



## **DEPARTMENT OF TRANSPORTATION**

### **Federal Railroad Administration**

#### **[Safety Advisory 2012-01]**

#### **Odorant Fade in Railroad Tank Cars**

**AGENCY:** Federal Railroad Administration (FRA), Department of Transportation (DOT).

**ACTION:** Notice of Safety Advisory.

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**SUMMARY:** FRA is issuing Safety Advisory 2012-01 to remind shippers and consignees of railroad tank cars containing odorized liquefied petroleum gas (LPG), of the importance of taking actions to ensure that a sufficient level of odorant remains in the LPG throughout the entire transportation cycle. FRA is issuing this notice to raise awareness within the hazardous materials community, of the potential consequences of having LPG reach end-users as under-odorized or essentially non-odorized material due to the diminishment of the added odorant during the transportation cycle (commonly known as “odorant fade”). This safety advisory recommends that shippers and consignees of bulk quantities of odorized LPG review their existing LPG odorization standards and procedures, and take appropriate actions to guard against odorant fade in their shipments.

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**SUPPLEMENTARY INFORMATION:** DOT’s Hazardous Materials Regulations (HMR), Title 49 Code of Federal Regulations (CFR) Parts 171–180, allow use of the proper shipping name, “liquefied petroleum gas” (or LPG), for a number of petroleum gases with properties similar to propane. Much of the LPG loaded and shipped in the United States by railroad tank car is from bulk suppliers to either industrial end-users or to “midstream” suppliers who then sell and redistribute the LPG to commercial, retail, and general public end-users. In 2010, LPG represented less than 9 percent of all loaded hazardous materials tank car shipments originating in the United States. Because LPG is a colorless and odorless gas, odorants are normally added to the material (with the exception of LPG being shipped to industrial end-users) in the liquid phase to enable human detection when its vaporized gases are released in the atmosphere. The majority of LPG produced for non-industrial uses is odorized by bulk providers of the material. The presence of LPG in the consumer supply chain, with either diminished levels of odorant or no odorant present, represents significant safety risks. Absent sufficient odorization of the commodity, LPG leaks can go undetected and ignite.

Diminished or absent levels of LPG odorant has been determined to have been a contributing factor in incidents that have resulted in injuries and fatalities. For example, a July 30, 2010, incident occurred at a condominium construction site in Norfolk, MA, when a release of LPG from a leaking connection in the basement of a building under

construction resulted in an explosion and fire. This incident resulted in one fatality and seven injuries. An investigation conducted by the Massachusetts Department of Fire Services, Division of Fire Safety, revealed that the LPG in the storage tanks at the construction site had virtually no odorant present, explaining why no one at the construction site reported smelling the LPG leak prior to the explosion. While the LPG involved in the Norfolk accident did not originate from a rail shipment, the investigation into the accident revealed that a large quantity of LPG—shipped via railroad tank car as odorized—had been delivered to commercial and retail end-users with either a diminished level of odorization or no odorization at all.

### **Odorization**

The proper odorization of LPG is addressed by a combination of Federal and State laws and regulations, as well as by accepted industry standards and practices. In accordance with the applicable laws and regulations, LPG intended for use by non-industrial entities (e.g., commercial and retail entities, and the general public) is generally required to be odorized (or “stenched”) to enable the detection of any unintended release or leak of the gas. In the context of the rail transportation of LPG, the HMR require the odorization of LPG transported in cargo tanks and portable tanks, but not railroad tank cars. Specifically, 49 CFR 173.315(b)(1) provides that odorizing LPG shipments in cargo and portable tanks with 1.0 pound of ethyl mercaptan per 10,000 gallons of LPG, or the equivalent, is an acceptable form of odorization.<sup>1</sup> That section also provides an exception from the odorization requirement if odorization would be “harmful in the use or further processing of the [LPG], or if odorization will serve no useful purpose as a

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<sup>1</sup> Ethyl mercaptan is a colorless organic liquid with a low odor threshold of 0.4 parts per billion, thus making it easily detectable by persons with a normal sense of smell when injected at standard industry rates.

warning agent in such use or further processing.” Essentially, this exception applies to LPG being transported to industrial end-users.

The Occupational Safety and Health Administration’s requirements regarding the storage and handling of LPG found at 29 CFR 1910.110(b)(1) essentially mirror DOT’s odorization requirements at 49 CFR 173.315(b)(1). In addition to these Federal regulations, the National Fire Protection Association (NFPA) has also established odorization standards that largely mirror the Federal requirements. See NFPA Standard 58, paragraph 1-4.1. In addition, most States have adopted laws, regulations, or codes that incorporate this NFPA standard. Further, it is standard industry practice to exceed the established regulatory minimums and add 1.5 pounds of ethyl mercaptan per 10,000 gallons of LPG in order to combat the effects of odorant fade should a release of material occur.

### **Odorant Fade**

Under-odorization of railroad tank cars containing LPG is sometimes caused by the phenomenon commonly known as odorant fade. While LPG may be satisfactorily odorized in accordance with the above requirements at the source, there are circumstances that may cause the odorant added to the LPG to “fade” and render it virtually undetectable by a person’s sense of smell. Typically, there are three different potential causes of odorant fade: oxidation, container condition, and gas quality.

This safety advisory focuses on recommendations to prevent odorant fade caused by oxidation and/or the condition of the LPG container. First, oxidation can cause odorant fade when the presence of rust in a tank car, or the subsequent formation of rust over time, as a result of the presence of oxygen and moisture, decreases the amount of

odorant that is in the LPG in the tank due to a chemical reaction between the odorant and the oxidized (rusted) surface. The presence of rust causes mercaptans to oxidize into other compounds that have a different odor and lower intensity. Residual oxygen from air and moisture that may be in the container can increase the oxidation rate of rust or even cause new rust to form where previously none existed, exasperating the rate at which the odorant fades.

Next, the condition of the LPG container itself can also potentially cause odorant fade. An odorant can adsorb onto the metal surface of the container or even potentially be absorbed into the metal surface itself. This process is most likely to occur when the container is new and has not previously contained odorized LPG. It can also occur when the inside of the container has been left open to the air while the container is out of service or after the container has been cleaned and purged (e.g., when a railroad tank car is cleaned and purged for repair or service at a tank car facility and then later placed back into LPG service).

There are existing industry procedures that can passivate (or treat) the interior surface of an LPG container in order to render the surface inactive so that the odorant will not be diminished through oxidation or adsorption/absorption. Also, there are several methods available to detect whether there are adequate amounts of odorant in LPG at any given point. The simplest, and most often used method, is a “sniff test” where a person uses their sense of smell to detect the presence of odorant. The person performing a sniff test should have a normal sense of smell, uncompromised by such factors as olfactory fatigue, sinus congestion, allergies, head colds, smoking, or the recent use of alcohol or drugs. Colorimetric tube testing and the gas chromatography test method provide more

quantitative methods to measure the concentration of the odorant in LPG. The colorimetric tube, or stain tube, test method measures the concentration of odorant by pulling a measured amount of LPG through a hermetically sealed glass tube containing a detecting reagent. The odorant causes a chemical reaction resulting in a color change of the tube material. The quantity of odorant can be measured by reading the concentration of the odorant from the calibration scale that is marked on the tube. The gas chromatography test method is the most accurate method because it separates the various components of the LPG and odorant for identification. However, this method is costly and requires sending LPG samples to a location that has the proper equipment and trained personnel to perform these tests.

### **Railroad Tank Cars**

At present, while DOT's regulation discussed above contains an odorization requirement for LPG transported in cargo and portable tank containers, there is no comparable DOT regulation regarding the transportation of LPG transported in railroad tank cars. FRA is currently reviewing this situation to determine if further action is warranted. During routine inspections at facilities that receive railroad tank cars loaded with LPG, FRA is obtaining data on the LPG odorization testing procedures being used by industry. FRA is also collecting data on the number of LPG shipments that are received yearly, the number of these shipments that are shipped as odorized versus non-odorized, and the number of odorized shipments received that failed odorization testing or were identified as having insufficient odorant.

As noted above, there are currently Federal regulations, State laws, and accepted industry standards and testing methods in place to ensure proper LPG odorization. FRA

encourages industry members to comply with all applicable requirements and standards.

In order to help prevent odorant fade incidents involving LPG transported by railroad tank car, and to facilitate compliance with existing requirements and standards, this safety advisory makes several recommendations below.

**RECOMMENDED ACTION:** In an effort to encourage industry members to take actions to ensure that a sufficient level of odorant remains in odorized LPG shipped via railroad tank car throughout the entire transportation cycle, FRA recommends that:

1. Facilities that load, offer, receive, or offload railroad tank cars containing LPG review their procedures to ensure they are adequate to address the issue of “odorant fade” and its various potential causes, and that those procedures ensure that tank car shipments of odorized LPG are odorized to meet applicable regulatory and industry requirements and maintain sufficient levels of odorant throughout the entire transportation cycle. Such procedures should ensure quantitative testing methods are used to measure the amount of odorant in LPG.
2. Facilities that load odorized LPG into railroad tank cars have adequate procedures in place to identify if a tank car received for loading of odorized LPG has been out of LPG product service for any extended length of time, is coming from a tank car repair or cleaning facility, or has been subjected to any condition that could lead to corrosion of the tank.
3. Facilities that load odorized LPG into railroad tank cars inspect, to the degree possible, railcars they receive for signs of oxidation or corrosion, which can lead to the loss of odorant.

4. Facilities that load odorized LPG into tank cars take any other corrective actions needed to ensure sufficient levels of odorization remain in the shipment throughout the entire transportation cycle, such as increasing the amount of odorant injected into the LPG, if necessary.

FRA encourages industry members to take actions consistent with the preceding recommendations, and to take other complementary actions to help ensure the safety of the Nation's citizens and railroads. FRA may modify this Safety Advisory 2012-01, issue additional safety advisories, or take other appropriate actions necessary to ensure the highest level of safety on the Nation's railroads, including pursuing other corrective measures under its regulatory authority.

Issued in Washington, DC, on April 9, 2012

Robert C. Lauby  
Acting Associate Administrator for Railroad Safety/Chief Safety Officer

[FR Doc. 2012-8970 Filed 04/12/2012 at 8:45 am; Publication Date: 04/13/2012]