 and 102-2, and Tables 102-1 and 102-2 are attached.

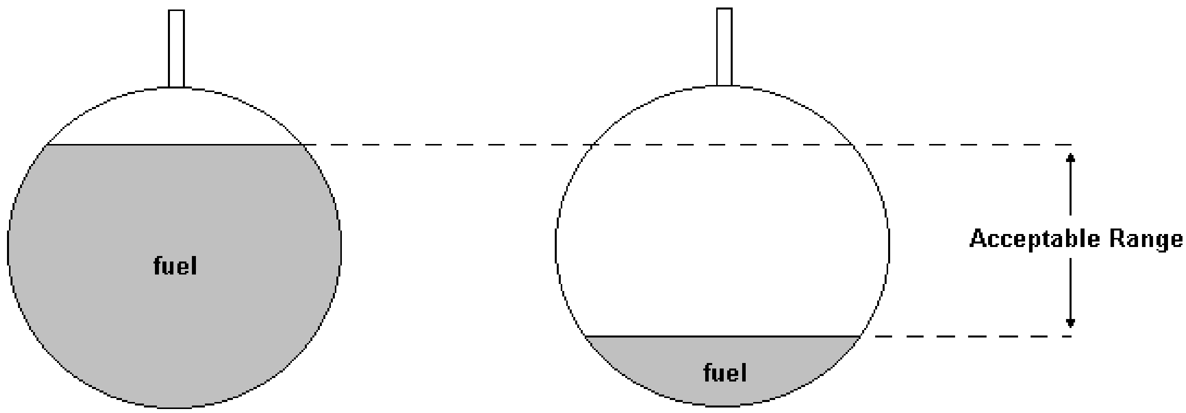
Table 102-1:
Minimum Pressure After 5 Minutes for Balance Systems and systems utilizing ASTs, Inches Water Column

Ullage (gallons)	Number of Affected Nozzles					Approximate Time to Pressurize at 5 CFM (in seconds)
	1-6	7-12	13-18	19-24	>24	
300 (AST only)	0.16	n/a	n/a	n/a	n/a	2
500	0.44	0.41	0.38	0.36	0.34	4
550	0.50	0.47	0.45	0.42	0.40	4
600	0.56	0.53	0.51	0.48	0.46	5
650	0.62	0.59	0.56	0.54	0.51	5
700	0.67	0.64	0.62	0.59	0.56	6
750	0.73	0.70	0.67	0.64	0.61	6
800	0.77	0.74	0.71	0.69	0.66	6
850	0.82	0.79	0.76	0.73	0.70	7
900	0.86	0.83	0.80	0.77	0.75	7
950	0.90	0.87	0.84	0.81	0.79	7
1000	0.93	0.91	0.88	0.85	0.82	8
1200	1.06	1.03	1.01	0.98	0.95	9
1400	1.16	1.14	1.11	1.09	1.06	11
1600	1.24	1.22	1.19	1.17	1.15	13
1800	1.31	1.29	1.27	1.24	1.22	14
2000	1.37	1.35	1.32	1.30	1.28	16
2200	1.42	1.40	1.38	1.36	1.34	17
2400	1.46	1.44	1.42	1.40	1.38	19
2600	1.49	1.47	1.46	1.44	1.42	20
2800	1.52	1.51	1.49	1.47	1.46	22
3000	1.55	1.54	1.52	1.50	1.49	24
3500	1.61	1.59	1.58	1.57	1.55	28
4000	1.65	1.64	1.63	1.61	1.60	32
4500	1.69	1.68	1.67	1.65	1.64	35
5000	1.72	1.71	1.70	1.69	1.67	39
6000	1.76	1.75	1.74	1.73	1.72	47
7000	1.79	1.79	1.78	1.77	1.76	55
8000	1.82	1.81	1.80	1.80	1.79	63
9000	1.84	1.83	1.83	1.82	1.81	71
10000	1.85	1.85	1.84	1.84	1.83	79
15000	1.90	1.90	1.89	1.89	1.89	118
20000	1.93	1.92	1.92	1.92	1.91	158
25000	1.94	1.94	1.94	1.93	1.93	197

Table 102-2:
Minimum Pressure After 5 Minutes for Assist Systems, Inches Water Column

Ullage (gallons)	Number of Affected Nozzles					Approximate Time to Pressurize at 5 CFM (in seconds)
	1-6	7-12	13-18	19-24	>24	
500	0.73	0.69	0.65	0.61	0.57	4
550	0.80	0.76	0.72	0.68	0.64	4
600	0.87	0.82	0.78	0.74	0.71	5
650	0.93	0.88	0.84	0.80	0.77	5
700	0.98	0.94	0.90	0.86	0.82	6
750	1.03	0.98	0.94	0.91	0.87	6
800	1.07	1.03	0.99	0.95	0.92	6
850	1.11	1.07	1.03	1.00	0.96	7
900	1.15	1.11	1.07	1.03	1.00	7
950	1.18	1.14	1.11	1.07	1.04	7
1000	1.21	1.18	1.14	1.10	1.07	8
1200	1.32	1.28	1.25	1.22	1.19	9
1400	1.40	1.37	1.34	1.31	1.28	11
1600	1.46	1.43	1.41	1.38	1.35	13
1800	1.51	1.49	1.46	1.44	1.41	14
2000	1.56	1.53	1.51	1.49	1.46	16
2200	1.59	1.57	1.55	1.53	1.51	17
2400	1.62	1.60	1.58	1.56	1.54	19
2600	1.65	1.63	1.61	1.59	1.57	20
2800	1.67	1.65	1.64	1.62	1.60	22
3000	1.69	1.68	1.66	1.64	1.62	24
3500	1.73	1.72	1.70	1.69	1.67	28
4000	1.76	1.75	1.74	1.72	1.71	32
4500	1.79	1.78	1.77	1.75	1.74	35
5000	1.81	1.80	1.79	1.78	1.77	39
6000	1.84	1.83	1.82	1.81	1.80	47
7000	1.86	1.85	1.85	1.84	1.83	55
8000	1.88	1.87	1.86	1.86	1.85	63
9000	1.89	1.89	1.88	1.87	1.87	71
10000	1.90	1.90	1.89	1.88	1.88	79
15000	1.93	1.93	1.93	1.92	1.92	118
20000	1.95	1.95	1.94	1.94	1.94	158
25000	1.96	1.96	1.96	1.95	1.95	197

Figure 102-1:
Ullage Requirements



Ullage must be greater than 25% of the total tank capacity or greater than 500 gallons (300 gallons for ASTs).

and

Ullage may be no more than 25,000 gallons.

Examples:
1) UST system capacity = 28,000 gallons
   Acceptable ullage range = 7,000 to 25,000 gallons

2) AST system capacity = 1,500 gallons
   Acceptable ullage range = 375 to 1,500 gallons

Figure 102-2:
"T" Connector Assembly

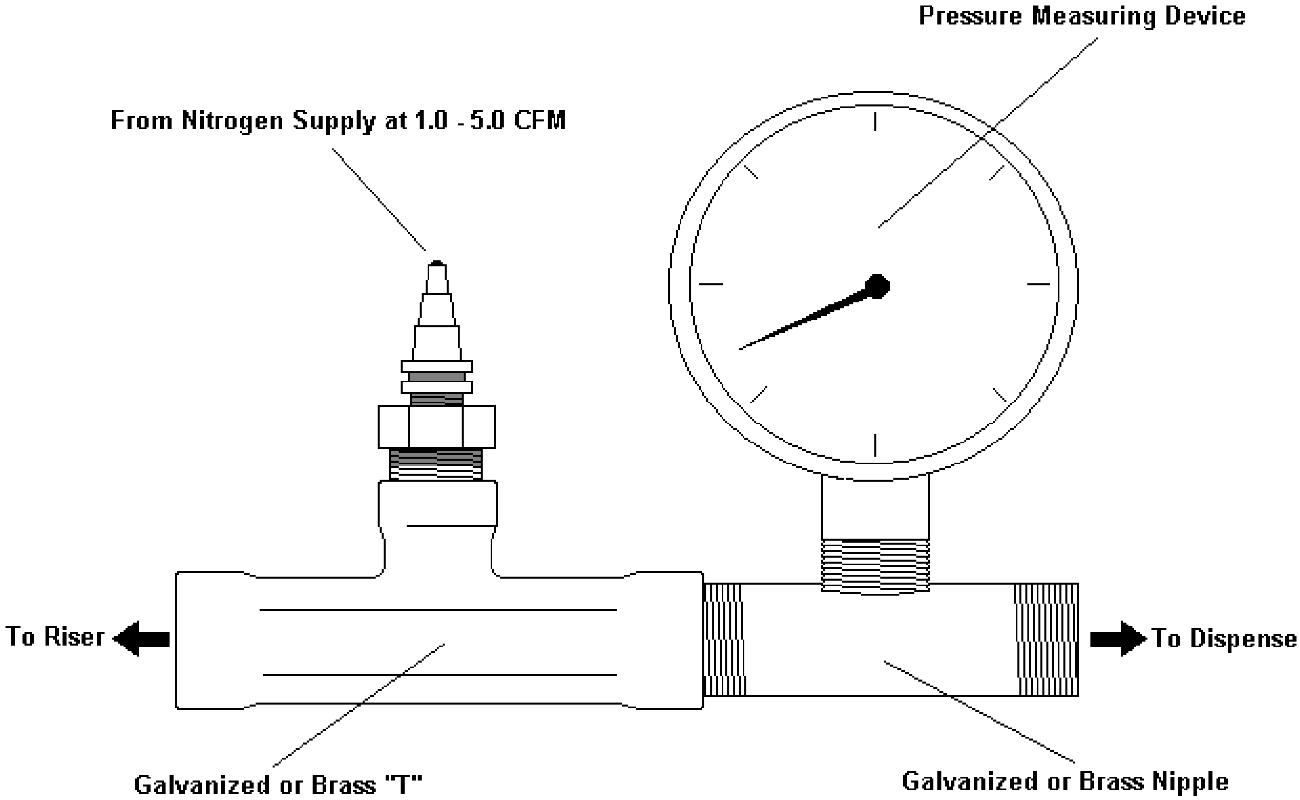
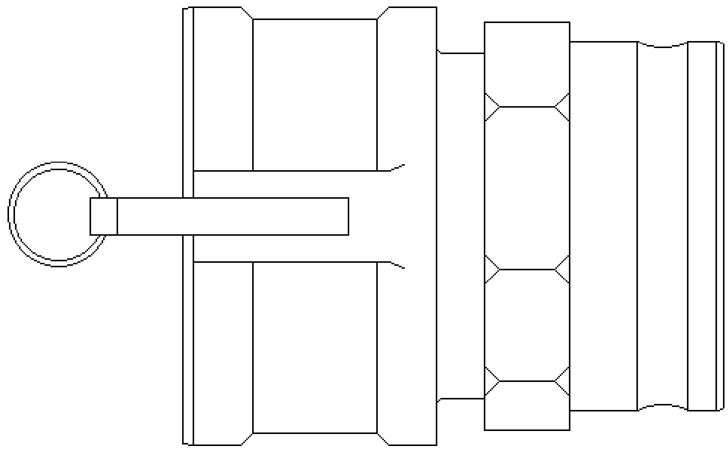
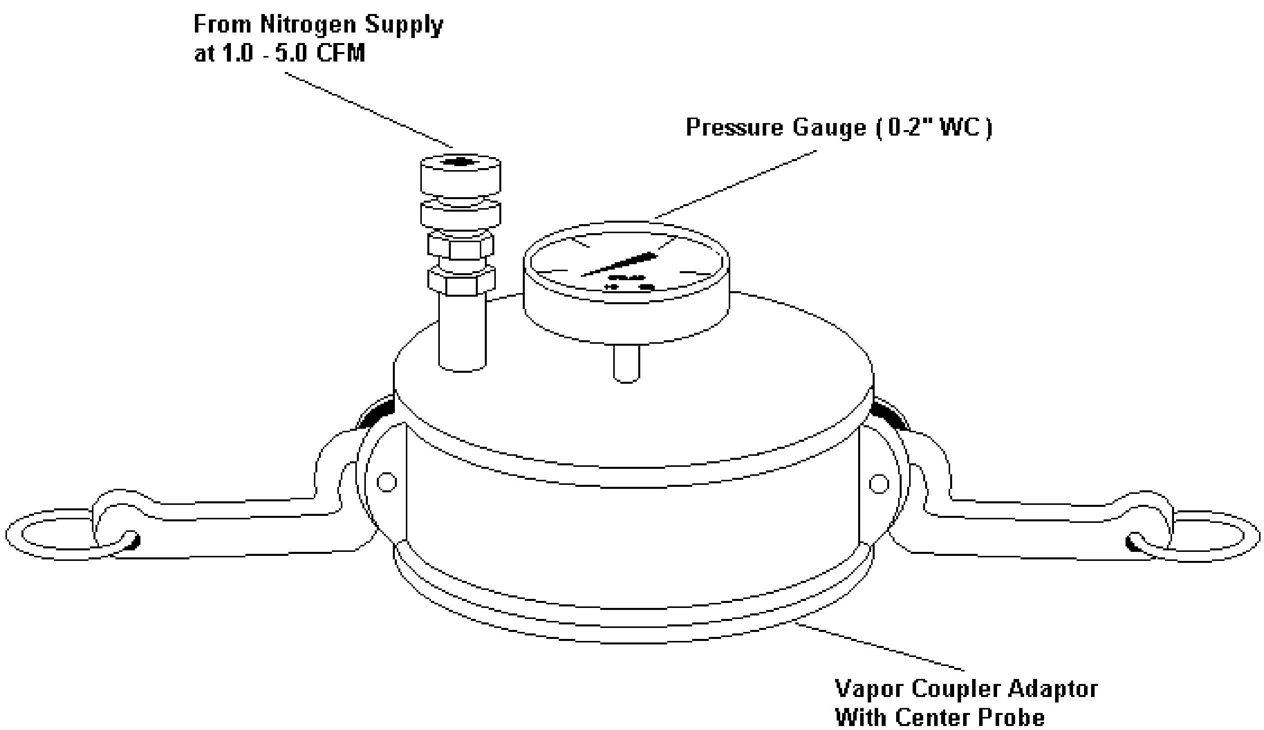


Figure 102-3:
Vapor Coupler Integrity Assembly



Male / Female Vapor Coupler Adaptor. Internal Volume less than 0.1 Ft^3

Figure 102-4:
Vapor Coupler Test Assembly



Form 102-1:
Pressure Decay Test Data

Test Date: ___/___/______
Page ___ of ___

Facility Name: ______________________ Facility ID Number: ____________

Test Company Name: ______________________

Type of Stage II System Installed: ______________ Executive Order: ____________

Describe Manifolding of System (if any): ______________________

Date and Time of Last Bulk Delivery / Removal : ___ / ___ / _______ @ ___ ___ : ___ ___

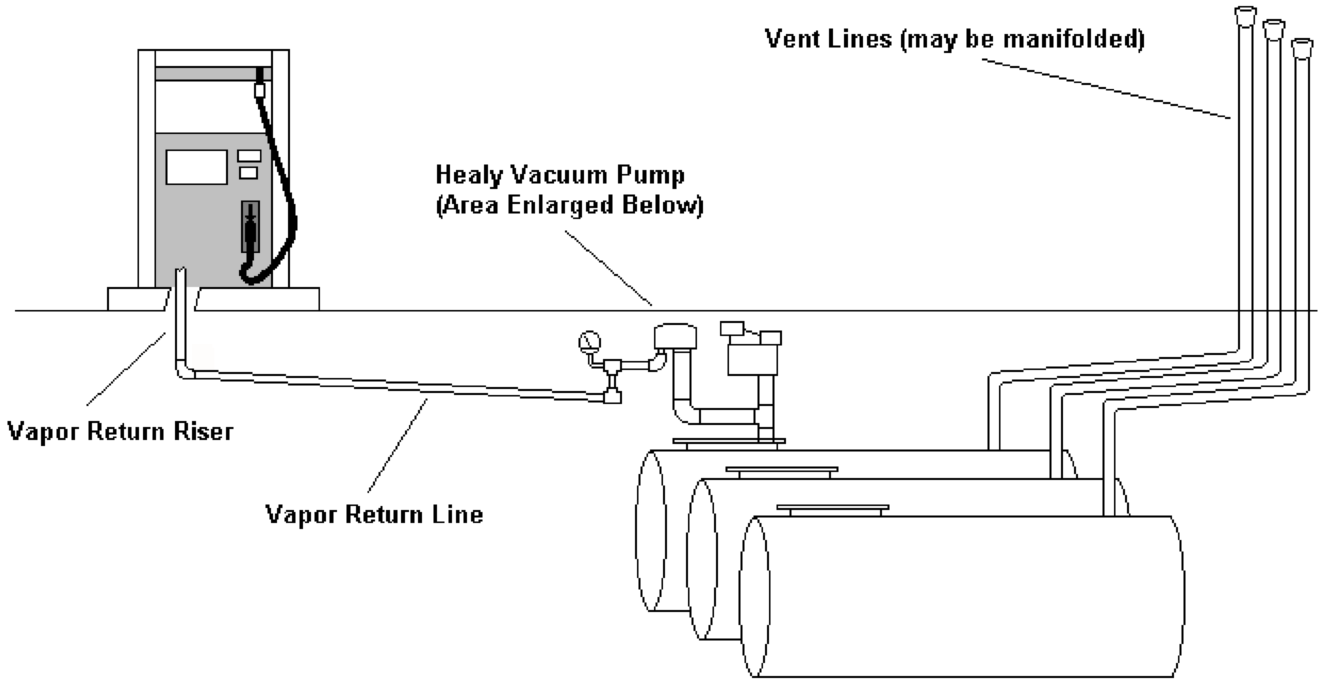
Time of Last Vehicle Refueling Prior to Test: ___ ___ : ___ ___ Time Test Began: ___ ___ : ___ ___

	Parameter (Indicate Manifolding by Circling Tank Numbers ➜)	**Tank Number** **1**	**2**	**3**	**4**	**Total**
1	Product Grade					
2	Type of Storage Tank (AST or UST)					
3	Actual Tank Capacity (gallons)					
4	Gasoline Volume (gallons)					
5	Ullage (gallons) (item 3 - item 4)					
6	Number of Nozzles w/ Vapor Return to Tank					
7	P/V Manufacturers Rated Cracking Pressure					
8	P/V Pressure When Cracking Began					
9	Time Required to Pressurize System (seconds)					
10	Nitrogen Flowrate Circle: **SCFM** or **SCFH**				Flowrate:	
11	Initial Pressure (Inches WC)					2.00
12	Pressure After 1 Minute (Inches WC)					
13	Pressure After 1 Minute (Inches WC)					
14	Pressure After 1 Minute (Inches WC)					
15	Pressure After 1 Minute (Inches WC)					
16	Pressure After 1 Minute (Inches WC)					
17	Allowable Final Pressure (from table or equation)*					
18	Healy Nozzle to Multi / Mini-Jet: Pass or Fail	ΔV= _____	Piping length= _____ ft.		AΔV= ____	
19	Test Result: Pass or Fail					

Comments (Include any equipment replaced and / or repairs made prior to or during the test): ____________

* Final regulatory compliance must be determined by using the appropriate equation in Section 9.2.

Figure 102-5:
Healy Vapor Return Leak Tightness Test Schematic
(for healy systems with central vacuum producing device)



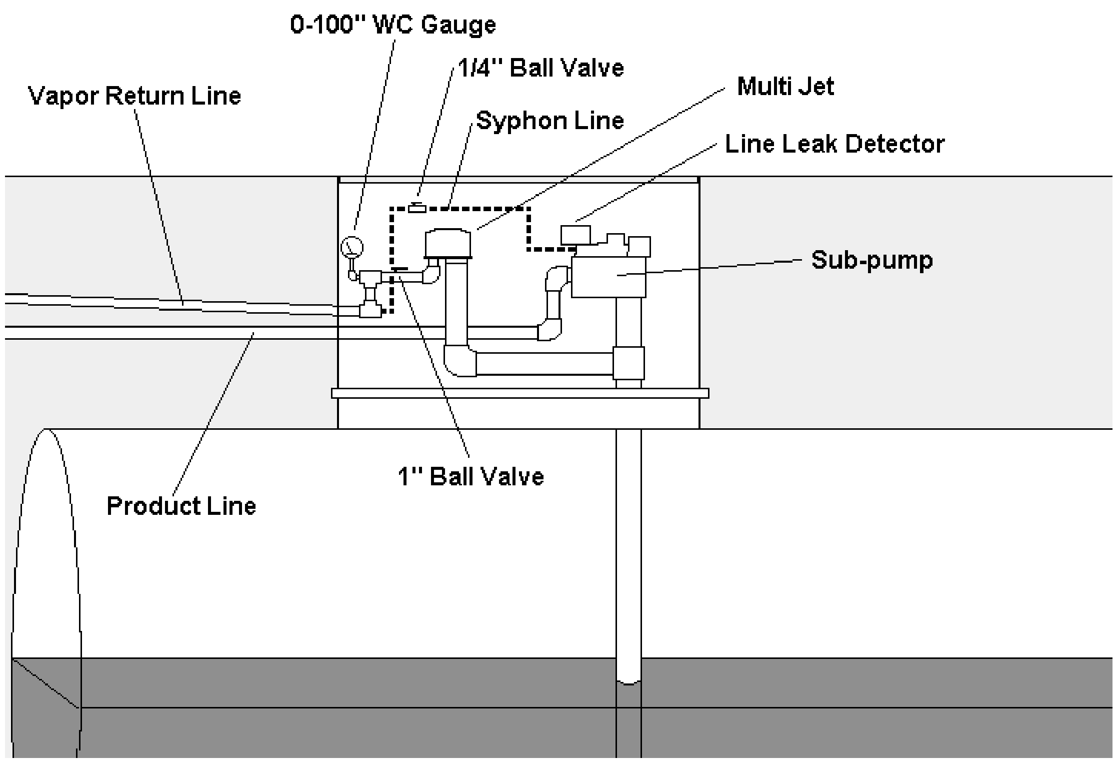
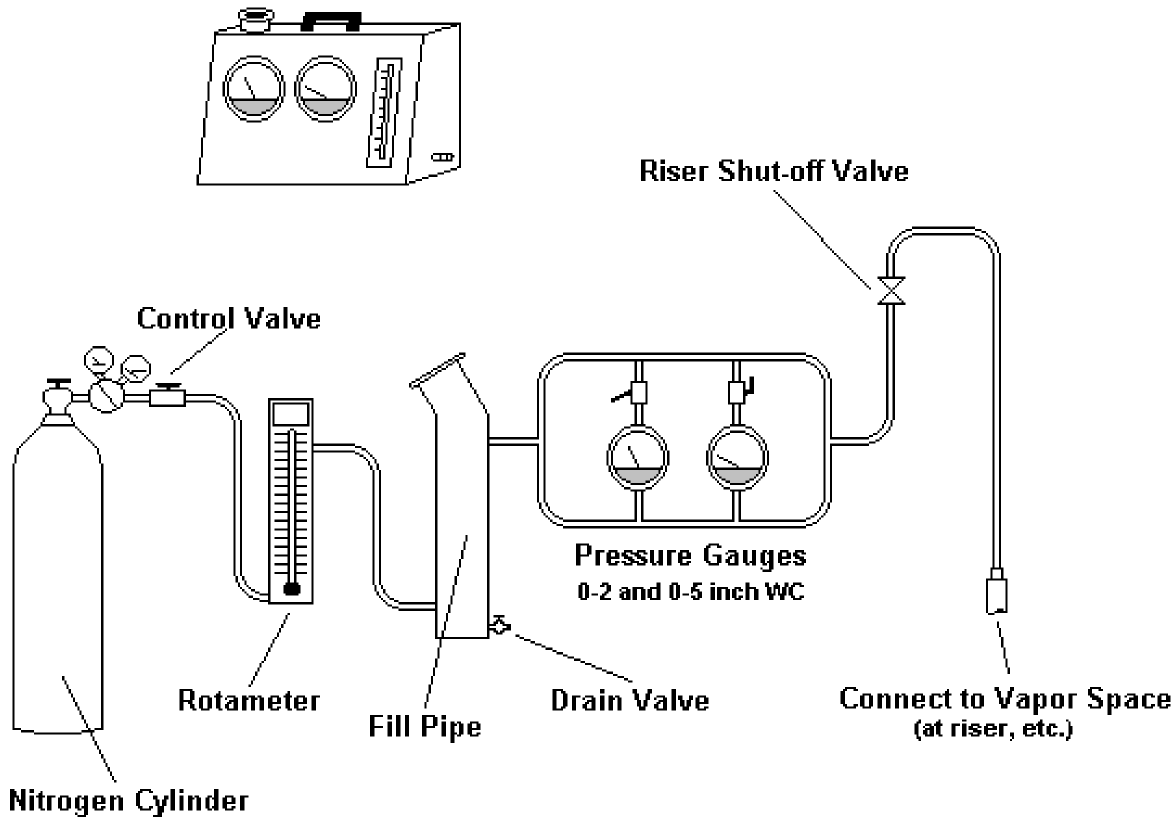


Figure 102-6:
Nitrogen Pressure Test Assembly



Form 102-2:
Pressure Gauge Calibration Form

DATE	0.0 - 2.0 inch Water Column Gauge				0.0 - 5.0 inch Water Column Gauge			
	% of Full Scale	Calibration Point	Acceptable Range	Gauge Reading	% of Full Scale	Calibration Point	Acceptable Range	Gauge Reading
	20%	0.4" W.C.	0.36-0.44"		20%	1.0" W.C.	0.9-1.1"	
	50%	1.0" W.C.	0.96-1.04"		50%	2.5" W.C.	2.4-2.6"	
	80%	1.6" W.C.	1.56-1.64"		80%	4.0" W.C.	3.9-4.1"	
	20%	0.4" W.C.	0.36-0.44"		20%	1.0" W.C.	0.9-1.1"	
	50%	1.0" W.C.	0.96-1.04"		50%	2.5" W.C.	2.4-2.6"	
	80%	1.6" W.C.	1.56-1.64"		80%	4.0" W.C.	3.9-4.1"	
	20%	0.4" W.C.	0.36-0.44"		20%	1.0" W.C.	0.9-1.1"	
	50%	1.0" W.C.	0.96-1.04"		50%	2.5" W.C.	2.4-2.6"	
	80%	1.6" W.C.	1.56-1.64"		80%	4.0" W.C.	3.9-4.1"	
	20%	0.4" W.C.	0.36-0.44"		20%	1.0" W.C.	0.9-1.1"	
	50%	1.0" W.C.	0.96-1.04"		50%	2.5" W.C.	2.4-2.6"	
	80%	1.6" W.C.	1.56-1.64"		80%	4.0" W.C.	3.9-4.1"	

Testing Company : ________________________ Signature : ______________________________

Instructions: Pressure gauges must be calibrated at least weekly against a reference gauge or incline manometer. Using the same pressure source, pressurize both the reference gauge (or manometer) and the gauge undergoing calibration to the “Calibration Points” listed on the table above. Record the pressure reading from the gauge undergoing calibration in the “Gauge Reading” column. If this value is within the “Acceptable Range”, then it may be used to conduct testing of vapor recovery systems.

TXP-103: Determination of Dynamic Pressure Performance (Dynamic Back-Pressure) of Vapor Recovery Systems at Gasoline Dispensing Facilities

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, "Control of Volatile Organic Compounds." To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is used to quantify the dynamic pressure in the vapor path leading from the dispensing nozzle and vent riser to the storage tank to verify that physical or liquid blockages do not exist in the piping system. The dynamic pressure associated with vehicle refueling is determined by various alternative procedures. The test procedures as outlined in TXP-103 have been adopted due to their ability to determine back-pressures in the numerous varieties of vapor recovery systems.

The compliance standard of dynamic back-pressure performance for a system is initially determined during the certification phase of a model system. This test procedure is used to determine compliance with the dynamic back-pressure performance standard of a vapor recovery system after the system is installed at a GDF.

This test procedure is applicable to all installations of balance and assist systems at GDFs utilizing Underground Storage Tank Systems (USTs) or Aboveground Storage Tank Systems (ASTs).

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The purpose of this test procedure is to determine the dynamic back-pressure of a vapor recovery system at known dispensing flow rates. Two alternative procedures are provided, one of which must be chosen dependent upon the type of vapor recovery system tested.

3 BIASES AND INTERFERENCES

Any leaks in the nozzle vapor path, vapor hose, or underground vapor return piping will result in erroneously low dynamic back-pressure measurements.

Testing systems which are manifolded above-ground through the vent line without dismantling the piping unions may conceal a blockage in one or more vent lines. Therefore, the above-ground vent piping manifold must be dismantled and each vent line tested independently.

4 SENSITIVITY, RANGE, AND PRECISION

The minimum and maximum dynamic back-pressures that can be measured are dependent upon the pressure gauge used.

5 EQUIPMENT

5.1 Nitrogen Pressure Drop Test Unit

See **Figure 103-1.**

Use a fill pipe known to be compatible with all nozzles and equipped with a pressure tap.

Use a high pressure nitrogen cylinder (rated at 2500 psig) and equipped with a compatible two stage pressure regulator. Use commercial grade nitrogen. Note that the nitrogen cylinder must be properly grounded (for safety reasons) prior to flowing nitrogen into any portion of the vapor recovery vapor space.

5.2 Rotameter(s)

Use a calibrated rotameter capable of accurately measuring nitrogen flow rates of 40, 60, 80, and 100 CFH and equipped with a flow control valve.

5.3 Pressure gauge(s)

For the nitrogen pressure drop test unit (**Figure 103-1**), use two Magnehelic differential pressure gauges, or equivalent, with appropriate ranges, and equipped with toggle valves connected to the high pressure inlets.

For all procedures, appropriate gauge ranges are:

0.0 to 2.0 inches Water Column (WC)
0.0 to 5.0 inches WC

5.4 Hand Pump

Use a gasoline compatible hand pump for draining liquid collection points or condensate pots (where applicable).

6 CALIBRATION PROCEDURE

6.1 Verify that there are no leaks in the test apparatus (see **Figure 103-1**). This may be done by plugging the nozzle end of the auto fill pipe, opening the nitrogen cylinder and toggling valves on the magnehelic gauges. Adjust the flow meter control valve until a pressure of 50 percent of full scale is indicated on the high range pressure gauge. Close the nitrogen cylinder valve and toggle valves. A pressure decay of 0.2 inches WC in five (5) minutes is considered acceptable.

6.2 Calibrate magnehelic gauges at least once a week against a known standard pressure source at values of 20, 50, and 80% of full scale. Retain calibration records indefinitely.

7 PRE-TEST PROTOCOL

7.1 Check Facility Operating Mode

7.1.1 Assemble the apparatus as shown in **Figure 103-1.**

7.1.2 Perform an initial visual examination for vapor leaks at the nozzle and hose of the Stage II system to be tested.

7.1.3 For installations utilizing liquid collection points or condensate pots, drain the pots prior to testing.

7.1.4 Remove the dust cover from the Stage I vapor connection dry break valve(s). Prop open the Stage I vapor connection dry break of the appropriate storage tank system prior to flowing nitrogen for the test. Each dry break must be propped open in such a manner that no damage is done to the poppet valve or seal.

7.1.4.1 As an alternative to propping the dry breaks, the test may be conducted by venting the nitrogen entering the storage tank (from the dispenser nozzle or riser, as the case may be) through an atmospheric vent with P/V valve removed. If this alternative is selected, the back-pressure values listed in Section 12.1 (for pressures of flow through the nozzle and vapor return piping) will be used to verify compliance, with the flows through pipe only (only vapor return piping, or the portion of the test through the vent line from tank to atmosphere) being compared against the standards listed in Section 12.2.

7.1.5 Use appropriate safety precautions at every stage of testing. At a minimum, verify that no ignition sources are present near the Stage I dry break while it is propped open, or while liquid gasoline is present. In addition, properly ground the Nitrogen Test Apparatus prior to flowing nitrogen into any portion of the vapor space.

8 TEST PROCEDURE

8.1 Procedure 1a: Nitrogen Flow through the Nozzle

All systems that require the Dynamic Back-Pressure to be determined by flowing nitrogen through the vapor recovery nozzle, such as the Balance (UST and AST) and Hirt (UST and AST) Systems.

8.1.1 A quantity of gasoline must be introduced into the system so that gasoline can be heard to splash into the appropriate storage tank. A minimum of two (2) gallons of gasoline or the quantity determined to permit an audibly verifiable (when listening through an open dry break) liquid flow of gasoline into the storage tank must be introduced. Often the minimum is 5 gallons for dispensers nearest the storage tank, but may be 10 or more gallons at the most distant dispensers.

The gasoline may be introduced through the coaxial hose connection at the dispenser base, accomplished by utilizing a pipe cap like fitting connected to the splitter section of the coaxial hose connector that would permit gasoline flowing through the dispenser to be routed directly into the vapor return piping in the dispenser. In the case of high-hang configurations, the gasoline may be introduced at a point in the dispenser so as to permit the gasoline introduced to flow through the maximum reasonable amount of vapor return piping in the dispenser (this may be at the riser inside the dispenser).

If gasoline was introduced through the nozzle vapor return path, drain the vapor hose in such a manner that any gasoline present in the hose exits the hose through the coaxial hose connection at the dispenser. The tester may allow up to fifteen (15) minutes for the vapor return lines to gravity drain.

8.1.2 If condensate pots are part of the installation, drain the condensate pots utilizing the automatic evacuation system if so equipped, or by hand pump if an automatic evacuation systems is not used in the installation.

8.1.3 On Hirt systems, turn the vacuum producing device off for the duration of the test.

8.1.4 Insert the vapor recovery nozzle into the fill pipe of the nitrogen pressure drop test assembly, assuring that the fill pipe/nozzle interface is sealed tightly. Insure that the riser shut off valve on the test equipment is closed. Always properly electrically ground the test apparatus prior to flowing nitrogen into the vapor recovery vapor space.

8.1.5 Close both toggle valves and connect the nitrogen supply. Close the rotameter valve on the test assembly.

8.1.6 Open the nitrogen supply, set the delivery pressure to 3-5 psig, and use the flow meter control valve to slowly adjust the flow rate up to 40 CFH.

8.1.7 Open the toggle valve on the 0.0 to 2.0 inches WC gauge. If the pressure is greater than 2.0 inches WC close this valve and use the 0.0 to 5.0 inch WC gauge.

8.1.8 A pulsating or pegged needle indicates nitrogen passing through a liquid obstruction or blockage in the vapor return system. If this occurs, close the flow meter control valve, disengage the nozzle and redrain the nozzle and hose assembly. Re-engage the nozzle, open the control valve and repeat the test. If the blockage is still present, cease the test and take steps to locate and repair the portion of the piping that permitted the blockage to form. Retest the system upon completion of the repair of the blockage problem.

8.1.9 Record the average dynamic pressure as described in Section 10, Recording Data.

8.1.10 Repeat Sections 8.1.4 through 8.1.9 for flow rates of 60 and 80 CFH. A pressure reading of 0.35 inches WC at 60 CFH flow rate is indicative of a liquid blockage, and constitutes failure of the test. The liquid blockage must be removed and the vapor path retested.

8.1.11 Repeat Sections 8.1.4 through 8.1.10 for each nozzle in the system.

8.2 Procedure 1b: Nitrogen Flow through Vapor Return Piping

Required for all systems whose design requires the test to be performed through the vapor piping only, and not through the nozzle such as the Amoco V-1, Gilbarco VaporVac, Healy, Hasstech Assist Systems.

8.2.1 For Healy systems configured with a mini-jet system, disconnect the vapor return line from the inlet side of the mini-jet pump and utilize a gasoline collection device to catch gasoline that is introduced into the piping in step 8.2.2 below.

8.2.2 Introduce a minimum of two (2) gallons of gasoline through each vapor return riser in each dispenser. The tester may wait up to fifteen (15) minutes before resuming the test to allow for the gasoline to drain from the line. For any system, sufficient gasoline must be introduced to permit liquid gasoline to flow into the storage tank or, in the case of a Healy system, the gasoline collection device.

8.2.3 If liquid collection points or condensate pots are part of the installation, drain them utilizing the automatic evacuation system if so equipped, or by hand pump if automatic evacuation system is not used in the installation.

8.2.4 Connect the Test Assembly shown in **Figure 103-1** to the Stage II vapor riser in the dispenser. Cap the nozzle end of the Test Assembly fill pipe tightly.

8.2.5 Close both toggle valves and connect the nitrogen supply. Close the rotameter valve on the test assembly.

8.2.6 Open the nitrogen supply, set the delivery pressure to 3-5 psig, and use the flow meter control valve to slowly adjust the flow rate up to 40 CFH. Always properly electrically ground the test apparatus prior to flowing nitrogen into the vapor recovery vapor space.

8.2.7 Open the toggle valve on the 0.0 to 2.0 inches WC gauge. If the pressure is greater than 2.0 inches WC, close this valve and use the 0.0 to 5.0 inch WC gauge.

8.2.8 If no pulsating/pegged gauge needle is present, increase nitrogen flow rate to 60 CFH. Record the average dynamic pressure as described in Section 10.

8.3 Procedure 2: Test of Storage Tank Vent Line(s)

Required of all systems.

8.3.1 Introduce a minimum of two (2) gallons of gasoline through the vent riser from each storage tank. If the system is manifolded above ground, introduce product through each vent pipe below the point of manifolding. The manifold must be dismantled and each vent line tested independently. The tester may wait up to fifteen (15) minutes before resuming the test to allow for the gasoline to drain from the line. The minimum amount of gasoline required may depend on manifolding method utilized at the system, pipe length, and diameter; therefore, introduce sufficient gasoline to permit liquid gasoline to be heard entering the storage tank when listening through the dry break. In the case of systems manifolded below ground, introduce sufficient gasoline to permit liquid gasoline to be heard entering at least one of the manifolded storage tanks when listening through the dry break.

8.3.2 Connect the Test Assembly shown in **Figure 103-1** to the vent riser in the same manner that would be used to connect the Test Assembly to the Stage II riser in each dispenser, utilizing the appropriate fittings to connect it to the 2 inch vent pipe. Cap the nozzle end of the Test Assembly fill pipe tightly.

8.3.3 Close both toggle valves and connect the nitrogen supply. Close the rotameter valve on the test assembly.

8.3.4 Open the nitrogen supply, set the delivery pressure to 3-5 psig, and use the flow meter control valve to slowly adjust the flow rate to 40 SCFH. Always properly electrically ground the test apparatus prior to flowing nitrogen into the vapor recovery vapor space.

8.3.5 Open the toggle valve on the 0.0 to 2.0 inches WC gauge. If the pressure is greater than 2.0 inches WC, close this valve and use the 0.0 to 5.0 inch WC gauge.

8.3.6 A pulsating or pegged gauge needle indicates nitrogen passing through a liquid obstruction or blockage in the vapor return system. Cease the test and take steps to locate and repair the portion of the piping that permitted the blockage to form. Retest the system upon completion of the repair of the blockage problem.

8.3.7 If no pulsating gauge needle is present, increase nitrogen flow rate to 60 CFH. Record the average dynamic pressure as described in Recording Data (Section 10).

8.3.8 Repeat Sections 8.3.2 through 8.3.7 for each storage tank vent pipe (if applicable).

8.3.9 Test for blockages in each underground tank manifold (if applicable) by repeating Sections 8.3.2 through 8.3.7 while depressing each dry break independently. If each UST does not have an associated dry break, remove the drop tube(s) to provide adequate vapor flow for the test.

9 QUALITY ASSURANCE/QUALITY CONTROL

This section reserved for future specifications.

10 RECORDING DATA

Form 103-1 is the field data sheet for procedures 1a and 2 above.

Form 103-2 is the field data sheet for procedures 1b and 2 above.

11 CALCULATING RESULTS

Determine the average dynamic back-pressure for each test above.

12 REPORTING RESULTS

12.1 Allowable Back-Pressure for Procedure 1a:

Table 103-1:
Maximum allowable average dynamic back-pressure for systems requiring nitrogen to be introduced through the nozzle

Flow Rate (cubic feet per hour)	Dynamic Pressure (inches water column)
40	0.16
60	0.35
80	0.62

Allowable back-pressures listed above only apply to systems which are tested with drybreaks in the open position.

12.2 Allowable Back-Pressure for Procedures 1b and 2:

Table 103-2:

Maximum allowable average dynamic back-pressure for systems requiring nitrogen to be introduced through the vapor return riser and for the vent lines on all systems

Flow Rate (cubic feet per hour)	Dynamic Pressure (inches water column)	
60	Amoco and Central Vacuum Healy Systems	0.10
60	All Other Assist Systems	1.00
60	Storage Tank Vent Line(s)	0.10

Allowable back-pressures listed above only apply to systems which are tested with drybreaks in the open position.

13 ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, must only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to this test procedure.

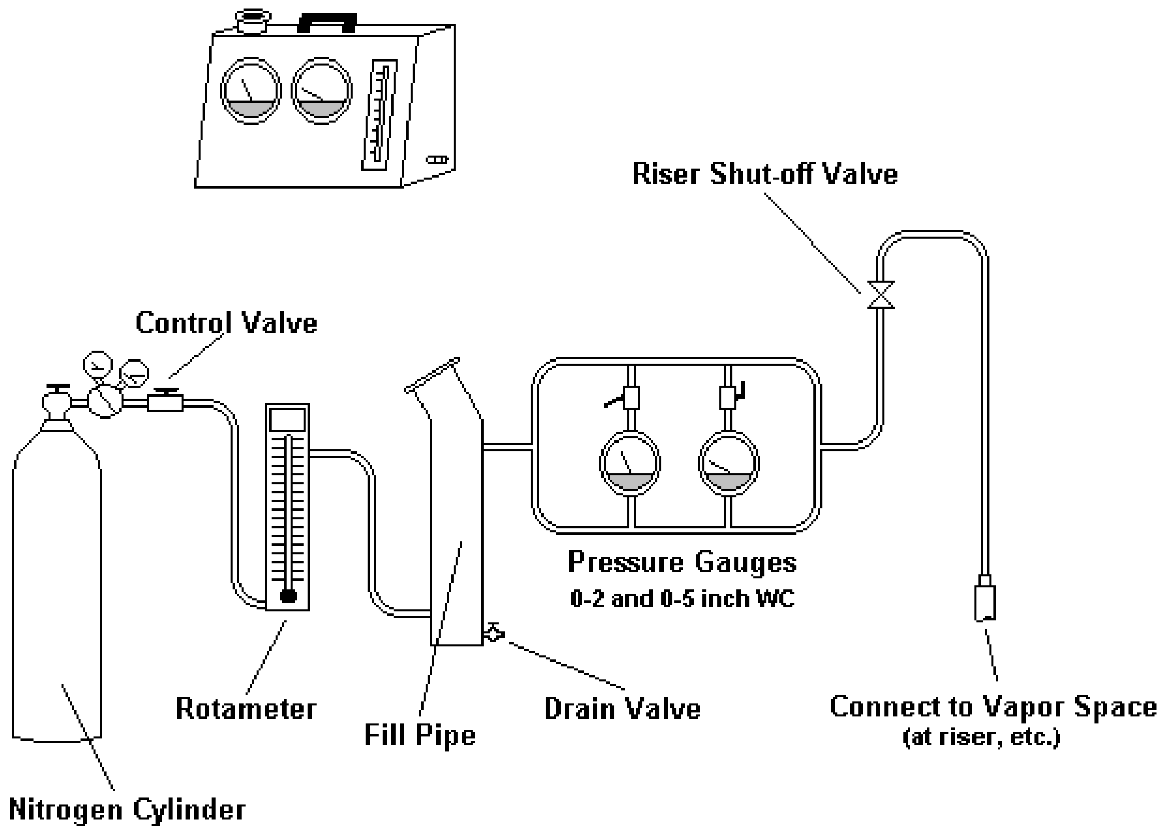
14 REFERENCES

California Air Resources Board TP-201.3 Determination of Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities. Workshop Drafts: Certification and Test Procedures for Vapor Recovery Systems., pp TP-201.3 1-TP 201.3 12.

15 FIGURES

Figure 103-1 and Forms 103-1 and 103-2 are attached.

Figure 103-1:
Nitrogen Pressure Test Assembly



Form 103-1:

Dynamic Back-Pressure Data: Nozzle Method
(for Procedures 1a & 2)

Test Date: ___/___/______
Page ___ of ___

Facility Name: ________________________________ Facility ID Number: _______________________

Vent Line to Tank Number	Gas Grade	System Manifold: ☐ Above-ground ☐ Below-ground					Pass or Fail [1]
		Back-Pressure ("WC) at 60 SCFH	Back Pressure ("WC) through below-ground manifold to tank # (If applicable)				
			1	2	3	4	
1			X				
2				X			
3					X		
4						X	

Nozzle			Back-Pressure (" WC) at Given Flow Rates:			Pass or Fail [1]
Number	Make & Model	Gas Grade	40 CFH	60 CFH	80 CFH	

[1] Compare flow-rate readings with the appropriate values from § 12.1 above to determine pass/fail status.

Form 103-2:

Dynamic Back-Pressure Data: Vapor Piping Method
(for Procedures 1b & 2)

Test Date: ___/___/______
Page ___ of ___

Facility Name: ________________________________ Facility ID Number: _______________________

Vent Line to Tank Number	Gas Grade	System Manifold: ☐ Above-ground ☐ Below-ground					Pass or Fail [1]
		Back-Pressure ("WC) at 60 SCFH	Back Pressure ("WC) through below-ground manifold to tank # (If applicable)				
			1	2	3	4	
1			X				
2				X			
3					X		
4						X	

Dispenser		Back-Pressure (" WC) at a Flow Rate of 60 CFH	Pass or Fail [1]
Numbers	Make		

[1] Compare flow-rate readings with the appropriate values from § 12.2 above to determine pass/fail status.

TXP-104: Determination of Gasoline Dispensing Rate at Gasoline Dispensing Facilities with Vapor Recovery Systems

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, "Control of Volatile Organic Compounds." To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is used to verify that the flow rate of gasoline through any vapor recovery nozzle does not exceed the maximum value, in gallons per minute (GPM), as stated in the Executive Order. This test is not needed if properly operating flow limiters, of the correct maximum flow rate, are correctly installed on the product line leading to the vapor recovery nozzle.

The compliance standard of maximum flow rate for a system is initially determined during the Certification phase of a model system. Such certification testing is conducted by the California Air Resources Board (CARB) who subsequently reports the appropriate values. This procedure is designed to test the as built system to determine if it meets the performance standard related to flow rate.

This procedure is applicable to all installations of balance and assist systems at GDFs utilizing Underground Storage Tank (UST) or Aboveground Storage Tank (AST) systems.

2 PRINCIPLE AND SUMMARY OF THE TEST PROCEDURE

By flowing at maximum speed and measuring the time required to dispense a measured volume of gasoline, flow rate in GPM can be determined. Maximum flow must be continued for at least 5 gallons into either a properly grounded test can or into the fuel tank of an automobile.

3 BIASES AND INTERFERENCES

3.1 A dirty fuel filter may artificially reduce flow rate at a nozzle, therefore a new fuel filter must be installed prior to conducting this test.

3.2 Maximum fueling rate can only be achieved when dispensing a given product grade from a single nozzle during the test.

4 SENSITIVITY, RANGE, AND PRECISION

Measurements must be made to the nearest tenth of a gallon, and to the nearest second of time.

5 EQUIPMENT

5.1 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.2 Gasoline test tank

The gasoline test tank must be configured with an automobile fuel tank fill neck known to be compatible with balance system style vapor recovery nozzles, fitted with an appropriate safety relief valve and proper electrical grounding capabilities. The tank must be on wheels, and constructed such that refueling it would be comparable to refueling an automobile. A capacity of 25-30 gallons is typical. See **Figure 104-1** for examples of suitable test tanks.

An actual automobile or truck may be used in lieu of a specially constructed gasoline tank, as long as there is sufficient volume in the fuel tank to permit unrestricted flow of at least 10 gallons of gasoline without triggering an automatic nozzle shut off mechanism.

6 CALIBRATION PROCEDURE

None noted.

7 PRE-TEST PROTOCOL

Replace the fuel filter in the product path of the nozzle being tested prior to initiating the test.

8 TEST PROCEDURE

8.1 Prepare to dispense gasoline

8.1.1 Locate the dispenser located nearest the product tank from which you will dispense gasoline. Situate the automobile or test tank at a normal distance from the dispenser for refueling and automobile.

8.1.2 Verify that no other dispensing from the product grade being used will occur during the duration of the dispensing portion of the flow rate test.

8.2 Dispense gasoline

8.2.1 Begin flowing gasoline at maximum flow rate or high hold clip rate, whichever is faster. Start stopwatch when one gallon has been dispensed.

8.2.2 Continue to dispense gasoline until at least 5 additional gallons of gasoline have been dispensed. Record the exact gallonage dispensed while timing with the stopwatch. Record the gallons dispensed in column ‘G’ and the number of seconds elapsed in column ‘S’ in **Form 104-1**.

8.3 Repeat steps if necessary

8.3.1 In the case of storage tank based turbine pumps being used to pump gasoline, repeat Section 8 for one dispensing nozzle for each separate storage tank fitted with a turbine pump.

8.3.2 In the case of suction pumps used to pump gas which are located at each dispenser, repeat Section 8 for one nozzle supplied by each separate suction pump.

9 QUALITY ASSURANCE/QUALITY CONTROL

This section reserved for future use.

10 RECORDING DATA

Record the data as instructed on **Form 104-1**.

11 CALCULATING RESULTS

$$F = (G / S) * 60$$

Where: F=Flow rate, gallons per minute (GPM)

G=Gallons dispensed while timing flow.

S=Seconds of flow timed.

12 REPORTING RESULTS

A system fails the test if the flow rate exceeds the maximum allowed in the Executive Order for that system.

13 ALTERNATIVE TEST PROCEDURES

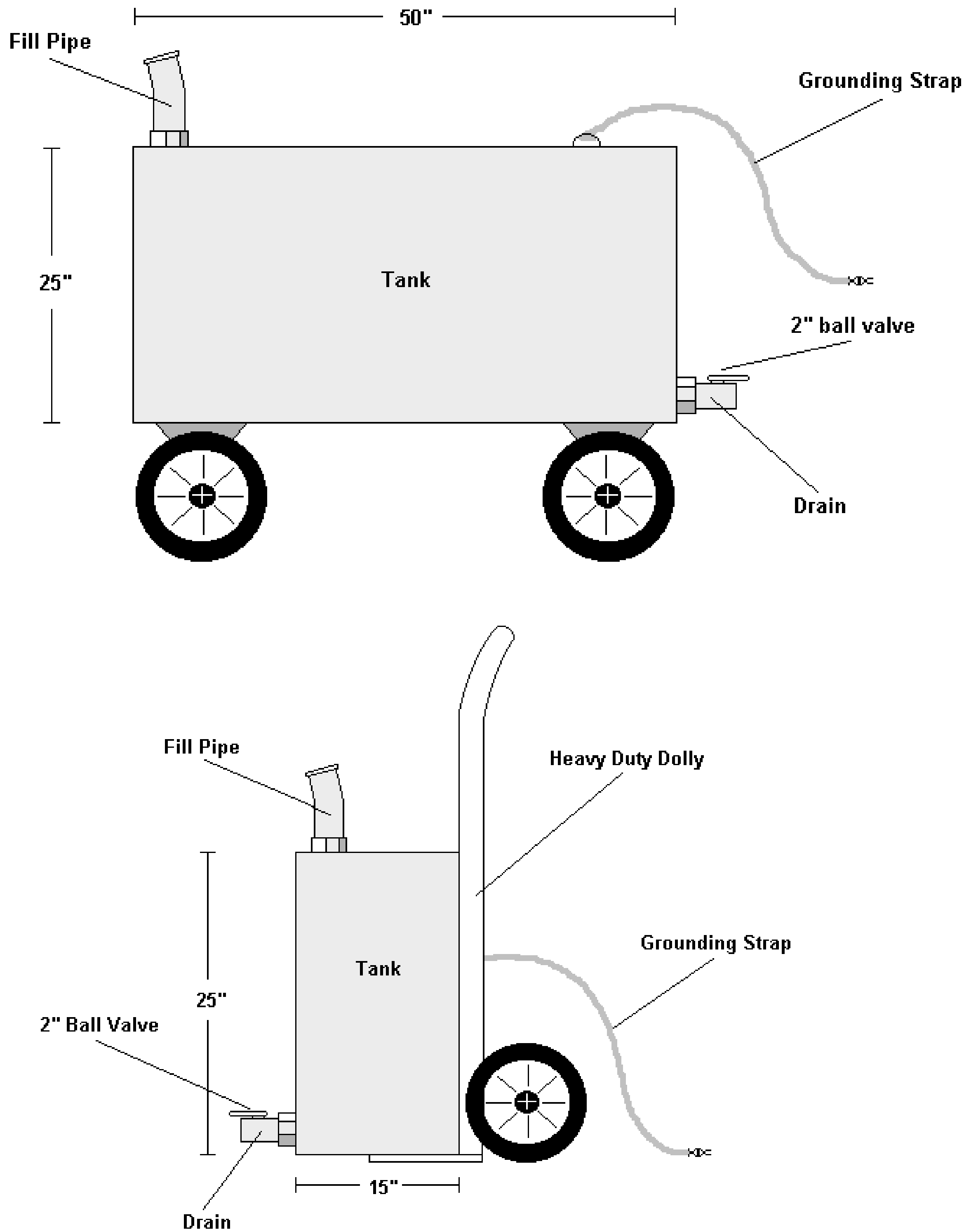
Test procedures, other than specified above, must only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to this test procedure.

14 REFERENCES

15 FIGURES

Figure 104-1, Form 104-1, and Table 104-1 are attached.

Figure 104-1:
Test Tank Configurations



Recommended configurations for vapor recovery test tanks. Similar configurations which meet the specifications are acceptable.

Form 104-1:
Gasoline Flow Rate Performance Data

Test Date: ___/___/______
Page ___ of ___

Facility Name: ________________________________ Facility ID Number: ______________________

Nozzle Number	Gas Grade	Measured Values		Calculated Flowrate [1]	Pass or Fail [2]
		Gallons Dispensed [3]	Seconds Elapsed		

[1] Calculate as per equation in § 11 above, or use the values in Table 1.
[2] Pass or Fail dependent on values calculated compared with values given in the Executive Order.
[3] Gallons recorded should not include the one gallon dispensed prior to beginning the stopwatch.

Table 104-1:
Flow Rates (Shown as Gallons per Minute)

Gallons Dispensed	Time to Dispense (Seconds)															
	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30
5.0	5.0	5.2	5.4	5.6	5.8	6.0	6.3	6.5	6.8	7.1	7.5	7.9	8.3	8.8	9.4	10.0
5.2	5.2	5.4	5.6	5.8	6.0	6.2	6.5	6.8	7.1	7.4	7.8	8.2	8.7	9.2	9.8	10.4
5.4	5.4	5.6	5.8	6.0	6.2	6.5	6.8	7.0	7.4	7.7	8.1	8.5	9.0	9.5	10.1	10.8
5.6	5.6	5.8	6.0	6.2	6.5	6.7	7.0	7.3	7.6	8.0	8.4	8.8	9.3	9.9	10.5	11.2
5.8	5.8	6.0	6.2	6.4	6.7	7.0	7.3	7.6	7.9	8.3	8.7	9.2	9.7	10.2	10.9	11.6
6.0	6.0	6.2	6.4	6.7	6.9	7.2	7.5	7.8	8.2	8.6	9.0	9.5	10.0	10.6	11.2	12.0
6.2	6.2	6.4	6.6	6.9	7.2	7.4	7.8	8.1	8.5	8.9	9.3	9.8	10.3	10.9	11.6	12.4
6.4	6.4	6.6	6.9	7.1	7.4	7.7	8.0	8.3	8.7	9.1	9.6	10.1	10.7	11.3	12.0	12.8
6.6	6.6	6.8	7.1	7.3	7.6	7.9	8.3	8.6	9.0	9.4	9.9	10.4	11.0	11.6	12.4	13.2
6.8	6.8	7.0	7.3	7.6	7.8	8.2	8.5	8.9	9.3	9.7	10.2	10.7	11.3	12.0	12.8	13.6
7.0	7.0	7.2	7.5	7.8	8.1	8.4	8.8	9.1	9.5	10.0	10.5	11.1	11.7	12.4	13.1	14.0
7.2	7.2	7.4	7.7	8.0	8.3	8.6	9.0	9.4	9.8	10.3	10.8	11.4	12.0	12.7	13.5	14.4
7.4	7.4	7.7	7.9	8.2	8.5	8.9	9.3	9.7	10.1	10.6	11.1	11.7	12.3	13.1	13.9	14.8
7.6	7.6	7.9	8.1	8.4	8.8	9.1	9.5	9.9	10.4	10.9	11.4	12.0	12.7	13.4	14.2	15.2
7.8	7.8	8.1	8.4	8.7	9.0	9.4	9.8	10.2	10.6	11.1	11.7	12.3	13.0	13.8	14.6	15.6
8.0	8.0	8.3	8.6	8.9	9.2	9.6	10.0	10.4	10.9	11.4	12.0	12.6	13.3	14.1	15.0	16.0
8.2	8.2	8.5	8.8	9.1	9.5	9.8	10.3	10.7	11.2	11.7	12.3	12.9	13.7	14.5	15.4	16.4
8.4	8.4	8.7	9.0	9.3	9.7	10.1	10.5	11.0	11.5	12.0	12.6	13.3	14.0	14.8	15.8	16.8
8.6	8.6	8.9	9.2	9.6	9.9	10.3	10.8	11.2	11.7	12.3	12.9	13.6	14.3	15.2	16.1	17.2
8.8	8.8	9.1	9.4	9.8	10.2	10.6	11.0	11.5	12.0	12.6	13.2	13.9	14.7	15.5	16.5	17.6
9.0	9.0	9.3	9.6	10.0	10.4	10.8	11.3	11.7	12.3	12.9	13.5	14.2	15.0	15.9	16.9	18.0
9.2	9.2	9.5	9.9	10.2	10.6	11.0	11.5	12.0	12.5	13.1	13.8	14.5	15.3	16.2	17.2	18.4
9.4	9.4	9.7	10.1	10.4	10.8	11.3	11.8	12.3	12.8	13.4	14.1	14.8	15.7	16.6	17.6	18.8
9.6	9.6	9.9	10.3	10.7	11.1	11.5	12.0	12.5	13.1	13.7	14.4	15.2	16.0	16.9	18.0	19.2
9.8	9.8	10.1	10.5	10.9	11.3	11.8	12.3	12.8	13.4	14.0	14.7	15.5	16.3	17.3	18.4	19.6

Table 104-1 (continued):
Flow Rates (Shown as Gallons per Minute)

Gallons Dispensed	Time to Dispense (Seconds)															
	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30
10.0	10.0	10.3	10.7	11.1	11.5	12.0	13.9	13.0	13.6	14.3	15.0	15.8	16.7	17.6	18.8	20.0
10.2	10.2	10.6	10.9	11.3	11.8	12.2	14.2	13.3	13.9	14.6	15.3	16.1	17.0	18.0	19.1	20.4
10.4	10.4	10.8	11.1	11.6	12.0	12.5	14.4	13.6	14.2	14.9	15.6	16.4	17.3	18.4	19.5	20.8
10.6	10.6	11.0	11.4	11.8	12.2	12.7	14.7	13.8	14.5	15.1	15.9	16.7	17.7	18.7	19.9	21.2
10.8	10.8	11.2	11.6	12.0	12.5	13.0	15.0	14.1	14.7	15.4	16.2	17.1	18.0	19.1	20.2	21.6
11.0	11.0	11.4	11.8	12.2	12.7	13.2	15.3	14.3	15.0	15.7	16.5	17.4	18.3	19.4	20.6	22.0
11.2	11.2	11.6	12.0	12.4	12.9	13.4	15.6	14.6	15.3	16.0	16.8	17.7	18.7	19.8	21.0	22.4
11.4	11.4	11.8	12.2	12.7	13.2	13.7	15.8	14.9	15.5	16.3	17.1	18.0	19.0	20.1	21.4	22.8
11.6	11.6	12.0	12.4	12.9	13.4	13.9	16.1	15.1	15.8	16.6	17.4	18.3	19.3	20.5	21.8	23.2
11.8	11.8	12.2	12.6	13.1	13.6	14.2	16.4	15.4	16.1	16.9	17.7	18.6	19.7	20.8	22.1	23.6
12.0	12.0	12.4	12.9	13.3	13.8	14.4	16.7	15.7	16.4	17.1	18.0	18.9	20.0	21.2	22.5	24.0
12.2	12.2	12.6	13.1	13.6	14.1	14.6	16.9	15.9	16.6	17.4	18.3	19.3	20.3	21.5	22.9	24.4
12.4	12.4	12.8	13.3	13.8	14.3	14.9	17.3	16.2	16.9	17.7	18.6	19.6	20.7	21.9	23.2	24.8
12.6	12.6	13.0	13.5	14.0	14.5	15.1	17.5	16.4	17.2	18.0	18.9	19.9	21.0	22.2	23.6	25.2
12.8	12.8	13.2	13.7	14.2	14.8	15.4	17.8	16.7	17.5	18.3	19.2	20.2	21.3	22.6	24.0	25.6
13.0	13.0	13.4	13.9	14.4	15.0	15.6	18.0	17.0	17.7	18.6	19.5	20.5	21.7	22.9	24.4	26.0
13.2	13.2	13.7	14.1	14.7	15.2	15.8	18.4	17.2	18.0	18.9	19.8	20.8	22.0	23.3	24.8	26.4
13.4	13.4	13.9	14.4	14.9	15.5	16.1	18.6	17.5	18.3	19.1	20.1	21.2	22.3	23.6	25.1	26.8
13.6	13.6	14.1	14.6	15.1	15.7	16.3	18.9	17.7	18.5	19.4	20.4	21.5	22.7	24.0	25.5	27.2
13.8	13.8	14.3	14.8	15.3	15.9	16.6	19.1	18.0	18.8	19.7	20.7	21.8	23.0	24.4	25.9	27.6
14.0	14.0	14.5	15.0	15.6	16.2	16.8	19.5	18.3	19.1	20.0	21.0	22.1	23.3	24.7	26.2	28.0

TXP-105:
Determination of Liquid Removal System Performance of Vapor Recovery Systems at Gasoline Dispensing Facilities

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, "Control of Volatile Organic Compounds." To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is used to verify the proper operation of liquid removal systems by quantifying the volume of liquid removed from the dispensing hose per gallon of gasoline dispensed or per minute of dispensing. The test should be performed after it has been determined through test procedure TXP-103.1 (dynamic back-pressure/liquid blockage test) that no liquid blockages exist in the vapor return piping.

The compliance standard of liquid removal performance for a system is initially determined during the Certification phase of a model system. Such certification testing is conducted by the California Air Resources Board (CARB) who subsequently reports the appropriate values. This test procedure is used to determine compliance with the liquid removal performance standard of a vapor recovery system after the system is installed at a GDF.

This test procedure is applicable to all installations of balance and assist systems at GDFs utilizing Underground Storage Tank Systems (USTs) or Aboveground Storage Tank Systems (ASTs).

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

By introducing a known quantity of gasoline into the vapor space of the vapor recovery hose, dispensing a certain quantity of gasoline, and measuring the gasoline remaining in the hose/nozzle assembly after dispensing is completed, one can determine whether the liquid removal system is operating correctly. Ordinarily, a liquid removal system should be capable of removing at a minimum 10 mL/gallon of gasoline dispensed.

3 BIASES AND INTERFERENCES

Any leaks in the nozzle vapor path or vapor hose result in erroneous measurements.

4 SENSITIVITY, RANGE, AND PRECISION

Measurements must be made to the nearest milliliter (mL) of volume.

5 EQUIPMENT

5.1 Stopwatch

Use a stopwatch accurate to within 0.2 seconds.

5.2 Graduated Cylinder

Use a shatterproof, gasoline compatible 0-250 mL graduated cylinder with minimum graduations not to exceed 5 mL.

5.3 Gasoline test tank

The gasoline test tank must be configured with an automobile fuel tank fill neck known to be compatible with balance system style vapor recovery nozzles, fitted with an appropriate safety relief valve and proper electrical grounding capabilities. The tank must be on wheels, and constructed such that refueling it would be comparable to refueling an automobile. A capacity of 25-30 gallons is typical. See **Figure 105-1** for examples of suitable test tanks.

An actual automobile or truck may be used in lieu of a specially constructed gasoline tank, as long as there is sufficient volume in the fuel tank to permit unrestricted flow of at least 10 gallons of gasoline without triggering an automatic nozzle shut off mechanism.

6 CALIBRATION PROCEDURE

None noted.

7 PRE-TEST PROTOCOL

7.1 Determining Flow Rates

7.1.1 Use a stopwatch to accurately measure the gasoline dispensing rates at high, medium, and low flow rate nozzle hold-open clip settings with no other refueling activity occurring at the facility. Allow at least one gallon to be dispensed during a dispensing event prior to timing the dispensing rate, dispense at least 5 gallons while timing the dispensing rate. For those nozzles without hold-open latches, use wooden (or any other non-sparking material) wedges to simulate the three latch positions, which should approximate 33, 66, and 95% of maximum flow rate, respectively. Calculate the flow rate (in gallons per minute) using a calculator or **Table 105-2** and record this value in the Flow Rate column of **Form 105-1** for each flow rate setting.

7.2 Determining liquid volume lost due to hose wall surface adhesion

7.2.1 Verify that the hose and nozzle are completely drained of any gasoline. Allow sufficient time for this to occur.

7.2.2 Introduce 150 mL of gasoline into the vapor passage of the hose using the graduated cylinder. Completely drain the gasoline from the vapor passage back into the graduated cylinder. Subtract the recovered volume from the initial volume introduced to obtain the volume of gasoline lost due to surface adhesion to the hose wall. Record this wall-loss value as VW in **Form 105-1**.

8 TEST PROCEDURE

8.1 Liquid Removal

8.1.1 Use the graduated cylinder to introduce about 150 mL of gasoline into the vapor passage of the hose. Record the exact amount (in milliliters) introduced in Column VI of **Form 105-1**.

8.1.2 Position the gasoline test tank or automobile 48 ± 2 inches form the face of the dispenser in order to represent a typical refueling configuration.

8.1.3 Using the low hold-open clip setting, dispense 9 to 10 gallons of gasoline into the fuel tank. Record the exact gallonage in column marked ‘G’ in **Form 105-1**.

8.1.4 Carefully drain any gasoline present in the vapor passage of the hose into the graduated cylinder. Record this quantity as VF in **Form 105-1**.

8.1.5 Repeat 8.1.1 through 8.1.4 for each of the medium and high hold-open clip settings.

8.1.6 Repeat steps in section 7 and 8 for each hose/liquid removal device to be tested.

9 QUALITY ASSURANCE/QUALITY CONTROL

This section reserved for future use.

10 RECORDING DATA

Record the data as instructed on **Form 105-1**.

11 CALCULATING RESULTS

11.1 The volume of liquid removed from the vapor passage per gallon of gasoline dispensed is calculated as:

$$VR_G = \frac{(VI - VW) - VF}{G}$$

Where: VR_G = Gasoline removed in milliliters per gallon dispensed.

VI = Total initial volume poured into hose vapor passage, milliliters.

VW = Liquid lost due to wall adhesion, milliliters (from 7.2.2 above).

VF = The volume of gasoline remaining in the hose vapor passage after dispensing gasoline, milliliters.

G = Total gasoline dispensed, gallons.

11.2 The volume of liquid removed from the vapor hose passage per minute is calculated as:

$$VR_M = (VR_G) * VM$$

Where: VR_M = Gasoline removed in milliliters per minute.

VR_G = Gasoline removed in milliliters per gallon dispensed.

VM = Gasoline dispensing rate, gallons per minute (from 7.1.1 above).

12 REPORTING RESULTS

Liquid removal values less than the minimum shown in **Table 105-1** below indicate failure of the liquid removal system.

Table 105-1:
Liquid Removal System Test Parameters

System Type	Minimum Removal Rate mL/gallon	Minimum Removal Rate mL/minute	Dispensing Rate gallons/minute
AMOCO V-1	**---**	**20**	**4-10**
All other systems	**10**	**---**	**≥5**

13 ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, must only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to this test procedure.

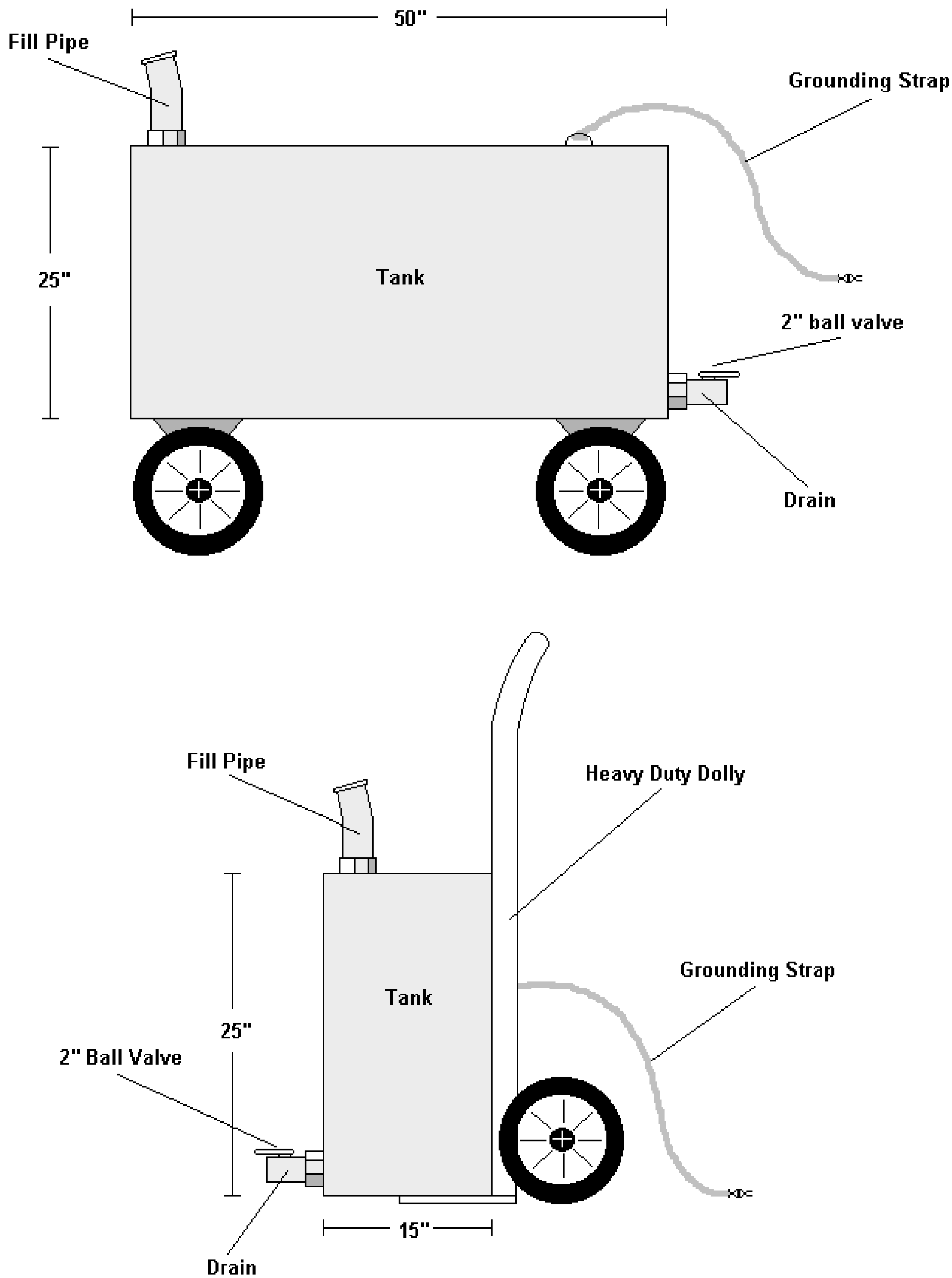
14 REFERENCES

California Air Resources Board, 1992. Draft TP-201.5: Determination of Liquid Blockage of Phase II Vapor Recovery Systems of Dispensing Facilities in Workshop Drafts: Certification and Test Procedures for Vapor Recovery Systems. TP-201.5 pp 1-5.

15 FIGURES

Figure 105-1, Form 105-1, and Table 105-2 are attached.

Figure 105-1:
Test Tank Configurations



Recommended configurations for vapor recovery test tanks. Similar configurations which meet the specifications are acceptable.

Form 105-1:
Liquid Removal Device Performance Data

Test Date: ___/___/______
Page ____of ___

Facility Name: ____ Facility ID Number: _______________________________

Nozzle Number	Gas Grade	Component			Nozzle Flow Setting	Flow Rate (GPM) VM	Liquid Removal Data [2]						Pass [3] or Fail
		Type	Make	Model			VI (mL)	VW (mL)	VF (mL)	G (gal.)	VR_G (mL)	VR_M (mL)	
		Nozzle			Low								
______	______	Hose			Med.								
		LRD [1]			High								
		Nozzle			Low								
______	______	Hose			Med.								
		LRD [1]			High								
		Nozzle			Low								
______	______	Hose			Med.								
		LRD [1]			High								
		Nozzle			Low								
______	______	Hose			Med.								
		LRD [1]			High								
		Nozzle			Low								
______	______	Hose			Med.								
		LRD [1]			High								

[1] LRD: Liquid Removal Device

[2] $VR_G=((VI-VW)-VF)/G$ where:
- VR_G = Gasoline removed in milliliters per gallon dispensed.
- VI = Total initial volume poured into hose vapor passage, milliliters.
- VW = Liquid lost due to wall adhesion, milliliters (from 7.2.2 above).
- VF = Volume of gasoline remaining in hose vapor passage after dispensing, milliliters.
- G = Total gasoline dispensed, gallons.

$VR_M=VR_G*VM$ where: VM = Flowrate, GPM (from **Table 105-2** below).

[3] Pass or Fail dependent on values calculated compared with values in **Table 105-1**.

Table 105-2:
Flow Rates (Shown as Gallons per Minute)

Gallons Dispensed	Time to Dispense (Seconds)															
	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30
5.0	5.0	5.2	5.4	5.6	5.8	6.0	6.3	6.5	6.8	7.1	7.5	7.9	8.3	8.8	9.4	10.0
5.2	5.2	5.4	5.6	5.8	6.0	6.2	6.5	6.8	7.1	7.4	7.8	8.2	8.7	9.2	9.8	10.4
5.4	5.4	5.6	5.8	6.0	6.2	6.5	6.8	7.0	7.4	7.7	8.1	8.5	9.0	9.5	10.1	10.8
5.6	5.6	5.8	6.0	6.2	6.5	6.7	7.0	7.3	7.6	8.0	8.4	8.8	9.3	9.9	10.5	11.2
5.8	5.8	6.0	6.2	6.4	6.7	7.0	7.3	7.6	7.9	8.3	8.7	9.2	9.7	10.2	10.9	11.6
6.0	6.0	6.2	6.4	6.7	6.9	7.2	7.5	7.8	8.2	8.6	9.0	9.5	10.0	10.6	11.2	12.0
6.2	6.2	6.4	6.6	6.9	7.2	7.4	7.8	8.1	8.5	8.9	9.3	9.8	10.3	10.9	11.6	12.4
6.4	6.4	6.6	6.9	7.1	7.4	7.7	8.0	8.3	8.7	9.1	9.6	10.1	10.7	11.3	12.0	12.8
6.6	6.6	6.8	7.1	7.3	7.6	7.9	8.3	8.6	9.0	9.4	9.9	10.4	11.0	11.6	12.4	13.2
6.8	6.8	7.0	7.3	7.6	7.8	8.2	8.5	8.9	9.3	9.7	10.2	10.7	11.3	12.0	12.8	13.6
7.0	7.0	7.2	7.5	7.8	8.1	8.4	8.8	9.1	9.5	10.0	10.5	11.1	11.7	12.4	13.1	14.0
7.2	7.2	7.4	7.7	8.0	8.3	8.6	9.0	9.4	9.8	10.3	10.8	11.4	12.0	12.7	13.5	14.4
7.4	7.4	7.7	7.9	8.2	8.5	8.9	9.3	9.7	10.1	10.6	11.1	11.7	12.3	13.1	13.9	14.8
7.6	7.6	7.9	8.1	8.4	8.8	9.1	9.5	9.9	10.4	10.9	11.4	12.0	12.7	13.4	14.2	15.2
7.8	7.8	8.1	8.4	8.7	9.0	9.4	9.8	10.2	10.6	11.1	11.7	12.3	13.0	13.8	14.6	15.6
8.0	8.0	8.3	8.6	8.9	9.2	9.6	10.0	10.4	10.9	11.4	12.0	12.6	13.3	14.1	15.0	16.0
8.2	8.2	8.5	8.8	9.1	9.5	9.8	10.3	10.7	11.2	11.7	12.3	12.9	13.7	14.5	15.4	16.4
8.4	8.4	8.7	9.0	9.3	9.7	10.1	10.5	11.0	11.5	12.0	12.6	13.3	14.0	14.8	15.8	16.8
8.6	8.6	8.9	9.2	9.6	9.9	10.3	10.8	11.2	11.7	12.3	12.9	13.6	14.3	15.2	16.1	17.2
8.8	8.8	9.1	9.4	9.8	10.2	10.6	11.0	11.5	12.0	12.6	13.2	13.9	14.7	15.5	16.5	17.6
9.0	9.0	9.3	9.6	10.0	10.4	10.8	11.3	11.7	12.3	12.9	13.5	14.2	15.0	15.9	16.9	18.0
9.2	9.2	9.5	9.9	10.2	10.6	11.0	11.5	12.0	12.5	13.1	13.8	14.5	15.3	16.2	17.2	18.4
9.4	9.4	9.7	10.1	10.4	10.8	11.3	11.8	12.3	12.8	13.4	14.1	14.8	15.7	16.6	17.6	18.8
9.6	9.6	9.9	10.3	10.7	11.1	11.5	12.0	12.5	13.1	13.7	14.4	15.2	16.0	16.9	18.0	19.2
9.8	9.8	10.1	10.5	10.9	11.3	11.8	12.3	12.8	13.4	14.0	14.7	15.5	16.3	17.3	18.4	19.6

Table 105-2 (continued):
Flow Rates (Shown as Gallons per Minute)

Gallons Dispensed	Time to Dispense (Seconds)															
	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30
10.0	10.0	10.3	10.7	11.1	11.5	12.0	13.9	13.0	13.6	14.3	15.0	15.8	16.7	17.6	18.8	20.0
10.2	10.2	10.6	10.9	11.3	11.8	12.2	14.2	13.3	13.9	14.6	15.3	16.1	17.0	18.0	19.1	20.4
10.4	10.4	10.8	11.1	11.6	12.0	12.5	14.4	13.6	14.2	14.9	15.6	16.4	17.3	18.4	19.5	20.8
10.6	10.6	11.0	11.4	11.8	12.2	12.7	14.7	13.8	14.5	15.1	15.9	16.7	17.7	18.7	19.9	21.2
10.8	10.8	11.2	11.6	12.0	12.5	13.0	15.0	14.1	14.7	15.4	16.2	17.1	18.0	19.1	20.2	21.6
11.0	11.0	11.4	11.8	12.2	12.7	13.2	15.3	14.3	15.0	15.7	16.5	17.4	18.3	19.4	20.6	22.0
11.2	11.2	11.6	12.0	12.4	12.9	13.4	15.6	14.6	15.3	16.0	16.8	17.7	18.7	19.8	21.0	22.4
11.4	11.4	11.8	12.2	12.7	13.2	13.7	15.8	14.9	15.5	16.3	17.1	18.0	19.0	20.1	21.4	22.8
11.6	11.6	12.0	12.4	12.9	13.4	13.9	16.1	15.1	15.8	16.6	17.4	18.3	19.3	20.5	21.8	23.2
11.8	11.8	12.2	12.6	13.1	13.6	14.2	16.4	15.4	16.1	16.9	17.7	18.6	19.7	20.8	22.1	23.6
12.0	12.0	12.4	12.9	13.3	13.8	14.4	16.7	15.7	16.4	17.1	18.0	18.9	20.0	21.2	22.5	24.0
12.2	12.2	12.6	13.1	13.6	14.1	14.6	16.9	15.9	16.6	17.4	18.3	19.3	20.3	21.5	22.9	24.4
12.4	12.4	12.8	13.3	13.8	14.3	14.9	17.3	16.2	16.9	17.7	18.6	19.6	20.7	21.9	23.2	24.8
12.6	12.6	13.0	13.5	14.0	14.5	15.1	17.5	16.4	17.2	18.0	18.9	19.9	21.0	22.2	23.6	25.2
12.8	12.8	13.2	13.7	14.2	14.8	15.4	17.8	16.7	17.5	18.3	19.2	20.2	21.3	22.6	24.0	25.6
13.0	13.0	13.4	13.9	14.4	15.0	15.6	18.0	17.0	17.7	18.6	19.5	20.5	21.7	22.9	24.4	26.0
13.2	13.2	13.7	14.1	14.7	15.2	15.8	18.4	17.2	18.0	18.9	19.8	20.8	22.0	23.3	24.8	26.4
13.4	13.4	13.9	14.4	14.9	15.5	16.1	18.6	17.5	18.3	19.1	20.1	21.2	22.3	23.6	25.1	26.8
13.6	13.6	14.1	14.6	15.1	15.7	16.3	18.9	17.7	18.5	19.4	20.4	21.5	22.7	24.0	25.5	27.2
13.8	13.8	14.3	14.8	15.3	15.9	16.6	19.1	18.0	18.8	19.7	20.7	21.8	23.0	24.4	25.9	27.6
14.0	14.0	14.5	15.0	15.6	16.2	16.8	19.5	18.3	19.1	20.0	21.0	22.1	23.3	24.7	26.2	28.0

TXP-106:
Determination of Vapor to Liquid Ratio (V/L) of Vapor Recovery Systems at Gasoline Dispensing Facilities

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, "Control of Volatile Organic Compounds." To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is used to quantify the vapor volume captured by the nozzle to liquid volume of gasoline dispensed (V/L) ratio for vapor recovery systems utilizing vacuum-assist vapor recovery systems. The V/L ratio is used to determine, in part, if the system is operating within the appropriate operating parameters as specified in the certification for that system.

The compliance standard for V/L ratio for a system is initially determined during the Certification phase of a model system. This test procedure is used to determine compliance with the V/L performance standard of a vapor recovery system after the system is installed at a GDF.

This test procedure is applicable to all installations of assist systems at GDFs utilizing Underground Storage Tanks (USTs) or Aboveground Storage Tank Systems (ASTs).

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The vapor to liquid ratio of a vapor recovery system is, for a given dispensing episode, the quotient of the volume of air and/or vapor collected by a nozzle and the volume of liquid dispensed by that nozzle. In this procedure, a nozzle adapter is placed over the vapor collection ports on the nozzle spout. This adapter is connected to a vapor volume meter. A given amount of gasoline is dispensed and the volume of air and vapors collected through the vapor collection ports is measured. The ratio of gasoline to vapor volume is calculated and compared to a standard given in the vapor recovery system certification.

3 BIASES AND INTERFERENCES

3.1 Nozzle spouts which are damaged such that the nozzle adapter will not properly fit over the spout may bias the test results. Any nozzle spout which is bent or not round precludes the use of this test.

3.2 A nozzle adapter which does not properly include all vapor collection ports on the nozzle spout will bias the test and must not be used for testing. Some nozzles require system-specific testing adapters. In these cases, only those system-specific adapters can be used to test the nozzle.

3.3 Gasoline dispensing rates outside the range allowed in the appropriate vapor recovery system certification will adversely affect the test results. Only those fueling points which meet the individual flowrate requirements are eligible for testing.

3.4 Sealing rings or O-rings in the nozzle adapter that are not properly lubricated may bias the test. To eliminate this bias, lubricate all sealing rings prior to each V/L test.

4 SENSITIVITY, RANGE, AND PRECISION

The values of the determinations required by this test procedure are well within the limits of sensitivity, range and precision of the specified equipment.

5 EQUIPMENT

5.1 Nozzle Adapter

5.1.1 The nozzle adapter must be compatible with the nozzle tested and must isolate all vapor inlet holes on the spout while excluding the primary shut-off inlet. All sealing rings must be free of nicks or cuts that would prevent a tight seal around the spout. **Figure 106-1** illustrates a typical nozzle adapter.

5.2 Vapor Volume Meter and Plumbing Hardware

5.2.1 The adapter must be connected to a vapor volume meter (Dresser Measurement Roots® Meter, or equivalent) by clear flexible tubing with a nominal inside diameter between 0.75 and 1.0 inches. This tubing must have a minimum length of 3.0 feet and a maximum length of 6.0 feet. The maximum allowable pressure drop across the vapor volume meter must be:

For a meter with a maximum rated capacity of 1,000 to 3,000 CFH:

1.10 inches H_2O at a flowrate of 3,000 CFH
0.05 inches H_2O at a flowrate of 30 CFH

For a meter with a maximum rated capacity of 800 to 1,000 CFH:

0.70 inches H_2O at a flowrate of 800 CFH
0.04 inches H_2O at a flowrate of 16 CFH

5.2.2 A T-shaped manifold with a minimum internal diameter of 2.0 inches must be attached to the inlet of the vapor volume meter. A secondary air or vapor inlet/outlet must be attached to the inlet manifold. This equipment allows air to enter or vapor to escape for nozzles which create a V/L ratio other than 1.0. This inlet/outlet must have a minimum internal diameter of 2.0 inches, a minimum length of 6.0 inches, a maximum length of 18.0 inches, and must point towards the ground to minimize tester exposure to hydrocarbon vapors and reduce the impact of wind on the test results.

5.2.3 The inlet manifold of the vapor volume meter must also be connected to the ullage space of the portable liquid tank by clear flexible tubing with a nominal inside diameter between 0.75 and 1.0 inches. This vapor return hose must have a minimum length of 6.0 feet and a maximum length of 10.0 feet. See **Figure 106-2** for an example.

5.3 Liquid (Gasoline) Volume Meter

5.3.1 The metering device integral to the dispenser is to be used.

5.4 Portable Test Tank

5.4.1 A portable test tank similar in design to that in **Figure 106-2** must be used. Gasoline vapors created inside the test tank are routed back through the vapor volume meter and into the vapor recovery system. This configuration reduces tester exposure to hydrocarbon vapors and decreases overall hydrocarbon emissions previously associated with vapor recovery testing. Minimum tank capacity must be 25 gallons.

5.5 Stopwatch

5.5.1 Use a stopwatch accurate to within 0.2 seconds.

5.6 Thermometer

5.6.1 Use a thermometer accurate to within ± 1°F.

5.7 Barometer

5.7.1 Use a mercury, aneroid or equivalent barometer accurate to within 0.2 inches mercury.

5.8 Lubricant

5.8.1 Grease or spray lubricant should be used to ensure a leak-tight seal between the nozzle adapter sealing rings and the nozzle spout.

6 CALIBRATION PROCEDURE

6.1 Vapor Volume Meter and Plumbing Hardware

6.1.1 Standard methods and equipment must be used to calibrate the meter. The calibration curves are to be traceable to National Bureau of Standards, or NIST standards. Calibration verification must be made annually, or as often as recommended by the manufacturer. Calibration documentation must be maintained with the testing equipment and must be available for review by TCEQ or local program investigators.

7 PRE-TEST PROTOCOL

7.1 Equipment must be tested on an “as found” basis unless otherwise specified by the applicable system certification. Liquid must not be drained or removed from the vapor passage of the hose or the vapor piping in the dispenser prior to performing the test. Doing so will bias the test towards compliance.

7.2 Ensure that the grounding strap is properly connected prior to dispensing gasoline.

7.3 Ensure that both the vapor supply and vapor return lines on the testing apparatus are free of any liquid (i.e. condensed gasoline) or debris.

7.4 Introduce a minimum of five (5) gallons of gasoline at the termination of the vapor return line(s). Gasoline must be introduced into each vapor return line or branch line that includes more than one dispenser or is greater than fifteen (15) feet in length. For all systems, sufficient fuel must be introduced to permit liquid gasoline to flow into the storage tank or, in the case of a Healy system, the gasoline collection device. If liquid collection points or condensate pots are part of the installation, drain them utilizing the automatic evacuation system if so equipped, or by hand pump if automatic evacuation system is not used in the installation.

8 TEST PROCEDURE

The procedures below must be performed by at least two persons familiar with the safety and mechanical principles of gasoline dispensing equipment. One person may be sufficient if it can be demonstrated that all necessary readings can be taken accurately with the equipment used. This test must be conducted without modification to any of the nozzles served by a common vapor motor or vacuum device.

8.1 Assemble the Equipment

8.1.1 Assemble equipment as shown in **Figure 106-1** and **Figure 106-2**.

8.2 Read and Record Initial Values

8.2.1 The air temperature (T) and barometric pressure (P_B) must be measured near the volume meter. Record these values in the appropriate column in **Form 106-1**.

8.2.2 Read and record the initial value on the volume meter (V_{INI}) immediately prior to dispensing gasoline. This device is extremely sensitive to any pressure drop across the meter orifice. A movement or slight breeze may cause a change in the reading. This initial reading must be taken prior to each test. Do not use the ending value of the previous test as the beginning value for the next, unless no change has occurred.

8.2.3 Set the stopwatch and the liquid dispensing meter (or totalizer) to read “0.00".

8.3 Begin Dispensing Gasoline

8.3.1 Fully engage the nozzle dispensing lever and hold for maximum flow rate of gasoline. For most systems, there will be a brief pause before the liquid flows and is registered by the dispenser volume meter.

8.4 Start the Stopwatch

8.4.1 As soon as the dispenser registers product flow, start the stopwatch.

8.5 Complete Dispensing

8.5.1 Dispense between four and one half (4.5) and five (5) gallons of gasoline. Simultaneously stop both the stopwatch and gasoline dispensing after the required amount of fuel has been dispensed.

8.6 Read and Record Final Values

8.6.1 Record the actual volume of gasoline dispensed (G) in the appropriate column of **Form 106-1**.

8.6.2 Record the actual elapsed time (S) (time required to dispense the volume of gasoline in 8.6.1) in the appropriate column of **Form 106-1**.

8.6.3 Read the final value on the vapor volume meter. Record this in the appropriate column (V_{END}) of **Form 106-1**. Calculate volume metered as V_{END}-V_{INI} and record this as V_M in **Form 106-1**.

8.6.4 Correct the vapor volume metered (V_M) to standard atmospheric conditions using the formula in § 11.1.

8.6.5 Calculate the V/L ratio using the formula in § 11.2.

8.7 Determine Compliance Status

If the calculated V/L ratio, as determined with the equation in section 11.2, is within the acceptable range specified in **Table 106-1** or the applicable CARB Executive Order or system certification, the fueling point complies with the specifications of the applicable system certification. No further testing is required at this fueling point.

If the calculated V/L ratio is outside the acceptable range by a V/L value less than or equal to 0.10, conduct the test two additional times at that fueling point. Do not make any modification to the gasoline dispensing or vapor recovery equipment until all three tests are completed. Adjustments to the V/L testing apparatus are permitted. Calculate the average of the three separate test runs. If the average V/L value is within the acceptable range, the fueling point complies with the testing requirements. If the average V/L value is outside the acceptable range, the fueling point does not comply with the specifications of the applicable CARB Executive Order or system certification.

If the calculated V/L value is outside the acceptable range by a V/L value of more than 0.10, the refueling point does not comply with the specifications of the applicable CARB Executive Order or system certification.

8.8 Testing Uni-Hose Dispensers

If the system tested utilizes a uni-hose configuration, each fueling point must be tested for every product grade for which there is a submersible pump. For example: if the system utilizes a uni-hose configuration with a blended midgrade product, each fueling point must be tested for the regular and premium product grades. The blended product grade (plus) does not require a separate V/L test, but the tester must confirm that the vacuum producing device is activated when that grade is dispensed.

9 QUALITY ASSURANCE/QUALITY CONTROL

This section reserved for future specifications.

10 RECORDING DATA

Form 106-1 is the field data sheet for reporting results from this procedure.

11 CALCULATING RESULTS

11.1 Correct the vapor volume metered to standard conditions (68° F and 29.92 in Hg)

$$V_{VS} = \frac{V_{VM}*PB*528}{(T+460)*29.92}$$

Where: V_{VS} = Volume of vapor corrected to standard conditions, ft^3

V_{VM} = Volume of Vapor/Gas Measured by the volume meter, ft^3

PB = Barometric pressure, inches mercury

T = Air temperature, °F

11.2 Calculate V/L

$$V/L = \frac{V_{VS}}{G*0.1337}$$

Where: V/L = Ratio of Volume of Vapors to Volume of Gasoline Dispensed

V_{VS} = Volume of vapor corrected to standard conditions, ft^3

G = Volume of gasoline dispensed, gallons

0.1337 = Conversion factor from gallons to cubic feet

12 REPORTING RESULTS

All values must be recorded in **Form 106-1**. Each calculated V/L ratio which complies with the specifications of the applicable CARB Executive Order or system certification will result in a passing test result for the respective fueling point. Each calculated V/L ratio which does not comply with the specifications of the applicable CARB Executive Order or system certification will result in a failing test result for the respective fueling point.

13 ALTERNATIVE TEST PROCEDURES

Test procedures, other than specified above, must only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to this test procedure.

14 REFERENCES

California Air Resources Board, February 1, 2001. TP-201.5: Air to Liquid Volume Ratio.

15 FIGURES

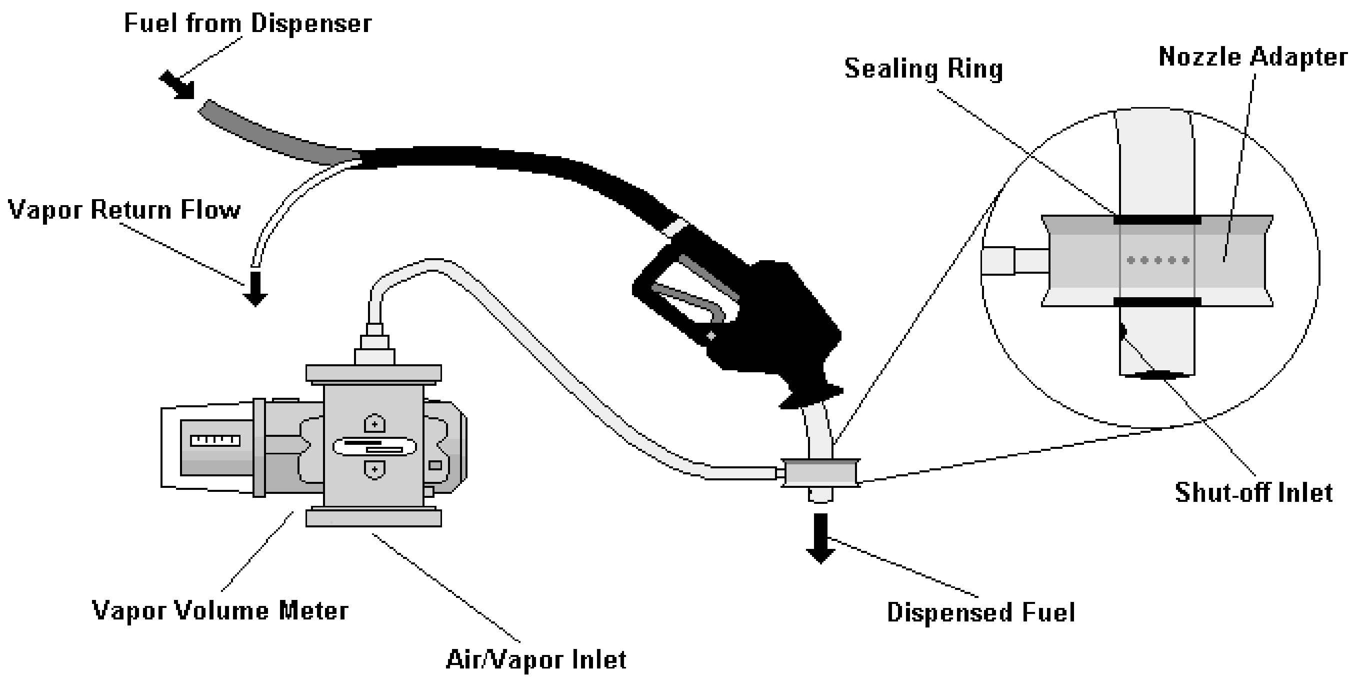
Figures 106-1 and 106-2, Forms 106-1 and 106-2, and Tables 106-1 and 106-2 are attached.

Table 106-1:
Acceptable Range of Values for V/L [1]

System Name	Executive Order	Acceptable V/L Range	
		Flowrate (GPM)	Range
Amoco	G-70-118 AA	7	≥1.11
		8	≥1.08
		9	≥1.06
		10	≥1.04
Gilbarco	G-70-150	>8	≥0.90
	G-70-150 AA	8-10	1.00-1.25
	G-70-150 AB	8-10	1.00-1.25
	G-70-150 AC	6-10	1.00-1.20
	G-70-150 AD	6-10	1.00-1.20
	G-70-150 AE	6-10	0.90-1.10 or 1.00-1.20 [2]
WayneVac	G-70-153 AA	7-10	0.90-1.10
	G-70-153 AB	7-10	0.90-1.10
	G-70-153 AC	7-10	0.90-1.10
	G-70-153 AD	7-10	0.90-1.10
Tokheim MaxVac	G-70-154	7-10	0.90-1.10
	G-70-154 AA	7-10	0.90-1.10
OPW Vapor EZ	G-70-163 AA	7-10	0.90-1.10
Hasstech	G-70-164 AA	6	1.40-2.40
		8	1.40-2.30
		10	1.40-2.15
Healy 600	G-70-165	7-10	0.90-1.10
Catlow	G-70-179	6-10	0.92-1.12
Catlow ICVN	G-70-188	6-10	0.90-1.10
Healy / Franklin VP-1000	G-70-191	6-10	1.00-1.20
SaberVac	G-70-196	6-10	0.85-1.05

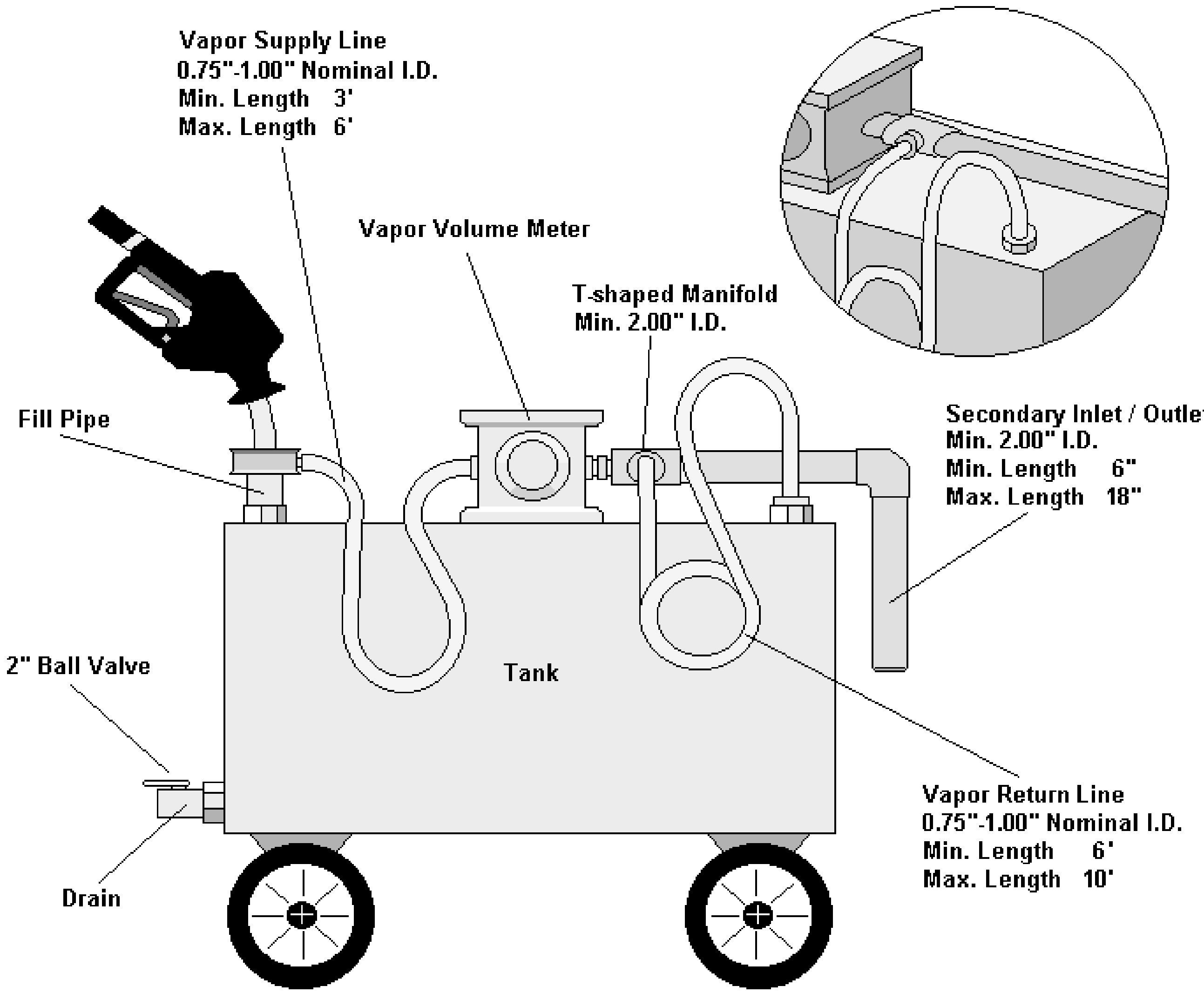
[1] If the acceptable value or range is not listed, refer to the applicable CARB Executive Order or other certification.
[2] Dependent upon nozzle type.

Figure 106-1:
V/L Test Equipment for Bootless Nozzles



Test fitting must cover the vapor recovery holes, but exclude the shut-off inlet.

Figure 106-2:
V/L Testing Apparatus



Configuration for V/L testing equipment. Hydrocarbon vapors created within the tank are routed back through the air volume meter and into the vapor recovery system. This configuration reduces the tester's exposure to hydrocarbons and decreases overall hydrocarbon emissions. Similar configurations which meet the specifications above are acceptable.

Form 106-1:
Vapor to Liquid Ratio Data

Test Date: ___/___/______
Page ___ of ___

Facility Name: ____ Facility ID Number: ______________________________

Nozzle Number	Fuel Grade	Make & Model	Flow Rate Calculation			Vapor Volume Metered			Ambient Conditions		Corrected Vapor Volume V_{VS} [3] (ft^3)	Calculated V/L Ratio		Pass [4] or Fail
			Gallons (G) Dispensed	Time (S) (seconds)	Flowrate [1] (GPM)	V_{END} (ft^3)	V_{INI} (ft^3)	V_M [2] (ft^3)	P_B (" Hg)	Temp (° F)		V/L	V/L Average (if needed)	

[1] Flowrate calculated as: GPM = (G/S)*60
[2] Vapor Volume Metered calculated as: $V_M = V_{END} - V_{INI}$
[3] Formula given for Corrected Volume in § 11.1
[4] Pass or Fail criteria found in **Table 106-1**

Form 106-2:
Air to Liquid Ratio Data for Hasstech Testing Equipment [1]

Test Date: ___/___/______
Page ___ of ___

Facility Name: ______________________________ Facility ID Number: ______________________________

Executive Order: ______________________________ Device Used: (circle one) VacuChek® VacuSmart®

Nozzle Number	Fuel Grade	Make & Model	Flow Rate Calculation			Flow Units *	Chart A/L Value * ①	A/L Correction Factor * ②	Correction Factor for Instrument Used * ③	Final Corrected A/L Value ①*②*③	Pass or Fail
			Gallons (G) Dispensed	Time (S) Seconds	Flow Rate[2] GPM						

[1] This reporting form to be used in conjunction with Hasstech VacuChek® or VacuSmart® devices
* Field not required if using VacuSmart® device

[2] Flowrate calculated as: GPM = (G/S)*60

Table 106-2:
Flow Rates (Shown as Gallons per Minute)

Gallons Dispensed	Time to Dispense (Seconds)															
	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30
5.0	5.0	5.2	5.4	5.6	5.8	6.0	6.3	6.5	6.8	7.1	7.5	7.9	8.3	8.8	9.4	10.0
5.2	5.2	5.4	5.6	5.8	6.0	6.2	6.5	6.8	7.1	7.4	7.8	8.2	8.7	9.2	9.8	10.4
5.4	5.4	5.6	5.8	6.0	6.2	6.5	6.8	7.0	7.4	7.7	8.1	8.5	9.0	9.5	10.1	10.8
5.6	5.6	5.8	6.0	6.2	6.5	6.7	7.0	7.3	7.6	8.0	8.4	8.8	9.3	9.9	10.5	11.2
5.8	5.8	6.0	6.2	6.4	6.7	7.0	7.3	7.6	7.9	8.3	8.7	9.2	9.7	10.2	10.9	11.6
6.0	6.0	6.2	6.4	6.7	6.9	7.2	7.5	7.8	8.2	8.6	9.0	9.5	10.0	10.6	11.2	12.0
6.2	6.2	6.4	6.6	6.9	7.2	7.4	7.8	8.1	8.5	8.9	9.3	9.8	10.3	10.9	11.6	12.4
6.4	6.4	6.6	6.9	7.1	7.4	7.7	8.0	8.3	8.7	9.1	9.6	10.1	10.7	11.3	12.0	12.8
6.6	6.6	6.8	7.1	7.3	7.6	7.9	8.3	8.6	9.0	9.4	9.9	10.4	11.0	11.6	12.4	13.2
6.8	6.8	7.0	7.3	7.6	7.8	8.2	8.5	8.9	9.3	9.7	10.2	10.7	11.3	12.0	12.8	13.6
7.0	7.0	7.2	7.5	7.8	8.1	8.4	8.8	9.1	9.5	10.0	10.5	11.1	11.7	12.4	13.1	14.0
7.2	7.2	7.4	7.7	8.0	8.3	8.6	9.0	9.4	9.8	10.3	10.8	11.4	12.0	12.7	13.5	14.4
7.4	7.4	7.7	7.9	8.2	8.5	8.9	9.3	9.7	10.1	10.6	11.1	11.7	12.3	13.1	13.9	14.8
7.6	7.6	7.9	8.1	8.4	8.8	9.1	9.5	9.9	10.4	10.9	11.4	12.0	12.7	13.4	14.2	15.2
7.8	7.8	8.1	8.4	8.7	9.0	9.4	9.8	10.2	10.6	11.1	11.7	12.3	13.0	13.8	14.6	15.6
8.0	8.0	8.3	8.6	8.9	9.2	9.6	10.0	10.4	10.9	11.4	12.0	12.6	13.3	14.1	15.0	16.0
8.2	8.2	8.5	8.8	9.1	9.5	9.8	10.3	10.7	11.2	11.7	12.3	12.9	13.7	14.5	15.4	16.4
8.4	8.4	8.7	9.0	9.3	9.7	10.1	10.5	11.0	11.5	12.0	12.6	13.3	14.0	14.8	15.8	16.8
8.6	8.6	8.9	9.2	9.6	9.9	10.3	10.8	11.2	11.7	12.3	12.9	13.6	14.3	15.2	16.1	17.2
8.8	8.8	9.1	9.4	9.8	10.2	10.6	11.0	11.5	12.0	12.6	13.2	13.9	14.7	15.5	16.5	17.6
9.0	9.0	9.3	9.6	10.0	10.4	10.8	11.3	11.7	12.3	12.9	13.5	14.2	15.0	15.9	16.9	18.0
9.2	9.2	9.5	9.9	10.2	10.6	11.0	11.5	12.0	12.5	13.1	13.8	14.5	15.3	16.2	17.2	18.4
9.4	9.4	9.7	10.1	10.4	10.8	11.3	11.8	12.3	12.8	13.4	14.1	14.8	15.7	16.6	17.6	18.8
9.6	9.6	9.9	10.3	10.7	11.1	11.5	12.0	12.5	13.1	13.7	14.4	15.2	16.0	16.9	18.0	19.2
9.8	9.8	10.1	10.5	10.9	11.3	11.8	12.3	12.8	13.4	14.0	14.7	15.5	16.3	17.3	18.4	19.6

Table 106-2 (continued):
Flow Rates (Shown as Gallons per Minute)

Gallons Dispensed	Time to Dispense (Seconds)															
	60	58	56	54	52	50	48	46	44	42	40	38	36	34	32	30
10.0	10.0	10.3	10.7	11.1	11.5	12.0	13.9	13.0	13.6	14.3	15.0	15.8	16.7	17.6	18.8	20.0
10.2	10.2	10.6	10.9	11.3	11.8	12.2	14.2	13.3	13.9	14.6	15.3	16.1	17.0	18.0	19.1	20.4
10.4	10.4	10.8	11.1	11.6	12.0	12.5	14.4	13.6	14.2	14.9	15.6	16.4	17.3	18.4	19.5	20.8
10.6	10.6	11.0	11.4	11.8	12.2	12.7	14.7	13.8	14.5	15.1	15.9	16.7	17.7	18.7	19.9	21.2
10.8	10.8	11.2	11.6	12.0	12.5	13.0	15.0	14.1	14.7	15.4	16.2	17.1	18.0	19.1	20.2	21.6
11.0	11.0	11.4	11.8	12.2	12.7	13.2	15.3	14.3	15.0	15.7	16.5	17.4	18.3	19.4	20.6	22.0
11.2	11.2	11.6	12.0	12.4	12.9	13.4	15.6	14.6	15.3	16.0	16.8	17.7	18.7	19.8	21.0	22.4
11.4	11.4	11.8	12.2	12.7	13.2	13.7	15.8	14.9	15.5	16.3	17.1	18.0	19.0	20.1	21.4	22.8
11.6	11.6	12.0	12.4	12.9	13.4	13.9	16.1	15.1	15.8	16.6	17.4	18.3	19.3	20.5	21.8	23.2
11.8	11.8	12.2	12.6	13.1	13.6	14.2	16.4	15.4	16.1	16.9	17.7	18.6	19.7	20.8	22.1	23.6
12.0	12.0	12.4	12.9	13.3	13.8	14.4	16.7	15.7	16.4	17.1	18.0	18.9	20.0	21.2	22.5	24.0
12.2	12.2	12.6	13.1	13.6	14.1	14.6	16.9	15.9	16.6	17.4	18.3	19.3	20.3	21.5	22.9	24.4
12.4	12.4	12.8	13.3	13.8	14.3	14.9	17.3	16.2	16.9	17.7	18.6	19.6	20.7	21.9	23.2	24.8
12.6	12.6	13.0	13.5	14.0	14.5	15.1	17.5	16.4	17.2	18.0	18.9	19.9	21.0	22.2	23.6	25.2
12.8	12.8	13.2	13.7	14.2	14.8	15.4	17.8	16.7	17.5	18.3	19.2	20.2	21.3	22.6	24.0	25.6
13.0	13.0	13.4	13.9	14.4	15.0	15.6	18.0	17.0	17.7	18.6	19.5	20.5	21.7	22.9	24.4	26.0
13.2	13.2	13.7	14.1	14.7	15.2	15.8	18.4	17.2	18.0	18.9	19.8	20.8	22.0	23.3	24.8	26.4
13.4	13.4	13.9	14.4	14.9	15.5	16.1	18.6	17.5	18.3	19.1	20.1	21.2	22.3	23.6	25.1	26.8
13.6	13.6	14.1	14.6	15.1	15.7	16.3	18.9	17.7	18.5	19.4	20.4	21.5	22.7	24.0	25.5	27.2
13.8	13.8	14.3	14.8	15.3	15.9	16.6	19.1	18.0	18.8	19.7	20.7	21.8	23.0	24.4	25.9	27.6
14.0	14.0	14.5	15.0	15.6	16.2	16.8	19.5	18.3	19.1	20.0	21.0	22.1	23.3	24.7	26.2	28.0

TXP-107: Determination of Proper Nozzle Operation for Booted Healy Vapor Recovery Systems at Gasoline Dispensing Facilities

1 APPLICABILITY

Definitions common to all test procedures are contained in Title 30 Texas Administrative Code (30 TAC) Section (§) 115.010, Subchapter A of Regulation V, “Control of Volatile Organic Compounds.” To obtain copies of TCEQ rules, go to **www.tnrcc.state.tx.us/oprd/rules/index.html**, call (512) 239-0028, or write to:

TCEQ Publications, MC 195
PO Box 13087
Austin TX 78711-3087

This test procedure is used to determine the proper operation of booted nozzles installed as part of a Healy vapor recovery system. By measuring the pressure exerted by the vapors during a dispensing episode, one can verify an aspect of proper system operation.

The compliance standard of pressure measured in the nozzle boot for the Healy system was determined during the certification phase of a model system. Such certification testing is conducted by the California Air Resources Board (CARB) or other third party, who subsequently reports the appropriate values. This test procedure is used to determine compliance with the nozzle boot pressure performance standard of a Healy vapor recovery system after the system is installed at a GDF.

This test procedure is applicable to all installations of booted nozzle Healy assist systems at GDFs utilizing Underground Storage Tank Systems (USTs) or Aboveground Storage Tank Systems (ASTs).

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The pressure in the nozzle boot is easily measured during a refueling episode if a test can is used that is outfitted with a proper fill tube and pressure gauge.

3 BIASES AND INTERFERENCES

None noted.

4 SENSITIVITY, RANGE, AND PRECISION

The values of the determinations required by this test procedure are well within the limits of sensitivity, range, and precision of the specified equipment.

5 EQUIPMENT

5.1.1 Outfit a gasoline test tank as per **Figure 107-1**. The tank should hold approximately 25 gallons of gas, and must be properly grounded when used. This volume should permit the operator to test several nozzles before having to dump the captured gas into the proper storage tank. The test tank must be fitted with a magnehelic pressure/vacuum gauge with a range of 1-0-1 inches water column (WC).

6 CALIBRATION PROCEDURE

6.1 Verify proper calibration of the 1-0-1 pressure/vacuum gauge against a standard at least weekly. Retain calibration records indefinitely.

7 PRE-TEST PROTOCOL

7.1.1 Equipment must be tested on an “as found” basis unless otherwise specified by an applicable certification procedure.

8 TEST PROCEDURE

8.1 Assemble the Equipment as shown in **Figure 107-1**.

8.2 Pre-load Test Tank

8.2.1 With the test tank drain hose valve closed, dispense approximately 2 gallons of gasoline into the tank. Replace the cap on the test tank and vigorously shake for at least 30 seconds. The objective is to achieve as closely as possible a condition of saturated vapor space within the test tank prior to running the actual test.

8.3 Dispense Gasoline

8.3.1 Dispense, at full flow rate, at least 5 gallons of gasoline. Observe the pressure gauge, and record the total gallons dispensed and the average pressure or vacuum value at each full gallon dispensed in **Form 107-1.**

8.4 Dump the gasoline into the proper storage tank as required.

8.5 Repeat steps 8.1 through 8.4 for each nozzle at the facility.

9 QUALITY ASSURANCE/QUALITY CONTROL

This section reserved for future specifications.

10 RECORDING DATA

Form 107-1 is the field data sheet for reporting data from this procedure.

11 CALCULATING RESULTS

12.1 Acceptable Range of Values for Nozzle Boot Pressure

12.1.1 Readings of between +1/4 inch water column (WC) and -1/2 inch WC are normal. If a value exceeds this range, in either direction, the nozzle fails the test and must be repaired or replaced.

Note: The pressure may exceed +1/4 inch WC at the beginning of the test due to failure to achieve full vapor saturation of the vapor space in the test tank. If this occurs, retest after attempting to create saturated conditions in the test tank per section 8.2.1 above.

13 Alternative Test Procedures

Test procedures, other than specified above, must only be used if prior approval is obtained from the Executive Director of the TCEQ. In order to secure the TCEQ Executive Director's approval of an alternative test procedure, the proponent is responsible for demonstrating to the TCEQ Executive Director's satisfaction that the alternative test procedure is equivalent to this test procedure.

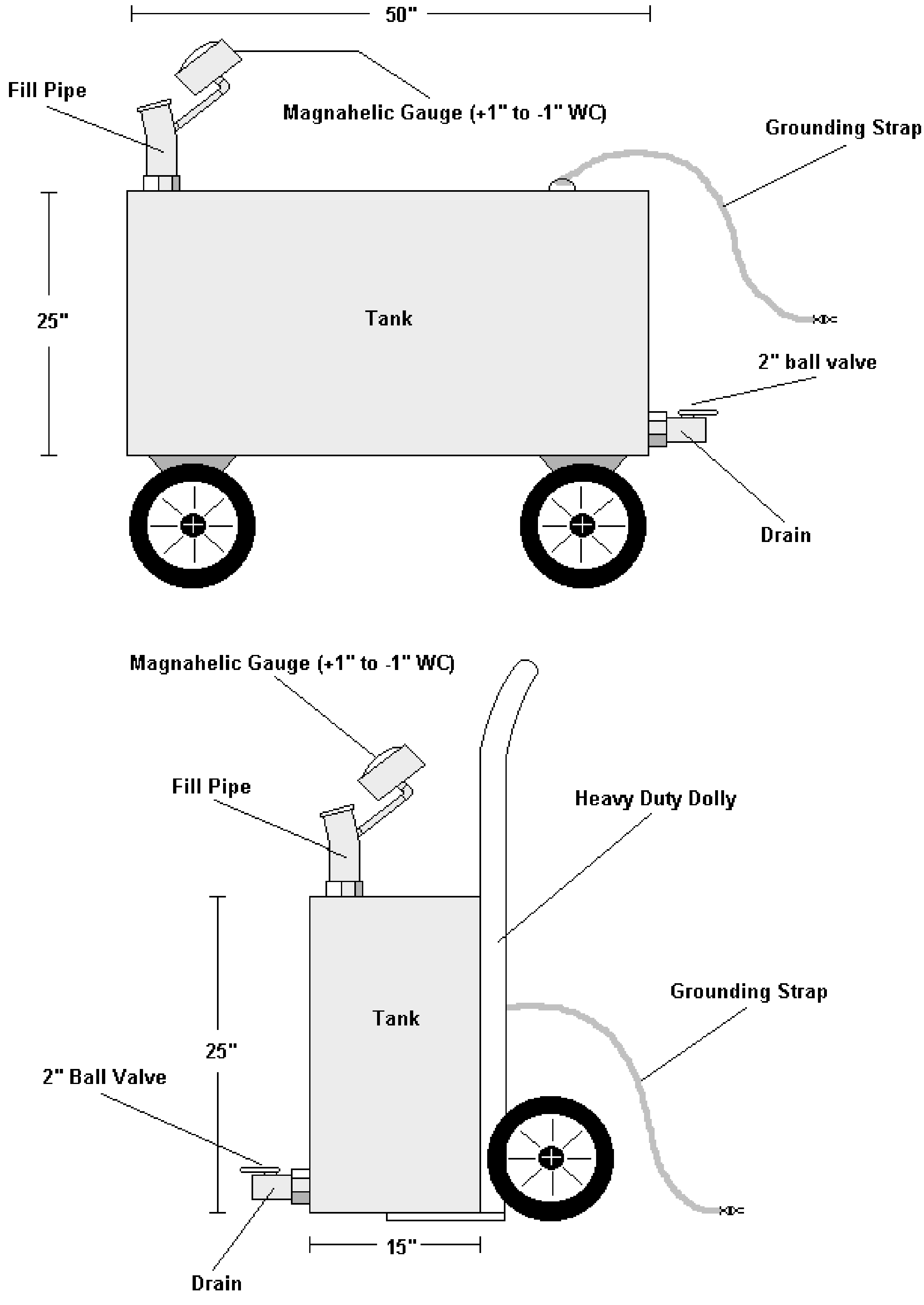
14 References

None.

15 Figures

Figure 107-1 and Form 107-1 are attached.

Figure 107-1:
Gasoline Test Tank for Healy Booted Nozzles



Recommended configurations for Healy nozzle test tanks. Similar configurations which meet the specifications are acceptable.

Form 107-1:
Determination of Healy Booted Nozzle Operation

Test Date: ___/___/______
Page ___ of ___

Facility Name: ________________________________ Facility ID Number: _______________________

Nozzle		Gallons Dispensed	Pressure / Vacuum ("WC) During Dispensing						Pass [1] or Fail
Number	Fuel Grade		Gal. 1	Gal. 2	Gal. 3	Gal. 4	Gal. 5	Average	

[1] Nozzle passes if the average Pressure / Vacuum value is between +1/4 and -1/2 inches of WC, and fails if the value is outside this range.