UL 109

STANDARD FOR SAFETY

Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use

UL Standard for Safety for Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use, UL 109

Sixth Edition, Dated June 19, 1997

Summary of Topics

This revision of ANSI/UL 109 dated May 20, 2020 includes revising the Moist Ammonia Air Stress Cracking Test; 5.4 and Section 11.

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 March 6, 2020.

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UL 109

Standard for Tube Fittings for Flammable and Combustible Fluids, Refrigeration Service, and Marine Use

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This ANSI/UL Standard for Safety consists of the Sixth Edition including revisions through May 20, 2020.

The most recent designation of ANSI/UL 109 as an American National Standard (ANSI) occurred on April 30, 2020. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 109 on August 14, 1991. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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 cover fittings to be used in tubing carrying:

a) Fuel gases such as acetylene, liquefied petroleum gas (LP-gas), manufactured and natural fuel gases, and other liquefied and non-liquefied flammable gases that are stable because of their composition or because of the conditions of storage,

b) Refrigerants,

c) Gasoline or gasohol formulated in accordance with Standard Specification for Automotive Spark-Ignition Engine Fuel, ANSI/ASTM D 4814,

d) Diesel fuel formulated in accordance with Standard Specification for Diesel Fuel Oils, ANSI/ASTM D 975,

e) Heating fuel oils formulated in accordance with Standard Specification for Fuel Oils, ANSI/ASTM D 396, and

f) Kerosene formulated in accordance with Specification for Kerosine, ANSI/ASTM D 3699.

1.2 The requirements for "Marine Use" cover fittings to be used with tubing carrying gasoline or gasohol formulated in accordance with Standard Specification for Automotive Spark-Ignition Engine Fuel, ANSI/ASTM D 4814, or diesel fuel formulated in accordance with Standard Specification for Diesel Fuel Oils, ANSI/ASTM D 975.

1.3 This standard does not cover tube fittings for liquid or gaseous Biofuels or Ethanol fuels other than gasohol noted in 1.1 (c) and 1.2.

1.4 Requirements for the selection, installation, and use of the fittings covered by this Standard are included in the Standards of the National Fire Protection Association pertaining to storage and use of flammable and combustible fluids, such as:

NFPA 30, Flammable and Combustible Liquids Code

NFPA 31, Installation of Oil-Burning Equipment

NFPA 32, Dry Cleaning Plants

NFPA 51, Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes

NFPA 54, National Fuel Gas Code

NFPA 58, Storage and Handling of Liquefied Petroleum Gases

1.5 Requirements for the selection, installation, and use of fittings for "Marine Use" as covered by this Standard are included in the Standard for Pleasure and Commercial Motor Craft, NFPA 302, and the appropriate publications of the American Boat and Yacht Council.

1.6 *Deleted*

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard 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.

3 Instructions

3.1 The manufacturer shall provide a copy of the instructions or equivalent information intended to accompany Marine-Use fittings, which cover the proper method of preparing the tubing, assembling and making up the fitting, as well as specifications as required concerning the proper tools to be used. These instructions are to be used in the examination and test of the fittings and, for this purpose, are not required to be in final printed form.

DESIGN AND CONSTRUCTION

4 General

4.1 Tube fittings shall be of the flare, inverted flare, threaded-and-ball-sleeve compression, and other types for use with copper, brass, aluminum, and steel tubing.

4.2 Tube fittings shall be designed and constructed to be equivalent in mechanical strength, provisions for assembly and disassembly, and resistance to corrosion to tube fittings conforming to the Standard for Automotive Tube Fittings, SAE J512; Cast Copper Alloy Fittings for Flared Copper Tubes, ANSI/ASME B16.26; or the Standard for Refrigeration Tube Fittings – General Specifications, SAE J513.

4.3 The design of the fitting shall be such as to minimize the risk of incorrect assembly, such as reversal of components.

5 Materials

5.1 The various parts of a tube fitting shall be formed using materials having the strength and resistance to corrosion associated with the intended use or as designated in the appropriate Standard. Such

materials include brass, bronze, stainless steel, or plated carbon steel in the form of bar stock or cast, forged, or extruded.

5.2 A Marine-Use fitting and component part shall have less than 38 percent zinc content or include inhibitors to attain equivalent resistance to dezincification. Metals shall be machined, forged, or extruded and shall be designed for use in salt atmosphere and shall not be affected significantly by submersion in salt bilge water.

5.3 Fittings for gas and refrigeration service shall be machined, forged, or extruded.

5.4 With reference to 5.2 and 5.3, the fitting shall be capable of withstanding, without cracking, the Moist Ammonia Air Stress Cracking Test, Section 11, for copper and copper alloys.

5.5 Carbon steel shall have a protective coating equivalent to that afforded by a cadmium or zinc plating 0.0002 inch (0.005 mm) in thickness plus a chromate treatment or phosphate coating.

5.6 Carbon steel and stainless steel Marine-Use fittings for use with seamless steel tubing in diesel engine fuel systems shall be resistant to corrosion in salt atmosphere. Stainless steel fittings shall have corrosion resistance equivalent to that of stainless steel No. 304.

5.7 The composition of metal alloys used for the fabrication of Marine-Use fittings shall be of known characteristics for normal corrosion resistance, dezincification resistance, and galvanic compatibility with other parts of the fuel system. The material shall be tested, when required, by a salt water atmosphere exposure test. The test is to be conducted for 500 hours.

5.8 Fittings shall be fabricated of a material having a melting point (solidus temperature) not less than 950°F (510°C).

5.9 Brazing material if used, shall have a melting point (solidus temperature) in excess of 1000° F (537°C).

Exception: Marine use fittings if soldered, shall be soldered or brazed with a material having a melting point exceeding 840° F (450° C), in accordance with the Standard for Pleasure and Commercial Motor Craft, NFPA 302.

PERFORMANCE

6 General

6.1 Representative samples of each fitting and related adaptor design shall be subjected to the tests described in this Standard.

6.2 Samples for the Pull Test, Section 7, and the vibration tests, Sections 8 and 9, are to be of the straight connector type, with one end threaded for pipe connection. Samples for the pull test are to be for female pipe connection in all cases.

7 Pull Test

7.1 Tubing and piping shall not pull out of a tube fitting, nor shall the tube fitting rupture, when the maximum loads designated in Table 7.1 are applied axially to the fitting and its connections. The requirements of this test are not applicable to Marine-Use fittings.

7.2 Two samples of each size fitting are to be used for this test.

Table 7.1
Pull strength test

Tubing size outside diameter,		Tubing wall thickness,		Pull load, pounds-force (kN)					
				Flammable liquid and refrigeration fittings					
				Compression type		Flare type		Gas fittings, all types	
inch	(mm)	inch	(mm)						
1/8	3.2	0.030	0.76	250	1.11	250	1.11	250	1.11
3/16	4.8	0.030	0.76	350	1.55	400	1.78	400	1.78
1/4	6.4	0.030	0.76	450	2.00	500	2.22	500	2.22
5/16	7.9	0.032	0.81	450	2.00	650	2.89	650	2.89
3/8	9.5	0.032	0.81	450	2.00	800	3.56	800	3.56
7/16	11.1	0.032	0.81	500	2.22	900	4.00	900	4.00
1/2	12.7	0.032	0.81	500	2.22	1000	4.45	1150	5.11
9/16	14.3	0.035	0.89	700	3.10	1250	5.56	1350	6.01
5/8	15.9	0.035	0.89	900	4.00	1450	6.45	1600	7.12
3/4	19.1	0.035	0.89	1300	5.77	1900	8.45	2000	8.9
7/8	22.2	0.045	1.14			2400	10.7	2500	11.1
1	25.4	0.045	1.14			2600	11.6	2900	12.9
1-1/8	28.6	0.050	1.27			2850	12.7	3300	14.7
1-1/4	31.8	0.050	1.27			3050	13.6	3500	15.6
1-3/8	34.9	0.055	1.40			3250	14.6	3700	16.5
1-1/2	38.1	0.060	1.52			3450	15.3	3950	17.6
1-5/8	41.3	0.060	1.52			3650	16.2	4150	18.5
1-3/4	44.5	0.060	1.52			3850	17.1	4350	19.3
1-7/8	47.6	0.065	1.65			4050	18.0	4550	20.2
2	50.8	0.065	1.65			4250	18.9	4750	21.1
2-1/8	54.0	0.072	1.83			4500	20.0	5000	22.2

7.3 *Deleted*

7.4 Each end of a short length of annealed copper tubing is to be connected, in accordance with the manufacturer's instructions, to one of the two fittings to be tested. The tubing is to have the wall thickness for the size as indicated in Table 7.1.

7.5 The female pipe threaded ends of the two sample fittings are to be fitted with suitable lengths of steel pipe such that the overall length of the test assembly is one foot minimal length. The pipe shall be assembled to the fittings while exerting the turning efforts designated in Table 7.2. The male threads shall be lubricated with SAE No. 10 machine oil prior to assembly. The opposite ends of each section of pipe are to be arranged for securing to the members of a tensile testing machine.

7.6 The load is to be increased at a uniform rate until rupture occurs or the tubing or piping pulls out of one of the fittings.

Table 7.2
Torque requirements for pipe connections

Pipe size, inches	Torque, pound-inches	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
1-1/2	1550	175
2	1650	186

8 Vibration Test

8.1 A tube fitting for other than Marine-Use shall be capable of withstanding exposure to vibration of an amplitude of 1/8 inch (3.2 mm) and a frequency of 1000 vibrations per minute for a period of not less than 30 consecutive hours without development of physical weakness which is capable of impairing its normal service. In evaluating a fitting subjected to this test, physical failure which requires repair or replacement of the fitting or the tubing within or immediately adjacent to the fitting collar does not comply with this requirement.

8.2 Two samples of each size fitting are to be used for this test.

8.3 For these tests, amplitude is the maximum displacement of sinusoidal motion from position of rest or one-half of the total displacement of the fitting.

8.4 Each end of a length of annealed copper tubing is to be connected, in accordance with the manufacturer's instructions, to one of the two fittings to be tested. The tubing is to have the wall thickness for the size as indicated in Table 8.1.

8.5 The length of tubing for the test is to be that required to conform to the arrangement for each size as illustrated in Figure 8.1 or Figure 8.2.

8.6 The pipe-threaded ends are to be snugly fitted into metal blocks as shown in Figure 8.1 and Figure 8.2. One block is to be securely attached to the vibrating table and the other to a stationary structure. The arrangement is to be such that the fittings and tubing are maintained under air pressure of 50 pounds per square inch (psi) (345 kPa) throughout the test.

Table 8.1
Vibration test

Tubing size, outside diameter, inches	(mm)	Wall thickness of tubing: Refrigeration fittings, inch	(mm)	All other type fittings, inch	(mm)
1/8	3.2	0.035	0.89	0.035	0.89
3/16	4.8	0.035	0.89	0.035	0.89

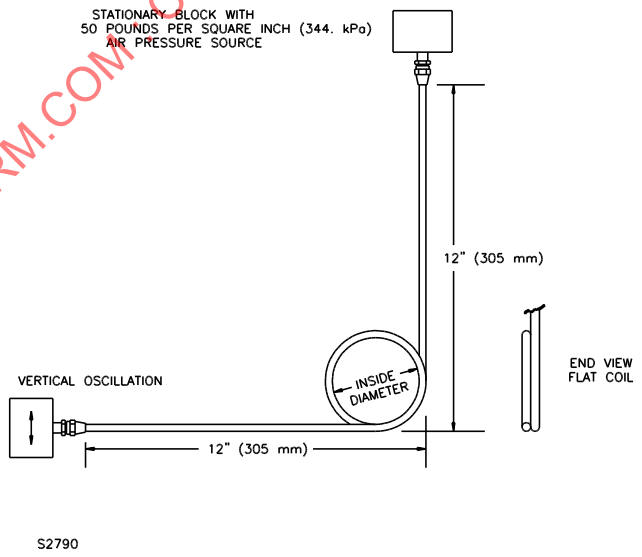
Table 8.1 Continued on Next Page

Table 8.1 Continued

Tubing size, outside diameter,		Wall thickness of tubing			
		Refrigeration fittings,		All other type fittings,	
inches	(mm)	inch	(mm)	inch	(mm)
1/4	6.4	0.035	0.89	0.035	0.89
5/16	7.9	0.035	0.89	0.035	0.89
3/8	9.5	0.035	0.89	0.035	0.89
7/16	11.1	0.035	0.89	0.035	0.89
1/2	12.7	0.035	0.89	0.049	1.24
9/16	14.3	0.035	0.89	0.049	1.24
5/8	15.9	0.035	0.89	0.049	1.24
3/4	19.1	0.042	1.07	0.049	1.24
7/8	22.2	0.049	1.24	0.065	1.65
1	25.4	0.049	1.24	0.065	1.65
1-1/8	28.6	0.049	1.24	0.065	1.65
1-1/4	31.8	0.049	1.24	0.065	1.65
1-3/8	34.9	0.055	1.40	0.065	1.65
1-1/2	38.1	0.060	1.52	0.072	1.83
1-5/8	41.3	0.060	1.52	0.072	1.83
1-3/4	44.5	0.060	1.52	0.072	1.83
1-7/8	47.6	0.065	1.65	0.072	1.83
2	50.8	0.065	1.65	0.072	1.83
2-1/8	54.0	0.072	1.83	0.083	2.11

Figure 8.1

Vibration test – bend



INSIDE DIAMETER:

3 inches (76.2 mm) for 1/8 to 3/16 inch (3.18 to 4.76 mm) outside diameter

6 inches (152 mm) for 1/4 to 7/16 inch (6.35 to 11.1 mm) outside diameter