NFPA 58 Odorization Requirements

Theodore Lemoff
NFPA
What does NFPA 58 Require?

- 4.2.1 All LP-Gases shall be odorized prior to delivery to a bulk plant by the addition of a warning agent of such character that the gases are detectable, by a distinct odor, to a concentration in air of not over one-fifth the lower limit of flammability.
No odorant will be completely effective as a warning agent in every circumstance.

Recommended that odorants be qualified to 4.2.1 by tests or experience.

Tests should be certified by a laboratory separate from the odorant manufacturer.

Experience has shown that ethyl mercaptan (1.0 lb /10,000 gal of liquid) has been recognized as an effective odorant.
Annex Text

NOT MANDATORY!

- Other odorants and quantities meeting the provisions of 4.2.1 can be used.
- Research on odorants has shown that thiophane (at least 6.4 lb per 10,000 gal of liquid) might satisfy the requirements of 4.2.1.
Non-Odorized Gas

4.2.2 Odorization shall not be required if it is harmful in the use or further processing of the LP-Gas or if such odorization will serve no useful purpose as a warning agent in such further use or processing.
Verification of Odorization

4.2.3* If odorization is required, the presence of the odorant shall be determined by sniff-testing or other means, and the results shall be documented as follows:

1. When LP-Gas is delivered to a bulk plant
2. When shipments of LP-Gas bypass the bulk plant
A.4.2.3 Another method is the stain tube test.

- Small handheld pump draws a sample thru a glass tube. Read the length of color change.

- GPA Standard 2188, *Tentative Method for the Determination of EM in LP-Gas Using Stain Tubes*

- ASTM D5305 Test Method for Determination of EM in LP-Gas Vapor (Not in NFPA 58)

- CAN/CGSB-3.0 No. 18.5, *Test for EM Odorant in Propane, Field Method.*

- Additional methods under development.
Odorization History

- Work using ethyl mercaptan as an odorant in the 1920’s
  - Bureau of Mines- Natural gas odorant 1929
- EM had been used to evacuate mines since the 1880’s
Odorization History

- 1937: First odorization requirements in NPFA 58
  - ... all liquefied petroleum gases shall be effectively odorized by an approved agent of such character as to positively indicate the presence of gas down to concentrations in air of not over one fifth the lower limit of flammability by a distinctive odor
- Follows Texas incident in March 1937
Odorization History

- 1939: Added Note
  - NOTE: The lower limits of combustibility of the more commonly used liquefied petroleum gases are: Propane--2.15; butane--1.55. These figures represent volumetric percentages of gas-air mixtures in each case.

- 1947: Added exception where odorization is harmful or serves no useful purpose
1956: New second paragraph

- (b) The odorization requirement of can be met by the use of
  - 1.0 pounds of ethyl mercaptan,
  - 1.0 pounds of thiophane or
  - 1.4 pounds of amyl mercaptan per 10,000 gallons of LP-Gas.
- Other odorants
Odorization History

- 1974: Amyl Mercaptan deleted
- 1976: Relocated Note (with odorant levels) to footnote. Added new footnote:
  - It is recognized that no odorant will be completely effective as a warning agent in every circumstance.
  - Changed thiophane level to 6.4 lb/10,000 gal
    - Based on Bartlesville study
Odorization History

- 1989: Added verification of Odorization by sniff test of other means:
  - At bulk plant or when shipments bypass a bulk plant
  - Cited 1977 ERDA Report on odor testing
- 1995: Added annex A text
  - Stain tube test
    - GPA Standard 2188-89
    - CAN/CGSB-3.0 No. 18.5-M89
So What’s the Problem?

- Odorization of propane requires an odorant that:
  - Is soluble in propane
  - Vaporizes as the propane vaporizes

- Propane boils at –40°F. EM boils at 95°F
  - More propane will boil (vaporize) from a new tank compared to EM than when the tank is nearly empty.
  - K-Factor puts numbers on this
K-Factor for EM in Propane

<table>
<thead>
<tr>
<th>Temperature (°F)</th>
<th>K-Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>-10</td>
<td>0.11</td>
</tr>
<tr>
<td>32</td>
<td>0.18</td>
</tr>
<tr>
<td>95</td>
<td>0.22</td>
</tr>
</tbody>
</table>

- What does this mean?
  - At – 10 F, the vapor concentration of EM will be 11% of the liquid propane/EM mixture.
  - At 95 F, vapor concentration will be 22% of the liquid propane/EM mixture.

- Therefore “extra” EM is added to the liquid for the initial withdrawal.
How is odorant measured?

- **Gas Chromatograph**
  - Not a portable instrument
  - Sample storage is critical to prevent odor fade in the sample. Lined cylinders are used

- **“Stain” Tube**
  - A portable, hand held instrument
  - Important to measure samples that represent the bulk contents of the tank.

- Representative sampling is as important as the measurement.
More on Samples

More important is how a sample is taken

- Vapor space samples are subject to the K-Factor
  - GPA method

- Liquid Samples can be used
  - Canadian method:
    - Inject a liquid sample into a clear “baggie”
    - Seal the “baggie”
    - When the sample is completely vaporized, use the stain tube to pierce the bag and test.
New Tanks

- We all know that new tanks come with a vacuum to keep moisture out.
  - Follow the tank manufacturer’s recommendations when placing into service.
  - Equalize container pressure with a bobtail vapor line or cylinder vapor connection.
  - Then, and only then, remove the cap from the multi-valve.
Thank you!

NFPA 58@nfpa.org