UL 330A

HOSE AND HOSE ASSEMBLIES FOR USE WITH DISPENSING DEVICES DISPENSING GASOLINE AND GASOLINE/ETHANOL BLENDS WITH NOMINAL ETHANOL CONCENTRATIONS UP TO 85 PERCENT (E0 – E85)

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SUMMARY OF TOPICS

This second issue of Subject 330A, Outline of Investigation for Hose and Hose Assemblies for Use With Dispensing Devices Dispensing Gasoline and Gasoline/Ethanol Blends With Nominal Ethanol Concentrations Up To 85 Percent (E0 – E85), which covers hose and hose assemblies, including vapor recovery hose and assemblies, for use on dispensing devices for motor fuels, is being published to revise the Construction section to allow other, suitable types of threads for use on the couplings.

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INTRODUCTION

1 Scope

1.1 These requirements cover hose and hose assemblies, including vapor recovery hose and assemblies, for use on dispensing devices for motor fuels. A flammable liquid hose assembly consists of flexible hose and fittings suitable for attachment to motor fuel dispensing equipment. Motor fuels, as defined by these requirements, include one or more of the fuels described in 1.2.

1.2 Hose and hose assemblies covered by these requirements are intended for use with one or more of the following motor fuels:

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 Hose assemblies are intended for use in accordance with the Code for Motor Fuel Dispensing Facilities and Repair Garages, NFPA 30A.

1.4 These requirements cover hose and hose assemblies (hose with couplings attached) in sizes up to and including 1-1/2 inches (38.1 mm).

1.5 Hose for conveying liquid fuel is intended for use at a maximum working pressure of 50 psig (345 kPa). Hose for conveying fuel vapors is intended for use at a maximum working pressure of 0.5 psig (3.4 kPa), including slight negative pressures from vacuum assist systems.

1.6 These requirements cover hose and hose assemblies for use at temperatures down to minus 40°C (minus 40°F) or optionally down to minus 54°C (minus 65°F).

1.7 These requirements also cover fuel hose assemblies optionally designated as “low permeation.” For the purposes of this standard, permeation is considered to encompass fuel loss through the flexible hose, fuel loss at the fittings and fuel loss at the connection between the hose assembly and the equipment to which it is intended to be attached in the dispensing system.

1.8 These requirements do not cover hose or hose assemblies, intended for use in automotive vehicles or in confined areas, except for locations inside the housings of dispensing devices complying with 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.

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1.9 These requirements do not cover hoses or hose assemblies for use with any other fuel other than as described in 1.2.

2 General

2.1 Units of Measurement

2.1.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

2.2 Undated References

2.2.1 Any undated reference to a code or standard appearing in the requirements of this Outline shall be interpreted as referring to the latest edition of that code or standard.

3 Glossary

3.1 For the purposes of this outline, the following definitions apply.

3.2 ADJUSTED MASS LOSS – The mass loss of the blank (unfilled hose assembly) subtracted from the mass loss of a filled hose assembly. The purpose of this is to adjust for factors other than fuel permeation that may affect mass loss.

3.3 BALANCE VAPOR RECOVERY HOSE – A coaxial hose consisting of an inner line for conveying fuel and an outer line. Fuel vapors are permitted to return to the fuel dispenser in the annular space between the two lines.

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 DISPENSING DEVICE – A product consisting of various components that is used to control and meter the flow of liquid from an upstream storage device.

3.6 HOSE ASSEMBLY VOLUME (V) – The total volume in cubic centimeters of a capped hose assembly, calculated as follows:

$$V = D^2 (L + 2d) \pi/4$$

in which:

D = the inner diameter of the hose in centimeters, as determined in 16.5.3

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L = the length of the hose in centimeters, as determined in 16.5.1

d = the depth of the cap in centimeters, as determined in 16.5.2

3.7 LEAST SQUARES FIT LINE – A best fit line drawn through a set of data such that the sum of the squared residuals has its least value, a residual being the difference between an observed value (data point) and the line.

3.8 PERMEATION SURFACE AREA – The length of the hose as determined in 16.5.1 multiplied by the inner circumference of the hose, expressed in square meters. For vacuum-assist vapor recovery hose, the length of the hose is multiplied by the inner circumference of the outer hose. For balance vapor recovery hose, the length of the hose is multiplied by the average inner circumference of the outer hose.

3.9 REINFORCEMENT – Natural or synthetic fibers or fabric, or metallic wire that is wrapped, braided or spiral wound in one or more layers over the tube, intended to provide longitudinal and transverse (hoop) strength to the hose.

3.10 SEAL, 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.

3.11 SEAL, 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.

3.12 VACUUM–ASSIST VAPOR RECOVERY HOSE – A coaxial hose consisting of an inner vacuum line for vapor recovery and an outer line. Fuel is dispensed through the annular space between the two lines.

PERFORMANCE

4 Tube and Cover

4.1 Single-line hose and double-line vapor recovery hose

4.1.1 The tube shall be made from a material resistant to the fuels anticipated by these requirements.

4.1.2 The cover shall be made from a material resistant to the fuels anticipated by these requirements and ozone.

4.1.3 The tube and cover shall be of uniform thickness, and free from pitting, blisters, or other imperfections. This requirement is not intended to exclude the use of a corrugated cover.

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4.2 Coaxial vapor recovery hose

4.2.1 The tube and cover, if any, of the inner hose shall be made from materials resistant to the fuels anticipated by these requirements.

4.2.2 The tube of the outer hose or a homogeneous outer hose shall be made from materials resistant to the fuels anticipated by these requirements.

4.2.3 The cover of the outer hose or a homogeneous outer hose shall be made from a material resistant to the fuels anticipated by these requirements and ozone. An outer homogeneous thermoplastic hose with no separate layer of reinforcement shall also be made from a material resistant to sunlight.

4.2.4 The tube and cover shall be of uniform thickness and free from pitting, blisters, or other imperfections. This requirement is not intended to exclude the use of a corrugated tube, cover, or outer vapor hose.

5 Thickness of Cover

5.1 The thickness of the cover shall not be less than 0.047 inch (1.19 mm) when measured in accordance with 5.2 – 5.6.

Exception: This requirement does not apply to the cover of the inner hose and the outer vapor hose of a coaxial type vapor recovery hose.

5.2 For removing irregularities in samples, the buffing machine or skiving machine outlined in the Standard Practice for Rubber – Preparation of Product Pieces for Test Purposes from Products, ASTM D3183, is to be used.

5.3 The abrasive wheel of the buffing machine is to be No. 30 – 60 grit and the diameter and rotary velocity of the wheel are to be such that it will have a peripheral speed of 4000 ±700 feet per minute (20.3 ±3.6 m/s). The machine is to be provided with a slow feed so that very little compound can be removed at one cut to avoid overheating of the specimen.

5.4 A dial micrometer graduated to 0.001 inch (0.03 mm) that exerts a load of 2.82 – 3.00 ounces (80 – 85 grams) by means of a weight is to be used to measure thickness. he load is to be applied through a flat contact foot 0.25 ±0.01 inch (6.4 ±0.3 mm) in diameter.

5.5 To determine the thickness of the tube and cover, a strip, 6 – 8 inches (152.4 – 203.2 mm) long and 1 inch (25.4 mm) wide, or as close to 1 inch (25.4 mm) as possible from small diameter hose, is to be cut longitudinally from the hose, and the part separated from the plies. When the thickness of the part is not uniform around the circumference of the hose, the strip is to be cut from the thinnest portion of the sample.

5.6 The strip specimen is to be buffed or skived to remove the impressions left by the fabric or braid or other surface irregularities, using the equipment described in 5.2 and 5.3. A series of five thickness measurements are to be taken within the area from which the impressions have been removed, and the maximum reading obtained is to be taken as the thickness of the part.

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6 Internal Diameter

6.1 The internal diameter of a hose shall be equal to the nominal diameter ±1/32 inch (0.8 mm) for sizes up to and including 3/4 inch (19.0 mm) and ±1/16 inch (1.6 mm) for larger sizes.

6.2 A tapered plug gauge of wood or metal having a taper of 3/8 inch per foot (31.3 mm/m), marked to indicate variations of 1/64 inch (0.4 mm) in diameter, or a set of wood or metal plug gauges, straight or ball type, in increments no greater than 0.01 inches (0.25 mm) for hoses in sizes 1 inch (25.4 mm) and less and 0.02 inches (0.51 mm) for hoses in sizes greater than 1 inch (25.4 mm), shall be used for measuring the internal diameter. An expanding ball gauge, and a micrometer or other equivalent means to accurately measure the expanded ball, are required in some cases. See 6.3.

6.3 The end of the hose is to be cut square. When a tapered plug gauge is used, the plug gauge is to be inserted in the hose sample until a close fit is obtained without forcing. The diameter of the gauge at the end of the sample, to the nearest 1/64 inch (0.4 mm), is to be recorded as the internal diameter of the hose. When a set of straight or ball-type plug gauges is used, the diameter of the gauge, which when inserted in the hose sample gives a close fit without forcing, is to be recorded as the internal diameter of the hose. When the end of a wire-braided hose is constricted or flared, the inside diameter is to be measured 1 inch (25.4 mm) from the end to be representative of the inside diameter by means of an expanding ball gauge.

7 Reinforcement

7.1 Reinforcement, if present, shall be evenly and firmly applied over the tube of hose conveying liquid fuel.

8 Electrical Bonding

8.1 Hose and hose assemblies shall be constructed so as to provide an electrically conductive and bonding path between the couplings at each end of the length in order to dissipate static electricity.

9 Couplings

9.1 Couplings provided on hose assemblies shall be made from metals and shall be constructed with a section for tightening with tools. See Materials, Section 10.

9.2 The coupling provided on single-line hose assemblies shall have male pipe threads complying with the Standard for Pipe Threads, General Purpose (Inch), ASME B1.20.1.

9.3 The couplings provided on coaxial type vapor recovery hose assemblies shall have male 1-7/8 – 12 SAE straight threads when the inner hose is intended to dispense the liquid fuel into the vehicle and 1-1/4 inch – 18 SAE Straight, M34 by 1.5 metric thread or 1 inch – 11-1/2 NPT threads, as required when the outer hose is intended to dispense the liquid fuel into the vehicle. All fittings are to be designed to fit the accessories connected to the hose couplings to form a leak-tight connection.

9.4 When the threads of the couplings of a single-line hose assembly or vapor recovery hose assembly are not as specified in 9.2 or 9.3, the installation instructions which accompany each assembly shall indicate the specific equipment which can be connected to the fitting or shall be marked in accordance with 34.10.

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10 Materials

10.1 Metallic materials

10.1.1 General

10.1.1.1 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, 10.1.2.1. For products rated for gasoline/ethanol blends with nominal ethanol concentrations greater than 25 percent, see Metallic materials – system level, 10.1.3.

10.1.1.2 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, 10.1.2.2.

10.1.1.3 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.

10.1.2 Metallic materials – material level

10.1.2.1 Corrosion due to fluid

10.1.2.1.1 All metallic materials used for fluid confining parts shall be resistant to corrosion caused by motor fuels. Compliance is verified by the Long Term Exposure Test, Section 30.

10.1.2.1.2 A coating or plating, applied to a base metal, shall be resistant to the action of motor fuels as determined by the Long Term Exposure Test, Section 30.

10.1.2.2 Atmospheric corrosion

10.1.2.2.1 Metallic materials used for fluid confining parts shall be resistant to atmospheric corrosion. Standard pipe and fittings conforming to the Standard for Welded and Seamless Wrought Steel Pipe, ASME B36.10M are acceptable when uncoated.

10.1.2.2.2 A protective coating shall provide resistance against atmospheric corrosion to a degree not less than that provided by the protective coatings specified in 10.1.2.2.3.

10.1.2.2.3 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 10.1.2.2.1 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.

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10.1.2.2.4 A metallic material other than as described in 10.1.2.2.1 – 10.1.2.2.3 shall be painted or protected in a manner that has been determined to be equivalent.

10.1.3 Metallic materials – system level

10.1.3.1 Combinations of metallic materials in products rated for use with gasoline/ethanol blends with nominal ethanol concentrations greater than 25 percent shall be chosen to reduce degradation due to galvanic corrosion in accordance with 10.1.3.2 – 10.1.3.4.

10.1.3.2 Table 10.1 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 is in the galvanic series of Table 10.1, the more pronounced the effects would be. Table 10.1 serves as a guide in selecting the appropriate test conditions based on manufacturer specified material combinations.

Table 10.1
Galvanic series of metal materials

Most passive	Platinum
	Gold
	Graphite
	Silver
	Stainless Steel Type 316 (Passive)
	Stainless Steel Type 304 (Passive)
	Titanium
	13 Percent 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
	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 Percent Chromium Stainless Steel (Active)
	Cast Iron
	Wrought Iron
	Mild Steel
	Aluminum 2024
	Cadmium

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Table 10.1 Continued

	Alclad Aluminum 6053 Aluminum 1100 Galvanized Steel Zinc Magnesium Alloys
Most active	Magnesium
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10.1.3.3 Platings, such as nickel plating, can be used to reduce or eliminate dissimilar metal contact areas, as long as the plating material complies with 10.1.3.2 as the contact metal. If used, the plating shall comply with the Long Term Exposure Test, Section 30.

10.1.3.4 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, 10.2, when they are in contact with the fluid.

10.2 Nonmetallic materials

10.2.1 General

10.2.1.1 A nonmetallic part in contact with motor fuel 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. Gaskets and seals are tested in accordance with 10.2.1.2 – 10.2.3.2. Hose materials are tested in accordance with the following:

a) Tensile Strength and Elongation, Section 24;

b) Accelerated Air Oven Aging Test, Section 25;

c) Ozone Exposure, Section 26;

d) Ultraviolet Light and Water Exposure Test, Section 27, if applicable;

e) Immersion Tests, Section 28.

10.2.1.2 Gaskets or seals shall be designated as dynamic and/or static seals. See 3.10 and 3.11 respectively. If the type of seal cannot be determined, then the material shall be treated as both a static and a dynamic seal.

10.2.1.3 Gaskets and seals shall comply with the requirements as outlined in Nonmetallic materials – material level, 10.2.2; Coupling seals, 10.2.3; and Nonmetallic materials – system level, 10.2.4.

10.2.1.4 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;

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c) Methyl-Methacrylate;

d) Polyvinyl Chloride (PVC);

e) Nylon 6/6; or

f) Polyurethane.

10.2.2 Nonmetallic materials – material level

10.2.2.1 Static seals

10.2.2.1.1 Static seals shall be evaluated in accordance with the Standard for Gaskets and Seals, UL 157, modified as indicated in 10.2.2.1.1 – 10.2.2.1.2. If a specific material complies with these requirements, the material can be considered to be qualified for system testing.

10.2.2.1.2 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 percent swell (increase in volume) or 1 percent shrinkage (decrease in volume). In addition, the weight loss shall not exceed 10 percent. There shall be no visual evidence of cracking or other degradation as a result of the exposure.

10.2.2.1.3 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; and

e) For all materials, the average compression set is calculated and shall not exceed 35 percent.

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

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10.2.2.2 Dynamic seals

10.2.2.2.1 Dynamic seals shall be evaluated in accordance with the Standard for Gaskets and Seals, UL 157 modified as indicated in 10.2.2.2.1 – 10.2.2.2.2. If a specific material complies with these requirements, the material can be considered to be qualified for system testing.

10.2.2.2.2 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 percent swell (increase in volume) or 1 percent shrinkage (decrease in volume). In addition, the weight loss shall not exceed 10 percent. There shall be no visual evidence of cracking or other degradation as a result of the exposure.

10.2.2.2.3 Dynamic seals shall be subjected to the Immersion 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.

10.2.3 O-rings

10.2.3.1 Seals (O-rings) shall show no cracking when flexed at minus 40°C (minus 40°F), or minus 54°C (minus 65°F) when hose is marked for use down to minus 54°C (minus 65°F), after conditioning at test temperature for 24 hours. The test methods and apparatus used are described in the Standard for Gaskets and Seals, UL 157.

10.2.3.2 Seals (O-rings) shall retain a minimum of 60 percent of tensile strength and elongation after 70 hours oven aging at 100°C (212°F). The test methods and apparatus used are described in the Standard for Gaskets and Seals, UL 157.

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