Title:	Fitness-for-Service Reference Updates	**Agenda Item # 653-1015**
Date:	08/27/2026	
Contact:	Name: Joel Andreani Company: Equity Engineering Phone: 216.338.1069 E-mail: jandreani@e2g.com	
Purpose:	1. Update API Standard 653 to align document fitness-for-service references and definitions with API 579-1/ASME FFS-1. 2. Revise text to explicitly reference fitness-for-service assessment, where appropriate.	
Source:	Task Group on Aboveground Storage Tank Fitness-for-Service	
Revision:	3	
Impact:	Provide clarity on fitness-for-service references and assessment opportunities.	
Rationale:	The proposed errata and editorial changes are intended to align API Standard 653 with API 579-1/ASME FFS-1. Additionally, references that implicitly refer to fitness-for-service assessment (i.e., stress analysis, rigorous evaluation) are revised to provide a clear reference for fitness-for-service assessment. Original proposed changes in red and blue font. New changes to previous ballot(s).	

Proposed verbiage:

Section 2—Normative References

API ~~Recommended Practice~~ 579-1/ASME FFS-1, *Fitness-For-Service*

Section 3—Terms and Definitions

3.16

fitness-for-service assessment

~~A methodology whereby flaws contained within a structure are assessed in order to determine the adequacy of the flawed structure for continued service without imminent failure.~~

Quantitative engineering evaluation that is performed to demonstrate the structural integrity of an in-service component that may contain a flaw or damage, or that may be operating under a specific condition that might cause a failure.

Section 4—Suitability for Service

4.3.3.6 As an alternative to the procedures described above, any thinning of the tank shell below minimum required wall thickness due to corrosion or other wastage may be evaluated to determine the adequacy for continued service ~~by employing the design by analysis methods defined in Section VIII, Division 2, Appendix 4 of the~~

~~ASME Code; or~~ through a fitness-for-service assessment in accordance with API 579-1/ASME FFS-1.~~, Section 4, Section 5, or Section 6, as applicable. When using the ASME criteria, the stress value used in the original tank design shall be substituted for the *Sm* value of Division 2, if the design stress is less than or equal to the lesser of 2/3*Y* (specified minimum yield strength) or 1/3*T* (specified minimum tensile strength). If the original design stress is greater than 2/3*Y* or 1/3*T*, then the lesser of 2/3*Y* or 1/3*T* shall be substituted for *Sm*.~~

4.3.5 Distortions

4.3.5.1 Shell distortions include out-of-roundness, buckled areas, flat spots~~,~~ dents ~~dents,~~ and peaking and banding at welded joints.

4.3.5.2 Shell distortions can be caused by many conditions such as foundation settlement, over- or underpressuring, high wind, poor shell fabrication, or repair techniques, and so forth.

4.3.5.3 Shell distortions ~~should~~ shall be evaluated in accordance with API 579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices on an individual basis to determine if specific conditions are considered acceptable for continuing tank service and/or the extent of corrective action.

4.3.6 Flaws

Flaws such as cracks or laminations ~~should~~ shall be thoroughly examined and evaluated in accordance with API 579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices to determine their nature and extent and need for repair. If a repair is needed, a repair procedure shall be developed and implemented. The requirement for repairing scars such as arc strikes, gouges, or tears from temporary attachment welds must be evaluated on a case-by-case basis. Cracks in the shell-to-bottom weld shall be removed.

4.3.8 Shell Welds

The condition of the tank shell welds ~~should~~ shall be evaluated for suitability for service using criteria from this standard, the as-built standard, or fitness-for-service assessment in accordance with API 579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices. Typical shell weld conditions are listed below with their required evaluation and/or repair actions. Repair procedures are given in 9.7.

4.4 Tank Bottom Evaluation

4.4.5.4 Unless a fitness-for-service assessment ~~stress analysis~~ is performed, the minimum bottom plate thickness in the critical zone of the tank bottom defined in 3.10 shall be the smaller of 3 mm (0.118 in.) (one-half the API 650-required bottom plate thickness not including corrosion allowance) or 50% of t_{min} of the lower shell course per 4.3.3.1 but not less than 2.5 mm (0.10in.) at the next inspection. Averaging of the bottom thickness is not permitted.

Updated to current 4.4.5.4 language

The structural integrity of the tank bottom critical zone may not be affected by isolated pitting and isolated corroded areas. For these critical zone areas, the minimum thickness at the next internal inspection may be determined by Table 4.4 or where an RBI assessment per 6.4.2.2.2 has been utilized.

The storage tank engineer shall determine if the isolated pitting and isolated corroded areas affect the tank bottom critical zone structural integrity. This may involve performing an engineering evaluation (see 4.3.3.6 for guidance) to verify that the structural integrity will be adequate until the next internal inspection.

4.4.5.7 Unless a fitness-for-service assessment ~~stress analysis~~ is performed that considers future corrosion allowance until the time it can be inspected, repaired, or replaced, the following criteria applies:

— the thickness of the projection of the bottom plate beyond the shell as measured at the toe of the outside bottom-to-shell fillet weld shall not be less than 0.10 in., and

— the projection of the bottom plate beyond the outside toe of the shell-to-bottom weld shall be at least 3/8 in.

4.4.6 Minimum Thickness for Annular Plate Ring

4.4.6.1 Due to strength requirements, the minimum thickness of annular plate ring is usually greater than 0.10 in. Isolated pitting will not appreciably affect the strength of the plate. Unless a fitness-for-service assessment ~~stress analysis~~ is performed, the annular plate thickness shall be in accordance with 4.4.6.2 or 4.4.6.3, as applicable.

Section 5—Brittle Fracture Considerations

5.3.10
Step 9—An evaluation can be performed to establish a safe operating envelope for a tank based on the operating history. This evaluation shall be based on the most severe combination of temperature and liquid level experienced by the tank during its life. The evaluation may show that the tank needs to be re-rated or operated differently; several options exist:

a) restrict the liquid level;

b) restrict the minimum metal temperature;

c) change the service to a stored product with a lower specific gravity;

d) combinations of Items a), b), and c), above.

The owner/operator may perform ~~can also~~ ~~make~~ a ~~more rigorous~~ fitness-for-service assessment ~~analysis~~ to determine the risk of failure due to brittle fracture in accordance with the principles and practices of API 579-1/ASME FFS-1. ~~by performing a fracture mechanics analysis based on established principles and practices. The procedures and acceptance criteria for conducting an alternative analysis are not included in this standard.~~

Annex B
(normative)
Evaluation of Tank Bottom Settlement

B.2 Types of Settlement

B.2.3 Edge Settlement

B.2.3.1 Edge settlement occurs when the tank shell settles sharply around the periphery, resulting in deformation of the bottom plate near the shell-to-bottom corner junction. Figure B.6 illustrates this settlement.

B.2.3.2 The equation given in B.3.4 can be used to evaluate edge settlement. Alternatively, a ~~rigorous stress analysis~~ fitness-for-service assessment in accordance with API 579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices may be performed. ~~can be carried out for the deformed profile.~~ The determination of the deformed profile should take into consideration the following.

B.2.4 Bottom Settlement Near the Tank Shell

B.2.4.1 Figure B.8 illustrates bottom settlement near the tank shell.

B.2.4.2 The equation given in B.3.3 can be used to evaluate settlement near the tank shell. Alternatively, a ~~rigorous stress analysis~~ fitness-for-service assessment in accordance with API 579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices may be performed. ~~can be carried out for the deformed profile.~~

B.3 Determination of Acceptable Settlement

B.3.1 General

For existing tanks with history of successful service, it may be possible to accept greater settlement and distortion of the foundation from a true plane than new tank construction standards allow. Each tank must be evaluated based on service conditions, materials of construction, soil characteristics, tank foundation design, and tank service history. The methods discussed in following sections are not mandatory and approximate the maximum permissible settlement. However, experience has shown that if settlements exceed the following requirements, a more rigorous evaluation, for example a fitness-for-service assessment may be performed in accordance with API-579-1/ASME FFS-1 or repair is required.

B.3.2.4 If measured out-of-plane settlement exceeds the applicable limits described in B.3.2.1 or B.3.2.2, a fitness-for-service assessment ~~more rigorous evaluation~~ may be performed by an engineer experienced in tank settlement analysis to determine the need for repairs. This fitness-for-service assessment ~~evaluation~~ may be performed ~~done~~ in accordance with API-579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices ~~by an engineer experienced in tank settlement analysis~~.

B.4 Repairs

B.4.1 If it is determined that settlements have occurred which are beyond the permissible limits established in the previous sections, then consideration should be given to an engineer experienced in tank settlement analysis performing a fitness-for-service assessment in accordance with API-579-1/ASME FFS-1 or other appropriate evaluation methodology based on established principles and practices, or by making repairs. ~~or a rigorous stress analysis should be performed to evaluate the deformed profile.~~

Other Background

API 510 mixes “should” and “may” in their summary of API 579 uses:

7.5 FFS Evaluations

Pressure-containing components found to have damage that could affect their load carrying capability (pressure loads and other applicable loads, e.g., weight and wind, per API 579-1/ASME FFS-1) shall be evaluated for continued service. FFS evaluations, such as those documented in API 579-1/ASME FFS-1, may be used for this evaluation and applicable to the specific damage observed. The following techniques may be used as an alternative to the evaluation techniques in 7.4.

a) To evaluate metal loss in excess of the corrosion allowance, an FFS assessment may be performed in accordance with API 579-1/ASME FFS-1 as applicable. This assessment requires the use of a future corrosion allowance, which shall be established based on Section 6 of this inspection code. These methods may also be used to evaluate blend ground areas where defects have been removed. It is important to verify there are no sharp corners in blend ground areas to minimize stress concentration effects.

b) To evaluate blisters, HIC/SOHIC damage, and laminations, an FFS assessment should be performed in accordance with API 579-1/ASME FFS-1, respectively. In some cases, this evaluation will require the use of a future corrosion allowance, which shall be established based on Section 6 of this inspection code.

c) To evaluate weld misalignment and shell distortions, an FFS assessment should be performed in accordance with API 579-1/ASME FFS-1.

d) To evaluate crack-like flaws, an FFS assessment should be performed in accordance with API 579-1/ASME FFS-1. When angle beam ultrasonic techniques are employed to size flaws, an industry-qualified UT angle beam examiner shall be used.

e) To evaluate potential creep damage on components operating in the creep regime, an FFS assessment should be performed in accordance with API 579-1/ASME FFS-1.

f) To evaluate the effects of fire damage, an FFS assessment should be performed in accordance with API 579-1/ ASME FFS-1.

g) To evaluate dent and gouge damage on components, an FFS assessment should be performed in accordance with API 579-1/ASME FFS-1.

h) To evaluate fatigue damage on components, an FFS assessment should be performed in accordance with API 579-1 / ASME FFS-1.

”May” in:
7.5, 7.5 a)

“Should” in:
7.5 b), c), d), e), f), g), h)

Some items do not apply to tanks