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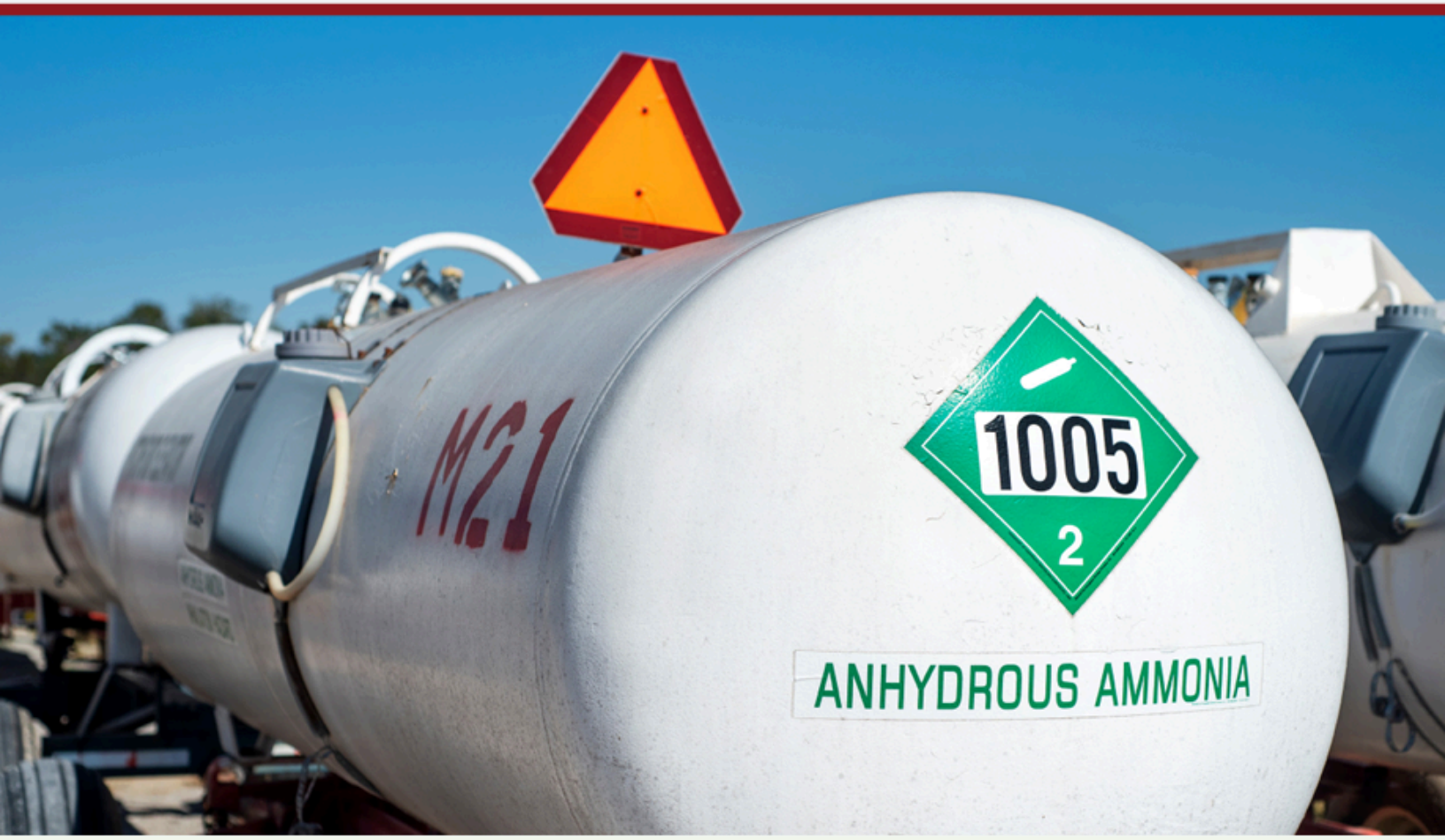
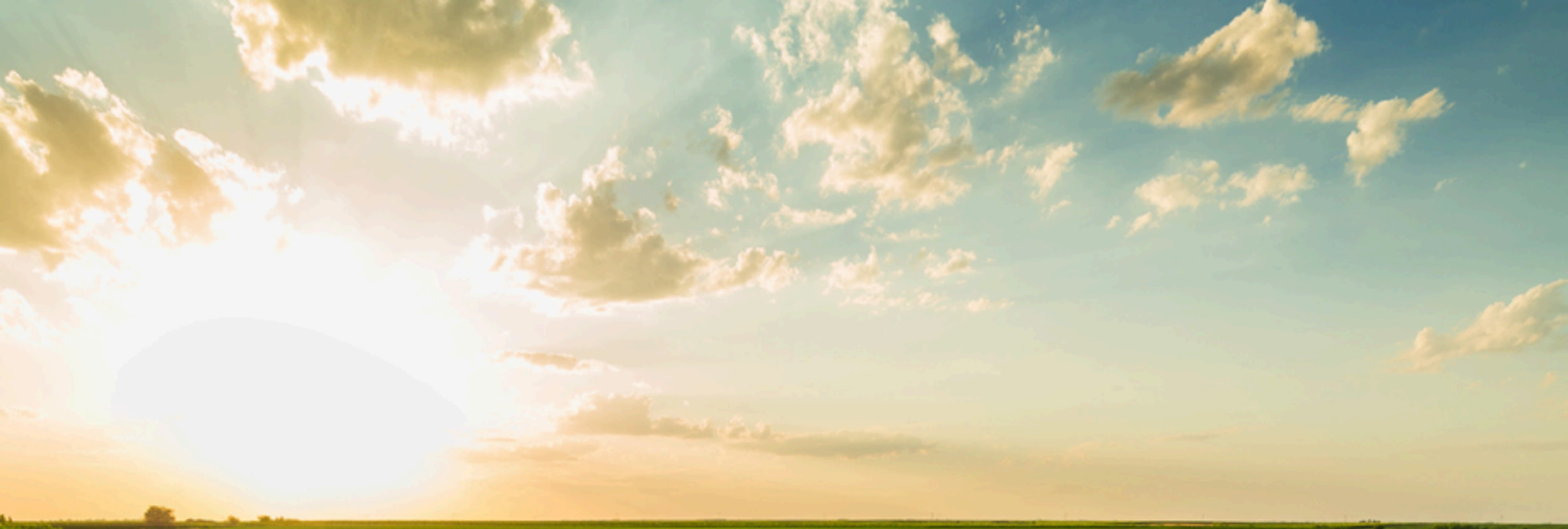
U.S. Department
of Transportation
**Pipeline and
Hazardous Materials
Safety Administration**



NURSE TANK TESTING

A Non-Destructive approach to Improve Nurse Tank Safety



Disclaimer: The contents of this guide do not have the force and effect of law and are not meant to bind the public in any way. This guide is intended only to provide information to the public regarding existing requirements under the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180).

The Pipelind and Hazardous Materials Safety Administration's (PHMSA) mission is to protect people and the environment by advancing the safe transportation of hazardous materials in commerce. To achieve its mission, PHMSA establishes national policy, sets and enforces regulations (i.e., the HMR), educates stakeholders, and conducts research to prevent hazardous materials incidents.

Additionally, federal hazardous materials law authorizes the Secretary of Transportation (the Secretary) to "prescribe regulations for the safe transportation, including security, of hazardous materials in intrastate, interstate, and foreign commerce" 49 U.S.C. 5103(b)(1). As such, the Secretary has delegated this authority to PHMSA as specified in 49 CFR 1.97(b). PHMSA's regulations (i.e., the HMR) are designed to achieve three primary goals:

1. *Ensure that hazardous materials are packaged and handled safely and securely during transportation.*
2. *Effectively communicate the hazards of the materials being transported to transportation workers and emergency responders.*
3. *Minimize the consequences of an accident or incident, should one occur.*

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SECTION **01**

NURSE TANK CHALLENGES

NURSE TANK CHALLENGES

WHAT ARE NURSE TANKS?

A nurse tank is a cargo tank considered an implement of husbandry for the transportation of bulk anhydrous ammonia. Nurse tanks must be operated by a private carrier and used exclusively for agricultural purposes (49 CFR §173.315(m)(1)).

REMEMBER

You must meet all of the conditions below to qualify for the exception. Otherwise, the tank will be fully regulated under the HMR:

EXCEPTIONS:

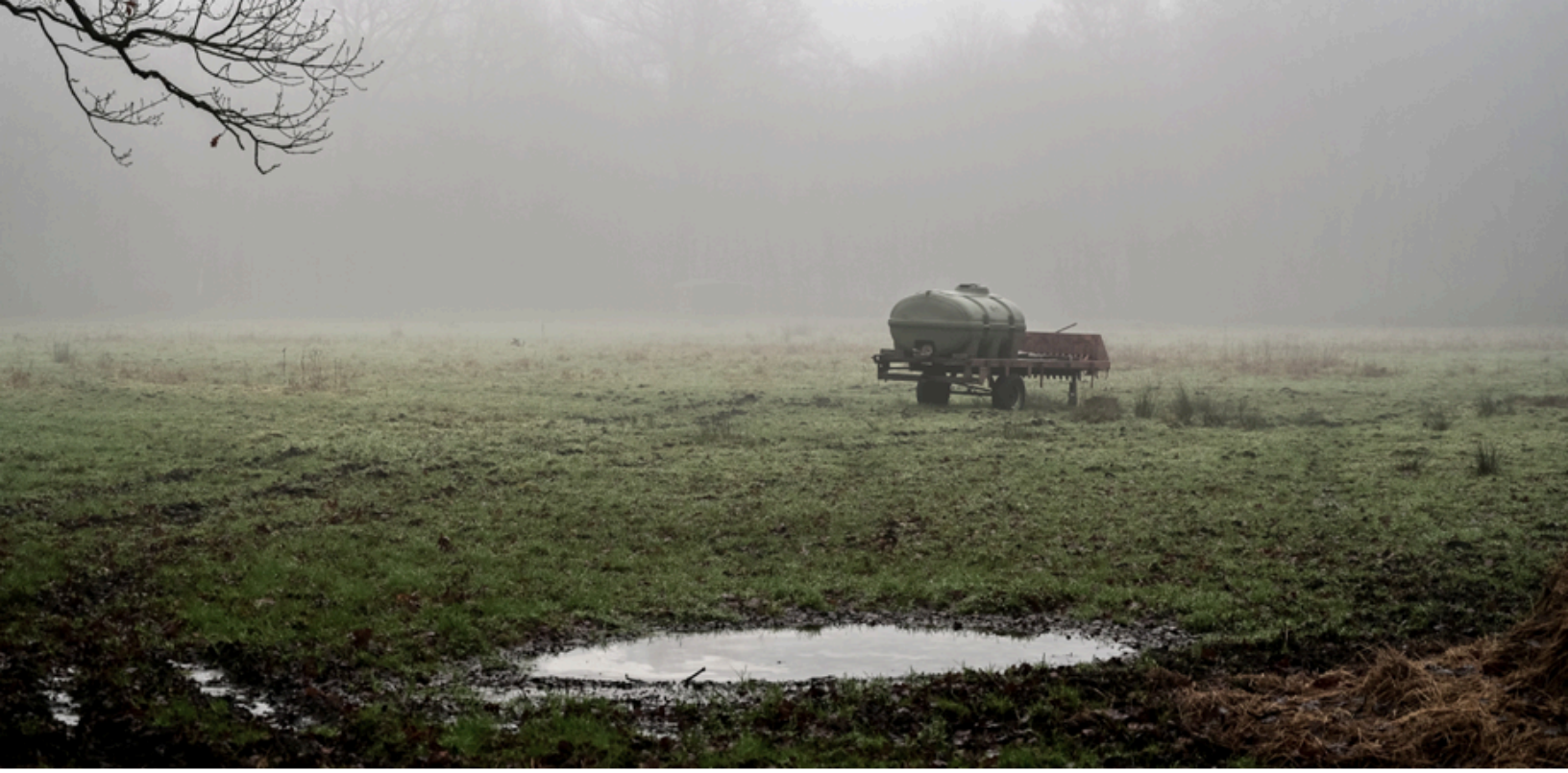
Under the HMR, nurse tanks are excepted from the Packaging Specification requirements of 49 CFR Part 178, if the tank:

- Has a minimum design pressure of 250 psig, meets the requirements of Section VIII of the American Society of Mechanical Engineers (ASME) Code, and is marked with a valid ASME data plate
- Is equipped with safety relief valves meeting the requirements of Compressed Gas Association (CGA) Standard S-1.2
- Is painted white or aluminum
- Has a capacity of 3,000 gallons or less
- Is loaded to a filling density no greater than 56 percent
- Is securely mounted on a farm wagon
- Is in conformance with the requirements of 49 CFR Part 172 of the HMR, including placarding, except: Shipping papers are not required, and markings and placards are not required on one end if valves, fittings, regulators or gauges prevent the markings and placard from being properly placed and visible

SAFETY ADVISORY ISSUED:

In February 2024, the Federal Motor Carrier Safety Administration (FMCSA) and PHMSA issued a safety advisory to provide notice of the possibility of catastrophic failure of nurse tanks.

This notice focused on nurse tanks manufactured from January 1, 2007, through December 31, 2011, by American Welding and Tank (AWT) at its Fremont, Ohio plant. Nurse tanks manufactured by AWT from 2009 to 2010 were the subject of a prior FMCSA investigation and enforcement action in response to improper manufacturing procedures.



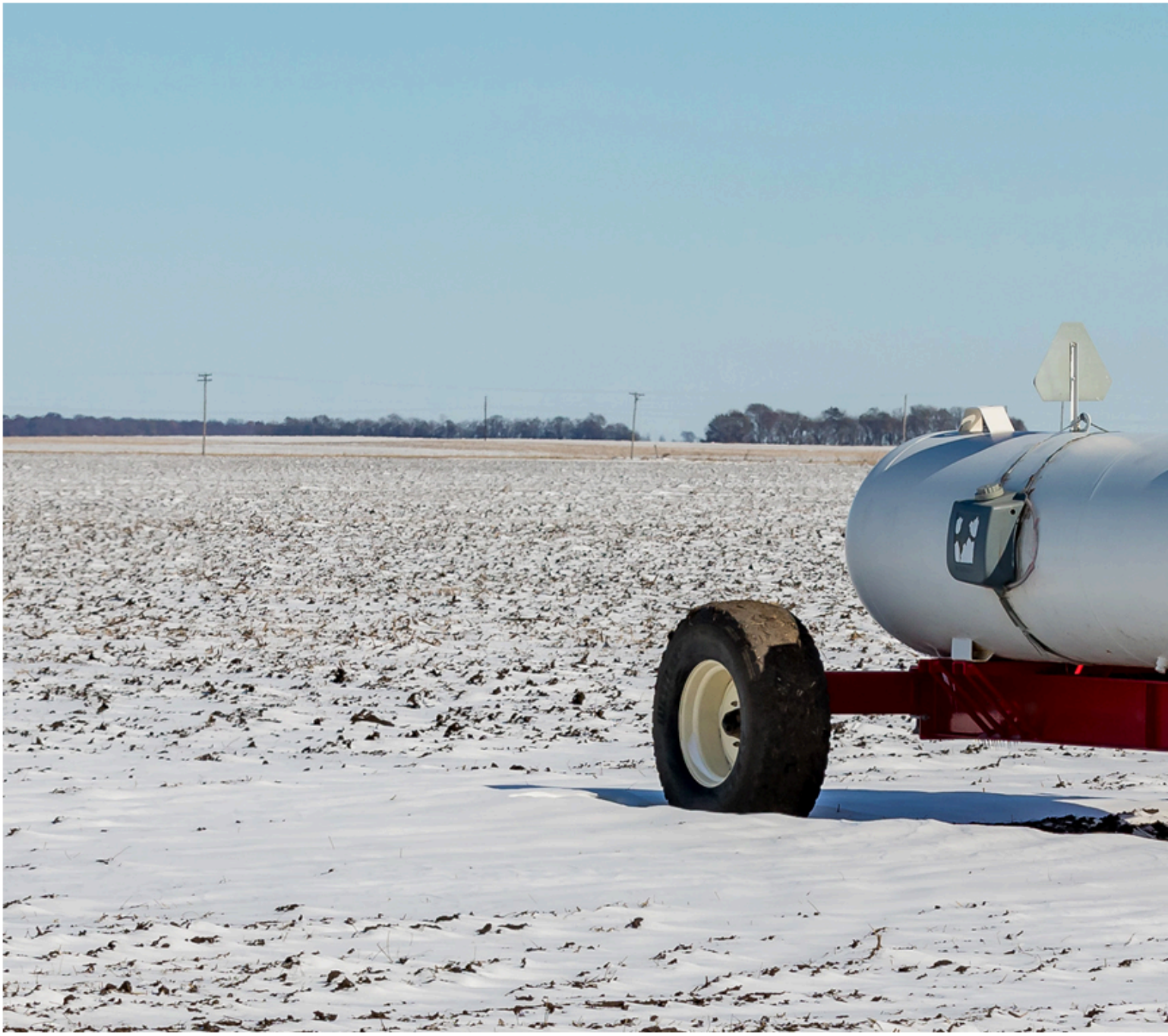
On August 23, 2023, a 2009 AWT nurse tank containing anhydrous ammonia experienced a catastrophic failure in a farm co-op lot, resulting in the release of all product. The failure caused the tank shell to “rocket” over 300 feet from its original location. While no injuries were reported, this event is an indicator of potential continuing problems with AWT nurse tanks that have now been in service for over a decade.

As a result of this incident, the owner of the nurse tank involved contracted with a third-party testing company to examine their AWT nurse tanks that were manufactured between 2008 and 2012. Radiographic testing showed that 7 of 8 nurse tanks tested had extreme stress corrosion cracking (SCC), porosity, and inclusions or voids in the welds where the heads and shells of the nurse tanks were joined.

COMMON SAFETY CHALLENGES:

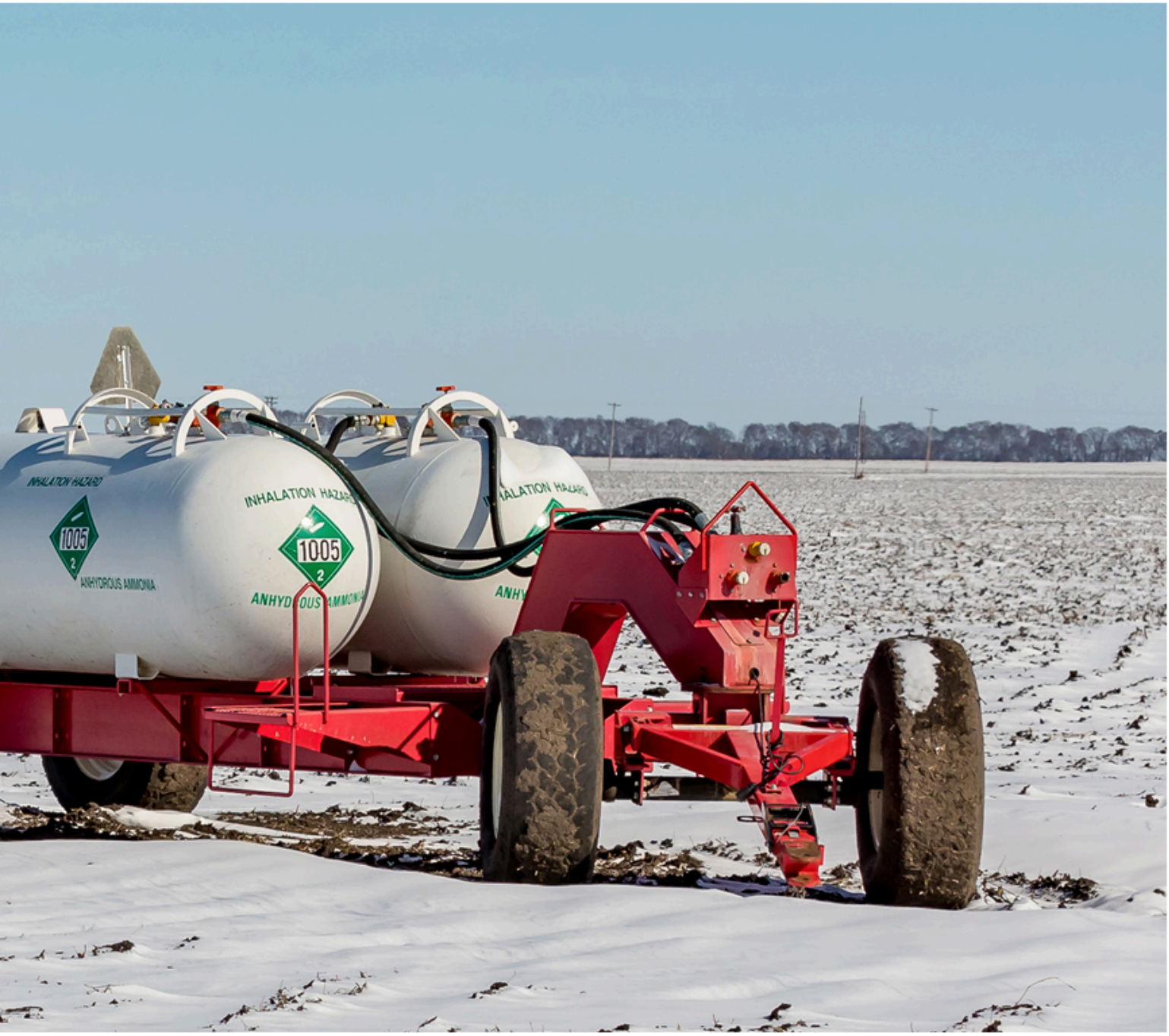
Below are some common safety challenges that have been identified through studies of nurse tank safety sponsored by the FMCSA. Through voluntary testing and best practice safety measures owners of nurse tanks can proactively avoid failures and potential disasters.

- Stress Corrosion Cracking - this problem occurs where cracks initiate around high-stress areas, especially in tanks manufactured with higher-strength steels or with unannealed welds.
- Improper Manufacturing - some nurse tanks have shown problems like porosity and inclusions in welds, particularly those from certain manufacturers, which can lead to structure issues.
- Tank Damage - damage to the tank during service can create high-stress areas, making it more susceptible to cracking. This can include dents, rust or gouges that reduce the structural integrity.



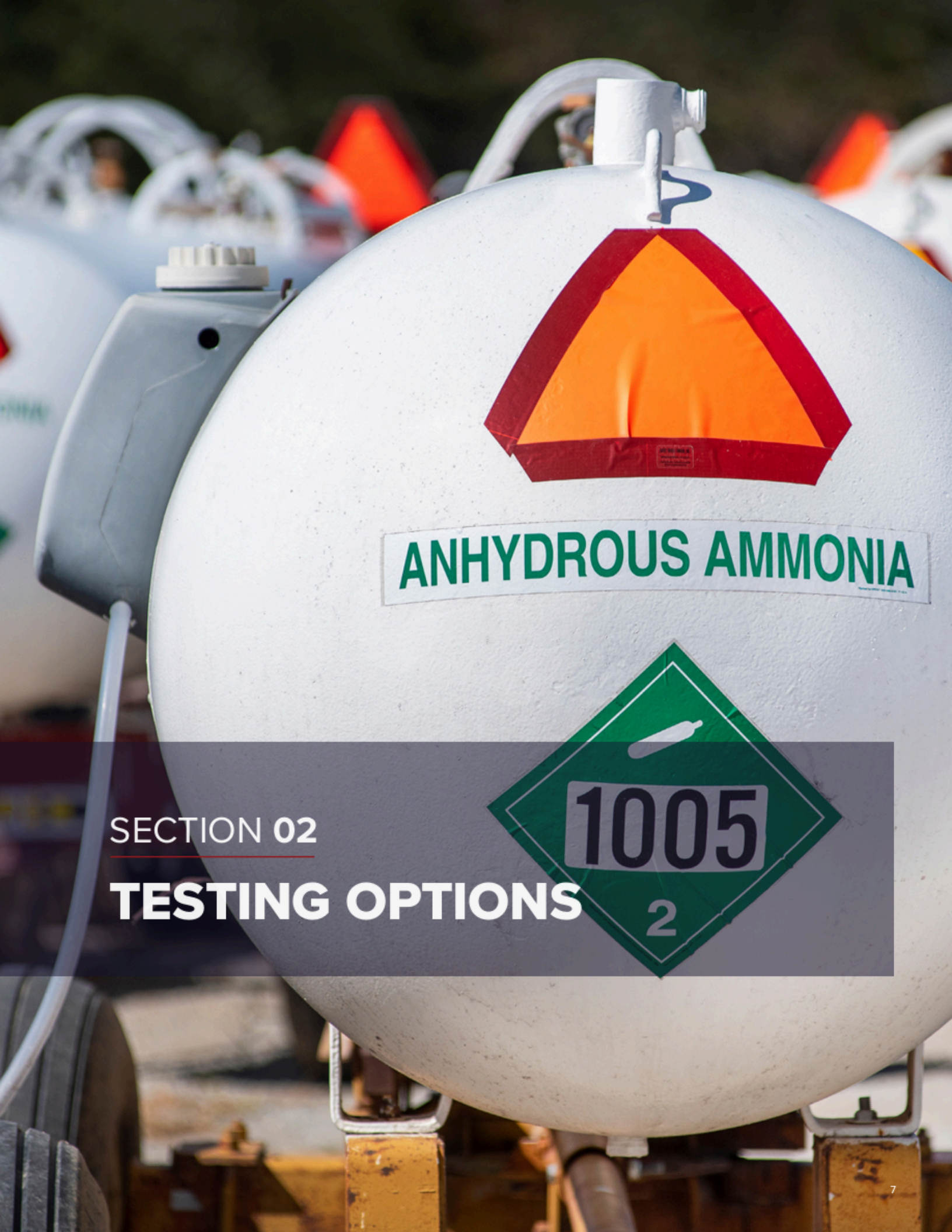
WHAT ABOUT FIELD TRUCK MOUNTED TANKS?

A non-DOT specification cargo tank securely mounted on a field truck is authorized as a nurse tank under certain conditions. “Field truck” means a vehicle designed to withstand off-road driving on hilly terrain, so field trucks must meet certain requirements for suspension, low-end torque, braking systems, and tires (see 49 CFR §173.315(m)(3)(iv)).



Field trucks must have low annual over-the-road mileage and be used exclusively for agricultural purposes. In addition, the tank itself must (49 CFR §173.315(m)(3)):

- Conform to the general nurse tank requirements listed above, except for the requirement to be mounted on a farm wagon
- Be inspected and tested as specified for an MC 331 cargo tank in 180 Subpart E
- Be restricted to rural roads within 50 miles of the fertilizer distribution point where it is loaded.



SECTION **02**

TESTING OPTIONS

TESTING OPTIONS

COMMONLY USED EXAMINATION TECHNIQUES:

Because nurse tanks are not manufactured with any manways (i.e., passages allowing a human to enter the tank), internal inspections for cracks using wet magnetic florescent particle tests, such as those that can be performed inside standard semi-trailer cargo tanks with manways, cannot be conducted inside nurse tanks.

Below are detailed descriptions of the three most commonly used inspection and testing methods for nurse tanks without a legible data plate to evaluate a tank's structural integrity. The chart on the following page summarizes all available techniques, along with their advantages and disadvantages for tank owners.

HYDRO TESTING:

This method, at a specified elevated pressure level, is effective at determining whether the tank can withstand an elevated pressure without failing (i.e., the tank does not have a major flaw that fails at that elevated pressure).

However, it is unknown whether this test is potentially destructive even for tanks that pass the test. This is because application of the elevated pressure may cause undetected crack growth in existing SCC locations.

Also, the wide application of hydro tests is both time and labor intensive. It requires emptying the tank of anhydrous ammonia, moving the tank to a safe location to conduct the pressure test, filling the tank with water, applying the prescribed pressure, then removing the water.

EXTERNAL VISUAL INSPECTION:

This method effectively detects external damage such as dents, loose fittings, or paint flaws that may indicate a pinhole leak due to SCC that has penetrated through the tank—usually at a weld.

The limitation of this test is that it is ineffective at assessing the presence and severity of internal SCC, which is a major cause of future tank failure.

ULTRASOUND MEASUREMENT OF WALL THICKNESS:

This method is effective at detecting tanks manufactured with steel that is too thin.

The limitation of this test is that it rarely identifies a properly manufactured tank (i.e., one that was manufactured in conformance with the minimum thickness steel) that was subsequently reduced below minimum acceptable wall thickness over time.

This is because uniform corrosion of interior steel tank walls by anhydrous ammonia is extremely slow, making it difficult to quantify the changes over time, except at tensile stressed locations (e.g., dents and unannealed welds that corrode and crack).

COMPARISON OF EXAMINATION METHODS

Different techniques have been used to monitor and examine anhydrous ammonia nurse tanks, either during the manufacturing process or once they are in the field. The chart below is a reference for the use and function of each technique.

TECHNIQUE	DESCRIPTION	ADVANTAGES	DISADVANTAGES
X-ray Radiography	Non-destructive testing method used during manufacture to monitor the quality of a weld. This involves obtaining x-ray images of the weld joint. Required by code.	Ensures that no tanks with substandard welds are permitted into service.	Not a technique easily performed in the field to determine whether post-manufacture cracking has occurred.
Visual Inspection	Simple examination to look for dents, scratches, any pinhole leaks, or other evidence of damage.	Quick and easy. Tank does not need to be emptied to conduct the test.	Gives no information concerning the internal state of the tank where corrosion is occurring.
Ultrasonic Examination-single beam	NDT method that uses a single-beam trans-ducer to investigate the steel. This can measure thickness of the steel and determine whether any cracks are present in the material.	Relatively inexpensive method that allows a skilled operator to examine and monitor tank quality including thickness and presence of cracks. Tank does not need to be emptied to conduct the test.	Subject to interpretation and operator training, especially when trying to separate weld effects from true cracks.
Ultrasonic Examination-phased array	NDT method that uses multiple transducers to sweep through in an arc.	Much more sensitive than single beam, less subject to operator interpretation, better able to separate weld effects from true flaws. Tank does not need to be emptied to conduct the test.	Can be very expensive compared to single beam units.
Hydro Testing	Involves filling a tank with water to a pressure higher than the normal operating pressure.	Relatively easy to do, also allows safety valves to be checked at the same time.	Requires the tank to be emptied. Time consuming.
Acoustic Emission	Involves placing sound transducers on a tank and then monitoring acoustic signals during pressurization of the tank.	Can pinpoint locations where AE events might indicate cracking has occurred.	Must be used in conjunction with ultrasound to determine whether cracking has occurred.

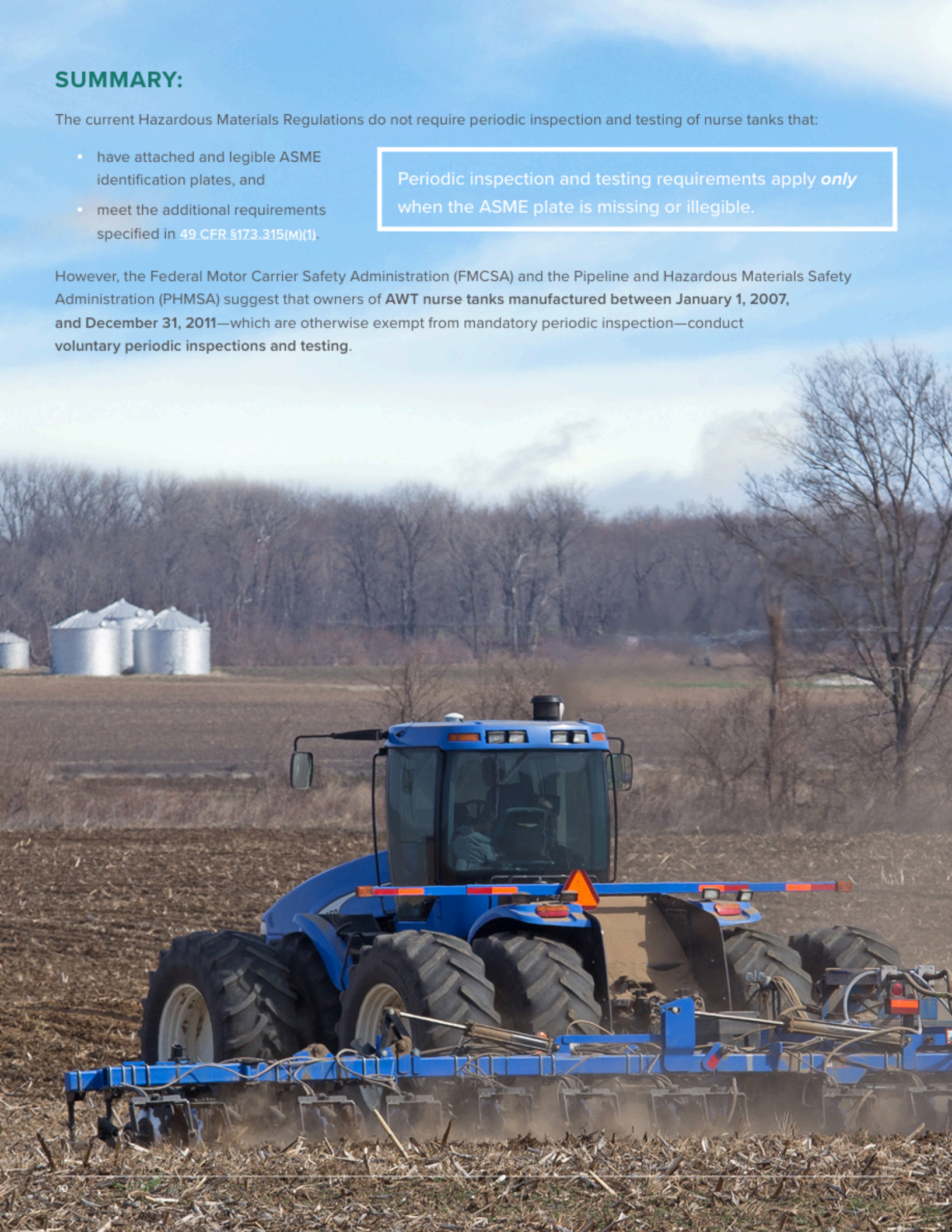
SUMMARY:

The current Hazardous Materials Regulations do not require periodic inspection and testing of nurse tanks that:

- have attached and legible ASME identification plates, and
- meet the additional requirements specified in 49 CFR §173.315(m)(1).

> Periodic inspection and testing requirements apply ***only*** when the ASME plate is missing or illegible.

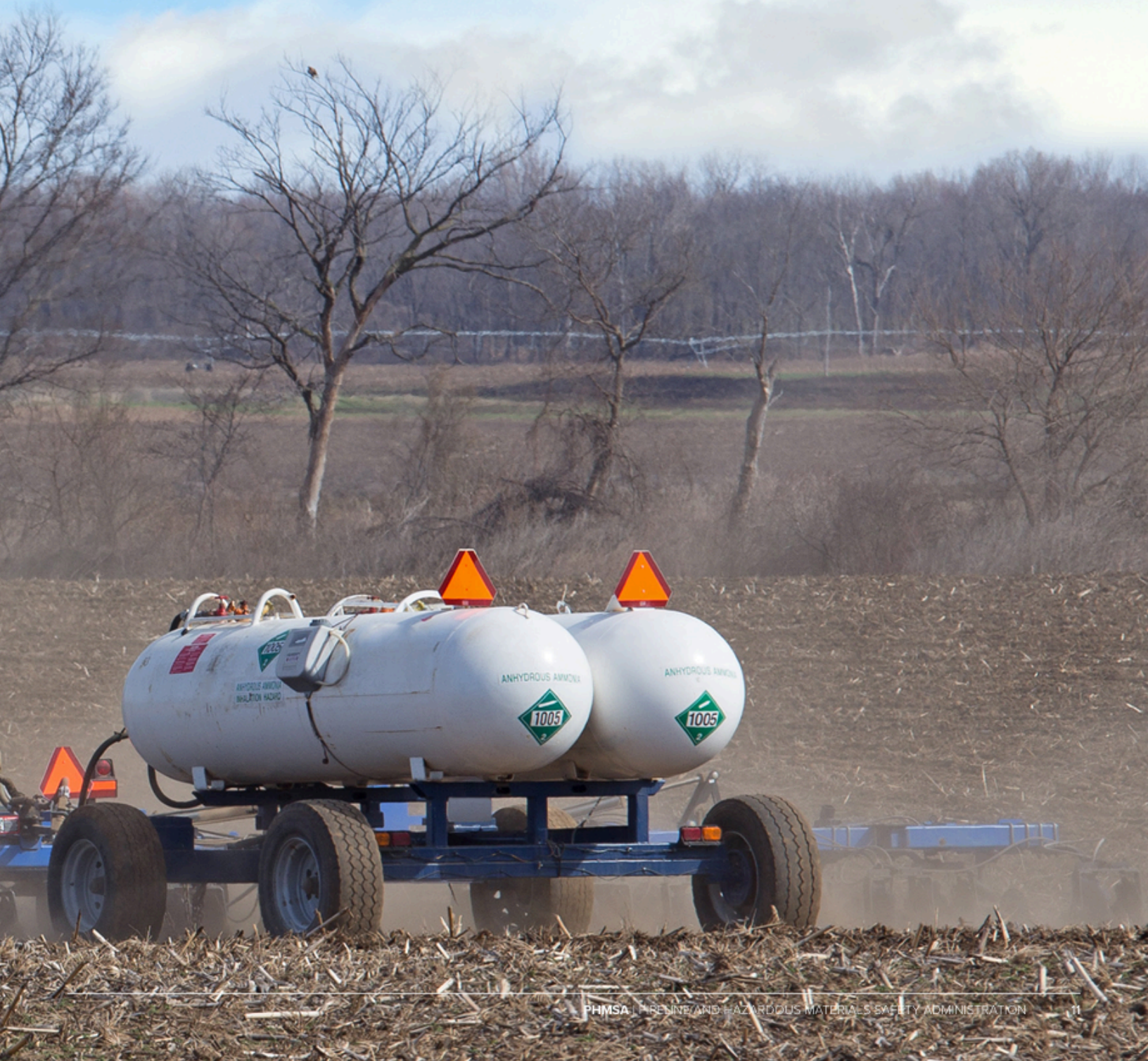
However, the Federal Motor Carrier Safety Administration (FMCSA) and the Pipeline and Hazardous Materials Safety Administration (PHMSA) suggest that owners of **AWT nurse tanks manufactured between January 1, 2007, and December 31, 2011**—which are otherwise exempt from mandatory periodic inspection—conduct **voluntary periodic inspections and testing**.



These suggestions apply specifically to tanks manufactured during the years in which certain units failed testing. Suggested voluntary testing includes:

- Visual Inspection – in accordance with 49 CFR §173.315(m)(2)(i)
- Thickness Testing – in accordance with 49 CFR §173.315(m)(2)(ii)
- Pressure Testing – in accordance with 49 CFR §173.315(m)(2)(iii)

For owners who are unable to conduct voluntary pressure testing, **radiographic or ultrasonic testing** is suggested as an alternative. While the frequency of voluntary inspection and testing is at the discretion of the tank owner, FMCSA and PHMSA note that conducting inspection and testing **at least once every five years** is consistent with 49 CFR §173.315(m)(2)(iv).



For additional information contact:

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