AGENDA ITEM: 650-1103

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TO: SC Ballot (5/2021) COMMITTEE NOTE: SG Design approved to SC Ballot with References Terms & Definitions moved to the appropriate Sections of Standard 650

PURPOSE: Update API Standard 650 Annex I terminology to align with API 655

INDUSTRY IMPACT: Standards Alignment, no cost impact.

EDIT LEGEND:
Unchanged text
~~Deleted text~~ (deleted from the document – single line through)
New text (Bold underlined)

API Standard 650

SECTION 2—NORMATIVE REFERENCES

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Standard 620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks*

API Technical Report 655, ***Vapor Corrosion Inhibitors for Storage Tanks***

API Standard 2000, *Venting Atmospheric and Low-Pressure Storage Tanks: Non-refrigerated and Refrigerated*

API Specification 5L, *Specification for Line Pipe*

EDITOR NOTE: Balance of this section remains unchanged.

API Standard 650

SECTION 3—TERMS AND DEFINITIONS

3.1 Aboveground Storage Tank (AST)

An on-grade, stationary, uniformly supported container, usually cylindrical in shape, consisting of a fixed or floating roof, shell, bottom, and support structure.

~~3.1~~ 3.2 Annular Plate (EDITOR NOTE, RENUMBER BALANCE)

~~3.2~~ 3.3 Annular Ring
The complete collection of annular plates positioned around the perimeter of a tank bottom, whose radial lengths are substantially equal.

3.4. Cathodic Protection

A technique to reduce the corrosion of a metal surface by making the entire surface the cathode of an electrochemical cell.

~~3.3~~ 3.5 centerline-stacked
The mid-thickness centerlines of plates in all shell courses coincide
~~3.4~~ 3.6 coating
A term that includes protective materials applied to or bonded to tank surfaces, including paint, protective metals (e.g. galvanizing or cadmium plating), adhered plastic or polyolefin materials. Coatings are used for atmospheric, immersion, or vapor-space service.
~~3.5~~ 3.7 contract
The commercial instrument, including all attachments, used to procure a tank.
~~3.6~~ 3.8 corroded thickness
A design condition equal to the nominal thickness less any specified corrosion allowance.
~~3.7~~ 3.9 corrosion allowance
Any additional thickness specified by the Purchaser for corrosion during the tank service life. Refer to 5.3.2.
~~3.8~~ 3.10 design metal temperature
The lowest temperature considered in the design, which, unless experience or special local conditions justify another assumption, shall be assumed to be 8 ° C (15 ° F) above the lowest one-day mean ambient temperature of the locality where the tank is to be installed. Isothermal lines of lowest one-day mean temperature are shown in Figure 4.2. The temperatures are not related to refrigerated-tank temperatures (see 1.1.1).
~~3.9~~ 3.11 design specific gravity
The maximum specific gravity of the stored liquid(s) at designated temperatures. The greatest value of all products when tanks are to be designed for multiple products
~~3.10~~ 3.12 design thickness
The thickness necessary to satisfy tension and compression strength requirements by this standard or, in the absence of such expressions, by good and acceptable engineering practice for specified design conditions, without regard to construction limitations or corrosion allowances.

~~3.11~~ 3.13 double-deck floating roof
The entire roof is constructed of closed-top flotation compartments.

3.14. Drain Pipes

Also referred to as monitoring ports, leak detection ports or tell-tale ports and may be used for VCI Application. Permits monitoring of the tank pad under a tank bottom to demonstrate that the Release Prevention Barrier is providing containment.

~~3.12~~ **3.15 examiner**
A person who performs Nondestructive Examinations (NDE) and is qualified and certified as required in Section 8 for the NDE method performed.

~~3.13~~ **3.16 floating suction line**
Internal piping assembly that allows operator to withdraw product from the upper levels of the tank.

~~3.14~~ **3.17 flush-stacked on the inside**
The inside surfaces of plates in all shell courses coincide.

~~3.15~~ **3.18 inlet diffusers**
Internal fill line piping with impingement plate, baffles, slots, or lateral openings. Diffusers limit splashing and misting of product, prevent product impingement on internal components, and disperse gases introduced into the tank.

~~3.16~~ **3.19 insert plate**
A steel plate that replaces part of a shell plate, with a nominal thickness that is equivalent to, or no more than 3 mm (1/8 in.) greater than the nominal thickness of the adjoining material. When an insert plate is equal to the full height of a shell ring, it is considered to be a shell plate.

~~3.17~~ **3.20 inspector**
A representative of an organization who ensures compliance with this standard and is responsible for various quality control and assurance functions, as outlined in this standard.

~~3.18~~ **3.21 liner**
A protective material used as a barrier but not adhered, nor bonded, to the protected surface. Typically used (1) inside a tank to protect steel, (2) under a tank for leak detection (as a "release prevention barrier"), (3) in a dike yard, or (4) on the dikes as secondary containment. Common examples are sheeting made from lead, rubber, plastic, polyolefin, or geosynthetic clay (bentonite). A liner is not a coating.

~~3.19~~ **3.22 lining**
An internal coating that consists of an applied liquid material which dries and adheres to the substrate, or a sheet material that is bonded to the substrate. It is designed for immersion service or vapor-space service. A lining can be reinforced or unreinforced.

~~3.20~~ **3.23 mandatory**
Required sections of the standard become mandatory if the standard has been adopted by a Legal Jurisdiction or if the Purchaser and the Manufacturer choose to make reference to this standard on the nameplate or in the Manufacturer's certification.

~~3.21~~ **3.24 Manufacturer**
The party having the primary responsibility to construct the tank (see 1.3 and 10.2).

~~3.22~~ **3.25 maximum design temperature**
The highest temperature considered in the design, equal to or greater than the highest expected operating temperature during the service life of the tank.

~~3.23~~ **3.26 mechanically-anchored tank**

Tanks that have anchor bolts, straps, or other mechanical devices to anchor the tank to the foundation.

~~3.24~~ **3.27 minimum design specific gravity for floating roof design**

The lowest specific gravity of the stored liquid(s) at designated temperatures. The lowest value of all products when tanks are to be designed for multiple products.

COMMITTEE NOTE: This is misleading and needs correction under separate Agenda Item. Definitions are to be INFORMATIVE, NOT Normative. In accordance with API Format & Style, "The standard shall contain normative text in the main sections of the document." The applicable annexes of the Standard (C & H) identify the "minimum design specific gravity for floating roof design". As defined in C.3.4.1 & H.4.2.1.1, not less than S.G = 0.7 is required for floating roof design regardless of any higher specific gravity product specified and/or stored).

~~3.25~~ **3.28 nominal thickness**

The ordered thickness of the material. This thickness includes any corrosion allowance and is used for determination of PWHT requirements, weld spacing, minimum and maximum thickness limitations, etc.

NOTE The thickness used in the final structure is the nominal thickness plus or minus any tolerance allowed by this standard.

~~3.26~~ **3.29 Purchaser**

The owner or the owner's designated agent, such as an engineering contractor.

~~3.27~~ **3.30 Purchaser's option**

A choice to be selected by the Purchaser and indicated on the Data Sheet. When the Purchaser specifies an option covered by an Annex, the Annex then becomes a requirement.

~~3.28~~ **3.31 recommendation**

The criteria provide a good acceptable design and may be used at the option of the Purchaser and the Manufacturer.

3.32 Release Prevention Barrier (RPB)

An RPB, includes steel bottoms, synthetic materials (also called flexible membrane liners), clay liners, concrete pads, and all other barriers or combinations of barriers placed in the bottom of or under a tank, which have the function of:

1) **preventing the escape of released material, and**
2) **containing or channeling released material for leak detection.**

~~3.29~~ **3.33 requirement**

The criteria must be used unless the Purchaser and the Manufacturer agree upon a more stringent alternative design.

~~3.30~~ **3.34 self-anchored tank**

Tanks that use the inherent stability of the self-weight of the tank and the stored product to resist overturning forces.

EDITOR NOTE: Spelling correction.

~~3.31~~ **3.35 single-deck pontoon floating roof**

The outer periphery of the roof consists of closed-top pontoon compartments, with the inner section of the roof constructed of a single deck without flotation means.

~~3.32~~ 3.36 **thickened insert plate**

A steel plate that replaces part of a shell plate, with a nominal thickness that is greater than the nominal thickness of the adjoining material by more than 3 mm (1/8 in.).

3.37 Tank Foundation

The foundation pad and structural support of the tank, including ring wall construction and penetrations through the ring wall, and any impermeable layers of flexible membrane, clay, geotextiles, or other equivalent layer.

3.38 Tank Pad

Tank pad refers to the layer directly underneath the tank bottom to be protected. This can be sand, gravel, concrete, asphalt, limestone, dirt or any material that is in contact with the bottom.

3.39 Vapor Corrosion Inhibitors (VCIs)

Substances that slowly release a corrosion preventative compound into an enclosed air space, effectively protecting exposed metal surfaces. VCIs (also known as Volatile Corrosion Inhibitors) are often used in situations where it is impractical or undesired to use rust preventative liquids or other surface treatments.

~~3.33~~ 3.40 **Welding Terms**

The terms defined in 3.33.1 through 3.33.21 are commonly used welding terms mentioned in this standard. See 5.1.5.2 for descriptions of fusion-welded joints.

EDITOR NOTE: Balance of this section remains unchanged.

ANNEX I
(normative)

Undertank Leak Detection and Subgrade Protection

This annex provides a number of design options requiring decisions by the Purchaser; standard requirements; recommendations; and information that supplements the basic standard. This annex becomes a requirement only when the Purchaser specifies an option covered by this annex or specifies the entire annex.

I.1 **Scope and Background**

I.1.1. This Annex provides acceptable construction details for the detection of product leaks through the bottoms of aboveground storage tanks, and provides guidelines for tanks supported by grillage.

NOTE API supports a general position of installation of a Release Prevention Barrier (RPB) under new tanks during initial construction. An RPB includes steel bottoms, synthetic materials, clay liners, and all other barriers or combination of barriers placed in the bottom of or under an aboveground storage tank, which have the following functions: (a) preventing the escape of contaminated material, and (b) containing or channeling released material for leak detection.

I.1.2. • Several acceptable construction details are provided for detection of leaks through the tank bottom and details for tanks supported by grillage (see Figures I.1 through **I-10** ~~I.11~~). Alternative details or methods may be used if agreed upon by the tank owner and Manufacturer, provided the details or methods satisfy the requirements of I.2.

I.1.3. • The tank owner shall determine whether the undertank area is to be constructed for leak detection. If leak detection is required, the owner shall specify the method or methods to be employed.

I.1.4. The bottoms of aboveground storage tanks may leak as a result of product side corrosion, soil side corrosion, or a combination of both. The extent of product side corrosion can be detected using standard inspection techniques during an internal inspection, but determining the nature and extent of soil side corrosion is more difficult. Therefore, in certain services and tank locations, it may be desirable to provide for undertank monitoring of leakage through the tank bottom plates.

I.1.5. For additional information on the use of internal linings to prevent internal bottom corrosion, see API **RP**652. Similarly, see API **RP**651 **and API TR655** for guidelines and requirements relating to preventing corrosion from the soil side of the bottom plate.

I.1.6. When the appropriate tank foundation design is being selected, it is important to consider the environmental and safety regulatory implications of leakage of tank contents into the containment space below the tank bottom. Specifically, the contamination of permeable material such as sand used as a floor support may constitute the generation of a hazardous waste. The treatment or disposal costs of such contaminated material must be determined.

I.1.7. The requirements for secondary containment as it relates to diked areas and impoundments are not within the scope of this Annex.

I.2 Normative References

There are no Normative References within this Annex, see the body of API Standard 650 Section 2 for Normative References

I.3 Terms and Definitions – See Section 3 of API Standard 650

~~I.2.~~ I.4 Performance Requirements

EDITOR NOTE: Inserted Section 2 and Section 3 above to address these in accordance with API Format & Style Manual (renumbered I.2 to I.4)

The following general requirements shall be satisfied for all leak detection systems:

a) Leaks through the tank bottom shall be detectable by observation at the tank perimeter. If a leak is detected, it shall be collected.

b) The use of electronic sensors for the detection of vapors and liquids is acceptable; however, the requirements of Item a above shall be satisfied. Any such sensor shall be fail-safe or have provision for calibration.

c) The materials of construction shall be chemically resistant to the range of products to be stored at the temperature range expected in service. Other physical properties shall be specified by the tank owner.

d) The permeability of the leak detection barrier shall not exceed 1×10^{-7} cm (4×10^{-5} mils) per second.

e) The material in contact with the subgrade shall be suitable for below-grade service or be protected against degradation.

f) The leak barrier shall be of one-piece construction, or the joints shall satisfy the leak tightness, permeability, and chemical resistance requirements for the base leak-barrier material. The

Manufacturer and a complete description of the leak barrier material shall be identified to the tank owner.

g) The installation of sumps and pipes below the tank bottom is acceptable; however, the required leak detection and leak tightness shall be maintained. See Figure **I-7** ~~I.8~~ and Figure **I-8** ~~I.9~~ for typical details.

I.5 Vapor Corrosion Inhibitors (VCIs)

Vapor Corrosion Inhibitors may be installed in conjunction with undertank leak detection systems. See API Technical Report 655 regarding the use of Vapor Corrosion Inhibitor Systems.

I.5 Cathodic Protection

Cathodic protection systems may be installed in conjunction with undertank leak detection systems. See API Recommended Practice 651 for guidelines on the use of cathodic protection methods.

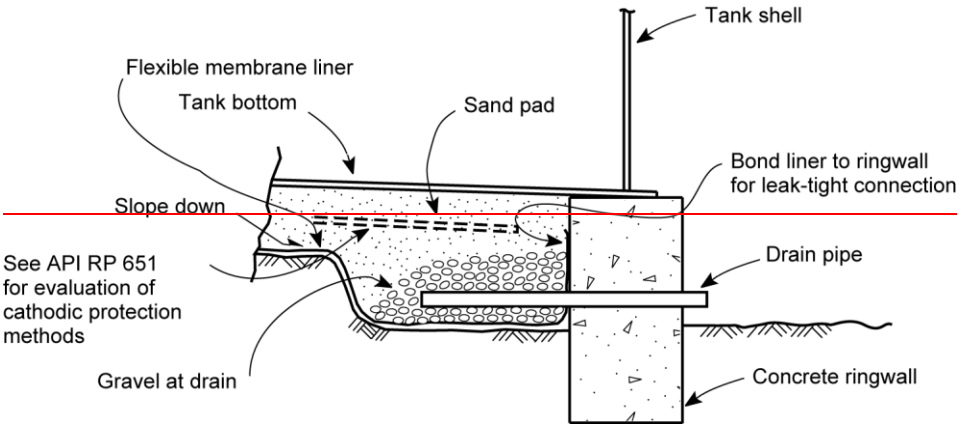
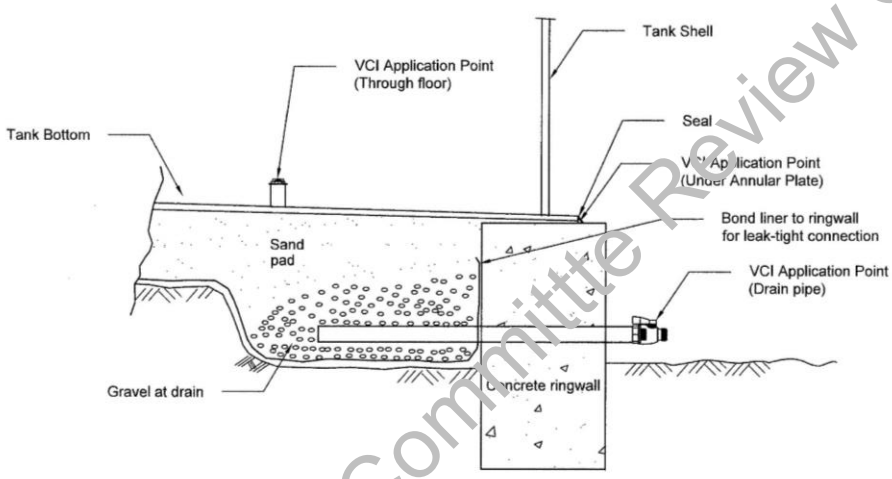


Figure I.1: DELETE ALL except note "See API RP 651…" and REPLACE WITH the following drawing Also adjacent to VCI Application Point (2 places) ADD note "See API TR655 for evaluation of Vapor Corrosion Inhibitors for Storage Tanks" Apply the existing (651) and new (TR655) "notes" as Footnotes.



14 **Figure I.1—Concrete Ringwall with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)**

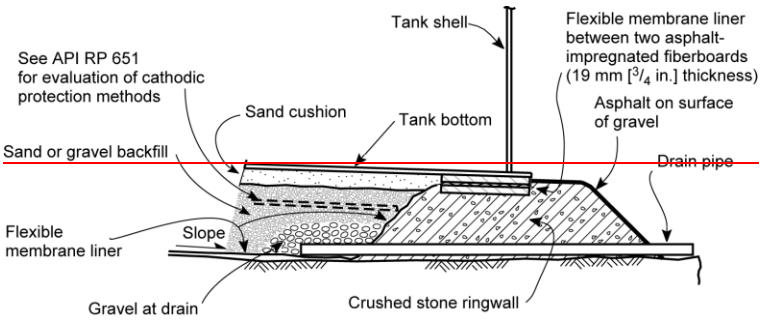


Figure I.2: DELETE ALL except note "See API RP 651…" and REPLACE WITH the following drawing. Also adjacent to VCI Application Point (3 places) ADD note "See API TR655 for evaluation of Vapor Corrosion Inhibitors for Storage Tanks". Apply the existing (651) and new (655) "notes" as Footnotes.

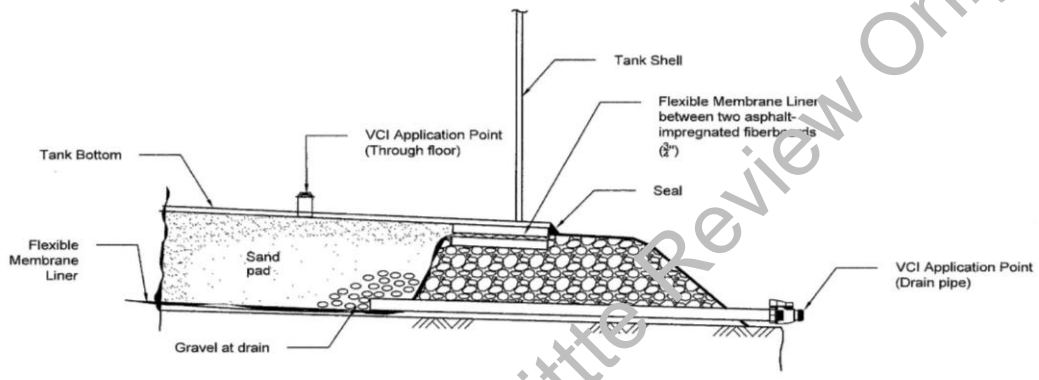
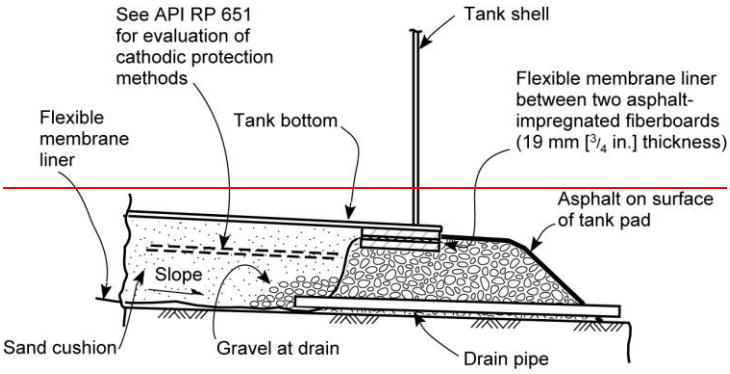


Figure I.2—Earthen Foundation and Crushed Stone Ringwall with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)



DELETE ALL

~~I.3 Earthen Foundation with Undertank Leak Detection at the Tank Perimeter (Typical Arrangement)~~

I.5 Double Steel Bottom Construction

I.5.1 If a double steel bottom is used, the details of construction shall provide for the proper support of the primary bottom and shell for all operating conditions. The design shall be evaluated to verify that the primary bottom and shell are not overstressed. The evaluation shall consider all anticipated operating conditions such as design metal temperature, maximum design temperature, fill height, hydrostatic testing, seismic conditions, and tank settlement. The evaluation is not required if the primary bottom is uniformly supported on both sides of the shell and is not structurally attached to the secondary bottom or primary bottom support.

I.5.2 For double steel bottom systems that use steel members (such as grating, structural shapes, or wire mesh) to separate the bottoms, ingress of water between the bottoms will result in local accelerated corrosion rates. If the perimeter of the bottoms is not sealed, corrosion protection of the tank bottoms shall be provided. See Figure I.4.

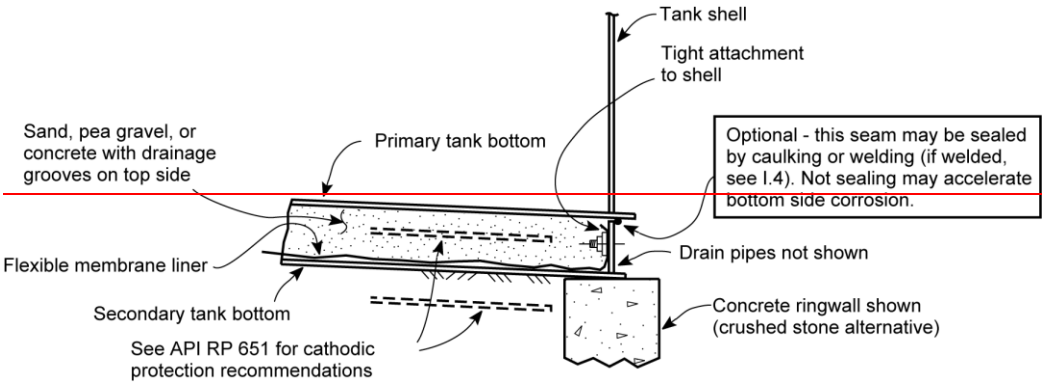


Figure I.4: **DELETE ALL except leave note & marks ("See API RP 651…") and REPLACE WITH the following drawing**
Also adjacent to VCI Application Point (1 place) ADD note "See API TR 655 for evaluation of Vapor Corrosion Inhibitors for Storage Tanks". Apply the existing (651) and new (655) "notes" as Footnotes.

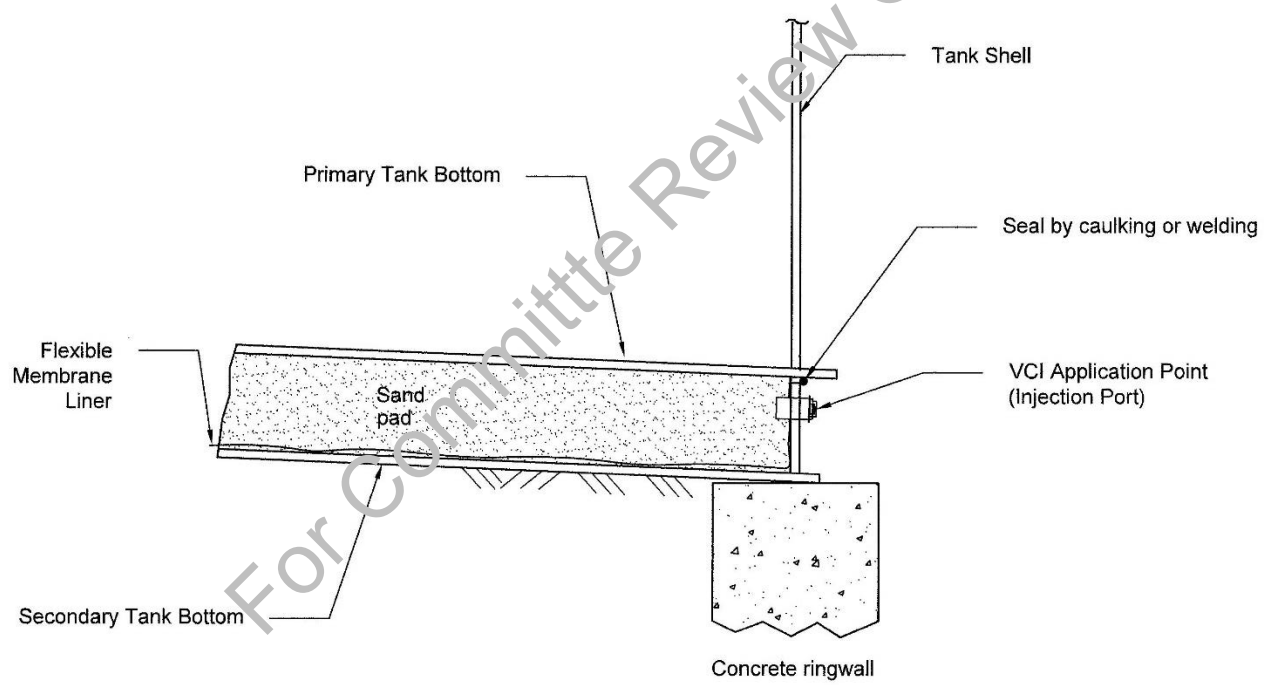


Figure I.3 (ED NOTE: renumber balance of figures) **—Double Steel Bottom with Leak Detection at the Tank Perimeter (Typical Arrangement)**

I.6 Material Requirements and Construction Details

(ED NOTE: No change to this paragraph except numbering)

I.7 Testing and Inspection

(ED NOTE: No change to this paragraph except numbering)

Adjacent to "NPS ½ pipe coupling at drain" ADD "VCI Application Point" (1 place) ADD note "See API TR 655 for evaluation of Vapor Corrosion Inhibitors for Storage Tanks". Apply existing ("See RP 651 for evaluation of…") and new "notes" as Footnotes.

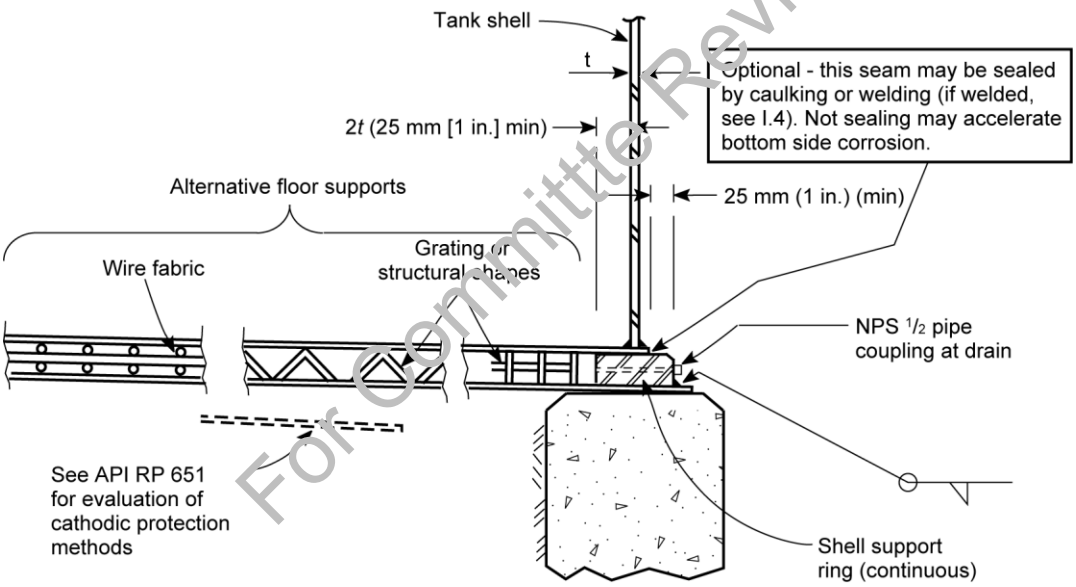


Figure I.4—Double Steel Bottom with Leak Detection at the Tank Perimeter (Typical Arrangement)

Adjacent to "drain pipe with optional sleeve" ADD "VCI Application Point" (1 place)
ADD note "See API TR 655 for evaluation of Vapor Corrosion Inhibitors for Storage Tanks".
Apply the existing ("See RP 651 for evaluation of…") and new "notes" as Footnotes.

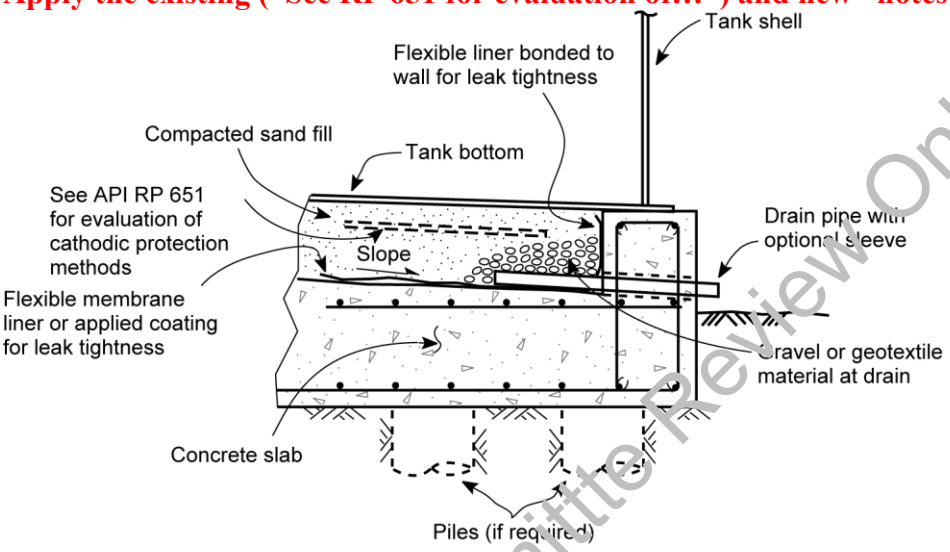


Figure I.5—Reinforced Concrete Slab with Leak Detection at the Perimeter (Typical Arrangement)

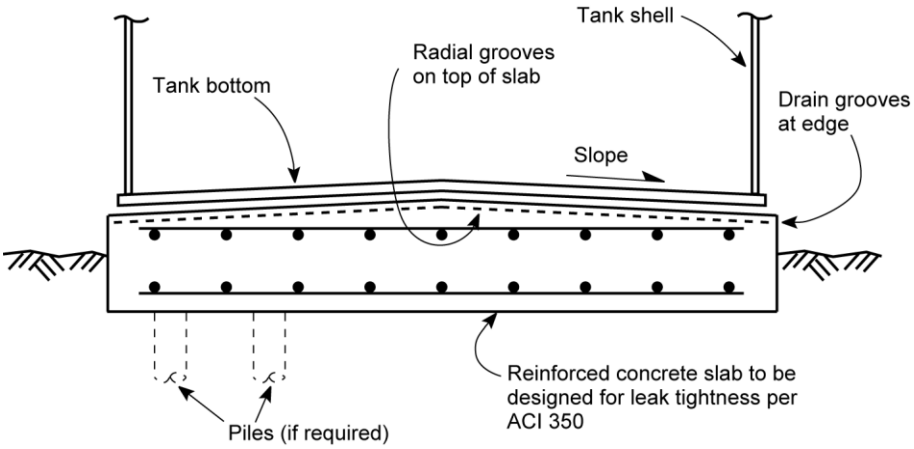


Figure I.6—Reinforced Concrete Slab

(ED NOTE: No change to balance of drawings except numbering)

I.8. Tanks Supported by Grillage

(ED NOTE: No change to this paragraph except numbering)

1.9. Typical Installations

Although it is not the intent of this Annex to provide detailed designs for the construction of undertank leak detection systems and tanks supported by grillage, Figures I.1 through **I.10** ~~I.11~~ illustrate the general use and application of the recommendations presented in this Annex.