



STANDARD FOR THE INSPECTION OF ABOVEGROUND STORAGE TANKS

SP001

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PREFACE

The Steel Tank Institute (STI), formed in 1916, is a not-for-profit organization whose purpose is to secure co-operative action in advancing by all lawful means the common purposes of its members and to promote activities designed to enable the industry to conduct itself with the greatest economy and efficiency. It is further the purpose of STI to cooperate with other industries, organizations and government bodies in the development of reliable standards which advance industry manufacturing techniques to solve market-related problems.

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1 GENERAL

1.1 Introduction

- 1.1.1 This Standard provides inspection and evaluation criteria required to determine the suitability for continued service of aboveground storage tanks (AST), as defined in this Standard, until the next scheduled inspection. The purpose of conducting inspections is to identify the condition of and changes to the AST.
- 1.1.2 This Standard is intended for use by organizations and/or individuals who are knowledgeable and experienced in aboveground tank inspection.
- 1.1.3 The inspection requirements included in this Standard are minimum requirements. When applicable federal, state, or local laws, codes, or regulations concerning tank inspection are more stringent than the requirements of this Standard, then these applicable federal, state, or local laws, codes, or regulations shall apply.
- 1.1.4 Other standards, recommended practices, and equivalent engineering and best practices exist that provide alternative inspection requirements for tanks defined both within and outside the scope of this Standard. For example, see API Standard 653, *Tank Inspection, Repair, Alteration, and Reconstruction*, for additional information pertaining to tanks built to API Standard 650 and API Specification 12C tanks; and API 12R1, *Recommended Practice for Setting, Maintenance, Inspection, Operation, and Repair of Tanks in Production Service*, for tanks employed in production service or other similar service.

1.2 Owner's Responsibility

- 1.2.1 The owner is responsible for compliance with this Standard, fire codes, ordinances, and other rules and regulations applicable to owner's tanks. The owner may choose to retain assistance from specialists to aid in inspection, regulatory compliance, safe operations, and installations, in accordance with recognized industry standards.
- 1.2.2 The owner shall verify that persons working on ASTs understand and address all hazards associated with the contents of the ASTs, as well as safe entry and hot work procedures associated with those ASTs.
- 1.2.3 The owner's inspector is responsible for performing the periodic AST inspections and documenting the results in accordance with Section 6.0 of this Standard.
- 1.2.4 The owner is responsible for assuring that the tank is appropriately designed, constructed, repaired (if necessary) and maintained to operate safely in the intended service conditions.
- 1.2.5 The owner has the responsibility to address corrective actions identified in inspection reports.

1.3 Scope

- 1.3.1 This Standard provides the minimum inspection requirements of aboveground storage tanks. These storage tanks include shop-fabricated tanks, field-erected tanks, and portable containers as defined in this Standard, as well as their containment systems.

- 1.3.2 This Standard applies to ASTs storing stable, flammable and combustible liquids at atmospheric pressure. Further, this Standard applies to ASTs storing liquids with operating temperatures between ambient temperature and 200 degrees F (93.3° C).
- 1.3.3 This Standard may be applied to ASTs containing other types of liquids as long as an individual with the appropriate training, education, and/or experience has evaluated such use and approved the application of this Standard or a modification of the Standard, including assessing the compatibility of the liquid with the AST materials to address potential failure mechanisms.
- 1.3.4 The requirements for heated thermoplastic tanks are covered separately in Appendix D.
- 1.3.5 At a minimum, the following tank components shall be inspected (as applicable):
- Primary tank
 - Secondary tank
 - Tank supports
 - Tank anchors
 - Tank foundation and external supports
 - Tank gauges and alarms
 - Overfill valves and alarms
 - Insulation covering
 - Tank appurtenances
 - Normal vents
 - Emergency vents
 - Release prevention barriers
 - Spill control systems
 - Tank valves and connections

2 DEFINITIONS

ABOVEGROUND STORAGE TANK (AST) – A tank or container designed to operate at pressures ranging from atmospheric pressure through a gauge pressure of one psig measured at the top of the tank. The tank may be sitting on the ground or set on supports such as saddles, skids or legs, etc., and may be installed in a vault. Included are shop-fabricated tanks, field-erected tanks, and portable containers.

CAPACITY – The amount of liquid that the AST is capable of holding. For the purposes of Table 5.5, the capacity of a compartment in a multi-compartmented AST shall be considered a separate and distinct capacity, provided that the bulkhead between compartments is fully welded around its perimeter and compartments are not manifolded. The capacity of an AST shall be determined by one of the following sources:

- A label on the AST that indicates its capacity;
- AST documentation, such as drawings or packing lists;
- Consulting the tank manufacturer, if known; OR
- Measuring the AST to determine its capacity. In the case of double-wall tanks, the dimensions of the inner tank will determine the capacity.

CERTIFIED INSPECTOR – A tank inspector who meets the certification requirements identified in Section 4.2 of this Standard.

COATING FAILURE – Significant peeling, cracking, spalling, blistering, pitting, chipping, etc. of the coating, paint or lining on an AST, resulting in the exposure of the metal surface and corrosion of the tank shell.

CONCRETE EXTERIOR ABOVEGROUND STORAGE TANK (CE-AST) – A shop-fabricated aboveground storage tank that includes a concrete exterior. A CE-AST with a UL 2085 label has integral secondary containment that allows monitoring for leakage in the interstice between the primary tank and the secondary containment.

CONTINUOUS RELEASE DETECTION METHOD (CRDM) – A means of detecting a release of liquid through inherent design. CRDM is passive because it does not require sensors or power to operate. Liquid releases are visually detected by facility operators (See Appendix A for additional information). The system shall be designed in accordance with good engineering practice. Several acceptable and commonly used CRDM systems are:

- Release prevention barrier (RPB) (described in definition of “Release prevention barrier”)
- Double-wall AST or double-bottom AST
- Elevated AST, with or without release prevention barrier
- Steel diked AST, open or closed top
- Concrete exterior AST (CE-AST) with an integral secondary containment and interstitial monitoring opening

CONNECTION - A method or fitting for fastening a pipe to the AST or an appurtenance. Examples are flanges, pipe threads, pipe welds, expansion joints, and flexible fittings.

CORROSION RATE – The rate of degradation of a material due to a chemical reaction with its environment.

DOUBLE-BOTTOM AST - An AST with a bottom plate integral to the primary container and a second bottom plate designed to provide an interstice. The interstice allows testing of both bottoms for tightness, or monitoring for leakage into the space.

DOUBLE-WALL AST – An AST manufactured as a tank-within-a-tank. The second tank provides integral secondary containment. An interstitial space between the two tanks is formed, which allows testing of both tanks for tightness, as well as monitoring for leakage into the space.

DYE PENETRANT TESTING (DT) – a method for nondestructively testing the surface of a material. A liquid dye is applied to the surface and excess is removed. A developing solution is then applied which indicates cracks in the material.

ELEVATED AST – An AST, which is not in contact with the ground, and which is raised above the surface of the ground or bottom of a vault using tank supports. An elevated AST allows for a visual, external inspection of the bottom of the tank.

FIELD-ERECTED AST – A welded carbon steel or stainless steel AST erected on the site where it will be used. For the purpose of this Standard, ASTs meeting either of the following descriptions are to be inspected as field-erected ASTs:

- a. The AST's nameplate (or other identifying means, such as accurate drawings) indicates that it is a field-erected AST with a maximum shell height of 50 feet (15.24 meters) and a maximum diameter of 30 feet (9.14 meters).
- b. The AST has no nameplate (or other identifying means such as accurate drawings), and is more than 75,000 U.S. gallons (283,906 liters) with a maximum shell height of 50 feet (15.24 meters) and a maximum diameter of 30 feet (9.14 meters).

FORMAL EXTERNAL INSPECTION (FEI) – A documented external inspection conducted by a Certified Inspector to assess the condition of the AST and determine its suitability for continued service, without entry into the AST interior.

FORMAL INTERNAL INSPECTION (FII) - A documented inspection conducted by a Certified Inspector to assess both the internal and external conditions of the AST and determine its suitability for continued service. A FII includes the inspection requirements of a FEI, therefore, a FII satisfies the requirements of a FEI and shall be considered equivalent to or better than a FEI for the purposes of inspection scheduling. Requires entry into the AST interior following emptying and cleaning. See Section 3 for guidance on cleaning and entry safety considerations.

INSPECTION PLAN – A written plan developed by the owner/operator, Certified Inspector or a Professional Engineer that details the inspection requirements for a facility.

INTERSTICE – In a double-wall AST, the space between the primary tank and secondary tank; in a double-bottom AST, the space or void between the two bottoms. This space may be open or closed to the atmosphere and may be monitored or tested by vacuum or leak detection equipment or by visual inspection.

INITIAL SERVICE DATE - The date on which liquid was first placed in the AST.

LEAK TESTING METHOD (LTM) – A point-in-time test method to determine if an AST is liquid-tight. Leak testing is not preventative: it provides an indication only of whether the AST's integrity has already been breached. Therefore, it may only be used as a tank integrity measure or as a supplement to other inspection procedures. LTMs may include the following technologies:

- Gas pressure decay (includes vacuum decay)
- Gas pressure soap bubble testing
- Gas tracers (e.g., helium tracer)
- Soil tracers (chemical marker)
- Mass measurement
- Level measurement
- Hydrostatic test

LOCKOUT/TAGOUT – A procedure for affixing lockout or tagout devices to energy-isolating equipment and otherwise disabling machines or equipment to prevent unexpected energization, startup, or release of stored energy. The intent of the procedure is to prevent injury to employees and to comply with the following Occupational Safety & Health Administration (OSHA) regulations or their equivalent:

- 29 CFR Part 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*
- 29 CFR Part 1910.333, *Electrical Lockout/Tagout*
- 1926.1200 Subpart AA Confined Space in Construction

MAGNETIC FLUX LEAKAGE (MFL) – A method used to nondestructively inspect ferromagnetic materials, such as a carbon steel floor plate. A magnetic field is applied to steel to near-saturation, so that it cannot hold any additional field. In the presence of a flaw (wall thinning), some of the magnetic flux escapes or “leaks” into the surrounding environment, where magnetic sensors detect it and qualitatively report a flaw signal. This method is commonly used on AST floors (MFL floor scan) to determine the underside condition of the tank floor.

MAGNETIC PARTICLE TESTING (MT) – A method used to nondestructively inspect ferromagnetic materials, such as a carbon steel. It is used for detecting surface and subsurface linear discontinuities by inducing a magnetic field into the material and applying iron oxide particles.

MANWAY – An opening designed to allow personnel entry into an AST.

MICROBIAL-INFLUENCED/INDUCED CORROSION (MIC) – Corrosion caused or accelerated by certain microbes. Depending on the type of bacteria, the degree of microbial activity, and the thickness and type of AST material, MIC is characterized by a high rate of corrosion. It sometimes penetrates tank walls and bottoms in two years or less. It is typically characterized by a ring-like pattern of crater-shaped or channel-like penetrations.

NONDESTRUCTIVE TESTING (NDT) – The development and application of technical methods to examine materials and/or components in ways that do not impair future usefulness and serviceability, in order to detect, locate, measure, interpret, and evaluate flaws.

OVERFILL PREVENTION - Systems, procedures or devices used to prevent liquid in ASTs from running over or spilling out of the AST during the filling process. A person who is physically present and in control of a shutoff device during the entire tank filling process is an acceptable procedure to achieve overfill prevention.

OWNER - The legal entity having control and responsibility for the operation of the existing AST and storage facilities.

OWNER’S INSPECTOR – The owner or owner’s designee responsible for conducting owner’s periodic AST inspections.

PERIODIC AST INSPECTION - A visual, documented inspection conducted by an owner’s inspector to assess the AST’s general condition without suspending AST operations or removing the AST from service.

PORTABLE CONTAINER - A closed AST having a liquid capacity equal to or greater than 55 U.S. gallons and not intended for fixed installation. This definition does not include a mobile storage container on a vehicle, or one being towed, that is used to store and transport liquids for transfer into or from vehicles, mobile equipment, or another storage container. This definition also does not include storage containers used for onboard propulsion of a vehicle.

PRIMARY TANK – The tank in direct contact with the liquid stored.

PROFESSIONAL ENGINEER (PE) – A person who has fulfilled specific education and/or experience requirements under state licensure laws and has received a license to practice engineering.

RELEASE PREVENTION BARRIER (RPB) – A liquid containment barrier that is installed under the AST. Its purpose is to divert leaks toward the perimeter of the AST where they can be easily detected, as well as to prevent liquid from contaminating the environment. RPBs are composed of materials compatible with the liquid stored in the AST and meet appropriate engineering standards. Examples are steel (as in steel double-bottom tanks), concrete, elastomeric liners, or other suitable materials, provided the above criteria are met.

REMOTE IMPOUNDING - A spill control system that uses a sloped spillway or drainage system to channel liquid releases away from an AST to a contained collection area that is remote from important facilities, adjoining property, or waterways. The containment area is sized for the capacity of the largest AST, plus sufficient freeboard to allow for precipitation. For the purposes of this Standard, remote impounding is equivalent to secondary containment. Remote impounding is further defined in NFPA 30.

SECONDARY CONTAINMENT DIKE/BERM – A spill control system consisting of walls and a floor completely surrounding single or multiple ASTs. It provides a secondary means of containment for the entire capacity of the largest single AST, plus sufficient freeboard to contain precipitation and the displacement volume present below the dike wall of other ASTs in the containment area. The secondary containment dike/berm is to be constructed according to accepted good engineering practices. (Note: See NFPA 30, 40 CFR Part 112, and/or other local requirements for additional requirements.)

SECONDARY CONTAINMENT SYSTEM - Provides a secondary means of containment for the entire volumetric capacity of the largest single AST within a dike/berm plus sufficient freeboard to contain precipitation. The secondary containment system is to be designed to contain a spill until it can be discovered and cleaned up. It must be constructed according to accepted good engineering practices. (Note: See NFPA 30 and/or 40 CFR Part 112, and/or other local requirements for additional requirements.)

STEEL DIKED AST – An AST with an integral steel secondary containment dike. These dikes may be pans, boxes, or containers, and are designed to contain the contents of the primary tank if it fails. A steel diked AST may be open or closed to the atmosphere. Closed-top steel dike ASTs have welded covers or movable rainshields to keep precipitation from collecting in the dike, but open-top dike ASTs do not have such covers. The secondary containment of steel diked ASTs must be sized to contain the primary tank volume, plus sufficient freeboard to contain precipitation as necessary.

SECONDARY TANK – The outer wall of a double-wall AST.

SHELL – For the purposes of this Standard, the AST shell includes the roof, bottom, head, and wall of the AST. Refer to Appendix A for more information.

SHOP-FABRICATED AST – A welded carbon steel or stainless steel AST fabricated in a manufacturing facility or an AST not otherwise identified as field-erected, with a volume less than or equal to 75,000 U.S. gallons (283,906 liters).

SINGLE-WALL AST – An AST with only one wall or shell.

SPILL CONTROL - A means of preventing a release of liquid to the environment, including adjoining property and waterways. Spill control methods include:

- Remote impounding
- Secondary containment system
- Secondary containment dike/berm
- Open top steel diked AST
- Closed top steel diked AST with overfill prevention
- Double-wall AST with overfill prevention
- CE-AST with overfill prevention

SUITABILITY FOR CONTINUED SERVICE – The determination that an AST's condition is adequate for continued use, based on the criteria presented in this Standard.

TANK SUPPORTS – Structures designed to elevate an AST above the ground. These include saddles, skids, beams, legs, and similar structures.

TELLTALE HOLE OR OPENING- An opening in a reinforcing plate that allows for leak monitoring where a tank penetration hole in the shell has been reinforced with a welded reinforcing plate.

THERMOPLASTIC – substances, such as asphalt cement, that are solid at ambient temperature and become molten upon heating. The application of this Standard is for thermoplastics stored in a liquid form.

ULTRASONIC TESTING SCAN (UTS) – An ultrasonic scan to evaluate the corrosion on the opposite side of the inspection surface using an ultrasonic flaw detector. This inspection is to be performed by an NDT examiner certified in accordance with ASNT-TC-1A (or equivalent), per paragraph 4.3.2 of this Standard.

ULTRASONIC THICKNESS TESTING (UTT) – A point thickness reading taken by a competent person, per paragraph 4.3.3 of this Standard, utilizing a digital ultrasonic thickness meter.

VACUUM BOX EXAMINATION (VB) – A weld-testing method used to check for leaks in the welds of the shell of an AST.

3 SAFETY CONSIDERATIONS

- 3.1 The hazards associated with cleaning, entry, inspection, testing, maintenance, or other aspects of ASTs are significant. Safety considerations and controls should be established prior to undertaking physical activities associated with ASTs.
- 3.2 This Standard does not address all applicable health and safety risks and precautions with respect to particular materials, conditions, or procedures. Information concerning safety and health risks and precautions should be obtained from applicable standards, regulations, and suppliers of materials and safety data sheets.
- 3.3 The following activities may be regulated. Consideration of the relevant requirements and best management practices shall be included in an inspection, such as:
- Breaking lines, isolating, and release of equipment
 - General work permit
 - Hot work
 - Lockout/tagout
 - Gas testing
 - Contractor safety
 - Respiratory protection
 - Tank cleaning, repair, and dismantling
 - Confined space entry
- 3.4 Plans to enter an AST require development and use of appropriate safety procedures, precautions and requirements. The owner, the contractors, and all persons associated with the AST inspection, cleaning, or entry shall review these safety procedures prior to the start of work.
- 3.4.1 Before the inspection begins, check for accumulation of harmful vapors around and in the AST. Refer to the following documents for additional information:
- NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning or Repair*
 - API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*
- 3.4.2 Each AST entry requires an Emergency Action Plan (EAP). The owner and contractor must develop the EAP together. The EAP describes the actions required for personal safety from fire and other emergencies and includes the following requirements, as well as others:
- Confined space entry plan as necessary
 - Appropriate personal protection equipment
 - Establishment and review of emergency escape routes and procedures with authorized entrants.
 - Establishment of an assembly area and procedures to account for all authorized entrants after emergency evacuation is complete.

- Establishment of rescue and first-aid duties for those authorized and assigned to perform them.
- 3.4.3 After plans, procedures, and administrative controls are in place and before entering the AST, isolate the AST by locking out and tagging all energy sources associated with the AST. Line isolation shall be at the closest practical flange to the equipment or space.
- 3.4.4 The atmosphere inside the space must be tested and confirmed safe before authorized entrants may enter without wearing supplied-air respiratory protection or SCBA. Continuous atmospheric monitoring is best. At minimum, test the space for the following, and in the following order:
- Oxygen
 - Flammable vapors
 - Toxics
- 3.5 In addition to entry hazards, there are those associated with the access to AST roofs. Corrosion may first attack the deck plate at the edge of a fixed roof and at the rafters in the center of the roof. Inspect the roof and support structures for soundness. Inspect stairs, ladders and platforms to determine that they can safely support equipment and people before accessing them. For AST roofs where one side is not visible, it may be necessary to check the plate thickness with ultrasonic instrument or hammer test it to verify its adequacy. If there is a doubt, place planks that span structural members on the roof and walk on the planks instead of directly on the roof. These same hazards may also apply to other AST walking surfaces, such as the surfaces of floating roofs. Guidance for these hazards is covered in API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*
- 3.6 A safety analysis shall be conducted prior to a leak test. Some leak testing scenarios may be hazardous. For example, the leak test methods referenced in 9.1.1 require that either an inert gas be used or that the tank be thoroughly cleaned and gas-free prior to testing and pressurizing an AST. Combining hydrocarbons with air generates a potentially hazardous atmosphere. Each test method may have unique hazards; these shall be considered and addressed in a pre-test safety plan prior to testing activities. A qualified person shall review the safety plan

4 AST INSPECTOR QUALIFICATIONS

4.1 Owner's Inspector Qualifications

- 4.1.1 Periodic Inspections are to be performed by an owner's inspector.
- 4.1.2 The personnel performing these inspections shall be knowledgeable about storage facility operations, the type of AST and its associated components, the spill control system for the facility, and characteristics of the liquid stored. Owner's inspectors must also be familiar with pumping, piping, and valve operations of the AST system.

NOTE: STI-SPFA has developed an online *Tank Integrity Management* program to educate owner's inspectors in tank inspection requirements. See the website

www.steeltank.com and refer to the tab “Education” for more information about this voluntary educational program.

4.2 Certified Inspector Qualifications

- 4.2.1 FEI and FII are to be performed by a Certified Inspector.
- 4.2.2 A Certified Inspector shall be certified by one or more of the following (Additional certifications may be required by individual states or other governing bodies.):
 - 4.2.2.1 American Petroleum Institute (API) Standard 653 Authorized Inspector Certification with STI SP001 Adjunct Certification.
 - 4.2.2.2 Steel Tank Institute (STI) Certified SP001 AST Tank System Inspector.

4.3 NDT Examiner Qualifications

- 4.3.1 Non-destructive test (NDT) examiner personnel performing non-destructive examinations shall meet the qualifications described below, but need not be certified in accordance with paragraph 4.2. The results of NDT work, however, must be considered in the evaluation of the tank by the Certified Inspector.
- 4.3.2 NDT personnel referenced within this Standard shall be qualified in accordance with their employer’s written practices, which must be in accordance with the American Society for Nondestructive Testing’s (ASNT) document SNT-TC-1A *Personnel Qualification and Certification in Nondestructive Testing*, unless otherwise noted within this Standard.
 - 4.3.2.1 Referenced within this Standard are the following nondestructive techniques. All inspectors performing the following inspection methods shall be certified per 4.3.2:
 - MT – Magnetic particle testing
 - UT – Ultrasonic testing (refer to definition of UTS above)
 - MFL – Magnetic flux leakage
 - PT – Penetrant testing
 - VB – Vacuum box testing
- 4.3.3 Testing personnel performing ultrasonic thickness (UTT) point readings are required to have the minimum training described in this paragraph to operate a digital ultrasonic thickness meter. A digital ultrasonic thickness meter is an ultrasonic unit which is only used to obtain a point thickness reading and display the resulting specimen thickness. The training does not cover the use of ultrasonic flaw detectors or interpretation of A, B or C scan unit readout.

- 4.3.3.1 The operator of the digital ultrasonic thickness unit must be trained for a minimum of one hour by a person competent in the operation, calibration, and set-up of the unit. Training is usually performed by the manufacturer or manufacturer's representative upon delivery of the unit. This training shall be documented and specifically state that the trainee has received at least one hour of training in the proper operation, calibration, and set-up of the unit. The unit manufacturer and model shall be noted on the documentation. The trainer shall sign his name on the documentation to attest that the training has been completed and the trainee is now proficient in the use of that ultrasonic digital meter. At the time of training, the trainee shall have all of the tools and materials needed to carry out the proper function of the meter. These tools and materials are:
- Step wedge of the correct thickness range and material for the desired application.
 - Ultrasonic couplant appropriate for the desired application.
 - Ultrasonic transducer of the correct type, frequency, and diameter for the desired application.
- 4.3.3.2 Testing personnel shall be aware of the many factors that affect performance and accuracy of a digital thickness meter, such as:
- Equipment calibration
 - Surface roughness of test specimen
 - Coupling technique
 - Couplant
 - Curvature of test piece
 - Taper or eccentricity of the test specimen
 - Acoustic properties of the material to be tested
 - Temperature of the test specimen
- 4.3.3.3 Surface coatings may have a significant effect on the performance and accuracy of the thickness reading. Where possible, UTT test equipment and procedures shall be selected to avoid the removal of coating from the tank. It may be necessary to remove the coating prior to taking a thickness reading, depending on the inspection equipment used, the type of coating applied, and the thickness of the coating. If the coating is removed during the thickness reading process, it must be properly repaired

5 INSPECTION SCHEDULE

- 5.1 The owner shall use the AST's type, capacity, installation characteristics, and previous inspection history, if any, to develop a schedule of applicable types of inspections for each AST, per Table 5.5. The interval for the initial inspection shall begin from the AST's initial service date. If the initial service date is not known, the owner shall be responsible for establishing and documenting the initial service date (for example, from nameplates, as-built drawings, manufacturer cut-sheets, due diligence reports, fire marshal inspection records, state operating permits, building code permits, etc.).
- 5.2 Owners who have an inspection plan shall use this Standard to establish inspection criteria for ASTs described in this Standard, using the AST's type, capacity, and installation characteristics.
- 5.3 Certified Inspectors using this Standard to conduct inspections shall use the AST's type, capacity, installation characteristics, corrosion rate, and the schedule determined by the owner.
- 5.4 AST categories used in Table 5.5 (Appendix A includes further explanation of some typical tank types and their corresponding AST category.):
 - 5.4.1 Category 1 - ASTs with spill control and CRDM
 - 5.4.2 Category 2 - ASTs with spill control, and without CRDM
 - 5.4.3 Category 3 - ASTs without spill control (note Category 3 ASTs may not meet regulatory requirements)
- 5.5 In Table 5.5, use the following designations:
 - 5.5.1 P – Periodic AST inspection by owner's inspector
Refer to Section 6
 - 5.5.2 E – Formal External Inspection by Certified Inspector
Refer to Section 7
 - 5.5.3 I – Formal Internal Inspection by Certified Inspector
Refer to Section 8
 - 5.5.4 L – Leak test by owner or owner's designee
Refer to Section 9
 - 5.5.5 Numbers included in parentheses, for example (5), indicate the maximum inspection interval in years.. Thus, E (5) indicates Formal External Inspection every 5 years.

TABLE 5.5 TABLE OF INSPECTION SCHEDULES

AST Type and Capacity in U.S. gallons (liters)		Category 1	Category 2	Category 3
Shop-Fabricated ASTs	0 – 1100 (0-4164 liters)	P	P	P, E&L(10)
	1101 – 5,000 (4168-18,927 liters)	P	P, E&L(10)	[P, E&L(5), I(10)] or [P, L(2), E(5)]
	5,001 – 30,000 (18,931-113,562 liters)	P, E(20)	[P, E(10), I(20)] or [P, E(5), L(10)]	[P, E&L(5), I(10)] or [P, L(1), E(5)]
	30,001 – 75,000 (113,566-283,906 liters)	P, E(20)	P, E&L(5), I(15)	P, E&L(5), I(10)
Portable Containers		P	P	P**

** Owner shall either discontinue use of portable container for storage or have the portable container DOT (Department of Transportation) tested and recertified per the following schedule (refer to Section 9.0):

Plastic portable container - every 7 years

Steel portable container - every 12 years

Stainless Steel portable container - every 17 years

6 PERIODIC AST INSPECTIONS

- 6.1 Periodic AST inspections are to be conducted by owner's inspector. Sample checklists for periodic AST inspections are found in Appendix C of this Standard. These are to be used as a guide for recording inspection data and can be adapted to the specific operational parameters for the AST to be inspected.
- 6.2 The owner's inspector must meet the requirements of paragraph 4.1.
- 6.3 Review prior inspection, repair, and alteration data before each inspection. Note special conditions for a particular AST.
- 6.4 The owner's inspector is to complete or update the *STI SP001 AST Record* for each AST or tank site as designated in the checklists. Note special conditions and changes or alterations to the tank.
- 6.5 The owner's inspector is to complete or update the *STI SP001 Monthly Inspection Checklist* or equivalent each month. Take note of instructions on the checklist. Note special conditions.
- 6.6 The owner's inspector is to complete the *STI SP001 Annual Inspection Checklist* or equivalent each year. Take note of instructions on the checklist. Note special conditions.
- 6.7 For portable containers, the owner's inspector is to complete only the *STI SP001 Portable Container Monthly Inspection Checklist* or equivalent each month. Take note of the instructions on the checklist. Note special conditions.

- 6.7.1 As an alternative, if documentation is kept on-site for each portable container that indicates how long each has been kept at the facility, then the owner's inspector is to complete only the STI SP001 Portable Container Monthly Inspection Checklist each month for containers onsite for 91 days or more. Take note of the instructions on the checklist. Note special conditions.
- 6.8 Additional requirements for field-erected tanks are included in Appendix B.
- 6.9 Refer to Section 10.0 for conditions that warrant immediate action.
- 6.10 The functional life of an AST can be significantly extended by regularly checking for the presence of water inside a tank and in the interstice of a double-wall AST (or double-bottom AST or CE-AST). Water found should be removed or other corrective action taken. Water affects the quality of some stored liquids. In water and certain stored liquids such as petroleum liquids, bacteria may develop and initiate microbial activity. Microbial activity can cause the formation of undesirable by-products, such as sludge and slime. Such activity will corrode metals and deteriorate plastics and may affect product quality.
- 6.10.1 Monitor for water accumulation monthly, except as described in paragraphs 6.10.2 through 6.10.6 and 6.11. If corrosion is found due to MIC, treat the AST with a proper biocide, emulsifier, or other water control additive, or otherwise sterilize the AST. In addition, take necessary steps to repair or remove the AST from service if warranted by the extent of the corrosion, per Section 10.
- 6.10.2 If no measureable amounts of free-standing water are found during four consecutive months of monitoring, the frequency of monitoring for water in Category 1 ASTs may be reduced to annually.
- 6.10.2.1 If measurable amounts of free-standing water are found during annual monitoring, one of the following actions shall be taken:
- a. The AST shall be tested for the presence of bacteria that could cause MIC. If bacteria that could cause MIC are present, the monitoring frequency shall be increased to monthly. The monitoring frequency may again be reduced to annually after four consecutive months if no measureable amounts of free-standing water are found. If bacteria that could cause MIC are not present, the monitoring frequency may remain at annual; OR
 - b. The monitoring frequency shall be increased to monthly and the source of water should be investigated. The monitoring frequency may again be reduced to annually if no measureable amounts of free-standing water are found after four consecutive months.
- 6.10.2.2 If a reduced frequency for water monitoring in ASTs is allowed and utilized as described above, documentation demonstrating no measurable amounts of free-standing water are present during monthly and annual checks shall be kept on file for as long as the reduced water monitoring frequency is used and three years thereafter.

- 6.10.3 ASTs containing liquids that are miscible with water, for example, gasoline with ethanol, and where water is known or expected to be present do not require monthly monitoring for water. However, such ASTs should be monitored for possible phase separation.
- 6.10.4 ASTs do not require monitoring for water if they are holding liquids that are drained from the lowest point in the tank and entirely emptied every 120 days or less, or where the tank throughput during the 120 day period is greater or equal to the tank capacity. Note that on some tanks, the lowest nozzle is not at the lowest point in the tank, so that some of the tank contents remain in the tank when emptied.
- 6.10.5 ASTs containing liquids which are agitated on a schedule to prevent the formation of a water layer that could support MIC do not require monitoring for water.
- 6.10.6 ASTs containing thermoplastics covered in Appendix D do not require monitoring for water.
- 6.11 For Category 1 tanks, as an alternative to checking for water in accordance with 6.10, the tank owner may follow a written program to ensure water is removed or treated on a regular basis to prevent damage due to MIC. The STI publication *Keeping Water Out of Your Storage System* is a good source of information when developing a written program. However, it is highly recommended to check for water periodically, even if there is a program to remove water regularly.

7 FORMAL EXTERNAL INSPECTION (FEI) GUIDELINES

- 7.1 General
 - 7.1.1 FEI are to be performed by Certified Inspectors, per paragraph 4.2.
 - 7.1.2 The following paragraphs describe minimum inspection guidelines. There are numerous AST configurations and components and it is the responsibility of the Certified Inspector to identify and properly inspect them to conform to the owner's requirements, industry standards and regulatory requirements, as applicable. The inspector or the inspection company shall develop detailed checklists that identify, record, and document all aspects of each inspection.
 - 7.1.3 Review prior formal and periodic inspections, repair alteration data, and records of functionality testing of alarms and equipment, before each inspection.
 - 7.1.4 Record AST nameplate data, if available, and check the information included for accuracy against actual conditions. Verify that the properties of the contents of the AST conform to the standard to which it was built. Record AST data, inspection findings, and problems identified.
 - 7.1.5 Inspect the fabrication of the AST against applicable industry standards.
 - 7.1.6 Inspect the AST foundations for indications of settlement, cracking, exposed rebar, or general disrepair. Inspect for areas of wash-out and voids under the AST. Confirm that the ground is sloped away from the AST and that there is no soil resting against the side of the AST, covering parts of the shell or bottom extension. Inspect for standing water against the AST or the indication of drainage problems.

- 7.1.7 Visually inspect the condition of the AST's supports. Severe cracking or spalling of concrete supports shall be noted and evaluated. If there are pad plates between the supports and the shell, inspect their condition. Inspect the supports to be sure that they are sitting securely on the foundation or grade. If the supports are welded to the shell, inspect the welds for visible signs of stress or deterioration.
- 7.1.8 Identify and record the type and condition of the secondary containment, spill control, and CRDM, if present.
- 7.1.8.1 Visually inspect the general condition of the containment area to ensure that it is in good condition and that there is not a breach in the containment structure. Note changes from the original design and installation information if available.
- 7.1.8.2 Inspect for foreign materials in the containment area. Inspect for liquid in the containment system and CRDM. If liquid is present, find the source and report findings. Record other ASTs or containers within the same containment area.
- 7.1.8.3 Verify that the drain valves are operable and in good condition. Report penetrations through the secondary containment that may compromise the integrity of the containment area. Report penetrations that are likely to lead to failure of the secondary containment should the liquid level of water or liquid rise to these penetrations.
- 7.1.9 Inspect and verify the operability of ancillary equipment, including the following items:
- 7.1.9.1 Visually inspect accessible piping, piping supports and piping connections for signs of stress or leakage, due to severe corrosion, rusted bolted connections, or other severe degradation.
- 7.1.9.2 Inspect normal and emergency vents and pressure/vacuum devices. Verify that the devices are of adequate size and capacity, operable, and in good condition. Refer to the device manufacturer's literature, typical industry venting requirements, and other appropriate resources. Record the types and locations of these devices.
- 7.1.9.3 Inspect primary tank level gauge and secondary tank interstitial gauge for free movement and determine if the floats, guides, and attachments are in working order. Verify the liquid level gauge length is sized correctly for the tank diameter.
- 7.1.9.4 Inspect the secondary tank interstitial monitoring equipment where present. Where possible verify free movement of floats and attachments and external alarms. Note that prior to triggering any alarm, proper warnings need to be made to the tank owner.
- 7.1.9.5 Verify and inspect tank overfill prevention devices including high level alarms and high level shut off valves. It may not be possible to verify operability of all devices, but where possible verify equipment is functional and calibrated to the appropriate liquid levels within the tank.

- 7.1.10 Inspect the bonding and grounding system of the AST, if present. (Refer to NFPA 780 *Standard for the Installation of Lightning Protection Systems*, NFPA 77 *Standard Practice on Static Electricity* or other applicable standard.)
- 7.1.11 Inspect stairways, handrails, and platforms for broken welds, bent members, and corrosion.
- 7.1.12 Inspect the coating on the AST shell, and supports for coating failure.
- 7.2 Determine the original shell thickness of the AST. Suggested methods are:
- 7.2.1 Review the original tank documentation, such as drawings and packing lists.
- 7.2.2 Consult the tank manufacturer.
- 7.2.3 Examine the tank labels for evidence of a widely accepted tank standard, such as Underwriters Laboratories Standard UL 142, etc. Consult the referenced standard to determine the minimum design shell thickness.
- 7.2.4 Measure the tank thickness of several areas of the tank that have no visible corrosion or pitting. The average of these measurements will result in a shell thickness measurement that can be used as the original shell thickness measurement.
- 7.3 Horizontal AST Requirements - in addition to the applicable items in 7.1:
- 7.3.1 Inspect shell plates and welds for indications of exterior corrosion, buckling, or distortion, as well as for cracking, pinholes, or mechanical damage. Inspect the shell of the AST and the ancillary equipment (per paragraph 1.3.5) for signs of distortion and stress.
- 7.3.1.1 Take and record UTT readings and the location of the reading of each plate or shell course in areas accessible without entering the AST. Readings must be concentrated in areas where corrosion is likely to occur. If significant internal corrosion is detected, further investigation using UTS is required. If applicable, include areas marked from previous readings. Refer to Section 10.0.
- 7.3.1.2 Existence of external corrosion may require the use of a pit depth measurement device in addition to the UTT to determine the remaining wall thickness.
- 7.3.2 Inspect shell attachments for changes made after the AST was fabricated. Refer to previous drawings or make new sketches that show all the appurtenances, attachments, and nozzle locations on the AST shell and heads or roof. Record repads (reinforcing plates) and/or insert plates. Inspect attachment welds for signs of stress and corrosion.
- 7.4 Vertical or Rectangular AST Requirements - in addition to the applicable items in 7.1:
- 7.4.1 Shell surface – Refer to 7.3.1 and 7.3.2
- 7.4.2 Shell attachments – Refer to 7.3.2

- 7.4.3 Vertical AST roof - Inspect for low areas on the roof and standing water that may corrode the roof areas. Inspect for coating failure, holes, and corrosion. Take UTT readings on the roof and record results. If possible, measure thicknesses in previously measured areas for corrosion rate determination. If significant corrosion is detected, further investigation using ultrasonic testing scans (UTS) is required. Refer to Section 10.0
- 7.5 Double-wall and Double-bottom AST Requirements - in addition to the applicable items in 7.1:
- 7.5.1 Verify that the leak detection equipment or method is operating, if the tank is so equipped.
- 7.5.2 Check for leaks or the presence of liquid in the interstice. When liquid is present in the interstitial space of the AST, thickness measurements should be taken on the secondary tank. UTT and UTS shall be of sufficient quantity and location to verify adequate containment integrity of the secondary tank. If product is found in interstitial space, perform a leak test to determine if primary tank is tight.
- 7.5.3 Double-bottom ASTs require UTT readings of areas that are single-wall as described in paragraph 7.3.1.1 above. Double-wall ASTs do not require UTT readings for the primary tank. In addition, if corrosion is evident on the outside surface of the secondary tank, UTT readings are required.
- 7.6 Steel Diked AST Requirements - in addition to the applicable items in 7.1 to 7.4:
- 7.6.1 For open-top dikes, inspect the condition of the dike and determine if liquid is present. For closed-top dikes that are fitted with an access port, inspect the condition of the inside of the enclosed diked area and determine if liquid is present. AST modifications may be needed in order to provide access for additional assessment. If liquid has entered the space or conditions indicate corrosion could be causing a problem, further evaluation is required.
- 7.6.2 Ultrasonic thickness measurements shall be taken on the tank shell wherever accessible, such as above the rain shields and by removing rain shields to gain access within the dike area where possible.
- 7.6.3 Ensure tank systems are operated with spill and overfill protection controls. Ensure an emergency vent is present and functions for closed-top containment structures.
- 7.7 Insulated AST Requirements - in addition to the applicable items in 7.1 through 7.4, except as modified below:
- 7.7.1 Inspect the insulation material and outer jacket for indications of damage where water may be allowed to wick into the insulating layer. Specifically inspect for areas where water may be trapped behind or within the insulation. If any of the following conditions are identified, then remove sections of the insulation to check for corrosion:

- Evidence that the tank may be compromised,
 - Evidence that the base of the tank is consistently in contact with standing water, or
 - Insulation is significantly compromised and has not been repaired or replaced in a timely manner
- 7.7.2 If corrosion under the insulation is suspected, remove sections of the insulation to check for corrosion. Damage done to the insulation for the purpose of inspection shall be repaired.
- 7.7.3 Take UTT readings of the shell where accessible and where insulation is removed per 7.7.1 and record results. In addition, include, if applicable, areas marked from previous readings. If significant internal corrosion is detected, further investigation using ultrasonic testing scans (UTS) is required. Refer to Section 10.0.
- 7.8 Concrete Exterior ASTs (CE-ASTs) Requirements - in addition to the applicable items in 7.1:
- 7.8.1 Follow the tank manufacturer's instructions for inspection and maintenance.
- 7.8.2 Inspect concrete exterior body of the tank for cleanliness, need of coating, or rust staining.
- 7.8.3 Inspect the entire exterior of the tank for cracks in concrete.
- Cracks larger than 1/16 of an inch in thickness require repair.
 - If cracks greater than 1/16 of an inch are present on all four top chamfer edges, then the tank shall be further evaluated and repaired in consultation with the tank manufacturer, due to the possibility of damage or over-pressurization of the secondary containment.
- 7.8.4 Check for leaks or the presence of liquid in the interstice. If liquid is found, then further investigation is needed to determine the cause.
- 7.8.5 Check the seal between the pipe nipples (and other tank top appurtenances) and concrete.
- 7.8.6 CE-ASTs with joints or seams in the concrete exterior require inspection of the joint seal for deterioration, holes, tears, and cracks.
- 7.9 Additional requirements for field-erected ASTs are included in Appendix B.
- 7.10 In the final report, include field data, measurements, pictures, drawings, tables, and an inspection summary. In the summary, identify unacceptable conditions and recommended and/or mandatory corrective actions. Determine the suitability for continued service of the AST per Section 10.0 and document this in the final report. Include the date of the next scheduled FEI or FII, as applicable. Include the inspector's name and certification number in the report.

8 FORMAL INTERNAL INSPECTION GUIDELINES

8.1 General

- 8.1.1 FII are to be performed by Certified Inspectors per paragraph 4.2.
- 8.1.2 The following paragraphs describe minimum inspection guidelines. There are numerous AST configurations and components; it is the responsibility of the Certified Inspector to identify and properly inspect them to conform to the owner's requirements and/or industry standards. The inspector or the inspection company shall develop detailed checklists that identify, record, and document all aspects of each inspection.
- 8.1.3 An FII includes the requirements of an FEI with the addition of the requirements described below. Refer to paragraphs 7.1 to 7.9 for FEI requirements.
- 8.1.4 For elevated ASTs where all external surfaces are accessible, the internal inspection requirements may be satisfied with an examination from the exterior by using such methods as UTS. For all other situations, entry into the interior of the AST is necessary to assess the condition of all surfaces.

8.2 Horizontal AST Internal Inspection

- 8.2.1 Identify, measure, inspect, and record all AST internal appurtenances. Inspect for mechanical damage, corrosion, cracking, etc. Inspect for deteriorating or corroding internal attachments and piping. Take thickness readings of internal structures and record the readings.
- 8.2.2 Inspect the welds for cracking by visual inspection or, if necessary, by magnetic particle (MT) inspection or equivalent method.
- 8.2.3 Internal NDT Inspection
 - 8.2.3.1 Ultrasonic testing equipment that is capable of scanning the tank (UTS), rather than measuring only individual points (UTT), is the preferred method of testing. Personnel performing UTS are to be qualified per paragraph 4.3.2. If ultrasonic testing equipment that is capable of scanning the tank is not practical, use equipment that tests individual points. In this case, take UTT measurements of at least 15 points per each 12 inches x 12 inches (0.3 meters x 0.3 meters) square area of the shell that is in contact with the ground. Any questionable areas are to be assessed by UTS.
 - 8.2.3.2 Perform a vacuum box (VB) examination of questionable welds to check for leaks.
 - 8.2.3.3 Refer to Section 10.0 for criteria for suitability for continued service.

8.3 Vertical and Rectangular AST Internal Inspection

- 8.3.1 Identify, record, inspect, and measure all AST internal surfaces and appurtenances. Inspect AST internals to check for mechanical damage, corrosion, cracking, etc. Check for deteriorating or corroding internal attachments and piping. Take thickness readings of internal structures and record the readings.

8.3.2 Inspect the welds for cracking, corrosion or incomplete fusion which may result in a leak by visual inspection. If additional investigation is needed, the weld may be tested using vacuum box (VB), or if necessary magnetic particle (MT) or liquid dye penetrant (DPT) inspection or equivalent method.

8.3.3 Internal NDT Inspection

8.3.3.1 AST floor thickness assessments is required as follows:

Complete coverage of the AST floor is recommended, due to random corrosion characteristics of metal in contact with the ground. Inspection of the AST floor is recommended using inspection methods capable of determining the underside floor condition, such as UTS, MFL followed by UTS of questionable areas, or other equivalent methods.

If ultrasonic testing equipment that is capable of scanning the tank is not practical, use equipment that tests individual points. In this case, take UTT measurements of at least 15 points per each 12 inches x 12 inches (0.3 meters x 0.3 meters) square area of the shell that is in contact with the ground. Any questionable areas are to be assessed by UTS.

8.3.3.2 Perform a vacuum box (VB) examination of questionable welds to check for leaks.

8.3.4 Refer to Section 10 for criteria for Suitability for Continued Service.

8.4 Additional requirements for field-erected ASTs are included in Appendix B.

8.5 Report

In the final report, include field data, measurements, pictures, drawings, tables, and an inspection summary. Identify in the summary unacceptable conditions and recommended and/or mandatory corrective actions. Determine the suitability for continued service of the AST per Section 10.0 and document this in the final report. Include the date of the next scheduled Formal External and/or FII, as applicable. Include the inspector's name and certification number in the report.

9 LEAK TESTING METHODS (LTM)

9.1 Shop-fabricated AST leak testing procedure

9.1.1 Consult the Steel Tank Institute Recommended Practice *R912, Installation Instructions for Shop Fabricated Stationary Aboveground Storage Tanks for Flammable, Combustible Liquids*. Air shall not be used for a pressure test; an inert gas shall be used instead. The introduction of a gas containing oxygen (such as air) to a tank that has previously held petroleum liquid can pose an explosion hazard.

9.1.2 Vacuum testing of the interstice of double-wall or double-bottom tanks is an option. Refer to the Steel Tank Institute Recommended Practice *R912, Installation Instructions for Shop Fabricated Stationary Aboveground Storage Tanks for Flammable, Combustible Liquids*.

- 9.1.3 Leak testing of CE-ASTs that are listed and labeled as UL2085 shall be performed in accordance with the specific requirements (or the testing manual) of the manufacturer. The testing, which includes brand-specific vacuum and hydrostatic testing, shall be performed by properly trained personnel.
- 9.2 Portable containers leak testing procedure – Refer to DOT Sections 49 CFR 173.28 (Reuse, reconditioning and remanufacturing of packagings - mainly for drums) and Part 178 - 49 CFR Subpart O - Testing of IBC's [Intermediate Bulk Container] (section 178.803 Testing and certification of IBC's) and 49 CFR 180.605, (Requirements for periodic testing, inspection and repair of portable tank), or equivalent, for portable container testing and recertification. Electronic versions of these documents are available online.
- 9.2.1 See the definition of Leak Testing Methods for more information.

10 SUITABILITY FOR CONTINUED SERVICE

- 10.1 Determination of suitability for continued service of the AST shall be performed by a Certified Inspector based on the results of Formal External and/or Internal Inspections. When the inspection results (refer to Section 7 and 8 of this standard) show that a change has occurred from the original physical conditions of the tank system, this section describes the recommended actions to be taken by the owner. These evaluations may require consultation with other individuals who have the appropriate training, education, and/or experience to evaluate the changes.
- 10.2 Aside from corrosion related tank degradation, a tank is not considered suitable for service if conditions are noted during the inspection that jeopardize the life or safety of personnel working near the tank. These conditions include but are not limited to:
- Lack of adequate emergency relief venting
 - Visible signs of leakage from appurtenances which cannot be resolved without removing the tank from service
 - Damaged or non-complaint electrical systems within the hazardous area which may create an imminent ignition source.
- 10.3 Corrosion related degradation noted during formal external and internal inspections (refer to AST categories in Section 5.0)
- 10.3.1 MIC – For all tanks in Table 5.5, if evidence of MIC is found at any time, then corrections and repairs shall be promptly made to the AST. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. Conduct the next Formal External or FII no more than two years after the discovery of MIC.
- 10.3.1.1 When Table 5.5 allows FEI to be performed in lieu of FII, then conduct the next Formal External Inspection no more than two years after the discovery of MIC. Under these circumstances, UTS of 100% of the shell shall be employed. If this is not possible, then a FII is required.

- 10.3.1.2 If the re-inspection confirms that MIC has been mitigated due to measures taken to eliminate it, such as regular and careful water removal and sterilization of the tank and piping systems, then the AST may be inspected according to Table 5.5.
- 10.3.2 Category 3 ASTs - If the shell thickness has been reduced to less than 75% of the original shell thickness at any point, then the AST shall be taken out of service and repaired or replaced. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. The Certified Inspector shall document in the report that the next Formal External or FII shall be within 5 years and each subsequent 5 years thereafter, until the condition that caused the tank degradation has been fully corrected. When the tank degradation has been arrested, or is in a steady-state condition, then follow the inspection intervals shown in Table 5.5 for subsequent inspections.
- 10.3.3 Category 2 ASTs – The AST shall be repaired or replaced if more than 3 square inches of any one square foot of the tank shell (i.e. approximately 2%) is found to be less than 75% of the original shell thickness; or if the remaining shell thickness of an area is less than 50% of the original shell thickness at any point. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. The Certified Inspector shall document in the report that the next Formal External or FII shall be within 5 years and each subsequent 5 years thereafter, until the condition that caused the tank degradation has been fully corrected. When the tank degradation has been arrested, or is in a steady-state condition, then follow the inspection intervals shown in Table 5.5 for subsequent inspections.
- 10.3.4 Category 1 ASTs - The AST shall be repaired or replaced if more than 3 square inches of any one square foot of the tank shell (i.e. approximately 2%) is found to be less than 50% of the original shell thickness; or if the remaining shell thickness of an area is less than 25% of the original shell thickness at any point. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. The Certified Inspector shall document in the report that the next Formal External or FII shall be within 5 years and each subsequent 5 years thereafter, until the condition that caused the tank degradation has been fully corrected. When the tank degradation has been arrested, or is in a steady-state condition, then follow the inspection intervals shown in Table 5.5 for subsequent inspections.
- 10.3.4.1 For Category 1 ASTs, alternatively, if the Certified Inspector establishes and documents a corrosion rate, the inspector may determine the next Formal External Inspection based upon corrosion rates. The calculated time until the next Formal External Inspection may exceed the values listed in Table 5.5 if corrosion rates allow.

- 10.3.4.2 Refer to *API 575, Inspection of Atmospheric and Low-Pressure Storage Tanks*, for some acceptable methods of determining corrosion rates.
- 10.3.4.3 Further, if the shell thickness is reduced anywhere to less than 25% of the original shell thickness, the AST shall be repaired or replaced. Refer to Steel Tank Institute *SP031 Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST.
- 10.3.5 Corrosion in the knuckle area - Corrosion in the knuckle area of a tank is considered a critical condition. The knuckle is the curved portion of the steel that joins the bottom or end of the AST to the shell. The AST is manufactured with a circular piece of steel with a formed flange and is often found on horizontal or vertical shop-fabricated ASTs. It may not be possible to accurately measure metal loss in the knuckle area from an external inspection alone. If suspected, more evaluation is needed and internal inspection may be justified. The maximum allowable metal loss at any single point is the same as the plate thickness limits shown in the previous paragraphs for each category of tank.
- 10.3.6 Double wall ASTs - The criteria for suitability for continued service of a double wall AST when corrosion of the secondary tank has been found shall be per paragraph 10.3.4 above (double wall ASTs are to be considered Category 1 for the suitability for continued service). Further, if a leak is found in the primary tank, the tank shall be repaired or replaced. Refer to Steel Tank Institute *SP031 Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. When the tank degradation has been arrested, or is in a steady-state condition, then follow the inspection intervals shown in Table 5.5 for subsequent inspections.
- 10.3.6.1 CE-ASTs shall be repaired or replaced if one of the following is found:
- Fuel or other product is found in the interstice.
 - The CE-AST has failed all published primary and secondary containment testing methods of the manufacturer. The testing, which includes brand-specific vacuum and hydrostatic testing, shall be performed by properly trained personnel.
 - CE-ASTs with joints or seams that show clear signs of failed joint seals shall be taken out of service if the joint seal is below the liquid level. CE-ASTs with joint seals above the liquid level shall have the joint seal repaired.
 - CE-ASTs with exterior wall damage greater than 3 inches in depth, 6 square inches in size, or showing exposed reinforcing steel shall be taken out of service. Repairs may be possible based on the tank manufacturer's recommendation.

- e. Where corrosion of pipe nipple below surface of concrete has caused a rust-through, the tank shall be taken out of service unless the fitting can be permanently sealed.
- f. If liquid is found in the interstice, the liquid shall be removed and additional investigation is required. Refer to paragraph 7.8. Repair is required per manufacturer's guidelines, and the CE-AST may or may not need to be removed from service.

10.3.6.2 Other tank damage – An AST subjected to damage caused by the following conditions requires evaluation by an engineer experienced in AST design or by a tank manufacturer who will jointly with the owner determine if an immediate Formal External or Internal Inspection is required:

- Fire - AST exposed to fire or flame impingement
- Natural disaster - AST exposed to flooding, hurricane force winds, etc. and has been lifted or damaged
- Excessive settlement - AST that has experienced excessive settlement
- Overpressure - AST exposed to excessive internal pressure caused by overfill or failure of venting devices or other reason
- Damage from cracking - AST with evidence of cracking of welds or of an AST surface

10.4 If a leak is discovered at any time by the owner or the inspector, the tank must be repaired, replaced, or closed and removed from service, in accordance with accepted good engineering practice.

11 RECORDKEEPING

- 11.1 Retain each AST Record for the life of the AST. Refer to Appendix C for example.
- 11.2 Retain each Monthly Inspection Checklist for at least 36 months. Refer to Appendix C for example.
- 11.3 Retain each Annual Inspection Checklist for at least 36 months. Refer to Appendix C for example.
- 11.4 Retain each Portable Container Monthly Inspection Checklist for at least 36 months. Refer to Appendix C for example.
- 11.5 Retain all formal inspection reports developed by certified inspectors for the life of the AST.

REFERENCES

American Petroleum Institute:

- API Publication 341, *A Survey of Diked-area Liner Use at Aboveground Storage Tank Facilities*
- API Recommended Practice 575, *Inspection of Atmospheric and Low Pressure Storage Tanks*
- API Standard 650, *Welded Steel Tanks for Oil Storage*
- API Bulletin D16, *Suggested Procedure for Development of a Spill Prevention Control and Countermeasure Plan*
- API Recommended Practice 12R1, *Recommended Practice for Setting, Maintenance, Inspection, Operation and Repair of Tanks in Production Service*
- API Standard 653, *Tank Inspection, Repair, Alteration, and Reconstruction*
- API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*
- API Specification 12D, *Specification for Field Welded Tanks for Storage of Production Liquids*
- API Specification 12F, *Specification for Shop Welded Tanks for Storage of Production Liquids*

American Society for Nondestructive Testing

- ANSI/ASNT Recommended Practice No. SNT-TC-1A, *Guideline to Personnel Qualification and Certification in NDT*

International Code Council

- *International Fire Code*

National Fire Protection Association:

- NFPA 30, *Flammable and Combustible Liquids Code*
- NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*
- NFPA 70, *National Electrical Code*
- NFPA 77: *Recommended Practice on Static Electricity*
- NFPA 326, *Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair*
- NFPA 780, *Standard for the Installation of Lightning Protection Systems*

STI/SPFA:

- SP031, *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids*
- R893, *Recommended Practice For External Corrosion Protection of Shop Fabricated Aboveground Tank Floors*
- R912, *Installation Instructions for Shop Fabricated Stationary Aboveground Storage Tanks for Flammable, Combustible Liquids*

Underwriters Laboratories Inc.

- UL 142, *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*
- UL 2085, *Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids*

United States Environmental Protection Agency:

- EPA 40 CFR part 112, *Oil Pollution Prevention and Response; Non-Transportation-Related Onshore and Offshore Facilities*
- EPA 510-K-15-001, *Musts for USTs*

United States Department of Labor, Occupational Safety & Health Administration (OSHA)

- 29 CFR Part 1910.147, *The Control of Hazardous Energy (Lockout/Tagout)*
- 29 CFR Part 1910.333, *Electrical Lockout/Tagout*
- 1926.1200 Subpart AA *Confined Space in Construction*

United States Department of Transportation

- DOT Sections 49 CFR 173.28, *Reuse, Reconditioning and Remanufacturing of Packaging*
- DOT part 178-49 CFR Subpart O, *Testing of IBC's*
- DOT 49 CFR part 178.803, *Testing and certification of IBC's*
- DOT 49 CFR part 180.605, *Portable container Testing and Recertification*

APPENDIX A SUPPLEMENTAL TECHNICAL INFORMATION

1 TYPICAL AST DIAGRAMS

- 1.1 The diagram below shows terms commonly associated with ASTs. For the purposes of this Standard, all of these surfaces are called the “shell” of the AST to avoid confusion.

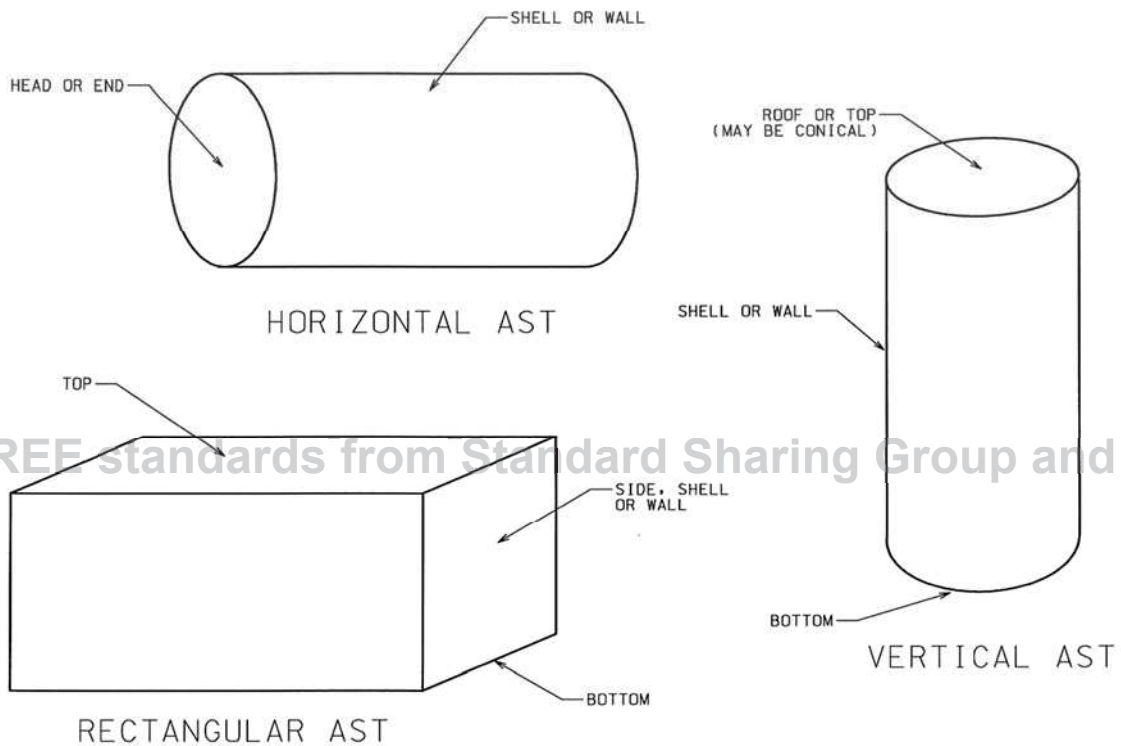


FIGURE A1.1

- 1.2 The diagram below identifies the appurtenances of an AST. A specific tank may include some or all of these appurtenances.

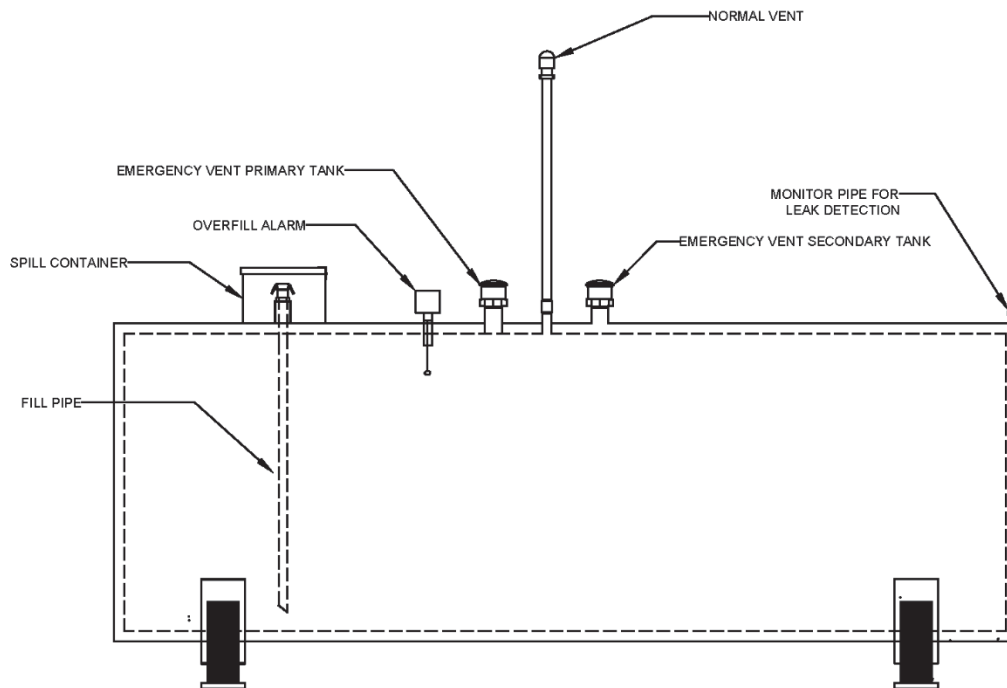


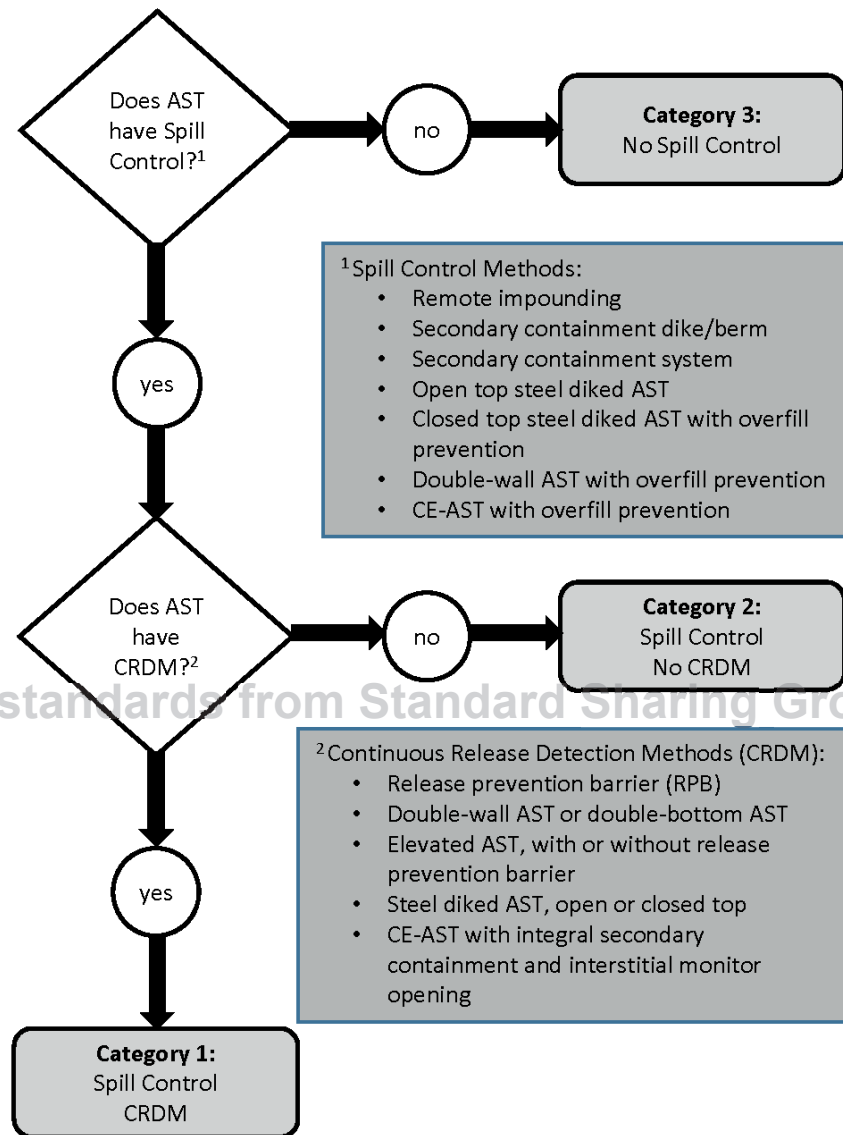
FIGURE A1.2

- 1.2.1 The purpose of these appurtenances is as follows:
- 1.2.1.1 Emergency vent (for primary and secondary tank) – These tank accessories prevent damage to the tank by allowing excess pressure to be vented. They are designed to relieve excess pressure in the event of an emergency, such as a fire.
 - 1.2.1.2 Monitor pipe for leak detection – A pipe installed in the air space (Interstice) between the primary tank and secondary tank of a double-wall tank. It is typically used with leak detection equipment to detect a leak in either the primary or the secondary tank.
 - 1.2.1.3 Normal vent – A primary tank accessory that allows air to enter the tank when liquid is being withdrawn and exhausts air when the tank is being filled. This prevents damage to the tank due to excessive pressure or vacuum.
 - 1.2.1.4 Overfill alarm – A device designed to alert personnel who are filling a tank when a predetermined level is reached.
 - 1.2.1.5 Spill container – A tank accessory designed to catch spills during tank filling operations. It typically has a lockable, hinged lid and may allow spilled fluid to drain into the tank.
 - 1.2.1.6 Tank supports – These structures are used to elevate the tank off the ground.

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2 TANK TYPES AND THEIR CORRESPONDING AST CATEGORY

2.1 Figure A2.1 is an aid to determine the Category of the tank (see paragraph 5.4 of the Standard for more information):



**FIGURE A2.1
TANK CATEGORY DECISION TREE**

- 2.2 Table A2.2 shows some typical tank types, although not an exhaustive list, and their corresponding AST category.

**TABLE A2.2
EXAMPLE TANK CONFIGURATION AND AST CATEGORY**

Tank Configuration	Tank has Spill Control?	Tank has CRDM?	AST Category
Single wall vertical AST in contact with ground and no spill control	No	No	3
Single wall vertical AST in contact with ground in an earthen dike	Yes	No	2
Single wall vertical AST in concrete dike with concrete floor. Concrete floor extends under tank completely	Yes	Yes	1
Single wall vertical AST in dike with elastomeric liner. Liner extends under tank completely	Yes	Yes	1
Single wall vertical AST installed on gravel and no spill control	No	No	3
Single wall vertical AST installed on gravel in an earthen dike	Yes	No	2
Elevated AST with spill control	Yes	Yes	1
Elevated AST without spill control	No	Yes	3
AST with double-bottom and spill control	Yes	Yes	1
Double-wall AST with overfill prevention	Yes	Yes	1
Double-wall AST without overfill prevention	No	Yes	3
Concrete exterior AST with overfill prevention	Yes	Yes	1
Concrete exterior AST without overfill prevention	No	Yes	3

3 RELEASE MANAGEMENT SYSTEM (RMS)

- 3.1 One of the basic purposes of AST inspection standards is to minimize the likelihood and consequences of leaks. Over extended periods, even small leaks may have considerable impact on the environment. The use of industry standards to prevent leaks is a fundamental principle of pollution prevention. Industry standards cover the tank life cycle from construction, to ongoing inspection and maintenance, to final closure.
- 3.2 Applying RMS can reduce the likelihood and consequences of leaks. Typically, RMS is applied to provide additional integrity assurance against leaks.
- 3.3 In the context of this Standard, RMS specifically refers to two basic methodologies as defined below:
- Leak Testing Methods (LTM)
 - Continuous Release Detection Methods (CRDM)

- 3.4 Experience has shown that long-term, slow leaks may develop and cause environmental damage from an AST that is in direct contact with the ground. These types of ASTs are subjected to the full hydrostatic pressure of the liquid on one side of the AST surface and are in direct contact with the ground on the other side of the AST surface. These ASTs may allow a slow leak over a long time under full liquid hydrostatic pressure, which may go undetected and cause environmental damage. LTM is a layer of protection beyond conventional AST inspection practices that is most effective when applied to ASTs that are in direct contact with the soil and that do not have CRDMs. An LTM is ordinarily not necessary for tanks that have CRDMs (continuous release detection methods) such as elevated tanks, double-wall tanks, or tanks with release prevention barriers.
- 3.5 Figure A4.5 shows RMS graphically.

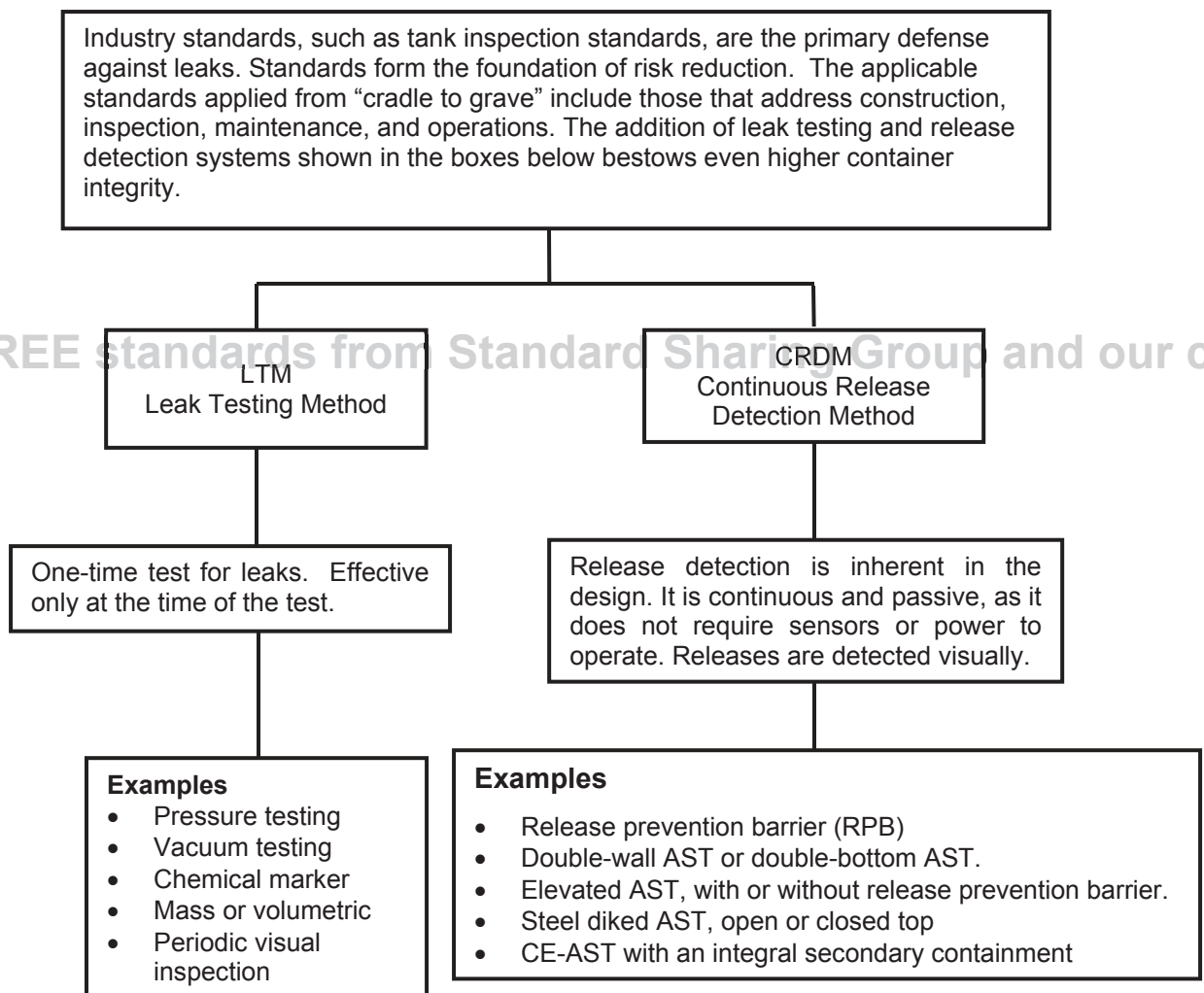


FIGURE A3.5
RELEASE DETECTION SYSTEMS

4 REGULATIONS

- 4.1 The Federal EPA has promulgated regulations regarding the storage and handling of oils, both petroleum and non-petroleum, called the *Spill Prevention Control and Countermeasures (SPCC) Rule* under the authority of the Clean Water Act (40 CFR part 112). Additionally some states and localities have developed AST regulatory programs under specific state or local authority. Entities regulated by these sections may use this Standard or others to inspect and determine the fitness of their storage systems. Refer to <https://www.epa.gov/oil-spills-prevention-and-preparedness-regulations> and American Petroleum Institute's (API) Recommended Practice Bulletin D16, *Suggested Procedure for Development of a Spill Prevention Control and Countermeasure Plan* for more information.

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APPENDIX B

INSPECTION OF FIELD-ERECTED ASTS

1 GENERAL

- 1.1 Purpose and Applicability – This Appendix addresses additional and special inspection requirements for field-erected tanks. Tanks larger than 30 feet (9.1 meters) in diameter or more than 50 feet (15.2 meters) high should be inspected according to an appropriate field-erected tank inspection standard. This Appendix is applicable only when specifically referenced by written contractual language between the owner and the inspector. Further, it is applicable only when not prohibited by the regulatory authority having jurisdiction. This Appendix specifies only those requirements which modify or exceed the requirements of the main body of the Standard.
- 1.2 Scope - This Appendix applies to steel ASTs that are:
 - 1.2.1 Welded and flat-bottom, cone-up or cone-down design
 - 1.2.2 Up to 30 feet (9.1 meters) in diameter and with a height of less than 50 feet (15.2 meters)
 - 1.2.3 Fabricated with full-fusion, butt-welded shells and with lap-welded or butt-welded bottom plates
 - 1.2.4 Fabricated with a shell thickness of each course less than ½ inch and with original nominal bottom thickness plates equal to ¼ inch or 6 mm
 - 1.2.5 Built to a nationally recognized standard
- 1.3 Brittle Fracture Assessment - Because the tank shells are less than ½ inch thick, the risk of brittle fracture is minimal. Brittle fracture assessments and documentation are not required for tanks that fall within the scope of this Standard.

2 INSPECTIONS

- 2.1 Refer to the Table B2.1 below for the inspection timetable. Category 1, 2 and 3 as well as the P, E, I, and L designations are described in the main body of the SP001 Standard. Note that the internal inspection intervals shown in this table are guiding values when corrosion rates are not determined, in accordance with recognized and accepted industry principles and practice.
 - 2.1.1 When corrosion rates are established, the corrosion rates may govern the internal inspection interval, which may be shorter or longer than the values shown.
 - 2.1.2 For Category 1 tanks, the maximum internal re-inspection interval is 30 years.
 - 2.1.3 For Category 2 tanks, the maximum internal re-inspection interval is 20 years.
 - 2.1.4 For Category 3 tanks, the maximum internal re-inspection interval may not be longer than shown in Table B2.1.

TABLE B2.1
TABLE OF INSPECTION SCHEDULES

AST Type and Capacity	Category 1	Category 2	Category 3
Field-erected AST	P, E(5), I(10)	P, E&L(5), I(10)	P, E&L(5), I(10)

2.2 Follow the requirements found in the main body of the SP001 *Standard for Periodic Inspections, FEI and FII* and any additional requirements in this Appendix. Also, follow all the requirements of the Safety Section. Leak testing methods for field-erected tanks are currently under research by API and STI, and additional requirements will be added to SP001 in the future.

2.3 Below are additional inspection requirements for field-erected ASTs.

2.3.1 Vertical AST Floating Roof

2.3.1.1 For safety, make sure that the roof pontoons are free of liquid and harmful vapors and that the floating roof is properly stabilized against collapse. (See API 2016, *Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks*.) Inspect the vapor space on top of the floating roof before gaining access.

2.3.1.2 For FII, inspect the seal for deterioration, holes, tears, and cracks to determine the Suitability for Continued Service.

2.3.1.3 For external floating roofs, assess the condition of the outer roof rim plate by visual or ultrasonic methods. It may be necessary to assess the condition by performing ultrasonic inspection from the inside of the pontoon. Inspect that either the roof drain is open or the drain plug in the roof is open in case of unexpected rain. Inspect the roof legs for their contact with the floor and that the striker plates are present and in position. Inspect the roof legs for corrosion and damage.

2.3.1.4 Inspect for standing water on top of the roof and inspect the roof drainage system operation. Inspect the pontoons for presence of liquid.

2.4 Suitability for Continued Service

2.4.1 As an alternative to the criteria in the main body of SP001, and if the Certified Inspector is API 653 Certified, then the methods included in API 653 maybe used to evaluate the AST.

2.4.2 The minimum allowable remaining thickness is 0.1 inch (2.54 mm). In setting the next inspection interval based upon corrosion rates, neither the bottom nor the shell shall be allowed to corrode less than 0.1 inch.

2.4.2.1 The minimum required thickness of each shell course shall be according to:

$$t_{\min} = \frac{(H-1)DG}{10,000}$$

- $t_{\min}$ = the minimum acceptable average thickness, in inches, for each course as calculated from the above formula. However, $t_{\min}$ shall not be less than 0.1 inch (2.54 mm) for any tank course.
- D = nominal diameter of tank, in feet.
- H = height from the bottom of the shell course under consideration to the maximum liquid level when evaluating an entire shell course, in feet.
- G = largest specific gravity of the contents.

2.4.3 One method of determining the interval between FII required by the tank bottom assessment is as follows (corrosion rates shall be assumed constant for these calculations):

$$MFIII = \frac{\min(RT_{bc}, RT_{ip}) - MRT}{(St\ Pr + U\ Pr)}$$

- MRT = minimum allowable remaining tank bottom thickness at the end of inspection interval which is 0.1 inch (2.54 mm).
- $MFIII$ = maximum Formal Internal Inspection interval (years to next internal inspection) not to exceed that allowed in paragraph 2.1 of this Appendix.
- RT_{bc} = minimum remaining thickness from bottom side corrosion after repairs.
- RT_{ip} = minimum remaining thickness from internal corrosion after repairs.
- $St\ Pr$ = maximum rate of corrosion not repaired on the top side. This value is zero for coated areas of the bottom. The expected life of the coating must equal or exceed MFIII to use $St\ Pr = 0$.
- $U\ Pr$ = maximum rate of corrosion on the bottom side. To calculate the corrosion rate, use the minimum remaining thickness after repairs. For tanks that have proven cathodic protection, the corrosion rate from the underside shall be $U\ Pr = 0.002$ inches per year (0.05 mm per year).

Note: For areas of a bottom that have been scanned by the magnetic flux leakage (or exclusion) process and do not have effective cathodic protection, the thickness used for calculating $U\ Pr$ must be the lesser of the MFL threshold or the minimum thickness of corrosion areas that are not repaired. The MFL threshold is defined as the minimum remaining thickness to be detected in the areas inspected. This value should be predetermined by the owner based on the desired inspection interval.

- 2.4.4 Widely scattered pitting will not significantly affect the strength of the tank shell and the tank may be allowed to continue operation, provided that both of the following conditions are met:
 - 2.4.4.1 Pit depths or thinning with a diameter or maximum dimension of less than 2 inches (50.8 mm) does not result in a remaining wall thickness of less than 0.05 inch (1.27 mm).
 - 2.4.4.2 No pit or thinned area results in any area 2 inches (50.8 mm) in diameter or larger with a thickness less than 0.1 inch (2.54 mm).

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APPENDIX C
AST RECORDS AND PERIODIC INSPECTION CHECKLISTS

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STI SP001 AST Record

Form completed by (Name) _____
(Title) _____

Date _____

OWNER INFORMATION	FACILITY INFORMATION	INSTALLER INFORMATION
Name	Name	Name
Number and Street	Number and Street	Number and Street
City, State, Zip Code	City, State, Zip Code	City, State, Zip Code
	Regulatory facility ID number (if applicable)	

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OWNER'S TANK ID	OTHER ID	INITIAL SERVICE DATE
Manufacturer:	Contents:	Construction Date:
Dimensions:	Capacity:	Last Repair/Reconstruction Date:
Design: ☐ UL _____	☐ SwRI _____	☐ API _____
☐ Horizontal	☐ Vertical	☐ Other _____
☐ Bare Steel ☐ Cathodically Protected (Check one: A. ☐ Galvanic or B. ☐ Impressed Current) Date Installed: _____ ☐ Coated Steel ☐ Concrete encased steel ☐ Stainless steel ☐ Other _____ ☐ Double-Bottom ☐ Double-Wall ☐ Lined inside; Date lining installed: _____		
Spill control: ☐ Earthen Dike ☐ Steel Dike ☐ Concrete ☐ None ☐ Other _____		CRDM: ☐ yes ☐ no If yes, type: ☐ Release Prevention Barrier ☐ Elevated tank ☐ Double bottom tank ☐ Double wall tank ☐ CE-AST ☐ other _____
Tank elevated on supports ☐ yes ☐ no Support material: ☐ steel ☐ concrete ☐ other _____		AST Category: ☐ Category 1 ☐ Category 2 ☐ Category 3
Release Prevention Barrier: ☐ yes ☐ no If yes, Date Installed: _____ If yes, Type: ☐ concrete ☐ synthetic liner ☐ clay liner ☐ steel ☐ other _____		

OWNER'S TANK ID		OTHER ID		INITIAL SERVICE DATE	
Manufacturer:		Contents:		Construction Date:	
Dimensions:		Capacity:		Last Repair/Reconstruction Date:	
Design: ☐ UL _____		☐ SwRI _____		☐ API _____ ☐ Other _____ ☐ Unknown	
☐ Horizontal		☐ Vertical		☐ Rectangular	
Construction: ☐ Bare Steel		☐ Cathodically Protected (Check one: A. ☐ Galvanic or B. ☐ Impressed Current)		Date Installed: _____	
☐ Coated Steel		☐ Concrete encased steel		☐ Stainless steel ☐ Other _____	
☐ Double-Bottom		☐ Double-Wall		☐ Lined inside; Date lining installed: _____	
Spill control: ☐ Earthen Dike ☐ Steel Dike ☐ Concrete			CRDM: ☐ yes ☐ no		
☐ None ☐ Other _____			If yes, type: ☐ Release Prevention Barrier ☐ Elevated tank ☐ Double bottom tank		
Tank elevated on supports ☐ yes ☐ no			☐ Double wall tank ☐ CE-AST ☐ other _____		
Support material: ☐ steel ☐ concrete ☐ other _____					
Release Prevention Barrier: ☐ yes ☐ no If yes, Date Installed: _____			AST Category: ☐ Category 1 ☐ Category 2 ☐ Category 3		
If yes, Type: ☐ concrete ☐ synthetic liner ☐ clay liner ☐ steel ☐ other _____					

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OWNER'S TANK ID		OTHER ID		INITIAL SERVICE DATE	
Manufacturer:		Contents:		Construction Date:	
Dimensions:		Capacity:		Last Repair/Reconstruction Date:	
Design: ☐ UL _____		☐ SwRI _____		☐ API _____ ☐ Other _____ ☐ Unknown	
☐ Horizontal		☐ Vertical		☐ Rectangular	
Construction: ☐ Bare Steel		☐ Cathodically Protected (Check one: A. ☐ Galvanic or B. ☐ Impressed Current)		Date Installed: _____	
☐ Coated Steel		☐ Concrete encased steel		☐ Stainless steel ☐ Other _____	
☐ Double-Bottom		☐ Double-Wall		☐ Lined inside; Date lining installed: _____	
Spill control: ☐ Earthen Dike ☐ Steel Dike ☐ Concrete			CRDM: ☐ yes ☐ no		
☐ None ☐ Other _____			If yes, type: ☐ Release Prevention Barrier ☐ Elevated tank ☐ Double bottom tank		
Tank elevated on supports ☐ yes ☐ no			☐ Double wall tank ☐ CE-AST ☐ other _____		
Support material: ☐ steel ☐ concrete ☐ other _____					
Release Prevention Barrier: ☐ yes ☐ no If yes, Date Installed: _____			AST Category: ☐ Category 1 ☐ Category 2 ☐ Category 3		
If yes, Type: ☐ concrete ☐ synthetic liner ☐ clay liner ☐ steel ☐ other _____					

STI SP001 Monthly Inspection Checklist

General Inspection Information:

Inspection Date: _____	Prior Inspection Date: _____	Retain until date: _____
Inspector Name (print): _____	Title: _____	
Inspector's Signature _____		
Tank(s) inspected ID _____		
Regulatory facility name and ID number (if applicable) _____		

Inspection Guidance:

- This checklist is intended as a model. Locally developed checklists are acceptable as long as they are substantially equivalent (as applicable). Inspections of multiple tanks may be captured on one form as long as the tanks are substantially the same.
- For equipment not included in this Standard, follow the manufacturer recommended inspection/testing schedules and procedures.
- The periodic AST Inspection is intended for monitoring the external AST condition and its containment structure. This visual inspection does not require a Certified Inspector. It shall be performed by an owner's inspector per paragraph 4.1.2 of the standard.
- Upon discovery of water in the primary tank, secondary containment area, interstice, or spill container, remove promptly or take other corrective action. Inspect the liquid for regulated products or other contaminants and dispose of properly.
- Non-conforming items important to tank or containment integrity require evaluation by an engineer experienced in AST design, a Certified Inspector, or a tank manufacturer who will determine the corrective action. Note the non-conformance and corresponding corrective action in the comment section.
- Retain the completed checklists for at least 36 months.
- **After severe weather (snow, ice, wind storms) or maintenance (such as coating) that could affect the operation of critical components (normal and emergency vents, valves), an inspection of these components is required as soon as the equipment is safely accessible after the event.**

ITEM		STATUS	COMMENTS / DATE CORRECTED
Tank and Piping			
1	Is tank exterior (roof, shell, heads, bottom, connections, fittings, valves, etc.) free of visible leaks? Note: If "No", identify tank and describe leak and actions taken.	☐ Yes ☐ No	
2	Is the tank liquid level gauge legible and in good working condition?	☐ Yes ☐ No ☐ N/A	
3	Is the area around the tank (concrete surfaces, ground, containment, etc.) free of visible signs of leakage?	☐ Yes ☐ No	

4	Is the primary tank free of water or has another preventative measure been taken? NOTE: Refer to paragraphs 6.10 and 6.11 of the standard for alternatives for Category 1 tanks. N/A is only appropriate for these alternatives.	☐ Yes ☐ No ☐ N/A	
5	For double-wall or double bottom tanks or CE-ASTs, is interstitial monitoring equipment (where applicable) in good working condition?	☐ Yes ☐ No ☐ N/A	
6	For double-wall tanks or double bottom tanks or CE-ASTs, is interstice free of liquid? Remove the liquid if it is found. If tank product is found, investigate possible leak.	☐ Yes ☐ No ☐ N/A	
Equipment on tank			
7	If overfill equipment has a "test" button, does it activate the audible horn or light to confirm operation? If battery operated, replace battery if needed.	☐ Yes ☐ No ☐ N/A	
8	Is overfill prevention equipment in good working condition? If it is equipped with a mechanical test mechanism, actuate the mechanism to confirm operation.	☐ Yes ☐ No ☐ N/A	
9	Is the spill container (spill bucket) empty, free of visible leaks and in good working condition?	☐ Yes ☐ No ☐ N/A	
10	Are piping connections to the tank (valves, fittings, pumps, etc.) free of visible leaks? Note: If "No", identify location and describe leak.	☐ Yes ☐ No	
11	Do the ladders/platforms/walkways appear to be secure with no sign of severe corrosion or damage?	☐ Yes ☐ No ☐ N/A	
Containment (Diking/Impounding)			
12	Is the containment free of excess liquid, debris, cracks, corrosion, erosion, fire hazards and other integrity issues?	☐ Yes ☐ No ☐ N/A	
13	Are dike drain valves closed and in good working condition?	☐ Yes ☐ No ☐ N/A	
14	Are containment egress pathways clear and any gates/doors operable?	☐ Yes ☐ No ☐ N/A	
Concrete Exterior AST (CE-AST)			
15	Inspect all sides for cracks in concrete. Are there any cracks in the concrete exterior larger than 1/16"?	☐ Yes ☐ No ☐ N/A	
16	Inspect concrete exterior body of the tank for cleanliness, need of coating, or rusting where applicable. Tank exterior in acceptable condition?	☐ Yes ☐ No ☐ N/A	
17	Visual inspect all tank top openings including nipples, manways, tank top overfill containers, and leak detection tubes. Is the sealant between all tank top openings and concrete intact and in good condition?	☐ Yes ☐ No ☐ N/A	
Other Conditions			
18	Is the system free of any other conditions that need to be addressed for continued safe operation?	☐ Yes ☐ No	

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

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STI SP001 Annual Inspection Checklist

General Inspection Information:

Inspection Date: _____	Prior Inspection Date: _____	Retain until date: _____
Inspector Name (print): _____		Title: _____
Inspector's Signature: _____		
Tank(s) inspected ID _____		
Regulatory facility name and ID number (if applicable) _____		

Inspection Guidance:

- This checklist is intended as a model. Locally developed checklists are acceptable as long as they are substantially equivalent (as applicable).
- For equipment not included in this Standard, follow the manufacturer recommended inspection/testing schedules and procedures.
- The periodic AST Inspection is intended for monitoring the external AST condition and its containment structure. This visual inspection does not require a Certified Inspector. It shall be performed by an owner's inspector per paragraph 4.1.2 of the standard.
- Remove promptly standing water or liquid discovered in the primary tank, secondary containment area, interstice, or spill container. Before discharge to the environment, inspect the liquid for regulated products or other contaminants and disposed of it properly.
- In order to comply with EPA SPCC (Spill Prevention, Control and Countermeasure) rules, a facility should regularly test liquid level sensing devices to ensure proper operation (40 CFR 112.8(c)(8)(v)).
- Non-conforming items important to tank or containment integrity require evaluation by an engineer experienced in AST design, a Certified Inspector, or a tank manufacturer who will determine the corrective action. Note the non-conformance and corresponding corrective action in the comment section.
- Retain the completed checklists for at least 36 months.
- Complete this checklist on an annual basis, supplemental to the owner monthly-performed inspection checklists.
- **Note: If a change has occurred to the tank system or containment that may affect the SPCC plan, the condition should be evaluated against the current plan requirement by a Professional Engineer knowledgeable in SPCC development and implementation.**

ITEM		STATUS	COMMENTS / DATE CORRECTED
Tank Foundation/Supports			
1	Free of tank settlement or foundation washout?	☐ Yes ☐ No	
2	Concrete pad or ring wall free of cracking and spalling?	☐ Yes ☐ No ☐ N/A	

3	Tank supports in satisfactory condition?	☐ Yes ☐ No ☐ N/A	
4	Is water able to drain away from tank if tank is resting on a foundation or on the ground?	☐ Yes ☐ No ☐ N/A	
5	Is the grounding strap between the tank and foundation/supports in good condition?	☐ Yes ☐ No ☐ N/A	
Tank Shell, Heads and Roof			
6	Free of visible signs of coating failure?	☐ Yes ☐ No	
7	Free of noticeable distortions, buckling, denting, or bulging?	☐ Yes ☐ No	
8	Free of standing water on roof?	☐ Yes ☐ No ☐ N/A	
9	Are all labels and tags intact and legible?	☐ Yes ☐ No	
Tank Manways, Piping, and Equipment			
10	Flanged connection bolts tight and fully engaged with no sign of wear or corrosion?	☐ Yes ☐ No ☐ N/A	
Tank Equipment			
11	Normal and emergency vents free of obstructions?	☐ Yes ☐ No	
12	Normal vent on tanks storing gasoline equipped with pressure/vacuum vent?	☐ Yes ☐ No ☐ N/A	
13	Are flame arrestors free of corrosion and are air passages free of blockage?	☐ Yes ☐ No ☐ N/A	
14	Is the emergency vent in good working condition and functional, as required by manufacturer? Consult manufacturer's requirements. Verify that components are moving freely (including long-bolt manways).	☐ Yes ☐ No ☐ N/A	
15	Is interstitial leak detection equipment in good condition? Are windows on sight gauges clear? Are wire connections intact? If equipment has a test function, does it activate to confirm operation?"	☐ Yes ☐ No ☐ N/A	

16	Are all valves free of leaks, corrosion and other damage? Follow manufacturers' instructions for regular maintenance of these items. Check the following and verify (as applicable): ☐ Anti-siphon valve ☐ Check valve ☐ Gate valve ☐ Pressure regulator valve ☐ Expansion relief valve ☐ Solenoid valve ☐ Fire valve ☐ Shear valve	☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A ☐ Yes ☐ No ☐ N/A	
17	Are strainers and filters clean and in good condition?	☐ Yes ☐ No ☐ N/A	
Insulated Tanks			
18	Free of missing insulation? Insulation free of visible signs of damage? Insulation adequately protected from water intrusion?	☐ Yes ☐ No ☐ N/A	
19	Insulation free of noticeable areas of moisture?	☐ Yes ☐ No ☐ N/A	
20	Insulation free of mold?	☐ Yes ☐ No ☐ N/A	
21	Free of visible signs of coating failure?	☐ Yes ☐ No ☐ N/A	
Tank / Piping Release Detection			
22	Is inventory control being performed and documented if required?	☐ Yes ☐ No ☐ N/A	
23	Is release detection being performed and documented if required?	☐ Yes ☐ No ☐ N/A	
Other Equipment			
24	Are electrical wiring and boxes in good condition?	☐ Yes ☐ No ☐ N/A	
25	Has the cathodic protection system on the tank been tested as required by the designing engineer?	☐ Yes ☐ No ☐ N/A	

[illegible]

STI SP001 Portable Container Monthly Inspection Checklist

General Inspection Information:

Inspection Date: _____	Prior Inspection Date: _____	Retain until date: _____
Inspector Name (print): _____		Title: _____
Inspector's Signature (): _____		
Container(s) inspected ID _____		
Regulatory facility name and ID number (if applicable) _____		

Inspection Guidance:

- This checklist is intended as a model. Locally developed checklists are acceptable as long as they are substantially equivalent (as applicable).
- This periodic Inspection is intended for monitoring the external condition and its containment structure. This visual inspection does not require a Certified Inspector. It shall be performed by an owner's inspector who is familiar with the site and can identify changes and developing problems. Note the non-conformance and corresponding corrective action in the comment section.
- Retain the completed checklists for at least 36 months.

Item		Area:	Area:	Area:	Area:
Portable Container Containment/Storage Area					
1	Are all portable container(s) within designated storage area?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
2	Is the containment and storage area free of excess liquid, debris, cracks or fire hazards?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
3	Are drain valves closed and in good working condition?	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
4	Are containment egress pathways clear and any gates/doors operable?	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A	☐ Yes ☐ No ☐ N/A
Container					
5	Is the container free of leaks? <i>Note: If "No", identify container and describe leak.</i>	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
6	Is the container free of distortions, buckling, denting or bulging?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

APPENDIX D INSPECTION OF THERMOPLASTIC ASTS

1 GENERAL

- 1.1 This Appendix applies to ASTs storing thermoplastics with operating temperatures between 200°F (93°C) and 500°F (260°C).
- 1.2 This Appendix applies to portable containers, shop-fabricated ASTs and field-erected ASTs as defined in the main body of this Standard.

2 INSPECTION SCHEDULE

- 2.1 AST Categories for thermoplastic ASTs are as follows:
 - 2.1.1 Category 1A - ASTs with spill control and with CRDM that contain a thermoplastic heated to temperatures greater than 200°F.
 - 2.1.2 Category 2A - ASTs with spill control and without CRDM that contain a thermoplastic heated to temperatures greater than 200°F.
 - 2.1.3 Category 3A - ASTs without spill control that contain a thermoplastic heated to temperatures greater than 200°F.
- 2.2 Refer to the Table D2.2 below for the inspection timetable. The P, E, I and L designations are described in the main body of this Standard.

**TABLE D2.2
TABLE OF INSPECTION SCHEDULES**

AST Type and Size (U.S. gallons)		Category 1A	Category 2A	Category 3A
Shop-Fabricated ASTs	0 – 1100 (0-4164 liters)	P	P	P
	1101 - 5,000 (4168-18,927 liters)	P	P	P, E (35)
	5,001 - 30,000 (18,931-113,562 liters)	P	P	P, E(30)
	30,001 - 50,000 (113,566-189,271 liters)	P	P, E(35)	P, E(25)
Field-erected ASTs		P, E(5), I(10)	P, E(5), I(10)	P, E(5), I(10)
Portable Containers		P	P	P

3 INSPECTION GUIDELINES

- 3.1 Follow the requirements found in the main body of the SP001 Standard for Periodic Inspections and FEI plus any additional requirements in this Appendix.

4 SUITABILITY FOR CONTINUED SERVICE

- 4.1 Evaluation for suitability for continued service is a result of Formal External and/or Internal Inspections performed by a Certified Inspector. This section describes the recommended actions to be taken by the owner as a result of these inspections. These conditions and others found during these inspections may require additional inspections or evaluations.
- 4.2 MIC – If evidence of MIC is found at any time, then corrections and repairs shall be promptly made to the AST. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. Conduct the next Formal External or Formal Internal Inspection no more than two years after the discovery of MIC.
- 4.3 If the re-inspection confirms that MIC has been mitigated due to measures taken to eliminate it, such as regular and careful water removal and sterilization of the tank and piping systems, then the AST may be inspected according to Table D2.2.
- 4.4 Shop-fabricated ASTs and Portable Containers containing thermoplastics
- 4.4.1 Category 3A ASTs - If the shell thickness has been reduced to less than 75% of the original shell thickness, then the AST shall be taken out of service and repaired or replaced. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. The Certified Inspector shall document in the report that the next Formal External or Formal Internal Inspection shall be within 5 years and each subsequent 5 years thereafter until the condition that caused the tank degradation has been fully corrected. When the tank degradation has been arrested or is in a steady-state condition, then follow the inspection intervals shown in Table D2.2 for subsequent inspections.
- 4.4.2 Category 2A ASTs – The AST shall be repaired or replaced if more than 3 square inches of any one square foot of the tank shell (i.e. approximately 2%) is found to be less than 75% of the original shell thickness or if the remaining shell thickness of an area is less than 50% of the original shell thickness at any point. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. The Certified Inspector shall document in the report that the next Formal External or Formal Internal Inspection shall be within 5 years and each subsequent 5 years thereafter until the condition that caused the tank degradation has been fully corrected. When the tank degradation has been arrested or is in a steady-state condition, then follow the inspection intervals shown in Table D2.2 for subsequent inspections.

- 4.4.3 Category 1A ASTs - The AST shall be repaired or replaced if more than 3 square inches of any one square foot of the tank shell (i.e. approximately 2%) is found to be less than 50% of the original shell thickness or if the remaining shell thickness of an area is less than 25% of the original shell thickness at any point. Refer to Steel Tank Institute SP031 *Standard for Repair of Shop Fabricated Aboveground Tanks for Storage of Combustible and Flammable Liquids* for alterations or repairs to an AST. The Certified Inspector shall document in the report that the next Formal External or Formal Internal Inspection shall be within 5 years and each subsequent 5 years thereafter until the condition that caused the tank degradation has been fully corrected. When the tank degradation has been arrested or is in a steady-state condition, then follow the inspection intervals shown in Table D2.2 for subsequent inspections.

4.5 Field-erected ASTs containing thermoplastics

- 4.5.1 The minimum allowable remaining thickness is 0.1 inch (2.54 mm). In setting the next inspection interval based upon corrosion rates, neither the bottom nor the shell shall be allowed to corrode less than 0.1 inch.
- 4.5.2 The minimum required thickness of each shell course shall be according to:

$$t_{\min} = \frac{(H - 1)DG}{8,000}$$

$t_{\min}$ = the minimum acceptable average thickness, in inches, for each course as calculated from the above formula. However, $t_{\min}$ shall not be less than 0.1 inch (2.54 mm) for any tank course.

D = nominal diameter of tank, feet.

H = height from the bottom of the shell course under consideration to the maximum liquid level when evaluating an entire shell course, feet.

G = largest specific gravity of the contents.

- 4.6 Refer to the Table D2.2 above for the inspection timetable. Note that the internal inspection intervals shown in this table are guiding values when corrosion rates are not determined, in accordance with recognized and accepted industry principles and practice.
- 4.6.1 When corrosion rates are established, the corrosion rates may govern the internal inspection interval, which may be shorter or longer than the values shown.
- 4.6.2 For Category 1A tanks, the maximum internal re-inspection interval is 30 years.
- 4.6.3 For Category 2A tanks, the maximum internal re-inspection interval is 20 years.
- 4.6.4 For Category 3A tanks, the maximum internal re-inspection interval may not be longer than shown in Table D2.2.