Update aboveground storage tank inspections

Checklist highlights new changes in API 653

D. E. Hendrix, The Hendrix Group, Inc., Houston, Texas

For many aboveground storage tank owners and operators, the rules for inspection, maintenance and repair are constantly changing. In December 1995, API revised API Standard 653, “Tank Inspection, Repair, Alteration and Reconstruction.” This industry-developed standard addresses suitability-for-service, repair and alteration for aboveground storage tanks that were constructed to API 650 and API 12C guidelines.

Since it was first issued in January 1991, tank owners, operators and inspection companies have struggled over how and why to use API 653. With the revised edition now published, an additional question arises: have the rules changed dramatically? Use this quick checklist to highlight major concerns and changes in your tank-inspection program.

Section 1—Introduction. API has added two definitions to the standard, Authorized Inspection Agency and Inspector. With these two new definitions, API addressed the increasing incorporation of API 653 requirements into state or local jurisdictions. Now, API 653 has a formalized description for "inspection agencies" and "inspectors." The new definitions are similar to The National Board Inspection Code and API Standard 510, "Pressure Vessel Inspection," governing ASME Section VIII pressure vessels. Depending on the jurisdiction, this addition could potentially impose regulations or restrictions to independent tank inspection companies.

Section 2—Suitability for service. A welcome revision to the tank-shell evaluation section is the inclusion of Table 2.1-Joint efficiencies for welded joints. This table lists various joint efficiencies that API 650 and API 12C used for new tank design. Using the table, a tank owner can facilitate maximum product-height calculations by incorporating joint efficiencies greater than the API 653 default 0.7. API 653 specifies a default 0.7 joint efficiency for product height calculations when the original joint efficiency is unknown. Based on Table 2-1, a joint efficiency as low as 0.7 has not been specified since API 12C (except for API 650 Appendix A construction with no radiographic inspection). Using 0.7 for product height calculations restricted maximum product heights for tanks that were designed with a greater efficiency. The primary reason for the default value was that most people did not have access to the original joint efficiency (it required having all of the previous standards).

Tank bottom evaluation. The wording "General" in paragraph 2.4.1 is revised. The language describes what are considered acceptable methods for satisfying periodic leak assessments between internal inspections. The first revision implied that leak assessments should be conducted at intervals less than or equal to the required internal tank inspections but gave no guidance as to what was an acceptable leak detection method. The revised edition specifies leak detection tests or monitoring systems (double bottoms) as examples of acceptable methods.

Foundation analysis. Some may be disappointed that the acceptance criteria for tank out-of-plane and edge settlement was not revised. It is this writer’s opinion that many people thought the foundation settlement acceptance criteria too conservative.

Bottom leak detection. API has added a footnote to paragraph 2.4.5 stating its support for release prevention systems (RPS) and release prevention barriers (RPB). This paragraph potentially affects API tank owners. This footnote reinforces the position that owners should consider equipping tanks with a leak prevention system or barrier, i.e., internal liners, cathodic protection, double bottoms, etc., when replacing an existing tank bottom.

Minimum thickness for tank bottom plate. Paragraph 2.4.7.4 defines the minimum required thicknesses for the “critical zone” of a tank bottom. The minimum “critical zone” thickness is now based on the original floor’s thickness (% of original thickness, not including any corrosion allowance) and the first-course shell thickness (% of tmin). An absolute minimum thickness of 0.1 in. still applies. Conceivably, the “critical zone” minimum required thickness may be greater than the rest of the floor and greater than that required by the first edition (0.1 in.).

Section 3—Brittle fracture considerations. This section has been rewritten to increase clarity; however, its main provisions have not changed.

Section 4—Inspection. Inspection frequency considerations—“change in service”—has been added to the list of factors that must be considered when determining tank inspection intervals.

In-service ultrasonic thickness measurements of the shell. The revised Paragraph 4.3.3.2 eliminates the requirement to inspect new tanks within five years of commissioning. This revision could lengthen the required first
inspection interval for newly constructed tanks if corrosion rates can be established by using experience gained from "similar service" tanks.

Internal inspection. A new paragraph (4.4.1.2) requires that internal inspections must be performed by the "authorized inspector." In certain jurisdictions, this requirement could place restrictions on personnel allowed to conduct internal inspections.

Inspector qualifications. API added an item to the required inspector qualification options to allow five years experience in inspecting HP1 aboveground storage tanks, in lieu of the previously required combination of education and experience. Paragraph 4.10.2 has been revised to include inspector certification as a requirement for authorized inspectors. Paragraph 4.10.3 has been revised so that personnel conducting nondestructive inspections do not have to be API Certified aboveground storage tank inspectors.

Appendix D—Authorized inspector certification. Paragraph D.3.2 implies that the "grandfather" clause originally permitted with the initial certification requirement in the January 1992 addendum to API 653 is being reinstated in the second edition. This paragraph is not correct and should have been omitted in the 1995 edition, according to API personnel.

Section 6—Design considerations for reconstructed tanks. For shell design, Paragraph 6.4.3 detailing the maximum liquid height for hydrostatic testing, was eliminated in the second edition. It is not clear why the paragraph was eliminated except that it may have conflicted with the "full" hydrostatic test required for reconstructed tanks in Section 10—Examination and testing.

Section 7—Tank repair and alteration. In paragraph 7.9.2, the repair of tank bottoms is revised to provide specific requirements for removing and replacing a tank floor. The first edition had no requirements. Paragraph 7.9.2.3 states that replacement tank bottoms shall meet all requirements of API 653, including shell weld spacing.

Section 10—Testing and examination. Paragraph 10.3.2.3, When hydrostatic testing not required, now references to paragraph 7.2, Removal and replacement of shell plate material, for weld-spacing requirements. This revision increases the minimum weld spacing between the bottom of the doorsheet and the shell-to-bottom weld from 3 to 6 in.

The author

David E. Hendrix is President of The Hendrix Group, Inc., Houston, Texas. Mr. Hendrix holds a BS degree in metallurgical engineering from the University of Alabama and has over 17 years of experience with material selection and equipment failure from mechanical and corrosion-related causes. He performs engineering integrity assessments of pressure vessels and aboveground-storage tanks and provides technical support to inspection companies and operating companies in the development of inspection-management programs, inspection procedures and repair specifications. Mr. Hendrix is a registered professional engineer in the state of Texas, a NACE Corrosion Technologist and an API-certified API 653 Aboveground Storage Tank Inspector. He has authored many papers in the areas of equipment failures, high-temperature metallurgy, paint and coating standards development and storage tank maintenance. He is a member of NACE International, ASM International, Steel Structures Painting Council, ASME and ASTM.