UL 87A

STANDARD FOR SAFETY

Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85)

UL Standard for Safety for Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 87A

First Edition, Dated February 13, 2015

Summary of Topics

This revision of ANSI/UL 87A dated January 14, 2020 includes the following:

> ***Add 16 percent isobutanol/gasoline blend; 1.8, 27.2, 29.1.1, 29.1.2, 33.2, 33.2A, 34.2, 34.2A, 42.4, 42.4A, 45.1.1, Supplement SA***
>
> ***Adding zones to the different divisions; 3.2, 3.5, 3.21, 3.22, 7.6, 21.1, Section 24, 25.7, 25.11, Figure 3.1, Figure 3.2, Figure 7.1, and Figure 8.1.***

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated August 23, 2019 and October 25, 2019.

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UL 87A

Standard for Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85)

Prior to the first edition, the requirements for the products covered by this standard were included in the Outline of Investigation for Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 87A.

First Edition

February 13, 2015

This ANSI/UL Standard for Safety consists of the First Edition including revisions through January 14, 2020.

The most recent designation of ANSI/UL 87A as an American National Standard (ANSI) occurred on December 12, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

1 Scope

1.1 These requirements apply to power-operated dispensing devices, rated 600 V ac or less, for use with motor fuels. Motor fuels, as defined by these requirements, include one or more of the fuels described in 1.2.

1.2 Dispensing devices covered by these requirements are intended for use with one or more of the following:

a) Gasoline formulated in accordance with the Standard Specification for Automotive Spark-Ignition Fuel, ASTM D4814;

b) Gasoline/ethanol blends with nominal ethanol concentrations up to 25 percent ethanol (E25), consisting of gasoline formulated in accordance with the Standard Specification for Automotive Spark-Ignition Fuel, ASTM D4814, when blended with denatured fuel ethanol formulated to be consistent with the Standard Specification for Denatured Fuel Ethanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel, ASTM D4806; or

c) Gasoline/ethanol blends with nominal ethanol concentrations above 25 percent formulated in accordance with the Standard Specifications in item (b) or formulated in accordance with the Standard Specification for Ethanol Fuel Blends for Flexible-Fuel Automotive Spark-Ignition Engines, ASTM D5798, as applicable.

1.3 Requirements for the installation and use of dispensing devices are included in the Code for Motor Fuel Dispensing Facilities and Repair Garages, ANSI/NFPA 30A, and the National Electrical Code, ANSI/NFPA 70.

1.4 These requirements apply to wiring methods used to install or interconnect such control equipment when the equipment is located directly on or within the housing of the dispensing device.

1.5 These requirements do not apply to control equipment that may authorize, monitor, or interrupt operation of a power-operated dispensing device, nor other auxiliary equipment. These products would be covered under the Standard for Control Equipment for Use with Flammable Liquid Dispensing Devices, UL 1238.

1.6 These requirements do not cover dispensing devices for use with diesel fuel, biodiesel fuel, diesel/biodiesel fuel blends, fuel oil, or kerosene, which are covered in the Standard for Power-Operated Dispensing Devices for Diesel Fuel, Biodiesel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations up to 20 Percent (B20), Kerosene and Fuel Oil, UL 87B.

1.7 These requirements do not cover dispensing devices for use with LP-Gas, which are covered under the Standard for Power-Operated Dispensing Devices for LP-Gas, UL 495.

1.8 Products intended to be rated for use with gasoline or gasoline/ethanol blends or gasoline/isobutanol blends with nominal alcohol concentrations:

a) Up to 25 percent (E0 – E25) shall be evaluated using the CE25a test fluid as the only applicable test fluid;

b) Up to 40 percent (E0 – E40) shall be evaluated using both the CE25a and CE40a test fluid;

c) Up to 85 percent shall be evaluated using both the CE25a and the CE85a test fluids; or

d) Up to 16 percent (CiBu0 – CiBu16) shall be evaluated using the CiBu20a test fluid as the only applicable test fluid.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this outline shall comply with the requirements for that component.

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

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

b) Is superseded by a requirement in this standard.

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

2.1.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

2.2 Units of measurement

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

2.3 Undated references

2.3.1 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.

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 AIR GAP – A minimum of 1 inch (25.4 mm) free air space provided between the planes of Division 1, Division 2, Zone 1 or Zone 2 hazardous locations and an unclassified area of a dispensing device.

3.3 BASE – The part of the assembly that is intended to be secured to the foundation on which the device will be installed.

3.4 BLENDING OPTION – Dispensing devices may be provided with an option that blends two specific fuels into one fuel to be dispensed. This blending occurs at the dispenser level and can be in two forms:

a) Fixed blending – Blending at the dispenser level that blends two specific fuels into one fuel to be dispensed, and that fuel to be dispensed is fixed. For example, fixed blending includes blend options where gasoline and denatured fuel ethanol can be blended to achieve E85, which is the actual dispensed fuel.

b) Variable blending – Blending at the dispenser level that blends two specific fuels into the fuel to be dispensed, but the fuel to be dispensed can be any of a number of previously set points. For

example, variable blending includes blend options where gasoline and E85 can be blended to achieve E40, E60, and E85 as the actual dispensed fuel.

3.5 CLASS I HAZARDOUS LOCATIONS – Locations in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. For the purpose of these requirements, as applied to dispensing devices, the flowing classified areas are further defined. The area of the dispensing system covered by these requirements is the envelope defined by the maximum outer dimensions. See Figure 3.1 and Figure 3.2 for an illustration of Class I hazardous locations.

a) Class I, Group D, Division 1 or Zone 1 –

1) The area within a dispenser housing up to 4 feet (1.2 m) vertically above the base, except for that area defined as Division 2 or Zone 2 or unclassified.

2) Any area within a nozzle boot.

b) Class I, Group D, Division 2 or Zone 2 –

1) Areas within a dispenser housing above the Division 1 or Zone 1 area.

2) The area surrounding the dispenser housing within 18 inches (46 cm) horizontally in all directions from the Division 1 Zone 1 area located within the housing.

3) The area within 18 inches horizontally, in all directions from the opening of a nozzle boot not isolated by a vapor tight partition, except that the area is not required to be extended around a 90 degree or greater corner.

Figure 3.1

Hazardous location classification within a typical dispenser

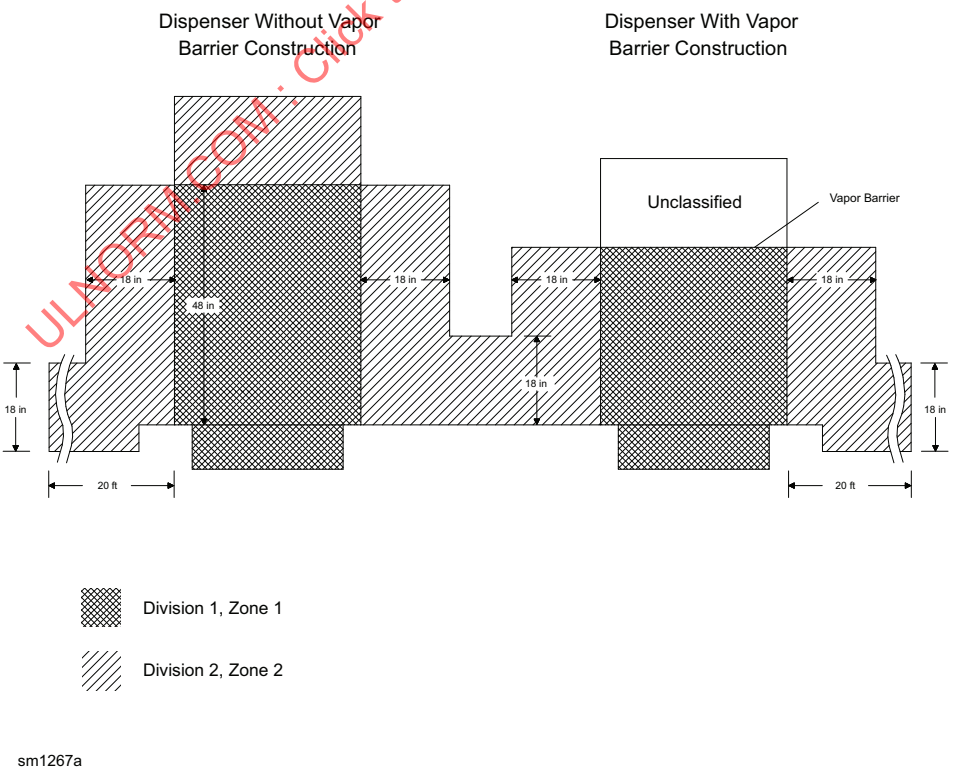

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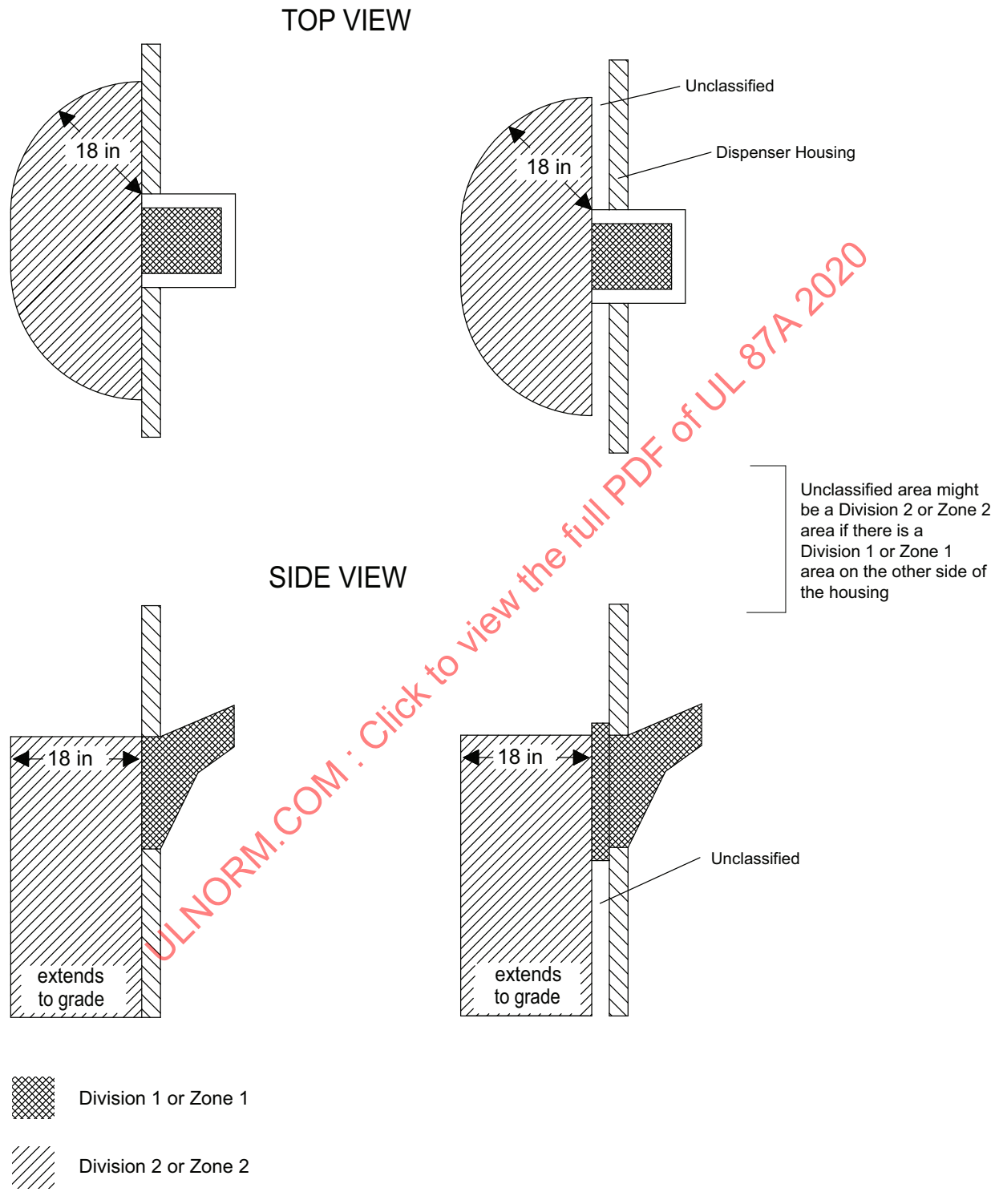
Figure 3.2

Hazardous location classifications associated with a hose nozzle boot



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3.6 DISPENSER, BLENDING – A dispensing device that is provided with a blending option

3.7 DISPENSER, REMOTE CONTROL TYPE – A dispensing device that does not contain a power-operated pump as part of the assembly, and which is intended for connection to a fluid piping system containing the power-operated pumps at a remote location. Also commonly identified as a “dispenser”.

3.8 DISPENSER, SELF-CONTAINED – A dispensing device that includes a power-operated pump as part of the assembly. Also commonly identified as a “pump” or “suction dispenser”.

3.9 DISPENSING DEVICE – A product consisting of various components as applicable, which are used to control and meter the flow of liquid from an upstream storage device.

3.10 ELECTRICAL CIRCUITS –

a) High Voltage Circuit – A circuit having a potential of not more than 600 volts and having circuit characteristics in excess of those of a low voltage or Class 2 circuit.

b) Low Voltage Circuit – A circuit involving a potential of not more than 30 volts ac (rms) (42.4 volts peak or dc) and

1) Supplied by a Class 2 transformer, or by a battery, by a battery and fixed impedance, or by a transformer and fixed impedance each of which, as a unit, is in compliance with what is required for a Class 2 transformer, or

2) Limited to a maximum of 100 volt-amperes.

A circuit derived from a source of supply classified as a high voltage circuit, by connecting resistance in series with the supply circuit as a means of limiting the voltage and current, is not considered to be a low voltage circuit.

c) Intrinsically Safe Circuit – A circuit incapable of releasing sufficient electrical energy under normal or abnormal conditions to cause ignition of a specific hazardous atmospheric mixture. Abnormal conditions include unintentional damage to any part of the equipment or wiring, insulation or other malfunction of electrical components, application of overvoltage, adjustment and maintenance operations, and other similar conditions.

3.11 GASOLINE/ETHANOL BLENDS – Blended fuels composed of a gasoline component and an ethanol component. The numerical value corresponding to the ethanol component determines the blend rating (such as E85 for 85% ethanol, 15% gasoline).

3.12 HANGING HARDWARE – The portion of the dispensing device that is connected to the outlet of the dispenser and consists of a hose assembly and hose nozzle valve, and with emergency breakaway couplings and swivel connectors as needed.

3.13 HOUSING – That section of the device that encloses and is intended to protect operating parts, control mechanisms, or other mechanical or electrical components, the damage of which would render the device incapable of being operated as intended, lead to tampering, introduce the possibility of escape of liquid, or expose bare live electrical parts.

3.14 INTENDED CARE AND USAGE – Intended care means tasks such as lubrication and cleaning. Intended usage covers the manipulations involved in starting the dispenser, dispensing the liquid, and restoring the dispenser to its standby condition.

3.15 MASTER-SATELLITE DISPENSER COMBINATION – Consists of two or more dispensing devices. The "Master" dispenser controls the dispensing operation; the "Satellite" dispenser actually dispenses as well, but is not used to control the dispensing function.

3.16 PANEL – A principal section of a housing or enclosure. A mounting arrangement for control and other components.

3.17 PEDESTAL – That part of the structure above the base which supports the component units, and to which they are attached.

3.18 PUMPING UNIT – A power-operated pump for gasoline or gasoline/ethanol blends, which may incorporate a strainer, air separator, relief device, or other auxiliary part.

3.19 SEALS, DYNAMIC – A seal that is subject to mechanical movement or other applied forces that result in movement or flexing of the seal under normal use conditions.

3.20 SEALS, STATIC – A seal that is not subject to mechanical movement or other applied forces other than compressing forces that are applied during installation and maintained during normal use conditions.

3.21 UNCLASSIFIED AREA – An area within a dispenser housing isolated from Division 1, Division 2, Zone 1, or Zone 2 locations by a vapor barrier or a solid nozzle boot, but not completely surrounded by a Division 1 or Division 2 area, that does not contain a level of flammable gases or vapors that are capable of producing explosive or ignitable mixtures.

3.22 VAPOR BARRIER – A solid, unpierced partition located between Division 1, Division 2, Zone 1, or Zone 2 locations and unclassified areas of a dispensing device. The vapor barrier is intended to reduce the entry of flammable gases or vapors into unclassified areas.

3.23 VAPOR RECOVERY SYSTEM – A system constructed to capture vapors displaced during filling operations. The vapors are not processed during the course of this activity. Examples of vapor recovery systems include balance-pressure vapor displacement systems and vacuum assist systems.

CONSTRUCTION

4 General Construction

4.1 General

4.1.1 A power-operated dispensing device includes as needed a base, housing or pedestal, power-operated pump, pressure relief device, strainer, meter, valves as required, hose, hose nozzle valve, motor control, locking mechanism, piping, electrical wiring, and fixtures. The pump may be integral with the dispensing device, or the dispensing device may be designed for use with a separate pump.

4.1.2 A dispensing device may be of the self contained type with components mounted in a common pedestal and housing, or it may comprise separate assemblies intended for installation as individual units but in conjunction with each other.

4.1.3 Devices having self-contained pumping units are judged on the use of suction lifts of not less than 2 feet (61 cm).

4.1.4 The construction shall be such that parts can be replaced or reassembled to function as intended after being dismantled.

4.1.5 The device shall incorporate provisions for support independent of piping, tubing, or conduit that may be connected thereto.

4.1.6 Fluid confining parts, except gaskets, seals, or hoses, shall be constructed of metallic materials.

4.2 Hose assemblies

4.2.1 A dispensing device may be furnished without a hose assembly. The dispenser shall be marked in accordance with 45.1.1(c) whether the hose assembly is furnished or not.

4.2.2 When the hose is located inside the housing, the assembly shall be such that electrical parts will not be sprayed with liquid in the case of hose leakage. In a weighted loop application, provision shall be made to prevent the weight from pulling on the hose coupling.

4.3 Strainers

4.3.1 A dispensing device shall be provided with at least one strainer. The strainer shall comply with Strainers, Section 12. The strainer or strainer assembly shall be constructed and located to permit the removal and replacement of the straining element without breaking liquid lines or disturbing any part of the dispensing device assembly and to permit ready access for cleaning with minimum spillage of fluid.

4.4 Electrically operated valves

4.4.1 A dispensing device for use in a remote control system, or a single inlet dual outlet self contained dispensing device, incorporating only one pump, shall have in each discharge line a shutoff valve that closes at the time or before the hose nozzle valve is hung in place on the device.

4.4.2 A power-operated dispensing device of the self contained single outlet type is not required to be equipped with a shutoff valve as specified in 4.4.1.

4.4.3 A plug or rotating disc type valve employing the bearing surface of the plug or disc as the liquid seal to the exterior of the valve body shall not be used in liquid lines.

4.4.4 An electrically operated shutoff valve shall close upon being de-energized, regardless of the position of any operating lever or reset handle.

4.4.5 Valves, as needed, are required in the construction of dispensing devices in order to maintain system priming thereby minimizing the risk of seal dry out.

4.5 Hose nozzle valve

4.5.1 A dispensing device may be furnished without a hose nozzle valve provided it is marked in accordance with 45.1.1(c).

4.6 Mechanically operated valves

4.6.1 A plug or rotating disc type valve, employing the bearing surface of the plug or disc as the liquid seal to the exterior of the valve body, shall not be used in liquid lines.

4.6.2 A petcock or other manually operated valve shall not be provided, which when open, permits the discharge of fluid.

5 Materials

5.1 Metallic materials

5.1.1 General

5.1.1.1 A metallic part, in contact with the fuels anticipated by these requirements, shall be resistant to the action of the fuel if degradation of the material will result in leakage of the fuel or if it will impair the function of the device. For all fuel ratings, see Corrosion due to fluid, 5.1.2.1. For products rated for gasoline/ethanol blends with nominal ethanol concentrations greater than 40%, see Metallic materials – system level, 5.1.3.

5.1.1.2 The exposed surfaces of metallic parts shall be resistant to atmospheric corrosion if this corrosion will lead to leakage of the fluid or if it will impair the function of the device. The material shall comply with the requirements in Atmospheric corrosion, 5.1.2.2.

5.1.1.3 Metallic parts in contact with the fuels anticipated by these requirements shall not be constructed of lead, or materials that are substantially lead. In addition, no coatings or platings containing lead shall be used, such as terne-plated steel.

5.1.2 Metallic materials – material level

5.1.2.1 Corrosion due to fluid

5.1.2.1.1 All metallic materials used for fluid confining parts shall be resistant to corrosion caused by the fuels anticipated by these requirements. In addition, metallic materials, used internally in fluid confining parts, that are required to operate in some manner to address safety (e.g. plunger on a valve) shall be resistant to corrosion caused by these fuels. This requirement also applies to all tubing, piping, or other interconnection means between components of a dispenser. Compliance is verified by the Long Term Exposure Test, Section 29.

5.1.2.1.2 A coating or plating, applied to a base metal, shall be resistant to the action of the fuels anticipated by these requirements as determined by the Long Term Exposure Test, Section 29.

5.1.2.2 Atmospheric corrosion

5.1.2.2.1 Metallic materials used for fluid confining parts shall be resistant to atmospheric corrosion. In addition, metallic materials that are required to operate to address safety (e.g. thermal links on shear valves) shall be resistant to atmospheric corrosion. Ferrous materials of the thickness specified in the following items are acceptable for the preceding when uncoated:

a) A casting having a wall thickness of not less than 1/4 inch (6.4 mm) if shown by production test to be free of leakage;

b) Standard pipe and fittings conforming to the Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M; and

c) Fabricated sheet steel parts having a minimum wall thickness of 0.093 inch (2.36 mm).

5.1.2.2.2 A protective coating shall provide resistance against atmospheric corrosion to a degree not less than that provided by the protective coatings specified in 5.1.2.2.3.

5.1.2.2.3 Cadmium plating shall not be less than 0.0003 inch (0.008 mm) thick, and zinc plating shall not be less than 0.0005 inch (0.013 mm) thick, except on parts where threads constitute the major portion of

the area in which case the cadmium or zinc plating shall not be less than 0.00015 inch (0.0038 mm) thick. Metallic parts are considered to comply with 5.1.2.2.1 when they are protected against atmospheric corrosion by:

a) Hot dipped, mill galvanized sheet steel complying with the coating designation G90 in Table I of the Specification for Sheet Steel, Zinc Coated (Galvanized) or Zinc-Iron-Alloy Coated (Galvannealed) by the Hot Dip Process, ASTM A653/A653M; or

b) Coatings which have been determined to be equivalent to G90 under the requirements of the Standard for Organic Coatings for Steel Enclosures for Outdoor Use Electrical Equipment, UL 1332.

5.1.2.2.4 A metallic material other than as described in 5.1.2.2.1 – 5.1.2.2.3 shall be painted or protected in a manner that has been determined to be equivalent.

5.1.3 Metallic materials – system level

5.1.3.1 Combinations of metallic materials in products rated for use with gasoline/ethanol blends with nominal ethanol concentrations greater than 40% shall be chosen to reduce degradation due to galvanic corrosion in accordance with 5.1.3.2 – 5.1.3.4.

5.1.3.2 Table 5.1 shows the galvanic series for metallic materials exposed to a conductive solution of sea water. The most active material in a given combination will experience increased levels of corrosion, while the most passive material in the combination will experience reduced levels of corrosion. The greater the separation of the materials are in the galvanic series of Table 5.1, the more pronounced the effects would be. Table 5.1 serves as a guide in selecting the appropriate test conditions based on manufacturer specified material combinations.

Table 5.1
Galvanic series of metal materials

Most passive	Platinum Gold Graphite Silver Stainless Steel Type 316 (Passive) Stainless Steel Type 304 (Passive) Titanium 13% Chromium Stainless Steel (Passive) 76 Ni – 16 Cr – 7 Fe Alloy (Passive) Nickel (Passive) Silver Solder M-Bronze G-Bronze 70:30 Cupro Nickel Silicon Bronze Copper Red Brass Aluminum Brass

Table 5.1 Continued on Next Page

Table 5.1 Continued

	Admiralty Brass
	Yellow Brass
	60 Ni – 30 Mo – 6 Fe – 1 Mn
	76 Ni – 16 Cr – 7 Fe Alloy (Active)
	Nickel (Active)
	Manganese Bronze
	Tin
	Stainless Steel Type 316 (Active)
	Stainless Steel Type 304 (Active)
	13% Chromium Stainless Steel (Active)
	Cast Iron
	Wrought Iron
	Mild Steel
	Aluminum 2024
	Cadmium
	Alclad
	Aluminum 6053
	Aluminum 1100
	Galvanized Steel
	Zinc
	Magnesium Alloys
Most active	Magnesium
Note – Reprinted with permission from NACE. Based on table titled "Galvanic Series of Metals Exposed to Seawater" from NACE Corrosion Engineer's Reference Book, Third Edition ©NACE International 2002.	

5.1.3.3 Platings, such as nickel plating, can be used to reduce or eliminate dissimilar metal contact areas, as long as the plating material complies with 5.1.3.2 as the contact metal. If used, the plating shall comply with the Long Term Exposure Test, Section 29.

5.1.3.4 Gaskets or nonmetallic spacers used to reduce or eliminate dissimilar metal contact areas, where permitted, shall be subjected to the applicable requirements for static seals in Nonmetallic materials, 5.2, when they are in contact with the fluid.

5.2 Nonmetallic materials

5.2.1 General

5.2.1.1 A nonmetallic part in contact with the fuels anticipated by these requirements, shall be resistant to the action of the fuel if degradation of the material will result in leakage of the fuel, or if it will impair the function of the device.

5.2.1.2 Gaskets or seals shall be designated as dynamic and/or static seals. See 3.19 and 3.20 respectively. If the type of seal cannot be determined, then the material shall be treated as both a static and a dynamic seal.

5.2.1.3 Gaskets and seals shall comply with the requirements as outlined in Nonmetallic materials – material level, 5.2.2 and Nonmetallic materials – system level, 5.2.3.

5.2.1.4 Materials used in the construction of hoses shall comply with 16.1.

5.2.1.5 Nonmetallic materials in contact with the fuels anticipated by these requirements shall not be constructed of the following:

a) Polysulfide rubber;

b) Ethylene propylene diene monomer (EPDM) rubber;

c) Methyl-Methacrylate;

d) Polyvinyl Chloride (PVC);

e) Nylon 6/6; or

f) Polyurethane.

5.2.2 Nonmetallic materials – material level

5.2.2.1 Static seals

5.2.2.1.1 Static seals shall be evaluated in accordance with the Standard for Gaskets and Seals, UL 157, modified as indicated in 5.2.2.1.2 – 5.2.2.1.4. If a specific material complies with these requirements, the material can be considered to be qualified for system testing.

5.2.2.1.2 A static seal shall be constructed of a material that is acceptable in accordance with the scope of Standard for Gaskets and Seals, UL 157.

5.2.2.1.3 Static seals shall be subjected to the Volume Change and Extraction Test in accordance with the Standard for Gaskets and Seals, UL 157, except for the following modifications:

a) The test duration shall be 1000 hours;

b) The applicable test fluids shall be as described in Supplement SA; and

c) For all materials, the average volume change shall not exceed 40% swell (increase in volume) or 1% shrinkage (decrease in volume). In addition, the weight loss shall not exceed 10%. For coated fabrics, alternate limits can be used with the average volume change not exceeding 60% swell or 5% shrinkage, and the weight loss shall not exceed 20%. There shall be no visual evidence of cracking or other degradation as a result of the exposure for any material including coated fabrics.

5.2.2.1.4 Static seals shall be subjected to the Compression Set Test in accordance with the Standard for Gaskets and Seals, UL 157, except for the following modifications:

a) The test duration shall be 1000 hours.

b) The samples shall be immersed, at room temperature, in the test fluids (see item c) while compressed for the entire test duration. No oven conditioning is required.

c) The applicable test fluids shall be as described in Supplement SA.

d) The recovery period shall consist of removing the sample from the compression device and immersing it in the applicable test fluid for 30 minutes at room temperature. The sample shall not be allowed to dry out due to exposure to air. The 30-minute immersion should use the same fluid as the test fluid for each sample.

e) For all materials, the average compressions set is calculated and shall not exceed 35 percent. For coated fabrics, alternate limits can be used with the average compression set not exceeding 70%.

Exception: This requirement does not apply to composite gasket materials as defined in accordance with the Standard for Gaskets and Seals, UL 157.

5.2.2.2 Dynamic seals

5.2.2.2.1 Dynamic seals shall be evaluated in accordance with the Standard for Gaskets and Seals, UL 157 modified as indicated in 5.2.2.2.2 – 5.2.2.2.4. If a specific material complies with these requirements, the material can be considered to be qualified for system testing.

5.2.2.2.2 A dynamic seal shall be constructed of a material that is acceptable in accordance with the scope of the Standard for Gaskets and Seals, UL 157.

5.2.2.2.3 Dynamic seals shall be subjected to the Volume Change and Extraction Test in accordance with the Standard for Gaskets and Seals, UL 157, except for the following modifications:

a) The test duration shall be 1000 hours;

b) The applicable test fluids shall be as described in Supplement SA; and

c) For all materials, the average volume change for a gasket or seal material shall not exceed 40% swell (increase in volume) or 1% shrinkage (decrease in volume). In addition, the weight loss shall not exceed 10%. For coated fabrics, alternate limits can be used with the average volume change not exceeding 60% swell or 5% shrinkage, and the weight loss shall not exceed 20%. There shall be no visual evidence of cracking or other degradation as a result of the exposure for any material including coated fabrics.

5.2.2.2.4 Dynamic seals shall be subjected to the Tensile Strength and Elongation Test in accordance with the Standard for Gaskets and Seals, UL 157, except for the following modifications:

a) The test duration shall be 1000 hours;

b) The applicable test fluids shall be as described in Supplement SA; and

c) For all materials, the average tensile strength and the average elongation of materials shall not be less than 60 percent of the as-received values. For coated fabrics, alternate limits can be used with the average tensile strength and the average elongation not less than 30% of the as-received values.

5.2.3 Nonmetallic materials – system level

5.2.3.1 For all materials, gaskets and seals, used as static seals, that have been shown to comply with the applicable requirements for static seals in the Standard for Gaskets and Seals, UL 157, along with the exceptions as noted in 5.2.2.1, the Long Term Exposure Test, Section 29 shall be waived.

5.3 Casting impregnation materials

5.3.1 Material level

5.3.1.1 The material shall be subjected to an infrared spectrum analysis in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

5.3.2 System level

5.3.2.1 The casting impregnation material, applied as intended to a casting, shall comply with the Long Term Exposure Test, Section 29. The casting shall not show indications of porosity leakage at any point during or after this test.

5.4 Internal parts

5.4.1 Nonmetallic parts located internally to a fluid confining part, degradation of which would not directly result in leakage, is not required to comply with Nonmetallic materials, 5.2. The part shall be tested in accordance with 5.4.2.

5.4.2 Internal nonmetallic parts shall be tested during the Long Term Exposure Test, Section 29. During this test, the part shall not degrade to the extent that visible particles can be observed in the fluid.

5.5 Blending options

5.5.1 Assemblies intended for use with dispensing equipment that provides for a variable blending option, at gasoline/ethanol blends with nominal ethanol concentrations above 25 percent, shall be subjected to the Blending Cycling Test, Section 44.

5.5.2 Assemblies intended for use with dispensing equipment that provides for a fixed blending option, as gasoline/ethanol blends with nominal ethanol concentrations above 25 percent, shall be evaluated in accordance with (a) or (b):

a) If intended to be located after the blending option such that the assembly is only subjected to the final blended fuel, then the Blending Cycling Test is not required.

b) If intended to be located at or before the blending option such that it is subjected to different gasoline/ethanol blend levels, the assembly shall be subjected to the Blending Cycling Test, Section 44.

5.5.3 Assemblies intended for use with dispensing equipment that provides for a variable or fixed blending of gasoline/ethanol blends with nominal ethanol concentrations below 25 percent are considered acceptable without further evaluation for the blending option.

6 Frame and Enclosure

6.1 Base

6.1.1 The base shall be ordinary cast iron of 1/4 inch (6.4 mm) minimum thickness, of commercial grade steel of 0.093 inch (2.36 mm) minimum thickness, or of other materials or constructions that have been determined to be of equivalent strength.

6.1.2 The base shall be provided with bolt holes to accommodate bolts not less than 1/2 inch (12.7 mm) diameter for anchoring the dispenser. At least two holes shall be provided if the dispenser is not more than 6 feet (1.83 m) tall and at least four holes if the dispenser is over 6 feet tall. If two holes are provided, they shall be located on opposite sides of the base and at least 13 inches (330 mm) apart. If more than two holes are provided, they shall be located approximately symmetrically on a bolt circle having a diameter of not less than 13 inches. The bolt holes shall be accessible, such as by being located in the base at the sides of the dispenser provided with doors or removable panels.

6.1.3 The requirement specified in 6.1.2 does not apply to a farm or non-retail type of dispenser of a special design, which includes other provisions for anchoring the dispenser.

6.2 Pedestal

6.2.1 The pedestal shall be made of cast iron, sheet steel, or of a framework consisting of angle iron, wrought iron, or steel pipe, or made of a construction that has been determined to be equivalent.

6.2.2 Piping carrying liquid shall not serve as part of the pedestal.

6.2.3 The pedestal shall provide strength and rigidity for the assembled structure. Provisions, such as by bolting or welding, shall be made to prevent loosening of joints of the pedestal. See 6.3.8.

6.3 Housing

6.3.1 Exposure of the assembly to the weather shall not interfere with the intended performance of the operating parts that it encloses. A recess or depression in the housing that may collect water shall be arranged to direct such collection to the outside or to points within the structure where it can fall to the ground without damage to the internal components.

6.3.2 A part employed in a main side section of a housing shall be:

a) Sheet steel having a minimum thickness of 0.036 inch (0.91 mm);

b) Stainless steel having a minimum thickness of 0.026 inch (0.66 mm);

c) Unreinforced aluminum having a minimum thickness of 0.053 inch (1.35 mm); or

d) Reinforced aluminum having a minimum thickness of 0.041 inch (1.04 mm).

Glass shall not be used as a part employed in a main side section. Nonmetallic material can be used if it complies with 6.3.4 and 6.3.5.

6.3.3 A part employed in a main top section of a housing shall be:

a) Sheet steel having a minimum thickness of 0.031 inch (0.79 mm);

b) Stainless steel having a minimum thickness of 0.023 inch (0.58 mm);

c) Unreinforced aluminum having a minimum thickness of 0.047 inch (1.19 mm); or

d) Reinforced aluminum having a minimum thickness of 0.036 inch (0.91 mm).

Glass shall not be used as a part employed in a main side section. Nonmetallic material can be used if it complies with 6.3.4 and 6.3.5.

6.3.4 A principal section or panel of the housing shall not be fabricated of nonmetallic material unless the material can be shown to have equivalent strength to the materials shown in 6.2.3 and 6.3.3. In addition, the material shall comply with 6.3.5. This requirement does not apply in the case of a dial glass, a small display panel, or to main panels that do not comply with these requirements, but which are backed up by metal plates that do comply with these requirements.

6.3.5 Nonmetallic materials used as a principal section or panel of the housing shall comply with all of the following:

a) The material qualifies for a minimum flammability classification of HB as described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94;

b) The material is resistant to deterioration and deformation;

c) The material is not used for support of internal functional components;

d) The material is not part of the basic dispensing pedestal;

e) The material is not in contact with heat producing parts; and

f) The temperature of the material does not exceed 65°C (149°F) in service.

6.3.6 Other metallic materials can be used as a part in a main top or side section, as long as they can be shown to have equivalent strength to the materials shown in 6.3.2 and 6.3.3.

6.3.7 When the housing also serves as a pedestal, it shall provide rigidity and strength for the assembly as well as support for the components. It shall be arranged in such a manner that removal of access panels does not affect strength, rigidity, or support.

6.3.8 The housing shall afford space for making field connections of fluid handling piping and electrical equipment. Openings with closures such as covers, panels, or similar parts, shall be provided for making field connections and for inspection and adjustment of the operating mechanism after the device is installed, unless sections of the housing are planned to be removed by authorized persons for this purpose.

6.3.9 The housing assembly shall incorporate vent openings near the bottom, totaling an area of not less than 1-1/4 square inches (8.06 cm^2), to permit the liberation of fuel vapors. These openings shall be if such size and arrangement as to avoid clogging.

6.3.10 Openings in the housing for the reception of hose nozzles, when they are not in use, shall be fitted with a nozzle guard or boot, constructed and positioned to drain to the outside of the housing, fluid which may escape from the nozzle.

7 Vapor Barrier

7.1 A dispensing device that requires the housing of electronic components within an unclassified area as defined in 3.21 shall be provided with a vapor barrier that reduces the entry of flammable gases or vapors within the enclosure.

7.2 The construction of a vapor barrier shall be equivalent to an unpierced partition. This shall be accomplished by one of the following methods, which are shown in Figure 7.1, and include:

a) An unpierced panel;

b) Two or more panels that are welded together with continuous seams; or

c) Other means determined to be equivalent to an unpierced panel. See 7.3.

7.3 Vapor barriers that are constructed in accordance with 7.2 (c) shall be evaluated to determine equivalency to an unpierced partition. The following are factors that are to be evaluated when determining equivalency:

a) Rigidity of the assembly and

b) Effectiveness of the assembly sealing against vapors.

7.4 Factors to be taken into consideration when evaluating the mechanical securement of the vapor barrier panels are:

a) The spacing and number of fasteners used to secure the panels and

b) The thickness of the panels used for the vapor barrier.

7.5 A vapor barrier shall be fastened by one of the following methods:

a) A metallic bolt and nut with machined flat surfaces and redundant machined flat washers. Machined is defined as an additional process that assures that the surface is flat.

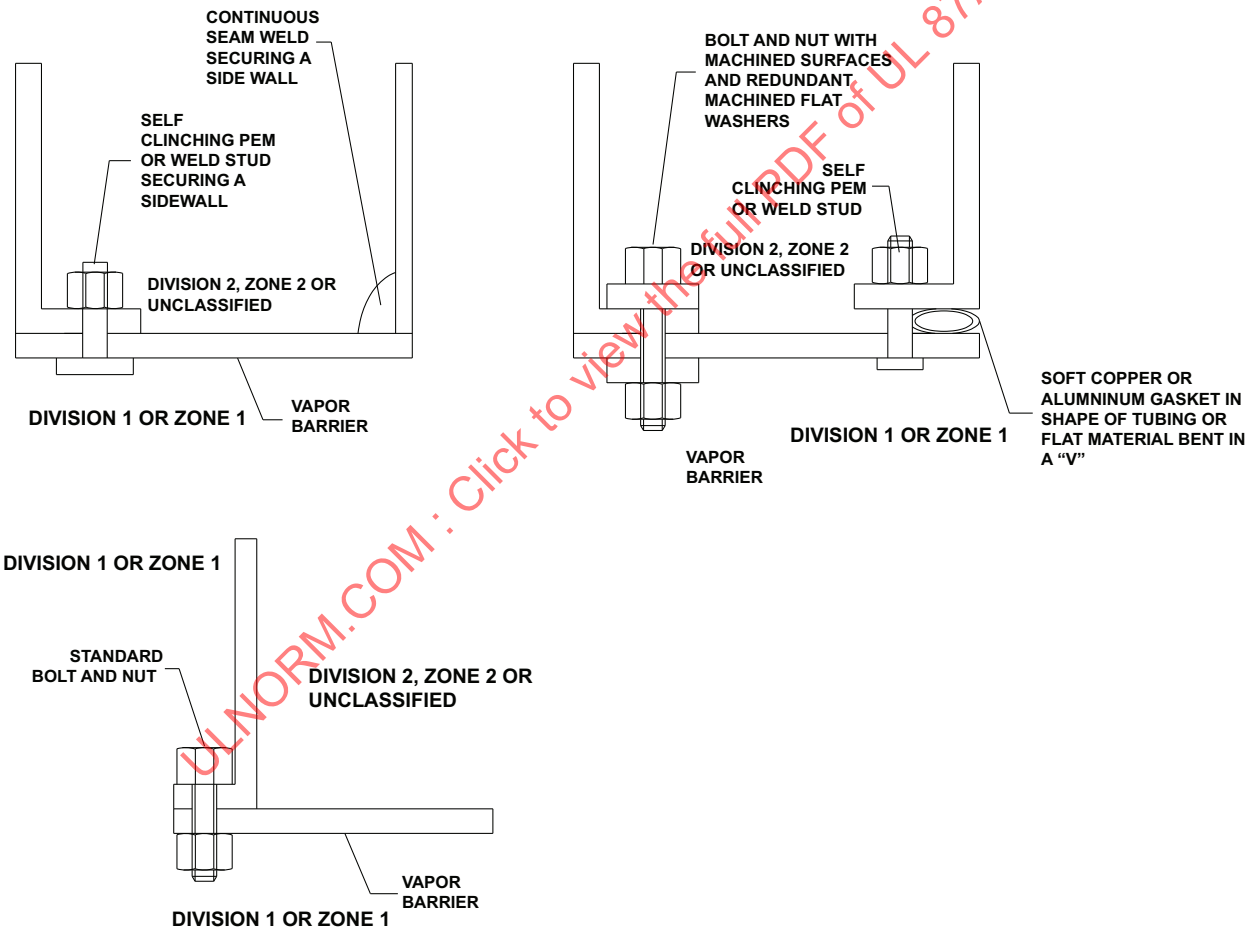
b) Metallic self-clinching threaded PEM studs;

c) Metallic welded threaded studs; or

d) Other methods that meet the intent of (a) – (c).

Figure 7.1

Typical vapor barrier construction



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7.6 Wiring which exits through the vapor barrier to a classified area shall be housed within rigid metal conduit when completing an explosion proof conduit system. Intrinsically safe wiring which exits through the vapor barrier to a classified area or wiring which exits through the vapor barrier to a Division 2 or Zone 2 classified area may be housed within assemblies that comply with 7.8. The exit means shall be provided with vapor/explosion seals as defined in 25.15.

7.7 The conduit seal shall be mechanically retained within the conduit when the conduit assembly completes an explosion proof conduit system.

7.8 Conduit or other assemblies, such as valves or pulsers, which exit the barrier, are required to be secured and sealed at the barrier with metallic bolts and nuts with machined flat surfaces and redundant machined flat washers.

Exception: Conduit and other assemblies that are secured and sealed at the vapor barrier by means other than that described above shall be evaluated to determine whether they comply with the intent of this requirement. The following are factors that are to be evaluated when determining compliance with the requirement:

a) Actual contact surface and

b) Softness of the metal.

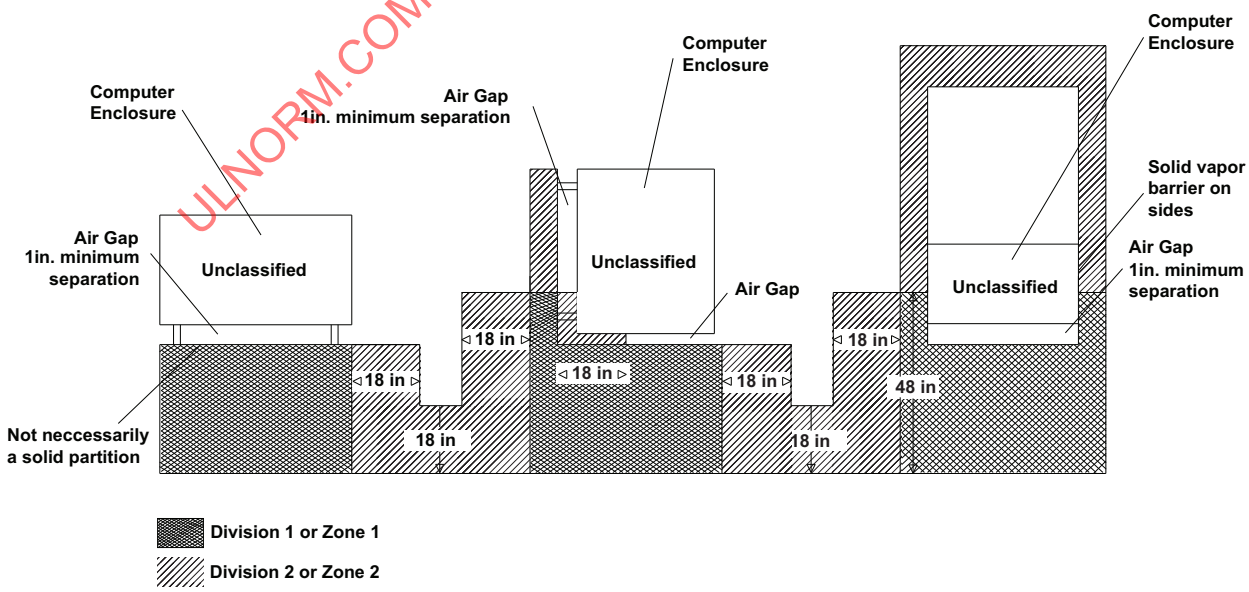
7.9 Unused openings in a vapor barrier shall be sealed in the same manner as described in 7.8.

8 Air Gap

8.1 Dispensing devices which incorporate an air gap construction shall provide a minimum 1 inch (25.4 mm) free air space between planes of classified areas and unclassified areas. See Figure 8.1 for details.

Figure 8.1

Use of air gaps within a typical dispensing device



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8.2 When an air gap is provided with a decorative cover that incorporates louvers, screens, or similar parts, a minimum 1-inch (25.4 mm) per “running” inch of the gap is required.

8.3 A decorative cover used on a horizontal air gap that is vertically larger than the air gap meets the intent of the requirements in this section as long as it does not extend above the plane of the unclassified area.

8.4 The front edge of a decorative cover that is located adjacent to the classified area shall be flush with the bottom of the cover, except for vertical members.

8.5 Conduit or other assemblies that are routed through the air gap shall be mechanically secured such that a minimal amount of open air is provided. The size and position of assemblies shall not create areas within the air gap where the movement of air is stopped.

8.6 Unused openings in the decks of the air gap shall be mechanically sealed.

8.7 Where nonmetallic materials are used to seal unused openings in the air gap panel, the materials shall be subjected to the testing indicated in 5.2.2.2.3 and 5.2.2.2.4, modified as follows – the materials shall be subjected to a saturated vapor exposure rather than immersing the materials in the fluids. The tests are to be performed by hanging the material samples 1 inch (25.4 mm) above the liquid level, such that the material is subjected to the vapors of the test fluid.

9 Pumping Units

9.1 A pumping unit shall be evaluated in accordance with the Standard for Power-Operated Pumps for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 79A.

9.2 Pumps provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option, shall additionally comply with 5.5.

10 Pressure Relief

10.1 A dispensing device assembly shall incorporate means for pressure relief, or it shall depend upon being connected at installation with a power-operated pump incorporating a pressure relief if complete instructions are provided for this purpose. Such pressure relief shall be constructed to prevent or relieve operating pressure and thermal expansion pressures in the system in excess of 50 psi (345 kPa) and anticipate a temperature rise of 50°C (27.8°F) in an ambient of 75°C (24°F).

10.2 Pumping unit operating pressures in a self-contained dispenser may be relieved by:

a) A bypass valve connected between the outlet and suction ports or

b) Automatic change in volumetric capacity of the pump upon an increase in pressure at its outlet.

10.3 Expansion pressures may be relieved by connection to:

a) An atmospheric vented air eliminator for a self-contained dispensing device;

b) A separate return line to the tank;

c) The suction side of the pump with instructions calling the user’s attention to avoid the use of suction line check valves unless provided with a relief valve; or

d) A variable volume expansion chamber.

10.4 An air eliminator or similar vent shall be made of metallic tubing of not less than 1/4 inch (6.4 mm) outside diameter. Its terminal shall be located outside of the pedestal housing, and it shall be protected from clogging and from exposure to the weather. A vent terminating in the hose nozzle space of a nozzle guard or boot is considered to be outside of the pedestal housing.

10.5 The suction return port and passageway from the float chamber of an air separator to the pump shall be sized to prevent the chamber from filling with liquid.

10.6 When a pressure relief requires communication with the storage tank, an instruction card shall be attached to the interior of a door or other part adjacent to return line fittings calling attention to the need for connecting this part by piping with the underground tank.

10.7 A return line fitting shall be not less than 3/8 inch taper nominal pipe thread (NPT) size and shall include a terminal pipe union or tubing connector fitting.

10.8 A valve used as a pressure relief device comply with the Start-to-Discharge Test, Section 32, both before and after the Long Term Exposure Test, Section 29.

10.9 A valve used as a pressure relief device shall comply with the material requirements in Materials, Section 5.

Exception: The valve seal is not required to comply with compression set requirements. Only Volume Change and Extraction are required at the material level.

11 Springs

11.1 A spring employed in a dispensing device assembly to reduce the risk of leakage, or in a safety mechanism, such as is employed in an operating handle, shall:

a) Be protected against abrasion and corrosion and

b) Demonstrate no loss in strength following subjection to a compression force of three times that exerted by the spring in any position of its intended function.

11.2 In reference to 11.1(a), springs that are exposed to the fuels anticipated by these requirements shall comply with the applicable material requirements from Materials, Section 5. Springs not exposed to fuels, but exposed to the environment, shall comply with the atmospheric corrosion requirements in 5.1.2.2.

12 Strainers

12.1 A strainer shall be evaluated to the applicable requirements in the Standard for Strainers for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent Ethanol, (E0 – E85), UL 331A. The additional requirements of 12.2 and 12.3 apply.

12.2 When provided, a drain opening shall be closed by a pipe plug not smaller than 1/4 inch pipe size. A petcock or valve shall not be provided for drainage purposes. The materials shall comply with Materials, Section 5.

12.3 The force necessary to open a strainer shall not permanently distort the assembly, the dispensing device, or piping to which it is attached.

13 Valves

13.1 Electrically operated valves

13.1.1 Electrically operated valves for use in non-classified areas of the dispenser shall be evaluated in accordance with the Standard for Electrically Operated Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 428A. Electrically operated valves for use in a classified location within a dispenser shall be evaluated in accordance with UL 428A and the Standard for Nonincendive Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2, Hazardous (Classified) Locations, ISA 12.12.01, for valves located in the Class I, Division 2 area; or in accordance with UL 428A and the Standard for Intrinsically Safe Apparatus and Associate Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations, UL 913 for valves located in the Class I, Division 1 area.

13.1.2 Electrically operated valves provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option, shall additionally comply with 5.5.

13.2 Hose nozzle valves

13.2.1 A hose nozzle valve shall comply with the applicable requirements in the Standard for Hose Nozzle Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 2586A.

13.2.2 Hose nozzle valves provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option, shall additionally comply with 5.5.

13.3 Shear valves

13.3.1 Shear valves shall comply with the applicable requirements in the Standard for Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 842A.

13.4 Mechanically operated valves

13.4.1 Mechanically operated valves shall comply with the applicable requirements in the Standard for Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 842A.

13.4.2 Mechanically operated valves provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option, shall additionally comply with 5.5.

14 Mechanical Line Leak Detectors

14.1 Mechanical line leak detectors shall comply with the applicable requirements in the Standard for Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 842A.

15 Piping and Fittings

15.1 Pipe threads shall be in accordance with the Standard for Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1.

15.2 An opening threaded for attachment to pipe shall be constructed so that a pipe threaded two threads beyond standard (for the size in question) may be run into the opening without distorting any part of the fitting.

15.3 A male thread for attachment to pipe fittings shall have no shoulder within the distance specified in Table 15.1, from the beginning of the thread, including any chamfer, nor shall any shoulder prevent an additional turn being made within this distance as determined by assembling the part into a fitting within a tolerance of plus or minus one thread.

Table 15.1
Shoulder distance from beginning of thread

Pipe size, ANSI B36.10 nominal inches	Shoulder distance,	
	inches	(mm)
1/8	3/8	9.5
1/4, 3/8	9/16	14.3
1/2, 3/4	3/4	19.1
1	15/16	23.8
1-1/4	31/32	24.6
1-1/2	1	25.4
2	1-1/32	26.2
2-1/2	1-33/64	38.5
3	1-37/64	40.1

15.4 A threaded pipe connection shall be made with litharge and glycerine cement, shellac, shellac and inert powder filler, or a suitable pipe joint sealing compound that is not alcohol based.

15.5 ASTM Schedule 40 metallic pipe shall be used, and the metallic materials shall comply with Materials, Section 5. A union, if used, shall be the ground joint type or a part that has been determined to be equivalent.

Exception: A fitting need not comply with these requirements if it complies with the requirements specified in Torque Test, Section 38.

15.6 Tube fittings shall be metallic, and all metallic materials shall comply with Materials, Section 5.

15.7 Tubing shall have a minimum wall thickness in accordance with Table 15.2 in any configuration that is used.

Table 15.2
Wall thickness for tubing

Outside diameter,		Minimum wall thickness,	
inches	(mm)	inch	(mm)
1/8	3.17	0.028	0.71
1/4	6.35	0.028	0.71
5/16	7.94	0.028	0.71
3/8	9.53	0.028	0.71
1/2	12.70	0.0315	0.80
5/8	15.88	0.0365	0.93
3/4	19.05	0.0385	0.98
7/8	22.23	0.049	1.24
1	25.40	0.049	1.24
1-1/8	28.58	0.049	1.24
1-1/4	31.75	0.0505	1.28
1-3/8	34.93	0.0505	1.28
1-1/2	38.10	0.065	1.65

15.8 A liquid line opening for field connection shall comply with Materials, Section 5. The connection shall be either a metal-to-metal seat union that complies with the requirements in the Standard for Pipe Unions for Flammable and Combustible Fluids and Fire Protection Service, UL 860, or a threaded connection shall comply with the Torque Test, Section 38, and Installation Instructions, Section 48. The opening shall be plugged or capped prior to shipment to reduce the risk of entrance of foreign material.

16 Hose Assemblies

16.1 Hose assemblies shall comply with the applicable requirements in the Outline of Investigation for Hose and Hose Assemblies for Dispensing Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 330A. The couplings shall be attached to the hose by suitable means.

16.2 Hose assemblies provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option, shall additionally comply with 5.5.

17 Control System

17.1 A motor shall not be started simultaneously with the lifting of the hose or its nozzle from its position on the device. A separate intentional, manual operation shall be required for closing the starting switch. The motor circuit shall be opened at the time or before the hose, or the last hose in the case of a multiple station remote control discharge system incorporating a single motor, is returned to its position on the device following operation.

17.2 As a means of complying with 17.1, the motor circuit may be opened by the weight of the hose and nozzle upon replacement in their intended position, or interference devices may be provided to prevent replacement of the nozzle until the opening of the motor circuit has been accomplished.

17.3 The discharge of liquid shall occur only when the hose nozzle valve is held in the open position manually, or when the hose nozzle valve is of the automatic closing type with latch open device, when the valve mechanism is latched to maintain the valve in the open position. In both cases, the valve is to be

removed from its position on the device. The discharge of liquid shall be stopped immediately upon the release of the hand control by the operator or the functioning of an automatic closing mechanism.

18 Meter

18.1 A meter shall be evaluated in accordance with the Standard for Meters for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 25A.

18.2 Meters provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option, shall additionally comply with 5.5.

19 Breakaway Couplings and Swivel Connectors

19.1 A breakaway device or a swivel connector shall be evaluated to the applicable requirements in the Standard for Emergency Breakaway Fittings, Swivel Connectors, and Pipe Connection Fittings for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85), UL 567A.

19.2 Breakaway couplings or swivel connectors provided as part of a dispenser rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent and provided with a blending option shall additionally comply with 5.5.

20 Vapor Recovery Devices

20.1 Devices for use in vapor recovery applications shall comply with 20.2 – 20.3.

20.2 The particular component involved, such as a pump, hose, or the like, shall be evaluated to the applicable requirements for that component based on the component standard, and in accordance with 20.3.

20.3 The rated pressure of the vapor-confining path of the device shall be specified by the manufacturer. Testing requiring pressurization of the device shall be based on the rated pressure of the device.

ELECTRICAL EQUIPMENT

21 General

21.1 Electrical equipment intended for use in hazardous locations shall comply with the requirements for Class I, Group D or Zone 1, equipment in the National Electrical Code, ANSI/NFPA 70, unless otherwise indicated by these requirements.

21.2 Intrinsically safe equipment may be housed in a general-purpose enclosure. A general-purpose enclosure may also be used for field connections to an intrinsically safe circuit.

21.3 Electrical equipment and wiring shall be arranged so that the liquid handled will not drip or drain on them during intended care and usage.

21.4 A device shall be constructed so that the enclosure or housing, frame, and similar non-current carrying parts of all high voltage electrical equipment are bonded to the means provided for connecting the conduit of the supply circuit. Means shall also be provided so that connection to a field installed equipment grounding conductor can be made in the same junction box used for field-installed conductors.

21.5 The surface of an uninsulated lead intended solely for the connection of an equipment grounding conductor shall be finished in a continuous green color or a continuous green color with one or more yellow stripes, and no other lead shall be so identified.

21.6 A soldering lug, a push-in, screwless connector, quick connect, or similar friction fit connector shall not be used for the grounding terminal intended for the connection of field supply connections.

21.7 A wire binding screw intended for the connection of an equipment grounding conductor shall have a green colored head that is hexagonal, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified such as by being marked “G”, “GR”, “GROUND”, or “GROUNDING”, or by a marking on a wiring diagram provided on the product. See also 21.8.

21.8 A pressure wire connector that is intended for grounding and that is located where it may be mistaken for a neutral conductor of a grounded supply shall be identified by a marking “EQUIPMENT GROUND”, by a green color identification, or both.

21.9 When a conduit run contains wiring to which field wiring connections are to be made, the conduit run shall terminate in an outlet box or enclosure complying with the requirements for equipment for the locations specified in the National Electrical Code, ANSI/NFPA 70. The box or enclosure shall be subjected so that the connections are capable of being made and so that clearance between it and adjacent parts is provided for gripping the installation conduit or fitting with a wrench intended for this purpose. The clearance shall enable wrench movement through an arc of not less than 45 degrees. To provide space for the field installation of conduit unions and sealing fittings, the clearance measured vertically between the lower end of the outlet box hubs and the plane of the lower edge of the dispenser base shall be no less than specified in Table 21.1.

Table 21.1
Trade size of conduit and vertical clearance for box hubs

Conduit sizes,		Vertical clearance,	
Trade size in inches	O.D. in mm	inches	(mm)
1/2	21	7	178
3/4	26	7	178
1	33	9	229
1-1/4	42	10-3/4	273
1-1/2	48	11-1/2	292

21.10 A vertical clearance less than that specified in 21.9 may be employed if the intended unions, sealing fittings, and interconnections are provided by the dispenser manufacturer.

21.11 An outlet box or enclosure shall have no unplugged openings other than those to which conduit will always be connected when the dispenser is installed.

21.12 An outlet box or enclosure included as part of the assembly, and in which a branch circuit is to be connected to the dispensing device, shall not require that it be moved for intended care of the device.

21.13 The size of a junction box in which field installed conductors are to be connected by splicing shall not be less than that specified in Table 21.2. A conductor passing through the box is counted as one conductor, and each conductor terminating in the box is also counted as one conductor. A field furnished conductor for pump motor and lighting circuits is considered to be not smaller than 14 AWG (2.1 mm^2). A field furnished conductor for a reset motor, signaling, or other circuit rated less than 5 amperes may be considered to be not smaller than 18 AWG (0.8 mm^2) when the wire size is marked on the installation wiring diagram.

Table 21.2
Size of junction boxes

Size of conductor,		Free space within box for each conductor			
		Box with hubs,		Box without hubs,	
AWG	(mm^2)	cubic inches	(cm^3)	cubic inches	(cm^3)
16 or smaller	1.3 or less	1.3	21.3	1.5	24.6
14	2.1	1.8	29.5	2.0	32.8
12	3.3	2.0	32.8	2.25	36.9
10	5.3	2.2	36.1	2.5	41.0
8	8.3	2.7	44.2	3.0	49.2

21.14 The size of a junction box in which field installed conductors are to be connected to factory installed terminal strips shall be determined by Table 21.2 as the summation of the volumes required for each field furnished conductor plus the approximate volume utilized by the factory installed wiring and terminal block.

21.15 A conductor intended to be spliced to a field-installed conductor shall be not smaller than 18 AWG (0.8 mm^2) and shall be rated for the maximum operating voltage of the dispenser. Factory wiring terminating at a terminal strip shall also be 18 AWG minimum unless arranged or guarded to be protected form damage during field wiring.

21.16 Terminals provided for the connection of field installed conductors shall have an ampacity not less than 125 percent of the full load motor current rating of horsepower rated motors, 100 percent of the ampere ratings of all other loads, or both.

21.17 A terminal wire binding screw to which field installed conductors are to be connected shall be not smaller than No. 8 (4.2 mm diameter), except that a No. 6 (3.5 mm diameter) screw may be used for the connection of one 18, 16, or 14 AWG (0.8, 1.3, or 2.1 mm^2) conductor.

21.18 A terminal plate tapped for a wire binding screw shall be of metal not less than 0.030 inch (0.76 mm) thick for 14 AWG (2.1 mm^2) or smaller wire, and not less than 0.050 inch (1.27 mm) thick for a wire larger than 14 AWG. Terminal plates shall provide at least two full threads and shall incorporate upturned lugs or parts that have been determined to be equivalent to hold the wires in position.

21.19 A terminal plate formed from stock having the minimum required thickness may have the metal extruded at the tapped hole for the binding screw to provide two full threads, except that two full threads are not required if a lesser number of threads results in a sufficiently secure connection in which the threads will not strip with tightening torque, in accordance with the Standard for Wire Connectors, UL 486A-486B.

21.20 Conductors intended for connection to a grounded neutral supply conductor shall be identified (finished a white or gray color) or the intended wiring connections shall be clearly indicated in some other manner, such as on an attached wiring diagram. All other current carrying conductors shall be finished in colors other than white, gray, or green with or without one or more yellow stripes.

21.21 A terminal for connection of a grounded neutral conductor shall be identified by a metallic plated coating, substantially white in color, and shall be distinguishable from other terminals; or it shall be clearly identified in some other manner, such as on an attached wiring diagram. The screw shell or white terminal or lamp holders shall be connected to the white or gray conductor.

22 Motors

22.1 When motor protection that is evident to the installer or user is furnished as part of a dispensing device, it shall provide protection under both stalled rotor and overload conditions.

22.2 A tag shall be attached to the motor circuit wires indicating the voltage from which the motor is intended to operate, in the case of motors of single voltage rating; or the voltage for which the motor has been connected, in the case of motors for dual voltage rating.

23 Switches

23.1 A switch shall be rated for the maximum load that it controls.

23.2 A motor switch shall have a sufficient number of poles to control the motor or motors. A single pole switch installed in either a lighting or motor circuit shall not be connected to the grounded neutral conductor.

24 Class I, Group D, Division 2 or Zone 2 Location, Lighting, Electrical, and Electronic Equipment

24.1 Lighting, electrical, and electronic equipment utilized in Class I, Group D, Division 2 or Zone 2 hazardous locations shall also comply with outdoor use requirements for such components and, unless of the weatherproof type, shall be in a raintight enclosure, see the Rain Test, Section 39; or shall be otherwise protected to reduce the risk of water entering a lamp holder or the enclosure for electrical and electronic equipment.

24.2 A lamp holder shall be an unswitched type. A lamp holder for a incandescent lamp shall be not larger than a medium base type. A lamp holder for an electric discharge (fluorescent) lamp shall not be of the combination type including a starter holder.

24.3 A lamp holder shall be mechanically supported and shall be wired in the assembly at the factory.

24.4 Lighting, electrical, and electronic parts other than lamp holders which may produce arcs or high temperatures shall be in an enclosure complying with the requirements for Class I, Group D equipment for use in hazardous locations specified in the National Electrical Code, ANSI/NFPA 70.

24.5 Lighting, electrical, and electronic parts other than lamp holders which do not produce arcs or high temperatures when operated as intended and which are located in the Class I, Group D, Division 2 or Zone 2 hazardous location may be in a general purpose enclosure. Such enclosure shall be of metal and shall be of the total enclosed type or constructed to reduce the risk of escape of sparks or hot metal particles.

24.6 The requirement specified in 24.5 is not intended to preclude the use of small areas of glass or plastic in a Class I, Group D, Division 2 or Zone 2 hazardous location, where such material is required for the transmission of price and volume data, instructional information, or both. The use of nonmetallic materials shall comply with the following:

a) The total area of nonmetallic material that is not backed up by metal panels shall not exceed 150 square inches (645 square millimeters);

b) A glass panel shall be at least 3/32 inch (2.4 mm) thick;

c) A plastic panel shall comply with Materials, Section 5;

d) The construction shall be such that breakage of the nonmetallic panel will not permit sparks or hot metal particles to enter a Class I, Group D, Division 2 or Zone 2 hazardous location.

24.7 Lighting, electrical, electronic equipment, and wiring in a Class I, Group D, Division 2 or Zone 2 hazardous location must be completely sealed off from a gasketed joint, hose, stuffing box, or hose nozzle boot in or above the Class I, Group D, Division 2 or Zone 2 hazardous location by means of a solid partition or enclosure.

24.8 A lighting fixture intended for mounting on a dispenser shall comply with the Standard for Electric Signs, UL 48. The dispenser and lighting fixture shall include means for secure mounting of the fixture and to reduce the risk of water entering the conduit system of the dispenser.

25 Wiring Methods

25.1 The wiring of circuits within the device shall comply with the requirements specified in 25.2 – 25.24. Splices in conductors shall be insulated and positioned to reduce the risk of high voltage parts contacting metallic parts of the dispensing device.

25.2 Conductors intended for field connection to a 120-volt branch circuit protective device shall be provided and arranged such that an individual grounded neutral conductor is provided for each ungrounded supply conductor.

25.3 Except for intrinsically safe circuit rated not more than 30 volts ac (42.4 volts peak), the internal wiring of the device shall consist of wires of a type or types that have been successfully evaluated for use with respect to the temperature, ampacity, voltage and conditions of service to which the wiring may be subjected. See 21.15.

25.4 Wiring resistant to fuels may be exposed to vapors of the fuels (not liquid fuel) at temperatures within the limits of the temperature rating of the wire type.

25.5 A conductor having solid neoprene insulation or other material that has been determined to have equivalent resistance to the vapors of fuels may be used for internal wiring and as leads for components, such as motors, ballasts, solenoid valves, or similar parts when it has a temperature rating consistent with its use.

25.6 Regarding the requirements specified in 25.5, appliance wiring material having 90°C (194°F) solid neoprene insulation may be used for internal wiring not exposed to fuel if the insulation is at least 3/64 inch (1.2 mm) in thickness for 12 and 14 AWG (3.3 and 2.1 mm^2) sizes and at least 1/32 inch (0.8 mm) in thickness for 16 and 18 AWG (1.3 and 0.8 mm^2) sizes. A braid covering may be provided, but is not required. Since the wire having 1/32 inch thickness of insulation is to be rated 300 volts, this wire shall not be used in discharge devices rated in excess of this voltage.

25.7 Factory installed internal wiring routed:

a) Through Class I, Group D, Divisions 1 and 2 or Zone 1 and Zone 2 hazardous locations;

b) From Division 1 to Division 2 or Zone 1 and Zone 2 hazardous locations; and

c) From Division 1 or Division 2 or Zone 1 and Zone 2 hazardous locations to unclassified areas within the dispensing device;

is not required to be resistant to fuel when it has been determined that the wiring is routed within the product so it does not come into contact with flammable liquids or their condensed vapors during normal use and routine servicing, such as changing filters cleaning strainers, or replacing meters or pumps.

25.8 Except as specified in 25.9, if wiring is not routed near components that may attain temperatures as great as, or in excess of, the temperature limit of the insulated conductor (such as resistors, coils, ballasts, or similar parts), wire size shall be as specified in Table 25.1. Wiring sized on the basis of the table is applicable to both component leads and other wiring except motor leads. Leads furnished with a Class I, Group D motor may be used.

25.9 The acceptability of conductors routed close to components producing heat, or wire size smaller than specified by Table 25.1, is to be evaluated on the basis of a temperature test.

Table 25.1
Wire sizes for circuit requirements

Wire size,		Circuits not employing motors, amperes	Circuit for motors, amperes
No. AWG	(mm^2)		
18	0.8	6	4.8
16	1.3	8	6.5
14	2.1	15	12.0
12	3.3	20	16.0

25.10 Except as permitted in 25.11 and 25.12, wiring shall be in threaded rigid metal conduit, threaded steel intermediate metal conduit, or Type MI cable with termination fittings that comply with the requirements for Class I, Group D, equipment for use in hazardous locations specified in the National Electrical Code, ANSI/NFPA 70. All boxes, fittings, and joints shall be threaded for connection to conduit or cable terminations in compliance with the requirements in Class I, Group D equipment for use in hazardous locations. At least five full threads shall engage in each threaded joint.

25.11 Wiring in a Class I, Group D, Division 2 or Zone 2 hazardous location shall be enclosed in conduit, electrical metallic tubing, or other raceway or general-purpose enclosure made of metal, excluding zinc. General-purpose fittings may be used.

25.12 The dispenser housing may be considered as the electrical enclosure for intrinsically safe circuit wiring.

25.13 One end of a wireway between two parts factory attached to an assembly may be secured to one of the parts by means of straight threads and, if necessary for security, with a locknut, if the other end of the wireway is secured to the other part by tapered threads.

25.14 A seal shall be provided at the location where a conduit enters an enclosure for a switch, lamp starter, or other part that may produce arcs, and in the conduit at any location where conduit, as specified in 25.10, is connected to a general-purpose enclosure, lamp holder, or receptacle.

25.15 When wiring is enclosed as permitted by 25.11, seals shall be located so that any vapors entering the conduit system in the area described in 3.5(a) will not enter or be communicated to the wiring system installed as specified in 25.11. There shall be no union, coupling, box, or fitting, in the conduit between the seal and the point at which the conduit connects to the wiring system installed as specified in 25.11.

25.16 A compartment enclosing a switch shall be sealed from any adjacent compartment in which field connections are to be made.

25.17 A factory installed conduit seal incorporated as part of the device shall comply with the requirements in the Hydrostatic Strength Test, Section 31, and the Leakage of Wire Seal Test, Section 41.

25.18 When a conduit seal is incorporated as part of the device, the wires or conductors shall be securely held and tightly sealed where they pass into the enclosure. When a sealing compound or cement is used, it shall:

a) Provide a tight fit;

b) Neither soften nor crack under service conditions;

c) Be resistant to the solvent action of the hazardous location chemicals to which it is capable of being exposed – see Tests on Sealing Compounds, Section 42;

d) Be resistant to moisture and aging; and

e) Have a depth equal to the inside diameter of the conduit, or 5/8 inch (15.9 mm), whichever is greater.

25.19 Sealing compounds used as a conduit seal shall not flow or creep at the operating temperature of the device. Sealing compounds that soften with the application of heat shall have a softening point of not less than:

a) 200°F (93.3°C) when used adjacent to motors having Class A (Class 105) insulation and

b) 236°F (113.3°C) when used adjacent to motors having Class B (Class 130) insulation.

The softening point is to be determined in accordance with the Standard Test Method for Softening Point by Ring-and-Ball Apparatus, ASTM E28.

25.20 When a nipple is used to retain the sealing standard compound for the lead wires of the device, the depth of the seal shall not be less than the internal diameter of the nipple, or 5/8 inch (15.9 mm), whichever is greater. Based on the compound, the size of the lead wires, and the construction of the sealing well, a greater depth of sealing compound may be required to form a tight seal. Means shall be provided in the nipple to anchor the sealing compound when the nipple completes an explosion proof conduit system or enclosure.

25.21 For a vapor tight fit, it may be necessary to split open the sheath of shielded and multi-conductor cables so the compound can be poured around individual conductors.

25.22 The ends of all conduit lengths, including nipples, shall be chamfered after threading to remove burrs or sharp edges.

25.23 Splices in wiring shall be located only in junction boxes or compartments that have been determined to be equivalent. Splices shall be made mechanically and electrically secure and be soldered unless a wire connector is used. Joints shall be covered with insulation that has been investigated and determined to be equivalent to that on the conductors.

25.24 Circuits for lighting and for motors shall be readily identifiable in the junction box, provided for field connections.

26 Locking Mechanism

26.1 A dispensing device shall be provided with effective means for locking both the motor switch and each hose nozzle valve. The locking mechanism shall be of such design that a simple locking operation for each dispensing control will prevent starting the motor and the is charging of even small quantities of fluid through the dispensing outlet. When the locking means is based upon the use of an ordinary padlock, the padlock [considered to have a 1/4 inch (6.4 mm) minimum diameter shackle] need not be supplied.

PERFORMANCE

27 General

27.1 Representative samples of a dispensing device or its component parts shall comply with the tests described in Sections 29 – 44 as applicable.

27.2 All tests shall be performed using the test fluids specified for that test. No substitution of test fluids is allowed. When the test indicates that CE25a, CE40a, CE85a, or CiBu20a are to be used, the test fluid shall be prepared as described in Supplement SA.

Exception: Testing with CE25a, CE40a, or CE85a covers CiBu20a testing.

27.3 For hydrostatic strength tests, the tests are to be conducted using water as the test fluid.

27.4 Tests performed on a dispensing device shall be performed in accordance with Test Sequence shown in Section 28, using one sample for each applicable test fluid. In addition, with reference to 10.8, a valve used as a pressure relief device shall be subjected to the Long Term Exposure Test, Section 29, using one sample for each applicable test fluid.

27.5 To reduce the effects of seal dry out due to removal of the test fluid after specific tests, the tests performed after long term exposure shall be started within 4 hours of removal of the test fluid. If necessary to coordinate testing, the sample may be left filled with the most recent test fluid at room temperature until the next test is initiated. If the previous test used an aerostatic or hydrostatic source, the sample shall be filled with kerosene.

27.6 With respect to Long Term Exposure Testing of full hydraulic trees of dispensers, see 27.4, portions of the hydraulic tree that were previously tested at the component level and using the correct metallic material closures for the fluid rating, see 29.2.3, need not be subjected to repeated Long Term Exposure testing. This waiver includes new parts that are made of the same material as previously tested components. Hydraulic trees that consist of components or materials that were all previously tested with the proper closures would be considered in compliance without a repeated Long Term Exposure Test. In these cases, the test sequence in Section 28 can be waived, and the High Pressure Leakage Test, Section 30, and the Hydrostatic Strength Test, Section 31, are performed on a sample of the hydraulic tree in the as-received condition.

28 Test Sequence

28.1 General

28.1.1 The following test sequences outline the order in which tests shall be performed on a full dispenser hydraulic tree. All tests in the sequence are to be performed in the order indicated and shall be performed on one sample for each applicable test fluid exposure during the Long Term Exposure Test.

28.2 General dispenser test sequence

28.2.1 A dispenser shall be subjected to the following tests in the order shown.

a) Long Term Exposure, Section 29;

b) High Pressure Leakage Test, Section 30;

c) Hydrostatic Strength Test, Section 31.

28.2.2 Tests indicated in 28.2.1 shall be performed on one sample in the sequence shown for each test fluid. The remainder of the tests in this standard may be performed on additional samples, as needed, and in any sequence.

29 Long Term Exposure Test

29.1 General

29.1.1 The test outlined in 29.2 – 29.4 is to be performed on one or two samples of the device in accordance with:

a) If the product is rated for use with gasoline or a gasoline/ethanol blends with a nominal ethanol concentration of up to 25 percent (E0 – E25), then the test shall be performed using the CE25a test fluid;

b) If the product is rated for use with gasoline or a gasoline/ethanol blends with a nominal ethanol concentration of up to 40 percent (E0 – E40), then the test shall be performed using both the CE25a and CE40a test fluids;

c) If the product is rated for use with a gasoline/ethanol blend with a nominal ethanol concentration of up to 85 percent, then the test shall be performed using both the CE25a and CE85a test fluids; or

d) If the product is rated for use with gasoline/isobutanol blends with a nominal isobutanol concentration of up to 16 percent (CiBu0 – CiBu16), then the test shall be performed using CiBu20a test fluid or one of the fluids listed in (a), (b) or (c).

29.1.2 Refer to Supplement SA for the test fluids details.

29.2 Samples

29.2.1 A sample of a complete device is to be tested. If an assembly is to be tested, the components may be tested individually. All inlet and outlet openings of the samples shall be sealed in accordance with 29.2.3.

29.2.2 If platings or coatings are used internal to the device, additional samples may be used. See 29.4.2.

29.2.3 Closures shall be provided to seal off inlet and outlet openings of all samples in accordance with 29.2.1. These closures shall be fabricated of materials as specified in 29.2.3. The closures shall be provided with a 1/4 inch NPT opening for connection to the test apparatus. All closures shall be installed by the manufacturer and provided with a torque rating. There will be no other adjustment to connections for the duration of the test.

29.2.4 Material combinations product and closure interface will be as specified by the manufacturer. All closures for assemblies rated for gasoline/ethanol blends with nominal ethanol concentrations up to 25 percent shall be fabricated of suitable materials. All closures for assemblies rated for gasoline/ethanol blends with nominal ethanol concentrations above 25 percent shall be fabricated of the materials representing permitted material to which the device may be connected, such as aluminum closures representing aluminum tubing. Table 5.1 shall be used to determine the worst case metal interactions. Materials that are specified by the manufacturer, but are not included in Table 5.1 shall be tested as necessary to represent worst case conditions.

29.2.5 Any o-rings, gaskets, or other sealing materials, shall be provided and installed by the manufacturer. The dynamic sealing devices shall be the same as those that will be used in the final product installation. Static seals shall be representative of the seals being used in the final product installation. If the sealing device or material is not considered part of the component under test, but will be provided in an end product at the time of installation, a representative seal shall be provided for the test. The testing of the static seals, as part of the assembly under test, is only required in the Long Term Exposure Test to test the surrounding components.

29.3 Method

29.3.1 The sample is to be exposed to the applicable test fluid in accordance with 29.1.1. The test fluids shall be prepared using the instructions in Supplement SA.

29.3.2 A quick connect device is connected to the 1/4 inch NPT connection at the inlet, and it is used to fill the samples with the applicable test fluids. A source of pressure may be used to assist in filling or draining the samples, however, the pressure shall not exceed the rated pressure of the device under test. Once the samples are filled to exclude all air, they are closed off and sealed. The samples are then placed in the test chamber.

29.3.3 The chamber temperature is increased to 60 ±2°C (140 ±4°F). When the chamber reaches this temperature, the exposure period begins. The samples are exposed to the applicable test fluid at 60 ±2°C for approximately 168 hours. At the end of this duration, the exposure period is halted and the chamber is allowed to cool. The samples are subjected to a 50 psi (347 kPa) pressure for one minute. The fluid is then drained from the samples and discarded. The samples are then immediately refilled with new test fluid and the chamber temperature is allowed to increase to 60 ±2°C again. The total duration of the test shall equal 1008 hours of exposure at 60 ±2°C.

29.3.4 At the end of the total exposure duration, the test fluid is left in the samples and the samples are removed from the chamber. The samples are then subjected to the next tests in the test sequence as outlined in Section 28 and in accordance with 27.5. Prior to the initiation of the next test in the test sequence, the test fluid is to be drained and discarded.

29.3.5 If the device contains any parts or surfaces that are plated or coated, if the device uses casting impregnation materials to eliminate porosity leakage, or if the device contains internal nonmetallic parts, the plating, coating, impregnation, or internal parts are tested both during and after this exposure. See 29.4.2 and 29.4.4.

29.4 Results

29.4.1 There shall be no leakage during this test. If leakage is observed at any point during the test, the test is to be stopped.

29.4.2 For platings or coatings, there shall be no softening of the plating or coating material. Compliance is checked by observance of the drained test fluid. There shall be no evidence of visible flaking or material. In addition, there shall be no substantial discoloration of the test fluid when observing the drained fluid. Discoloration is an indication of chemical attack on the plating or coating internal to the device. In order to determine that the base metal is not exposed, visual inspections shall be made. If the visual examination requires examination of internal surfaces, the samples shall be cut open to determine compliance. If this is necessary, additional samples can be used to determine compliance with this requirement, such that the remaining test sequence will not be disturbed by cutting open the samples.

29.4.3 For casting impregnation materials, the sample shall not show evidence of porosity leakage during or after the fluid exposure duration.

29.4.4 For internal nonmetallic parts, there shall be no visible evidence of this material in the drained test fluid.

30 High Pressure Leakage Test

30.1 All products subjected to this test shall be subjected to a test pressure as indicated in 30.2. Test pressures shall be developed from a hydrostatic source and maintained for 1 minute.

30.2 All products are to be subjected to a test pressure equal to 1-1/2 times the rated pressure of the product, but not less than 75 psi (518 kPa).

30.3 There shall be no leakage outside of fluid confining areas and there shall be no evidence of casting porosity leakage during this test.

30.4 For all tests, the inlet of the device is to be connected to the source of pressure and the outlet is to be blocked.

30.5 A positive shutoff valve and a calibrated pressure indicating device shall be installed in the pressure supply piping. The pressure indicating device is to be installed in the piping between the shutoff valve and the device under test.

30.6 In accordance with 30.5, the pressure indicating device shall comply with one of the following:

a) An analog gauge having a pressure range such that the test pressure is between 30 and 70 percent of the maximum scale reading of the gauge;

b) A digital pressure transducer, or other digital gauge, that is calibrated over a range of pressure that includes the test pressure; or

c) Other devices that are equivalent to the devices in (a) and (b).

31 Hydrostatic Strength Test

31.1 A liquid handling part of the dispensing device shall withstand, without rupture, an internal hydrostatic pressure of 250 psig (1.72 MPa) for 1 minute. An air separator housing that is vented to the atmosphere, when so tested, shall withstand 100 psig (0.69 MPa).

31.2 If the Hydrostatic Strength Test is being used as an alternate test method for the Tests on Sealing Compounds, Section 42, then the sample shall be subjected to the following test. The conduit seal in a factory sealed device shall withstand for 1 minute, without rupture or permanent distortion, a hydrostatic test pressure of 600 psig (4.148 MPa). When unintended leakage results in the inability of the test apparatus to maintain the required test pressure during the test of a seal for a 2-inch (60.3 mm outside diameter) or larger trade size conduit with wires sealed in place, a device with a seal and without wires may be used. The hydrostatic pressure is to be gradually increased until the required internal pressure is reached. Gaskets or other means shall be used when required to prevent leakage of water during application of pressure.

32 Start-To-Discharge Test

32.1 The start-to-discharge pressure of a sample of a relief valve shall not be less than 100 percent, nor more than 110 percent, of the set pressure marked on the valve, both before and after the Long Term Exposure Test, Section 29.

32.2 A relief valve is to be connected to an air or other aerostatic supply source capable of being maintained at a pressure of at least 50 psi (344 kPa) above the marked set pressure of the valve being tested. A positive shutoff valve and a pressure-indicating device are to be installed in the pressure supply piping. The pressure-indicating device is to be installed in the piping between the valve being tested and the shutoff valve. Start-to-discharge pressures are to be observed through a water seal not more than 4 inches (101.6 mm) deep.

32.3 In accordance with 47.2, the pressure indicating device shall comply with one of the following:

a) An analog gauge having a pressure range such that the test pressure is between 30 and 70 percent of the maximum scale reading of the gauge;

b) A digital pressure transducer, or other digital gauge, that is calibrated over a range of pressure that includes the test pressure; or

c) Other devices that are equivalent to the devices in (a) or (b).

32.4 The shutoff valve is to be opened to permit the pressure to the valve being tested to increase to within about 25 psi (172 kPa) of the set pressure marked on the valve. The pressure to the valve is then to be increased slowly, at a rate no greater than 2 psi (13.8 kPa) per second, until the first bubbles through the water seal are observed. The pressure at this instant, as indicated by the pressure indicating device, is to be recorded as the start-to-discharge pressure of the valve under test.

33 Dimensional Stability of Floats

33.1 A set of three samples of the float shall be used for this test for each fluid exposure in accordance with Supplement SA. Prior to the immersion conditioning described in 33.2, the dimensions of each float is to be determined with appropriate measuring instruments. Immediately following the immersion conditioning, and after drying for 70 ±1.2 hours at 23 ±2°C (73 ±4°F), the dimensions of each sample shall be measured. The percentage change in dimensions is to be calculated as specified in the following equation for each of the three samples in each set and then averaged.

$$\frac{[(Mb - Ma) \times 100]}{Mb}$$

in which:

Mb is the dimension of the sample before the immersion conditioning and

Ma is the dimension of the sample after the immersion conditioning.

33.2 For products rated for gasoline/ethanol blends or gasoline/isobutanol blends:

a) With a nominal ethanol concentration of up to 25 percent (E0 – E25), the test shall be performed on one set of samples using the CE25a test fluid;

b) With a nominal ethanol concentration of up to 40 percent (E0 – E40), then the test shall be performed using both the CE25a and CE40a test fluids;

c) With a nominal ethanol concentration of up to 85 percent, then the test shall be performed on two sets of samples using both the CE25a and CE85a test fluids; or

d) With a nominal isobutanol concentration of up to 16 percent (CiBu0 – CiBu16), then the test shall be performed on one set of samples using the CiBu20a test fluid or one of the fluids listed in (a), (b) or (c).

33.2A Refer to Supplement SA for the test fluids details. Each set of samples shall be immersed (completely submerged) in vessels containing the applicable test fluid for 168 hours at 23 ±2°C (73 ±4°F).

33.3 At the conclusion of the test described in 33.2, the percentage change in dimensions shall not change by more than 2 percent.

34 Weight Change of Floats

34.1 A set of three samples of the float shall be used for this test for each fluid exposure in accordance with Supplement SA. Prior to the immersion conditioning described in 34.2, the weight of each sample is to be determined with an analytical balance. Immediately following the immersion conditioning, and after drying for 70 ±1.2 hours at 23 ±2° C (73 ±4° F), the weight of each sample is to be measured. The percentage change in weight is to be calculated as specified in the following equation for each of the three samples in each set and then averaged.

$$\frac{[(Mb - Ma) \times 100]}{Mb}$$

in which:

Mb is the weight of the sample before the immersion conditioning and

Ma is the weight of the sample after the immersion conditioning.

34.2 For products rated for gasoline/ethanol blends or gasoline/isobutanol blends:

a) With a nominal ethanol concentration of up to 25 percent (E0 – E25), the test shall be performed on one set of samples using the CE25a test fluid;

b) With a nominal ethanol concentration of up to 40 percent (E0 – E40), then the test shall be performed using both the CE25a and CE40a test fluids;

c) With a nominal ethanol concentration of up to 85 percent, then the test shall be performed on two sets of samples using both the CE25a and CE85a test fluids; or

d) With a nominal isobutanol concentration of up to 16 percent (CiBu0 – CiBu16), then the test shall be performed on one set of samples using the CiBu20a test fluid or one of the fluids listed in (a), (b) or (c).

34.2A See Supplement SA. Each set of samples shall be immersed (completely submerged) in vessels containing the applicable test fluids for 168 hours at 23 ±2°C (73 ±4°F).

34.3 At the conclusion of the test described in 34.2, the percentage change in weight shall not increase by more than 25 percent or decrease by more than 10 percent.

35 Endurance Test – Hose Retrieving Mechanism

35.1 A hose, when intended for storage on a reel or in a weighted loop inside the housing, shall not leak nor show evidence of breakdown of the hose or any of its parts when tested as specified in 35.3.

35.2 A hose arranged as described in 35.1 and assembled in the device in the intended manner and subjected continuously to the maximum operating or bypass pressure, whichever is greater, is to be withdrawn and returned as specified in 35.3. The pressure in the hose shall be maintained while the hose is filled with kerosene.

35.3 This test is to consist of 100,000 cycles of operation for the reel application and 35,000 cycles for the weighted loop application. In each case, the hose is to be withdrawn in a direction parallel to the side of the housing through which the hose passes. The rate of cycling is to be similar to that of intended operation, and the hose is to be under tension during the entire operating cycle. Leakage in the hose assembly, damage to the hose or couplings, or malfunction of the reel assembly or other operating parts shall not result from this test.

36 Endurance Test – Hose Fastening Means

36.1 A retrieving mechanism provided for an extra long hose to be supplied entirely outside the housing shall not show evidence of damage when tested as specified in 36.2. Any clamp or fitting for attachment to the hose shall not cause damage to the hose during this test.

36.2 A retrieving mechanism equipped as above is to be operated through 35,000 withdrawal and return cycles. The hose need not contain liquid during this test.

37 Marking Adhesion Test

37.1 Representative samples of a pressure sensitive label, or a label secured by cement or adhesive are to be subjected to exposure conditions for indoor use (standard atmosphere, water immersion, and oven aging) or, if applicable, to exposure conditions for outdoor use (the preceding plus low temperature exposures and ultraviolet light and water exposure), to determine compliance with the applicable requirements for permanence and legibility in the Standard for Marking and Labeling Systems, UL 969.

37.2 When the labels are exposed to additional conditions in service (such as motor fuels, oils, detergents, or similar chemicals), representative samples are to be subjected to an applicable immersion exposure in Table 7.4, Exposure conditions for common agents, of the Standard for Marking and Labeling Systems, UL 969, and shall comply with the requirements for permanence and legibility in UL 969. For exposure to fuel, the test fluids shall be as described in Supplement SA, and the exposure time shall be 60 minutes. For exposure to detergents, the solution is to consist of a mixture of 25 grams of a commercial detergent per liter of water.

38 Torque Test

38.1 A fitting other than one complying with 15.5, having an opening threaded for pipe connection, shall withstand without breakage or leakage the turning effort specified in Table 38.1, exerted as if to screw the fitting onto a pipe or into a pipe fitting.

Table 38.1
Torque requirements for pipe connections

Pipe size, ANSI B2.1 nominal inches	Torque, lb-in	Torque, (N·m)
1/8	150	16.9
1/4	250	28.2
3/8	450	50.8
1/2	800	90.4
3/4	1000	113
1	1200	136
1-1/4	1450	164

Table 38.1 Continued on Next Page

Table 38.1 Continued

Pipe size, ANSI B2.1 nominal inches	Torque, lb-in	(N·m)
1-1/2	1550	175
2	1650	186
2-1/2	1750	198
3	1800	203

38.2 The sample fitting used in this test is to be rigidly anchored or otherwise supported. A section of Schedule 80 pipe is to be connected to a female pipe threaded section of the sample, or an appropriate pipe fitting is to be connected to a male pipe threaded section, the male threads having first been lubricated with No. 10 SAE machine oil. After the torque force has been applied, the fitting shall not leak when tested as specified in the High Pressure Leakage Test, Section 30.

39 Rain Test

39.1 To determine whether an enclosure complies with 6.3.1, the enclosure shall be tested as described in 39.2. At the conclusion of the test there shall be no accumulation of water within the enclosure, and no water shall appear within the enclosure at a level higher than any area intended for live parts.

Exception: For enclosures containing live parts, the water is not prohibited from entering the enclosure above these live parts when the construction is such that the water is not visible on live parts, insulating materials, or mechanism parts. However, no water shall enter any space that is above live parts and in which wiring is present under any proper installation conditions.

39.2 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 39.1. Spray heads are to be constructed in accordance with the details shown in Figure 39.2. The enclosure is to be set up as intended by the manufacturer. The enclosure is to be positioned in the focal area of the spray heads so that the greatest quantity of water enters the enclosure. The water pressure is to be maintained at 5 psi (34.5 kPa) at each spray head. The enclosure is to be exposed to the water spray for 1 hour.