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NATIONAL STANDARD

ANSI/CAN/UL/ULC 2583:2021

STANDARD FOR SAFETY

Fuel Tank Accessories for Flammable and Combustible Liquids

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Approved American National Standard
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ANSI/UL 2583-2021

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UL Standard for Safety for Fuel Tank Accessories for Flammable and Combustible Liquids, ANSI/CAN/UL/ULC 2583

First Edition, Dated December 8, 2021

Summary of Topics

This First edition of ANSI/CAN/UL/ULC 2583 dated December 8, 2021, Standard for Fuel Tank Accessories for Flammable and Combustible Liquids, has been issued to reflect the latest ANSI and SCC approval dates, and to incorporate the proposals dated March 5, 2021 and July 30, 2021.

The requirements are substantially in accordance with Proposal(s) on this subject dated March 5, 2021 and July 30, 2021.

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ANSI/UL 2583-2021

DECEMBER 8, 2021

ANSI/CAN/UL/ULC 2583:2021

Standard for Fuel Tank Accessories for Flammable and Combustible Liquids

First Edition

December 8, 2021

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

The most recent designation of ANSI/UL 2583 as an American National Standard (ANSI) occurred on December 8, 2021. 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 December 8, 2021.

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Preface

This is the First Edition of ANSI/CAN/UL/ULC 2583, Standard for Fuel Tank Accessories for Flammable and Combustible Liquids.

UL 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 2583 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.

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.

This joint American National Standard and National Standard of Canada is based on, and now supersedes, CAN/ULC-S661, CAN/ULC-S663, and Outline of Investigation, UL 2583.

Comments or proposals for revisions on any part of the Standard may be submitted at any time. Proposals should be submitted via a Proposal Request in the On-Line 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 UL Standards Technical Panel (STP) on Valves for Flammable Fluids, STP 842.

This list represents the STP 842 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 842 Membership

Name	Representing	Interest Category	Region
Barker, Ann-Marie	Technical Standards and Safety Authority (TSSA)	AHJ	Ontario
Bishoff, Mark	Lorax Systems Inc.	Producer	Canada
Boyd, Dennis	BP America Inc.	Commercial/Industrial User	USA
Brossett, Matt	Morrison Bros Co.	Producer	USA

STP 842 Membership Continued on Next Page

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STP 842 Membership Continued

Name	Representing	Interest Category	Region
Deschamps, Claude	Régie du Bâtiment du Québec (RBQ)	AHJ	Quebec
Dutton, John	J Dutton	General Interest	Canada
Fasel, Mark	Viega LLC	Producer	USA
Henderson, Tom	State Water Resources Control Board	AHJ	USA
Koch, Wolf	Technology Resources International	General Interest	USA
Kuehn, Justin	Franklin Fueling Systems Inc.	Producer	USA
Lauber, Matt	OPW Fueling Components	Producer	USA
Legault, Pierre	Integrated Review Services – Consulting	General Interest	Ontario
Meyer, Jeanne Murphy	Core Engineered Solutions Inc.	Supply Chain	USA
Petersen, James	Petersen Engineering	General Interest	USA
Prusko, Jeffrey	Underwriters Laboratories Inc.	Project Manager – Non-voting	USA
Wade, John A.	ULC Standards	STP Chair – Non-voting	Canada
Werner, Laura	ULC Standards	Project Manager – Non-voting	Canada
Wiegert, B.	PMMIC	General Interest	USA
Wolff-Klammer, Edgar	UL LLC	Testing and Standards Org	USA

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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 These requirements cover mechanical type accessories that are typically intended for attachment to storage tanks or connecting pipe for flammable and combustible liquids in commercial (public) or private (fleet) automotive fueling station and similar storage or dispensing applications and are designed to provide automatic safety or operational functions.

1.2 These products may be used with underground or aboveground tank systems and with liquid and/or vapor phases of the fuels and similar fuels or liquids covered by each Part of this Standard as identified below:

a) Part I Vapor Control Products – applies to functional devices and accessories intended for connection to tank top openings (directly on fittings or indirectly on pipe) and perform safety or operational functions in vapor spaces, such as emergency vents, normal vents, interstitial vacuum/e-vent plugs, adapters and caps.

b) Part II Liquid Control Products – applies to functional devices and accessories intended for connection to tank top openings (directly on fittings or indirectly on pipe) and perform safety or operational functions in liquid spaces, such as spill containment devices, overfill prevention devices, and liquid level gauges.

c) Part III Structural and Containment Products (reserved for future use) – applies to metallic components such as access devices, manways, supports, and dikes.

d) Part IV Corrosion Protection Products (reserved for future use) – applies to components such as tank anchors, coatings and resins.

e) Part V Miscellaneous Products – applies to devices and accessories such as portable/mobile tank spill prevention devices, lift lugs, striker plates and monitor well caps.

1.3 These products are intended for use with storage tanks or fueling systems containing automotive fuels and similar fuels or liquids under the expected use conditions and exposures that have similar chemical, physical and material compatibility properties as represented in these requirements. The applicable fuels are intended to be formulated as:

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.

1.4 Products covered by this Standard are intended to be installed and used in accordance with the applicable documents in the following list:

a) In the United States:

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1) NFPA 30, Flammable and Combustible Liquids Code;

2) NFPA 30A, Code for Motor Fuel Dispensing Facilities and Repair 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, such as DOT for portable/mobile tanks.

b) In Canada:

1) National Fire Code of Canada;

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

3) CCME PN1326, 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.

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

1.6 Requirements for use in hazardous locations are also provided for any electrical devices and components that form part of the accessory(ies).

1.7 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.

1.8 These requirements do not address use of the accessories after natural disasters, fires or exposures to chemicals not representative of the test liquids/vapors or excessive physical damage beyond the expected assembly, installation and uses as identified in these requirements.

1.9 These requirements do not address special applications where the accessories are 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.

1.10 Emergency vent (E-vent) and Pressure/Vacuum vent (P/V-vent) requirements do not cover flame arrester features. The applicable requirements are found in the Standard for Flame Arresters, UL 525, but may optionally be addressed by EPA 40 CFR Part 63 Subpart CCCCCC, CARB (CP-201), CCME PN1184, Environmental Code of Practice for Vapour Recovery During Vehicle Refueling at Service Stations and Other Gasoline Dispensing Facilities, or other air quality regulations at the request of the manufacturer.

1.11 The requirements for Overfill Preventers do not cover any general-purpose manual or automatic safety valves. The applicable requirements are found in UL/ULC 842, UL 842A and UL 842B. Requirements for combustible liquid only rated devices are found in UL/ULC 180.

1.12 The requirements for Spill Containers are intended for aboveground tank applications and do not cover long term fuel exposures or use as a tank sump for underground or below-grade applications, which are found in UL 2447 and CAN/ULC-S664.

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1.13 Communication requirements, for characteristics such as electromagnetic compatibility (EMC), electromagnetic interference (EMI) including regulations of the Federal Communications Commission (FCC) or Industry Canada for wired or wireless options are not covered under this Standard.

2 Units of Measurement

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

3 Reference Publications

3.1 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.

UL Standards

UL 157, *Standard for Gaskets and Seals*
UL 525, *Standard for Flame Arresters*
UL 842A, *Standard for Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85)*
UL 842B, *Standard for Valves for Diesel Fuel, Biodiesel Fuel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations up to 20 Percent (B20), Kerosene, and Fuel Oil*
UL 913, *Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations*
UL 969, *Standard for Marking and Labeling Systems*
UL 1203, *Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations*
UL 1238, *Standard for Control Equipment for Use with Flammable Liquid Dispensing Devices*
UL 1332, *Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment*
UL 2447, *Outline of Investigation for Containment Sumps, Fittings and Accessories for Fuels*
UL 60079-1, *Explosive Atmospheres – Part 1: Equipment Protection by Flameproof Enclosures “d”*
UL 60079-5, *Explosive Atmospheres – Part 5: Equipment Protection by Powder Filling “q”*
UL 60079-6, *Explosive Atmospheres – Part 6: Equipment Protection by Liquid Immersion "o"*
UL 60079-7, *Explosive Atmospheres – Part 7: Equipment Protection by Increased Safety “e”*
UL 60079-11, *Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety “i”*
UL 60079-15, *Explosive Atmospheres – Part 15: Equipment Protection by Type of Protection "n"*
UL 60079-18, *Explosive Atmospheres – Part 18: Equipment Protection by Encapsulation "m"*
UL 60079-28, *Explosive Atmospheres – Part 28: Protection of Equipment and Transmission Systems Using Optical Radiation*
UL 61010-1, *Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use – Part 1: General Requirements*
UL 121201, *Standard for Safety for Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations*

ULC Standards

CAN/ULC-S601, *Standard for Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids*
CAN/ULC-S603, *Steel Underground Tanks for Flammable and Combustible Liquids*
CAN/ULC-S603.1, *External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids*
CAN/ULC-S664, *Standard for Containment Sumps, Sump Fittings, and Accessories for Flammable and Combustible Liquids*

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UL/ULC Standards

ANSI/CAN/UL/ULC 180, *Standard for Combustible Liquid Tank Accessories*
ANSI/CAN/UL/ULC 842, *Standard for Valves for Flammable and Combustible Liquids*
ANSI/CAN/UL/ULC 2586, *Standard for Hose Nozzle Valves for Flammable and Combustible Liquids*

Other Standards

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*
ASTM D471, *Standard Test Method for Rubber Property – Effect of Liquids*
ASTM D664, *Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration*
ASTM D910, *Standard Specification for Leaded Aviation Gasolines*
ASTM D975, *Standard Specification for Diesel Fuel*
ASTM D1655, *Standard Specification for Aviation Turbine Fuels*
ASTM D3699, *Standard Specification for Kerosine*
ASTM D4304, *Standard Specification for Mineral and Synthetic Lubricating Oil Used in Steam or Gas Turbines*
ASTM D4806, *Standard Specification for Denatured Fuel Ethanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel*
ASTM D4814, *Standard Specification for Automotive Spark-Ignition Engine Fuel*
ASTM D5798, *Standard Specification for Fuel Ethanol Blends for Flexible-Fuel Automotive Spark-Ignition Engines*
ASTM D6158, *Standard Specification for Mineral Hydraulic Oils*
ASTM D6615 Rev A, *Standard Specification for Jet B Wide-Cut Aviation Turbine Fuel*
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 D7719, *Standard Specification for High Aromatic Content Unleaded Hydrocarbon Aviation Gasoline*
ASTM D7862, *Standard Specification for Butanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel*
ASTM G153, *Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials*
ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*
CARB CP-201, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities*
CARB TP-201.1E, *Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves*
CCME PN1184, *Environmental Code of Practice for Vapour Recovery During Vehicle Refueling at Service Stations and Other Gasoline Dispersing Facilities*
CCME PN1326, *Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products*
CEPA, 1999, *Canadian Environmental Protection Act*
CGSB-3-GP-531M, *Methanol, Technical*
CGSB-3.11, *Naval Distillate Fuel*
CAN/CGSB-3.18, *Diesel Fuel for Locomotive-Type Medium-Speed Diesel Engines*
CAN/CGSB-3.2, *Heating Fuel Oil*
CAN/CGSB-3.22, *Wide-Cut Type Aviation Turbine Fuel (Grade JET B)*
CAN/CGSB-3.23, *Aviation Turbine Fuel (Grades JET A and Jet A-1)*
CAN/CGSB-3.24, *Aviation Turbine Fuel (Military Grades F-34, F-37 and F-44)*
CAN/CGSB-3.27, *Naphtha Fuel*
CAN/CGSB-3.3, *Kerosene*
CAN/CGSB-3.5, *Automotive Gasoline*
CAN/CGSB-3.511, *Oxygenated Automotive Gasoline Containing Ethanol (E1-E10)*
CAN/CGSB-3.512, *Automotive ethanol fuel (E50-E85)*
CAN/CGSB-3.516, *Denatured Fuel Ethanol for Use in Automotive Spark-Ignition Fuels*
CAN/CGSB-3.517, *Diesel Fuel*
CAN/CGSB-3.520, *Diesel Fuel Containing Low Levels of Biodiesel (B1-B5)*

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CAN/CGSB-3.522, *Diesel Fuel Containing Biodiesel (B6-B20)*
CAN/CGSB-3.524, *Biodiesel (B100) for Blending in Middle Distillate Fuels*
CGSB-3.6, *Off-Road Diesel Fuel*
CSA-A123.3, *Asphalt Saturated Organic Roofing Felt*
CSA-B139, *Installation Code for Oil-Burning Equipment*
CSA C22.2 No. 0.15, *Adhesive Labels*
CSA C22.2 No. 30, *Explosion-proof equipment*
CSA C22.2 No. 142, *Process Control Equipment*
CSA C22.2 No. 157, *Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations*
CSA C22.2 No. 60079-1, *Explosive atmospheres – Part 1: Equipment protection by flameproof enclosures "d"*
CSA C22.2 No. 60079-5, *Explosive atmospheres – Part 5: Equipment protection by powder filling "q"*
CSA C22.2 No. 60079-6, *Explosive atmospheres – Part 6: Equipment protection by liquid immersion "o"*
CSA C22.2 No. 60079-7, *Explosive atmospheres – Part 7: Equipment protection by increased safety "e"*
CSA C22.2 No. 60079-11, *Explosive atmospheres – Part 11: Equipment protection by intrinsic safety "i"*
CSA C22.2 No. 60079-15, *Explosive atmospheres – Part 15: Equipment protection by type of protection "n"*
CSA C22.2 No. 60079-18, *Explosive atmospheres – Part 18: Equipment protection by encapsulation "m"*
CSA C22.2 No. 60079-28, *Explosive atmospheres —– Part 28: Protection of equipment and transmission systems using optical radiation*
EPA 40 CFR Part 63, *National Emission Standards for Hazardous Air Pollutants for Source Category: Gasoline Dispensing Facilities*
EPA 40 CFR Part 80, *Regulation of Fuels and Fuel Additives*
EPA 40 CFR Parts 280 and 281, *Underground Storage Tanks Containing Petroleum*
NFPA 1, *Fire Code*
NFPA 30, *Flammable and Combustible Liquids Code*
NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages*
NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*
NFC, *National Fire Code of Canada*
SAE J1681, *Gasoline, Alcohol, and Diesel Fuel Surrogates for Material Testing*

Abbreviations

ANSI – American National Standards Institute
ASTM – American Society for Testing and Materials
CAN – National Standard of Canada designation
CARB – California Air Resources Board
CCME – Canadian Council of the Ministers of the Environment
CFR – Code of Federal Regulations
CGSB – Canadian General Standards Board
CSA – CSA Group
EPA – Environmental Protection Agency
NFPA – National Fire Protection Association
SAE – Society of Automotive Engineers

4 Glossary

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

4.2 ADAPTER (Automatic Tank Gauge (ATG), Fill Opening and/or Vapor Types) – Devices designed to connect tank fittings or pipe to normal vents and filling hose or vapor recovery hose or liquid level monitoring equipment. Adapters are intended for installation on aboveground or underground tanks or to connecting pipe above the normal liquid level. Adapters may have lock, swivel and/or self-seal features, and may be separate from, or attached to, other devices.

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4.3 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.

4.4 CAP (Adapter or Tank Types) – Devices designed to prevent water or debris from entering adapter, tank or pipe openings, and are intended for periodic removal to facilitate fill, vent or liquid level monitoring operations. Caps may also have locking features and/or allow passage of low voltage monitor or sensor wiring, and may be separate from, or attached to, other devices above the normal liquid level.

4.5 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.

NOTE: The definition of Combustible Liquid applied in NFPA documents differs from the above in that it does not include the upper flashpoint limit. This results from the fact that Class IIIB liquids are included in the scope of NFPA 30, but not in the scope of the National Fire Code of Canada.

4.6 DOUBLE WALL TANK(S) (aka DWT) – A primary tank with an integral secondary containment where the inner and outer walls are in intimate contact and the interstice is vacuum monitored.

4.7 EMERGENCY VENT (aka E-Vent) – Normally closed devices designed to automatically relieve excessive internal tank pressures of primary compartments or interstitial spaces during a fire exposure. Emergency vents are intended for installation above the normal liquid level on aboveground tanks, on short lengths of connecting vent pipe, or on extended pipe systems where remote venting is required.

Note: Factory installed interstitial vacuum/e-vent plugs are considered single-use, for a pressure relief event, on double wall tanks described in CAN/ULC-S601.

4.8 FLAMMABLE LIQUID – Any liquid having a flash point below 37.8 °C (100 °F) and a vapor 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.

4.9 FLOW RATING – The volume/time value for normal or emergency vents measured under steady flow conditions at a specific pressure or vacuum for marked rating purposes.

4.10 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, Standard Specification for Automotive Spark-Ignition Engine Fuel, or CAN/CGSB-3.511, Oxygenated Automotive Gasoline Containing Ethanol (E1-E10): AKA gasoline, gasohol, oxygenated gas, or low blend ethanol (maximum E10);

b) ASTM D5798, Standard Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines, or CAN/CGSB-3.512, Automotive ethanol fuel (E50-E85): AKA high blend ethanol or (E51 – E83);

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

d) ASTM D7467, Standard Specification for Diesel Fuel Oils, Biodiesel Blend, or CAN/CGSB-3.522, Diesel Fuel Containing Biodiesel (B6 – B20): AKA mid blend biodiesel (B6 – B20);

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e) Mid-Range Ethanol Blends (E11 – E50) using variable mixtures of ASTM D4814 or CAN/CGSB-3.511 Low Blend Ethanol and ASTM D5798 or CAN/CGSB-3.512 High Blend Ethanol.

f) Isobutanol Fuel Blends (maximum iBu16) using variable mixtures of ASTM D4814 or CAN/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).

4.11 INTENDED (aka Recommended) – An application, use or connection of the product or device in accordance with the manufacturer's instructions.

4.12 LIQUID LEVEL GAUGE (aka Level Gauge or LLG) – A device that accurately detects, measures and displays the liquid level(s)in a storage tank, primarily fuel, and optionally identifies water bottoms. These devices may be mechanical, electrical, or a combination thereof, typically consisting of a level sensor and an attached or remote display and optional audible and/or visual indicator.

4.13 MANWAY – An opening on a tank designed to provide personnel with access to the interior of the tank.

4.14 NORMAL VENT (aka Pressure/Vacuum Vent, N-Vent or P/V Vent) – Normally closed device designed to automatically equalize tank pressure or vacuum in primary compartments or interstitial spaces due to atmospheric changes or fill and withdraw operations. Normal vents are intended for installation above the normal liquid level on aboveground or underground tanks, or on short lengths of connecting vent pipe, or on extended piping systems where remote venting is required.

4.15 OVERFILL PREVENTION DEVICES (aka Overfill Preventers or OPDs) – A device installed in a tank's fill opening (typically assembled to the fill adapter and drop tube) that significantly reduces the potential for overfilling the tank either above the rated liquid level, or beyond the primary containment capacity. Mechanical OPDs are typically float arm types connected to a closing valve that indicate overfill conditions to the operator, and may be designed for gravity fill, pressure fill or both types. Electrical OPDs are typically magnetic or ultrasonic type sensors wired to a remote-control panel that supplies power and analyzes data, so as to signal the operator when the liquid level is near an overfill condition, and may have audible and/or visual signals.

4.16 PORTABLE/MOBILE TANK SPILL PREVENTION DEVICE (aka PTSPD) – A device intended for field installation into the fill opening of a portable/mobile tank to prevent or significantly reduce leakage out of the opening during on/off road transport on vehicles (such as pick-up trucks) over rough terrain.

4.17 RELIEF PRESSURE or RELIEF PRESSURE/VACUUM (aka Crack Pressure, Operational Relief or Emergency Relief) – The pressure or vacuum at which a normal or emergency vent begins to open and operate under low flow conditions.

4.18 SPILL CONTAINMENT DEVICES (aka Spill Containers or SCDs) – An aboveground, liquid-tight, weather resistant container designed to temporarily collect and retain small fuel spills that can occur during tank filling processes. SCDs are also provided with means for evacuation to an appropriate container and may either be integral to the tank around the fill opening (spin-on or weld-on type spill containers) or attached to remote fill stations connected to the tank with piping (side mounted or standalone type fill boxes).

4.19 STRIKER PLATES – also known as impact pads, deflector or deflection plates, or gauge plates. A device designed to prevent possible damage to the inside tank wall surface from repeated impact of dipsticks or other devices used to gauge tank contents.

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CONSTRUCTION

5 General Construction – All Tank Accessories

5.1 Tank accessories shall be designed and constructed to resist damage and/or malfunction resulting from expected assembly, installation, environmental and other use conditions for their intended application(s) in accordance with the applicable performance tests described in this Standard.

5.2 Tank accessories may be constructed from any combination of materials, and shall be capable of assembly, installation and inspection by qualified persons. Wires or cables connecting device components, such as sensors and panels, shall be rated for the intended location and use.

5.3 Tank accessories provided with threaded connections shall be of NPT, NPTF, BSPT, BSPP, MPSM, or similar types using industry recognized specifications, or if a proprietary type, both ends shall be supplied by the manufacturer.

5.4 If required for a specific product, testing in accordance with the requirements of 21.1, Electrical Continuity Test, shall be used to determine acceptable electrical grounding and bonding.

5.5 Refer to Part I for specific Vapor Control Product requirements.

5.6 Refer to Part II for specific Liquid Control Product requirements.

5.7 Refer to Part III Structural and Containment Products (reserved for future use)

5.8 Refer to Part IV Corrosion Protection Products (reserved for future use)

5.9 Refer to Part V Miscellaneous Products

PERFORMANCE

6 General Performance – All Tank Accessories

6.1 Representative production samples of each tank accessory or component shall be subjected to the appropriate Performance Tests, with sample variations of product type, design, material and size as specified in each test method.

6.2 Representative samples for Performance Tests are defined as either:

a) “ALL” = all nominal or trade sizes within a manufacturer's product range for each design series;

b) “WC” = worst case size, thickness, materials or other variations in a design series; or

c) As otherwise indicated in a specific test.

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

6.3 Assembly of tank accessory samples and connection to intended pipe, hose or fittings shall be done in accordance with the manufacturer’s instructions (such as thread torque or other critical assembly parameters) using manufacturer-supplied components (such as gaskets).

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6.4 Damage of any critical product or component after testing (if required for assessment of function, selection of WC samples, or manufacturer's instruction information), shall be determined by visual examination without magnification. The following items are examples of non-compliant results; however, the final determination of damage characteristics shall consider input from the manufacturer prior to testing, or shall be qualified by a specific test pass/fail criterion:

a) Inability of functional parts to operate as intended from either mechanical damage or exposure incompatibility, (such as bent or corroded springs, or torn or distorted seals);

b) Cracking, splitting, or permanent distortion of structural or protective components (such as bodies or enclosures), and dislodging or puncture of screens or caps;

c) Other damage that would result in a reduction of the safety functions that the product is intended to perform.

Exception No. 1: If the damage is obviously visible during initial installation, and it is indicated in the manufacturer's instructions, per 28.3(d), that products with this specific damage may be placed into service, then it is acceptable.

Exception No. 2: If protective packaging is used to prevent damage during storage and transit, and markings per 27.1(g) indicating it should not be removed prior to installation, the drop test may be conducted with the packaging in place.

6.5 Unless otherwise indicated in a specific test method, all tests shall be conducted with working fluids (air, water, etc.) at 21 ±5.6 °C (70 ±10 °F) or at normal ambient room temperatures between 18 °C and 29 °C (65 °F and 85 °F) and 50 % (±20 %) RH. All pressures shall be measured with respect to gauge (psig).

6.6 Unless otherwise indicated in a specific test method, hydrostatic strength tests shall be conducted with water (or similar liquids) and pneumatic tests shall be conducted with air (or similar gasses). In either case, precautions shall be used to prevent personal injury, in the event of product or test equipment failures at high pressures.

PART I – VAPOR CONTROL PRODUCTS

CONSTRUCTION

7 General

7.1 Emergency vents shall meet the following construction criteria:

a) Not exceed a 2.0 in to 12.0 in (50.8 to 304.8 mm) nominal pipe size range;

b) Be normally closed;

c) Resist the entry of water; and

d) Provide initial emergency pressure relief within a 0.5 psig to 1.0 psig (3.4 to 6.9 kPa) pressure range, or if this is below 0.5 psig (3.4 kPa), the product marking shall identify that the relief pressure is below 0.5 psig (3.4 kPa), refer to 27.1(c).

7.2 Normal vents shall meet the following construction criteria:

a) Not exceed a 2.0 in to 6.0 in (50.8 to 152.4 mm) nominal pipe size range;

b) Be normally closed;

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c) Resist the entry of water; and

d) Provide initial operational pressure relief within a 0 to 1.0 psig (0 to 6.9 kPa) pressure range and 0 to 0.5 psig (0 to 3.4 kPa) vacuum range.

7.3 Fill and vapor adapters shall meet the following construction criteria:

a) Not exceed a 2.0 in to 4.0 in (50.8 to 101.6 mm) nominal pipe size range;

b) Provide leak tight connections to couple with typical delivery hoses;

c) Withstand typical delivery truck operating pump and vacuum pressures; and

d) For UST Types – Meet CARB CP-201 Fig 3A (Fill) or Fig 3B (Vapor) dimensional specifications or meet the requirements of CCME Environmental Code of Practice for Vapour Recovery During Vehicle Refueling at Service Stations and Other Gasoline Dispensing Facilities.

7.4 Adapter Caps shall meet the following construction criteria:

a) Be readily removable during delivery operations;

b) Protect adapter hose connections from physical damage; and

c) Protect adapter openings against entry of water and debris.

7.5 Tank Caps shall meet the following construction criteria:

a) Be readily removable during inspection operations;

b) Protect monitor/sensor wiring (if included) from pullout; and

c) Protect tank openings against entry of water and debris.

PERFORMANCE

8 General Test Matrix

8.1 Representative production samples of each vapor control product or component shall be subjected to the appropriate Performance Tests identified in Table 8.1 with sample variations of product type, design, material and size as specified in each test method.

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Table 8.1
Vapor Control Products Test Matrix

Performance tests	E-Vents	N-Vents	Adapters/Caps
Functional Tests	9.1	10.1	11.1
E-Vent Relief and Flow	12.1	–	–
N-Vent Relief and Flow[a]	–	12.2	–
Leakage and Hydrostatic strength	–	–	12.3
Assembly/Abuse Tests	9.2	10.2	11.2
Drop	13.1	13.1	13.1
Assembly	13.2	13.2	13.2

Table 8.1 Continued on Next Page

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Table 8.1 Continued

Performance tests	E-Vents	N-Vents	Adapters/Caps
Impact	13.3	13.3	13.3
Repeat Function	13.4[b]	13.4[b]	13.4[b]
Exposure/Compatibility Tests	9.3	10.3	11.3
Air Aging	14.1[c]	14.1[c]	14.1[c]
UV Light	14.2[c]	14.2[c]	14.2[c]
Salt Fog	14.3[c]	14.3[c]	14.3[c]
Fuel Exposure (Vapor)	14.4[c]	14.4[c]	14.4[c]
Repeat Function	14.5[b]	14.5[b]	14.5[b]
Special Tests	9.4	10.4	11.4
Rain	15.1	15.1	–
Icing	15.2	15.2	–
Fire	15.3	–	–
Leak Rate[a]	–	15.4[a]	–
Cycling	–	15.5	15.5
Repeat Function	15.6[b]	15.6[b]	15.6[b]
Metallic Stress Crack	15.7[c]	15.7[c]	15.7[c]
Nonmetallic Stress Crack	15.8[c]	15.8[c]	15.8[c]

[a] Optional testing to air quality regulations.

[b] Dependent upon sample condition and test results.

[c] Dependent upon material(s).

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9 Emergency Vent Tests

9.1 Emergency vent functional tests

9.1.1 As specified in 12.1, Emergency vent tests for pressure relief and flow rating, one emergency vent sample in each size shall be subjected to Functional Tests for Pressure Relief and Flow Rating under the following conditions:

a) Room temperature and, if applicable, to affected products (per 9.1.2 and 9.1.3);

b) High temperature of 50 ±2 °C (122 ±3.6 °F) using the same sample; and/or

c) Low temperature of -30 ±2 °C (-22 ±3.6 °F) using the same sample.

The results shall be used for the initial determination of compliance (per 12.1, Emergency vent tests for pressure relief and flow rating) and to establish marked ratings [per 27.1(c)(1)]. The results shall also establish a baseline, against which results from repeat tests after other test conditions are judged for comparison.

9.1.2 To determine whether tests at high and/or low temperatures are needed, assessment of the design and materials with respect to increased pressure relief or reduced air flow shall use engineering principles including, but not limited to, the effects of thermal expansion and/or contraction and thermal changes in viscosity, flexibility, hardness, adhesion, etc.

9.1.3 If the high and/or low temperature effect on performance cannot be determined, at least the largest and smallest sizes shall be subjected to the exposure condition(s) and then retested, and if they are found

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to have lower performance results than at room temp, the worst values shall be applied to ratings of all sizes in the product range.

9.2 Emergency vent assembly and abuse tests

9.2.1 As specified in Section 13, Assembly and Abuse Tests, one emergency vent sample in each size shall be subjected to sequential testing under the following conditions. Refer to 6.4 for requirements for damage assessment, and for exceptions:

a) Room temperature and, if applicable, to affected products (per 9.2.2 and 9.2.3);

b) High temperature of 50 ±2 °C (122 ±3.6 °F), using new samples; and/or

c) Low temperature of -30 ±2° C (-22 ±3.6 °F), using new samples.

9.2.2 To determine whether tests at high and/or low temperatures are needed, assessment of the design and materials with respect to increased damage causing reduced function from all abuse tests at each temperature shall use engineering principles including, but not limited to, changes in material strength, impact resistance, flexibility, etc., resulting from temperature changes or heat transfer.

9.2.3 If the WC sample size for reduced performance after each abuse test at each temperature cannot be determined, at least the largest and smallest sizes shall be subjected to the exposure condition(s) and then retested for function, with the worst values applied to ratings of all sizes in the product range.

9.3 Emergency vent exposure and compatibility tests

9.3.1 As specified in Section 14, Long Term Compatibility Tests, one WC emergency vent sample (per 9.3.2) shall be subjected to each applicable Exposure and Compatibility Test below, followed by repeat testing in accordance with 13.3, Impact test:

a) Aging (refer to 14.1) – for designs with functional polymers and/or liquids;

b) UV Light (refer to 14.2) – for designs with external polymers;

c) Salt Fog (refer to 14.3) – for designs with functional metals; and

d) Fuel Compatibility (Vapors only, refer to 14.4) – for all designs and materials except for DWT Interstitial Vacuum/E-Vent Plugs.

Following completion of each test, samples shall be assessed for damage, with WC sample(s) subjected to repeat testing in accordance with 14.5, Functional testing after long term compatibility tests, if applicable. The results shall then be compared to initial values, and ratings revised if applicable (per 9.3.3).

9.3.2 To determine the WC sample, assessment of design and materials with respect to changes or damage causing reduced function from each condition shall use engineering principles including, but not limited to, material changes or reduced impact resistance from metal corrosion and polymer or elastomer changes in dimensions, flexibility, hardness, or other key characteristics. The WC sample size shall be consistent for comparison purposes.

9.3.3 WC sample(s) selected for repeat Functional Tests shall be based on material change or damage that may result in reduced performance. If a WC sample cannot be determined, multiple samples, with the worst values applied to ratings of all sizes in the product range, shall be tested.

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9.4 Emergency vent special tests

9.4.1 As specified in Section 15, Special Tests, one WC emergency vent sample shall be subjected to each Special Test below as applicable:

a) Rain (refer to 15.1) – for all designs and materials except for DWT Interstitial Vacuum/E-Vent Plugs;

b) Icing (refer to 15.2) – for all designs and materials;

c) Fire (refer to 15.3) – for all designs and materials;

d) Metallic Stress Crack (refer to 15.7) – for designs with fittings of ≥15 % zinc; and

e) Nonmetallic Stress Crack (refer to 15.8) – for designs with polyethylene (any type or percentage blend) components.

Following completion of each applicable test, samples shall meet the individual pass/fail criteria and, if required, be subjected to repeat testing in accordance with 15.6, Repeat functional testing after special tests.

9.4.2 To determine the WC sample, assessment of the design and materials with respect to the intent of each Special Test and highest failure probability shall be selected. If a WC sample cannot be determined, multiple samples shall be tested.

10 Normal Vent Tests

10.1 Normal vent functional tests

10.1.1 As specified in 12.2, Normal vent tests for pressure/vacuum relief and flow rating, one sample in each size shall be subjected to Functional Tests for Pressure/Vacuum Relief and Flow Rating under the following conditions:

a) Room temperature and, if applicable, to affected products (per 10.1.2 and 10.1.3);

b) High temperature of 50 ±2 °C (122 ±3.6 °F) using the same sample; and/or

c) Low temperature of -30 ±2 °C (-22 ±3.6 °F) using the same sample.

The results shall be used for initial compliance (as specified in 12.2, Normal vent tests for pressure/vacuum relief and flow rating) and marked ratings [per 27.1(c)(2)] and shall also establish a baseline to which repeat tests after other test conditions are judged for comparison.

10.1.2 To determine whether tests at high and/or low temperatures are needed, assessment of the design and materials with respect to increased pressure/vacuum relief or reduced air flow shall use engineering principles including, but not limited to, the effects of thermal expansion and/or contraction and thermal changes in viscosity, flexibility, hardness, adhesion, etc.

10.1.3 If the high and/or low temperature effect on performance cannot be determined, at least the largest and smallest sizes shall be subjected to the exposure condition(s) and then retested, and if they are found to have lower performance results than at room temperature, the worst pressure/vacuum values shall be applied to ratings of all sizes in the product range.

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10.2 Normal vent assembly and abuse tests

10.2.1 As specified in Section 13, Assembly and Abuse Tests, one normal vent sample in each size shall be subjected to sequential testing under the following conditions. Refer to 6.4 for requirements for damage assessment, and for exceptions:

a) Room temperature and, if applicable, to affected products (per 10.2.2 and 10.2.3);

b) High temperature of 50 ±2 °C (122 ±3.6 °F) using new samples; and/or

c) Low temperature of -30 ±2 °C (-22 ±3.6 °F) using new samples.

Following completion of all tests, samples shall be assessed for damage, with WC sample(s) subjected to repeat testing in accordance with 13.4, Repeat functional testing after assembly and abuse tests, if applicable. The results shall then be compared to initial values, and ratings revised if applicable (per 10.2.3).

10.2.2 To determine whether tests at high and/or low temperatures are needed, assessment of the design and materials with respect to increased damage causing reduced function from all Abuse Tests at each temperature shall use engineering principles including, but not limited to, changes in material strength, impact resistance, flexibility, etc., resulting from temperature changes or heat transfer.

10.2.3 If the WC sample size for reduced performance after each Abuse Test at each temperature cannot be determined, at least the largest and smallest sizes shall be subjected to the exposure condition(s) and then retested for function, with the worst values applied to ratings of all sizes in the product range.

10.3 Normal vent exposure and compatibility tests

10.3.1 As specified in Section 14, Long Term Compatibility Tests, one WC normal vent sample shall be subjected to each applicable Exposure and Compatibility Test below, followed by repeat testing in accordance with 13.3, Impact Test:

a) Aging (refer to 14.1) – for designs with functional polymers and/or liquids;

b) UV Light (refer to 14.2) – for designs with external polymers;

c) Salt Fog (refer to 14.3) – for designs with functional metals; and

d) Fuel Compatibility (Vapors only, refer to 14.4) – for all designs and materials.

Following completion of each test, samples shall be assessed for damage, with WC sample(s) subjected to repeat testing in accordance with 14.5, Repeat Functional testing after long term compatibility tests, if applicable. The results shall then be compared to initial values, and ratings revised if applicable (per 10.3.3).

10.3.2 To determine the WC sample, assessment of design and materials with respect to changes or damage causing reduced function from each condition shall use engineering principles including, but not limited to, material changes or reduced impact resistance from metal corrosion and polymer or elastomer changes in dimensions, flexibility, hardness, or other key characteristics. The WC sample size shall be consistent for comparison purposes.

10.3.3 WC sample(s) selected for repeat Functional Tests shall be based on material change or damage that may result in reduced performance. If WC samples cannot be determined, multiple samples, with the worst values applied to ratings of all sizes in the product range, shall be tested.

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10.4 Normal vent special tests

10.4.1 As specified in Section 15, Special Tests, one WC normal vent sample (per 10.4.2) shall be subjected to each Special Test below as applicable:

a) Rain (refer to 15.1) – for all designs and materials;

b) Icing (refer to 15.2) – for all designs and materials;

c) Leak Rate (refer to 15.4) – (optional) for air quality compliance;

d) Cyclic Endurance (refer to 15.5) – for all designs and materials;

e) Metallic Stress Crack (refer to 15.7) – for designs with fittings of ≥15 % zinc; and

f) Nonmetallic Stress Crack (refer to 15.8) – for designs with polyethylene (any type or percentage blend) components.

Following completion of each applicable test, samples shall meet the individual pass/fail criteria and, if required, shall be subjected to repeat testing in accordance with 15.6, Repeat functional testing after special tests.

10.4.2 To determine the WC sample, assessment of the design and materials with respect to the intent of each Special Test and highest failure probability shall be selected. If a WC sample cannot be determined, multiple samples shall be tested.

11 Adapter and Cap Tests

11.1 Adapter and cap functional tests

11.1.1 As specified in 12.3, Adapter and cap leakage and hydrostatic strength tests, one sample in each size shall be subjected to Functional Tests for Leakage and Hydrostatic Strength under the following conditions:

a) Room temperature and, if applicable, to affected products (per 11.1.2 and 11.1.3);

b) High temperature of 50 ±2 °C (122 ±3.6 °F) using the same sample; and/or

c) Low temperature of -30 ±2 °C (-22 ±3.6 °F) using the same sample.

The results shall be used for initial compliance with leakage and hydrostatic strength pressure/vacuum values (as specified in 12.3, Adapter and cap leakage and hydrostatic strength tests) and shall also establish a baseline to which repeat tests after other test conditions are judged for comparison.

11.1.2 To determine whether tests at high and/or low temperatures are needed, assessment of the design and materials with respect to leakage or rupture shall use engineering principles including, but not limited to, the effects of thermal expansion and/or contraction and thermal changes in strength, flexibility, hardness, etc.

11.1.3 If the high and/or low temperature effect on performance cannot be determined, at least the largest and smallest sizes shall be subjected to the exposure condition(s) and then retested, and if they are found to have lower performance results than at room temperature, the worst pressure/vacuum values shall be applied to ratings of all sizes in the product range.

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11.2 Adapter and cap assembly and abuse tests

11.2.1 As specified in Section 13, Assembly and Abuse Tests, one adapter and cap sample in each size shall be subjected to sequential testing under the following conditions: Refer to 6.4 for requirements for damage assessment, and for exceptions.

a) Room temperature and, if applicable, to affected products (per 11.2.2 and 11.2.3);

b) High temperature of 50 ±2 °C (122 ±3.6 °F) using new samples; and/or

c) Low temperature of -30 ±2 °C (-22 ±3.6 °F) using new samples.

Following completion of all tests, samples shall be assessed for damage, with WC sample(s) subjected to repeat testing in accordance with 13.4, Repeat functional testing after assembly and abuse tests, if applicable. The results shall then be compared to initial values, and ratings revised if applicable (per 11.2.3).

11.2.2 To determine whether tests at high and/or low temperatures are needed, assessment of the design and materials with respect to increased damage causing reduced function from all abuse tests at each temperature shall use engineering principles including, but not limited to, changes in material strength, impact resistance, flexibility, etc., resulting from temperature changes or heat transfer.

11.2.3 If the WC sample size for reduced performance after each abuse test at each temperature cannot be determined, at least the largest and smallest sizes shall be subjected to the exposure condition(s) and then retested for function, with the worst values applied to ratings of all sizes in the product range.

11.3 Adapter and cap exposure and compatibility tests

11.3.1 As specified in Section 14, Long Term Compatibility Tests, one WC adapter and cap sample shall be subjected to each applicable Exposure and Compatibility Test below, followed by repeat testing in accordance with 13.3, Impact Test:

a) Air Aging (refer to 14.1) – for designs with functional polymers;

b) UV Light (refer to 14.2)– for designs with external polymers;

c) Salt Fog (refer to 14.3)– for designs with functional metals; and

d) Fuel Compatibility (Vapors only, refer to 14.4) – for all designs and materials.

Following completion of each test, samples shall be assessed for damage, with WC sample(s) subjected to repeat testing in accordance with 14.5, Repeat functional testing after long term compatibility tests, if applicable. The results shall then be compared to initial values, and ratings revised if applicable (per 11.3.3).

11.3.2 To determine the WC sample, assessment of design and materials with respect to changes or damage causing reduced function from each condition shall use engineering principles including, but not limited to, material changes or reduced impact resistance from metal corrosion and polymer or elastomer changes in dimensions, flexibility, hardness, or other key characteristics. The WC sample size shall be consistent for comparison purposes.

11.3.3 WC sample(s) selected for repeat Functional Tests shall be based on material change or damage that may result in reduced performance. If WC samples cannot be determined, multiple samples, with the worst values applied to ratings of all sizes in the product range, shall be tested.

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11.4 Adapter and cap special tests

11.4.1 As specified in Section 15, Special Tests, one WC adapter and cap sample shall be subjected to each Special Test below as applicable:

a) Cyclic Endurance (refer to 15.5) – for all designs and materials;

b) Metallic Stress Crack (refer to 15.7) – for designs with fittings of ≥15 % zinc; and

c) Nonmetallic Stress Crack (refer to 15.8) – for designs with polyethylene (any type or percentage blend) components.

Following completion of each applicable test, samples shall meet the individual pass/fail criteria and, if required, shall be subjected to repeat testing in accordance with 15.6, Repeat functional testing after special tests.

11.4.2 To determine the WC sample, assessment of the design and materials with respect to the intent of each Special Test and highest failure probability shall be performed. If a WC sample cannot be determined, multiple samples shall be evaluated in accordance with 15.6, Repeat functional testing after special tests.

12 Functional Tests

12.1 Emergency vent tests for pressure relief and flow rating

12.1.1 Emergency vent samples shall be measured for pressure and flow ratings before and after (if necessary) additional test conditions per 9.1.1, 9.2.1, 9.3.1, and 9.4.1. The test shall target at least 0.5 psig (3.4 kPa), 1.0 psig (6.9 kPa), 2.5 psig (17.2 kPa) and the expected relief pressure point. If determination of these data points requires interpolation or extrapolation on a generated pressure/flow curve, a minimum of 4 measurements is required.

12.1.2 The E-vent shall be installed on a pipe length at least ten times the inlet ID and connected to a suitable air reservoir. The pipe shall have a control valve, pressure gauge and flow meter, and the equipment shall be capable of producing an even flow throughout the tests.

12.1.3 The relief pressure shall be within the 0.5 psig to 1.0 psig (3.4 to 6.9 kPa) range, or if the E-vent is marked per 27.1(c)(1), it may leak at not more than 10 % of the flow rate at 0.5 psig (3.4 kPa). The relief pressure shall be a measured or interpolated point.

12.1.4 The flow rate in ft^3/h (m^3/h) at 2.5 psig (17.2 kPa) shall be used for the marked flow rating refer to 27.1(c)(1). If equipment capabilities are insufficient to deliver sufficiently high flow rates for larger vents, extrapolation to the flow rate at 2.5 psig (17.2 kPa) is permitted, provided that at least one measured flow rate data point is at no less than 2.0 psig (13.8 kPa).

12.1.5 If the E-vent performance is affected by high or low temperatures, the pressure relief part of the test shall be repeated on an as-received sample while maintained at:

a) -30 ±2 °C (-22 ±3.6 °F), and/or

b) 50 ±2 °C (122 ±3.6 °F) per 9.1.1.

Exception No. 1: It is permitted to eliminate Pressure Relief Tests on some sizes in a design series range provided that:

a) At least 50 % of the sizes in the range are tested;

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b) No more than 2 intermediate nominal sizes are skipped;

c) No more than 1 end of the range is skipped;

d) There is no difference in the damage characteristics between sizes; and

e) The required relief range of untested sizes is verified by area and mass versus pressure calculations, based on comparing calculations from adjacent higher and lower sizes tested with measured values and applying the appropriate differential adjustments.

Exception No. 2: It is permitted to eliminate Flow Rating Tests on some sizes in a design series range provided that:

a) At least 50 % of the sizes in the range are tested;

b) No more than 2 intermediate nominal sizes are skipped;

c) No more than 1 end of the range is skipped;

d) There is no difference in the damage characteristics between sizes; and

e) The flow ratings determined from the performance curve (least squares fit) for all sizes shall apply a reduction factor of 5 % for interpolations and 10 % for extrapolations.

12.2 Normal vent tests for pressure/vacuum relief and flow rating

12.2.1 Normal vent samples shall be measured for pressure/vacuum and flow ratings before and after (if necessary) additional test conditions per 10.1.1, 10.2.1, 10.3.1, and 10.4.1. The test shall target at least -0.5 psig (-3.4 kPa), +0.5 psig (+3.4 kPa), +1.0 psig (6.9 kPa) and the expected relief points. If determination of these data points requires interpolation or extrapolation on a generated pressure/flow curve, a minimum of 4 measurements is required.

12.2.2 The N-vent shall be installed on a pipe length at least ten times the inlet ID and connected to a suitable air reservoir. The pipe shall have a control valve, pressure/vacuum gauge and flow meter, and the equipment shall be capable of producing an even flow throughout the tests.

12.2.3 The operational relief values shall be in a 0.5 to 0.0 psig (3.4 to 0 kPa) vacuum range and a 0.0 to 1.0 psig (0 to 6.9 kPa) pressure range. These operational relief values shall be measured or interpolated points.

12.2.4 If optionally requested, the flow rating(s) shall be measured and recorded using a published test method and test parameters specified by the requesting manufacturer (such as CARB TP-201.1E). The flow rate(s) at specific pressure and/or vacuum values shall be identified in the marked ratings.

12.2.5 If the N-vent performance is affected by high or low temperatures, the pressure/vacuum relief part of the test shall be repeated on an as-received sample while maintained at:

a) -30 ±2 °C (-22 ±3.6 °F), and/or

b) 50 ±2 °C (122 ±3.6 °F) per 10.1.1.

12.3 Adapter and cap leakage and hydrostatic strength tests

12.3.1 Tank accessories which are intended to contain liquids and/or vapors during operations (such as fill and vapor adapters), or to resist water entry and vapor escape in normal use (such as adapter or

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monitor caps) shall be subjected to the Leakage and Hydrostatic Strength Tests before and after additional test conditions per 11.1.1, 11.2.1, 11.3.1, and 11.4.1.

12.3.2 Adapters with bodies or enclosures that are subject to pressure and/or vacuum from Stage I fill and vent hose couplings or Stage II connecting equipment shall be held for at least 1 min at each test value as follows:

a) Leak Test at 25 psig (172.4 kPa) pressure followed by 5.0 psig (34.5 kPa) vacuum; and

b) Hydrostatic Strength Test at 50 psig (344.7 kPa) pressure followed by 12.5 psig (86.2 kPa) vacuum.

Internal valve seals shall be held open to facilitate testing and prevent damage for additional tests in the sequence. The test pressure or vacuum shall be applied to the connector side of the body using the intended hose coupling types (if applicable), with the tank side plugged or capped.

12.3.3 Adapters with normally closed valve seals that are subject to atmospheric tank pressures or periodic field leak testing shall be held for at least 1 min at each test value as follows:

a) Leak Test at 1.0 psig (6.9 kPa) pressure followed by 0.5 psig (3.4 kPa) vacuum; and

b) Hydrostatic Strength Test at 2.5 psig (17.2 kPa) pressure followed by 1.0 psig (6.9 kPa) vacuum.

The test pressure or vacuum shall be applied to the tank side of the valve, with the connector side open for observation.

12.3.4 Caps for fill/vapor adapters or tank openings that are subject to atmospheric tank pressures or periodic field leak testing shall be attached to the intended opening, and held for at least 1 min at each test value as follows:

a) Leak Test at 2.5 psig (17.2 kPa) pressure followed by 1.0 psig (6.9 kPa) vacuum;

b) Hydrostatic Strength Test at 5.0 psig (34.5 kPa) pressure followed by 2.0 psig (13.8 kPa) vacuum.

The test pressure or vacuum shall be applied to the tank side of the cap, with any wires or other interface parts included in the cap assembly under a 1.0 lbf (4.4 N) pull load.

12.3.5 If the adapter or cap performance is affected by high or low temperatures, the Leakage and Hydrostatic Strength Tests shall be repeated on an as-received sample while maintained at:

a) -30 ±2 °C (-22 ±3.6 °F), and/or

b) 50 ±2 °C (122 ±3.6 °F) per 11.1.1.

12.3.6 Pass/fail criteria – During each test while under pressure or vacuum, the accessory shall be visually examined, and there shall be:

a) For Leakage – No leakage from intended couplings, seals or caps;

b) For Hydrostatic Strength – No rupture of bodies, seals or caps (leakage is acceptable).

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13 Assembly and Abuse Tests

13.1 Drop test

13.1.1 Tank accessory samples shall be subjected to the drops while maintained at the temperatures as applicable per 9.2.1, 10.2.1 and 11.2.1.

13.1.2 Samples shall be dropped from a height of 4 ft (1.2 m) onto flat concrete surface, with an area on the sample targeted that is most likely to cause damage or result in malfunction.

13.1.3 Following the Drop Test, the samples shall be:

a) Visually examined for damage;

b) Subjected to other applicable Assembly and Abuse Tests in the sequence; and

c) Assessed to determine whether Repeat Functional Tests are required per 13.4, Repeat functional testing after assembly and abuse tests.

13.2 Assembly test

13.2.1 The same samples from the Drop Test shall then be assembled while maintained at the temperatures, as applicable per 9.2.1, 10.2.1 and 11.2.1.

13.2.2 Samples shall be assembled in accordance with the manufacturer's instructions. Products with threaded ends shall be connected to steel pipe at 1.5 times the recommended torque. Products with other connecting means shall be attached to the intended component as recommended.

13.2.3 Following the Assembly Test, the samples shall be:

a) Visually examined for damage;

b) Subjected to other applicable Assembly and Abuse Tests in the sequence; and

c) Assessed to determine whether Repeat Functional Tests are required per 13.4.

13.3 Impact test

13.3.1 The same samples from the Assembly Test shall then be impacted while maintained at the temperatures as applicable per 9.2.1, 10.2.1 and 11.2.1.

13.3.2 Samples shall be impacted at 5.0 ft-lbf (6.78 J) with a 2.0 in (50.8 mm) diameter steel ball, with an area on the sample targeted that is most likely to cause damage or result in malfunction.

13.3.3 Following the Impact Test, the samples shall be visually examined for damage and assessed for proper function to determine whether Repeat Functional Tests are required in accordance with the requirements of 13.4.

13.4 Repeat functional testing after assembly and abuse tests

13.4.1 If any damage from any of the Assembly and Abuse Tests in the prior sequence may result in reduced functional performance of the accessory, the following Functional Tests shall be repeated, and the individual pass/fail criteria applied.

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a) E-vents as specified in 12.1, Emergency vent tests for pressure relief and flow rating – Pressure Relief Test only;

b) N-vents as specified in 12.2, Normal vent tests for pressure/vacuum relief and flow rating – Pressure/Vacuum Relief Test only;

c) Adapters and caps as specified in 12.3, Adapter and cap leakage and hydrostatic strength tests – Leakage and Hydrostatic Strength Tests.

13.4.2 Any repeat Functional Test results used for marked ratings shall be compared to the results of the original tests and, if applicable, the marked ratings shall be revised to the lesser values.

14 Long Term Compatibility Tests

14.1 Air aging

14.1.1 Tank accessory samples as applicable per 9.3.1, 10.3.1 and 11.3.1 shall be subjected to accelerated aging in an air circulating oven for the time and temperature as indicated below:

a) E-vents – 180 days at 70 ±2 °C (158 ±3.6 °F);

b) N-vents – 90 days at 70 ±2 °C (158 ±3.6 °F);

c) Adapters and caps – 60 days at 70 ±2 °C (158 ±3.6 °F).

14.1.2 Following the air oven exposure, the samples shall be visually examined for material changes, subjected to repeat testing in accordance with 13.3, Impact Test, visually examined for physical damage, then assessed for proper function to determine whether repeat testing in accordance with 14.5, Repeat functional testing after long term compatibility tests, is required.

14.2 UV Light

14.2.1 Tank accessory samples as applicable per 9.3.1, 10.3.1 and 11.3.1 shall be subjected to cycles of 17 min UV light followed by 3 min UV light and water, or equivalent cycle times per:

a) ASTM G153, Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials, for 720 h; or

b) ASTM G155, Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials, for 1000 h.

14.2.2 Following the UV light exposure, the samples shall be visually examined for material changes, subjected to repeat testing in accordance with 13.3, Impact Test, visually examined for physical damage, then assessed for proper function to determine whether repeat testing in accordance with 14.5, Repeat functional Testing after long term compatibility tests, is required.

14.3 Salt fog

14.3.1 Tank accessory samples as applicable per 9.3.1, 10.3.1 and 11.3.1 shall be subjected to 600 h of a 5 % NaCl H_2O Solution [6.5 to 7.2 pH and 1.033 to 1.039 specific gravity (spg)] atomized through nozzles at 18 ±2 psig (124 ±14 kPa) in 35 ±2 °C (95 ±3.6 °F) humid air in accordance with ASTM B117, Standard Practice for Operating Salt Spray (Fog) Apparatus. The test chamber shall be sealed with the samples suspended in the salt fog.

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14.3.2 Following the salt fog exposure, the samples shall be visually examined for material changes, subjected to repeat testing in accordance with 13.3, Impact Test, visually examined for physical damage, then assessed for proper function to determine whether repeat testing in accordance with 14.5, Repeat functional Testing after long term compatibility tests, is required.

14.4 Fuel compatibility

14.4.1 Tank accessory samples as applicable per 9.3.1, 10.3.1 and 11.3.1 shall be subjected to long term compatibility exposure fluid phase, time and temperature combinations below using the test fuels and/or vapors indicated in 14.4.2.

a) E-vents – Vapors and occasional liquids (*) for 180 days at 40 ±2 °C (104 ±3.6 °F), with valves held in the open position (!);

b) N-vents – Vapors and occasional liquids (*) for 90 days at 40 ±2 °C (104 ±3.6 °F), with valves held in the open position (!);

c) Adapters and caps – Vapors and occasional liquids (*) for 60 days at 40 ±2 °C (104 ±3.6 °F), with adapters open, and caps connected to the intended fittings.

(*) Vapors and occasional liquids – primary exposure to vapors with occasional exposure to liquids by lowering the temperature for 8 h during each 10th day of exposure time in order to produce condensate. Alternatively, the container may be shaken to expose samples to liquids (except for liquid-type N-Vents).

(!) Methods used to hold open valves shall not damage or deform the gaskets.

14.4.2 The samples shall be exposed to all of the test fuels as identified below:

a) 100 % ASTM D471 Reference Fuel F (D2 Type S15 Grade);

b) F75/B25a (#);

c) C75/E25a (#); and

d) C15/E85a (#).

(#) – Refer to Annex A for aggressive biodiesel and ethanol formulas and test fuel blends.

14.4.3 Following the fuel exposures, the samples shall be visually examined for material changes, subjected to repeat testing in accordance with 13.3, Impact Test, visually examined for physical damage, then assessed for proper function to determine whether repeat testing in accordance with 14.5, Repeat functional testing after long term compatibility tests, is required.

14.5 Repeat functional testing after long term compatibility tests

14.5.1 If any material change or damage from any of the tests in the Long-Term Compatibility Tests may result in reduced functional performance of the accessory, the following Functional Tests shall be repeated, and the individual pass/fail criteria applied.

a) E-vents as specified in 12.1, Emergency vent tests for pressure relief and flow rating – Pressure Relief Test only;

b) N-vents as specified in 12.2, Normal vent tests for pressure/vacuum relief and flow rating – Pressure/Vacuum Relief Test only;

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c) Adapters and caps as specified in 12.3, Adapter and cap leakage and hydrostatic strength tests – Leakage and Hydrostatic Strength Tests.

14.5.2 Any repeat Functional Test results used for marked ratings shall be compared to the results of the original tests and, if applicable, the marked ratings shall be revised to the lesser values.

15 Special Tests

15.1 Rain test

15.1.1 Samples of WC tank accessories as applicable per 9.4.1 and 10.4.1 shall be evaluated for resistance of water entry into a simulated tank or pipe opening. The sample shall be installed on the intended tank, pipe or flange below, which shall also be connected to a flat steel plate sized at least 6 in (152.4 mm) beyond the sample projected area:

a) Emergency vents shall be tested in the normally closed position with the top of the pipe or flange 6.0 in (152.4 mm) above the plate; and

b) Normal vents shall be tested in the normally closed position with the top of the pipe or flange 12.0 in (304.8 mm) above the plate.

15.1.2 The tank accessory installed on the test plate shall be positioned on a level surface and subjected to a 30-min simulated rain emitted from a Rain Test Spray Head, as shown in Figure 15.1, focused on the accessory area(s) most likely to allow entry of water. The nozzle shall operate at 5.0 psig (34.5 kPa) within 3.0 to 5.0 ft (0.914 to 1.524 m) of the test area at a 45° angle for 15 min directly on the accessory, followed by 15 min on the test plate to cause upward splashing.

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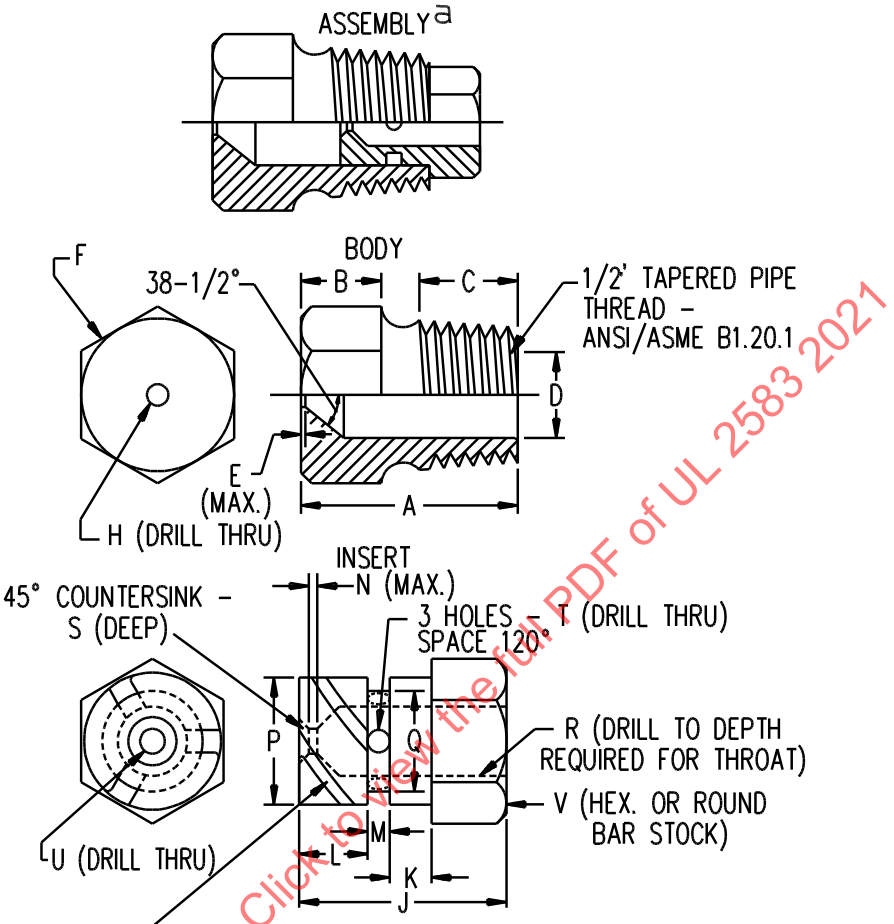
Figure 15.1

Rain-Test Spray Head



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

[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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15.1.3 Following the Rain Test, the samples shall be visually examined and there shall be:

a) Emergency vents – no entry of water past the vent gasket;

b) Normal vents – no more than 0.85 US fl oz (25 mL) of water past the vent valve.

15.2 Icing test

15.2.1 Samples of WC tank accessories as applicable per 9.4.1 and 10.4.1 shall be evaluated for resistance against the action of accumulated ice blocking the functional venting. The sample shall be installed on the intended tank or pipe fittings below, then placed in a cold chamber at -6.0 ±2.0 °C (21.2 ±3.6 °F) ambient and subjected to simulated freezing rain.

a) Emergency vents shall be tested in the normally closed position on a connecting fitting at least 6.0 in (152 mm) above a supporting surface;

b) Normal vents shall be tested in the normally closed position on a connecting fitting at least 12.0 in (305 mm) above a supporting surface.

15.2.2 The tank accessories shall be intermittently sprayed with water at a 45° angle for 4 h at a cycle rate of 14 to 16 s on/160 to 180 s off. The water shall be delivered through a nozzle [0.8 ±0.1 US gal/h (3 ±0.4 L/h)] to simulate rain, and at a temperature, pressure and distance sufficient to cause ice formation on the sample. The sample shall remain in the chamber for 1 h after the last water cycle.

15.2.3 Following the Icing Test, and while still at the test temperature, the samples shall be visually examined, then connected to a suitable pressure/vacuum source to evaluate its function. There shall be:

a) Emergency vents – relief at no more than 2.5 psig (17.2 kPa) pressure;

b) Normal vents – relief at no more than 1.5 psig (10.3 kPa) pressure and 1.0 psig (6.9 kPa) vacuum.

15.3 Emergency vent fire exposure test

15.3.1 Samples of WC emergency vent(s) as applicable per 9.4.1 shall be installed on piping and equipment per 15.3.2, then subjected to the fire conditions per 15.3.3. WC samples shall be determined with respect to the design size and the E-vent material's ability to function as intended.

Exception: If the structural and working vent components are constructed of materials with a melting point of greater than 1093 °C (2000 °F) (such as steel or cast iron), the test may be waived.

15.3.2 Emergency vents shall be installed on a steel pipe connected to a suitable compressed air source of at least 5 psig (34.5 kPa) with control valve and pressure gauge. Only the E-vent and the end of the connecting pipe are required to be in the furnace.

15.3.3 The furnace shall be capable of achieving a 1093 ±111 °C (2000 ±200 °F) temperature range as measured by type K thermocouples placed 2 to 6 in (50.8 to 152.4 mm) above the sample. The furnace or equipment shall have a means to observe or detect functional operation and vent obstruction during the fire exposure.

15.3.4 The samples shall be subjected to a 2 h fire exposure (start time when 1093 °C (2000 °F) is reached), with the vent evaluated at 5 min intervals (including pre-heating period) for pressure relief function and flow obstruction by using measurements and observations. The test may be terminated at any time if complete degradation of materials is achieved (such as metal melting or polymer burning) with the ultimate end results determined.

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15.3.5 All E-vents tested shall not exceed a relief pressure of 2.5 psig (17.2 kPa) at each interval as measured in the connecting pipe or tank and shall not have vent obstruction as determined by visual examination during/after testing.

15.4 Normal vent vapor leak rate test (optional)

15.4.1 If requested by the manufacturer, WC normal vent samples as applicable per 10.4.1 may optionally be measured for vapor leakage rate(s) at pressure, vacuum and/or other operating conditions.

15.4.2 The test shall be conducted in accordance with a published method and test parameters specified by the requesting manufacturer (such as CARB TP-201.1E).

15.4.3 If requested by the manufacturer, the measured leakage rate(s) at pressure, vacuum and/or other operating conditions may be identified in marked ratings according to 27.1(c)(2).

15.5 Cyclic endurance test

15.5.1 Samples of WC tank accessories as applicable per 10.4.1 and 11.4.1 which are constructed with moving parts, removable parts, or couplings that, during normal use, are intended to be frequently actuated or periodically disassembled, shall be subjected to the cycling conditions below:

a) N-vents with moving valve parts (such as spring actuated seals) shall be connected to suitable pressure and/or vacuum sources with control valves, then subjected to 6,000 combined or separate cycles of at least 0 to 0.5 psig (0 to 3.4 kPa) pressure and 0 to 0.5 psig (0 to 3.4 kPa) vacuum, at a 6 to 10 cycles/min rate, with the peak pressure and vacuum values held for at least 1 sec/cycle. For vents with opening pressures greater than 0.5 psig (3.4 kPa), the peak test pressure shall be at least 0.5 psig (3.4 kPa) above the opening pressure;

b) Adapters with moving valve parts (such as spring actuated seals) shall be connected to suitable pressure and/or vacuum sources with control valves, then subjected to 6,000 combined or separate cycles of at least 0 to 0.5 psig (3.4 kPa) pressure and 0 to 0.5 psig (3.4 kpa) vacuum, at a 6 to 10 cycles/min rate, with the peak pressure and vacuum values held for at least 1 sec/cycle. For adapters with opening pressures greater than 0.5 psig (3.4 kPa), the peak test pressure shall be at least 0.5 psig (3.4 kPa) above the opening pressure;

c) Adapters with swivel features (such as rotating collar bearings or other articulating means intended for use during normal delivery operations) shall be connected to a standard truck delivery nozzle and filled 1 ft (0.3048 m) connecting hose section, then rotated for 6,000 cycles (45° back and forth). The test shall be oriented with the adapter opening vertical and the unsupported nozzle/hose horizontal to create a moment arm during the cycling.

d) Caps intended for periodic removal (such as for adapter, monitor and sensor openings) shall be subjected to 2,000 cycles of removal and replacement in accordance with the manufacturer's instructions at a rate of not more than 20/min. The cycling shall be done by hand, or alternatively by a machine provided the intended hand actions are simulated. If wires (or similar interface parts) require repositioning, this action shall be included in the cycle.

15.5.2 Following the Cyclic Endurance Test, the samples shall be visually examined for wear or other damage, then assessed for proper function to determine whether repeat testing in accordance with 15.6, Repeat functional testing after special tests is required.

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15.6 Repeat functional testing after special tests

15.6.1 If any wear or other damage from any of the Special Tests may result in reduced functional performance of the accessory, the following Functional Tests shall be repeated, and the individual pass/fail criteria applied.

a) E-vents as specified in 12.1, Emergency vent tests for pressure relief and flow rating – Pressure Relief Test only;

b) N-vents as specified in 12.2, Normal vent tests for pressure/vacuum relief and flow rating – Pressure/Vacuum Relief Test only;

c) Adapters and caps as specified in 12.3, Adapter and cap leakage and hydrostatic strength tests – Leakage and Hydrostatic Strength Tests.

15.6.2 Any repeat Functional Test results used for marked ratings shall be compared to the results of the original tests and, if applicable, the marked ratings shall be revised to the lesser values.

15.7 Metallic stress crack test

15.7.1 For accessories constructed with threaded end fittings containing at least 15 % zinc (excluding platings), one WC product sample in all sizes shall be exposed to a moist ammonia-air mixture of minimum 20 fl oz (600 mL) of 0.94 spg aqueous ammonia for 10 days at 35 °C (95 °F) in a heated water bath or oven.

15.7.2 All samples shall be grease-free, with end fittings assembled to steel plugs or bushings at the recommended torque and positioned above the ammonia in a suitable container.

15.7.3 Following the exposure, the samples shall be visually examined without magnification. The samples shall not show any evidence of cracking, crazing, or similar damage.

15.8 Nonmetallic stress crack test

15.8.1 For accessories constructed with polyethylene (any type or percentage blend), one WC product sample in all sizes 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.

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15.8.2 All product samples shall be cleaned, assembled to steel pipe, bushings or adapters as intended, and immersed in the igepal test solution.

15.8.3 Following the exposure, the samples shall be visually examined without magnification. The samples shall not show any evidence of surface cracking, crazing, or similar damage.

PART II – LIQUID CONTROL PRODUCTS

CONSTRUCTION

16 General

16.1 All Spill Containers shall meet the following construction criteria for use on/with aboveground steel tanks. The spill container shall:

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a) Be one of the types listed below, and designed for containment of minor spills from tank filling operations conducted either above, or below, the rated liquid level:

1) For Weld-On types –welded to the tank shell or manway around the top fill opening;

2) For Spin-On types –threaded to a mating tank top fill fitting around the top fill opening;

3) For Side Mount types –mounted to the tank head/shell below the fill line and intended for direct connection or indirect connection to the fill opening; or

4) For Stand Alone types – remotely installed from the tank below the fill line and intended for indirect pipe connection to the fill opening;

b) Be constructed of steel at least 16 gauge thick (0.060 in or 1.52 mm) with liquid-tight weld joints for containment of at least:

1) 2.5 US gal (9.46 L) for tanks of rated capacity 1320 US gal (5000 L) or less, not including the top 0.25 in (6.4 mm); or

2) 5.0 US gal (18.9 L) for tanks of rated capacity more than 1320 US gal (5000 L), not including the top 0.5 in (12.7 mm);

c) Have (except for weld on types) a bottom/side minimum nominal pipe outlet size for attachment to the fill opening/pipe or a connecting pipe of:

1) Nominal 1.5 in (38.1 mm) for tanks of rated capacity 1320 US gal (5000 L) or less; or

2) Nominal 2.0 in (50.8 mm) for tanks of rated capacity more than 1320 US gal (5000 L);

d) Be provided with a minimum nominal 1/2 in (12.7 mm) bottom opening to completely drain the containment area of captured spills to either the fuel tank or an external container. The opening shall be provided with a threaded fitting and a plug or a drain valve that either requires manual actuation, or is an automatic type that is normally closed;

e) Be provided with a corrosion resistant coating on exposed inner and outer carbon steel surfaces of the container and lid. The coating shall comply with Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment, UL 1332, for outdoor use or shall be evaluated for corrosion resistance per 18.3.1(b) or 19.3.1(b). Galvanizing or Zinc plating is not permitted, except if it is additionally coated with paint;

f) Be provided with a hinged cover to resist rain entry, a handle or equivalent to open the cover, and a hasp or equivalent to lock the cover. Any gaskets relied on to meet rain resistance tests shall comply with Standard for Gaskets and Seals, UL 157, for outdoor use. The closed lid shall not be vapor-tight as verified by visual examination or leak testing; and

g) Be provided with a ground lug, for a minimum 12-gauge (2.1 mm) wire, near the fill opening, which is either green or has a grounding symbol. For parts that may be electrically isolated by gaskets, sealants, coatings or other non-conductive components in the assembly, a means for bonding to the ground lug shall be provided. Bonding wires, if used, shall be minimum 12 gauge (2.1 mm) and green or green/yellow. All isolated metal parts shall be compliant with the requirements of 21.1, Electrical Continuity Test.

16.2 All spill containers may optionally be provided with other integral components in an assembly, if they meet the additional requirements below, to facilitate aboveground tank filling or remote connections:

a) Tank fill opening adapters and fill caps connected within the spill container to the bottom/side opening or a connecting pipe shall comply with the appropriate requirements in Part I of this Standard;

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b) Manual shutoff valves connected within the spill container to the bottom of the fill opening adapter and/or bottom/side opening or connecting pipe shall comply with Valves for Flammable Fluids, UL/ULC 842, and/or Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0-E85), UL 842A and/or Valves for Diesel Fuel, Biodiesel Fuel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations up to 20 Percent (B20), Kerosene, and Fuel Oil, UL 842B, with the appropriate markings;

c) Mechanical check valves connected within the spill container downstream of a tank fill opening adapter or manual shutoff valve shall comply with UL/ULC 842, and/or UL 842A and/or UL 842B, with the appropriate markings and rated for the fuels covered under the scope of this standard;

d) Pipe fittings such as bushings and reducers to facilitate connection with an internal spill container component or external tank fitting or drop tube shall be ASTM steel threaded types;

e) Automatic drain valves shall be normally closed manual actuated types, such as a spring-loaded poppet, and shall be located within the spill container; and

f) Adjacent SCD may be connected by chase pipe to route fuel pipe and electrical conduit and shall be leak tight if part of the spill containment.

16.3 Side Mount type SCDs shall additionally be provided with means, which include but are not limited to brackets or flanges, for attachment to the tank shell or integral structures such as dike walls or working platforms.

16.4 Stand Alone type SCDs shall additionally be provided with means, which include but are not limited to legs or pedestals with foot flanges, for attachment to/through walls of equipment or buildings in fueling areas, or to working surfaces around the tank, such as concrete or steel decks.

16.5 Flange Mount type SCDs shall connect to the tank manway flange with bolts. Gaskets, if the SCD is installed below the liquid level, shall be tested for conformance to fuel compatibility requirements per 14.4.

16.6 OPDs shall significantly reduce the potential for overfilling a tank during normal gravity fill or pumped fill operations, and shall conform to other construction criteria as follows. The OPD shall:

a) Not exceed a 2.0 to 6.0 in (50.8 to 152.4 mm) nominal size range, and be capable of installation in/to a tank's fill fitting and/or fill pipe;

b) Have a normally open valve actuated by a float or other means that progressively or quickly closes with rising liquid levels near the tank top;

c) Be capable of adjustment during installation to allow for different liquid level actuation ranges and tank sizes; and

d) Not significantly restrict liquid flow in the fill pipe until it's intended actuation starting near the manufacturer's rated tank fill level (% capacity, height from top, etc.), and shall:

1) Provide an audible and visual alarm or partially restrict liquid flow to ≤ 10.0 % rated flow or ≤ 10.0 US gal/min (37 L/min) beginning at the manufacturer's rated tank fill level, so as to alert the operator the tank is nearing full capacity; or

2) Provide automatic shutoff of, or an audible and visual alarm different than 16.6(d)(1) beginning at the manufacturer's rated tank fill level, so as to signal the operator to stop the filling of the tank, or to trigger automatic shutoff.

NOTE: Percent capacity values for tank fill alert and shutoff levels may be based on NFPA 30 Clause 22.11.4.5 or NFPA 30A Clause 4.3.6.3 for Aboveground Tanks, or EPA 40 CFR Parts 280 and 281, Subpart B – UST Systems: Design, Construction, Installation and Notification, Section 280.20(b)(4)(c)(ii) for Underground Tanks, CSA B139.1.0-15 Clauses 10.2.4 and 10.5.1.3, and NFC 2015 Clause 4.3.1.8. However, this test may be used to demonstrate a device's ability to

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function at other values if it is adjustable for compliance with other Codes or Regulations, without re-testing at these other values.

16.7 Electrically-powered OPDs shall be designed to detect an overfill condition and signal the operator to stop the fill operation. The device and/or its components shall meet the appropriate requirements in Annex C for the applicable Classified Area rating (see 27.1(g), Marking and 28.3(e), Instructions).

Note – Classified Areas are identified in NFPA 30 Ch 7 Table 7.3.3.

16.8 Liquid Level Gauges (LLGs) shall accurately detect, measure and display the liquid level in a storage tank.

a) LLGs shall be capable of adjustment during installation to allow for initial calibration against the tank dimensions, any differences in flammable liquid properties covered by the rating, and for optional fluids as requested by the manufacturer (lube oils, water bottoms, etc.).

b) Components that measure the liquid level (floats, sensors, etc.) shall be capable of mounting in/on the tank, or of passing through a tank top fitting of 2.0 NPT size.

c) Components that display the liquid level, may be mechanical or electrical and may be located either directly (mounted on the tank) or indirectly (remotely from the tank).

d) Electrically-powered components shall comply with the general electrical safety and/or Classified Areas requirements of 16.7.

e) The LLG output shall display at least the empty, 1/4, 1/2, 3/4 and full fuel levels in either words, %, US gallons, liters and/or fuel height, with minimum ±5 % of actual volume accuracy, and shall be legible from at least 3.0 ft (0.92 m) after installation.

f) An LLG with optional water bottom detection shall additionally indicate “water” with minimum ±5 % of accuracy, with respect to claims by the manufacturer, and the display shall be legible from at least 3.0 ft (0.92 m) after installation.

g) An LLG with optional overfill protection shall be accurate to ±2 % of the overfill level, and additionally shall comply with the requirements of 16.6 (c) and (d).

h) The LLG shall prevent entry of water into the tank as determined by visual examination or 15.1, Rain test.

i) Hollow floats shall be evaluated for compliance to 19.5.1(c), Float Crush Test.

j) The combined system shall meet the functional requirements of 20, Liquid level gauge tests.

PERFORMANCE

17 General Test Matrix

17.1 Representative production samples of each liquid control product or component shall be subjected to the appropriate Performance Tests identified in Table 17.1, with sample variations of product type, design, material and size as specified in each test method.

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Table 17.1
Liquid Control Products Test Matrix

Performance tests	Spill containers	Overfill preventers	Liquid level gauges
Abuse & Assembly	18.1	19.1	20.1
Drop	18.1.1(a)	19.1.1(a)	20.1.1(a)
Assembly	18.1.1(b)	19.1.1(b)	20.1.1(b)
Impact	18.1.1(c)	19.1.1(c)	20.1.1(c)
Capacity, Leak & Drain	18.2	–	–
Capacity	18.2.2	–	–
Leakage	18.2.3	–	–
Drainage	18.2.4	–	–
Functional Operation	–	19.2	20.2
Flow Rating	–	19.2.2	–
Liquid Level	–	19.2.3	–
Warning Signals	–	19.2.4	–
Environmental Resistance	18.3	19.3	20.3
Rain	18.3.1(a)	–	16.8(h)
Extreme Temperature	–	19.3.1(a)	20.3.1(a)
Corrosion	18.3.1(b)	19.3.1 (b)	20.3.1(c)
UV Light	–	–	20.3.1(b)
Valve/Product Actuation	18.4	19.4	20.3.1(b)
Endurance	18.4.1(a)	19.4.1(a)	20.4.1(a)
Fuel Exposure	18.4.1(b)	19.4.1(b)	20.4.1(b)
Thermal Aging	18.4.1(c)	19.4.1(c)	20.4.1(c)
Special Tests	18.5	19.5	–
Electrical Continuity	18.5.1(a)	19.5.1(a)	–
Hydrostatic Strength	18.5.1(b)	18.5.1(b)	–
Mechanical Strength	18.5.1(c)	–	–
Float Crush	–	19.5.1(c)	19.5.1(c)

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18 Spill Container Tests

18.1 Assembly and abuse tests

18.1.1 One sample of each spill container type in each size and shape variation shall be subject to the assembly and abuse tests in the order below, and shall be inspected for visible damage per 18.1.3 before the next test in the sequence is conducted: See 6.4 for damage assessment, and for exceptions.

a) Drop – Samples shall be dropped from 4 ft (1.2 m) onto a flat concrete surface, on external target areas of the sample most likely to cause damage or result in malfunction;

b) Assembly – Samples shall be assembled as per the manufacturer's instructions and the assembly parameters per 18.1.2 to simulate end use installation; and

c) Impact – Samples shall be impacted at 5.0 ft-lbf (6.78 J) with a 2.0 in (50.8 mm) steel ball, on external target areas of the sample most likely to cause damage or result in malfunction.

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18.1.2 The following equipment and installation parameters shall be used for assembly of different types of spill containers and their intended components:

a) Parts requiring connection by welding may be attached to only the intended parts of a tank, so as to simulate installation and to facilitate further testing, provided that the minimum recommended tank wall thickness is used;

b) Parts requiring threaded connection shall be assembled with schedule 40 steel pipe or 80 lb (ANSI Class 80) steel fittings attached at 1.5 times the recommended torque rating. Sealants are permitted, if they are recommended by the manufacturer;

c) Parts requiring bolt or screw connections shall be attached to the minimum recommended bracket/frame size or wall thickness at 1.5 times the recommended torque ratings; and

d) Standalone types of SCDs shall simulate installation processes (welding to steel plates, or bolting to concrete floors, etc.) as recommended, and, if threaded connections and/or bolts are required, the assembly shall comply with (b) and (c) above.

18.1.3 Following each test, there shall be no unacceptable damage, such as permanent deformation, pipe bending, stripped threads, malfunctioning lids, or delamination of protective coatings. However, also refer to 6.4 to determine whether damage is unacceptable, or acceptable, based on either test results or the manufacturer's instructions.

18.2 Capacity, leakage and drainage tests

18.2.1 After conducting the Assembly and Abuse tests, the same spill container samples, with connected components, shall be subject to the Capacity, Leakage and Drain tests in the order below. It is permitted to plug or block spill container openings and/or connecting components to determine actual capacity and/or to assess connection leakage.

18.2.2 Capacity shall be measured by filling the container with water 1.0 in (25.4 mm) below the top opening. The measured water volume shall:

a) Meet minimum capacities as per 16.1(b); and

b) Be used for the marked rating, as per 27.1(c)(5).

18.2.3 Leakage shall be assessed by visual examination or blotting paper after maintaining the water level constant for at least 10 min. There shall be no leakage at any:

a) Joints in the spill container below the rated liquid level; and

b) Outlet fittings or internal components, such as drains.

18.2.4 Drainage shall be assessed by visual exam after the means provided to evacuate liquid, such as a connected pipe valve or integral drain valve, is opened and:

a) The spill container shall completely drain all liquid. Small residual amounts that are capable of being wiped dry with a rag may remain in the SCD.; and

b) Any drain valves that automatically close, such as spring types, shall reset without leakage, when the container is refilled with water.

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18.3 Environmental resistance tests

18.3.1 The following environmental resistance tests shall be conducted on representative WC product samples of each spill container design type or specific components, after simulated installation as intended per the manufacturer's instructions. Any damage from Assembly and Abuse tests per 18.1 that was acceptable, without manufacturer's instructions to not place the product into service (see 28.4), shall be re-created prior to conducting these tests.

a) Rain – Containers with lids, covers or hatches in normally closed positions shall be subjected to the Rain Test (refer to 15.1). There shall be no entry of water into the container.

b) Corrosion – Containers with corrosion resistant coatings not meeting the requirements of 16.1(f) shall be subjected to the Salt Fog Test as per 14.3. There shall be no evidence of base metal corrosion.

18.4 Drain valve tests

18.4.1 The following performance tests shall be conducted on a representative WC product size sample of each drain valve that automatically closes and has non-metallic components, such as spring actuated types with seals, after simulated installation as intended per the manufacturer's instructions. Any damage from Assembly and Abuse tests per 18.1 that was acceptable without manufacturer's instructions to not place the product into service (see 28.4), shall be re-created prior to conducting these tests.

a) Endurance – The valve shall be subject to 100 complete actuation cycles (at least 1 min each in the open and closed positions) without liquid. The first 50 cycles shall be conducted at a high temperature of 50 ±2 °C (122 ±3.6 °F). The second 50 cycles shall be conducted at a low temperature of -30 ±2 °C (-22 ±3.6 °F). The valve shall not leak as per 18.2.3, and the valve shall drain and reset as per 18.2.4.

b) Fuel Exposure – The valve shall be subjected to fuel and vapor exposures per the 14.4, Fuel compatibility test, for 60 days at 40 ±2 °C (104 ±3.6 °F) using cycle conditions for vapors and occasional exposure to liquids. The valve shall not leak as per 18.2.3, and the valve shall drain and reset as per 18.2.4.

c) Thermal Aging – The valve shall be subjected to thermal aging exposure as per the 14.1, Air Aging test, for 60 days at 70 ±2 °C (158 ±3.6 °F). The valve shall not leak as per 18.2.3, and the valve shall drain and reset as per 18.2.4.

18.5 Special SCD tests

18.5.1 The following special performance tests shall be conducted on representative WC spill container product or component samples in accordance with the referenced methods in Section 21, Special Test Method Details. Any damage from Assembly and Abuse tests per 18.1 that was acceptable, without manufacturer's instructions to not place the product into service (see 28.4), shall be re-created prior to conducting these tests.

a) Electrical Continuity – Any combination of SCD components that may be electrically isolated during the filling operation shall comply with the Electrical Continuity Test as per 21.1.

b) Hydrostatic Strength – Any combination of SCD components that are pressurized during the filling operation shall comply with the Hydrostatic Strength Test as per 21.2.

c) Mechanical Strength – Any side mount or standalone type SCDs shall comply with the applicable Mechanical Strength Tests as per 21.3.

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19 Overfill Preventer Tests

19.1 Assembly and abuse tests

19.1.1 One sample of each overfill preventer in each design and size variation shall be subject to the assembly and abuse tests in the order below, and shall be inspected for visible damage per 19.1.3 before the next test in the sequence is conducted. Refer to 6.4 for requirements for damage assessment, and for exceptions:

a) Drop – Samples shall be dropped from 4 ft (1.2 m) onto a flat concrete surface, on external target areas of the sample most likely to cause damage or result in malfunction;

b) Assembly – Samples shall be assembled as per the manufacturer's instructions and the assembly parameters per 19.1.2 to simulate end use installation;

c) Impact – Any parts that are accessible after installation shall be impacted at 5.0 ft-lbf (6.78 J) with a 2.0 in (50.8 mm) steel ball on target areas of the sample most likely to cause damage or result in malfunction.

19.1.2 The following installation parameters shall be used for assembly of overfill preventers to their intended connecting components at 1.5 times the recommended torque rating. Sealants are permitted, if they are recommended by the manufacturer.

a) Products requiring threaded connection to specific components, such as extractor fittings or drop tubes, shall be assembled to only the supplied/intended parts identified in the manufacturer's instructions; or

b) Products allowing threaded connections to common components, shall use schedule 40 steel pipe or 80 lb (ANSI Class 80) steel fittings, unless otherwise identified in the manufacturer's instructions; or

c) Products using connection means other than screw threads shall be assembled and installed in accordance with the manufacturer's instructions.

19.1.3 Following each test, there shall be no unacceptable damage, such as permanent deformation, pipe bending, stripped threads or malfunctioning part. However, also see 6.4 to determine whether damage is unacceptable, or acceptable, based on either test results or the manufacturer's instructions.

19.2 Flow rating and functional operation tests

19.2.1 After conducting the Assembly and Abuse tests, the same OPD samples, with connected components, shall be subject to flow rating and functional operation tests in the sequence identified below. It is permitted to install these products in a collection tank and/or to attach equipment, such as flow meters, to facilitate testing and measurement.

19.2.2 The rate of vapor or liquid flow through the device shall be measured when water is delivered at the manufacturer's flow and pressure rating, but at not less than 50 US gal/min (189 L/min) and 5 psig (34.5 kPa) for gravity fill types, or 100 US gal/min (379 L/min) and 10 psig (68.9 kPa) for pumped fill types, from the recommended hose or pipe size, both before and after it fully operates as intended (blocked pipe or closed valve). The flow rate shall:

a) Before operation – Be used for the marked rating as per 25.1(c)(6) and (7); and

b) After operation – Comply with the operating requirements of 16.6(d) for OPDs.

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Exception: If electric-type sensors are not installed in the fill opening, the test shall be conducted at the marked pressure rating.

19.2.3 In conjunction with, or separate from, the above flow rating test, the liquid levels (height from the tank top), both before and after the device fully operates as intended, shall be measured. The average levels of at least 3 trials shall:

a) Before operation – Begin alert or restriction at the manufacturer's level rating (% capacity, height from top, etc.); or

b) After operation – Complete the shutoff at the manufacturer's level rating (% capacity, height from top, etc.).

19.2.4 In conjunction with, or separate from, the above flow rating and liquid level test, the output from each product intended to additionally provide warning signals (audible and/or visual) when the tank is reaching fill limits, shall be measured. The signals shall:

a) Audible signals – Be ≥75 dB from at least 50 ft (15 m) horizontal distance from the audible alarm device. The measurement shall be taken with a general purpose sound pressure level meter on the A scale with a slow dynamics setting; and/or

b) Visual signals – Be visible (emit a continuous or flashing light) around a horizontal arc of >120° from at least 50 ft (15 m) from the center of the visual alarm device. The measurement shall be taken by an observer outdoors (in daylight) or indoors (with at least two 100 W bulbs).

19.3 Environmental resistance tests

19.3.1 The following environmental resistance tests shall be conducted on representative WC product samples of each overfill preventer design type or specific components, after simulated installation as intended per the manufacturer's instructions. Any damage resulting from assembly and abuse tests as per 19.1 that was acceptable, without manufacturer's instructions to not place the product into service (refer to 28.4), shall be re-created prior to conducting these tests.

a) Extreme temperature – OPD products shall be subjected to a repeat of the liquid level functional operation test per 18.2.3 while at -30 ±2 °C (-22 ±3.6 °F) and 50 ±2 °C (122 ±3.6 °F). The operating levels shall be within ±1.97 in (50 mm) of the original averages;

b) Corrosion – OPD products not constructed of corrosion resistant materials, such as brass or stainless steel, shall be subjected to a repeat of the liquid level functional operation test per 18.2.3 after the Salt Fog test as per 14.3. The operating levels shall be within ±1.97 in (50 mm) of the original averages.

19.4 Product actuation tests

19.4.1 The following performance tests shall be conducted on a representative WC size product sample of each overfill preventer device, after simulated installation as intended per the manufacturer's instructions. Any damage resulting from Assembly and Abuse tests as per 19.1 that was acceptable, without manufacturer's instructions to not place the product into service (see 28.4), shall be re-created prior to conducting these tests.

a) Endurance – Any products with moving parts shall be subjected to 3000 complete actuation cycles (at least 1 min each in the open and closed positions) with or without liquid. Following the cycles, the liquid level functional operation test per 18.2.3 shall be repeated, and the operating levels shall be within ±1.97 in (50 mm) of the original averages;

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b) Fuel Exposure – All products shall be subjected to fuel and vapor exposures as per the 14.4, Fuel compatibility test, for 120 days at 40 ±2 °C (104 ±3.6 °F) using cycle conditions for vapors and occasional exposure to liquids. Following the cycles, the liquid level functional operation test per 18.2.3 shall be repeated, and the operating levels shall be within ±1.97 in (50 mm) of the original averages;

c) Thermal Aging – Any products or components constructed with nonmetallic materials shall be subjected to thermal aging exposure as per the 14.1, Air Aging test, for 90 days at 70 ±2 °C (158 ±3.6 °F). Following the cycles, the liquid level functional operation test per 18.2.3 shall be repeated, and the operating levels shall be within ±1.97 in (50 mm) of the original averages.

19.5 Special OPD tests

19.5.1 The following special performance tests shall be conducted on representative WC overfill preventer products or component samples in accordance with the referenced methods in Section 21, Special Test Method Details. Any damage resulting from Assembly and Abuse tests as per 19.1 that was acceptable, without manufacturer's instructions to not place the product into service (refer to 28.4), shall be re-created prior to conducting the following tests:

a) Electrical continuity – Any combination of OPD components that may be electrically isolated during the filling operation shall comply with the requirements of 21.1, Electrical Continuity Test;

b) Hydrostatic strength – Any combination of OPD components that are pressurized during the filling operation shall comply with the requirements of 21.2, Hydrostatic Strength Test; and

c) Float crush – Any float that is hollow or constructed of easily compressed materials (such as open cell foams) shall be subjected to an external pressure of 25 psig (172 kPa) for at least 1 min, followed by a visual examination. If there is any damage that may change the operating features of the product, the liquid level functional operation test per 18.2.3 shall be repeated, and the operating levels shall be within ±1.97 in (50 mm) of the original averages.

20 Liquid Level Gauge Tests

20.1 Assembly and abuse tests

20.1.1 One WC product sample of each liquid level gauge in each design and size variation shall be subject to the assembly and abuse tests in the order below, and shall be inspected for visible damage per 20.1.3 before the next test in the sequence is conducted. Refer to 6.4 for requirements for damage assessment, and for exceptions:

a) Drop – Samples shall be dropped from 4 ft (1.2 m) onto a flat concrete surface, on external target areas of the sample most likely to cause damage or result in malfunctions;

b) Assembly – Samples shall be assembled as per the manufacturer's instructions and the assembly parameters as per 20.1.2 to simulate end use installation;

c) Impact – Any parts that are accessible after installation shall be impacted at 5.0 ft-lbf (6.78 J) with a 2.0 in (50.8 mm) steel ball on external target areas of the sample most likely to cause damage or result in malfunction.

Exception: Electrical panels or components in compliance with 16.7 are not required to meet the Drop and Impact Tests.

20.1.2 The following installation parameters shall be used for assembly of liquid level gauges to their intended connecting components at 1.5 times the recommended torque. Sealants are permitted, if they are recommended by the manufacturer.

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a) Products requiring threaded connection to specific components, such as electrical wires or conduit, shall be assembled to only the supplied/intended parts identified in the manufacturer's instructions; or

b) Products allowing threaded connections to common components, shall use schedule 40 steel pipe or 80 lb (ANSI Class 80) steel fittings, unless otherwise identified in the manufacturer's instructions; or

c) Products using connection means other than screw threads shall be assembled and installed in accordance with the manufacturer's instructions.

20.1.3 Following each test, there shall be no unacceptable damage, such as permanent deformation, pipe bending, stripped threads or malfunctioning part. However, also refer to 28.4 to determine whether damage is unacceptable, or acceptable, based on either test results or in the manufacturer's instructions.

20.2 Liquid level and functional operation tests

20.2.1 After conducting the Assembly and Abuse tests, the same LLG samples, with connected components, shall be subject to liquid level and functional operation tests in the order below. It is recommended that these products be installed in a high and narrow vertical tank with calibrated equipment to verify the gauge's level range, to facilitate testing and measurement.

20.2.2 Each product shall measure and display the liquid level at 0 %, 25 %, 50 %, 75 % and 100 % of the maximum rated height, which shall be legible from 3.0 ft (0.92 m) and accurate to ±5 % (or ±2 % for optional overfill prevention levels) of the actual level verified by a calibrated tool or geometric calculations, when installed in accordance with the manufacturer's instructions and after:

a) Environmental Resistance Tests per 20.3; and

b) Endurance and Compatibility Tests per 20.4.

20.2.3 Water may be used to conduct this test, unless the float or sensor reacts differently to various fuel properties (such as density or reflectivity). For LLGs optionally rated for water bottoms, the tests shall be conducted with water in fuel.

20.2.4 For LLGs optionally rated for heavy oils that may coat and weight down the float, the tests shall additionally apply the Fuel Exposure Test method specified in 20.4.1(b) with the heaviest liquid that the product is rated for.

20.2.5 For LLGs optionally rated for overfill prevention detection, the samples shall comply with the applicable requirements of 19, Overfill preventer tests.

20.3 Environmental resistance tests

20.3.1 The following environmental resistance tests shall be conducted on representative WC product samples of each liquid level gauge design types or specific components, after simulated installation as intended as per the manufacturer's instructions. Any damage from Assembly and Abuse tests per 20.1 that was acceptable, without manufacturer's instructions to not place the product into service (refer to 28.4), shall be re-created prior to conducting these tests:

a) Extreme temperature – LLGs or components rated for installation outdoors and having designs/materials which could change the function and accuracy of the LLG in extreme hot or cold environments shall be subjected to a repeat of the liquid level functional operation test per 20.2.2 while at -30 ±2 °C (-22 ±3.6 °F) and 50 ±2 °C (122 ±3.6 °F).

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b) UV Light – LLGs or components rated for installation outdoors and having designs/materials which could change the function and accuracy of the LLG after UV exposure shall be subjected to a repeat of the liquid level functional operation test as per 20.2. after testing to 14.2, UV Light.

c) Corrosion – LLGs or components located outdoors, and not constructed of corrosion resistant materials shall repeat the liquid level functional operation test per 20.2.2 after the Salt Fog Test per 14.3.

Note: Alternate compliance procedures to evaluate potential changes in gauge accuracy after the above tests are permitted, if they have been demonstrated to be equivalent to the method described in 20.2.2.

20.4 Endurance and compatibility tests

20.4.1 The following performance tests shall be conducted on a representative WC product size sample of each liquid level gauge, after simulated installation as intended per the manufacturer's instructions. Any damage from Assembly and Abuse tests per 20.1 that was acceptable, without manufacturer's instructions to not place the product into service (refer to 26.3), shall be re-created prior to conducting these tests:

a) Endurance – LLGs with moving parts shall be subjected to 3000 complete actuation cycles [at least at 6 in/min (152 mm/min) with a maximum of 1 min between up and down directions] with or without liquid. Following the cycles, the liquid level functional operation test per 20.2.2 shall be repeated;

b) Fuel Exposure – LLGs shall be subjected to fuel and vapor exposures as per 14.4, Fuel compatibility, for 120 days at 40 ±2 °C (104 ±3.6 °F), with different gauge components exposed to liquids and/or vapors as applicable. Following the fuel exposures, the liquid level functional operation test per 20.2.2 shall be repeated;

c) Thermal Aging – LLGs or components constructed with nonmetallic materials shall be subjected to thermal aging exposure as per the 14.1, Air Aging test, for 90 days at 70 ±2 °C (158 ±3.6 °F). Following thermal aging, the liquid level functional operation test per 20.2.2 shall be repeated.

Note: Alternate compliance procedures to evaluate potential changes in gauge accuracy after the above tests are permitted, if they have been demonstrated to be equivalent to the method described in 20.2.2.

21 Special Test Method Details

21.1 Electrical continuity tests

21.1.1 Any components (such as nonmetallic parts or pipe tape) used in the construction of a liquid control product that may electrically isolate it from the metal frame/enclosure, ground/bond lug and/or other components in the assembly (such as fill adapters, connector pipe or drop tubes) shall be measured for electrical continuity. The resistance between these components shall not exceed 0.5 MΩ as measured by an electrical multi-meter or similar resistance measuring equipment.

21.2 Hydrostatic strength test

21.2.1 Representative WC samples of liquid control products with any liquid confining parts and their integral connections that are pressurized during the fill operation shall be subjected to a pressure of 100 psig (689.5 kPa) or two times the rated fill pressure, whichever is greater, for 5 min. There shall be no damage, such as cracking, bulging or permanent deformation, and the system (components and connections) shall not leak.

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21.3 Mechanical strength tests

21.3.1 Representative WC samples of side mount and standalone type spill container products shall be installed as per the manufacturer's instructions with any supplied or specified hardware and tested for structural integrity by applying the following loads or forces. There shall be no failure, such as detachment from the installation point, or damage to the SCD and installation surface, such as permanent deformation or cracking that leads to leakage:

a) Vertical Load – A load of two times the weight of the maximum liquid capacity rating plus one times the weight of the completely assembled SCD shall be added to the attachment means for at least 1 min;

b) Horizontal Force – A 50 lbf (222.4 N), or 100 lbf (444.8 N) for stand-alone types, shall be applied horizontally to the top rim or cover of the SCD in the direction most likely to cause damage, for at least 1 min.

PART III – STRUCTURAL AND CONTAINMENT PRODUCTS (RESERVED FOR FUTURE USE)

PART IV – CORROSION PROTECTION PRODUCTS (RESERVED FOR FUTURE USE)

PART V – MISCELLANEOUS PRODUCTS

CONSTRUCTION

22 General

22.1 Portable/Mobile Tank Spill Prevention Devices (PTSPDs) shall be capable of field assembly in tank top fill openings, have automatic closures to prevent or reduce leaks under the conditions specified in the performance tests, and shall meet the following construction criteria:

a) The closure device unit shall be 2 to 4 in (50.8 to 101.6 mm) from the tank top internal wall;

b) The throat diameter shall be at least 1-1/4 in (31.8 mm) nominal pipe size;

c) The throat length shall allow dispenser nozzles to open the closure during fill operations;

d) Fitting threads for installation in the tank opening shall be standard NPT types and sizes;

e) Fitting configurations for caps shall be standard "quick connects" or NPT types; and

f) Provide at least 1/8 in (3.2 mm) diameter equivalent venting to a breather type fill cap

22.2 For PTSPDs provided with optional features for higher normal venting capacities, the product shall include a fill cap, with the assembly, that resists water entry yet allows automatic venting under both pressure and vacuum conditions, and additionally as per 24.5 Special Tests. These fill caps shall:

a) Provide initial operational relief within a 0 to 1.0 psig (0 to 6.9 kPa) pressure and 0 to 0.5 psig (0 to 3.4 kPa) vacuum range;

b) Provide at least 3/8 in (9.5 mm) diameter equivalent venting, or not cause the tank to exceed 0.5 psig (3.4 kPa) vacuum at a liquid withdraw rate of 35 US gal/min (132 L/min) as per 24.5.2; and

c) Be marked as per 27.1 and provided with added instructions per 28.1.

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22.3 For PTSPDs provided with optional features for higher emergency venting capacities, the product shall include a fill cap, with the assembly, that resists water entry yet allows automatic venting under emergency venting conditions, and additionally as per 24.5 Special Tests. These fill caps shall:

a) Provide initial operational relief within a 0.5 to 1.0 psig (3.4 to 6.9 kPa) pressure range;

b) Provide at least 2.0 in (50.8 mm) diameter equivalent venting, or not cause the tank to exceed 2.5 psig (17 kPa) pressure at an airflow rate of 32,700 ft^3/h (926 m^3/h) as specified in 24.5.2; and

c) Be marked as per 27.1 and provided with added instructions per 28.1

PERFORMANCE

23 General

23.1 Representative production samples of each miscellaneous tank accessory shall be subjected to the appropriate Performance tests with sample variations of product type, design, material and size as specified in each test method:

24 Portable/Mobile Tank Spill Prevention Device Tests

24.1 Assembly and abuse tests

24.1.1 One sample of the WC size per 24.1.7 of each PTSPD design type shall be subject to the assembly and abuse tests in the order below at the temperatures specified by 24.1.3, and shall be inspected for visible damage per 24.1.4 before the next test in the sequence is conducted:

a) Assembly – Samples shall be assembled in accordance with the manufacturer's instructions and the assembly parameters per 24.1.2 to simulate end use installation in the portable test tank specified in 24.1.5;

b) Drop – Samples shall be dropped from 4 ft (1.2 m) onto a flat concrete surface, on external target areas of the sample most likely to cause damage or result in malfunction; and

c) Impact – Samples shall be impacted at 5.0 ft-lbf (6.78 J) with a 2.0 in (50.8 mm) steel ball, on external target areas of the sample most likely to cause damage or result in malfunction.

24.1.2 The following installation parameters shall be used for assembly of different types of PTSPDs and their intended components into a simulated portable tank (refer to 24.1.5) fill opening:

a) Bodies shall be threaded into an 80 lb (ANSI Class 80) steel fitting at 1.5 times the recommended torque rating. Thread sealants are permitted, if they are recommended by the manufacturer;

b) Pipes, if optionally provided or required, shall be assembled at 1.5 times the recommended torque rating. If required, a schedule 40 steel type shall be used for the test;

c) Caps, if optionally provided or required, shall be either hand tightened (for quick connect types) or wrench tightened at 1.5 times the recommended torque rating (for threaded types).

24.1.3 The tests shall be conducted at room temperature [65 °F to 85 °F (18 to 29 °C) and 50 ±20 % RH] and, if applicable, to affected products per 24.1.6:

a) High temperature of 50 ±2 °C (122 ±3.6 °F) using new samples; and/or

b) Low temperature of -30 ±2 °C (-22 ±3.6 °F) using new samples.

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