2022 Fluid Technology Workshop

November 30th, 2022
The Blackhawk Marriot
Davenport, Iowa

2:10 PM

Liquid Storage Tank Safety Recommendations.
Is your fertilizer tank fit for service?

John Cornell, H.I.R. Technical Services

DRAKE WELL
MUSEUM AND PARK
Titusville, PA • 1859

The information in this presentation is 100% real situations that I have seen first hand.

- Numerical values and pictorial references have been changed as not to be vendor specific.
  - ✓ *Any similarities to inspection reports provided by others are not to be deemed as relating to any individual or specific party.*
  - ✓ *For training purposes only.*
  - ✓ *The tank owner can drive quality. <u>We must demand better reports!</u>*

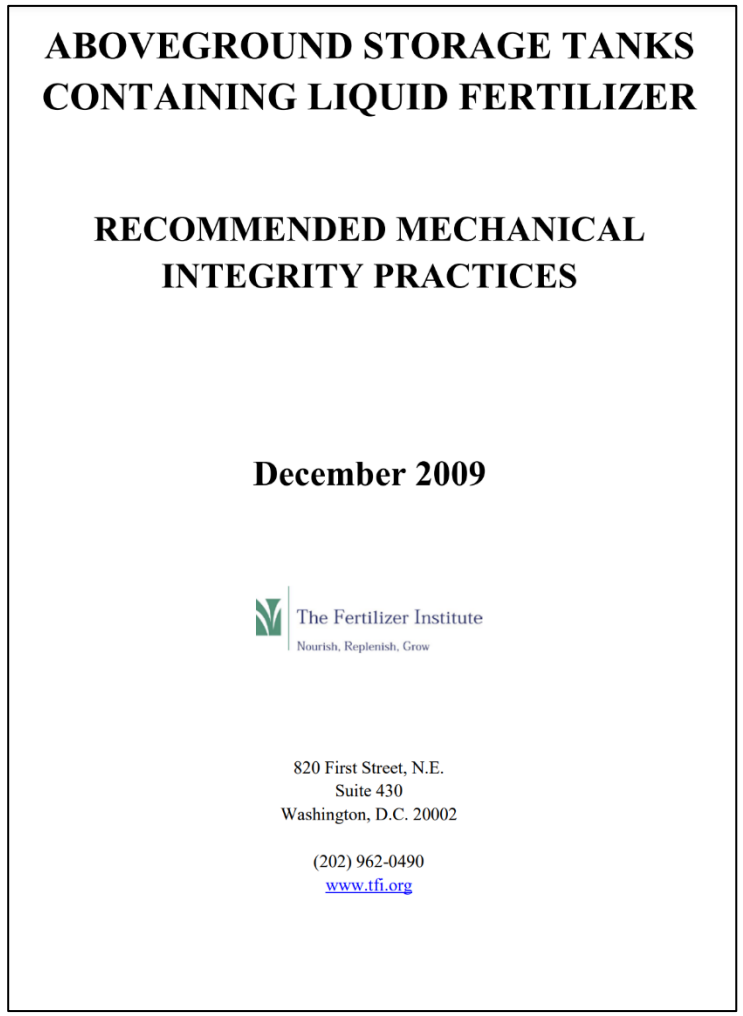
1.2 Compliance with This Standard

The owner/operator has ultimate responsibility for complying with the provisions of this standard. The application of this standard is restricted to organizations that employ or have access to an authorized inspection agency as defined in 3.3. Should a party other than the owner/operator be assigned certain tasks, such as relocating and reconstructing a tank, the limits of responsibility for each party shall be defined by the owner/operator prior to commencing work.

- ✓ *<u>Remember, if former employees accepted shotty tank inspection reports, the onus is on the company to go back over the reports and to make sure they are in compliance.</u>*

Is there guidance for the construction, inspection, and repair of larger Liquid Fertilizer tanks.

Yes, The Fertilizer Institute.



ABOVEGROUND STORAGE TANKS CONTAINING LIQUID FERTILIZER

RECOMMENDED MECHANICAL INTEGRITY PRACTICES

December 2009

The Fertilizer Institute
Nourish, Replenish, Grow

820 First Street, N.E.
Suite 430
Washington, D.C. 20002

(202) 962-0490
www.tfi.org

*"In general, the Tank Integrity Work Group and the UAN Working Group recommend that all new tanks should be designed and built to American Petroleum Institute (API) Standard 650 and inspections of existing tanks **should** be based upon API Standard 653, but with modifications for the unique characteristics of a tank storing liquid fertilizer."*

"3.4 For ASTs used to store liquid fertilizer and of unknown design, or built to known criteria other than API 650, (perhaps AWWA D100 or 103). inspection criteria should be in accordance with the guidelines and recommendations of API 653 to the extent possible. An authorized inspector, or an authorized inspector in conjunction with an experienced storage tank engineer, may modify the inspection in consideration of original construction details that do not meet API 650 design criteria. The result of the inspection should be equivalent to the API 653. In addition, consideration should be given to other ancillary criteria as described in Sections 4, 5, 6 and 7 regarding fertilizer-specific issues."

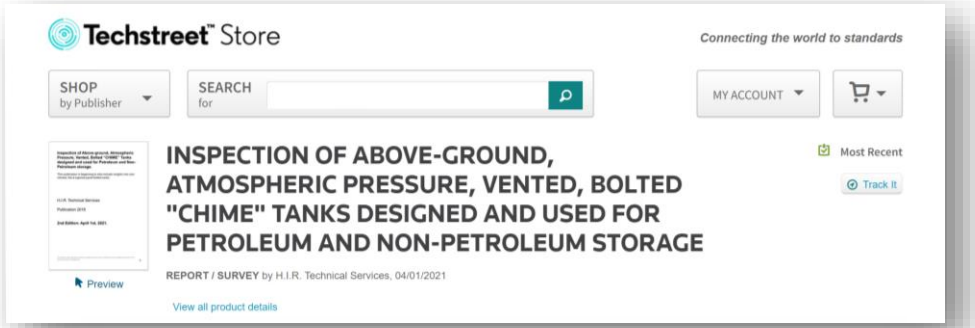
The reason for this presentation….

1) API 653 inspection reports must be complete “d”.

2) Fertilizer tanks are covered under the law. *Some say that a fertilizer tanks can be inspected to a lesser degree than a gasoline tank.*

3) Some say that any certified inspector can inspect any tank.

4) An Inspection report should be used to right the past.



Appendix C, Checklist, General rules regarding inspections.

79) Intentionally left blank.

80) Inspect the floor staves for topside coating failure and corrosion. Inspect the underside for corrosion. Coating failures **must** be addressed before the tank is returned to service.

81) Any nuts that do not appear to have as much thread engagement as the others in their proximity, should just be checked to see if they are loose by using only your fingers to see if you can easily tighten them. Only the owner should use a wrench to tighten any nuts that are found to be loose.

82) Check the vertical ladder, and the roof rafters for signs of corrosion or structural failure.

83) Intentionally left blank.

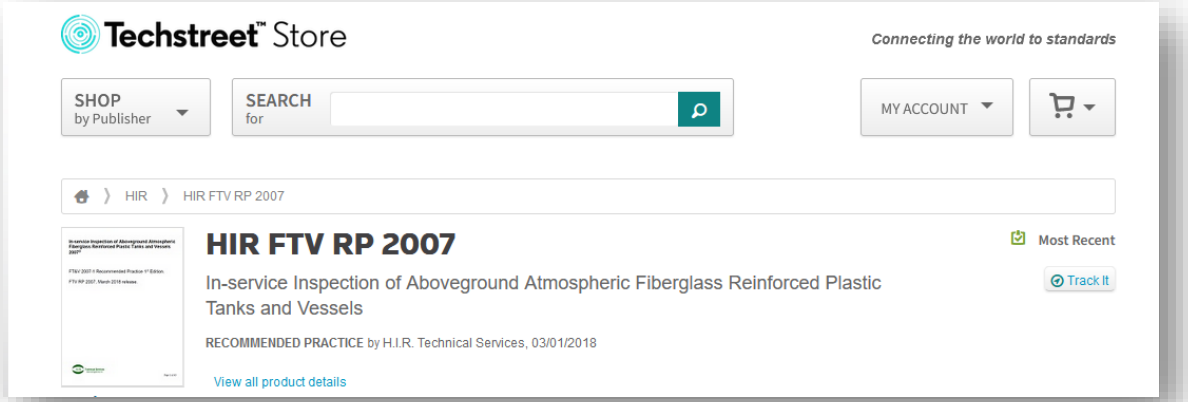
84) Take photos capturing all of the interior of the tank, so the tank owner can clearly see the condition of the internal coating. Take close-ups of all areas exhibiting a higher rate of corrosion than the remaining portion of the tank's interior. One common cause of metal loss could be related to abrasion caused by movement of suspended solids.

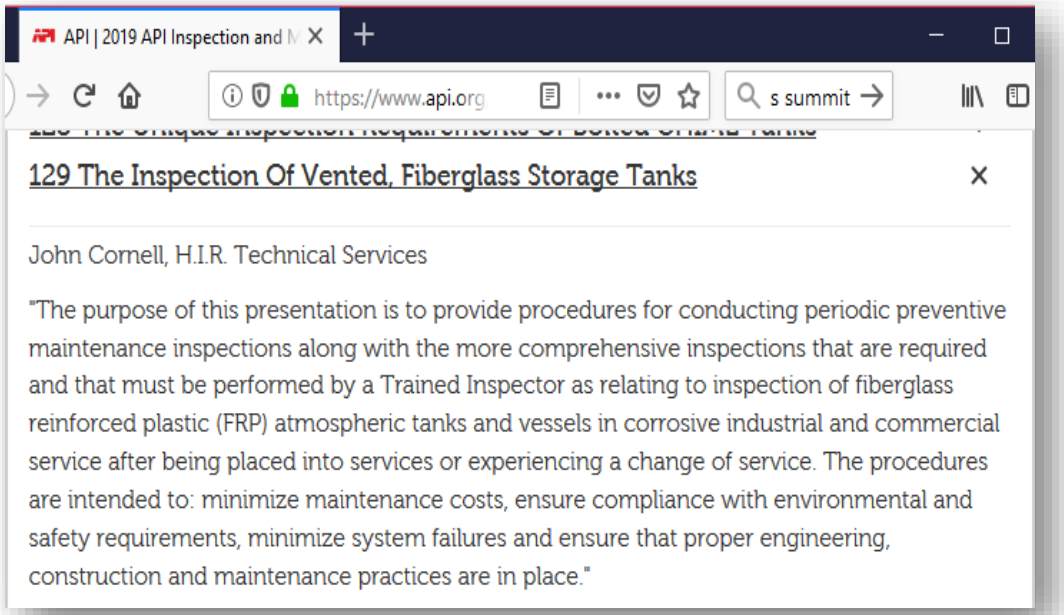
85) Use a pit gage* to record the depth of isolated pits. Afterwards, create a drawing showing the exact locations of all active corrosion and pits found on the inside of the shell. This will allow the owner to visually monitor these areas for possible through wall corrosion that may eventually occur.

86) Intentionally left blank.

87) Intentionally left blank.

*What a pit gage is and how it is used? Turn to 14.025 of this publication.





One tank inspection website states:

"For liquid fertilizer tanks, no federal requirements exist as to how often an API 650 tank must be inspected."

Citation 312927429/01001

Inspection	Reporting ID	Open Date	SIC	Establishment Name
312927429	0626700	04/01/2011	2869	

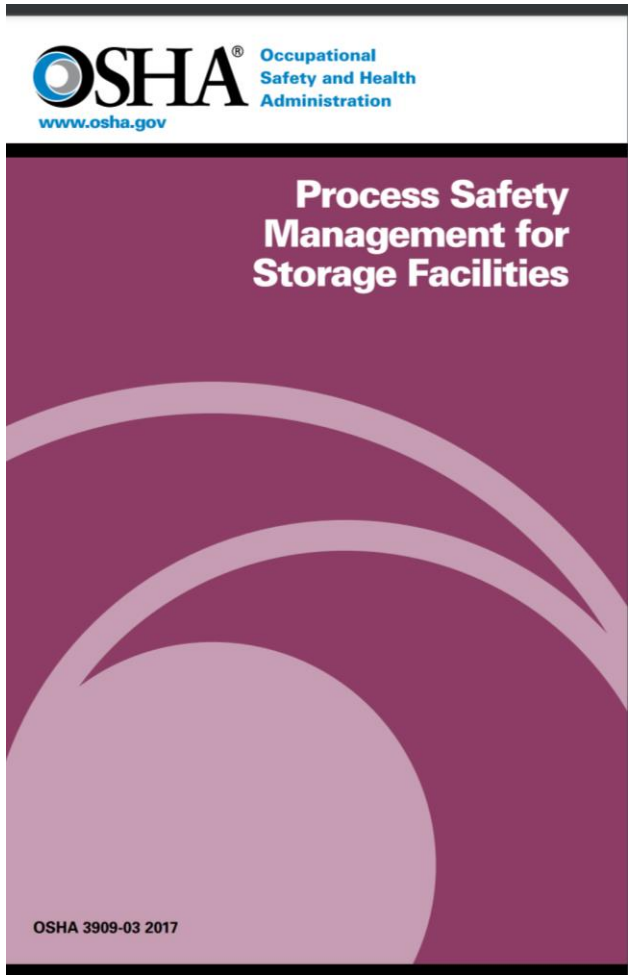
Citation	Issuance Date	Hazard Category
01001	09/23/2011	Chemical

Section 5(a)(1) of the Occupational Safety and Health Act of 1970: The employer did not furnish employment and a place of employment which were free from recognized hazards that were causing or likely to cause death or serious physical harm to employees in that: Employees were exposed to inhalation of toxic chemicals, fire and thermal burn, and struck-by hazards caused by the rupture of aboveground atmospheric storage tank containing flammable and combustible products. The employer failed to perform inspections and test on atmospheric storage tanks in accordance with Recognized and Generally Accepted Good engineering Practices (RAGAGEP), exposing employees to serious fire, explosion and toxic release hazards in the event a leak or rupture were to occur as a result of corrosion and or wall thinning. The employer did not develop and implement an inspection plan or procedure to perform internal and external inspection to ensure the ongoing integrity of any of the facilities atmospheric storage tanks and charge tanks. Feasible means of abatement, among others, include the following: 1) Adhere to the tank manufacturers instructions (2 Adhere API RP 575, section 6.1 FREQUENCY OF INSPECTION - Tanks covered by API Std 653 should be checked at least monthly. These routine in-service inspections should include checking for corrosion, leaks, settlement, distortion, and determining the condition of the foundation, insulation systems, and paint systems. The value of the API Std 653 informal monthly inspection is to detect changes. Personnel experienced in the tanks operation usually perform the monthly inspection. Observations, especially changed conditions, should be reported to a tank specialist for further assessment and evaluation. (3 Adhere API Std 653, section 6.4.2 INSPECTION INTERVALS - The interval from initial service until the initial internal inspection shall not exceed 10 years.

One tank inspection website states:

No federal requirements exist as to how often an API 650 liquid fertilizer tanks must be inspected.

I say that false statements like the one aforementioned could lead to more tank failures with the liquid fertilizer industry.



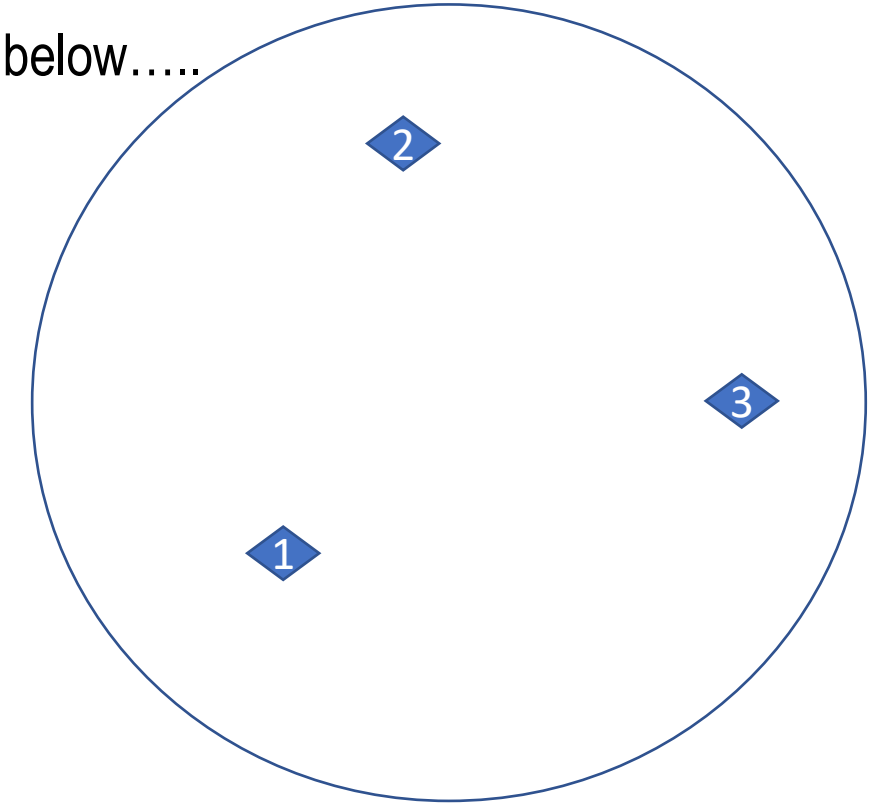
- A starting point for creating a mechanical integrity program is listing all equipment and etc..
- Recommendations from the manufacturer.
- Employers should look for applicable codes/standards or industry best practices.
- Inspections and tests must follow Recognized and Generally Accepted Good Engineering Practices (RAGAGEP).
- Inspection and test frequency must be consistent with manufacturer's recommendations and good engineering practices.

Sited therein:

- In 2008, a nearly 90-year-old liquid fertilizer storage tank catastrophically failed.
- Seriously injured two employees.
- Further, some tank inspection and testing activities did not follow recognized and generally accepted good engineering practices.

#1, API 653 Inspection Reports must be complete w/ very little guessing.

We took 3 Ultrasonic thickness readings on the roof as illustrated below…..



a. Do you believe this is complete or acceptable.

b. How many times have you walked on a tank roof and would you feel comfortable knowing this was the limit of the last inspection?

Roof plates as measured: .186”, .184”, and .182”

Average roof plate thickness as calculated…. = .184”

#1, API 653 Inspection Reports must be complete w/ very little guessing.

We took 3 Ultrasonic thickness readings on the roof as illustrated below…..

TANK ROOF EVALUATION

Any area or roof plates with any holes through the roof plate shall be repaired or replaced.

Minimum "t" thickness for a existing steel roof plate.

4.2 TANK ROOF EVALUATION

4.2.1 General

4.2.1.1 The structural integrity of the roof and roo
verified.

4.2.1.2 Roof plates corroded to an average thickness of less than 0.09 inches in any 100 inch area or roof plates with any holes through the roof plate shall be repaired or replaced.

#1, API 653 Inspection Reports must be complete w/ very little guessing.

This tank was inspected using API 653 as the basis…..

But….. This tank is only 7) years old and a settlement survey is not provided....

4.4 Tank Bottom Evaluation

Excessive foundation settlement of storage tanks can affect the integrity of tank shells and bottoms. Therefore, monitoring the settlement behavior of tanks is a recognized practice to assess the integrity of tank bottoms. See Annex B for techniques for evaluating tank bottom settlement.

B.3.4.5 In general, settlement occurs slowly, and for most existing tanks, the majority of settlement is presumed to have occurred in the first few years of service. Significant additional settlement will not be expected after the initial inspections.

And also, “Check for settlement” is found in Annex “C” twice.

#1, API 653 Inspection Reports must be complete w/ very little guessing.

$$t_{\min} = \frac{2.6\ (H-1)DG}{SE}$$

Sometime they do this…….. $\dfrac{2.6 \quad 28 \quad 47 \quad 1.00}{21000 \quad 1.0} = \dfrac{3421.6}{21000} = 0.163$

Fertilizer

This is what they should have done……. $\dfrac{2.6 \quad 28 \quad 47 \quad 1.35}{21000 \quad 1.00} = \dfrac{4619.16}{21000} = 0.220$

#2, What is required for a report to contain and does it change in relationship to the product being stored? Some say that a fertilizer can be inspected to a lesser degree than a gasoline tank?

Notes:

- Tanks usually don't fail due to the product type, but instead to stress and corrosion.

- To say you are going to perform a complete 653 inspection sort of makes everyone think that you are going to perform a complete 653 inspection.

- Truth be told, owners of more hazardous product tanks (gasoline) have more regulators involved so they must cross the "t"s and dot the "i"s. Some tank like fertilizer tanks are more remote and who's really paying attention.

- And yes, there are more issues for the owners of PHMSA and EPA regulated tanks and the owners know what to look for and don't fall for the low-bidders sales pitch, "you don't need to do that because it's not required for your type of product" or "API 653 is just a guide"

#3, Some say that any certified inspector can inspect any tank.

Notes:

- This is just not true.

- Inspectors start out with a basic understanding of tank design and then compare what is currently standing right in front of them to what they are convinced to have been there many, many years ago.

- An inspector that only has experience with inspecting small, Annex “J” (shop-fabricated) tanks would be hard-pressed to inspect a 200’-0 diameter PHMSA regulated gasoline storage tank, having a modern full-surface contact floating roof having a wiper seal around the perimeter, a foam system and a beautiful geodesic dome on top. Don’t send this person to my refinery. I as the tank owner can say no. I as the owner am responsible for my tank’s inspection.

- Are they sending API 653 Certified Inspectors out to inspect your given tank? Sometimes, NO.

- API 653, Section 12.1.1.2, Personnel performing NDE shall be qualified in accordance with API 650, Section 8, and any supplemental requirements given herein.

#4, An Inspection report should be used to right the past.

Assumptions can hurt the client….

* Original roof thickness assumed to be 12ga. (.104).

This was NOT a bolted tank with a baked-on coating or galvanized coating.

How was this derived?

Wrong!!

Individual spot UT reading taken on roof plates.

Maximum reading .102”

Minimum Current minimum thickness: .096”

CR = (.104-.096) / 38 years =.00021” per year.

R_L = (.096 -.090) / or .006 / .00021= 28.5 years.

Individual spot UT reading taken on roof plates.

Maximum reading .102”

Minimum Current minimum thickness: .096”

CR = (.~.188-.096) / 38 years =.0024” per year.

R_L = (.096 -.090) / or .006 / .0024 = 2.5 years

Closer!!

When the inspector assumes that one part of the tank was not built in accordance with API 650, all other variables within the required calculations need to be investigated.

In closing I would like to once again thank the management team here at NISTM for this continued opportunity.

I would like to open the floor for any questions regarding today's presentation.

Afterwards, feel free to track me down for any generic tank questions that you may have.

Thank you.

John Cornell, Sr. Storage Tank Specialist
H.I.R. Technical Services

LinkedIn: https://www.linkedin.com/in/john-cornell-3a2b8346/
Twitter: https://twitter.com/TankTrainer1
Bizfluence: https://bizfluenceapp.com/hubs/storage-tanks