Failures in the protective coating system on a newly constructed water tank are often the result of discontinuities left behind by the construction contractor during welding. Such defects should have been removed by the construction contractor at the time of erection (before surface preparation and painting). If not, the unsuspecting owner will pay a second time for their removal—when the paint fails—at a higher cost.

One approach owners can take to prevent coating failures related to weld defects is to include provisions in the initial construction contract for in-process inspections to be made before the erection crew leaves the site. This Maintenance Tip describes the types of surface defects created during welding that affect coating performance, inspection before surface preparation and after coating application, and qualification criteria for inspectors.

Identifying Surface Defects
Surface defects caused by welding include the following:

• weld spatter (metal particles left after welding, which do not form part of the weld);
• pickups (depressions left at the end of a weld); and
• scabs (rough metal or partial welds remaining from fabrication that are not part of the permanent structure).

Weld design and finishing also have a long-term effect on coating performance. NACE standard RP0178, “Fabrication Details, Surface Finish Requirements, and Proper Design...”

Fig. 1 - Observed holidays (coating voids) along an inadequately prepared weld seam following short-term service. Photos courtesy of author

Fig. 2 - New tank construction showing a weld seam with proper attention given to removing weld imperfections.

Fig. 3 - Photo identifies a poorly completed weld after grinding. Weld is undercut with indications of linear porosity.
sign Considerations for Tanks and Vessels to be Lined for Immersion Service," outlines recommended practices to be included in the construction documents.¹

Without the repair of weld surface defects or incorporation of defined design practices, corrosion may be induced from resulting holidays (pinholes) or peel-backs (the peeling of paint from an edge or sharp corner). Corrosion will likely begin once the tank has been in service for a short time.

Left unchecked, corrosion may spread to surrounding areas, leading to eventual repairs that may be both extensive and costly. While the one-year warranty inspection of the coating will often reveal that weld defects have started a breakdown in the coating, earlier detection could mean less extensive and less costly repairs.

**Inspecting the Tank before Surface Preparation**

Correction of discontinuities should be part of the tank's pre-surface preparation as referenced in the American Water Works Association (AWWA) Standard D100, section 10.8.3, “Cleaning of Welds.” The standard states the following. “The constructor’s crew shall remove weld scale of slag, spatter, burrs, and other sharp or rough projections in a manner that will leave the surface suitable for subsequent cleaning and painting operations.”²

Reference is also made in the new AWWA Manual M42 under Part II, Chapter 8, “Inspecting New Tank Construction—Tank Erection.” (Manual M42 represents the replacement guide for AWWA D1-1.) The subsection titled “Welding Quality” states the following. “It is vital for the tank constructor and inspector to visually inspect all welds to ensure the removal of all weld spatter, sharp surfaces, overlaps, and unacceptable undercuts that will be detrimental to the coating life.”³

It is important to address how much inspection is necessary and how much it will cost. A full-time inspector during the entire tank erection is inefficient and expensive.

There is little to inspect when the crew is in the process of fit-up, tacking, or finish welding. In many cases, a weekly inspection schedule works best. It allows for examination of multiple section assemblies before they are hoisted into place. Inspection and correction of defects to plates and weld seams when tank assemblies are on the ground is much easier than completing the same operation in the air. Ground inspection is also safer.
Weekly visits need to be coordinated with the site superintendent. Weekly inspections should identify and mark observed defects. Repairs are normally made by additional welding to fill in pick-ups or by cleaning weld seam areas with a surface grinder.

As a final check, when construction of the tank is near completion and before scaffolding is removed, weld seams joining tank sections can be examined and defects marked. The final inspection should be conducted in the presence of the superintendent or an appointed crew member. Once the final inspection and final repairs are completed, there is usually no reason for the erection crew to return.

Qualifications of Weld Inspectors
The weld inspector should be able to demonstrate at least the following qualifications:

- certification as a welding inspector (CWI) through the American Welding Society’s (AWS) QC 1 1996, Standard for AWS Certification of Welding Inspectors; or
- AWS certification as an associate welding inspector (CAWI) and direct supervision by a CWI.

Although not part of the AWS QC 1 1996, some contracts allow for inspection by a CAWI under the direct supervision of a structural engineer. Additional qualifications may include familiarity with nondestructive examination, training through NACE International, and basic experience in water tank construction.

Post-Application Inspection
After final inspection, the tank can be considered ready for the painting contractor to prepare and coat. Following paint application, holiday testing for interior surfaces subject to immersion will determine the effectiveness of the pre-surface preparation and inspection. Holiday testing detects minute voids in the coating system using either a low-voltage wet sponge or a high-voltage spark tester as specified. The test is conducted in accordance with NACE’s standard recommended practice, NACE RP0188, Discontinuity (Holiday) Testing of Protective Coatings.

Sparks occurring around weld seams indicate weld defects that, if not corrected, will lead to coating failure. (Holiday testing thus makes the welding crews as well as the inspector and painting contractor each accountable for their work.)

Conclusion
Pre-surface preparation after welding is the responsibility of the construction contractor; it is not a value-added service to the owner.

Coating failures related to weld discontinuities can be avoided in water tank construction if an in-process inspection schedule is included in the specifications of the contract.

The estimated cost to the owner for possible repairs after the tank has been placed in service generally outweighs the cost of a weekly inspection during construction. The inspection can also prevent the indirect costs associated with taking a newly constructed and coated tank out of service for repair.

References
1. RP0178, Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service (Houston, TX: NACE International)