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Standard Guide for Investigation of ~~Equipment Problems and Releases for Petroleum~~ the Source and Cause of Releases from Underground Storage Tank Systems[1]

This standard is issued under the fixed designation E2733; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

INTRODUCTION

This guide provides a framework for the development of procedures and directions for the investigation of ~~equipment problems associated with petroleum underground storage tank (UST) systems and releases.~~ underground storage tank (UST) equipment problems and the source and cause of releases. Source and cause investigations are similar to origin and cause investigations in property insurance claims. It gives the user practical suggestions of how to investigate equipment and installation problems, document findings, ~~and in some cases prepare samples of~~ collect and preserve failed equipment for ~~laboratory analysis.~~ forensic evaluation or laboratory analysis if necessary, and implement visual and analytical processes to document the source of a release. Use of this guide may result in the identification of equipment and installation problems that can be corrected in future tank system designs and equipment maintenance programs to prevent releases to the environment. Use of this guide may assist regulatory agencies to determine and document the source and cause of releases from UST systems.

1. Scope

1.1 *Overview*—This guide is an organized collection of information and series of options for industry, regulators, consultants and the public, intended to assist with the development of investigation protocols for underground storage tank facilities in the United States. While the guide does not recommend a specific course of action, it establishes an investigation framework, and it provides a series of techniques that may be employed to: identify equipment problems; in some cases ~~prepare samples of~~collect and preserve failed equipment for ~~laboratory analysis;~~ forensic evaluation or laboratory analysis; identify the source of a release; and document the investigation. The guide includes information on methods of investigation, documentation, ~~taking samples of problem equipment; preservation of equipment~~ collecting and preserving samples; chain of custody; storage; shipping; working with equipment manufacturers; and notification of regulators and listing laboratories. The goal in using the guide is to identify the appropriate level of investigation and to gather and preserve information, in an organized manner, which could be used in the future to improve system design or performance. While this guide may act as a starting point for users with limited experience in failure investigation, the user is encouraged to consult with failure analysis experts for specific investigation procedures that may be needed for certain equipment and the investigation should be conducted by a qualified professional. As users develop their specific investigation protocols, they may find that the investigations can be streamlined for certain types of facilities.

1.2 *Limitations of This Guide:*

[1] This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.01 on Storage Tanks.

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1.2.1 Given the variability of the different investigators that may wish to use this guide and the different types of facilities and failures that will be investigated, it is not possible to address all the relevant standards that might apply to a particular investigation. This guide uses generalized language and examples to guide the user. If it is not clear to the user how to apply standards to their specific circumstances, it is recommended that users seek assistance from qualified professionals.

1.2.2 This guide does not address safety issues associated with the investigation, taking samples and storing equipment. ~~users~~Users are cautioned to exercise proper care in handling equipment that was in contact with flammable and combustible liquids and vapors. Some of the activities described in this guide may be subject to OSHA (Occupational Safety and Health Administration) regulations or may only be conducted by individuals with appropriate HAZWOPER (Hazardous Waste Operations and Emergency Response) training certifications recognized by federal and state regulatory authorities, such as HAZWOPER training.

1.2.3 This guide does not address laboratory investigations of material properties and detailed failure analysis.

1.2.4 This guide does not cover underground storage tank systems storing liquefied petroleum gas (LPG).

1.2.5 This guide does not replace state-required closure assessments and investigations. Requirements vary from state to state and often include specific sampling requirements. The user should comply with the requirement of the authority having jurisdiction.

1.2.6 Prior to implementing the steps described in Section 5, users of this guide must determine if the authority having jurisdiction has any qualification requirements for the individual performing the investigation.

1.2.7 Investigations addressed by this guide may involve knowledge, skills, and abilities generally attributed to individuals certified as tank systems installers, inspectors, or removers, or those who are trained in soil and groundwater sampling protocols (for example, geologists, groundwater professionals, or engineers).

1.3 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E1188 Practice for Collection and Preservation of Information and Physical Items by a Technical Investigator

E1990 Guide for Performing Evaluations of Underground Storage Tank Systems for Operational Conformance with 40 CFR, Part 280 Regulations

E2681 Guide for Environmental Management of Underground Storage Tank Systems Storing Regulated Substances

F1127 Guide for Containment of Hazardous Material Spills by Emergency Response Personnel

2.2 *Other Standards:*

STD 2015 Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks, 6th Edition—August 2001[3]

RP 2016 Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks, 1st Edition—August 2001[3]

PEI/RP 100 Recommended Practices for Installation of Underground Liquid Petroleum Storage ~~Systems, Petroleum Equipment Institute (PEI)~~Systems[4]

PEI/RP 1700 Tank Closure and Removal[4]

NFPA 30 Flammable and Combustible Liquids Code[5]

2.3 *Federal Regulations:*[6]

~~49 CFR 172~~§49 CFR §172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[3] Available from American Petroleum Institute (API), 1220 L. St., NW, Washington, DC 20005-4070, http://www.api.org.

[4] Available from Petroleum Equipment Institute (PEI), P. O. Box 2380, Tulsa, OK 74101-2380, http://www.pei.org.

[5] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[6] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

29 CFR 1910.146§29 CFR §1910.146 Occupational Safety and Health Standards, Subpart J, General Environmental Controls, Permit-required Confined Spaces

3. Terminology

3.1 *Definitions:*

3.1.1 *compromised, adj*—a loss of structural integrity or diminished ability to perform as designed.

3.1.2 *equipment problems or problem* ~~*equipment*~~*equipment, n*—any failure, malfunction, compromised condition or other issue that has resulted in impairment, abnormal equipment condition or operation or that has resulted in a release or suspected release.

3.1.3 *free product, n*—a regulated substance that is present as a nonaqueous phase liquid (for example, liquid not dissolved in water).

3.1.4 *release, v*—any spilling, leaking, emitting, discharging, escaping, leaching or disposing from an UST into groundwater, surface water or subsurface soils.

3.1.5 *release* ~~*prevention*~~*prevention, n*—activities that reduce the risk of human and environmental exposure to petroleum or hazardous substances. In the United States, underground storage tank and toxic use reduction regulations are examples of such requirements.

3.1.6 *regulated substance, n*—Any substance defined in section 101(14) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 (but not including any substance regulated as a hazardous waste under subtitle C); and Petroleum, including crude oil or any fraction thereof that is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute).

3.1.6.1 *Discussion*—
The term regulated substance includes but is not limited to petroleum and petroleum-based substances comprised of a complex blend of hydrocarbons, such as motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oils.

3.1.7 *tightness test, n*—a procedure capable of detecting a 0.1 gallon per hour leak rate from any portion of the tank that routinely contains product while accounting for the effects of thermal expansion or contraction of the product, vapor pockets, tank deformation, evaporation or condensation, and the location of the water table.

3.1.7.1 *line tightness test, n*—A periodic test of piping that can detect a 0.1 gallon per hour leak rate at one and one-half times the operating pressure.

3.1.7.2 *tank tightness test*—includes a wide variety of test methods that must be able to detect a leak at least as small as 0.1 gallon per hour with certain probabilities of detection and of false alarm.

3.1.8 *underground storage* ~~*tank*~~*tank, n*—a tank and any underground piping connected to the tank that has at least 10 % of its combined volume underground.

3.1.9 *waste*—discarded solid or liquid materials that may be hazardous to public health or the environment. Solid and hazardous waste require controls on handling, transport, storage treatment, and disposal.

4. Significance and Use

4.1 This guide may be used in the investigation of underground storage tank systems for equipment problems in a wide variety of applications. Use of this guide is voluntary. It is intended to assist users who want to investigate equipment ~~failures and malfunctions.~~ failures, malfunctions, and other potential causes of suspected releases.

4.2 The following groups of users may find the guide particularly helpful:

4.2.1 Storage tank system ~~designers;~~designers and manufacturers;

4.2.2 Storage tank ~~installers;~~installers, testers, and inspectors;

4.2.3 Storage tank maintenance contractors;

4.2.4 Storage tank removal contractors;

~~4.2.5 Storage tank inspectors;~~

4.2.5 Federal, ~~state~~ state, tribal or local regulators, including departments of health, departments of environmental protection, and fire departments;

~~4.2.7 Storage tank release detection installers;~~

~~4.2.8 Storage tank testers;~~

4.2.6 Petroleum release remediation ~~consultants;~~professionals;

~~4.2.10 Storage tank equipment manufacturers;~~

4.2.7 Insurance adjusters;

4.2.8 Storage tank owners and operators;

~~4.2.12.1 Retail fuel service station owners and operators;~~

~~4.2.12.2 Small businesses or enterprises;~~

~~4.2.12.3 Service industries;~~

~~4.2.12.4 Waste managers, including liquid and solid waste haulers, treatment, recycling, disposal and transfer;~~

~~4.2.12.5 Non-regulatory government agencies, such as the military;~~

~~4.2.12.6 Specific industrial sectors such as dry cleaners, printers, photo processors, laboratories; and~~

4.2.9 Consultants, auditors, ~~inspectors,~~ and compliance assistance personnel.

4.3 This guide is intended to assist in the development of protocols for determination of source and cause of a release and the investigation of a malfunction or failure of ~~storage tank systems~~ any component of a UST system and the implementation of said protocols. This guide outlines steps that may be necessary and include, but are not limited to initial evaluation of the UST system to determine ~~the malfunction(s);~~ if there has been a component failure preparation of samples of failed or compromised equipment for laboratory analysis; ~~and document~~ visual; and analytical evaluation of release indications; and documentation of the investigation. The guide provides a series of investigation options ~~on~~from which the user may design failure investigation protocols. The guide describes common investigation techniques in the order in which they might be employed in an investigation.

4.4 A user may elect to utilize this guide for a number of reasons, which include, but are not limited to:

4.4.1 To differentiate new releases from new discovery of old releases;

4.4.2 To establish malfunction and failure rates of various ~~storage tank equipment~~ UST system components;

4.4.3 To determine expected life spans of various ~~storage tank equipment~~ UST components;

4.4.4 To identify opportunities for improving the performance and reliability of storage tank equipment;

4.4.5 To focus inspection and maintenance efforts on those ~~portions~~component of the ~~tank~~UST system that are most prone to compromise, malfunction and failure;

4.4.6 To identify those components of the ~~storage tank~~ UST system that require more frequent maintenance;

4.4.7 To reduce ~~remediation and~~ equipment replacement costs;

4.4.8 To prevent petroleum releases;

4.4.9 To identify those conditions that may cause or contribute to ~~the~~ equipment or component compromise, deterioration or other cause ~~the malfunction and failure of various components of~~ of malfunction or failure of the UST system; ~~and~~

4.4.10 To comply with environmental regulations that require the investigation of ~~release detection alarms and the source of releases.~~suspected releases and determine the source and cause of releases; and

4.4.11 To identify conditions that may cause or contribute to nonsudden releases that may not be detected by other leak detection methods.

4.5 This guide may be used to establish a ~~framework, which~~framework that pulls together the common approaches to investigation. The framework will allow the user to establish an investigation protocol to meet ~~their~~ the user's specific requirements. Specific user requirements will vary depending upon the purposes of the data collection and the decisions that the investigation is intended to support. This guide does not provide methods to establish specific user investigation requirements nor does it establish minimum levels of documentation.

4.6 This guide will acquaint users with methods and tools that may be used in investigations of equipment problems associated with USTs. The user may include a subset of the methods described in this guide in their investigation. The user may consider a variety of factors in determining which combination of the methods to employ.

4.7 This guide is not intended to require the user to conduct a failure investigation.

4.8 This guide is focused on the identification, documentation, and preservation of ~~underground storage tank system equipment problems.~~ compromised UST system equipment. It does not provide guidance on establishing root causes of compromise, malfunction or failure. The identification of root causes of compromise, malfunction or failure may require further expert analysis of the data and equipment collected during the failure investigation.

4.9 Determination of equipment failures and evidence of the source and cause of a release are often unavailable due to the loss of critical information necessary to pinpoint equipment failures and conduct an investigation. Adjustment, repair or removal of failed equipment before determining and documenting the cause of the failure may interfere with the failure investigation. Failures may be caused by compatibility issues, manufacturer defects, corrosion, degradation, improper installation, damage, age, misuse, use or other causes. This guide may be used to identify techniques and procedures applicable to maintenance personnel and equipment vendors that will allow an investigator to evaluate possible equipment failures before equipment is adjusted, repaired, replaced or destroyed.

4.10 This guide does not address all the safety measures that must be taken when removing and disassembling ~~underground storage tank~~ UST systems. Because most ~~underground storage tank~~ UST systems have contained flammable or combustible liquids special precautions should be taken to prevent fire, explosions and exposure to toxic vapors. API standard STD 2015 and RP 2016 address some of the safety considerations as do many of the procedures available from fire departments.

5. Elements of Failure Investigation

5.1 *Failure Investigation Process*—The ~~guide will acquaint users with methods and tools that may be used in investigations of equipment problems associated with petroleum underground storage tanks and releases. The user may include a subset of the methods described in this guide in their investigation. The user may consider a variety of factors in determining which combination of the methods to employ. For example, the manner of discovering a~~ manner of discovering equipment problems or evidence of a release may influence the ~~methods employed. If there is an indication of a release from release detection or off site impacts, the user may select failure investigation methods that rely on records reviews and non-destructive tests. If the release is discovered during tank removal, some equipment tests may not be possible, and the user may choose visual examination techniques. If there are no indications of a release, the user may choose to employ visual examination techniques to check on the site assessment~~

~~information that indicated that no release occurred.~~ investigation methods employed. The qualifications of the investigator may depend upon whether the investigation occurs while the system is still operational or during system closure. Investigator qualifications are addressed in 5.18.

5.1.1 For all investigations, knowledge of the tank system obtained through review of 5.2 *General Records* is recommended. Knowledge of the age, material, and construction of the system prior to investigation will allow for a more focused investigation by an appropriately qualified investigator.

5.1.2 *Suspected Releases from Operational Systems.* If there is an indication of a release from unusual operating concerns such as inventory loss, failed or inconclusive leak detection or tightness tests, or receptor impacts, the user may select failure investigation methods that initially rely on records reviews and non-destructive tests identified in 5.3 *Release Detection Records*, and 5.4 *Release Preventions Records*. See Fig. 1.

5.1.2.1 . If release detection records are inconclusive or indicate a the release has occurred, 5.6.4 *tightness testing* may identify a tank or piping run as the source.

5.1.2.2 If tightness tests do not confirm a release, proceed with the inspection techniques of 5.5 and 5.6.

5.1.2.3 If a tank or piping run fails leak detection or a tightness test, the system should be shut down and the investigator should proceed with the investigation techniques of 5.7 and 5.8.

5.1.2.4 If release detection records and release prevention records do not indicate a release, proceed with the inspection techniques of 5.5 and 5.6.

5.1.2.5 If there is an indication of a release based upon a visually identified equipment leak or damaged component, proceed with the investigation techniques of 5.5 and 5.6. While continuous operation or return to normal operation may be a priority when an equipment problem is suspected, any condition that may be the source of a release should be investigated with the potential equipment failure fully documented before any equipment is adjusted, repaired or removed. If a release is suspected, maintenance personnel or service companies should not be allowed to adjust, repair or remove failed equipment without approval from the investigator.

5.1.3 *System closure.* Many releases discovered during system closure are the result of nonsudden releases which may not be identified by leak detection records, release prevention records or other investigative techniques. Tank and piping closures result in the discovery of a significant number of previously unidentified releases. Investigators should be prepared to conduct suspected release investigations during closure activities. Advance review of records identified in 5.5, 5.6 and 5.7 will prepare the investigator for possible indications of a release during closure activities. If a release is suspected during tank or piping closure, some equipment tests may not be possible, and the user may choose other visual examination techniques identified in 5.7.

5.1.3.1 If there is an indication of a release, the investigation techniques of 5.8 may be applicable.

5.1.3.2 If the review of records in 5.5 and 5.6 do not provide indications of a release, the user may choose to employ visual examination techniques in 5.7 and field screening techniques from 5.8 to determine if there are indications of soil or groundwater (if encountered) contamination associated with specific components of the tank system. If closure sampling requirements of the authority having jurisdiction do not indicate a release has occurred, no further investigation is required.

5.2 *General Records*—Gathering and reviewing records prior to the physical investigation may help focus the investigation and make the investigation run smoothly. Reviewing records from the following categories may help inform the user what types of equipment to expect, where the equipment can be found, the repair and maintenance history and prior releases. These records may be in the possession of the owner(s) of the petroleum underground storage tank system; a third party consultant or maintenance contractor; or one or more regulatory entities. The user may find that it is beneficial to organize the records and bring them to the field investigation for reference. Installation, repair, maintenance and testing records should be retained in accordance with the guidance in Guides E1990 and E2681.

5.2.1 Equipment purchase records.

~~5.2.2 Installation records:~~

~~5.2.2.1 "Record" or "as-built" drawings andor site plans;~~

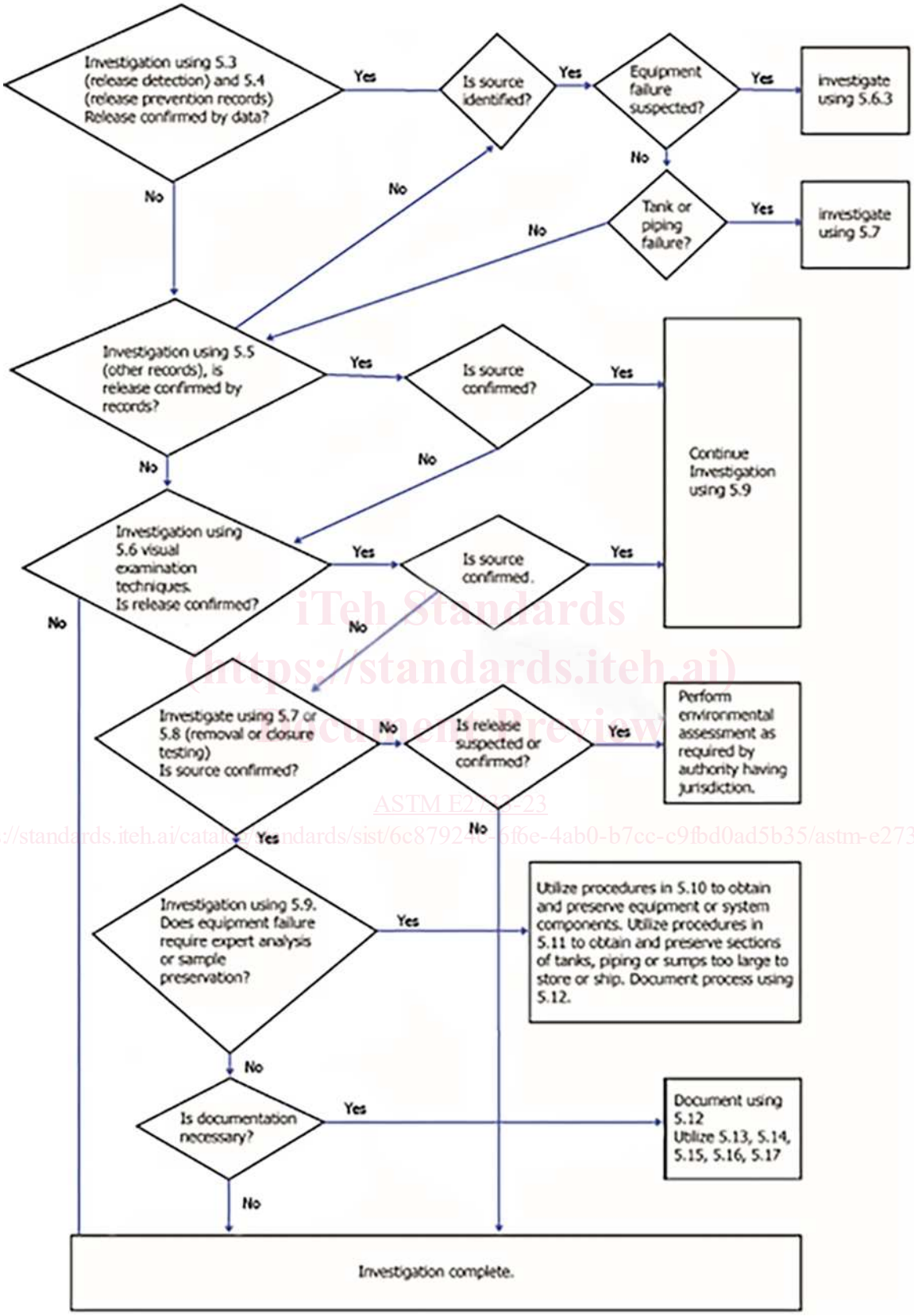

FIG. 1 Failure Investigation of Suspected Release

~~5.2.2.2 Installation check lists;~~

~~5.2.2.3 Pre-operation leak checks;~~

~~5.2.2.4 Regulatory registration data;~~

~~5.2.2.5 Warranty registration data; and~~

~~5.2.2.6 Photos and videos of the original installation.~~

5.2.2 ~~*Operating and Maintenance Manuals*—Some equipment manufacturers make copies of operation and maintenance manuals available in printed or electronic form. The user can check the manufacturers' web sites for ordering or downloading manuals.~~ Installation records:

5.2.2.1 "Record" or "as-built" drawings and /or site plans;

5.2.2.2 Installation check lists;

5.2.2.3 Pre-operation leak checks;

5.2.2.4 Regulatory registration data;

5.2.2.5 Warranty registration data;

5.2.2.6 Photos and videos of the original installation;

5.2.2.7 Compatibility records for all products stored; and

5.2.2.8 *Operating and Maintenance Manuals*—Some equipment manufacturers make copies of operation and maintenance manuals available in printed or electronic form. The user can check the manufacturers' web sites for ordering or downloading manuals.

~~5.2.4 Repair records;~~

~~5.2.5 Inventory control records;~~

~~5.2.6 Release detection records;~~

~~5.2.7 Equipment alarm histories;~~

~~5.2.8 Tightness testing records; and~~

~~5.2.9 Prior monitoring well, site assessment and remediation records.~~

5.3 *Release detection records.* Regulated UST systems in the United States are required to perform monthly release detection that is able to detect a release from any portion of the tank or piping that routinely contains product. There are several possible methods of release detection with specific record keeping requirements. Review of release detection records may assist to identify a suspected release. Release detection alarms may indicate that a system is leaking. They can also indicate that the release detection equipment is malfunctioning. Some state regulations require that the owner or operator determine the source of a suspected release following a release detection alarm. In addition to required release detection records, other operational records may assist to identify a suspected release:

5.3.1 Inventory control records. Inventory records may indicate if there is a significant loss in one or more stored products. Inventory records are often not accurate and should not be relied upon alone to indicate that a release did or did not occur. Inventory records should be compared to delivery records, dispensing records and leak detection records;

5.3.2 Delivery records including invoices;

5.3.3 Dispensing or sales records;

5.3.4 Equipment alarm histories;

5.3.5 *Tank and piping tightness testing records.* Tightness testing may detect breaches in the underground storage tank system. A variety of methods are available with various degrees of accuracy and sensitivity. Tightness tests are generally divided into two categories: volumetric and non-volumetric. Some tightness testing methods detect breaches in specific portions of the underground storage tank system. The user should consider the characteristics of the tightness test when selecting a test method and evaluating the results of the test.

5.3.5.1 Volumetric tests apply pressure to the system and measure for an change in volume over time. Each test has requirements for the amount of fuel that must be in the system to obtain a valid test.

5.3.5.2 Non-volumetric tests use other methods to determine if the system is leaking. Some methods place a chemical marker or tracer in the system and then check for the presence of the marker outside the system. Some tracers may be able to permeate through some materials that are liquid tight and even some materials that are impermeable to most vapor components of motor fuel. The user should consider the characteristics of the tracer when selecting a test method and evaluating the results of the test.

5.4 *Release prevention records.* Regulated UST systems in the United States are required to comply with technical regulations that are designed to prevent releases. The regulations require operation and maintenance activities that must be documented and records maintained. These records may assist in the investigation if a release is suspected.

5.4.1 Cathodic protection installation, testing and maintenance records

5.4.2 Walkthrough inspection records:

5.4.2.1 30 day walkthrough;

5.4.2.2 Annual walkthrough;

5.4.3 Other periodic testing records:

5.4.3.1 Spill prevention equipment tests;

5.4.3.2 Liquid tight tests of containment sumps used for interstitial monitoring;

5.4.3.3 Leak detection equipment tests:
(1) Automatic tank gauge and other controllers;
(2) Probes and sensors;
(3) Automatic line leak detectors;
(4) Vacuum pumps and pressure gauges; and
(5) Hand-held electronic sampling equipment

5.5 *Other records:*

5.5.1 Prior monitoring well, site assessment and remediation records

5.5.1.1 An increase in a contaminant of concern may indicate a new release;

5.5.2 Maintenance and service records including any invoices

5.5.2.1 Recent maintenance activities may have disturbed existing components or created an equipment failure;

5.5.3 Inspection records and photos including inspection response documentation;

5.5.4 Repair records including repair invoices

5.5.4.1 Recent repairs may have addressed an equipment failure or created a new equipment failure;

5.6 *Pinpointing ~~The~~the Source of a Release and ~~Malfunctioning Equipment in an Operating or Undisturbed Tank System: Identifying Equipment Problems During Excavation, Prior to Equipment Removal~~*—Most releases are not identified by leak detection methods. Components such as pumps, leak detectors and dispensers may leak and not be detected by traditional leak detection methods. Evaluation of tank top and dispenser components may identify failed equipment or other sources of leaks.

5.6.1 *Dispenser evaluation.* Dispensers have been identified as a primary source of leaks. Dispensers and components located above the shear valve are not included in the definition of a UST system under federal regulations but may be regulated by the authority having jurisdiction. Dispensers may or may not have under dispenser containment (UDC) and the UDC may or may not be monitored for releases. Careful observation and photo documentation of the dispenser and connected piping under the dispenser before the dispenser is disconnected from the UST system and during the disconnection process may reveal improper installation or component compromise that may contribute to a release.

5.6.2 Tank top and other surface component evaluations. Containment sumps containing piping, pumps, leak detectors and other equipment may be sources of leaks. Careful observation and photo documentation of sumps, piping and other equipment before the sumps, piping or equipment are disconnected from the UST system and during the disconnection process may reveal improper installation or component compromise that may contribute to a release.

5.6.3 ~~*Visual—*~~*Visual examination*—If a release is suspected, maintenance personnel or service companies should not be allowed to adjust, repair or remove failed equipment without approval from the investigator. Careful observation of the equipment may reveal misalignment of equipment and malfunctioning or compromised components. While not always the case, generally ~~underground storage tank~~ UST equipment is installed in alignment and should remain in alignment throughout the life of the system. Poor alignment of the installed equipment may indicate shifting, settling, creep, ~~expansion~~ expansion, compromise or failure of components. Installation photos or inspection photos when compared to the current conditions may help determine if the condition of the ~~underground storage tank~~ UST system has deteriorated. Visual indicators of potential problems ~~in the underground storage tank system~~ of system components include, but are not limited to:

5.6.3.1 Misalignment;

5.6.3.2 Equipment not performing to original specifications, for example loose, rattling or intermittent operation;

5.6.3.3 Indications of prior repairs;

5.6.3.4 Water intrusion into primary containment;

5.6.3.5 Drips and staining in sumps and beneath dispensers;

5.6.3.6 Stored product, water intrusion, stains and sheens in secondary containment;

5.6.3.7 Dead vegetation and staining of surface soil and pavement; ~~and~~

5.6.3.8 Unusual system operation (~~that is,~~(such as slow discharge of product from pumps), which may indicate a leak or a component failure in the ~~system.~~system;

5.6.3.9 Lack of structural integrity including the existence of cracks, holes or physical damage ;

5.6.3.10 Indications of component compromise such as material degradation, corrosion, surface delamination, swelling, elongation or growth.

~~5.3.2 Inventory records may indicate if there is a significant loss in one or more stored products. Inventory records are often not accurate, and should not be relied upon alone to indicate that a release did or did not occur.~~

~~5.3.3 Release detection alarms may indicate that a system is leaking. They can also indicate that the release detection equipment is malfunctioning. Some state regulations require that the owner or operator determine the source of a suspected release following a release detection alarm.~~