



Steven W. Troxler
Commissioner

North Carolina Department of Agriculture
and Consumer Services
Standards Division

Stephen Benjamin
Director

April 26, 2013

MEMORANDUM

TO: Propane Dealers and Inspection Officials

FROM: Richard Fredenburg, LP-Gas Engineer

SUBJECT: ANCHORING OF LP-GAS TANKS IN FLOOD-PRONE AREAS

Since the *LP-Gas Code* (NFPA 58) does not provide specific instructions for how LP-Gas tanks are to be secured in flood-prone or high-water-table areas, this memo is provided to give guidance in that area. The development for our position and this interpretation can be seen on the Standards Division web site at www.ncagr.gov/standard/LP/LPgasConcerns/FloodAnchoringProtection.htm, where a number of magazine articles are shown. These articles reflect what we learned after some storms, about a study that was done to determine some theoretical anchoring concepts, some experimentally-determined securing methods, and some searching for and examination of various anchoring manufacturers product offerings and documentation.

The *LP-Gas Code* is clear about anchoring requirements:

Where necessary to prevent flotation due to possible high flood waters around aboveground or mounded containers, or high water table for those underground and partially underground, containers shall be securely anchored. (NFPA 58, section 6.6.1.6 (2011 Edition))

It might appear that the code establishes an absolute requirement. Actually, the requirement for anchoring is absolute, but the requirement for the tank to stay in place is not clearly established. This recognizes that nature can sometimes be much stronger than our efforts. Hurricanes can cause sand and soil to wash away, sometimes resulting in breaches where land disappears. Hurricane-driven storms can generate rivers so swollen with fast-rushing water that few structures by man survive. If a dune or other coastal property is washed away by wind and waves or if land along a river floodplain disappears, a tank placed there is gone, too. No reasonable amount of anchoring in that situation will keep the tank there. However, an effort must be made.

The code is less clear about how to meet the anchoring requirements. We have seen a variety of methods employed. A few types seem to be the most effective. Others are questionable.

Smaller containers that are placed right beside a building may be secured to that building by chains or straps. The chains, straps, and connecting hardware must be of sufficient strength and attached to the structure well enough to provide assurance to an inspector that the tank will remain attached. Securely attaching to a structural member of the building is required. These containers may instead be secured to the ground or to a concrete or asphalt pad. Consider cushioning material to keep chains and straps from damaging the paint on the container and to prevent galvanic action.

The most popular anchors for propane containers are helix anchors, also known as mobile home anchors. These are rods with helical discs attached that you literally screw into the ground. They vary in length, disc diameter and number of discs. They should be used with soil charts or test probe charts, which will show which size anchors can be expected to hold in the soil at the tank site. The cable or straps that connect the anchors to the tank are a key part of the anchoring system. These, too, must be properly sized to ensure they do not fail.

Earth anchors appear to be another effective form of securing tanks. These use triangular wedges with an attached cable that you drive into the ground with a hammer. Once the wedge reaches the desired depth, you pull on the cable and the anchor pivots to the most pull-resistive configuration. Again, proper sizing and depth are dictated by use of appropriate charts.

Some imaginative uses of various devices to anchor tanks must be discouraged, as they have no engineering basis to determine if they will do as expected. One person described digging a hole, running a cable through the hole of an old harrow disc, burying the disc, and attaching the cable to the tank. There are a couple of problems with this. Since the soil is disturbed by digging, he does not know what its strength is unless he follows some specific soil compaction steps as he puts the soil back. Also, what is the appropriate depth for the disc? That will depend on the soil characteristics and disk diameter. If the conclusion when you finish installing the anchor is, "Well, that oughta hold," then you probably did not use the right type of anchor. You should think, "That's gonna keep it there, and I've got documentation to support it."

The best anchors are those with some engineering behind them. There are a number of resources online. You can access information about Minute Man Anchors in East Flat Rock, N.C. at minutemananchors.com/propane-tank-anchors-and-supplies. They have drawings, load tables, soil charts and other good information. Tie Down Engineering also has information online at www.tiedown.com. Suggested tables with good information are at www.tiedown.com/pdf/d909.pdf and www.tiedown.com/pdf/d215.pdf.

Federal Emergency Management Agency also has online information at www.fema.gov. There are documents on Fuel Systems, Anchoring and Bracing, Anchor Fuel Tank, and others. Go to the FEMA website and search on "anchor propane tank." Or you can go to our website at www.ncagr.gov/standard/LP/LPgasConcerns/index.htm#Anchor and click on the links there for the FEMA, Minuteman Anchors, and Tie Down Engineering web sites.

In North Carolina, anything below the 100-year flood level must be anchored. This is also a FEMA requirement. For many of the barrier islands, that includes the whole island. Most counties have flood maps showing the 100-year flood level. If you place tanks, it is your responsibility to know where this level is and to anchor where appropriate. Remember, this applies to all areas of the state, as all counties are subject to some type of occasional flooding.

Anchoring also means that the tank will not turn bottom side up. If it does so, the propane line will most assuredly break, causing a potentially hazardous gas leak. Be sure to run a cable through the legs or foot ring instead of the lifting lugs. Another choice is to weigh the tank down by fastening it to a concrete slab heavy enough to hold it. Keep in mind the likely action of wind, waves, and current when you do this. Also, consider adding an insulator between the strap and tank, as these are usually dissimilar metals and you can set up galvanic action, which will corrode the tank and/or the strap.

Keep in mind that this applies to underground tanks, too. Since propane weighs less than water, even a full tank will float. Underground tanks have been observed to float right up through sandy soil, especially if they are empty or nearly empty.

You should be aware that three municipalities have adopted at least enough of NFPA 58 so they can enforce the anchoring requirements. The municipalities are New Hanover County, Wrightsville Beach and Leland. Other coastal municipalities are considering it.

In summary:

- Tanks in flood-prone areas or in high-water-table areas must be securely anchored.
- We recognize that even well-secured tanks can be dislodged by strong storms.
- Owners of tanks must secure tanks in threatened areas using anchors or anchoring systems that have some engineered basis for being able to resist the forces of wind, wave, and current in the type of soil present at the tank location.
- The tanks must be secured against being dislodged and against turning bottom up.
- Tanks located in the 100-year flood zone must be secured.

Revised on 9/18/2013