



# Standard Guide for Investigation of Equipment Problems and Releases for Petroleum Underground Storage Tank Systems<sup>1</sup>

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 ( $\epsilon$ ) 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. It gives the user practical suggestions of how to investigate equipment and installation problems, document findings, and in some cases prepare samples of failed equipment for laboratory analysis. 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.

### 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 failed equipment for laboratory analysis; and document the investigation. The guide includes information on methods of investigation, documentation, taking samples of problem equipment; preservation of equipment 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:*

1.2.1 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 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.

<sup>1</sup> 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 E50.04 on Corrective Action.

Current edition approved April 1, 2015. Published May 2015. DOI: 10.1520/E2733-10R15.

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.

## 2. Referenced Documents

### 2.1 *ASTM Standards:*<sup>2</sup>

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

**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<sup>3</sup>

**RP 2016** Guidelines and Procedures for Entering and Cleaning Petroleum Storage Tanks, 1st Edition—August 2001<sup>3</sup>

**PEI/RP 100** Recommended Practices for Installation of Underground Liquid Petroleum Storage Systems, Petroleum Equipment Institute (PEI)<sup>4</sup>

**NFPA 30** Flammable and Combustible Liquids Code<sup>5</sup>

### 2.3 *Federal Regulations:*<sup>6</sup>

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

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

3.1.2 *release prevention*—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.

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

3.1.4 *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.

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

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

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

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

<sup>6</sup> 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>.

## 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.

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

4.2.1 Storage tank system designers;

4.2.2 Storage tank installers;

4.2.3 Storage tank maintenance contractors;

4.2.4 Storage tank removal contractors;

4.2.5 Storage tank inspectors;

4.2.6 Federal, state 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;

4.2.9 Petroleum release remediation consultants;

4.2.10 Storage tank equipment manufacturers;

4.2.11 Insurance adjusters;

4.2.12 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

4.2.13 Consultants, auditors, inspectors, and compliance assistance personnel.

4.3 This guide is intended to assist in the development of protocols for the investigation of a malfunction or failure of storage tank systems 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); preparation of samples of failed equipment for laboratory analysis; and document the investigation. The guide provides a series of investigation options on 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 components;

4.4.3 To determine expected life spans of various storage tank equipment 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 of the tank system that are most prone to malfunction and failure;

4.4.6 To identify those components of the storage tank 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 deterioration or cause the malfunction and failure of various components 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.

4.5 This guide may be used to establish a framework, which pulls together the common approaches to investigation. The framework will allow the user to establish an investigation protocol to meet their 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 is not intended to require the user to conduct a failure investigation.

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

4.8 This guide does not address all the safety measures that must be taken when removing and disassembling underground storage tank systems. Because most underground storage tank 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 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 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.

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.

5.2.1 Equipment purchase records.

5.2.2 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; and

5.2.2.6 Photos and videos of the original installation.

5.2.3 *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 *Pinpointing The Source of a Release and Malfunctioning Equipment in an Operating or Undisturbed Tank System:*

5.3.1 *Visual*—Careful observation of the equipment may reveal misalignment of equipment and malfunctioning components. While not always the case, generally underground storage tank 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 or failure of components. Installation photos when compared to the current conditions may help determine if the condition of the underground storage tank system has deteriorated. Visual indicators of potential problems in the underground storage tank system include, but are not limited to:

5.3.1.1 Misalignment;

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

5.3.1.3 Indications of prior repairs;

5.3.1.4 Water intrusion into primary containment;

5.3.1.5 Drips and staining in sumps and beneath dispensers;

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

5.3.1.7 Dead vegetation and staining of surface soil and pavement; and

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

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.

5.3.4 Tightness testing may detect breaches in the underground storage tank system. A variety of methods are available with various degrees of accuracy and sensitivity. 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 Tracer testing can be conducted using a variety of gases. Some tracers, such as helium can 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.

5.3.6 Soil and groundwater contamination testing conducted prior to removing an underground storage tank system may help identify releases and in some cases may indicate the proximity of the release. It is important to identify the presence of older releases and to determine if the release came from the the equipment currently in place or from older equipment that has been removed.

5.4 *Pinpointing the Source of a Release and Identifying Equipment Problems During Excavation, Prior to Equipment Removal*—Careful observation and tests during the removal of underground storage tank systems may yield valuable information on the proximity of a release, whether the release came from the equipment at the site and conditions that may have contributed to equipment failure. The following observations and tests can be conducted during the excavation of underground storage tank equipment:

5.4.1 *Soil Staining*—Most motor fuels can stain soils and backfill materials when released from an underground storage tank system. In many cases, careful excavation in stained areas will help pinpoint sources of release. Soil staining can also provide a rough indication of how long the released product has been in the ground, although this age indication is highly dependent on the product released and specific conditions at the location being examined. The soil color change is due, in large part, to changes in soil redoximorphology and geochemistry from degradation of the fuel. Colors can be recorded using a standard chart system such as Munsell and stratum colors at the point of the release. Documenting soil colors away from the point of release can be useful for comparison and to further document the cause of the staining. The user is cautioned that some soils are naturally mottled and that there are other sources of staining besides releases from underground storage tank systems, thus the user should investigate the source of the stain

to determine if in fact it is the result of a release from the underground storage tank system.

5.4.2 *Visual Assessment of Equipment*—Careful examination of the underground storage tank system may help identify equipment problems.

5.4.2.1 Staining and discoloration may be caused by product releases;

5.4.2.2 Damage such as fractures and breaches;

5.4.2.3 Corrosion; and

5.4.2.4 Improper alignment.

5.4.3 *Backfill Conditions*—Improper backfill can lead to many types of equipment failure. Excessive settlement in the backfill can lead to inadequate support for tanks. Signs of settlement and inadequate compaction may be observed during excavation. Settlement may also result from finer surrounding soil migrating into coarse backfills such as pea stone. Some types of equipment can be damaged by sharp backfill or backfill that contains trash, clumps of clay or large rocks. Unclean or varied backfill can lead to accelerated corrosion of metallic components. Backfill that is not adequate when compared to the equipment manufacturer's installation requirements may indicate that there is an increased likelihood of failure in the component.

5.4.4 Soap tests can be conducted on piping, tank connections and bungs after they have been exposed. In a soap test the pressure is raised inside the equipment to be tested and the outside is sprayed with a soap solution. Bubbles forming in the soap solution may indicate the location of a leak. Users of this guide are cautioned to use safe procedures when introducing pressurized gasses into an underground tank system that may still contain vapors. Inert gas may be required to safely conduct a soap test on an underground tank system that has contained petroleum.

5.4.5 Similarly to testing of an operating or undisturbed system, tracer tests can be conducted during and after removal using a variety of gases. Some tracers permeate through 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.

5.4.6 *Age of Fuel*—In some cases, the age of the petroleum can be estimated. There are a variety of techniques that can be used on free product, soil, and groundwater that might be sampled during excavation. Estimating the age of the petroleum may help determine if more than one release has occurred or if the release occurred prior to a repair or replacement date. One of the techniques, "fingerprinting" attempts to estimate the age by relating the characteristics of the petroleum in the investigation to known changes in formulations of fuels, refining practices and additives.

5.5 *Pinpointing the Source of a Release and Identifying Equipment Problems During and After Equipment Removal*—A number of observations can be made as the underground storage tank system is removed. Many of these are similar to the observations and tests described in 5.4 above. The user may conduct additional observations and tests on equipment as described below, Most of these observations can be made after the equipment is uncovered and before it is removed from the



ground, although some of the items indicated below, such as 5.5.3 may be more appropriate after removal.

5.5.1 Soil staining.

5.5.2 Equipment Condition:

5.5.2.1 Staining;

5.5.2.2 Damage;

5.5.2.3 Corrosion;

5.5.2.4 Improper alignment;

5.5.2.5 Loose Fittings can be observed as equipment is disassembled;

5.5.2.6 Softening of plastic materials may indicate that strength properties of the equipment have deteriorated. For example, soft and spongy pipe may indicate chemical attack and weakening; and

5.5.2.7 Excessive microbial growth on system components can indicate deterioration of plastics or rubber materials.

5.5.3 *Stored Product Trapped in Secondary Containment*—Product can build up in the secondary containment system if the primary containment is leaking faster than the secondary containment system. This can be detected by creating a small hole in the secondary containment system with a pocket knife or an awl. In some cases, particularly in certain models of thermoplastic pipe where the secondary containment pipe is in intimate contact with the primary pipe, the product can become trapped in the secondary containment and build up pressure. Trapped product can indicate that there is a breach in the primary containment in that section. This investigation technique may not be reliable if the secondary containment system is open to migration of releases from sumps unless the product trapped in the secondary is under pressure. The user should assess the potential quantity of product that could be trapped in the secondary containment and be prepared to capture the released product with absorbent pads and containers such as those described in Guide F1127.

5.5.4 *Soap Test*—Soap tests can be conducted using the manufacturer's recommended practice or standard industry methods such as those described in PEI and API installation guides (PEI/RP 100).

5.5.5 Groundwater and soil testing can be used to confirm that a release has occurred and to determine what product was released and when it occurred. There are a variety of field and laboratory techniques for assessing soil and groundwater constituent concentrations. The user should consult with an contamination assessment professional to determine which techniques to employ and the skills and equipment needed.

5.5.5.1 *Source Area Identification*—Concentrations from several sample locations can be plotted on a map to indicate the likely area of highest concentration. The area of highest concentration is also often the area of the release. A three-dimensional plot method such as a box diagram may be helpful, particularly for analyzing the tank excavation area.

5.5.5.2 *Age of Fuel*—In some cases the age of the petroleum can be estimated. There are a variety of techniques that can be used on free product, contaminated soil, and groundwater. Estimating the age of the petroleum may help determine if more than one release has occurred or if the release occurred prior to a repair or replacement date. One of the techniques, "finger printing" attempts to estimate the age by relating the

characteristics of the petroleum in the investigation to known changes in formulations of fuels, refining practices and additives.

5.6 *Identification of Suspected Equipment Problems*—Underground storage tank equipment has changed considerably over the years. Manufacturers are constantly introducing new equipment and making changes to older equipment designs. Manufacturing defects are often isolated to one model or even one lot of a particular type of equipment. Complete identification of equipment problems from many sites can help the user identify trends in malfunctions and failures informing preventive maintenance programs and preventing future malfunctions and failures and improving tank system design practices.

5.6.1 *Make, Model and Serial Number*—The make and model number can help identify equipment design, manufacturing technologies used, general installation requirements, possible age, and so forth. The serial number can help identify manufacturing date, materials and manufacturing technologies used, age, and so forth.

5.6.2 *UL Listing*—Many underground storage tank system components carry a UL mark. The Underwriters Laboratory (UL) mark often includes lot numbers and date of manufacture. UL has a system for investigating malfunctions and failures of listed equipment that can aid in the improvement of their standards. A UL reporting form for underground piping is contained in X1.3. Contact UL at the number listed in the Underground Piping Field Report form to report other malfunctions and failures of listed petroleum equipment.

5.6.3 *Documentation*—Pictures and field notes of equipment model numbers, serial numbers and any other identifying marks can be valuable to inform later analysis of equipment problems.

5.6.4 *Working with Equipment Manufacturers*—Equipment manufacturers are often keenly interested in investigating equipment failures. They should be consulted as soon as possible when a piece of equipment is suspected of failing or malfunctioning. They may have specific removal and sample preparation recommendations. In some cases, the equipment manufacturer will send a representative to the site to observe or participate in the investigation.

5.7 *Removing Suspected Problem Equipment*—In some cases, the user may choose to prepare failed equipment for laboratory analysis. Laboratory analysis may be warranted if there is uncertainty in the mode of failure or the reason for the equipment problem. In preparing equipment for laboratory analysis, it is important that equipment be removed in a way that does not cause further damage and allows for further testing. The following are some general guidelines for removing equipment that is intended to be subjected to laboratory tests and analysis. For some laboratory tests, samples of product, backfill, and equipment should be preserved in their as-removed condition as much as possible to more closely represent actual use conditions. For example, drying the hydrocarbons out of a plastic can cause dramatic changes in its physical properties. In some cases, this type of preservation is

not practical due to packaging, storage and shipping constraints. The user should consult with the testing expert for specific removal requirements to meet the user's goals.

NOTE 1—User(s) should never attempt to cut samples from any tank or equipment that has not been thoroughly degassed or inerted. User(s) should never attempt to enter deactivated fuel tanks or contaminated sumps without proper confined space entry training. See 29 CFR 1910.146. Many states require special certifications for individuals to remove or repair petroleum storage tank equipment.

**5.7.1 Preparing Samples or Documenting the Equipment Problems**—The equipment should be removed carefully, and care should be taken to not damage or disturb it further. For example the equipment should not be wiped off. Equipment connected to pipes should be removed by cutting the pipe on either side of the problem equipment, if possible rather than unscrewing the pipe connections. In many cases it is helpful to prepare samples of similar, but properly functioning equipment at the site for benchmarking by the expert. Photographs and field notes are often used by experts to analyze the failure when it is not possible to preserve the equipment.

**5.7.2 Preparing Samples of Stored, Trapped, Released Product**—As discussed above chemical analysis of the released product can help estimate the date of the release. Chemical analysis of the product can also identify the mode of the malfunction or failure. For example the presence of plasticizers in released product can indicate that the product has attacked particular plastics or gaskets. It may be helpful to preserve stored product, product trapped in the secondary containment, as well as released product to make a complete analysis of the failure. The user should consult with the testing expert for specific sampling and preservation requirements to meet the user's goals. Generally chemical preservation of liquid product is not required for most analyses.

**5.7.3 Documentation**—Field notes, photos, and videos can all be used to show the condition of the equipment and released product. It is often important to document the removal and sample preparation process so the experts who conduct later analysis can trace the condition of the equipment.

**5.8 Removing Sections of Suspected Problem Equipment**—The user may sometimes need to save sections of equipment such as tanks, piping, and sumps because they are too large to store or ship. It is important to take the sections in a way that allows them to be useful in later analysis. Careful documentation of the sectioning process may help experts who conduct later analysis to trace the condition of the equipment.

NOTE 2—User(s) should never attempt to cut samples from any tank or equipment that has not been thoroughly degassed and inerted. User(s) should never attempt to enter deactivated fuel tanks or contaminated sumps without proper confined space entry training. See 29 CFR 1910.146. Many states require special certifications for individuals to remove or repair petroleum storage tank equipment.

**5.8.1 Preparing Samples or Documenting the Malfunction or Failure**—Most laboratory analysis can be conducted on sections as described below. However, some types of analysis need larger sections or special sample preparation techniques. The user should consult with the testing expert for specific sectioning and preservation requirements to meet the user's goals. Samples of the product, residue or backfill that was in

contact with the equipment section of interest may be needed for the testing expert to make a complete analysis. This is particularly true when investigating corrosion-related failures as certain chemicals and bacteria have been reported to accelerate corrosion,

**5.8.1.1 Tanks**—In many investigations of tank failures, both the exterior and interior of the tank is examined for signs of failure. Careful visual inspection of the tank may help identify areas of suspected corrosion or flaws. These areas may then be removed for laboratory analysis. Failed or flawed tank sections should be cut out using carbide, Carborundum, or diamond-tipped tools. Typically tank sections are at least 40 by 40 in. and include the jacket material on composite tanks and two ribs on fiberglass tanks when structural testing is planned. Smaller, 12 by 18 in. sections are generally sufficient for visual examination and compatibility testing. Sections should be taken where there is visual evidence of flaws or failures. In analyzing fiberglass tank failures, additional tank samples are often taken at the bottom of the tank (6:00) or near the bottom and at 3:00 or 9:00 positions. Samples at the top of fiberglass tanks (12:00) are sometimes taken for comparison purposes. Internal corrosion of steel tanks is generally most severe in the bottom of the tank near the striker plate and at the sludge line. However, in some cases internal corrosion occurs at the top of the tank. Documenting the suspected corrosion or flaws in the tank with notes, diagrams, measurements and pictures may help experts who were not present at the investigation analyze the failure when it is not practical or desirable to remove sections of the tank.

**5.8.1.2 Pipe**—Typically, failed or flawed pipe sections are cut with 2 to 3 diameters of pipe before and after the failed or flawed section, or about ten (10) diameters overall to allow for test plugs to be inserted in the pipe during later mechanical testing. Pipe sections can be cut shorter if mechanical testing is not going to be conducted.

**5.8.2 Documentation**—Field notes, photos, and videos can all be used to show the condition of the equipment. It is often important to document the removal and preservation process so the experts who conduct later analysis can trace the condition of the equipment. The field notes should include a description of any fluid in the secondary containment.

**5.9 Documenting the Progress of the Failure Investigation**—As discussed in the above sections, documentation is important for experts to trace the condition of the equipment. Documentation is also important to help put together the pieces of an investigation and to substantiate the conditions that were observed during component removal through analysis of the preserved equipment. The following documentation is typically conducted at failure investigations. The user may collect additional documentation to meet specific goals. Practice E1188 provides guidelines for the collection and preservation of information and physical items by any technical investigator.

**5.9.1 Notes** should be kept to document the progress of the investigation. Notes that are taken in a way that can not be altered, such as in bound books or time-stamped electronic files may allow more reliable determinations of the sequence of events in the investigation.

5.9.2 *Logging Personnel on Site*—The notes should include a log of all personnel on the site during the removal and failure investigation. The names, employers, and contact information for each person should be noted. This may make it easier to contact individuals in the future if interviews are needed for the failure analysis.

5.9.3 *Weather and Surrounding Site Conditions*—Including the weather and surrounding site conditions may provide important information on the investigation process and on factors that could influence the investigation.

5.9.4 Pictures can be helpful in documenting the conditions at the site. The photographs should include date and time stamps. High-resolution photographs can be blown up for later expert analysis. Computer analysis techniques on digital photos can be especially helpful.

5.9.5 Video can be helpful as well, especially if it includes narration of the removal and investigation activities. Video is also valuable in documenting the site geography and the storage tank system layout. The video should include date and time stamps and some visual reference for hardware size, location, and orientation. Generally, video documentation complements photographs rather than replacing them because video cameras do not have the level of resolution of photographs and are thus less useful for enlargement.

5.10 *Preparing Samples Equipment for Laboratory Analysis*—Samples and sections of equipment should be preserved as they are removed if they are intended for laboratory analysis. While it is not possible to fully duplicate the conditions at the site, preservation may allow for a wider range of tests and conclusions to be made by experts conducting analysis later. The choice of preservation technique depends upon the type of laboratory analysis that will be conducted later. Some container materials could interfere with planned chemical analysis. The user should discuss preservation requirements and the choice of containers with the laboratory that will be analyzing the samples prior to taking and preserving samples. The following preservation techniques are used in failure investigations.

5.10.1 Empty (unused) metal paint cans are available in a variety of sizes up to 5 gal from paint stores. In some cases, the plastic liner of the paint cans is soluble in the fuel and can interfere with later testing of equipment stored in the cans.

5.10.2 Sample jars are available in a variety of sizes from chemical supply houses or analytic laboratories.

5.10.3 Sample bags are available in a variety of materials and sizes. Polyethylene bags with zipper-type closures are sold in a variety of stores and are available in sizes less than a pint to 2 by 2.7 ft. While polyethylene bags are inexpensive and readily available, they are not as chemically inert as PTFE (polytetrafluoroethylene) or PVF (polyvinyl fluoride) bags, which can be obtained from chemical supply houses or analytic laboratories in a variety of sizes.

5.10.4 Wrapping in two layers of thick polyethylene sheeting or several layers of contractor's stretch wrap is an effective way to preserve large irregular pieces of equipment. The sheeting edges can be sealed with liberal application of duct tape. PTFE (polytetrafluoroethylene) or PVF (polyvinyl fluo-

ride) sheeting can be used instead of polyethylene sheeting where the wrapping material needs to be chemically inert.

5.10.5 Wrapped, bagged, canned, or jarred samples can be protected further by wrapping them with absorbent, insulating padding prior to placing them in shipping boxes.

5.11 *Establishing Chain of Custody*—In some cases, a chain of custody is needed to establish the date the sample was taken, when it was shipped, and who was responsible for the package. The sample chain of custody form in **X1.1** can be used to establish chain of custody for equipment. Laboratories as well as many state agencies have chain of custody forms available for use. Some of these forms have additional information to document sample preservation and holding times, which can be critical for determining contaminant levels, but are rarely needed for equipment samples that are going to be physically examined.

5.12 *Storing Equipment, Sections, and Samples*—Once the samples and equipment are obtained they should be stored securely in a well ventilated cabinet or in a limited access enclosure where they are protected from rain, heat, damage and direct sunlight. A cool storage temperature may preserve the in-ground condition of the samples longer. Sturdy wooden crates that are ventilated are often used to store sealed samples and equipment. The crates can make storage and moving the samples and equipment easier. Soil and water samples may need to be cooled or otherwise preserved while in storage.

**NOTE 3**—Explosive vapors can build up from equipment that was in contact with liquid product. The user should consult NFPA 30 for guidance in safe storage of equipment that contained liquid petroleum products.

5.13 *Shipping Equipment, Sections, and Samples*—Hazardous material regulations and special shipping instructions may apply to equipment, sections and samples removed from underground storage tank sites. Soil and water samples may need to be cooled or otherwise preserved while in transit to the laboratory. Users should consult with the laboratory, shipper and DOT regulations 49 CFR 172 to determine if special packing, labeling, and shipping are needed. In accordance with 49 CFR 172.704, only those individuals who have successfully completed training as required in 49 CFR 172.700(c) or 49 CFR 171.11 may offer hazardous materials for transportation.

5.14 *Example Investigation Forms:*

5.14.1 An example investigation form is in **X1.2**.

5.14.2 *UL Incident Reporting Forms*—Many underground storage tank system components carry a UL mark. The UL mark often includes lot numbers and date of manufacture. UL has a system for investigating malfunctions and failures of listed equipment that can aid in the improvement of their standards. The UL Underground Piping Field Report form is contained in **X1.3**. Contact UL at the number listed in the Underground Piping Field Report form to report other malfunctions and failures of listed petroleum equipment.

## 6. Keywords

6.1 petroleum equipment failure; petroleum release; petroleum tanks; release detection; storage tank; underground storage tank system; UST

**APPENDIX**

**(Nonmandatory Information)**

**X1. REPORT FORMS**

X1.1 Sample Chain of Custody Form for Equipment—See  
Fig. X1.1.

X1.3 Sample UL Underground Piping Field Report Form—  
See Fig. X1.3.

X1.2 Sample Storage Tank System Release Report Form—  
See Fig. X1.2.



**LABORATORY CHAIN-OF-CUSTODY FORM**

**SECTION 1**

Investigator Name:		Date Submitted:	
Agency:		Agency Case No.:	
Address:			
City/County:		State:	ZIP Code:
Phone No.:	Fax No.:	E-mail:	
Emergency Contact:		Phone No.:	

  

Submitter:		Agency:	Date:
(Print Name):		Telephone: ( )	

**SECTION 2**

Sampling Site:		Site Address:	
Collected By:	Date Collected:	Agency:	
<b>Submitter Description:</b> Include the number of containers, identification number(s) and a physical description of each sample submitted for testing. <b>{Relinquish sample(s) on page 2.}</b>			
Submitter Comments:			
Lockbox Evidence Seal Number:			

**SECTION 3**

<b>Chain of Custody:</b> Persons relinquishing and receiving evidence: Provide signature, organization and date/time to document evidence transfers. (Start with Box Number 1 below)							
<b>1.</b>	Relinquished By	Organization	Date/Time	<b>2.</b>	Received by	Organization	Date/Time
<b>3.</b>	Relinquished By	Organization	Date/Time	<b>4.</b>	Received by	Organization	Date/Time
<b>5.</b>	Relinquished By	Organization	Date/Time	<b>6.</b>	Received by	Organization	Date/Time
<b>7.</b>	Relinquished By	Organization	Date/Time	<b>8.</b>	Received by	Organization	Date/Time
<b>9.</b>	Relinquished By	Organization	Date/Time	<b>10.</b>	Received by	Organization	Date/Time

**FIG. X1.1 Sample Chain of Custody Form for Equipment**

## Storage Tank System Release Report Form

Please check all blocks that apply for the entire form and **PRINT LEGIBLY**

### Site Information

Facility Name	Facility ID Number	County	Owner/Operator Name	Discharge Date
	/			

### System Information (At the Time of Release)

#### Tank

Tank Type
<input type="checkbox"/> <b>Underground Storage Tank</b> (greater than 110 gallons containing pollutants or CERCLA Hazardous Substances)
<b>Tank installation date(s)</b> (Note if unknown): _____
<b>Tank capacity(ies)</b> (Note if unknown): _____
<b>Tank manufacturer name(s)</b> (Note if unknown): _____
<b>Tank model(s)</b> (Note if unknown): _____
<b>Piping installation date</b> (Note if unknown): _____
<b>Piping manufacturer name(s)</b> (Note if unknown): _____
<b>Piping model(s)</b> (Note if unknown): _____
<b>Piping diameter(s)</b> (Note if unknown): _____
<b>Repair date and description</b> (Note if unknown): _____
<b>Repair date and description</b> (Note if unknown): _____
<b>Repair date and description</b> (Note if unknown): _____

### System Information

Please check all blocks that apply for the entire form

#### USTs

	<b>Material</b>		<b>Other Attributes</b>		<b>Ancillary Equipment</b>
<input type="checkbox"/>	Unprotected steel	<input type="checkbox"/>	Sacrificial anodes	<input type="checkbox"/>	Spill bucket
<input type="checkbox"/>	Galvanized steel	<input type="checkbox"/>	Impressed current system	<input type="checkbox"/>	No spill containment
<input type="checkbox"/>	Cathodic-protected steel	<input type="checkbox"/>	Internal lining	<input type="checkbox"/>	Overfill protection
<input type="checkbox"/>	Fiberglass-coated steel	<input type="checkbox"/>	Single wall	<input type="checkbox"/>	No overfill protection
<input type="checkbox"/>	Fiberglass	<input type="checkbox"/>	Double wall (same material)	<input type="checkbox"/>	Flow shut-off
<input type="checkbox"/>	Other approved	<input type="checkbox"/>	Double wall (different material)	<input type="checkbox"/>	Ball check valve
<input type="checkbox"/>	Polyethylene-jacketed	<input type="checkbox"/>	Secondary containment with a liner	<input type="checkbox"/>	Alarm system
<input type="checkbox"/>	Concrete	<input type="checkbox"/>	Other approved (tank bladders, etc.)	<input type="checkbox"/>	Remote fill
<input type="checkbox"/>	Unknown	<input type="checkbox"/>	Compartmented	<input type="checkbox"/>	Tight fill
<input type="checkbox"/>	Other (Specify)	<input type="checkbox"/>	External liner	<input type="checkbox"/>	Other (specify)

FIG. X1.2 Sample Storage Tank System Release Report Form

Piping

	<b>Material</b>		<b>Other Attributes</b>		<b>Ancillary Equipment</b>
<input type="checkbox"/>	Unprotected steel	<input type="checkbox"/>	Sacrificial anodes	<input type="checkbox"/>	Dispenser(s)
<input type="checkbox"/>	Galvanized steel	<input type="checkbox"/>	Impressed current system	<input type="checkbox"/>	No dispenser(s)
<input type="checkbox"/>	External coating	<input type="checkbox"/>	Single wall	<input type="checkbox"/>	Dispenser sump(s)
<input type="checkbox"/>	Other metallic _____	<input type="checkbox"/>	Double wall (same material)	<input type="checkbox"/>	No dispenser sumps
<input type="checkbox"/>	Cathodic-protected steel	<input type="checkbox"/>	Double wall (different material)	<input type="checkbox"/>	Piping sump(s)
<input type="checkbox"/>	Fiberglass	<input type="checkbox"/>	Double-wall within a piping chase	<input type="checkbox"/>	No piping sumps
<input type="checkbox"/>	Flexible thermoplastic Polyethylene	<input type="checkbox"/>	Co-axial	<input type="checkbox"/>	Single check valve beneath dispenser
<input type="checkbox"/>	Semi-rigid high-density polyethylene	<input type="checkbox"/>	Secondary containment with a synthetic liner	<input type="checkbox"/>	Foot valves
<input type="checkbox"/>	Fiberglass-coated steel	<input type="checkbox"/>	Other approved secondary containment (box trench liner, etc.)	<input type="checkbox"/>	Mechanical line leak detector (3-gallon/hr test)
<input type="checkbox"/>	Other approved	<input type="checkbox"/>	Pressurized	<input type="checkbox"/>	Electronic line-leak detector (3-gallon/hr test)
<input type="checkbox"/>	Unknown	<input type="checkbox"/>	Not-pressurized except when in use	<input type="checkbox"/>	Continuous line-leak detector (.2gph test)
<input type="checkbox"/>	Other (specify)	<input type="checkbox"/>	Suction	<input type="checkbox"/>	Electronic line-leak detector (.2gph test)
		<input type="checkbox"/>	Manifolded	<input type="checkbox"/>	No line-leak detector
		<input type="checkbox"/>	Bulk product	<input type="checkbox"/>	Anti-siphon valves
		<input type="checkbox"/>	Small diameter	<input type="checkbox"/>	Block valves
		<input type="checkbox"/>	Hydrant system	<input type="checkbox"/>	Solenoid valves
		<input type="checkbox"/>	Aboveground, no contact with soil	<input type="checkbox"/>	Remote fill with spill protection
		<input type="checkbox"/>	Over surface water	<input type="checkbox"/>	Remote fill without spill protection
		<input type="checkbox"/>	Other (Specify)	<input type="checkbox"/>	Spill containment within dike field (shop-fabricated tanks)
				<input type="checkbox"/>	Spill containment outside dike field (shop-fabricated tanks)
				<input type="checkbox"/>	Other (Specify)

*Leak Detection Method Used at the Facility*

	<b>UST</b>		<b>Piping</b>
<input type="checkbox"/>	Interstitial monitoring using vacuum	<input type="checkbox"/>	Interstitial monitoring using vacuum
<input type="checkbox"/>	Interstitial monitoring using pressure	<input type="checkbox"/>	Interstitial monitoring using pressure
<input type="checkbox"/>	Interstitial monitoring using a hydrostatic system	<input type="checkbox"/>	Interstitial monitoring using a hydrostatic system
<input type="checkbox"/>	Interstitial monitoring with sensors or probes	<input type="checkbox"/>	Interstitial monitoring with sensors or probes
<input type="checkbox"/>	Interstitial monitoring with visual inspections	<input type="checkbox"/>	Interstitial monitoring with visual inspections
<input type="checkbox"/>	Interstitial monitoring within an external UST liner system	<input type="checkbox"/>	Interstitial monitoring within an external liner system
<input type="checkbox"/>	Electronic system with immediate notice to owner	<input type="checkbox"/>	Electronic system with immediate notice to owner
<input type="checkbox"/>	Groundwater monitoring wells	<input type="checkbox"/>	Groundwater monitoring wells
<input type="checkbox"/>	Vapor monitoring wells	<input type="checkbox"/>	Vapor monitoring wells
<input type="checkbox"/>	Statistical Inventory Reconciliation	<input type="checkbox"/>	Pressure tests (small diameter piping)
<input type="checkbox"/>	Automatic Tank Gauge	<input type="checkbox"/>	Pressure tests (bulk product piping)
<input type="checkbox"/>	Manual tank gauging	<input type="checkbox"/>	External cable systems
<input type="checkbox"/>	Other approved methods	<input type="checkbox"/>	Tracer technology
<input type="checkbox"/>	Unknown	<input type="checkbox"/>	Mechanical line leak detectors
<input type="checkbox"/>	None	<input type="checkbox"/>	Electronic line leak detectors
<input type="checkbox"/>		<input type="checkbox"/>	Other approved methods
			None

**FIG. X1.2 Sample Storage Tank System Release Report Form (continued)**

**Release Information**

Date of receipt of test results or discovery of confirmed discharge: _____	month/day/year	
Estimated number of gallons discharged: _____	Latitude _____	Longitude _____ of the Discharge

***Discharge affected***

<input type="checkbox"/> Air	<input type="checkbox"/> Drinking water well(s)
<input type="checkbox"/> Soil	<input type="checkbox"/> Surface water
<input type="checkbox"/> Ground water	<input type="checkbox"/> Other _____

**Type of regulated substance discharged: (check one)**

<input type="checkbox"/> Gasoline	<input type="checkbox"/> Bio-diesel
<input type="checkbox"/> Diesel	<input type="checkbox"/> Used/waste oil
<input type="checkbox"/> Kerosene	<input type="checkbox"/> New/lube oil
<input type="checkbox"/> Jet fuel	<input type="checkbox"/> Mineral acid
<input type="checkbox"/> Aviation gas	<input type="checkbox"/> Petroleum Contact Water
<input type="checkbox"/> Gasohol	<input type="checkbox"/> Pesticides
<input type="checkbox"/> Emergency Generator Diesel Fuel	<input type="checkbox"/> Chlorine Compounds
<input type="checkbox"/> Heating oil	<input type="checkbox"/> Ammonia Compounds
<input type="checkbox"/> Hazardous substance	<input type="checkbox"/> Petroleum Derivative Products
<input type="checkbox"/> Grades 5 & 6 Residual Oils	<input type="checkbox"/> Other
<input type="checkbox"/> Ethanol	<input type="checkbox"/> Unknown

***Method of Discovery of the Discharge***

<input type="checkbox"/> Leak detection methods>>>>>>	<b>&gt;&gt;&gt;&gt;&gt;&gt;If Leak Detection, specify method:</b>	
<input type="checkbox"/> Closure-in-place	<input type="checkbox"/> Manual tank gauging	<input type="checkbox"/> Mechanical LLD
<input type="checkbox"/> Removal	<input type="checkbox"/> Groundwater monitoring	<input type="checkbox"/> Electronic LLD
<input type="checkbox"/> Installation or upgrade	<input type="checkbox"/> Vapor monitoring	<input type="checkbox"/> Cable systems
<input type="checkbox"/> Property transfer	<input type="checkbox"/> SIR	<input type="checkbox"/> Tracer technologies
<input type="checkbox"/> Inventory reconciliation	<input type="checkbox"/> ATG	<input type="checkbox"/> Visual Inspection of USTs
<input type="checkbox"/> Visual	<input type="checkbox"/> Tank tightness testing	<input type="checkbox"/> Bulk product piping pressure tests
<input type="checkbox"/> Olfactory	<input type="checkbox"/> External electronic sensors or probes	<input type="checkbox"/> Small diameter piping pressure tests
<input type="checkbox"/> Water in UST	<input type="checkbox"/> Interstitial monitoring using vacuum	<input type="checkbox"/> Tank shell monitoring system
<input type="checkbox"/> Annual or regularly scheduled tank tightness testing	<input type="checkbox"/> Interstitial monitoring using pressure	<input type="checkbox"/> Fiber-optic systems
<input type="checkbox"/> Tank or line tightness testing performed for other reasons _____	<input type="checkbox"/> Interstitial monitoring using a hydrostatic system	<input type="checkbox"/> Other approved methods
<input type="checkbox"/> UST internal inspection	<input type="checkbox"/> Interstitial monitoring with sensors or probes	<input type="checkbox"/> Other (specify)_____
<input type="checkbox"/> Hydrostatic test	<input type="checkbox"/> Interstitial monitoring with visual inspections	<input type="checkbox"/>
<input type="checkbox"/> Integrity test	<input type="checkbox"/> Interstitial monitoring within an external liner system	<input type="checkbox"/>
<input type="checkbox"/> Analytical tests or samples		
<input type="checkbox"/> Tracer or helium tests		
<input type="checkbox"/> Unknown		
<input type="checkbox"/> Other _____		

<p><b>Did the method of Leak Detection relied on for compliance purposes fail to detect the release? (Y <input type="checkbox"/> N <input type="checkbox"/> U <input type="checkbox"/>) If so, what was the method relied on for compliance purposes?</b></p>
---

FIG. X1.2 Sample Storage Tank System Release Report Form (continued)



**Source of Discharge**

If there are multiple sources, check all that apply, but explain in comments  
 Note manufacturer and model number and serial number of equipment suspected of being source of discharge

<b>USTs</b>		<b>Small Diameter Piping</b>	
<input type="checkbox"/>	Single-wall UST that is not protected from corrosion	<input type="checkbox"/>	Single-wall small diameter steel pipe that is not corrosion-protected
<input type="checkbox"/>	Single-wall fiberglass UST	<input type="checkbox"/>	Single-wall rigid fiberglass small diameter piping
<input type="checkbox"/>	Single-wall steel UST coated with fiberglass	<input type="checkbox"/>	Single-wall small diameter flexible polyethylene piping
<input type="checkbox"/>	Single-wall internally-lined UST	<input type="checkbox"/>	Single-wall small diameter semi-rigid polyethylene piping
<input type="checkbox"/>	Single-wall steel UST with an impressed current cathodic protection system	<input type="checkbox"/>	Single-wall small diameter corrosion-protected steel pipe
<input type="checkbox"/>	Single-wall UST with sacrificial anodes	<input type="checkbox"/>	Single-wall aboveground small diameter steel pipe
<input type="checkbox"/>	Single-wall UST jacketed with polyethylene coating	<input type="checkbox"/>	Double-wall rigid fiberglass small diameter piping
<input type="checkbox"/>	Other-approved single-wall UST	<input type="checkbox"/>	Double-wall rigid co-axial fiberglass small diameter piping
<input type="checkbox"/>	Single-wall UST within an external liner system	<input type="checkbox"/>	Double-wall small diameter flexible polyethylene piping
<input type="checkbox"/>	Single-wall UST with an internal bladder system	<input type="checkbox"/>	Double-wall small diameter semi-rigid polyethylene piping
<input type="checkbox"/>	Double-wall fiberglass UST	<input type="checkbox"/>	Double-wall small diameter corrosion-protected steel pipe
<input type="checkbox"/>	Double-wall steel UST coated with fiberglass	<input type="checkbox"/>	Single-wall small diameter piping protected by a liner
<input type="checkbox"/>	Double-wall steel UST with sacrificial anodes		<b>Bulk Product Piping</b>
<input type="checkbox"/>	Double-wall steel UST with an impressed current cathodic protection system	<input type="checkbox"/>	Single-wall bulk product steel pipe that is not corrosion-protected
<input type="checkbox"/>	Double-wall UST jacketed with polyethylene coating	<input type="checkbox"/>	Single-wall rigid fiberglass bulk product piping
<input type="checkbox"/>	UST with internal secondary containment	<input type="checkbox"/>	Single-wall bulk product flexible polyethylene piping
<input type="checkbox"/>	UST vent line	<input type="checkbox"/>	Single-wall bulk product semi-rigid polyethylene piping
	<b>UST equipment</b>	<input type="checkbox"/>	Single-wall bulk product corrosion-protected steel pipe
<input type="checkbox"/>	UST submersible turbine pump	<input type="checkbox"/>	Single-wall aboveground bulk product steel pipe
<input type="checkbox"/>	UST electronic line leak detector	<input type="checkbox"/>	Double-wall rigid fiberglass bulk product piping
<input type="checkbox"/>	UST mechanical line leak detector	<input type="checkbox"/>	Double-wall rigid co-axial fiberglass bulk product piping
<input type="checkbox"/>	UST dispenser (Meter, filter, connections, or other)	<input type="checkbox"/>	Double-wall bulk product flexible polyethylene piping
<input type="checkbox"/>	UST flex-connector	<input type="checkbox"/>	Double-wall bulk product semi-rigid polyethylene piping
<input type="checkbox"/>	UST spill bucket	<input type="checkbox"/>	Double-wall bulk product corrosion-protected steel pipe
<input type="checkbox"/>	UST shear valves		
<input type="checkbox"/>	UST swing joints		<b>Other Sources</b>
<input type="checkbox"/>	UST dispenser sumps	<input type="checkbox"/>	Delivery vehicle
<input type="checkbox"/>	UST piping sumps	<input type="checkbox"/>	Customer vehicle
<input type="checkbox"/>	UST fill pipe	<input type="checkbox"/>	Barge or vessel
<input type="checkbox"/>	UST remote fill pipe	<input type="checkbox"/>	Steel pipeline not regulated by DEP
<input type="checkbox"/>	UST vapor riser pipe	<input type="checkbox"/>	Non-regulated system (if so, file is invalid)
<input type="checkbox"/>	UST vent lines	<input type="checkbox"/>	Unknown (if unknown, file is invalid)
<input type="checkbox"/>	UST vapor recovery	<input type="checkbox"/>	Other (Specify) _____

**Cause of the Discharge (if there are multiple causes, check all that apply, but explain in comments)**

<input type="checkbox"/>	Loose Component (filter, pipe connection, bung)	<input type="checkbox"/>	Puncture
<input type="checkbox"/>	Corrosion	<input type="checkbox"/>	Mechanical or wear damage
<input type="checkbox"/>	Improper installation	<input type="checkbox"/>	Physical damage
<input type="checkbox"/>	Material Failure (crack, split, etc.)	<input type="checkbox"/>	Human error
<input type="checkbox"/>	Material Incompatibility	<input type="checkbox"/>	Vandalism or malicious intent
<input type="checkbox"/>	Spill (other than customer)	<input type="checkbox"/>	Fire/explosion
<input type="checkbox"/>	Customer spill	<input type="checkbox"/>	Weather
<input type="checkbox"/>	Vehicle accident	<input type="checkbox"/>	Natural disaster (sinkholes, earthquakes, etc.)
<input type="checkbox"/>	Vehicle overfill	<input type="checkbox"/>	Unknown
<input type="checkbox"/>	Tank overfill	<input type="checkbox"/>	Other (Specify) _____

**Release Identified by:**

<input type="checkbox"/>	Owner/Operator	<input type="checkbox"/>	Service Contractor	<input type="checkbox"/>	Local Government Inspector
<input type="checkbox"/>	Third Party	<input type="checkbox"/>	State Inspector	<input type="checkbox"/>	Other (Specify)

FIG. X1.2 Sample Storage Tank System Release Report Form (continued)

**Additional Information: (Attach Photos if available)**

NAME: \_\_\_\_\_

AFFILIATION: \_\_\_\_\_

FIG. X1.2 Sample Storage Tank System Release Report Form (continued)

**UNDERGROUND PIPING FIELD REPORT**

**1 REPORT LOCATION & REPORTING AGENCY**

**Date Submitted:**

**Install Date:**

**Incident Date:**

**1.1 FACILITY INFORMATION**

TYPE:  Public Retail       Commercial       Industrial       Government

Facility Name/ID:

Street Address:

City/County/State/Zip:

Contact – Owner Name:

Phone and/or E-Mail:

Reporting AHJ:

Inspector:

FIG. X1.3 Sample UL Underground Piping Field Report Form

**2 INCIDENT DETAILS**

**3 FUEL TYPE**

<input type="checkbox"/> Premium / Super	<input type="checkbox"/> Plus / Extra	<input type="checkbox"/> Regular	<input type="checkbox"/>
<input type="checkbox"/> % MTBE	<input type="checkbox"/> % Ethanol	<input type="checkbox"/> % Methanol	<input type="checkbox"/>
<input type="checkbox"/> Diesel	<input type="checkbox"/> Kerosene	<input type="checkbox"/> Fuel Oil	<input type="checkbox"/>

**3.1 PUMP SYSTEM**

3.2 <input type="checkbox"/> Pressure Pump @ _____ psig	3.3 <input type="checkbox"/> Suction Pump @ _____ inHg
---	--

**3.4 SPILL INCIDENT DETAILS**

<input type="checkbox"/> Contained	<input type="checkbox"/> Release of gal to _____	<input type="checkbox"/> Soil and/or _____	<input type="checkbox"/> Water
------------------------------------	--	--	--------------------------------

**4 PIPING SYSTEM DETAILS and INSTALLATION HISTORY**

<b>Primary Pipe</b> _____ in Size		<input type="checkbox"/> Flex	<input type="checkbox"/> Rigid	<input type="checkbox"/> UL Listed
Pipe Mfgr.:		Series / Model:		
Mfg. Date / Code:	Fuel Groups (1)	Pressure	psig	
Fitting Mfgr.:		Series / Model:		
<input type="checkbox"/> New or Expanded Installation		<input type="checkbox"/> Replacement of Existing System		
<input type="checkbox"/> Routed in Secondary Pipe		<input type="checkbox"/> Direct Buried or Integral Pri / Sec		
Installed on:	by:	Approved by:		
Repaired on:	by:	Approved by:		
Replaced on:	by:	Approved by:		
<b>Secondary Pipe</b> _____ in Size		<input type="checkbox"/> Flex	<input type="checkbox"/> Rigid	<input type="checkbox"/> UL Listed
<input type="checkbox"/> Buried in pea-gravel bed		<input type="checkbox"/> Buried in sand bed		
Pipe Mfgr.:		Series / Model:		
Mfg. Date / Code:	Fuel Groups (1)	Pressure	psig	
Fitting Mfgr.:		Series / Model:		
<input type="checkbox"/> New or Expanded Installation		<input type="checkbox"/> Replacement of Existing System		
Installed on:	by:	Approved by:		
Repaired on:	by:	Approved by:		
Replaced on:	by:	Approved by:		

Before initial installation (except first time digs), was soil checked or tested for fuel contamination?  No  Yes - Result

Before repair or replacement (where spills were suspect), was soil checked or tested for fuel contamination?  No  Yes - Result

Was initial installation contractor qualified by manufacturer to perform all work on their system at that time?  No  Yes

Was repair or replacement contractor qualified by manufacturer to perform all work on their system at that time?  No  Yes

FIG. X1.3 Sample UL Underground Piping Field Report Form (continued)

**CONTAINMENT & MONITORING SYSTEM DETAILS**

<b>Tank Sump</b> gal		<input type="checkbox"/> Flex	<input type="checkbox"/> Rigid	<input type="checkbox"/> UL Listed
Sump Mfgr.:		Series / Model:		
Mfg. Date / Code:	Fuel Groups (1)	Size:	Diameter	H
Fitting Mfgr.:		Series / Model:		
<input type="checkbox"/> Evidence of fuel in sump?				
<b>Dispenser Sump</b> gal		<input type="checkbox"/> Flex	<input type="checkbox"/> Rigid	<input type="checkbox"/> UL Listed
Sump Mfgr.:		Series / Model:		
Mfg. Date / Code:	Fuel Groups (1)	Size:	L	W
Fitting Mfgr.:		Series / Model:		
<input type="checkbox"/> Evidence of fuel in sump?				
<input type="checkbox"/> Monitor (2) Type:		Operation:	Frequency:	

Did monitor alarm or visual inspections indicate leakage?  No  Yes

Was pipe interstitial space leak tested at required intervals?  No  Yes

If leakage was indicated, how long before incident was reported? \_\_\_\_\_ days

Do you have information as to the cause of this alleged failure? Please provide all details.  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**5 PIPING SYSTEM AUTOPSY INFORMATION**

<b>Primary Pipe</b>			
<input type="checkbox"/> Rupture / Burst	<input type="checkbox"/> Leakage / Drip	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Length Increase	<input type="checkbox"/> Diameter Increase	<input type="checkbox"/> Softening	<input type="checkbox"/> Separation
<input type="checkbox"/> Entire Length	<input type="checkbox"/> Pipe Center	<input type="checkbox"/> Pipe Ends	<input type="checkbox"/> Mixed Areas
<input type="checkbox"/> Fitting Pullout	<input type="checkbox"/> Cracking	<input type="checkbox"/> Corrosion	<input type="checkbox"/> Loosening
Other Details (3)			
<b>Secondary Pipe</b>			
<input type="checkbox"/> Rupture / Burst	<input type="checkbox"/> Leakage / Drip	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Length Increase	<input type="checkbox"/> Diameter Increase	<input type="checkbox"/> Softening	<input type="checkbox"/> Separation
<input type="checkbox"/> Entire Length	<input type="checkbox"/> Pipe Center	<input type="checkbox"/> Pipe Ends	<input type="checkbox"/> Mixed Areas
<input type="checkbox"/> Fitting Pullout	<input type="checkbox"/> Cracking	<input type="checkbox"/> Corrosion	<input type="checkbox"/> Loosening
Other Details (3)			

- (1) - (PP) Petroleum Products, (PA) Alcohol Blends, (PG) Gasahol Blends
- (2) - Type: (MF)=Mechanical Float (EL)=Electric Liquid (EV)=Electric Vapor  
 Operation: (A)=Active (D)=Disabled (V)=Visual Sump Inspection  
 Frequency: (C)=Continuous (\_\_\_\_)=# of times/month monitor was checked
- (3) - Include other inspector observations, send photos of damaged areas and samples if possible (contact UL Field Reports Rep. Z. Lama Alchaar @ (847) 664-2178 (e-mail: [Zahredden.I.Alchaar@us.ul.com](mailto:Zahredden.I.Alchaar@us.ul.com)) for sample details or questions.

The Reporting EPA Name:  
 Address:  
 City: \_\_\_\_\_ State: \_\_\_\_\_

FIG. X1.3 Sample UL Underground Piping Field Report Form (continued)



**RELATED MATERIAL**

*ASTM Standards:*<sup>2</sup>

E620 Reporting Opinions of Scientific or Technical Experts  
E678 Reporting Opinions of Scientific or Technical Experts  
E860 Practice for Examining And Preparing Items That Are Or May Become Involved In Criminal or Civil Litigation  
E1020 Practice for Reporting Incidents that May Involve Criminal or Civil Litigation  
E1526 Practice for Evaluating the Performance of Release Detection Systems for Underground Storage Tank Systems (Withdrawn)  
E1527 Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process  
E1903 Guide for Environmental Site Assessments: Phase II Environmental Site Assessment Process

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

E2332 Practice for Investigation and Analysis of Physical Component Failures

*Other Standards:*<sup>3</sup>

Publication 1624 Guide for Assessing and Remediating Petroleum Hydrocarbons in Soils

Publication 1628 Assessment and Remediation of Underground Petroleum Releases

Publication 2009 Safe Welding and Cutting Practices in Refineries, Gasoline Plants and Petrochemical Plants

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