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Tank Talk

Is Your Tank Old? Rusty? Both? Why?

By: Ray Penny, Manager, Southwest Regional Office

The ravages of time are well known. Just look at grandpa's high school graduation picture. Old tanks are normally torn down before they fall down, and most of the tanks erected when your grandfather graduated from high school have already been torn down. The average elevated tank is demolished when it's 40 to 60 years old, but a few older tanks are still standing. Did you ever wonder why?

Time has no affect on the steel used to construct water storage tanks, but rust is a killer. Rust is the common name for the process of oxidation; the steel in tanks will rust unless steps are taken to prevent it.

Regular inspection and good maintenance are keys to tank longevity. Some tanks rust faster and more severely than others, because they are more difficult to maintain. Nooks and crannies are difficult to inspect and hard, if not impossible, to affectively protect from the elements that promote rust. The pinned connections at the ends of diagonal bracing and sway rods are good examples. Tanks with smoother, simpler outlines are replacing multi-legged elevated tanks with lattice legs.

Tank owners know that replacing steel lost to rust and repainting tanks are expensive. Regular inspections, preventive maintenance, and good engineering details are important to the service life of the tank. Inspections have to be thorough and detailed and performed by experienced and qualified inspectors. Maintenance has to be done when needed and well done. Good engineering details aren't standard. Design standards, like AWWA D-100 provide only minimum requirements. Details that reduce maintenance problems are specific to each style of tank. Unless these details are included in the specifications, contractors will furnish the minimum. This applies to new tanks as well as to the rehabilitation of existing tanks.

When you decide you need a new tank or your existing tank needs to be evaluated, call Tank Industry Consultants. We have twenty-six years of experience helping owners avoid and solve tank problems. We inspect tanks, coatings, and contractors' work . We know the details and how to specify them to minimize your maintenance costs.

The first steel tanks were constructed from steel or wrought iron plates fastened together with rivets. World War II accelerated the progress of electric arc welding. Welding has proven to be more "maintenance-friendly" than riveted construction.

To find out more about the design and maintenance of water tanks, log on to TIC's website at **www.TankIndustry.com** and look under the technical papers tab. Some previous articles that may be of interest include:

- *Maintaining Aged Steel Water Tanks: What to Look For and Why*
- *Proper Evaluation Plays Important Role in Planning Tank Preventive Maintenance*
- *Proper Maintenance Makes Tanks Last Longer*

Ray Penny is Manager of TIC's Southwest Regional Office, and Director of Industrial Sales and Marketing. Ray has nearly thirty years experience in storage tank engineering, including twenty-seven years with Chicago Bridge and Iron Company, an international tank fabrication and construction company.

Inside This Issue

President's Corner

by Steven P. Roetter, P.E., President, Tank Industry Consultants

One of the biggest mistakes I see tank owners make is selecting a tank inspection service based on the way the inspection is performed. For instance, it is not uncommon for owners to solicit proposals for diving inspections on their tank. I ask owners, "Why do you want a diving inspection?" The answer is usually, "I can't drain my tank." Well, if the tank truly cannot be drained, an inspection is a waste of money because any deficiencies cannot be fixed. I think what the owners really mean is, "The cost of product or loss of service pressures make it very inconvenient for me to drain a tank for inspection." While *this* is a valid response, it usually misses some important analysis.

Underwater inspections (either diving or remote operated vehicles) cannot be as thorough as drain-down inspections. Perspective is lost as the diver or vehicle travels around the tank and is able to see (or video) only a short distance. Additionally, sediment stirred from the bottom or scraping the shell can significantly reduce visibility. I know you have all seen crystal clear photos from underwater inspections; however, in reality, underwater photos are usually blurred by the water and sediment in the tank.

So, what type of evaluation is best for your specific circumstances? I recommend you retain the most qualified tank consultant who can assist your utility in ALL phases of your tank ownership. Involve this specialist in the planning of both the evaluation of tanks and the prioritization of maintenance. As an owner, you are really buying information and recommendations, not an inspection. The consultant should be able to discuss the pros and cons of different types of inspections under different conditions and then assist you in getting the necessary information given the water systems constraints. For instance, the consultant might suggest a drain-down inspection of an older deteriorated tank with a follow-up rafting inspection of the roof structure in order to get all the information necessary to plan for future maintenance. The consultant may also suggest that a diving inspection be performed on a different tank because it is in better condition and you only need to update its condition. A firm that performs all types of inspections will be more likely to give unbiased advice on inspection types than a firm that only dives.

With this information, a good consultant will be able to assist you in prioritizing maintenance based on available funding. This involves spending scarce resources where it will do the community the most good. You might elect to do safety upgrades to multiple tanks in the first year, paint the outside of one tank and the inside of another tank in year two, and paint two complete tanks in year three. There is no rule that dictates that funds cannot be split among tanks. It is difficult for general consultants to have the depth of experience or the perspective to make these prioritization decisions, and a "tank inspector" doesn't have the experience or the resources to execute a project like this.

I heard a quote attributed to the legendary oil well firefighter Red Adair. During the first Gulf War when the cost of his services was being debated, he was reported to have said "If you think it's expensive to hire an expert, try hiring an amateur." How many of you remember the results? The fires were extinguished in a fraction of the time that was thought necessary and in the process saved millions of barrels of oil and minimized the environmental disaster. Sometimes the cheapest ain't the cheapest after all.

Visit us on the Web TankIndustry.com

Emerging Issues

Watch for Chip Stein's article, *A Specifier's Perspective on Tank Painting: A Review of Four Practical Issues* in the May edition of Journal of Protective Coatings and Linings.

Choosing a Tank Evaluation Firm

So...it's been a while since you've had your water tank evaluated. Or maybe the coating on the outside of the tank looks pretty bad and you'd like to know if it needs to be repainted. What should you look for when selecting a firm to evaluate your tank?

AWWA M42—*Steel Water-Storage Tanks*, the benchmark for water tank evaluations which has replaced D101, lists the following qualifications for a tank maintenance engineer:

- **Knowledge**
- **Effective communications skills**
- **Climbing ability**

If you compare TIC's qualifications to other firms you will find that we excel in each of these areas. But in addition, there are some key differences between our evaluations and those provided by most firms.

- TIC's evaluation reports are **easy to read and understand**. The reports are in narrative format, not a fill-in-the-blank form. This allows a smooth transition into the design phase without extensive, costly rework.
- TIC provides **pertinent dimensions** which allow structural calculations to be performed (if necessary) and verification of compliance with safety, sanitary, and operational standards.
- TIC has the **coatings laboratory tested** for the three most regulated common ingredients in coatings: lead, cadmium, and chromium.
- TIC provides repair and coating **alternatives *specifically* for the tank** based on coating condition, the environment, the existing tank condition, and future and immediate system requirements.
- TIC includes **color photos with captions** keyed to the appropriate observations in the evaluation report for ease of reference.
- TIC provides **economic factors** with the report. This allows for comparisons of different recommended alternatives and assists in the budgeting process.
- A **Registered Professional Engineer** on our full-time staff will certify the evaluation report.

Contact us for more information on the tank evaluation services offered by Tank Industry Consultants.

Major Revisions to AWWA D100-05 – Welded Carbon Steel Tanks for Water Storage

Stephen W. Meier, P.E., S.E.
Vice President, Engineering and Technology—Chair, AWWA Steel Tank Committee

The revision to AWWA D100 is complete and is expected to be approved by the AWWA Board at the Annual Conference in San Francisco. This revision is quite extensive and affects nearly every section of the Standard. The following summarizes the major changes.

Contractual Language Eliminated

At the direction of the Standards Council, all sections have been revised to eliminate contractual language such as "purchaser shall…" and "constructor shall…"

Restructuring the Standards

Several sections of the previous edition contained a mixture of requirements (i.e., material, design, welding, fabrication, erection, and inspection requirements). These requirements have been segregated and moved to appropriate sections for ease of use. The previous edition also contained many recommendations that were not considered minimum requirements. These recommendations have been moved to a new Appendix A as commentary.

Title and Scope

The title and scope of the standard has been revised to emphasize that the scope is new tanks constructed of welded carbon steel.

Anchorage Details

Anchorage detail requirements have been added for anchor bolts and anchor straps. A minimum width requirement has been added for butt-welded annulus plates.

Wind Loads

Wind load requirements are based on ASCE 7-02. The wind stiffening requirements for shells have been revised to allow the use of the as-ordered shell thickness less the specified corrosion allowance. A one-third increase in the foundation allowable bearing stress for wind loads when specified in the geotechnical report is now permitted.

Allowable Local Buckling Compression

Two new methods for determining the allowable local buckling compressive stress for water-filled shells have been added. These methods permit an increase in the allowable stress due to pressure stabilization. Measurement and documentation is required for shells using these methods.

Roof Rafters

Roof rafters designed using a roof live load of 50 lb/ft^2 or less must be designed using allowable stresses for A36 material, regardless of the material used. Roof rafters designed using a roof live load greater than 50 lb/ft^2 may utilize higher allowable stresses when using material with minimum specified yield strength greater than A36 material.

Corrosion Allowance

The thickness to which corrosion allowance is added has been changed to the thickness determined by design for elements other than bottom plates of flat-bottom ground tanks.

Splices in Tension-Bracing

The requirement that welded splices in tension-bracing for multicolumn tanks must be designed for 100% joint efficiency has been clarified.

Flush-Type Cleanouts

The 1/16 in. (1.59 mm) additional shell thickness requirement for flush-type cleanouts has been eliminated to match the current requirements of API 650.

Communications Equipment

Recommendations for antennas and related communications equipment have been added to Appendix A as commentary.

Section 6 Eliminated

Section 6 (AWWA D100-96), entitled "Sizing of Ground-Supported Standpipes and Reservoirs" has been deleted.

Dissimilar Metals

Electrical isolation requirements for dissimilar metals inside the tank below the TCL have now been included.

Welding Procedures & Testing

Full-size proof test requirements for the qualification of welding procedure specifications for tension bracing splice welds to 4/3 times the published minimum yield strength of the bracing member have been revised.

Minimum fillet weld size requirements relative to roof opening have been clarified. A maximum roof opening requirement (3/16 in. [4.76 mm]) has been added. Seal welding requirements for corrosion protection are also clarified as are preheat requirements.

Inspection based on sectional segments has been eliminated. Visual inspection of all welds and new acceptance criteria are added.

Qualification of welder and production testing requirements have been added for tension-bracing splice welds. The proof test for tension-bracing splice welds has been increased to 4/3 times the published minimum yield strength of the bracing material.

Seismic Design

The seismic design requirements have been changed extensively to align with the seismic load requirements of FEMA 450 and ASCE 7-05 which are based on a maximum considered earthquake ground motion for an event with a 2% probability of exceedance within a 50-year period (recurrence interval of approximately 2,500 years). General and site-specific procedures for determining design response spectra are included. Alternate procedures for elevated tanks have been added and allow the use of soil-structure and fluid-structure interaction. Soil structure interaction procedures are added for ground storage tanks.

Vertical design acceleration requirements are now mandatory for all tanks. The requirement that P-delta effects be considered has been added for all elevated tank styles. A critical buckling check for pedestal type elevated tanks has been added to guard against premature buckling failure. Equations have been added to calculate the overturning moment for mat or pile cap foundations supporting flat-bottom tanks. Minimum freeboard requirements similar to those of ASCE 7-05 have been added for all tanks. Piping flexibility requirements similar to those of ASCE 7-05 have been added for all tanks.

Appendices

A new Appendix A, "Commentary for Welded Carbon Steel Tanks for Water Storage," has been added to provide background information for many of the requirements contained in the standard.

Appendix B, "Default Checklist," has been added to highlight a few key issues that users of the standard may wish to evaluate to determine if the default requirement in the standard meets their needs.

Steve Meier, TIC Vice President of Engineering and Technology, chairs the AWWA Steel Tank Committee which oversees the activities of the standards committees and revision task forces. Steve is noted as one of the foremost structural engineering experts for the design, construction and rehabilitation of concrete and steel structures for storage systems, with specialized expertise in seismic design.

For a schedule of tank-related committee meetings at AWWA ACE '05, contact Tank Industry Consultants or log on to the AWWA website at www.awwa.org and follow the links to ACE '05.

Watch for information on TIC's upcoming seminars and presentations on the changes in D100-05.

See you in San Francisco

Stop by Booth # 913
at the
AWWA Annual Conference and Exposition in San Francisco
and we'll
Talk about Tanks!

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