Recommendations for Owners and Installers on the Installation and Testing of a Stage II Vapor Recovery System

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Since the beginning of the Stage II vapor recovery program in Vermont the Air Pollution Control Division (APCD) has observed numerous initial compliance tests of Stage II vapor recovery systems. From these observations we have developed the following list of common problems and suggestions relating to installation and testing of Stage II systems.

I. Installation of Underground Vapor Recovery Piping

Problems with the installation of underground vapor recovery piping, if not detected before the piping is backfilled and paved over, can result in expensive repairs later on. There are a number of important factors to keep in mind when installing underground vapor recovery piping as summarized below:

- Proper Pitch

It is very important that the vapor recovery piping have uniform slope from the dispensers to the underground tanks so that any liquid in the piping will drain to the tanks. Liquid gasoline may be present in the vapor return piping from topping off when dispensing gasoline or from condensation of vapors. If the piping is not sloped toward the tanks, this liquid gasoline can accumulate and cause a partial or total blockage of the vapor return pathway. This is especially significant for balance type Stage II systems. In order to avoid this situation, a slope of 1/4 inch per foot is preferred but there should be at least 1/8 inch per foot. As a rule of thumb, the California Air Resources Board (CARB) has determined that 1 to 2 gallons of condensate will collect in the vapor recovery piping for every 10,000 gallons of product pumped. This figure only includes true condensate, that is, gasoline vapor that condenses underground back into liquid. Any liquid gasoline that may enter the vapor recovery piping from topping off or overfilling would be an additional volume.

In some installations it may not be possible to achieve the proper pitch due to individual site conditions. In these situations an alternative is to install a condensate trap (drop-out tank) to allow for a built-in low spot where any liquid can accumulate without blocking the vapor return path. When installing a condensate trap it should be equipped with a means to automatically remove accumulated liquid. This is generally achieved by use of a siphon line that is connected to the submersible pump used to supply gasoline to the dispensers. The Vermont Underground Storage Tank Program requires that the condensate trap and the siphon line be installed with secondary containment unless they grant a specific waiver. Typically, this would be accomplished through use of a double wall tank or a containment sump for the condensate trap and double wall piping for the siphon line.

- Flexible vapor return piping

Use of flexible piping for underground piping can cause problems due to the greater likelihood of the piping sagging and creating a low spot where gasoline can accumulate.

- Piping Diameter

Use of larger diameter vapor return piping (such as three inch piping) can help to avoid liquid blockage problems if there are some dips or low spots in the piping. Most CARB executive orders certifying Stage II systems now require three inch diameter piping. With the larger diameter, some liquid gasoline may be able to accumulate without causing a blockage sufficient to compromise the efficiency of the vapor recovery system.

- Preliminary Testing

It is highly recommended that preliminary testing be conducted before backfilling the vapor recovery piping. A preliminary pressure decay test of the system can detect leaks on the tank top or in the vapor recovery piping while a dynamic backpressure test will confirm a clear vapor path from the dispensers to the tanks. If problems are discovered, they can be corrected before backfilling. Compliance testing will still be required after the system is backfilled and paved over, so this testing may be viewed as an unnecessary expense. But if a problem with the vapor recovery piping is discovered before it is covered over, it is money well spent to avoid having to dig it up again later.

II. Manifolding of Tank Vapor Spaces

Manifolding of the vapor spaces of the gasoline storage tanks is required for all installations of Stage II vapor recovery controls. Any new installation of Stage II equipment, that includes the underground vapor recovery piping, must meet the standards for this equipment specified in the CARB executive order for that system. These executive orders require that the vapor return lines be manifolded below ground at the tanks. At stations where a vacuum-assist system is being installed and the underground vapor recovery piping was installed prior to August 1, 1997, with a vapor return line directly to only one tank, an above-ground manifold of the vent lines is permissible. By manifolding the vent pipes, the vapor spaces of all the tanks are connected to allow vapors to be dispersed among the tanks. For all stations using a balance system, the manifold must be below ground.

III. Coaxial Stage I Vapor Recovery Controls With Vacuum-Assist Stage II Systems

All new installations of vacuum-assist Stage II systems, that include the underground vapor recovery piping, will be required to install a two-point Stage I system. The APCD will allow existing coaxial Stage I controls to remain in use with vacuum-assist Stage II controls where the underground vapor recovery piping was installed prior to August 1, 1997. This is a deviation from the provisions in the CARB executive orders that only allow poppeted coaxial Stage I systems to be used with vacuum-assist Stage II controls.

IV. Swivel Fill Adaptors and Other Devices that Prevent Loosening of Fill Adaptors

The fill adaptor is a very common source of vapor leaks since it is prone to loosening over time from the repeated connecting, draining and disconnecting of the product delivery hose on gasoline tank trucks. Results of testing at gas stations carried out under contract to the APCD indicated that the fill adaptor was one of the most common sources of vapor leaks. The CARB has approved several swivel fill adaptors or locking clamps that prevent unintentional loosening of fill adaptors and use of these devices is now required for all vacuum-assist Stage II vapor recovery systems.

A potential concern with locking clamps is that the torque from the fuel delivery hose can be transferred to the riser pipe and could cause the riser pipe to turn and loosen. To address this concern, the current CARB certifications require the riser to be secured to the spill bucket. There are two methods to accomplish this depending upon the design of the spill bucket and the locking clamp. One method is to use thread sealant on the nipple where it threads into the spill bucket. A second method can be used with the locking clamp manufactured by OPW when it is used with the appropriate OPW spill bucket. This locking clamp is designed to be used in pairs where the ears of one clamp (ears facing upward) fit into notches on the fill adaptor to lock the adaptor to the riser while the ears of the second clamp (ears facing downward) fit into notches in the spill bucket to lock the riser pipe to the spill bucket. Alternatively, the OPW locking clamp can also be used singly with the use of thread sealant as described above. If you are considering the use of a locking clamp, be aware of the possibility of loosening the riser pipe if it is not locked to the spill bucket by use of thread sealant and the difficulty in removing the nipple from the spill bucket in the future when a thread sealant has been used. Because of the potential problems associated with the use of locking clamps, the APCD recommends use of swivel fill adaptors.

The following devices for preventing the unintentional loosening of fill adaptors on gasoline storage tanks have been approved by the California Air Resources Board. Any of these devices are acceptable to be used in Vermont. Such devices are recommended, but not currently required, at facilities equipped with balance type Stage II systems.

1. Swivel Fill Adaptors
   - Bravo B-70B
   - OPW 61SA-1000 Rotatable
   - Phil-tite Enterprises Model SWF-100
   - Emco Wheaton Model A0030-124

2. Locking Clamps
   - OPW 633LC Locking Clamp

CNI Locking Clamp, Part #613 BC, 611DB4-AC or 434

The requirement to install swivel adaptors or lock clamps will be phased in at stations equipped with vacuum-assist Stage II vapor recovery systems as follows:

1) After July 1, 2000, any fill adaptor newly installed or replaced at a station equipped with vacuum-assist Stage II vapor recovery must be a swivel fill adaptor or fill adaptor with a lock clamp; and,
2) all stations equipped with vacuum-assist Stage II vapor recovery must be equipped with swivel fill adaptors or fill adaptors with locking clamps by December 31, 2003.

V. Marconi Commerce Systems (formerly known as Gilbarco) Vapor Vac System - CARB Executive Order G-70-150-AE

A revision of this executive order, issued by the CARB on July 12, 2000, made the following changes:
1) All new Marconi Commerce Systems (MCS) Vapor Vac systems installed after August 1, 2000, must use nozzles that incorporate the following components: a vapor check valve located in the nozzle and a "mini-boot". The following nozzles meet these requirements: Catlow ICVN, Emco Wheaton A4505, Husky V34 Model 6250 and OPW 12VW.
2) All new MCS Vapor Vac systems installed after August 1, 2000, shall have an allowable air to liquid (A/L) ratio range of 1.0 ± 0.1.
3) The MCS Encore and Eclipse dispensers are approved for use with the MCS Vapor Vac system.

It is permissible to have a mixture of old and new nozzles at the same station provided that all nozzles served by the same vacuum pump are either the old style nozzles or the new style. In other words, at a station with dispensers that have one nozzle per side, you could replace an old nozzle with a new one on just one side. At a station with dispensers that have three nozzles per side, if one of these is replaced by a new style nozzle, then the other two must also be replaced at that time.

The APCD is following these new criteria with one exception. Rather than using an installation date of August 1, 2000 as the date by which these new nozzle requirements apply, the APCD will expect these requirements to be met where the nozzles were ordered after August 1, 2000.

VI. Other Installation Tips

In addition to the underground vapor recovery piping, there are a number of other aspects of an installation where attention to detail can avoid problems.

- Tighten Fittings

A commonly observed problem during compliance testing is the failure to adequately tighten fittings. Not infrequently, leaks are observed at fittings that are only hand tight. This leads to problems with getting systems to pass the pressure decay test.

- Vacuum Pumps

Problems with the vacuum pumps have caused nozzles to fail the air to liquid ratio test, necessitating a return visit from the testing firm to retest the failed nozzle(s). At a number of stations, vacuum pumps have been wired improperly so that the wrong pump would activate when a nozzle was in use or pumps didn't operate at all.

- Test Fittings and Ball Valves

It saves a lot of time and aggravation for the person conducting testing of the Stage II controls if the installer takes into account the fact that the system will need to be tested and provides easy access for the tester. Keep in mind while doing the installation that the tester will need to introduce gasoline and nitrogen into the vapor recovery piping at each dispenser. The easiest way to accommodate this is by providing test tee's. It can also save a lot of time in troubleshooting leaks in the system if ball valves are installed on the vapor return lines beneath the dispensers so that the dispensers can be easily isolated from the underground vapor return lines and the tanks for testing purposes.

VII. Things to Do Before Compliance Testing

We understand that no one likes to have his or her station shut down for testing. Testing is very important to make sure that the equipment is operating properly so that the investment that has been made in Stage II equipment is actually achieving the goal of reducing air pollution. It is necessary to shut the station down for at least a portion of the testing; however, there are things that the owner or operator can do before the test to help make the test go faster.

The prime ingredient for getting the test done quickly and allowing the station owner or operator to get back to business is having a proper installation in the first place. The fewer leaks that the tester has to track down and repair, the faster the testing will go. The amount of vapor space in the tanks that the tester has to fill with nitrogen gas in order to conduct the pressure decay test is related to the amount of time it will take to conduct this test. Therefore, making sure tanks are relatively full for the test can reduce the time it takes to complete the test, but do remember that there must be at least three (3) hours between a delivery and the test. Beyond the initial installation, there are important maintenance tasks that can be done before testing. Testing the nozzles for proper air to liquid (A/L) ratio requires that the gasoline flowrate through the nozzles be within a specified range. A flowrate that is too high (over 10 gpm) is a violation of a federal regulation and if it is too low it can reduce the A/L ratio enough to cause a nozzle to fail this test. Even if the nozzle's A/L ratio is within the allowed range, the test is not valid unless the flowrate is also within the specified range. To avoid these potential problems, check your flowrates or, if you have any doubts, replace the fuel filters before testing.

Further Information

For further information about Vermont's requirements concerning Stage II vapor recovery, contact the Air Pollution Control Division at the following telephone number and address:

Toll Free Line: (888) 520-4879
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