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ANSI/CAN/UL/ULC 2447:2023

STANDARD FOR SAFETY

Containment Sumps, Fittings and Accessories for Flammable and Combustible Liquids

Approved American National Standard
ANSI

ANSI/UL 2447-2023

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UL Standard for Safety for Containment Sumps, Fittings and Accessories for Flammable and Combustible Liquids, ANSI/CAN/UL/ULC 2447

First Edition, Dated November 28, 2023

Summary of Topics

This new edition of ANSI/CAN/UL/ULC 2447, Standard for Containment Sumps, Fittings and Accessories for Flammable and Combustible Liquids, dated November 28, 2023, has been issued to reflect the latest ANSI and SCC approval dates and to incorporate the proposals dated February 17, 2023, July 14, 2023 and October 27, 2023.

The requirements are substantially in accordance with Proposal(s) on this subject dated February 17, 2023, July 14, 2023 and October 27, 2023.

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NOVEMBER 28, 2023

ANSI/CAN/UL/ULC 2447:2023

Standard for Containment Sumps, Fittings and Accessories for Flammable and Combustible Liquids

First Edition

November 28, 2023

This ANSI/CAN/UL/ULC Safety Standard consists of the First Edition.

The most recent designation of ANSI/UL 2447 as an American National Standard (ANSI) occurred on November 28, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on November 28, 2023.

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PREFACE

This is the First Edition of ANSI/CAN/UL/ULC 2447, Standard for Containment Sumps, Fittings and Accessories for Flammable and Combustible Liquids.

ULSE is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO). ULC Standards is accredited by the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL/ULC 2447 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

This joint American National Standard and National Standard of Canada is based on, and now supersedes, the First Edition of CAN/ULC-S664.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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This Edition of the Standard has been formally approved by the Technical Committee (TC) for Containment Sumps For Flammable And Combustible Liquids, TC 2447.

This list represents the TC 2447 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

TC 2447 Membership

Name	Representing	Interest Category	Region
James (Russ) Brauksieck	US Environmental Protection Agency (EPA)	Government	USA
John Dutton	Standards Individuals	General Interest	Canada
Don Edgecombe	Alberta Petroleum Storage Systems Contractors Association (APSSCA)	Commercial / Industrial User	Alberta
Laura Fisher	State Water Resources Control Board	AHJ/Regulator	USA
Kristopher Kane	OPW	Producer	USA

TC 2447 Membership Continued on Next Page

TC 2447 Membership Continued

Name	Representing	Interest Category	Region
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Pierre Legault	Integrated Review Services – Consulting	Commercial / Industrial User	Canada
Jeff Lexvold	Xerxes Corp.	Producer	USA
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William (Bill) Schneider	National Oilwell Varco	Producer	USA
Jamie Thompson	Association For Petroleum & Explosives Administration	AHJ/Regulator	United Kingdom
Laura Werner	UL Standards & Engagement	TC Project Manager – Non-voting member	Canada
Gillian Wintonic	UL Standards & Engagement	TC Chair – Non-voting member	Canada

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This Standard is intended to be used for conformity assessment.

The intended primary application of this Standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

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INTRODUCTION

1 Scope

1.1 This Standard sets forth the minimum requirements for containment sumps, and associated sump fittings and accessories (products) intended for below-grade, or at-grade, or above-grade use as an enclosure for the housing of, and access to, underground piping, connector piping, and other fueling system components (such as pumps, valves, sensors, wiring, etc.), in addition to temporary containment of typical liquid fuels as identified in this Standard. These products are intended for use in commercial (public) or private (fleet) automotive fueling station applications or similar fuel dispensing applications, and in piping systems for fuel supply to generators, burners or similar equipment. Some sump fitting or sump accessory products may be optionally evaluated for repair or replacement applications in containment sumps that have been in service.

1.2 Containment sumps may be either primary or secondary constructions of metallic, nonmetallic or composite materials. Typical containment sump types are:

a) Tank sumps – Sumps intended for installation above underground flammable and combustible liquid storage tanks;

b) Dispenser sumps – Sumps intended for installation below flammable and combustible liquid dispensing equipment;

c) Transition sumps – Sumps intended for access to liquid or vapour piping run manifolds, fittings and valves in a fueling system; and

d) Fill/vent sumps – Sumps intended for housing of fill and/or vent pipe ends, drain valves, gauges or monitors connected to the tank.

1.3 Sump fittings may be included as either an integral part of the containment sump, or as a field-installed kit, and may include but are not limited to the following sump applications:

a) Penetration fittings – Fittings intended for sealing pipe penetrations through the sump wall;

b) Termination fittings – Fittings intended for connecting pipe terminations at the sump wall;

c) Internal fittings – Fittings intended for connection of working components inside the sump; and

d) Test and monitor fittings – Fittings intended for periodic testing or continuous monitoring of the sump and/or pipe.

1.4 Sump accessories may be included as either an integral part of the containment sump, or as a field-installed kit, and may include but are not limited to the following sump applications:

a) Sump covers and sump lids – Covers or lids intended to limit access to the sump with structural and leak resistance features;

b) Sump frames – Frames intended to provide structural support of the sump walls and/or components above or in the sump;

c) Sump brackets – Brackets intended to provide structural attachment points for components inside the sump; and

d) Chase pipes – Soil pipes intended to provide a structural conduit for routing underground carrier pipes for flammable and combustible liquids to and from the sump.

1.5 Containment sumps, fittings and accessories are intended for the containment of flammable and combustible liquids under the expected use conditions and exposures that have similar chemical, physical and material compatibility properties as represented in these requirements. Examples of these liquids include:

a) Petroleum products, including petroleum hydrocarbon fuels with low-biofuels blends, and similar flammable or combustible liquid petroleum derivatives, such as fuel components (cetane, hexane, heptane), and oils (lubricating, hydraulic, machine);

b) Oxygenated fuel blends, including all “petroleum product” liquids plus petroleum hydrocarbon fuels with low-biofuels blends;

c) Oxygenates, including all “petroleum product” and “oxygenated fuel blends” liquids plus pure/denatured or highest oxygenated blend stocks for use in mixing of dispensed lower fuel blends and components, such as biodiesel and ethanol; and

d) Other flammable and combustible liquids (for which the test fuels in Annex A are not considered to be sufficient or applicable) that can be demonstrated or determined to be compatible with the accessory materials as determined by the certifier.

1.6 Products covered by this Standard are intended to be installed and used in accordance with, but not limited to, any of the following documents:

a) In Canada

1) National Fire Code of Canada, Part 4;

2) CSA B139 series, Installation code for oil-burning equipment;

3) CCME PN 1326, Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products; and

4) Regulation of the authority having jurisdiction.

b) In the United States

1) NFPA 30, Flammable and Combustible Liquids Code;

2) NFPA 30A, Code for Motor Fuel Dispensing Facilities and Garages;

3) NFPA 1, Fire Code;

4) International Fire Code published by the International Fire Council; or

5. Other Applicable Federal and State regulations for the specific product or application it is being utilized in.

1.7 These products are factory manufactured and intended for on-site field assembly, inspection and leak testing for the specified applications and use conditions by qualified persons in accordance with the manufacturer's instructions and local requirements.

1.8 These products are intended to be periodically inspected and maintained for continued service, or taken out of service if necessary by qualified persons in accordance with industry recommended practices and/or the manufacturer's instructions.

1.9 These products have not been evaluated for use after natural disasters, fires or exposures to chemicals not representative of the test liquids or excessive physical damage beyond the expected assembly, installation and uses as identified in these requirements.

1.10 These products have not been evaluated for special use applications where exposed to heavy or continuous physical abuses, excessive mechanical stresses; or environments that operate outside of the expected atmospheric conditions and ambient use temperature range.

1.11 These requirements do not cover underground piping products which are found in UL 971, Standard for Nonmetallic Underground Piping for Flammable Liquids, UL 971A, Outline for Investigation of Metallic Underground Piping for Flammable Liquids, or ULC-S679, Standard for Metallic and Nonmetallic Underground Piping for Flammable and Combustible Liquids.

1.12 These requirements do not cover connector or aboveground piping products which are found in UL/ULC 2039, Standard for Flexible Connector Piping for Flammable and Combustible Liquids, or UL/ULC 1369, Standard for Aboveground Piping for Flammable and Combustible Liquids.

NOTE: Refer to Annex C for historic information about applicable standards.

1.13 These requirements do not cover tank accessories which are found in UL/ULC 2583, Standard for Fuel Tank Accessories for Flammable and Combustible Liquids.

NOTE: Refer to Annex C for historic information about applicable standards.

1.14 These requirements do not cover floating docks, submerged, or shipboard marine applications.

2 Components

2.1 Except as indicated in Section 3, a component of a product covered by this standard shall comply with the requirements for that component.

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard; or

b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

4 Referenced Publications

4.1 The documents shown below are referenced in the text of this Standard. Any undated reference to a code or standard appearing in the requirements of this Standard shall be interpreted as referring to the latest edition of that code or standard.

40 CFR Part 80, Regulation of Fuels and Fuel Additives

Canadian Environmental Protection Act, 1999 (CEPA, 1999)

International Fire Code (IFC)

National Fire Code of Canada (NFC)

ASME B1.20.1, *Pipe Threads, General Purpose (NPT Inch)*

ASTM A653/A653M, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM D256, *Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics*

ASTM D412, *Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension*

ASTM D471, *Test Method for Rubber Property – Effect of Liquids*

ASTM D638, *Standard Test Method for Tensile Properties of Plastics*

ASTM D664, *Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration*

ASTM D790, *Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials*

ASTM D975, *Standard Specification for Diesel Fuel*

ASTM D1193, *Standard Specification for Reagent Water*

ASTM D4814, *Standard Specification for Automotive Spark-Ignition Engine Fuel*

ASTM D5798, *Standard Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines*

ASTM D6751, *Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels*

ASTM D7467, *Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)*

ASTM D7862, *Standard Specification for Butanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel*

ASTM G62, *Standard Test Methods for Holiday Detection in Pipeline Coatings*

ASTM G153, *Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials*

ASTM G155, *Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials*

CCME PN 1326, *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*

CGSB-3.511, *Oxygenated automotive gasoline containing ethanol (E1-E10 and E11-E15)*

CGSB-3.512, *Automotive Ethanol Fuel (E50-E85 and E20-E25)*

CGSB-3.517, *Diesel Fuel*

CGSB-3.520, *Diesel Fuel Containing Low Levels of Biodiesel (B1-B5)*

CGSB-3.522, *Diesel Fuel Containing Biodiesel (B6-B20)*

CSA B139 Series, *Installation code for oil-burning equipment*

CSA C22.2 No. 0.15, *Adhesive labels*

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Garages*

NFPA 1, *Fire Code*

SAE J1681, *Gasoline, Alcohol, and Diesel Fuel Surrogates for Material Testing*

UL 797, *Electrical Metallic Tubing – Steel*

UL 969, *Marking and Labeling Systems*

UL 971, *Nonmetallic Underground Piping for Flammable Liquids*

UL 971A, *Outline of Investigation for Metallic Underground Fuel Pipe*

UL 1746, *External Corrosion Protection Systems for Steel Underground Storage Tanks*

UL 2039, *Flexible Connector Piping for Fuels*

UL/ULC 1369, *Aboveground Piping for Flammable and Combustible Liquids*

UL/ULC 2039, *Flexible Connector Piping for Flammable and Combustible Liquids*

UL/ULC 2583, *Fuel Tank Accessories for Flammable and Combustible Liquids*

ULC-S603.1, *External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids*

ULC-S633, *Flexible Connector Piping for Fuels*

ULC-S679, *Metallic and Nonmetallic Underground Piping for Flammable and Combustible Liquids*

5 Glossary

5.1 For the purpose of this Standard, the following definitions apply.

5.2 ABOVE-GRADE SUMPS – A steel containment sump design with bottom and sides, integral with the aboveground tank. Intended to house liquid or vapour piping manifolds, fittings, valves and other fueling components.

5.3 AUTHORITY HAVING JURISDICTION (AHJ) – The governmental body responsible for the enforcement of any part of this Standard or the official or agency designated by that body to exercise such a function.

5.4 CHASE PIPE – Typically a flexible or semi-rigid underground nonmetallic soil pipe. Intended to resist earth loading and to provide a structural conduit for routing underground piping to/from the sump, but does not provide rated fuel containment.

5.5 COMBUSTIBLE LIQUID – Any liquid having a flash point at or above 37.8 °C (100 °F) and below 93.3 °C (200 °F) and as defined in the National Fire Code of Canada and NFPA 30, Flammable and Combustible Liquids Code.

5.6 CONTAINMENT SUMPS – Primary and/or secondary atmospheric enclosures of various types (see 5.2 – 5.26) for burial below-grade, at-grade, or above-grade. Sumps are intended to provide a connection interface for underground piping, wiring, and accessible housing for fueling system components and other fueling components, and the temporary containment of these liquids in the event of spills or leaks, and when attached to the dispenser, prevent the entrance of run off ground water into the sump.

5.7 DISPENSER SUMPS – A containment sump design with a bottom and partially open top or lid. Intended for attachment to a frame under a liquid dispensing device at a fueling island.

5.8 FILL SUMPS or VENT SUMPS (aka Spill Buckets or Vapour Recovery Sumps) – A containment sump design with bottom opening and lid. Intended to interface with tank fuel fill or vapour recovery connecting pipe and to house adapters/caps, drain valves, gauges or monitors.

5.9 FLAMMABLE LIQUID – Any liquid having a flash point below 37.8 °C (100 °F) and a vapour pressure not exceeding 40 psig [275 kPa (absolute)] at 37.8 °C (100 °F) and as defined in the National Fire Code of Canada, and NFPA 30.

5.10 FUELS – Typically those liquids identified in US Code of Federal Regulations 40 CFR Part 80 "Regulation of Fuels and Fuel Additives" or fuels regulations made under sections 140 or 145 of the Canadian Environmental Protection Act, 1999 (CEPA, 1999), and compliant with only the Fuel Specifications below that are dispensed in commercial or fleet motor vehicle fueling stations for use in automotive engines (internal combustion or compression ignition):

a) ASTM D4814 or CGSB-3.511: AKA gasoline, gasohol, oxygenated gas, or low blend ethanol (max E10);

b) ASTM D5798 or CGSB-3.512, Automotive Ethanol Fuel (E50-E85 and E20-E25): AKA high blend ethanol or (E51 – E83);

c) Mid Range Ethanol Blends (E11 to E50) using variable mixtures of ASTM D4814 or CGSB 3.511, Low Blend Ethanol and ASTM D5798 or CGSB-3.512, High Blend Ethanol.

d) ASTM D975, Standard Specification for Diesel Fuel, or CGSB 3.517, Diesel Fuel, or CGSB-3.520, Diesel fuel containing low levels of biodiesel (B1 – B5): AKA on- road diesel, or low blend biodiesel (max B5);

e) ASTM D7467, Standard Specification for Diesel Fuel Oil and Biodiesel Blends (B6 to B20), or CGSB-3.522, Diesel Fuel Containing Biodiesel (B6 – B20): AKA mid blend biodiesel (B6 to B20); and

f) Isobutanol Fuel Blends (maximum iBu16) using variable mixtures of ASTM D4814 or CGSB-3.511 Gasoline (E0) and ASTM D7862, Standard Specification for Butanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel, (2-methyl-1-propanolisomer).

5.11 INTERNAL FITTINGS – Fittings intended to provide a liquid-tight seal and the securement of various fueling system components inside the containment sump, such as interstitial access ports, leak detection tubes, plugs.

5.12 PRIMARY SUMP (PRIMARY) – A single-wall sump construction intended to temporarily contain any liquids leaking from pipe, valves or other liquid-conveying components housed inside or above the sump. Internal primary sump walls are not intended for long term exposure of contained fuels but may be subjected to long term fuel vapour exposures.

5.13 PROFESSIONAL ENGINEER – A person who is licensed or otherwise authorized by a state, provincial or territorial engineering association to provide engineering services to the public in that territory, state or province.

NOTE – The AHJ may require a third-party engineering review if the geographic location for which the product/equipment is being installed is different from the professional engineer's geographic region and licensing of engineering practice, and if there are regional concerns that may not have been addressed by the original engineering review. For more information:

a) In the USA: National Council of Examiners for Engineering and Surveying (NCEES); or

b) In Canada: Engineers Canada.

5.14 QUALIFIED PERSON – A person specifically trained, by the manufacturer or manufacturer's representative, to perform proper field installations of its sumps, sump fittings, and sump accessories in accordance with the specified manufacturer's instructions. The qualified person is not required to be an employee of the manufacturer.

5.15 SECONDARY SUMP (SECONDARY) – The outer wall of a double-wall sump construction intended to surround the primary sump, temporarily contain any liquids leaking from the primary sump or from connecting secondary piping, and to provide fluid communication and monitoring capabilities. Interstitial spaces are not intended for long term exposure of contained fuels.

5.16 SIZE (PIPE SIZE or FITTING SIZE) – Nominal or trade dimensions (in or mm) of pipe and fittings based on inside diameters or thread.

NOTE – Nominal or trade sizes may not be equivalent to the actual measurements.

5.17 SUMP ACCESSORIES – Various types (see 5.18 – 5.21) and designs (bolted, clamped, fused) of mechanical hardware or parts intended to provide structural support of sump walls, fueling system components within sumps, fueling system equipment outside sumps, or loads above the sump. Accessories are typically for new constructions but may be additionally designed for repair/replacement of in-service sumps.

5.18 SUMP BRACKETS – Typically a minor rigid structural support connected to the sump wall or frame. Intended to provide a load bearing attachment point for internal fueling system components inside the sump such as valves, pipes, sensors, controls, etc.

5.19 SUMP COVERS and SUMP LIDS – Typically either a rigid structural plate or semi-rigid cap over the mating sump top opening. Intended to limit access to the sump, to resist surface or ground water entry, and support either working loads (for below-grade lids) or vehicle load (for at-grade covers).

5.20 SUMP FITTINGS – Primary and/or secondary connections of various types (see 5.11 – 5.25) and designs (threaded, clamped, fused), intended for liquid-tight joining or sealing of internal or external piping or other fueling system components to or through sump wall(s). Fittings are typically for new constructions but may be additionally designed for repair/replacement of in-service sumps.

5.21 SUMP FRAMES – Typically a major rigid structural framework connected to the sump top wall perimeter. Intended to resist earth loading, and to support external equipment or internal component loads, and below-grade lids or at-grade covers.

5.22 SWIVEL JOINT – A connection or joint designed to allow frequent rotational movement of the pipe during normal functional use.

5.23 TANK SUMP – A containment sump design with or without a bottom, and with a lid. Intended for attachment to a manway ring, collar, or connecting pipe above an underground tank.

5.24 TERMINATION FITTINGS – Fittings intended to provide a liquid-tight seal and securement of primary, secondary or chase piping ending at the inner or outer containment sump wall.

5.25 TEST or MONITOR FITTINGS – Fittings intended to provide a means to conduct periodic testing or continuous monitoring of primary and/or secondary piping from inside the sump.

5.26 TRANSITION SUMPS – A containment sump design with bottom, lid, and some above grade parts. Intended to house liquid or vapour piping manifolds, fittings, valves and other fueling components.

5.27 UNION JOINT – A connection or joint designed to allow rotational movement of the pipe only during assembly, installation or maintenance.

CONSTRUCTION

6 General

6.1 All materials used in the construction of sumps, fittings and accessories shall be suitable for their intended use locations with respect to normal (expected use within marked ratings) and abnormal (reasonable foreseeable misuse) conditions per the required performance tests described in this Standard.

6.2 Nonmetallics used in the construction of products shall be evaluated for long-term exposure compatibility to air, soil, water, ultraviolet light, and internal and external fluids within the expected ambient use temperature range evaluated by the requirements in this Standard.

6.3 All components required for a complete field assembly of the product and other fueling system products to which they are designed to be connected, as applicable, shall either be provided with the sump, fitting or accessory, or if a common item, specified in the manufacturer's instructions. Alternately, components (fittings, lids, pipes or accessories) not made by the sump manufacturer, but successfully evaluated as a system when used with the sump per this Standard, may be provided separately for field assembly provided the sump manufacturer allows for such components in their instructions per 22.11. Sumps shipped without lids shall be marked per 21.8 and the sump manufacturer shall identify in their instructions per 22.11 at least one lid that has been successfully evaluated for use with the sump. Also, components not made by the sump manufacturer, but successfully evaluated as a system when used with the sump per this Standard, may be attached to the sump as provided in that component's instructions.

6.4 All adhesives, gaskets, sealing compounds, fusion welds and other joining methods shall be evaluated with the complete assembly after installation per the manufacturer's instructions.

7 Sumps

7.1 Containment sumps shall be primary or secondary design types for below-grade use with the capability for at-grade access or above-grade use, and may be constructed of any material combinations. Sumps may be constructed in any shape, and of multiple pieces for field assembly with manufacturer-supplied installation kits (hardware, seals, etc.). In addition:

a) Only fittings or accessories described in the sump manufacturer's instructions may be factory or field-installed on or through the sump. The recommended sump, fitting and accessory combinations may be specific model(s) and/or generic material(s)/type(s);

b) Any parts of the sump wall that are also part of an underground pipe, and functions as a liquid or vapour containing part of the piping system shall additionally comply with UL 971, UL 971A, or ULC-S679, as applicable; and

c) Any parts of the sump wall that are also part of an aboveground pipe, and functions as a liquid or vapour containing part of the piping system shall additionally comply with UL/ULC 1369.

7.2 Tank sumps shall not exceed a total height/depth of 12.0 ft (3.66 m) or diameter/length of 10.0 ft (3.05 m) and shall have closed bottoms or open bottoms that connect to a tank manway collar, riser or pipe. Tank sumps requiring entry shall have a top access opening of at least 30.0 in (762 mm) diameter. Tank sumps shall be provided with a water resistant lid and may be provided with a structural cover.

7.3 Dispenser sumps shall not exceed a total height/depth of 10.0 ft (3.05 m) or diameter/length of 8.0 ft (2.44 m) and shall have a closed bottom. Dispenser sumps shall be provided with top opening(s) intended for use below dispensers which permit the passage of pipes and/or wires and resist water entry and may be provided with a structural cover.

7.4 Transition sumps shall not exceed a total height/depth of 8.0 ft (2.44 m) or maximum other dimension of 6.0 ft (1.83 m) and shall have a closed bottom. Transition sumps shall be provided with a water-resistant sump lid, and may be provided with a structural sump cover.

7.5 Fill/vent sumps shall not exceed a total height/depth of 4.0 ft (1.22 m) or diameter/length of 4.0 ft (1.22 m) but shall contain at least a 4 US gal (15 L) spill and shall have provisions for a bottom connection to fill/vent piping. Fill sumps shall be provided with a water-resistant sump lid and may be provided with a structural cover.

7.6 Above-grade sumps shall be constructed of steel, have provisions for connection to the aboveground tank, and shall have at least a bottom and sides.

8 Fittings

8.1 Sump fittings shall be primary or secondary types designed to form leak-tight connections through or to the sump wall and piping and may be constructed of any material combinations. Fittings may be constructed of multiple pieces for assembly with manufacturer-supplied installation kits (hardware, seals, etc.). In addition:

a) The fitting manufacturer's instructions shall identify the recommended fitting-sump combinations which have been evaluated to this Standard by specific model(s) and/or generic material(s)/type(s), and whether they are intended for new and/or repair/replacement installations; and

b) Any part of the fitting that is also part of an underground pipe, and that functions as a liquid or vapour containing part of the piping system shall also comply with UL 971, UL 971A, or ULC-S679, as applicable.

8.2 Penetration fittings shall be designed to provide a fixed, leak-tight connection between the sump wall and through piping without disabling any containment functions of either the mating sump or pipe. Penetration fittings shall not exceed an NPS 8 in (203.2 mm) pipe size, but may be rigid or flexible, and may be secured and sealed by any means.

8.3 Termination fittings shall be designed to provide a fixed, leak-tight connection for piping, ending at the sump wall without disabling any containment functions of either the mating sump or pipe. Termination

fittings shall not exceed an NPS 8 in (203.2 mm) pipe size, but may be rigid or flexible, and may be secured and sealed by any means.

8.4 Internal fittings shall be designed to provide a fixed, leak-tight connection for various fueling system components to the inside of the sump wall without compromising containment. Internal fittings shall not exceed a nominal 4.0 in (101.6 mm) pipe size, shall have rigid connections, and may be secured and sealed by any means.

8.5 Test and monitor fittings may be integral options on penetration fittings, termination fittings or internal fittings specifically designed to interface with periodic testing or continuous monitoring devices. The test and monitor connection of these fittings shall not exceed a nominal 0.5 in (12.7 mm) pipe size, shall have rigid connections, and may be secured and sealed by any means.

8.6 All fitting end threads shall be per ASME B1.20.1 or meet similar nationally recognized thread design specifications, such as NPTF, BSPT, BSPP or NPSM. Union joints are permitted. Swivel joints are not permitted.

9 Sump Accessories

9.1 Sump accessories shall be designed to provide various structural support and/or water resistance for sumps and sump components and may be constructed of any material combinations. Accessories may be constructed of multiple pieces for assembly with manufacturer-supplied installation kits (hardware, seals, etc.). In addition:

a) The accessory manufacturer's instructions shall identify the recommended accessory-sump combinations which have been evaluated to this Standard by specific model(s) and/or generic material(s)/type(s), and whether they are intended for new and/or repair/replacement installations; and

b) Sump accessories shall not modify, damage or disable the working function(s) of any of the sump components to which they attach or interface with.

9.2 Sump lids shall be rigid or semi-rigid designs sized to fit the mating sump top opening, resist water entry and support worker loads. Tank, dispenser and transition lids shall be completely closed. Dispenser lids shall have openings to allow passage of dispenser piping, wiring and leaking fluids from the dispenser into the sump.

9.3 Sump covers shall be rigid designs intended for at-grade use and are subject to vehicle traffic and snowplow impacts. Sump covers shall be designed for American Association of State Highway Transportation Officials (AASHTO) H-20 loads and for installation flush with the surrounding surface. If of a raised design, sump covers shall have a perimeter mounting ring angled at no more than 45° from the horizontal.

9.4 Sump frames shall be rigid designs sized to fit the mating sump top wall (internal or external), resist earth/water loads, and support equipment and lid or cover loads. The connection of a frame to a sump shall not compromise the leak-tight containment features of any part of the sump below the maximum liquid containment level rating per 21.5(f).

9.5 Sump brackets shall be rigid designs sized to connect to the sump wall or frame (internal only) and provide a load bearing attachment point for components inside the sump. The connection of brackets to a sump shall not compromise the leak-tight containment features of any part of the sump below the maximum liquid containment level rating per 21.5(f).

9.6 Chase pipe shall be sized to connect with external penetration fittings or termination fittings but shall not permit the transfer of soil fluids into the sump. The pipe and fitting combination shall resist the entry of soil fluids into the sump.

NOTE: Chase pipe is not rated to contain flammable or combustible liquids.

10 Corrosion Resistance

10.1 Metallics used in the construction of products that are exposed to the internal atmosphere of a sump shall be inherently corrosion resistant (such as stainless steel, aluminum, brass), plated or coated as per 10.2, or evaluated for equivalent alternate corrosion protection as per 10.4.

Exception: Above-grade sumps constructed of steel of at least 0.093 in (2.36 mm) thick with a primer coat do not require further plating or coating, or a corrosion evaluation.

10.2 Corrosion resistant internal coatings or platings shall be minimum designation Z275 (G90) (minimum 40 % zinc galvanizing on all sides) per ASTM A653/A653M.

10.3 Corrosion resistant external coatings or platings shall be in accordance with the applicable requirements for thin film dielectric coating, cladding, or coating in ULC-S603.1 or UL 1746.

10.4 Equivalent alternate corrosion protection methods shall be determined in accordance with UL 797, using a visual corrosion comparison between benchmark Z275 (G90) and the alternate protection after exposures to the test liquids identified in Table 19.1, Compatibility Test Liquids.

PERFORMANCE

11 General

11.1 Representative production samples of each general type of sump product (containment sump, sump fitting and sump accessory) shall be subjected to the appropriate Performance Tests as specified in Table 11.1 with sample variations of product type, design, materials, size and ratings as specified in each method.

Table 11.1
General Sump, Fitting and Accessory Test Matrix

Performance Tests	Sumps	Fittings	Accessories
Section 12 – Material Property Tests	All materials (1)	All materials (1)	All materials (1)
Section 13 – Physical Abuse Tests	All designs (2)	All designs (2)	All designs (2)
13.2 – Drop	See 13.2.2 WC details	See 13.2.3 WC details	See 13.2.4 WC details
13.3 – Impact	See 13.3.2 WC details	See 13.3.3 WC details	See 13.3.4 WC details
Section 14 – Fitting Assembly, Installation and Use Tests	All samples tested (3)	All samples tested (3)	
14.2 – Torque		See 14.2 test details	
14.3 – Bending		See 14.3 test details	
14.4 – Push-Pull		See 14.4 test details	

Table 11.1 Continued on Next Page

Table 11.1 Continued

Performance Tests	Sumps	Fittings	Accessories
Section 15 – Accessory Assembly Tests	All samples tested (4)		All samples tested (4)
15.2 – Frame and Bracket Strength			See 15.2 test details
15.3 – Cover and Lid Strength			See 15.3 test details
15.4 – Chase Pipe Strength			See 15.4 test details
Section 16 – Leakage Tests	All samples tested (5)	All samples tested (5)	All samples tested (5)
16.2 – Sump Leakage	See 16.2 test details	See 16.2 test details	See 16.2 test details
16.3 – Fitting Leakage		See 16.3 test details	
16.4 – Cover and Lid Leakage			See 16.4 test details
16.5 – Chase Pipe Leakage			See 16.5 test details
Section 17 – Interstitial Communication	All secondary types	All secondary types	All secondary types
Section 18 – Short Term Compatibility Tests	WC samples for each specific test per 18.2, 18.3 and 18.4	WC samples for each specific test per 18.2, 18.3 and 18.4	WC samples for each specific test per 18.2, 18.3 and 18.4
18.2 – UV Exposure			
18.3 – Metallic Stress Crack			
18.4 – Nonmetallic Stress Crack			
Section 19 – Long Term Compatibility Tests	WC samples for sump fitting and accessory combinations per 19.2, 19.3, 19.4 and materials per 19.5	WC samples for sump fitting and accessory combinations per 19.2, 19.3, 19.4 and materials per 19.5	WC samples for sump fitting and accessory combinations per 19.2, 19.3, 19.4 and materials per 19.5
19.2 – Sumps			
19.3 – Fittings			
19.4 – Accessories			
19.5 – Material Bars/Plaques			

NOTE: "WC" (worst case) indicates a sample, size, or test condition that is most likely to cause a non-complying result. Material, thickness, construction, components, and connections are to be considered for the selection of WC samples or test conditions. See 11.3 – 11.8 and each referenced section for sample selection details.

(1) All generic materials of critical components of a product shall be tested to the appropriate physical property tests using representative samples described in the Material Property Test sub-sections. However, WC grades may be selected from alternates of each generic material.

(2) All design types with WC materials selected from alternate grades shall be tested with representative sumps and pipe as appropriate per 14.1. WC shapes/sizes are described in the referenced Abuse Test sub-sections.

(3) All fitting design types with WC samples selected for the Section 13 Physical Abuse Tests shall be evaluated in combination with WC representative sumps and pipes per 14.1. See 14.2, 14.3 and 15.4 sub-section details for fitting tests and type deviations.

(4) All accessory design types with WC samples selected for the Section 13 Physical Abuse Tests shall be evaluated in combination with WC representative sumps and pipes per 15.1. See 15.2, 15.3 and 15.4 sub-section details for accessory tests and type deviations.

(5) All sample combinations previously selected for the Section 13 Physical Abuse Tests and assembled per Section 14 for Fittings or Section 15 for Accessories shall be evaluated for leakage using the appropriate test(s) in 16.2 to 16.5.

11.2 Critical dimensions (such as length, width, height, diameter, thickness, etc.) of three randomly selected test samples of each sump product type evaluated, shall be measured before any tests are conducted. All test sample dimensions shall be within the manufacturer's quality control specifications.

11.3 Representative sample sizes for the Performance Tests specified in Table 11.1 are defined as either:

a) "ALL" for all types, shapes, and sizes within a manufacturer's product range;

b) "WC" for worst types, shapes and sizes per 11.4 to 11.8, Table 11.1 notes and other guidance in each specific test; or

c) As otherwise indicated in the specific test.

When determining a WC sample(s), the test objectives, parameters, pass/fail criteria and other sequential tests using the same sample shall be considered in addition to construction variations in a design series.

11.4 Engineering calculations for loads, forces or stresses may be used to determine WC sizes for sump products of similar type, design, material, and options for some tests to reduce samples. If these calculations are inconclusive, all sizes shall be tested.

11.5 The selection of Representative WC samples for containment sumps shall be made with respect to maximum dimensions, minimum thickness and shape for hydrostatic loads and static loads; maximum weight, minimum thickness, and shape for drop; minimum thickness and shape for flex; and minimum thickness for impact and torque.

11.6 The selection of Representative WC samples for sump fittings shall be made with respect to maximum pressure rating, minimum thickness, and shape for hydrostatic loads; maximum weight, minimum thickness and shape for drop; minimum thickness and shape for flex and static loads; and minimum thickness for impact and torque.

11.7 The selection of Representative WC samples for sump accessories shall be made with respect to maximum load rating, minimum thickness and shape for hydrostatic loads and static loads; maximum weight, minimum thickness, and shape for drop; minimum thickness and shape for flex; and minimum thickness for impact and torque.

11.8 The selection of Representative WC sample sizes for Section 19, Long Term Compatibility Tests and Section 10, Corrosion Resistance Tests, shall be based on the minimum thickness of interior or exterior materials in contact with the test fluids.

11.9 New samples representative of production shall be used for Section 12, Material Property Tests, Section 18, Short Term Compatibility Tests, Section 19, Long Term Compatibility Tests or other destructive tests. The same samples shall be used for successive Section 13, Physical Abuse Tests, Section 14, Fitting Assembly Installation and Use Test, and Section 15, Accessory Assembly, Installation and Use Tests. Tests samples which require assembly to other products (ex – penetration fittings connected to sumps and pipe) shall use the type(s), manufacturer(s) and model(s) recommended by the OEM.

11.10 Assembly of all sump product samples shall be conducted by a qualified person using manufacturer-supplied components and tools in accordance with the manufacturer's instructions (assembly preparation and sequence, minimum thread or screw torques, minimum cure temperature and time, crimp setting, or other critical parameters). If multiple assembly methods are used, each shall be evaluated.

11.11 Damage shall be determined by visual examination with the naked eye from arms-length (approximately 3 ft (0.91 m)), of any critical part of a component or system sample after testing. The following items are examples of complying and non-complying results; however, final determination of damage characteristics and results shall be based on manufacturer input prior to testing, or shall be qualified by a specific test:

a) Metallics – discoloration or minor dimensional change are compliant, but excessive permanent deformation, cracking, crazing, splitting and plating damage are noncompliant examples;

b) Nonmetallics – discoloration or minor dimensional change are compliant, but excessive dimensional change, cracking, splitting, bulging, collapse, and delamination are noncompliant examples; and

c) Composites – discoloration or minor dimensional change are compliant, but dis-bonding or peeling of composite layers, or base metal corrosion are noncompliant examples.

11.12 Unless otherwise indicated in a specific test method, all tests shall be conducted with working fluids (air, water, etc.) at 21 ±6 °C (70 ±11 °F) and/or at normal ambient temperatures (aka room temperature) between 17 °C and 29 °C (62.6 °F and 84.2 °F) and 50 ±20 % RH. All pressures shall be measured with respect to gauge [psig (kPa)].

11.13 Unless otherwise indicated in a specific test method, hydrostatic tests shall be conducted with water (or similar liquids) and pneumatic tests shall be conducted with air (or similar inert gasses). In either case, precautions shall be used to prevent personal injury.

12 Material Properties Tests

12.1 General

12.1.1 Materials used in the fabrication of containment sumps, sump fittings and sump accessories that are relied on for structural integrity, fuel containment, corrosion resistance and/or other critical functions shall be subjected to the following tests as appropriate for the material type to measure the basic "as received" properties. These values may then be used for comparison and determination of retention values after other tests.

12.1.2 All polymeric samples may be cut from completed products, formed sheets, molded plaques or other types representative of the end product material and process (temperature, pressure, curing, etc.) in the minimum thickness. The preparation of machined, cut or stamped samples shall not damage the material such as excessive heating, bending, compression or tension. All physical property values shall be based on the average of three test samples.

12.1.3 All plating and coating samples shall be applied to either the complete end product or component, or to minimum 6.0 in (152.4 mm) square test plaques representative of the factory process (pre-treating, application, curing, etc.) in the minimum thickness applied to the intended base metal(s) of minimum thickness.

12.1.4 Minor components such as bolts, screws, washers or similar fasteners may be judged acceptable without testing based on other nationally recognized standards for corrosion resistance (such as SAE or UPC). However, their effect on the end product may need to be evaluated, such as fasteners on/through plated or coated metals.

12.2 Elastomers

12.2.1 All elastomer materials shall be measured for Tensile Strength and Ultimate Elongation properties in accordance with ASTM D412. Small formed gaskets or O-rings used between rigid members, and caulk or putty type sealing compounds are exempt from this requirement, but shall be evaluated within the end product if they are determined to be a critical component.

12.2.2 Three tensile strength bar samples in the minimum thickness shall be evaluated on a suitable tension testing machine. The bar type and test rate shall be determined by the generic material type and minimum thickness per the ASTM D412 method.

12.3 Thermoplastics

12.3.1 All thermoplastic materials shall be measured for Tensile Strength and Ultimate Elongation properties in accordance with ASTM D638. Minor components and joining or sealing compounds are exempt from this requirement but shall be evaluated within the end product if they are determined to be a critical component.

12.3.2 Three tensile strength bar samples in the minimum thickness shall be evaluated on a suitable tension testing machine. The bar type and cross head speeds between 2.0 and 20.0 in/min (50.8 and 508 mm/min) shall be determined by the generic material type and minimum thickness per the ASTM D638 method.

12.4 Thermosets

12.4.1 All thermoset materials shall be measured for Flexural Strength in accordance with ASTM D790, and Impact Resistance in accordance with ASTM D256. Minor components and joining or sealing compounds are exempt from this requirement but shall be evaluated within the end product if they are determined to be a critical component.

12.4.2 Three flexural strength bar samples in the minimum thickness shall be tested in accordance with ASTM D790 as modified in Annex B with the coupon tested with the tank interior surface in tension and ASTM D256.

12.5 Coated or plated metals

12.5.1 All external coatings or platings intended to provide corrosion protection of base metals shall be evaluated for scratches, pinholes, or reduced thickness areas in accordance with ASTM G62. Decorative coatings or coatings on non-functional parts are exempt from this requirement, but any coated/plated fasteners shall be evaluated with the end product if they are determined to be a critical component.

Exception: Above-grade sumps constructed of steel of at least 0.093 in (2.36 mm) thick with a primer coat do not require ASTM G62 corrosion protection evaluation.

12.5.2 Either the completed part or three plaque samples shall be evaluated with a suitable holiday testing machine. The test head voltage characteristics and detection limits shall be determined per the ASTM G62 method. There shall be no breakdown of the coating at less than 15 000 V.

12.6 Composites

12.6.1 All composites of metal with integral external polymeric corrosion protection systems shall be evaluated for cracking, disbonding, delamination, or other damage that would reduce the composites critical mechanical strength or material compatibility properties. Non-functional composites are exempt from this requirement, but functional composites shall be evaluated with the end product if they are determined to be a critical component.

12.6.2 Either the complete part or three plaque samples shall be subject to a 5.0 ft·lb_f (6.78 J) impact with a 2.0 in (50.8 mm) steel ball dropped onto the worst case area (complete parts) or center of the material clamped in a 6.0 in (152.4 mm) steel ring (test plaque). There shall be no non-compliant damage.

13 Physical Abuse Tests

13.1 General

13.1.1 Prior to conducting the Section 14, Fitting Assembly, Installation and Use Tests, Section 15, Accessory Assembly, Installation and Use Tests, and final Section 16, Leakage Tests, to assess pass/fail results, representative production samples of sumps and sump components shall be evaluated for damage after simulating expected physical abuses during transport, handling, assembly, installation and use as appropriate.

13.1.2 Abuse Tests are intended as a pre-conditioning of sump products, so the same samples shall additionally be used for Section 14, Fitting Assembly, Installation and Use Tests, Section 15, Accessory Assembly, Installation and Use Tests, and Section 16, Leakage Tests, in sequence per this Standard. Therefore, only a visual examination for damage shall be performed after each Abuse Test.

13.1.3 Following each Abuse Test, there shall be no non-compliant damage to the sample as defined in Section 11, Performance – General, except if a field repair kit and manufacturer's instructions to repair the non-compliant damage are additionally supplied for use by the qualified person, and the repaired component complies with all other tests, as applicable.

13.1.4 All worst case combinations of sumps, fittings and accessories as specified by the manufacturer's instructions shall be evaluated. See Section 21, Markings, and Section 22, Installation Instructions, for required identification of acceptable sump product combinations. All products shall be installed in accordance with the manufacturer's instructions.

13.1.5 In determining worst case sump sample(s), combinations of design type, materials, dimensions, shapes, sizes, supports, and any intended fittings or accessories allowed in the manufacturer markings and manufacturer's instructions, shall be considered within the sample exceptions below:

Exception No. 1: In order to facilitate testing within generally expected equipment capabilities and for testing consistency, the assembled sump sample size shall not exceed dimensions of approximately 6 ft (1.83 m) in any direction; and

Exception No. 2: Special samples combining different shapes, dimensions and other features of production variations are permitted to reduce the number of samples, provided the materials are representative of production methods.

13.1.6 In determining worst case fitting sample(s), combinations of design type, materials, dimensions, shapes, sizes, plus the generic or specific sump and pipe to which it is intended to be installed on or connected to per the manufacturer markings and manufacturer's instructions, shall be considered.

13.1.7 In determining worst case accessory sample(s), combinations of design type, materials, dimensions, shapes, plus the generic or specific sump and device to which it is intended to be installed on or connected to per the manufacturer markings and manufacturer's instructions, shall be considered.

13.1.8 Abuse Tests for all nonmetallic and composite sump products shall be conducted at both high 50 ±2 °C (122 ±3.6 °F) and low –30 ±2 °C (–22 ±3.64 °F) temperatures using separate samples for each test temperature. Abuse Tests for all metallic sump products may be conducted within a range of –20 °C (–4 °F) to 40 °C (104 °F).

NOTE: See Section E2 of Annex E for optional temperatures for Climate Change resistance.

13.1.9 Sump products shipped with protective packaging may be tested to assess compliant or non-compliant damage with the packaging in place provided it is weather resistant and is marked with a warning that it is not to be removed until installation of the product by the qualified person [refer to 21.4(e)].

13.1.10 Unless otherwise specified in the individual method, the length of underground pipe or chase pipe if required for testing shall extend no more than 1.0 ft (0.30 m) from the fitting.

13.2 Drop test

13.2.1 The worst case representative samples shall be subjected to a 4.0 ft (1.22 m) drop at the high and low temperatures (per 13.1.8) onto a flat concrete surface at the areas indicated below for each sump product. All drop heights shall be measured between the concrete surface and target area specified in each product type detail. Drops of rubber gaskets, O-rings and minor metal parts are not required.

13.2.2 For containment sumps, one sample of each sump to be evaluated shall be dropped on two locations (side and bottom surfaces). For multiple piece sumps, all major components before assembly and complete unit after assembly shall be subject to the drop.

13.2.3 For sump fittings, one sample of each fitting to be evaluated shall be dropped on three locations (top, bottom and side). For multiple piece fittings, all major components before assembly and the complete unit after assembly shall be subject to the drop.

13.2.4 For sump accessories, one sample of each accessory to be evaluated shall be dropped on three locations (top, bottom and side). For multiple piece accessories, all major components before assembly and the complete unit after assembly shall be subject to the drop.

13.2.5 The drop test is not required if the manufacturer's instructions require that the sump not be installed if it has been dropped without inspection for damage and repair by the manufacturer or the manufacturer's representative.

13.3 Impact test

13.3.1 The worst case representative samples shall be subjected to a 5.0 ft·lb$_f$ (6.78 J) impact at high and low temperatures (per 13.1.8) with a 2.0 in (50.8 mm) steel ball at the points indicated. All impact heights shall be calculated using the ball mass and measured between the ball bottom and target point specified in each product type detail. Impacts on rubber gaskets, O-rings and minor metal parts are not required.

13.3.2 For containment sumps, one sample of each sump to be evaluated shall be impacted at three locations (side, bottom and corner). For multiple piece sumps, all major components and joints after assembly shall be subject to the impact.

13.3.3 For sump fittings, one sample of each fitting to be evaluated shall be impacted at three locations (top, bottom and side). For multiple piece fittings, all major components and joints after assembly shall be subject to the impact.

13.3.4 For sump accessories, one sample of each accessory to be evaluated shall be impacted at three locations (top, bottom and side). For multiple piece accessories, all major components and joints after assembly shall be subject to the impact.

14 Fitting Assembly, Installation and Use Tests

14.1 General

14.1.1 Following the Section 13, Physical Abuse Tests, the same fitting samples shall be assembled to the sump wall and connecting pipe per the manufacturer's instructions and evaluated for damage after simulating expected rough handling during assembly, installation and use as appropriate. Following each of the Section 14, Fitting Assembly, Installation and Use Tests, and Section 15, Accessory Assembly, Installation and Use Tests, there shall be no non-compliant damage to the sump, fitting or pipe samples as defined in Section 11, Performance – General.

14.1.2 The worst case fittings in combination with the sump wall and connecting pipe or other accessories, according to the fitting design, shall be tested at both –30 ±2 °C (–22 ±3.6 °F) and 50 ±2 °C (122 ±3.6 °F). Tests for all metallic sump products may be conducted within a range of –20 °C (–4 °F) to 40 °C (104 °F).

14.1.3 Connections made with threaded fittings shall be tested with metal ends and sealing compounds specified by the manufacturer. Connections made with non-threaded fittings shall be fully cured before testing. If the fitting is designed for connection to generic metal pipe, Schedule 40 steel pipe shall be used for the test.

14.1.4 For sump manufacturers who do not make fittings, one fitting representative of each generic type, design, material, shape, and size range that the manufacturer specifies for use with their product(s) shall be installed in/through the sump wall per the fitting manufacturer's instructions to assess damage and leakage after assembly.

14.1.5 For fitting manufacturers who do not make sumps, one sump representative of each generic type, design, material, shape, and thickness range the manufacturer specifies for use with their product(s) shall have a fitting installed in/through the sump wall per the fitting manufacturer's instructions to assess damage and leakage after assembly.

14.1.6 To demonstrate the effectiveness of repair or replacement type fittings in used systems that rely on fusion, adhesives, encapsulants, or similar bonds with the sump or pipe that may have absorbed fuels, these fittings shall be assembled to a representative sump/fitting/pipe combination according to the manufacturer’s instructions, that has been pre-conditioned in an equal part mixture of all test fuels in Table 11.1 for a minimum of 10 d at 40 ±2 °C (104 ±3.6 °F).

14.2 Torque tests

14.2.1 Sump penetration fittings and termination fittings shall be assembled and installed per the manufacturer's instructions, then subjected to the applicable torques below applied through the pipe's longitudinal axis at high and low temperatures (per 13.1.8). Penetration fittings shall connect through a sump wall with a 2.0 ft (0.61 m) length of pipe [1 ft (0.30 m) outside / 1 ft (0.30 m) inside]. Termination fittings shall connect to a sump wall with a 1.0 ft (0.30 m) length of pipe (external or internal per the fitting design).

a) For pipes with threaded, fused, bonded or other fixed connections to rigid fittings, torques shall be per Table 14.1 or 1.5 times the rated value, whichever is greater.

b) For pipes with clamped or other loose connections to flex fittings, torques shall be per Table 14.1, or until the fitting is offset by 30° or the pipe slips in the fitting.

Table 14.1
Fitting Torques

Nominal size (inches)	Torque	
	in·lb$_f$	(N·m)
0.25	100	(11.3)
0.38	125	(14.1)
0.50	150	(16.9)
0.75	200	(22.6)
1.00	250	(28.3)
1.25	300	(33.9)
1.50	350	(39.6)
2.00	450	(50.9)
2.50	550	(62.2)
3.00	650	(73.5)
4.00	850	(96.1)
6.00	1250	(141.3)

14.2.2 If the intended connecting pipe exceeds a 45° twist before any of the above torques or conditions are achieved, the test shall be discontinued.

14.2.3 Sump internal fittings and test fittings shall be connected to the accessory or device per the manufacturer's instructions, then subjected to the applicable torques below applied through the accessory or equipment interface component.

a) For components with threaded, fused, bonded or other fixed connections to rigid fittings, torques shall be per Table 14.1 or 1.5 times the rated value, whichever is greater.

b) For components with clamped or other loose connections to flex fittings, torques shall be per Table 14.1, or until the fitting is offset by 15° or the component slips in the fitting.

14.2.4 If the accessory or device disconnects, exceeds a 30° twist or other obvious damage before any of the above torques or conditions are achieved, the test shall be discontinued.

14.3 Bending tests

14.3.1 Following the 14.2, Torque tests, penetration fittings and termination fittings shall be subjected to the applicable bend force below applied perpendicular to the end of the external section of underground pipe and/or internal section of connector pipe for 1 min at high and low temperatures (per 13.1.8).

a) For rigid pipe, a force at which the pipe breaks, kinks or reaches a 15° angle, but not more than 100 lb$_f$ (445 N);

b) For flexible or semi-rigid pipe, a force sufficient to bend the pipe 1.5 times below its marked minimum bend radius.

14.3.2 Following the 14.2, Torque tests, internal fittings and test fittings shall be subjected to the applicable bend force below applied perpendicular to the end of the connecting pipe/tube or other intended component for 1 min.

a) For rigid pipe or components, a force at which the pipe or component breaks, kinks or reaches a 15° angle, but not more than 50 lb$_f$ (222 N);

b) For flexible tubing or components, a force at which the tubing or component fails or disconnects, but not more than 50 lb_f (222 N).

14.4 Push-pull test

14.4.1 Following the 14.3, Bending tests, penetration fittings and termination fittings shall be subjected to the applicable push/pull force below applied parallel to the end of the external section of underground pipe and/or internal section of connector pipe for 1 min at high and low temperatures (per 13.1.8).

a) For rigid pipe, a push and pull force of 50 lb_f (222 N), or until the fitting displaces more than 4.0 in (101.6 mm); or

b) For flexible pipe, a push and pull force of 50 lb_f (222 N), or until the pipe kinks, or fitting displaces more than 4.0 in (101.6 mm).

14.4.2 Following the 14.3, Bending tests, internal fittings and test fittings shall be subjected to the applicable push/pull force below applied parallel to the end of the connecting pipe, tube or other intended component for 1 min.

a) For rigid pipe or components, a force of 20 lb_f (89 N), or until the fitting displaces more than 2.0 in (50.8 mm); or

b) For flexible tubing or components, a force of 20 lb_f (89 N), or until it kinks, fails, or the fitting displaces more than 1.0 in (25.4 mm).

15 Accessory Assembly, Installation and Use Tests

15.1 General

15.1.1 Following the Section 13, Abuse Tests, the same accessory samples shall be assembled to the sump wall and other components per the manufacturer's instructions and evaluated for damage after simulating expected rough handling during assembly, installation and use as appropriate. Following each of the Section 14, Fitting Assembly, Installation and Use Tests, and Section 15, Accessory Assembly, Installation and Use Tests, there shall be no non-compliant damage to the sump, accessory or other component samples as defined in Section 11, Performance – General.

15.1.2 The worst case accessories in combination with the sump wall and other components, according to the component design, shall be tested at high and low temperatures (per 13.1.8). Tests for all metallic sump products may be conducted within a range of –20 °C (–4 °F) to 40 °C (104 °F).

15.1.3 Connections made with threaded fittings shall be tested with metal ends and sealing compounds as specified by the manufacturer. Connections made with non-threaded fittings shall be fully cured before testing. If the fitting is designed for connection to generic metal pipe, schedule 40 steel pipe shall be used for the test.

15.1.4 For sump manufacturers who do not make accessories, one accessory representative of each generic type, design and material that the manufacturer specifies for use with their product(s) shall be installed in/to the sump wall per the accessory manufacturer's instructions to assess damage and leakage after assembly.

15.1.5 For accessory manufacturers who do not make sumps, one sump representative of each generic type, design and material that manufacturer specifies for use with their product(s) shall have an accessory installed in/to the sump wall per the accessory manufacturer's instruction to assess damage and leakage after assembly.

15.1.6 To demonstrate the effectiveness of repair or replacement type accessories in used systems that rely on fusion, adhesives, encapsulants, or similar bonds with the sump or pipe that may have absorbed fuels, these accessories shall be assembled to a representative sump/pipe combination per the manufacturer's instructions, that has been pre-conditioned in an equal part mixture of all test fuels in Table 19.1 for a minimum of 10 d at 40 ±2 °C (104 ±3.6 °F).

15.2 Frame and bracket strength tests

15.2.1 Sump frames and general use brackets shall be assembled per the manufacturer's instructions without removable lids, and with the sump fixed to simulate the intended installation. The combined product shall then be subjected to the applicable loads and forces below at high and low temperatures (per 13.1.8). For the purposes of these tests, noncompliant frame or bracket damage is defined as permanent deformation greater than 1.0 in (25.4 mm), any tear in the base material or joints, or cause of noncompliant damage to the sump.

a) Earth Loading – A vacuum of 2.0 times the maximum rated burial depth pressure based on water shall be applied to the sump for 1 min. The sump may be inverted in a water pan to facilitate the test;

b) Equipment Loading – A vertical load of 2.0 times the rated load shall be evenly distributed over all connection points provided, or at the center of each side or member for 1 min;

c) Brackets intended to secure vapour or vent pipe shall be fixed to 4.0 ft (1.22 m) of Schedule 40 steel pipe, then subjected to a 50 lb_f (222 N) force applied parallel and perpendicular to the pipe end for 1 min;

d) Brackets intended to secure electrical conduit shall be fixed to 3.0 ft (0.91 m) of metal conduit, then subjected to a 20 lb_f (89 N) force applied parallel and perpendicular to the pipe end for 1 min; and

e) Brackets intended to support equipment inside the sump shall be subjected to the higher value of 2.0 times the rated load or 50 lb_m (22.7 kg) suspended from the worst case point for 1 min.

15.2.2 Sump frames with shear valve brackets shall be assembled with a representative shear valve (or special fitting for the impact tests) at the center of the bracket, and with the sump fixed to simulate installation, the combined product shall then be subjected to the applicable forces below at high and low temperatures (per 13.1.8). For the purposes of these tests, unacceptable frame or bracket damage is defined as permanent deformation greater than 0.50 in (12.7 mm), any tear in the base material or joints, or cause of noncompliant damage to the sump.

a) Torque – A minimum 6.0 in (152.4 mm) length of schedule 40 steel pipe shall be connected to the largest size valve at torque values per Table 15.1. The valve shall not rotate in the bracket;

b) Impact I – With one valve modified not to shear, a horizontal impact of 650 ft·lb_f (881 J) shall be applied to the valve pipe both perpendicular and parallel to the longitudinal center of the frame or bracket; and

c) Impact II – With multiple valves modified not to shear, a horizontal impact of 650 ft·lb_f (881 J) per valve shall be applied to the valve pipes both perpendicular and parallel to the frame or bracket.

Table 15.1
Shear Valve Torques

Nominal size (inches)	Torque	
	in·lb$_f$	(N·m)
0.75	1050	(118.7)
1.00	1150	(130.0)
1.25	1250	(141.3)
1.50	1350	(152.6)
2.00	1500	(169.5)
2.50	1650	(186.5)
3.00	1800	(203.4)
4.00	2000	(226.0)

15.3 Cover and lid strength tests

15.3.1 Sump covers and lids shall be assembled to the connecting sump, supporting ring or other equivalent means to simulate installation at- or below-grade according to the cover design. The combined product shall then be subjected to the applicable forces below at high and low temperatures (per 13.1.8).

a) Cover Loading – Covers at-grade shall be evaluated for AASHTO H-20 loading compliance (max 16 000 lb$_m$ (7257.5 kg) rear wheels) by testing or design approval stamped by a Professional Engineer;

b) Lid Loading – Lids below-grade shall withstand without collapse a 1 000 lb$_m$ (454 kg) load distributed on a 1.0 ft^2 (0.093 m^2) plate at the lid center for 1 min; and

c) Lids marked "CAUTION – Do Not Stand on Lid – Injury May Result" per 21.7(e) shall be subjected to test method B, except with a 500 lb$_m$ (227 kg) load.

15.4 Chase pipe strength tests

15.4.1 A minimum 1 ft (0.3 m) length of chase pipe shall be connected to the sump fitting specified by the manufacturer at one end and provided with a test fitting at the other, then subjected to the loads or forces below at high and low temperatures (per 13.1.8):

a) Crush – The pipe or fitting shall not break, crack or show evidence of non-compliant damage under a 250 lb$_m$ (113 kg) load applied to the center of the pipe through a 6 in (152.4 mm) wide flat steel plate with the pipe on a flat concrete surface for 1 min;

b) Pull – The pipe or fitting shall not break, pull out or show evidence of non-compliant damage under a 100 lb$_f$ (445 N) force applied longitudinally to the pipe for 1 min. Sump connection fittings may be modified to facilitate the test; and

c) Bend – The pipe or fitting shall not break, crack or show evidence of non-compliant damage when bent 1.5 times below the minimum bend radius for 1 min. Mandrels or similar devices are permitted to facilitate the test.

16 Leakage Tests

16.1 General

16.1.1 Following testing per Section 13, Physical Abuse Tests, Section 14, Fitting Assembly, Installation and Use Tests, at high and low temperatures (per 13.1.8) and Section 15, Accessory Assembly, Installation and Use Tests, the same sump samples with the installed fittings and accessories shall be subjected to the appropriate leakage test method(s) without the aid of backfill, frames or other supports not integral with the sump or intended for field assembly. The leakage tests shall be conducted at room temperature (per 11.12), and the samples shall not leak during any of the tests.

16.2 Sump leakage

16.2.1 For separate primary or secondary types, the test sumps with connected fittings and pipes shall be filled 3/4 full with water or to the maximum level as indicated by the manufacturer per 21.5(f), whichever is greater, for at least 15 min. Afterwards, the sump wall and each fitting shall be visually inspected for external leakage. There shall be no sump leakage.

16.2.2 For integral primary/secondary types, the primary sump shall be tested as per 16.2.1, except the visual inspection for leakage shall be done at each interstitial monitor location. Afterwards, with water still in the primary sump, the interstitial space shall be subjected to one of the methods below. There shall be no sump leakage:

a) Filling 3/4 full with water or to the maximum level as indicated by the manufacturer per 21.5(f), whichever is greater, for at least 15 min, then visually inspecting the external sump wall and fittings for leakage;

b) A pressure of at least 5.0 psig (35 kPa) for 15 min, then visually inspecting the primary (air bubbles) and secondary (soap suds); or

c) A vacuum of at least 10 in Hg (254 mm Hg) for 5 min, then determining leakage by any loss of vacuum after an additional 10 min.

Exception: Interstitial spaces of sumps and/or fittings intended for connection to continuous monitoring devices shall be tested at 1.5 times rated pressure per method B and/or 1.5 times rated vacuum per method C.

16.2.3 Visual leak detection shall be applied to all surfaces, joints and connections to fittings and accessories. Fluid dyes, leak solutions, blotting paper, or any other accurate and repeatable methods may be used to aid in leakage assessment.

16.2.4 The full-scale range of gauges used to determine leakage shall not exceed 2 times the test values in 16.2.2, and shall have increments of one half the test unit value (0.5 psig (3.45 kPa) or 0.5 in Hg (12.7 mm Hg)) or better. Gauges shall be calibrated with an accuracy of 2 % or better.

16.3 Fitting leakage

16.3.1 For fittings that form part of the primary piping system (normally in contact with pressurized fuels), the fitting with connecting pipe shall be pressurized to 2 times the pipe rating for 1 min. The pressure may be aerostatic or hydrostatic with appropriate leak detection methods used. There shall be no sump leakage.

16.3.2 For fittings that form part of the secondary piping system (potential contact with leaking fuels), the fitting with connecting pipe shall be pressurized to the appropriate value below for 1 min. The pressure

medium may be aerostatic or hydrostatic with the appropriate leak detection methods used. There shall be no sump leakage.

a) For fittings rated for only open secondary piping system, 5.0 psig (35 kPa); or

b) For fittings rated for open or closed secondary piping system, 50 psig (345 kPa).

16.4 Cover and lid leakage

16.4.1 Sump covers and sump lids shall be assembled to the connecting sump or supporting ring that is fixed to simulate installation at- or below-grade according to the product design. The combined product shall then be subjected to the applicable water resistance tests below. There shall be no sump leakage:

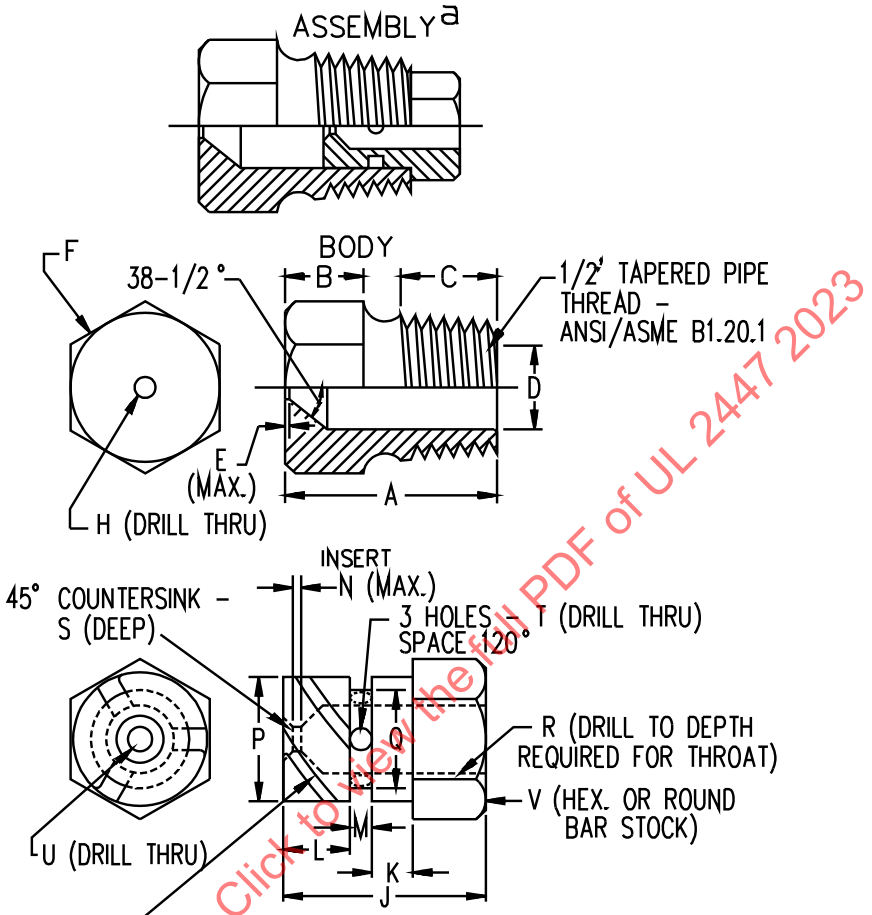
a) Cover Submersion – At-grade covers shall be subjected to a 6 in (152.4 mm) water submersion for 30 min;

b) Lid Rain – Below-grade lids and dispenser sump covers designed for raised islands shall be subjected to a 30 min simulated rain emitted from a Rain Test Spray Head (Figure 16.1) at 5.0 psig (35 kPa) at a distance of 3 to 5 ft (0.91 to 1.52 m) above the lid.

NOTE: See Section E4 of Annex E for optional pressure requirements for Climate Change resistance.

Figure 16.1

Rain Test Spray Head



Item	inch	mm	Item	inch	mm
A	1 7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No.9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

[c] Optional - To serve as a wrench grip.

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16.5 Chase pipe leakage

16.5.1 Combinations of chase pipes and fittings assembled to the sump shall be capped at the pipe end and subjected to one of the pressures below for 1 min. There shall be no sump leakage:

a) A pressure of at least 5.0 psig (35 kPa) for 15 min, then visually inspecting the primary (air bubble) and secondary (soap suds); or

b) A vacuum of at least 10 in Hg (254 mm Hg) for 5 min, then determining leakage by any loss of vacuum after an additional 10 min.

17 Interstitial Communication Test

17.1 Following the Section 16 Leakage Test, the same assembled sample combinations of secondary sumps with connecting fittings and pipe shall be tested for both internal and external leakage communication.

Exception: Sumps and Fittings with continuous interstitial spaces of at least 0.1 in (2.5 mm) between primary and secondary walls are exempt.

17.2 With 1/8 in (3.2 mm) holes drilled in the primary pipe and primary sump at the furthest distance from the interstitial monitor, water at maximum 1.0 psig (6.9 kPa) shall be separately introduced into the holes and communicate the leak to the monitor opening within 2 h.

17.3 With 1/8 in (3.2 mm) diameter holes drilled in the secondary pipe and secondary sump, water at maximum 1.0 psig (6.9 kPa) shall be separately introduced into the holes and communicate the leak to the monitor opening within 2 h.

18 Short Term Compatibility Tests

18.1 General

18.1.1 Representative samples of each sump, fitting, accessory or component as indicated in each method shall be tested in accordance with the:

a) UV Exposure Test (see 18.2) for nonmetallic sump products;

b) Metallic Stress Test (see 18.3) for metallic sump products; and/or

c) Nonmetallic Stress Test (see 18.4) for nonmetallic sump products.

18.1.2 Representative samples a minimum 6 in (152.4 mm) square plaques either cut from sump walls or specially prepared if the materials, thickness and process are consistent with production sumps shall be used for each test.

18.1.3 Representative worst case size samples may be used for fittings or accessories if the materials, thickness and process are consistent between a range of sizes or types.

18.2 UV exposure test

18.2.1 Three worst case samples of only sump products with nonmetallic exterior components shall be subjected to either of the test methods and light/water cycle rates. Following the UV exposure, samples shall be evaluated per 18.2.2 for flat plaques or 18.2.3 for small components:

a) 360 h (all products) or 720 h (products subject to sunlight after installation) using the Apparatus and Procedures per ASTM G153, using Table X1.1 Cycle 1 (102 min light and 18 min light/water); or

b) 500 h (all products) or 1000 h (products subject to sunlight after installation) using the Apparatus and Procedures per ASTM G155, using Table X3.1 Cycle 1 (102 min light and 18 min light/water).

NOTE: See Section E3 of Annex E for optional UV Exposure requirements for Climate Change resistance.

18.2.2 Flat plaque samples (recommended for sumps, and larger sump products) shall be examined for damage, then subjected to repeat testing according to the requirements of Section 12, Materials Properties Tests. The samples shall not sustain non-compliant damage as per Section 11, Performance – General, and the average physical property retention values shall be at least 70 % of the as-received values.

18.2.3 Small component samples (recommended for small fittings and accessories) shall be examined for damage, then subjected to repeat Abuse Tests per Section 13 and Leakage Tests per Section 16 at only standard lab temperature. The samples shall not sustain non-compliant damage per Section 11 and shall not leak.

18.3 Metallic stress crack test

18.3.1 For sump products with connecting threads, flanges or clamp rings and constructed with at least 15 % zinc (excluding platings), one worst case sample shall be exposed to a moist ammonia-air mixture of minimum 20 fl oz (591.5 mL) of 0.94 spg aqueous ammonia for 10 days at 34 °C (93.2 °F) in a heated water bath or oven.

18.3.2 The samples shall be grease free, fitted with steel plugs, caps or the intended connection device at the manufacturer's recommended torque, and positioned above the test fluid in a suitable container.

18.3.3 Following the exposure, the samples are to be visually examined without magnification tools. The sample shall not have any evidence of surface cracking, crazing or other non-compliant damage per Section 11, Performance – General.

18.4 Nonmetallic stress crack test

18.4.1 For sump products with connecting threads, flanges, clamp rings or having mold seams and constructed with polyethylene (any type or percentage blend), one worst case sample shall be exposed to a 10 % poly-oxyethylated nonylphenol (Type CO-630 IGEPAL®) water solution for 180 h at 60 °C (140 °F) in a heated water bath or oven.

NOTE: IGEPAL is a Registered Trade Mark of Rhodia Operations.

18.4.2 All samples shall be cleaned, fitted with steel plugs, caps or the connection device for which they are designed at the manufacturer's recommended torque, and filled with or immersed in the IGEPAL test solution.

18.4.3 Following the exposure, the samples are to be visually examined without magnification tools. The sample shall not have any evidence of surface cracking, crazing or other non-compliant damage per Section 11.

19 Long Term Compatibility Test

19.1 Representative samples of each sump type, except above-grade sumps constructed of steel of at least 0.093 in (2.36 mm) thick with a primer coat, with installed fittings and accessories, plus separate test plaques as indicated in 19.2 to 19.5 shall be subjected to each test liquid identified in Table 19.1 under the exposure conditions and time period(s) of Table 19.2 to simulate long term compatibility to fuels, vapours, soil fluids and environmental conditions. During and after the exposures, samples shall be evaluated per 19.7. No other materials, regardless of chemical resistance or corrosion resistance, shall be exempt from this test.

Table 19.1
Compatibility Test Liquids

External soil and environmental test fluids at 40 °C (104 °F)	Flammable and combustible test fuels at 40 °C (104 °F)
pH 3.0 sulfuric acid	
1 % hydrochloric acid[a]	F75/B25a[d]
1 % nitric acid[a]	F25/B75a[d]
pH 12 sodium hydroxide	C75/E25a[e]
pH 10 sodium carbonate/bicarbonate[b]	C15/E85a[e]
Saturated sodium chloride	Optional Test Liquids as Requested by the Manufacturer, such as:
Distilled water[c]	B100a, Fuel Oil #6 @xx°C, M100, E100, or other flammable and combustible liquids[f]
Air at 70 °C only for nonmetallic components	
1) Test parameters, such as temperature and concentrations of media, are increased in severity over those of normal operating conditions to obtain observable deterioration in a reasonable time period. This accelerated test does not give a direct correlation with service performance. However, this method of testing yields comparative data on which to evaluate the product. 2) ASTM Reference Fuel C and F are described in ASTM D471. Fuel C is a 50/50 mixture of Iso-Octane and Toluene. Fuel F shall be Grade D2 S15.	
[a] Percentage by weight. [b] A pH 10 is obtained by mixing 10.6 grams per liter of sodium carbonate and 8.4 grams per liter of sodium bicarbonate. A pH meter shall be used to measure and adjust ratio of sodium carbonate to sodium bicarbonate to obtain a pH of 10. [c] Distilled water having a maximum total matter of 2.0 ppm and a maximum electrical conductivity of 5.0 µΩ/cm at 25 °C (77 °F), as described for Type IV grade reagent water in ASTM D1193. [d] The chemical formulation of UL B100 aggressive biodiesel as a test fuel and component of F75/B25a can be found in Annex A. B = UL B100 and F = ASTM Ref Fuel F. [e] The chemical formulation for aggressive alcohols used in mixing C75/E25a and C15/E85a can be found in Annex A. C = ASTM Ref Fuel C and E = Ethanol. [f] Other flammable and combustible liquids (for which the test fuels in Annex D are not considered to be sufficient or applicable) that can be demonstrated or deemed to be compatible with the sump, fitting or accessory materials as determined by the certifier may be added to a manufacturer's listing.	

Table 19.2
Compatibility Sample Exposure Details

Sample types	Primary containment sump		Secondary containment sump	
	Test fuels	Test fluids	Test fuels	Test fluids
Assembled sumps with components below	90 days (*)	120 days (*)	60 days (*)	120 days (*)
All fittings and chase pipe	Liquids and vapours (1)	Liquids and vapours (1)	Liquids and vapours (2)	Liquids and vapours (2)
Lids and covers	Vapours only (3)	Liquids and vapours (4)	Vapours only (3)	Liquids and vapours (4)
Frames and brackets	Liquids and vapours (5)	Liquids and vapours (5)	Liquids and vapours (5)	Liquids and vapours (5)
Bars/Plaques	Liquids and/or Vapours Depending on Use (6)		Liquids and/or Vapours Depending on Use (6)	

(*) All air oven samples shall be exposed for 90 days. All surfaces shall be exposed by keeping sump fittings or pipes open. Caps or plugs may be added for leak testing after exposures.

(1) – The sump wall, fitting surfaces and chase pipe forming primary containment shall be exposed to both liquids and vapours by filling the sump to levels that immerse approximately 1/4 to 3/4 the fitting.

(2) – The sump wall, fitting surfaces and chase pipe forming the secondary containment shall be exposed to both liquids and vapours by filling the interstitial space to levels that immerse approximately 1/4 to 3/4 the fitting.

(3) – Lids and covers forming primary or secondary containment shall be exposed only to fuel vapours by keeping the samples above the liquid level.

(4) – Lids and covers forming primary or secondary containment shall be exposed primarily to fluid vapours and occasional to liquids by sloshing, tipping or similar methods to wet the seal and top once every 7 days.

(5) – Frames and brackets evaluated to repeat structural strength tests shall be exposed primarily to vapours by keeping the samples above the liquid level, and occasionally to liquids by sloshing, tipping or similar methods to wet the parts once every 7 days.

(6) – Bars and plaques evaluated to repeat material property tests shall be exposed to liquids and/or vapours depending upon their intended use. For materials with multiple uses, the most severe exposure shall apply:

a) Sump, fitting and chase materials shall keep approximately ½ the sample length immersed in the liquid.

b) Lid/cover materials shall keep samples above the liquids except occasional fluid exposures per (4)

c) Frame/bracket materials shall keep samples above the liquids except occasional fuel and fluid exposures per (5).

19.2 The test samples for each test liquid shall consist of one worst case sump representative of each generic material and highest containment type with worst case fittings and accessory sample(s) representative of each generic material and design type intended for use with the sump installed per the manufacturer's instructions. The test sump shall be as small as possible and in the minimum thickness, but shall be capable of accommodating the combination of representative fittings and accessories. Special sump samples representative of production are permitted to evaluate the different combinations of shapes, fittings, accessories and other features in the design series. All sump product samples with acceptable damage after the Drop test (see 13.2), and Impact test (see 13.3), pre-conditioning tests shall repeat the tests at room temperature (per 11.12) prior to installation. Additional sample requirements and guidelines are as follows:

a) For sump manufacturers who do not make fittings, one fitting representative of each generic type, design, material, shape and size range that is specified to be used with their sump(s) shall be evaluated;

b) For fitting manufacturers who do not make sumps, one sump representative of each generic type, design, material, shape and thickness range that is specified to be used with their fitting(s) shall be evaluated;

c) Fittings for fuel exposures shall be installed through/in the sump wall normally to expose the fitting and connecting pipe to internal test fuels stored inside the test sump;

d) Fittings for fluid exposures may be installed through/in the sump wall reversed per the manufacturer's instructions to expose the fitting and connecting pipe to external soil fluids stored inside the test sump.

e) Pipe used to connect with the fitting shall be representative of the specified types in smaller sizes with plugs/caps as appropriate used to contain the liquids during tests;

f) Frames and brackets evaluated for repeat strength tests may be installed inside the sump (for internal types), or hung inside the sump and installed after exposures (for external types). Alternately, representative bar or plaque samples of the same material(s), thickness, corrosion protection, and production methods may be evaluated for physical property retention as per 19.5.

g) To demonstrate the effectiveness of repair or replacement type fittings in used systems that rely on fusion, adhesives, encapsulants, or similar bonds with the sump or pipe that may have absorbed fuels, these fittings shall be assembled to a representative sump/fitting/pipe combination according to the fitting design, that has been pre-conditioned in an equal part mixture of all test fuels in Table 19.1 for a minimum of 10 d at 40 °C ±2 °C (104 °F ±3.6 °F).

19.3 Fittings installed through/on the sump wall shall be representative worst case with respect to material, shape, size, location and connection means. Fittings shall be located in the bottom half of the sump, and additionally:

a) Penetration and termination type fittings shall connect with short lengths of pipe types, according to the fitting design, provided with internal or external plugs/caps as appropriate to contain the test liquids;

b) Internal, test and monitor type fittings shall be closed with their provided seals to contain the test liquids.

19.4 Accessories installed in the sump shall be representative worst case with respect to material, shape size, location and connection means. Accessories shall be located as intended, and additionally:

a) Lids and covers shall be provided, but may be secured or sealed other than designed to contain the test liquids in unintended positions and vapours at increased pressures during testing; and

b) Chase pipe connecting to the sump or fitting shall be provided with plugs/caps to contain the test liquids.

19.5 In addition to the completely assembled sump samples, materials forming primary or secondary sump walls, fittings/accessories forming part of a liquid containment barrier, and structural components as per 19.2(f), alternate method shall be measured for physical property retention as per Section 12, Material Properties Tests, after exposures. Sets of three plaque/bar samples per time period for each liquid shall be:

a) Cut from sections of a production sump, lid, cover, frame or other component with a consistent minimum thickness; or

b) Cut or molded from specially prepared samples representative of the sump, fitting or accessory production materials, thickness and processes.

Exception: Gaskets fixed between rigid components (such as sump wall or clamp ring) or seal materials (such as joining epoxies) are exempt from these tests, but shall be evaluated for leakage within the sump assembly.

19.6 Following sample preparation, each assembled sump and components shall be exposed to the test liquids, exposure conditions and time periods as follows in Table 19.2. The sump assembly may be used as a storage container for plaque and bar samples. The test sump in Table 19.2 may be inverted so as to expose different portions or components to liquids or vapours.

19.7 Following completion of each exposure condition, the different sample types shall be evaluated per Table 19.3. If requested by the manufacturer, it is permitted to conduct non-destructive evaluations before the full time period for informational purposes.

Table 19.3
Compatibility Evaluation Details

Sample types	Primary containment	Secondary containment
Sump assembly	Visual Exam (1) and Repeat Leakage per 16.2	Visual Exam (1) and Repeat Leakage per 16.2
Fittings	Visual Exam (1) and Repeat Leakage per 16.3	Visual Exam (1) and Repeat Leakage per 16.3
Covers/lids	Visual Exam (1) and Repeat Leakage per 16.4	Visual Exam (1) and Repeat Leakage per 16.4
Chase pipe	Visual Exam (1) and Repeat Leakage per 16.5	Visual Exam (1) and Repeat Leakage per 16.5
Frames/brackets	Visual Exam (1) and Repeat Load Test per 16.2 (2)	Visual Exam (1) and Repeat Load Test per 16.2 (2)
Bars/plaques	Visual Exam (1) and Repeat Material Test per Section 12 (3)	Visual Exam (1) and Repeat Material Test per Section 12 (3)
(1) = There shall be no non-compliant damage for each material type as appropriate as per Section 11, General.		
(2) = Repeat Load Tests are not required if there is no evidence of material degradation as per Section 11, General, or if alternately evaluated for minimum 70 % physical property strength retention as per 19.2(f).		
(3) = Repeat Material Tests results measuring physical properties shall retain at least 70 % of the as received values.		

20 Manufacturing and Production Tests

20.1 General

20.1.1 All sump products and components shall be subjected to material, process, construction and performance checks by the manufacturer to adequately control the quality of the products. Material checks shall include pre-process acceptance of raw materials and post process evaluations of critical properties. Process checks shall include process parameters (such as time, temperature, pressure or other machine settings). Details of the manufacturer's quality control program shall be documented.

20.1.2 Construction checks shall include Dimensional Measurements (see 20.2).

20.1.3 Performance tests shall include a Leakage Test (see 20.3).

20.2 Dimensional measurements

20.2.1 Dimensional checks on finished sump products or components shall be conducted by the manufacturer to ensure compliance with at least the minimum/maximum ranges of critical shapes, dimensions, thickness and pipe thread or other connection specifications. Random sampling of batches or lots at a rate of at least 1 per 100 units shall be the minimum compliance criteria.

20.3 Leakage test

20.3.1 At least 1 per 100 completed sumps, lids, covers and fittings or individual sump components shall be subjected to the Leakage Tests in Section 16 at ambient or room temperature (per 11.12), except the test pressure may be reduced to the marked rating and the duration reduced to 1 min. Any combination of air, vacuum or water may be used with an appropriate leak detection method that shall have been shown to be accurate and repeatable. Prior to each testing period, any equipment used to identify a leak shall be demonstrated to be in working order.

MARKINGS

Advisory Note: Markings required by this Standard may have to be provided in other languages to conform with the language requirements of the country or region where the product is to be used. In Canada, there are two official languages, English and French.

21 General

21.1 Each completed sump product shall be marked with the following required information identified in this section on the product where visible after assembly. Markings for small fittings and accessories or field assembly kits or field assembly kits of multiple components are permitted on tags or packaging. Abbreviations may be used for smaller parts if detailed information is also provided in the manufacturer's instructions.

21.2 Permanent markings are defined as use of die or ink stamping, paint stenciling, etching or molding. Adhesive labels shall be evaluated for the intended surface for outdoor use in accordance with UL 969 or CSA C22.2 No. 0.15, using minimum/maximum temperature ratings of –29 °C to 60 °C (–20 °F to 140 °F), exposure to water, exposure to ultraviolet light, and occasional exposure to fuels.

21.3 Legible markings are defined as raised, indented, or printed text in minimum 0.08 in (2.03 mm) high letters for sumps, lids, covers, frames and brackets and minimum 0.04 in (1.02 mm) high letters for fittings in a contrasting color to the product or label surface. Other methods that are equivalent may be alternatively used.

21.4 All sump products shall be marked with the following general information in addition to specific information in 21.5 – 21.7, as applicable:

a) The manufacturer's name, trade name, trademark or other descriptive mark that identifies the company responsible for the product. If the product is manufactured at more than one location, a factory code shall also be provided;

Exception: The manufacturer's identification may be in a traceable code if the product is identified by the brand or trademark owned by a private labeler.

b) Manufacturing date, with a minimum combination of day, month, year, or time period not exceeding three consecutive months (for example, first quarter of the year);

Exception: A date code may be used provided it is traceable by the manufacturer, does not repeat in less than 20 years, and does not require reference to production records.

c) Catalog, model, part or equivalent number used by the manufacturer to identify the sump product or critical component;

d) The statement "For Installation by Qualified Persons – Follow All Instructions". and "Available At (*)" if not included with product per 22.1, where (*) is the link to the product website; and

e) For sump products shipped with protective packaging per 13.1.9 "Protective Packaging – Do Not Remove Until Installation".

21.5 In addition to the markings required by 21.4, all containment sumps (or the main section of a multiple part design for field assembly) shall be marked with:

a) The sump type "(*) Sump" where (*) = "Tank", "Dispenser", "Transition" "Fill", "Vent" "Fill/Vent", or “Above-grade”, as applicable;

b) The sump containment rating "Primary" or "Secondary";

c) The sump burial rating "Max __ ft m. Burial Depth", "At-Grade Use Only", as applicable;

Exception: Above-grade sumps.

d) The liquid rating "Automotive Fuels", or if evaluated for optional test liquids per Table 19.1 “B100a”, “Fuel Oil #6 @xx°C”, “M100”, “E100”, or “##”, as applicable;

– other flammable or combustible liquid;

e) The statement "Use Only OEM Recommended Fittings and Accessories"; and.

f) The sump liquid containment level rating “Max liquid level # %”, “Max liquid level # in (# mm) above highest penetration fitting” or other acceptable means of identifying the liquid level rating.

– numerical value as stated by the manufacturer

21.6 In addition to the markings required by 21.4, all sump fittings (or package of fitting components) shall be marked with:

a) The fitting type " Sump (*) Fitting" where (*) = "Penetration", "Termination", "Internal", "Test", "Monitor" or "Test/Monitor", as applicable;

b) The fitting containment rating "Primary", "Secondary" or "Coaxial", as applicable;

c) The liquid rating "Automotive Fuels", or if evaluated for optional test liquids per Table 19.1 “B100a”, “Fuel Oil #6 @xx°C”, “M100”, “E100”, or “##”, as applicable; and

– other flammable or combustible liquid

d) The nominal size (in or mm) and maximum pressure/vacuum rating (psig or kPa or in Hg or mm Hg), as applicable.

21.7 In addition to the markings required by 21.4, all sump accessories (or package of accessory components) shall be marked with:

a) The accessory type "Sump (*) Accessory" where (*) = "Lid" or "Cover", "Frame" or "Bracket" or "Chase Pipe", as applicable;

b) For lids or covers – "For Use With (*)" where (*) = the manufacturer and model or size of the mating sump or bracket evaluated for;

c) For frames and brackets – "Max (*)" where (*) = the max load rating (lb or kg) and/or number of shear valves evaluated for;

d) For chase pipe – "For Underground Pipe Routing", nominal size (in or mm) and minimum bend radius (ft or m) evaluated for; and