

California Environmental Protection Agency



Vapor Recovery Test Procedures

TP - 201.4

**DETERMINATION OF DYNAMIC PRESSURE PERFORMANCE OF
VAPOR RECOVERY SYSTEMS OF
DISPENSING FACILITIES**

Adopted: April 12, 1996

**California Environmental Protection Agency
Air Resources Board**

Vapor Recovery Test Procedure

TP-201.4

**Determination of Dynamic Pressure Performance of
Vapor Recovery Systems of
Dispensing Facilities**

1 APPLICABILITY

Definitions common to all certification and test procedures are in:

**D-200 Definitions for
Certification Procedures and
Test Procedures for
Vapor Recovery Systems**

For the purpose of this procedure, the term "ARB" refers to the State of California Air Resources Board, and the term "ARB Executive Officer" refers to the Executive Officer of the ARB or his or her authorized representative or designate.

This test procedure can be used to quantify the dynamic pressure (back-pressure) in the vapor path leading from the dispensing nozzle to the storage tank. The dynamic pressure associated with vehicle fueling is determined by various alternative procedures, one of which is applied as appropriate for the operational characteristics of the subject vapor recovery system.

This test procedure is used to determine the static pressure performance standard of a vapor recovery system during the certification process and subsequently to determine compliance with that performance standard for any installations of such a system.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The principle of this test procedure is to determine the dynamic pressure of a vapor recovery system at known dispensing flow rates. Some alternative procedures are provided and one procedure shall be chosen for application appropriate to the operational characteristics of the subject vapor recovery system. A novel test procedure may be developed and used which incorporates some aspects of the procedures provided.

3 BIASES AND INTERFERENCES

- 3.1 Any leaks in the nozzle vapor path, vapor hose, or underground vapor return piping will result in erroneously low dynamic back pressure measurements.
- 3.2 The same procedure must be used to:
 - (1) determine a dynamic pressure performance standard and
 - (2) determine compliance with that standard.

4 SENSITIVITY, RANGE, AND PRECISION

4.1 Sensitivity

4.1.1 Inclined Liquid Manometers and Electronic Pressure Meters

Maximum incremental graduations at, above, and below a pressure observation shall be 0.01 inches water column ("WC).

Each such graduation shall be defined as the resolution, P_{Res} , of a pressure observation.

The maximum bias shall be plus-or-minus one-half percent ($\pm 0.5\%$) of full-scale.

4.1.2 Mechanical Spring Diaphragm Pressure Gauges

The minimum diameter of the pressure gauge face shall be 4 inches.

Maximum incremental graduations at, above, and below a pressure observation shall be 0.05 "WC.

Each such graduation shall be defined as the resolution, P_{Res} , of a pressure observation.

The maximum bias shall be plus-or-minus two percent ($\pm 2\%$) of full-scale.

4.2 Range

4.2.1 Pressure

The pressure range for §8, Procedure 1, is 0.16 to 0.62 "WC.

4.2.2 Volume Flow

The volume flow range for §8, Procedure 1, is 40 to 80 cubic feet per hour.

4.3 Precision

The precision of a pressure observation shall affect the compliance status of a system as described below, where:

$P_{\text{req@Q}}$ = pressure requirement, at a specified volume flow, per the appropriate certification procedure, rounded to the nearest integral multiple of P_{Res} ,

and

$P_{\text{obs@Q}}$ = pressure observation, at the specified volume flow.

The precision for a pressure observation shall be one-half of P_{Res} .

$P_{\text{obs@Q}}$ shall be an integral multiple of P_{Res} .

Non-Compliance with a pressure requirement shall be determined when, at a specified volume flow:

$$P_{\text{Req@Q}} - P_{\text{Obs@Q}} \geq P_{\text{Res}}$$

5 EQUIPMENT

5.1 Nitrogen Pressure Drop Test Unit

See Figure 1; the ranges on the pressure gauges are for example only.

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

Use a high pressure nitrogen cylinder capable of maintaining a pressure of 2000 psig and equipped with a compatible two-stage pressure regulator. Use commercial grade nitrogen.

5.2 Rotameter(s)

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

5.3 Pressure gauge(s)

Use pressure measuring device (transducer, inclined manometer or Magnahelic gauge) with a design range suitable for the pressure being measured.

For the nitrogen pressure drop test unit (Figure 1 for example), use two differential pressure gauges equipped with toggle valves connected to the high pressure inlets.

5.4 Hand Pump

Use a gasoline compatible hand pump to drain condensate pots.

6 CALIBRATION PROCEDURE

7 PRE-TEST PROTOCOL

7.1 Location of Test Site

Prototype systems will be located within 100 miles of Sacramento for testing. Other locations may be accepted at the discretion of the ARB Executive Officer.

7.2 Specification of Test, Challenge, and Failure Modes

The specification of test, challenge, and failure modes such as the number of liquid transfer episodes, volume and volumetric rate of liquid transfer, storage tank volumes, etc. shall be done according to the principles of CP-201 § 5 for the testing and evaluation of vapor recovery equipment.

7.3 System and Facility Preparation

System equipment and components shall be completely operational and any storage tanks involved in the test shall be filled to the appropriate volume a minimum of 24 hours prior to the scheduled test.

In addition, the system and facility shall be prepared to operate according to any specified test, challenge, and failure modes.

7.4 Check Facility Operating Mode

7.4.1 (1) If performing a test during the certification process, examine the subject facility to determine the most appropriate application of the alternative test procedures provided. If none of these are appropriate, document those features necessary for incorporation into a novel test procedure. If reasonable and practical, make field revisions to the most appropriate procedure and proceed. Otherwise report the need for novel test procedure development.

(2) If performing a test to determine the compliance status of a subject facility, use the test procedure which was specified during the certification process.

7.4.2 For those Phase II systems which do not utilize a remote vapor check valve, assemble the apparatus as shown in Figure 1 for example, ensuring that the riser shut-off valve on the test equipment is closed. If a Hirt Phase II system is used, the vacuum producing device shall be turned off during this test.

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

7.4.4 Disconnect and drain the vapor hose for all dispensers to be tested. Pour two (2) gallons of gasoline into each vapor return riser. Reconnect vapor hose. Allow fifteen (15) minutes for liquid in the vapor return piping to drain. For Phase II systems which do not employ a remote vapor check valve, the 2 gallons of gasoline may be introduced through the vapor passage in the nozzle.

7.4.5 Completely drain all gasoline from the spout and bellows, if appropriate.

- 7.4.6 For those vapor piping configurations which utilize a condensate pot, drain the pot prior to testing.
- 7.4.7 For Procedures 2 and 3 the Phase I vapor poppet shall be propped open in such a manner that the valve is not damaged.

7.5 Check Equipment and Supplies

The test equipment must be leak-checked prior to use.

For the nitrogen pressure drop test unit, plug the nozzle end of the auto fill pipe, open the nitrogen cylinder and the toggle valves on the magnahelic 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 H₂O, in five minutes, is considered acceptable.

8 TEST PROCEDURE

The facility and system shall be prepared to operate according to any specified test, challenge, and failure modes.

Each test procedure is based on direct measurements only; no sampling, recovery, or analysis is involved.

8.1 Procedure 1 - Nitrogen Pressure Test

(Systems *without* a Remote Vapor Check Valve)

Phase II systems which do not utilize a remote vapor check valve may be tested using the following procedure. Insert the nozzle into the fill pipe of the nitrogen pressure drop test assembly, ensuring that a tight seal at the fillpipe/nozzle interface is achieved. Ensure that the riser shut-off valve on the test equipment is closed.

- 8.1.1 Close both toggle valves and connect the nitrogen supply.
- 8.1.2 Open the nitrogen supply, set the delivery pressure to 10 psig, and use the flowmeter control valve to adjust the flowrate to 40 CFH.
- 8.1.3 Open the toggle valve on the 0 to 0.5 inches H₂O gauge. If the pressure is greater than 0.5 inches H₂O, close this valve and use, for example, the 0 to 2.0 inches H₂O gauge.
- 8.1.4 A pulsating gauge needle indicates nitrogen passing through a liquid obstruction in the vapor return system. If this occurs, close the flowmeter control valve, disengage the nozzle and redrain the nozzle and hose assembly. Re-engage the nozzle, open the flowmeter control valve and repeat the test.
- 8.1.5 Repeat Sections 8.1.2 through 8.1.4 for nitrogen flowrates of 60 and 80 CFH.
- 8.1.6 Close and replace the dust cover on the Phase I poppet.
- 8.1.7 Record data as instructed in the section, "RECORDING DATA".

8.2 Procedure 2 - Torus Pressure Test

For some systems, the dynamic pressure can be measured directly during dispensing into vehicles using apparatus assembled according to the design in Figure 2; the range on the pressure gauge is for example only.

Warning: This procedure shall only be used as a screening procedure for the other procedures provided. If this is the only procedure with which a system is compatible, then such system shall be considered to be incompatible with the application of TP-201.4 unless an alternative procedure is developed per § 13.

8.2.1 Measure the dispensing rate and dynamic pressure for any fueling episode during which four or more gallons is dispensed.

8.2.2 Collect data at high, mid-range, and low dispensing rates for five dispensing episodes at each rate.

8.2.3 Record the actual dispensing rate and dynamic pressure for each dispensing episode.

8.3 Procedure 3 - Fixed Volume Pressure Test

For some systems, the dynamic pressure can be measured directly during dispensing into a surrogate for a vehicle tank using apparatus assembled according to the design in Figure 3; the range on the pressure gauge is for example only.

In theory, this procedure yields the least direct measurement of dynamic pressure performance of the procedures provided; yet in some cases the other procedures can not be applied practically. The practical requirements for the application of this procedure are:

- (1) the fixed volume (can, tank, etc.) can be sealed around the nozzle product dispensing path and the vapor return path;
- (2) the dispensing rate can be known and controlled for repeated dispensing episodes of half of the fixed volume;
- (3) a characteristic and repeatable dynamic pressure can be observed for repeated dispensing episodes of half of the fixed volume;
- (4) the variation of the results of this procedure can be correlated with the variation of efficiency test results on the same vapor recovery equipment.

8.3.1 Measure the dispensing rate and dynamic pressure for any fueling episode during which half of the fixed volume is dispensed.

8.3.2 Collect data at high, mid-range, and low dispensing rates for five dispensing episodes at each rate.

8.3.3 Record the actual dispensing rate and dynamic pressure for each dispensing episode.

9 QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

This section is reserved for future specification.

10 RECORDING DATA

Figure 4, for example, is the field data sheet for the procedures provided.

Data sheets for other procedures shall be composed in a similar manner, based on field operating parameters.

The following information shall be recorded on the field data sheet:

- Facility Identification and Address
- Pump Number and Product Grade
- Nozzle Make and Model
- Nitrogen Flowrate, CFH
- Dynamic Back Pressure, inches H₂O

11 CALCULATING RESULTS

Calculate the average dynamic pressure for each dispensing rate tested.

12 REPORTING RESULTS

12.1 Procedure 1

The maximum allowable average dynamic back pressures for a system, with the dry breaks open, are as follows:

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

The dynamic pressure performance shall be reported as the average dynamic pressure at each flow rate.

The dynamic pressure performance measured during certification shall be the performance standard for any installation of the subject vapor recovery system tested.

12.2 Procedure 3

The dynamic pressure performance shall be reported as the average dynamic pressure at each flow rate.

The dynamic pressure performance measured during certification shall be the performance standard for any installation of the subject vapor recovery system tested.

13 ALTERNATIVE TEST PROCEDURES

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

- (1) Such approval shall be granted on a case-by-case basis only. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval shall not be granted in subsequent cases without a new request for approval and a new demonstration of equivalency.
- (2) Documentation of any such approvals, demonstrations, and approvals shall be maintained in the ARB Executive Officer's files and shall be made available upon request.

14 REFERENCES

This section is reserved for future specification.

15 EXAMPLE FIGURES AND FORMS

Each figure or form provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the figures or forms are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

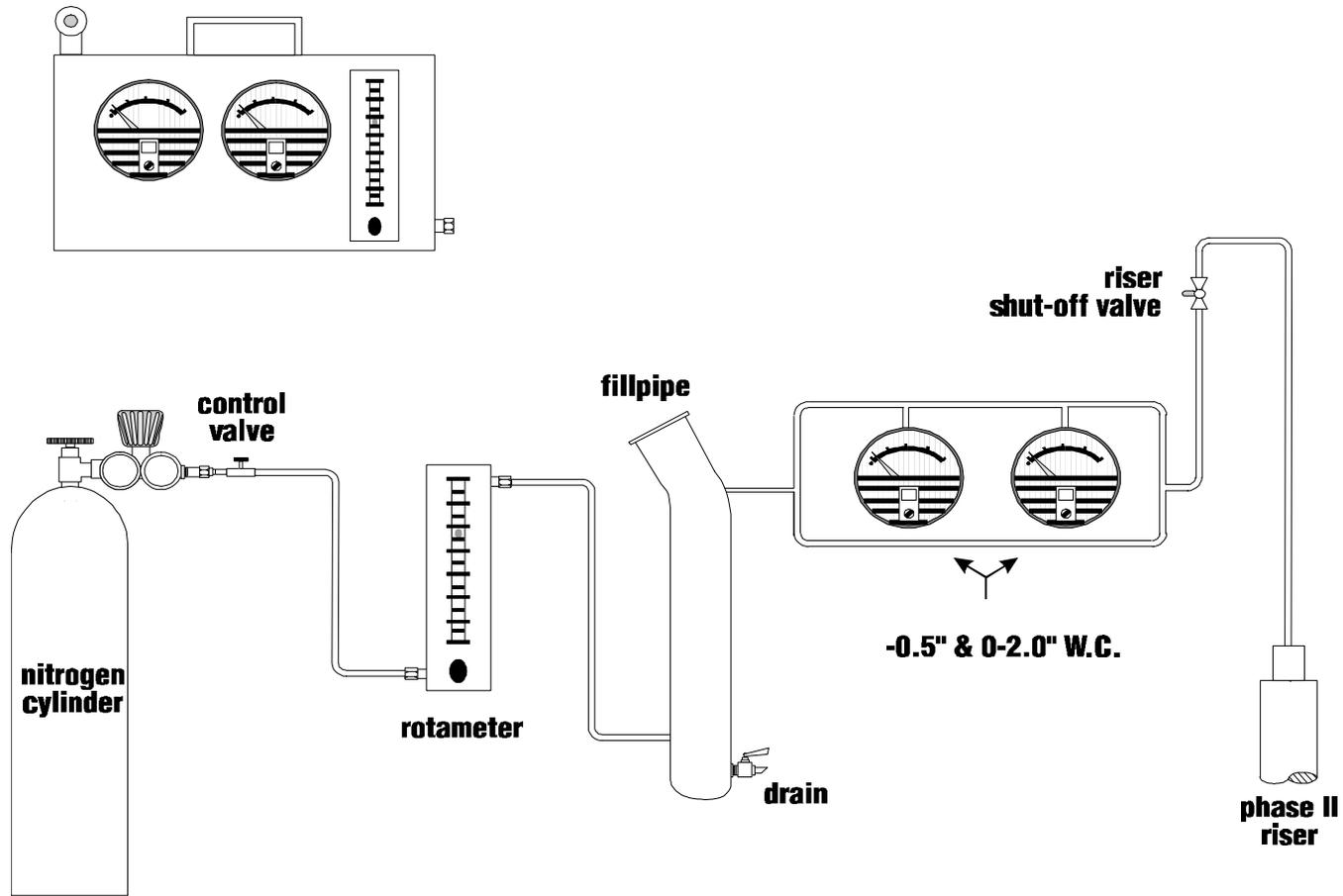
Figure 1
Nitrogen Pressure Test Assembly

Figure 2
Torus Pressure Test Assembly

Figure 3
Fixed-Volume Pressure Test Assembly

Figure 4
Field Data Form

FIGURE 1



TP 201.4 F.1/ B. CORDOVA '95

FIGURE 2

Torus Pressure Test Assembly

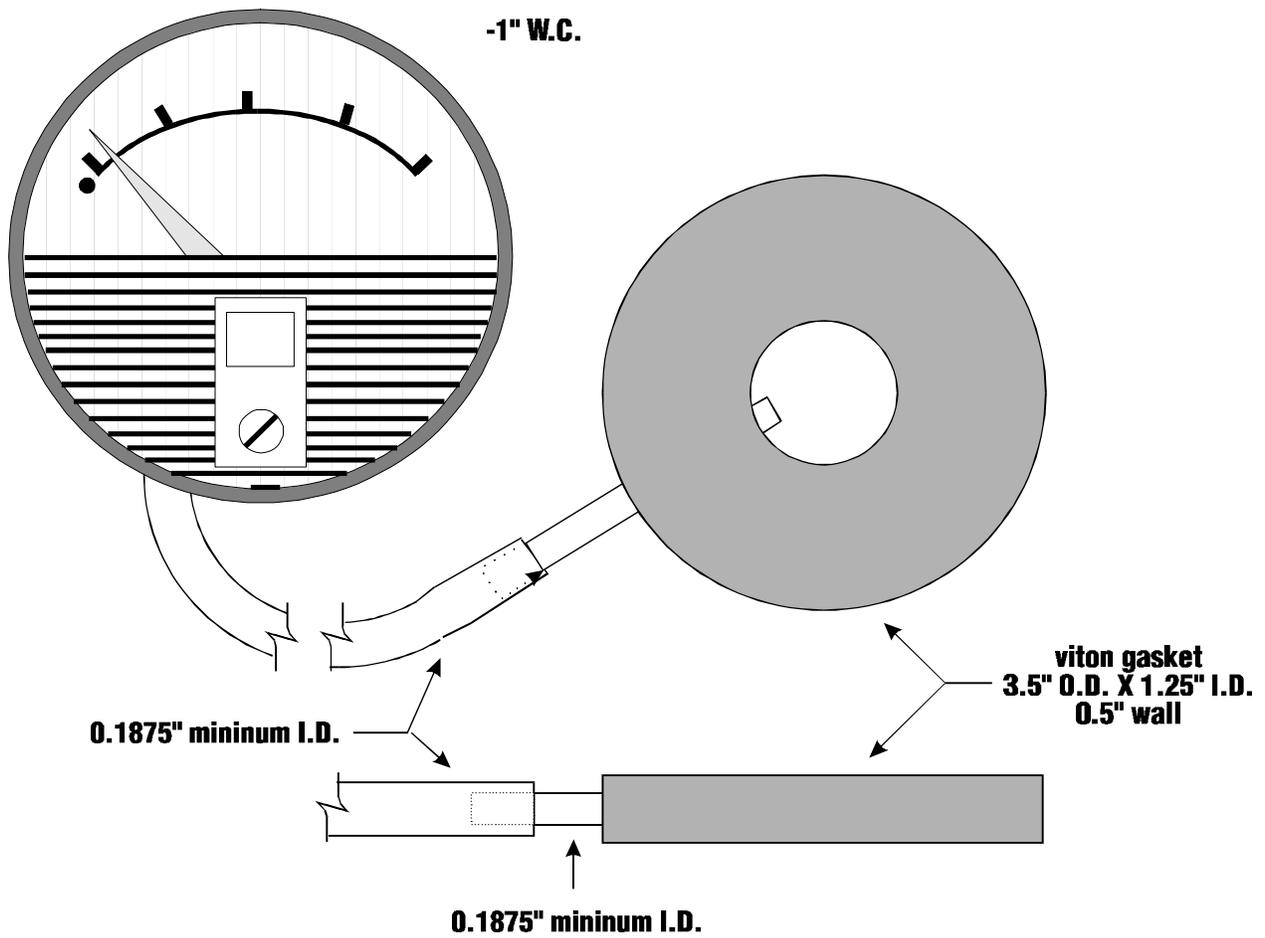


FIGURE 3
Fixed Volume Pressure Test Assembly

