

**New Jersey Department of Environmental Protection**

**Bureau of Release Prevention**

**A Guide to the Inspection and Testing of Aboveground Storage Tanks**

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This document supersedes both the September 2001 edition of "A Guide to the Inspection and Testing of Aboveground Storage Tanks" and the April 1999 edition of "A Guide to the Implementation of API 653 Tank Inspection, Repair, Alteration and Reconstruction"

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## Introduction

N.J.A.C. 7:1E, “Discharges of Petroleum and Other Hazardous Substances”, specifies testing and inspection requirements for aboveground storage tanks over 2,000 gallons in capacity which contain hazardous substances identified pursuant to N.J.A.C. 7:1E-1.7. These standards apply to major facilities as defined at N.J.A.C. 7:1E-1.6.

The tank testing and inspection requirements formerly found at N.J.A.C. 7:1E-2.2(a) have been revised in their entirety and, effective March 28, 2007, are now located at N.J.A.C. 7:1E-2.16. The purpose of this guidance is to assist the regulated community in compliance with N.J.A.C. 7:1E-2.16.

Please note that as a result of these extensive regulatory revisions, the extended intervals for performing internal inspections offered under the previous edition of this guidance document will no longer be approved. Storage tanks at some facilities have had measures alternative to the former regulatory requirements approved under the provisions of N.J.A.C. 7:1E-1.11(e). Pursuant to N.J.A.C. 7:1E-4.9(b), as a part of the plan renewal, the owner or operator of the facility will either submit a certification that alternative measures pursuant to N.J.A.C. 7:1E-1.11(e), such as tank integrity testing methods or intervals being used for a particular tank, are compliant with the current requirements of N.J.A.C. 7:1E or else submit revisions to the plan. The Bureau of Release Prevention (bureau) will evaluate the submitted information as a part of the review of the plan renewal, taking into consideration the original reasons for the granting of alternative measures as well as the results of any recently completed inspections. In addition, N.J.A.C. 7:1E-2.16(i) establishes that an owner or operator can propose a protocol for testing to the bureau for approval. In any case, previously granted approvals of alternative measures will remain in effect at least until the next plan renewal.

Various industry-developed standards have been incorporated by reference into N.J.A.C. 7:1E-2.16. This document describes those standards, as well as state-defined testing protocols, along with their application to various types of tanks. The Appendix provides web links to where these standards can be obtained. The bureau does not provide copies of these standards.

This guide has been prepared to assist the regulated community in selecting a method of integrity testing. Mention of any trade name or commercial product in this document does not constitute an endorsement of the product by the bureau or the New Jersey Department of Environmental Protection.

Any questions regarding the inspection and testing of aboveground storage tanks may be directed to the Bureau of Release Prevention, NJDEP, PO Box 424, Trenton, NJ 08625-0424 or by telephone at (609) 633-0610.

## Testing New Tanks and Tanks Entering Hazardous Substance Service

N.J.A.C. 7:1E-2.16(b) requires that any aboveground storage tank over 2,000 gallons in capacity installed or placed into service on or after July 22, 1990, be subject to integrity testing prior to being placed into service for hazardous substance storage.

**New field-erected storage tanks** must be tested in accordance with the standard used for their construction. For example, American Petroleum Institute (API) Standard 650, “Welded Steel Tanks for Oil Storage” and API 620, “Design and Construction of Large, Welded, Low-Pressure Storage Tanks”, include testing procedures to be used upon completion of construction.

**Existing storage tanks** that were not in hazardous substance service but are brought into hazardous substance service must be tested in accordance with the applicable protocol contained in N.J.A.C. 7:1E-2.16, described in the “Subsequent Testing” section of this document.

**Shop-built storage tanks** typically undergo testing by the manufacturer at the site of manufacture based on the standard to which the tank was manufactured; for example, Underwriters Laboratory (UL) Standard 142, “Steel Aboveground Tanks for Flammable and Combustible Liquids”. In addition, shop-built storage tanks must be tested after installation on site to ensure the integrity of the tank following transport of the tank to the site and of all connections to it, using a test such as a pneumatic or static head test.

The static head test measures the stability of a volume of liquid in a tank filled to at least 75% capacity and held over a minimum period of 24 hours. If temperature fluctuations are likely to occur, as when a tank is outdoors, a volume correction factor is required to determine the standardized adjusted volume at 60 degrees Fahrenheit; the correction factor is calculated in accordance with the API Manual of Petroleum Measurement Standards. If the beginning and ending temperature-adjusted level readings are within 0.2% of each other and no abnormal conditions are observed, the newly installed shop-built tank has successfully passed the static head test. Modifications to this procedure may also be acceptable; contact the Bureau of Release Prevention for review and approval of any modification prior to implementation.

Any tank that becomes subject to N.J.A.C. 7:1E as a result of regulatory changes or as result of increased storage capacity must undergo integrity testing immediately upon entering the DPCC program as described in the “Subsequent Testing” section of this document.

## Subsequent Testing

Subsequent testing must be performed as specified under N.J.A.C. 7:1E-2.16(d) through (i); the testing to be performed will depend on the material of construction of the tank and whether the tank is shop-built or field-erected.

### All tanks under any testing protocol

During an external or internal visual inspection required under any of the testing protocols, the tank inspector should look for signs that may indicate threatened structural integrity. These will be based on the tank's material of construction and may include but are not limited to, cracks, discoloration, staining, leaks, corrosion, erosion, settlement, delamination, and deformation. The external inspection must include inspection of the support structures and appurtenant piping.

In addition, all storage areas, including tanks with associated piping, must be visually inspected for integrity and signs of leakage pursuant to N.J.A.C. 7:1E-2.10(a). As appropriate or required by the standard used, a qualified professional engineer, API certified inspector, or STI certified inspector should review the results of integrity tests and internal visual inspections to ensure the tank is fit for service. If integrity test or internal inspection results indicate significant deterioration of structural strength or other signs that the tank is not sound, the tank must either be repaired or removed from service as stated at N.J.A.C. 7:1E-2.16(j).

If none of the outlined protocols for integrity testing are found to be applicable for a particular tank, an alternate protocol may be proposed to the Department. If an alternate method of integrity testing will be used for a particular tank under the provisions of N.J.A.C. 7:1E-2.16(i) and 1.11(e), this method must be clearly described in the facility's approved DPCC plan prior to implementation.

### Field-erected steel aboveground storage tanks operated at atmospheric pressure

Field-erected steel aboveground storage tanks operated at atmospheric pressure must follow an inspection and maintenance program that is in compliance with API Standard 653 (API 653), "Tank Inspection, Repair, Alteration and Reconstruction".

API 653 is a maintenance and inspection program adopted and revised by the American Petroleum Institute to provide for an ongoing assessment of a facility's storage tanks. A facility must follow all of the procedures for maintenance and inspections outlined in the API 653 standard and perform any repairs recommended by the authorized inspector in order to use API 653 to show compliance with the integrity testing requirements of N.J.A.C. 7:1E-2.16. The four major components of the integrity testing portion of API 653 are as follows:

- Routine in-service inspection,
- External inspection,
- Ultrasonic thickness inspection, and

- Internal inspection.

All recommendations noted by the authorized inspector or contained in the inspection report must be addressed according to API 653 standards. These findings and repairs must be documented as specified by API 653.

Please note that simply testing a tank using techniques described in API 653 is not equivalent to having an inspection and maintenance program that is in compliance with API 653; ultrasonic thickness (UT) tests performed to “API 653 standards” does not establish that a storage tank is in full compliance with API 653. It merely states that the procedures for performing that test were conducted following the protocol for UT testing contained in API 653. The current edition of API 653 must be used except that similar service and risk based inspection scheduling described in API 653 are not permitted.

### **Field-erected steel aboveground storage tanks operated under pressure**

Field-erected steel aboveground storage tanks operated under pressure must follow API 510, “Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair, and Alteration” or American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII, “Rules for Construction of Pressure Vessels”, as applicable.

API 510 is a maintenance inspection, rating, repair and alteration standard for pressure vessels. It is applicable to vessels constructed and maintained in accordance with ASME Section VIII or other recognized pressure vessel codes. Facilities following the API 510 inspection standard must follow all aspects of the current edition of the code. This includes, but is not limited to, maintenance, repair, alteration and inspection of these tanks. The major components of the integrity testing portion of API 510 are the external inspection and the internal inspection. On-stream inspections can be substituted for internal inspections at the recommendation of an authorized inspector if all requirements are met. The justification for on-stream inspection must be documented as part of the inspection.

All recommendations noted by the authorized inspector or contained in the inspection report must be addressed according to API 510 standards. These findings and repairs must be documented as specified by API 510.

### **Shop-built steel aboveground storage tanks**

Shop-built steel aboveground storage tanks operated at atmospheric pressure must follow an inspection and maintenance program that is in compliance with either API 653 or the current edition of the Steel Tank Institute’s standard SP001, “Standard for The Inspection of Aboveground Storage Tanks”. For shop-built steel aboveground storage tanks operated under pressure, the owner or operator may propose an appropriate integrity testing protocol to the Department in accordance with N.J.A.C. 7:1E-2.16(i) and 1.11(e); API 510 or ASME Section VIII may be applicable to these types of tanks.

The major components of the integrity testing portion of SP001 are as follows:

- Periodic AST inspection,
- Formal external inspection,
- Formal internal inspection, and
- Leak test.

SP001 requires periodic AST inspections for all tanks regardless of tank size and configuration; other components may or may not be applicable to a particular tank.

SP001 is applicable to double-walled storage tanks as well as to single-walled tanks. API 653 is *not* applicable to double-walled storage tanks.

### **Fiberglass reinforced plastic (FRP) aboveground storage tanks**

FRP aboveground storage tanks with a storage capacity greater than 2,000 gallons must undergo integrity testing every five (5) years consisting of acoustic emission testing, in accordance with ASTM International (ASTM) Standard E1067, “Standard Practice for Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels”, in combination with internal and external inspections of the tank and all appurtenant structures by an experienced, qualified inspector.

ASTM E1067 is a standard practice for the acoustic emission examination of FRP tanks and applies to both new and in-service equipment. The current version of ASTM E1067 must be used.

### **Homogenous plastic tanks**

Homogenous plastic tanks with a storage capacity greater than 2,000 gallons must undergo integrity testing every five (5) years consisting of internal and external visual inspections of the tank and all appurtenant structures by an experienced, qualified inspector.

### **Other types of tanks**

If a particular tank does not fall into one of the established categories for which a specific testing protocol is mandated or if an alternative to the established integrity testing protocol is otherwise necessary, integrity testing may be performed every five (5) years that includes the following:

- a shell thickness test,
- a bottom thickness test,
- a visual inspection of the tank exterior, and
- a visual inspection of the foundation and ancillary equipment.

The shell thickness test and bottom thickness test must be performed to a standard such as ASME Boiler and Pressure Vessel Code, Section V “Nondestructive Examination”

and must be capable of detecting corrosion, erosion or other wall or bottom thinning to less than a predetermined thickness to ensure sufficient structural strength. At the time of a bottom thickness test done from the tank interior, a visual inspection of the tank interior looking for cracks and similar problems should also be performed.

Facilities following this option should not expect that any aspect of the inspection program, including the bottom thickness test, would be granted any extension beyond the regulatory requirement of five years.

If a tank is on legs or saddles such that the entire tank can be thickness tested from the outside, tank entry may not be required. However, if the tank bottom is on the ground or otherwise not accessible from the outside of the tank, the bottom thickness test will necessarily be performed from inside the tank. Robotic, rather than human, tank entry is acceptable if the tank size, configuration, and contents allow for this option.



## **Integrity Test Report**

The integrity test report, which must be kept for the lifetime of the tank, should consist of the following components:

- The name of the major facility
- Tank identification
- Test method used
- Results, including data, calculations, and the date of the next test, as applicable
- Recommendations, including indicating any that necessitate immediate action
- Name and affiliation of the person(s) that prepared the report

Report formats are provided in API 653 and SP001 and are acceptable as long as the above information is included in the report.

## Appendix

### Web links for organizations mentioned in this guidance document

American Petroleum Institute

[www.api.org](http://www.api.org)

American Society of Mechanical Engineers

[www.asme.org](http://www.asme.org)

Underwriters Laboratories

[www.ul.com](http://www.ul.com)

Steel Tank Institute

[www.steeltank.com](http://www.steeltank.com)

ASTM International (originally known as the American Society for Testing and Materials)

[www.astm.org](http://www.astm.org)