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ANSI/CAN/UL/ULC 1337:2022

STANDARD FOR SAFETY

LP-Gas, Natural Gas, and Manufactured Gas Devices for Engine Fuel Systems

Approved American National Standard
ANSI

ANSI/UL 1337-2022

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SCC FOREWORD

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UL Standard for Safety for LP-Gas, Natural Gas, and Manufactured Gas Devices for Engine Fuel Systems, ANSI/CAN/UL/ULC 1337

First Edition, Dated December 7, 2022

Summary of Topics

This First Edition of ANSI/CAN/UL/ULC 1337, Standard for LP-Gas, Natural Gas, and Manufactured Gas Devices for Engine Fuel Systems, dated December 7, 2022 is a new joint standard and has been issued to reflect the latest ANSI and SCC approval dates and to incorporate the proposals dated March 18, 2022.

The new requirements are substantially in accordance with Proposal(s) on this subject dated March 18, 2022.

No Text on This Page

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ANSI/CAN/UL/ULC 1337:2022

Standard for LP-Gas, Natural Gas, and Manufactured Gas Devices for Engine Fuel Systems

First Edition

December 7, 2022

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

The most recent designation of ANSI/UL 1337 as an American National Standard (ANSI) occurred on December 7, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This standard has been designated as a National Standard of Canada (NSC) on December 7, 2022.

No Text on This Page

CONTENTS

Preface **5**

INTRODUCTION

1 Scope 7
2 Components 8
3 Units of measurement 8
4 Referenced publications 8
5 Glossary 9
6 Pressure and Temperature Ratings 11

CONSTRUCTION

7 General 11
8 Materials 11
9 Bodies 13
10 Springs 13
11 Electrically Operated Automatic Shutoff Valves and Devices Containing Solenoids or Other Electrical Components 13
12 LP-Gas Liquid Level Gauges 15
13 LP-Gas Automatic Liquid Level Control Valves 15
14 Vacuum Actuated Fuel Locks and Automatic Shutoff Valves 15
15 Regulators, Vaporizers, and Vaporizer-Regulators 15
16 Relief Devices 15
17 Air-Fuel Mixers/Carburetors 16
18 Fittings and Connectors 16
19 Filters 16
20 Motors 16
21 Low Level Sensors 16

PERFORMANCE

22 General 16
23 Deformation Test 17
24 Leakage Test 18
25 Endurance Test 19
26 Start-To-Discharge Test for Relief Valves 19
27 Hydrostatic Strength Test 20
28 Operation Test for Excess Flow Valves 21
29 Vibration Test 22
30 Solenoid Primer Cycling Test 22
31 Freeze Test 22
32 Resistance to Impact Test – Low Level Sensor 22
33 Creep Test – Low Level Sensor 24
34 Dielectric Voltage-Withstand Test – Low Level Sensor 24
35 Accelerated Aging Test 25
36 Fuel Gas Compatibility Test 25
37 Low Temperature Test 26
38 Moist Ammonia-Air Stress Cracking Test 26
39 Ignition Test 27

MARKINGS

40 General 28

Preface

This is the First Edition of ANSI/CAN/UL/ULC 1337, Standard for LP-Gas, Natural Gas, and Manufactured Gas Devices for Engine Fuel Systems.

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

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

This ANSI/CAN/UL/ULC 1337 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

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

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

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This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Valves and Safety Relief Valves for Anhydrous Ammonia and LP-Gas, STP 125.

This list represents the STP 125 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 125 Membership

Name	Representing	Interest Category	Region
Fredenburg, Richard	North Carolina Department of Agriculture & Consumer Services	AHJ	USA
Hoffmann, Richard	R A Hoffman Engineering P C, Dba Hoffman & Feige	General	USA
Kim, Yeon	US Consumer Product Safety Commission	Non voting member	USA
Ko, Solomon	TSSA	AHJ	Ontario
Legault, Peter	Integrated Review Services	General	Canada
Lemoff, Theodore	T Lemoff	General	USA
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This Standard is intended to be used for conformity assessment.

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

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INTRODUCTION

1 Scope

1.1 This standard sets forth minimum requirements for the following types of devices for engine fuel system applications intended for use with liquefied petroleum gas (LP-Gas), natural gas, and/or manufactured gas.

a) Automatic shutoff valves – electrically operated or vacuum actuated (mechanical);

b) Combination manual/automatic shutoff valves – electrically operated or vacuum actuated (mechanical);

c) Carburetors or air-fuel mixers;

d) Regulators;

e) Vaporizers and vaporizer/regulators;

f) Filters and strainers;

g) Fuel locks and fuel-lock filters;

h) Fittings and connectors;

i) Quick connect couplings and quick closing couplings;

j) Liquid level gauges;

k) Liquid level control valves (also known as overfilling prevention devices);

l) Low level sensor;

m) Relief devices; and

n) Fuel control valves.

1.2 Products covered by this standard are intended to be installed and used in accordance with the applicable Codes and Regulations as determined by the Authority Having Jurisdiction (AHJ), such as, but not limited to:

a) In the United States:

1. Liquefied Petroleum Gas Code, NFPA 58;

2. Vehicular Natural Gas Fuel Systems Code, NFPA 52; and

3. Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37.

b) In Canada:

1. Natural gas and propane installation code, CSA B149 Series;

2. Provincial or other regulations.

1.3 Devices covered by this standard are intended to be installed and used on vehicle (automobile, fork-lift, etc.) or engine generators. This standard does not cover these devices for general use.

1.4 Except for such observations as are required to ascertain performance characteristics, the assigning of flow capacity ratings are not within the scope of these requirements.

1.5 These requirements do not cover products for use in hazardous (Classified) locations.

2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component.

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

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

b) Is superseded by a requirement in this standard.

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

2.4 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.

3 Units of measurement

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

4 Referenced publications

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

ANSI/ASME B1.20.1, *Pipe Threads, General Purpose*

ASTM B86, *Standard Specification for Zinc-Alloy Die Castings*

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

ASTM B858, *Standard Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys*

CSA-C22.2 No. 157, *"Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations"*

CSA-C22.2 No. 60079-0, *Explosive Atmospheres – Part 0: Equipment – General Requirements*

CSA-C22.2 No. 60079-11, *Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "I"*

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*

NFPA 52, *Vehicular Fuel Systems Code*

NFPA 58, *Liquefied Petroleum Gas Code*

UL 157, *Gaskets and Seals*

UL 119, *Outline of Investigation for Adapters, Fittings, and Couplings for Anhydrous Ammonia and Fuel Gases*

UL 429, *Electrically Operated Valves*

UL 508, *Industrial Control Equipment*

UL 565, *Liquid-Level Gauges and Indicators for Anhydrous Ammonia and LP-Gas*

UL 840, *Insulation Coordination Including Clearance and Creepage Distances for Electrical Equipment*

UL 913, *Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations*

UL 1004-1, *Rotating Electrical Machines – General Requirements*

UL 1349, *Outline of Investigation for LP-Gas Vaporizers*

UL 1977, *Component Connectors for Use in Data, Signal, Control, and Power Applications*

UL 2227, *Overfilling Prevention Devices*

UL 60079-0, *Explosive Atmospheres – Part 0: Equipment – General Requirements*

UL 60079-11, *Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "i"*

UL/ULC 125, *Flow Control Valves for Anhydrous Ammonia and LP-Gas*

UL/ULC 132, *Safety Relief Valves for Anhydrous Ammonia and LP-Gas*

UL/ULC 144, *LP-Gas Regulators*

Abbreviations

ANSI – American National Standards Institute

ASME – American Society of Mechanical Engineers

ASTM – American Society for Testing and Materials

CSA – Canadian Standards Association

NFPA – National Fire Protection Association

5 Glossary

5.1 For the purposes of this standard, the following definitions apply.

5.2 AUTOMATIC SHUTOFF VALVE – A type of shutoff valve that uses energy (electrical or mechanical) based upon some input, to open and close the valve member.

5.3 COMBINATION MANUAL/AUTOMATIC SHUTOFF VALVE – A shutoff valve for fuel gas service that can be operated by both manual and automatic means.

5.4 FUEL LOCK – An industry term used to indicate an automatic shutoff valve that is placed in the fuel line ahead of the vaporizer-regulator.

5.5 FUEL LOCK FILTER – A device that combines a fuel lock (automatic shutoff valve) with a fuel gas filter.

5.6 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.

5.7 LIQUEFIED PETROLEUM GAS (LP-GAS OR LPG) – Any material having a vapor pressure not exceeding that allowed for commercial propane that is composed predominantly of the following hydrocarbons, either by themselves (excluding propylene) as mixtures: propane, propylene, butane (normal butane or isobutane) and butylenes.

5.8 LOCKUP PRESSURE – The outlet pressure of a positive outlet pressure type vaporizer-regulator or regulator under no flow conditions.

5.9 MANUFACTURED GAS – Synthetically produced mixture of methane and other gases, such as carbon monoxide, produced by chemically treating coal.

5.10 NATURAL GAS – A naturally occurring hydrocarbon gas mixture consisting primarily of methane, along with other hydrocarbons, carbon dioxide, nitrogen, and hydrogen sulfide.

5.11 QUICK CLOSING COUPLING – A device that consists of two parts (male and female), which provides for a means of connecting and disconnecting a fuel gas cylinder assembly from the fuel line without the use of tools. The two parts are threaded together. The coupling incorporates 1-1/4 in ACME threads and each part contains a check valve that closes when the two parts are separated.

5.12 QUICK CONNECT COUPLING – A device that consists of two parts (male and female), which provides for a means of connecting and disconnecting a fuel gas cylinder assembly from the fuel line without the use of tools. The two parts are pushed together and are not threaded. Each part contains a check valve that closes when the two parts are separated.

5.13 REGULATOR, NEGATIVE OUTLET PRESSURE TYPE – A secondary stage fuel gas regulator that takes in vapor at a specified pressure and then reduces the pressure to a pressure less than atmospheric pressure (vacuum) at its outlet or final stage. This term may also apply to vaporizer-regulator.

5.14 REGULATOR, POSITIVE OUTLET PRESSURE TYPE – A regulator (primary or secondary type) that takes in fuel gas vapor at a specified pressure and then reduces the pressure to a lower pressure, but greater than atmospheric pressure at its outlet or final stage. This term may also apply to vaporizer-regulator.

5.15 REGULATOR, PRIMARY STAGE TYPE – A type of regulator for fuel gas, that has an inlet pressure rating equal to or greater than cylinder pressure or main gas supply pressure and reduces this pressure to some lower pressure.

5.16 REGULATOR, SECONDARY STAGE TYPE – A type of regulator for fuel gas that has an inlet pressure rating less than cylinder or main gas supply pressure. It is intended for connection into the fuel gas train at some point after a primary stage regulator. It serves as the final regulator in the fuel train.

5.17 STATIC SEAL – A seal that is not subject to mechanical movement or other applied forces other than compressive forces that are applied during installation and maintained during normal use conditions.

5.18 VAPORIZER-REGULATOR – A combination vaporizer and primary stage regulator that takes in liquid fuel at its inlet and adds heat to change the liquid to a vapor and then reduces the vapor pressure to a specified amount at its outlet or final stage.

6 Pressure and Temperature Ratings

6.1 The pressure rating of a device intended for use in LP-Gas service subjected to container pressure shall not be less than 250 pounds per square in (psi) (1.7 MPa) and shall not exceed 1/5 of its rupture pressure.

6.2 The pressure rating of a device intended for use in natural gas, manufactured gas, or LP-Gas service not subjected to container pressure shall be in accordance with the manufacturer's rating and shall not exceed 1/5 of its rupture pressure.

6.3 The temperature rating for devices other than those installed in an engine compartment shall comply with the following ranges:

a) For outdoor use devices, minus 40 °C (minus 40 °F) to 55 °C (130 °F), or

b) For indoor use devices, 0 °C (32 °F) to 55 °C (130 °F).

6.4 For devices within an engine compartment, the temperature range shall be set by the manufacturer, but shall not be smaller than the range in (a) above. See Accelerated Aging Test, Section 35.

CONSTRUCTION

7 General

7.1 An engine fuel device shall include all of the components required for its normal function and installation, and shall be furnished as a single unit or assembly.

7.2 When an engine fuel device is of a design that requires the use of special pipe flanges, gaskets, bolts, or other special fittings or parts for making a proper installation, such parts shall be furnished by the manufacturer with each device.

7.3 A seat disc shall be attached to its poppet or holder, or otherwise assembled so as to prevent it from becoming dislocated under service conditions. The means to secure the disc shall not rely on cement or adhesive.

7.4 Vaporizers and vaporizer-regulators shall not be provided with a fusible plug.

8 Materials

8.1 Fluid-confining parts of a device or operating parts shall have the strength and durability to provide reliable service of the parts and of the assembly.

8.2 To determine compliance with 8.1, a material (except a valve disc or soft seat, a seal ring, a diaphragm, or a gasket) shall have a melting point (solidus temperature) of no less than 510 °C (950 °F) and a tensile strength of no less than 10,000 psi (68.9 MPa) at 204 °C (400 °F).

Exception No. 1: Bodies and bonnets of vaporizer-regulators, and regulators are allowed to be made of Zinc alloys AG 40A, AG 40B, AC 41A, or AC 43A as specified in the Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings, ASTM B86.

Exception No. 2: Fluid confining parts of vaporizer-regulators are not required to comply with 8.2 if the fluid passage is restricted by a No. 54 drill orifice [0.055 in (1 mm)] or the flow of gas will be stopped if a fault occurs in the fluid confining portion.

8.3 A nonmetallic part in contact with fuel gas which will cause unsafe operation or leakage of the fuel gas shall be resistant to the action of such fuel gas.

8.4 With reference to the requirement in 8.3, elastomeric materials shall be subjected to:

a) The Accelerated Aging Test, Section 35;

b) The Fuel Gas Compatibility Test, Section 36; and

c) The Low Temperature Test, Section 37.

Exception No. 1: Acetal polymers, chlorotrifluorethylene polymers, tetrafluorethylene, fluorinated ethylene propylene polymers and polyamides of composition polyhexamethylene adipamide or polycaproamide polymers (nylon 6, 6/6 or 6/16) shall only be subjected to the Accelerated Aging Test, Section 35.

Exception No. 2: Nonmetallic parts that serve as static seals in negative pressure chambers of regulators are not required to be subjected to the Fuel Gas Compatibility Test or Low Temperature Test.

8.5 With reference to the requirement in 8.3, polymeric materials shall be subjected to:

a) The Accelerated Aging Test, Section 35; and

b) The Fuel Gas Compatibility Test, Section 36.

8.6 Nonductile cast iron (regular gray iron) shall not be used for bodies or closures for engine fuel devices. This does not prohibit the use of nodular iron.

8.7 A brazing material used for joining pressure-confining parts of an engine fuel device shall have a melting point (solidus temperature) of no less than 538 °C (1000 °F).

8.8 Metals used in combination shall be galvanically compatible. Aluminum shall not be used in combination with copper or copper alloy.

8.9 When corrosion of a part interferes with the proper function of a valve, the part shall be of a corrosion-resistant material or be provided with a corrosion-resistant protective coating.

8.10 A protective coating shall provide resistance against corrosion, to a degree no less than that provided by the protective coatings specified in 8.11.

8.11 Cadmium plating shall have a thickness of no less than 0.0003 in (0.008 mm), and zinc plating shall have a thickness of no less than 0.0005 in (0.013 mm).

Exception: On parts where threads constitute the major portion of the area, the thickness of the cadmium or zinc plating shall be no less than 0.00015 in (0.0038 mm).

8.12 When warping of a casting affects the tightness of liquid-confining joints or the proper fit of parts, the casting shall be stress-relieved to reduce the risk of warping.

8.13 A part made of drawn brass or machined from brass rod shall be capable of withstanding, without cracking, the Moist Ammonia Air Stress Cracking Test, Section 38, for copper and copper alloys.

9 Bodies

9.1 A threaded section of an engine fuel device designed for connection to piping shall be constructed with a section to serve as a wrench grip.

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

Exception: Engine fuel devices intended for use in installations where pipe fittings incorporate other than NPT type threads shall be permitted to be provided with pipe threads complying with a national pipe thread standard compatible with those fittings. The pipe thread type shall be identified in accordance with 40.4.

9.3 Joints in a body constructed of two or more parts shall be prevented from loosening as the result of the turning effort exerted by connecting or disconnecting piping. See the Deformation Test, Section 23.

9.4 A flange of a flange-type device shall comply with the appropriate American National Standard for Pipe Flanges and Flanged Fittings covering the material from which the flange is made, or it shall be of a design determined by investigation to be appropriate for the application. See 7.2.

9.5 Openings for bolts or screws used for assembly shall not extend through the outer walls of a body into a liquid-handling section.

10 Springs

10.1 A spring shall be guided and arranged to minimize binding, buckling, or other interference with its free movement. When required, ends of a spring shall be closed and squared.

11 Electrically Operated Automatic Shutoff Valves and Devices Containing Solenoids or Other Electrical Components

11.1 Electrically operated automatic shutoff valves shall comply with the requirements for "automotive fuel valves" in the Standard for Electrically Operated Valves, UL 429, except as noted in 11.4. Additionally, electrically operated automatic shutoff valves shall comply with the Vibration Test, Section 29.

Exception No. 1: Valves intended for use with male plugs and female receptacle wiring connectors need not be marked with the intended mating connector.

Exception No. 2: For these applications, male plug and female receptacle wiring connectors evaluated in accordance with the Standard for Component Connectors for Use in Data, Signal, Control, and Power Applications, UL 1977, are considered to be representative of the connector requirements in the Standard for Electrically Operated Valves, UL 429 and may be provided instead of field wiring connections.

Exception No. 3: Spacings evaluated to the Standard for Insulation Coordination Including Clearance and Creepage Distances for Electrical Equipment, UL 840, in accordance with this option in the Standard for

Electrically Operated Valves, UL 429, shall be based on Overvoltage Category III (safety valves) and no further control or identification of this Overvoltage Category is required.

11.2 Combination Manual/Automatic Shutoff Valves shall incorporate an excess flow check valve. The manual valve and excess flow check valve portion shall comply with the requirements for "other than safety relief valves" in the Standard for Flow Control Valves for Anhydrous Ammonia and LP-Gas, UL 125. The electrically operated portion of the valve shall comply with 11.1.

11.3 The manual valve and excess flow check valve portion of the device as described in 9.2 shall comply with the requirements of this standard when intended for use with natural gas or manufactured gas.

11.4 Electrically operated fuel locks and automatic shutoff valves for use as other than primers, shall be considered "safety valves". Electrically operated fuel locks and automatic shutoff valves used as primers in vaporizer-regulators, and on air fuel mixers and carburetors, shall be considered "general purpose valves", and subjected to the Solenoid Primer Cycling Test, Section 30. All electrically operated valves that are required to be subjected to the deformation test shall be subjected to the Deformation Test, Section 23, in lieu of, or in addition to, the deformation test in the Standard for Electrically Operated Valves, UL 429.

11.5 Electrical components such as switch contacts, a resistance heating element, or a part that may arc or glow that are included in a device for an engine fuel system shall not be located in the main gas stream or in a compartment that may contain gas in the event of rupture of a bellows or diaphragm, except as indicated in 11.6 or 11.7.

11.6 Electrical parts may be located in a gas containing compartment only if supplied by an intrinsically safe circuit in accordance with the following:

a) In the United States:

1. UL 913, Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations;

2. UL 60079-0 Explosive Atmospheres – Part 0: Equipment – General Requirements; and

3. UL 60079-11 Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "i".

b) In Canada:

1. CSA-C22.2 No. 157, "Intrinsically Safe and Non-Incendive Equipment for Use in Hazardous Locations"; or

2. CSA-C22.2 No. 60079-0 Explosive Atmospheres – Part 0: Equipment – General Requirements; and

3. CSA-C22.2 No. 60079-11, “Explosive Atmospheres – Part 11: Equipment Protection by Intrinsic Safety "I"

11.7 Electrical parts may be located in a compartment that may contain gas in the event of rupture of a bellows or diaphragm if a sample of a device has been subjected to an Ignition Test, Section 39. During the test, there shall be no throwing of parts and ignition of a flammable gas-air mixture in the compartment containing the electrical parts shall not cause ignition of a similar mixture in the main gas stream.

Exception: The Ignition Test is waived when the compartment containing the electrical parts is fully potted, encapsulated, filled with silicone, or equivalent so no air is present, and low level sensors with capacitors,

diodes, or other solid state components shall comply with the breakdown test in the Standard for Industrial Control Equipment, UL 508.

12 LP-Gas Liquid Level Gauges

12.1 Liquid level gauges for LP-Gas service shall comply with the requirements in the Standard for Liquid-Level Gauges and Indicators for Anhydrous Ammonia and LP-Gas, UL 565. Additionally, the liquid level gauge shall comply with the Vibration Test, Section 29.

12.2 Liquid level gauges intended for natural gas or manufactured gas service shall comply with the requirements in this standard.

13 LP-Gas Automatic Liquid Level Control Valves

13.1 Automatic liquid level control valves for LP-Gas service shall comply with the requirements in the Standard for Overfilling Prevention Devices, UL 2227. Additionally, the automatic liquid level control valve shall comply with the Vibration Test, Section 29.

13.2 A liquid level control valve intended for natural gas or manufactured gas service shall comply with the requirements in this standard.

14 Vacuum Actuated Fuel Locks and Automatic Shutoff Valves

14.1 Vacuum actuated (mechanical) fuel locks and vacuum actuated automatic shutoff valves intended for LP-Gas service shall comply with the Standard for Flow Control Valves for Anhydrous Ammonia and LP-Gas, UL/ULC 125. Additionally, these devices shall comply with the Vibration Test, Section 29.

14.2 Vacuum actuated (mechanical) fuel locks and vacuum actuated automatic shutoff valves intended for natural gas or manufactured gas service shall comply with the requirements in this standard.

15 Regulators, Vaporizers, and Vaporizer-Regulators

15.1 Primary and secondary stage regulators for LP-Gas applications shall comply with the requirements in the Standard for LP-Gas Regulators, UL/ULC 144. Additionally, the regulator shall comply with the Vibration Test, Section 29.

15.2 Primary and secondary stage regulators for natural gas or manufactured gas service shall comply with the applicable requirements in this standard.

15.3 Vaporizers for LP-Gas service shall comply with the Outline of Investigation for LP-Gas Vaporizers, UL 1349. Additionally, these vaporizers shall comply with the Vibration Test, Section 29.

15.4 Vaporizers for natural gas or manufactured gas service shall comply with the requirements of this standard.

15.5 Vaporizer-Regulators for fuel gas service shall comply with the requirements of this outline.

16 Relief Devices

16.1 Hydrostatic relief valves for LP-Gas applications shall comply with the requirements in the Standard for Safety Relief Valves for Anhydrous Ammonia and LP-Gas, UL 132. Additionally, the relief valve shall comply with the Vibration Test, Section 29.

16.2 Hydrostatic relief valves for natural gas or manufactured gas service shall comply with the requirements in this standard.

17 Air-Fuel Mixers/Carburetors

17.1 Electrically operated air-fuel mixers or carburetors shall meet the requirements of 11.4.

17.2 Mechanically operated air-fuel mixers or carburetors shall comply with the requirements in this standard.

18 Fittings and Connectors

18.1 Fittings for use with fuel gases shall comply with the requirements in the Standard for Adapters, Fittings, and Couplings for Anhydrous Ammonia and Fuel Gases, UL 119. Additionally, these devices shall comply with the Vibration Test, Section 29, when installed as intended.

19 Filters

19.1 Fuel gas filters shall be subjected to the Leakage and Hydrostatic Strength Tests, in accordance with Sections 24 and 27 respectively.

19.2 For fuel gas filters provided as part of an overall assembly, such as a fuel-lock filter assembly, the filter portion shall comply with 19.1.

20 Motors

20.1 Motors shall comply with the requirements in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1.

21 Low Level Sensors

21.1 Low level sensors shall comply with the temperature test in the Standard for Electrically Operated Valves, UL 429.

PERFORMANCE

22 General

22.1 Representative samples, as noted in 22.6, of each size and type of device shall be subjected to the tests described in these requirements. Additional samples of parts constructed of nonmetallic materials, such as seal materials and valve seat discs, are required for physical and chemical tests. Tests are conducted at room temperature 21 ±5.5 °C (70 ±10 °F) unless otherwise indicated.

22.2 Leakage tests at pressures of 1000 psi (6.9 MPa) or less are to use a source of aerostatic pressure such as air, nitrogen or other inert gas. Leakage tests at pressures greater than 1000 psi are to be conducted using a source of hydrostatic pressure such as water. For products tested with an aerostatic source, if the sample is submerged in water to detect leakage, the sample shall be submerged to a depth not greater than 4 in (101 mm), measured from the highest point on the sample. If tubing is connected to the outlet, to determine seat leakage, the end of the tubing shall be submerged in water to a depth not greater than 1 in (25 mm). The use of a soap and water solution, or other leak detection solution, that can be applied over the entire body section of the sample, is an alternate method to check for external leakage.

22.3 Water or other liquid may be used for developing the required pressure in a hydrostatic pressure strength test.

22.4 All leakage tests conducted using an aerostatic pressure source are to be maintained for at least 1 min. All leakage tests conducted using a hydrostatic pressure source are to be maintained for a minimum of 5 min. All hydrostatic strength tests are to be conducted for at least 1 min.

22.5 The investigation is to be limited to the service conditions for which the product is intended, such as the fluid handled and the pressure of the fluid. Samples shall be tested in the orientation intended in service, and as indicated in the installation instructions.

22.6 When compliance with another standard is specified in this standard, the number of samples and test requirements from each of the referenced standards shall be followed. When compliance with the tests in this standard is being determined, unless otherwise noted, three samples of each type of device shall be subjected to each required test.

23 Deformation Test

23.1 Joints in a device shall not leak, nor shall there be evidence of loosening of joints, distortion, or other damage resulting from the stress imposed on pipe-threaded sections when tested in accordance with these requirements.

23.2 Each sample device shall be rigidly anchored or otherwise supported. A length of Schedule 80 pipe is to be connected to a female pipe threaded section of the body. The male threads shall have pipe joint sealing compound or polytetrafluoroethylene (PTFE) tape applied to them first or be coated as specified by the manufacturer. Each pipe is then to be tightened to the torque specified in Table 21.1.

Table 21.1
Torque requirements for pipe connections

Pipe size, nominal inches	Outside diameter,		Torque,	
	in	(mm)	pound-inches	(N·m)
1/8	0.4	(10.3)	150	(17)
1/4	0.5	(13.7)	250	(28)
3/8	0.7	(17.2)	450	(51)
1/2	0.8	(21.3)	800	(90)
3/4	1.1	(26.7)	1000	(113)
1	1.3	(33.4)	1200	(136)
1-1/4	1.7	(42.2)	1450	(164)
1-1/2	1.9	(48.3)	1550	(175)
2	2.4	(60.3)	1650	(186)
2-1/2	2.9	(73.0)	1750	(198)
3	3.5	(88.9)	1800	(203)
4	4.5	(114.2)	1900	(214)

23.3 After the torque force has been applied to each connected pipe, the test sample is to be subjected to the Leakage Test, Section 24.

23.4 Upon removal of the pipe from the test sample, the assembly is to be examined for loosening of body joints.

24 Leakage Test

24.1 An engine fuel device shall not leak in excess of the amount defined in this section, and shall not show evidence of porosity in castings, when tested as described in this section. A positive shutoff valve and a pressure indicating device are to be installed in the supply piping. The pressure indicating device is to be installed in the piping between the shutoff valve and the sample under test. When lock up pressure is being monitored, a second pressure indicating device shall be installed in the outlet of the sample. The pressure indicating devices 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 % of the maximum scale reading of the gauge;

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

c) Any other device that is equivalent to the devices in (a) or (b).

24.2 Vaporizer-regulators and regulators having a positive outlet pressure shall be subjected to the leakage test as described in 24.3. The lock-up pressure at two times maximum rated inlet pressure shall not be greater than 150 % of the value determined at rated inlet pressure.

24.3 Primary and secondary regulators of the positive outlet pressure type are subjected to a seat leakage test as follows. Samples are in accordance with 22.6. A pressure indicating device is connected to the outlet and a test pressure equal to the maximum rated pressure and then two times the maximum rated pressure is applied. Each pressure is applied for a period of 1 min at the inlet of the device. If the regulator is adjustable, the test shall be conducted at the maximum setting. The outlet pressure shall be observed and recorded after stabilization is achieved. During the test at two times maximum rated inlet pressure, the sample is to be checked for external leakage in accordance with 22.2.

24.4 Vaporizer-regulators and primary stage regulators of the negative outlet pressure type shall be subjected to a leakage test as follows. Samples are in accordance with 22.6. With the outlet open, the inlet of each sample shall be subjected to a test pressure of two times the rated inlet pressure. If the device incorporates any adjustment means, the test is conducted at minimum and maximum settings. The pressure is maintained for 1 min. There shall be no leakage at the outlet or at any body joint at all possible adjustments when determined in accordance with 22.6. This test shall be repeated following the endurance, vibration, and freeze tests; one sample for each test. No leakage shall be observed after any of the tests.

24.5 Secondary stage regulators having a negative outlet pressure shall be subjected to a leakage test as follows. Samples shall be in accordance with 22.6. At manufacturer's maximum rated inlet pressure, no leakage shall be observed at the outlet or at any joints in accordance with 22.2. At 2 times the manufacturer's maximum rated inlet pressure, there shall be no leakage at any body joints in accordance with 22.2. Additionally, there shall be no leakage at the outlet is excess of 200 cc/h. Leakage at the outlet is determined by a suitable flow meter connected to the outlet or other suitable means. This test shall be repeated following the endurance and vibration tests; one sample for each test.

24.6 ACME threaded quick closing couplings for LP-Gas service shall be subjected to this test. Samples shall be in accordance with 22.6. With the outlet open, the inlet of the coupling shall be subjected to an aerostatic pressure of two times the rated inlet pressure and examined for leakage past the seat in accordance with 22.2. Each sample shall also be subjected to aerostatic pressure while connected to a mating socket or coupling with one end plugged. The assembly shall be examined for external leakage using the procedure described in 24.3. The pressure shall be maintained for 1 min in each case.

24.7 All other devices not covered in 24.2 – 24.6 shall be subjected to a leakage test as follows. Samples shall be in accordance with 22.6. Valves and fittings having a maximum rated pressure of 500 psig

(3450 kPa) or less shall be subjected to a test pressure of 2 times maximum rated pressure. Valves and fittings having a maximum rated pressure greater than 500 psig shall be subjected to a test pressure of 1-1/2 times maximum rated pressure. There shall be no leakage through stems, body seals, or other joints, or past the seat in accordance with 22.2. For external leakage tests, the test pressure is applied in the direction of normal gas flow, with the device open and the outlet blocked. For seat leakage tests, the test pressure is applied in the direction of normal gas flow, with the device in the closed position and the outlet open.

25 Endurance Test

25.1 One sample of each type of vaporizer, vaporizer-regulator, secondary stage or primary stage regulator, or liquid level control valve shall be subjected to this test. The sample is connected to a constant aerostatic inlet pressure of rated pressure for regulators, other than vaporizers or vaporizer-regulators for LP-Gas service, and the outlet or vacuum port is connected to an appropriate vacuum or outlet pressure (as specified by the manufacturer). For vaporizers and vaporizer-regulators for LP-Gas service, 100 psig (690 kPa) is used. Each device shall be cycled 100,000 times by varying the vacuum or positive pressure from maximum setting to atmospheric pressure. The sample shall meet the requirements of the Leakage Test, Section 24, before and following this test, except for vaporizers and vaporizer-regulators, the lock-up pressure shall not exceed 130 % of the value determined initially during the Leakage Test, Section 24.

25.2 One sample of each type of non-electric automatic shutoff valve, fuel-lock and fuel-lock-filter shall be subjected to this test. The sample is connected to a constant aerostatic inlet pressure of 100 psig (690 kPa) for LP-Gas service and rated inlet pressure for natural gas service, and the device is to be mechanically or otherwise cycled 100,000 times. The sample shall meet the requirements of the Leakage Test, Section 24, before and following this test.

25.3 One sample of each type of ACME Type Quick-Closing Coupling or quick connect coupling is to be subjected to this test. The sample is connected to a constant aerostatic inlet pressure of 100 psig and the device is to be mechanically cycled 30,000 times utilizing the probe portion of a mating socket component. The sample shall meet the requirements of the Leakage Test, Section 24, before and following this test.

25.4 One sample of each type fuel control valve shall be subjected to this test. The sample is connected to a constant aerostatic inlet pressure of rated pressure and shall be cycled 100,000 times by applying and releasing the pressure. The sample shall meet the requirements of the Leakage Test, Section 24, before and following this test.

25.5 For any device in 25.1 – 25.4 that has a manual actuation feature, that manual device shall be tested as shown in 25.2 – 25.4 as applicable, except the duration of the test shall be 6000 cycles.

26 Start-To-Discharge Test for Relief Valves

26.1 Three samples of the device shall be subjected to this test. The "first trial" start-to-discharge (s-t-d) pressure, as described in 26.5, for each sample shall not be less than 100 % or more than 110 % of the marked set pressure of the device. The "final" s-t-d pressure result for the three samples shall be based on the average of the three measurements in accordance with 26.6. Each individual sample measurement for "final" s-t-d pressure shall be within ±3 % of the average of the three samples, and the average "final" s-t-d pressure shall not be less than 100 % or more than 110 % of the marked set pressure of the device.

26.2 The resealing pressure of the device for each trial as described in 26.6 shall not be less than 90 % of the initially observed start-to-discharge pressure for each trial.

26.3 Each sample is to be connected to a source of regulated aerostatic pressure by connecting it to a hose assembly, pressure confining pipe section, or container that has a pressure rating at least equal to the marked set pressure of the sample. A positive shutoff valve and a pressure indicating device are to be

installed in the supply piping. The pressure indicating device is to be installed in the piping between the shutoff valve and the sample under test. When lock up pressure is being monitored, a second pressure indicating device shall be installed in the outlet of the sample. The pressure indicating devices 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 % of the maximum scale reading of the gauge;

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

c) Any other device that is equivalent to the devices in (a) or (b).

26.4 Each sample is then to be submerged into a water bath or tub to a depth of not more than 4 in (102 mm). It is preferred that the sample be positioned so that its discharge is in a vertical upwards orientation. Alternately, the outlet connection of the sample may be filled with water if the construction is such that it can be filled to detect bubbles. The drain hole of the sample may be taped or otherwise closed to permit filling the cavity with water.

26.5 With the positive shutoff valve open, the regulated source of pressure shall be increased to within 25 psig (172 kPa) of the set pressure and held for approximately 10 to 15 s. The pressure shall then be increased slowly at a rate not in excess of 2 psig (14 kPa) per second. The pressure at which the first bubble occurs is to be recorded as the "first trial" start-to-discharge (s-t-d) pressure. The pressure shall then be slowly increased until the discharge bubbles resemble a "very gentle" boil, at which point the sample is considered to be unseated and no increase in pressure is to be applied. The positive shutoff valve shall then be closed tightly, which should slowly decrease the pressure to the sample, and the pressure at which the bubbles cease (no bubble detected within a 10 to 15 s time period shall be recorded as the resealing pressure. Trials shall be conducted until two consecutive s-t-d pressure readings are within 2 psig.

26.6 The values from all of the trials, after the first trial, of a single sample are to be averaged to obtain the "final" s-t-d pressure for that sample.

27 Hydrostatic Strength Test

27.1 Three samples shall be subjected to this test. All portions of the engine fuel device that are subjected to rated inlet pressure shall be subjected to a hydrostatic pressure of five times the maximum rated inlet pressure. The pressure is maintained for at least 1 min. There shall be no rupture.

27.2 A positive shutoff valve and a pressure indicating device are to be installed in the supply piping. The pressure indicating device is to be installed in the piping between the shutoff valve and the sample under test. The pressure indicating devices 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 % of the maximum scale reading of the gauge;

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

c) Any other device that is equivalent to the devices in (a) or (b).

27.3 For engine fuel devices other than regulators and vaporizer-regulators, the pressure shall be applied to the inlet with the device in an open position and the outlet plugged. Regulators and vaporizer-regulators shall have the pressure applied to that portion of the regulator subjected to inlet pressure. For Quick-Closing Couplings the test shall be conducted with the mating components connected together.

27.4 The samples of a vaporizer regulator shall be previously subjected to the Deformation Test, Section 23, and the Endurance Test, Section 25.

27.5 External leakage observed during this test is acceptable if, following the hydrostatic test, the valve complies with the requirements for external leakage specified in 24.7.

28 Operation Test for Excess Flow Valves

28.1 An excess flow valve shall operate at no more than 10 % above, nor less than 20 % below the rated closing flow capacity specified by the manufacturer, and shall close automatically at a pressure differential across the valve of no more than 15 psi (103 kPa) during the operation tests described below. Compliance with these requirements shall be determined by taking the average of the trials and samples in all of the flow directions.

28.2 Three samples of each size and style of excess flow valve are to be subjected to these tests. An excess flow valve shall be tested with water and air. Except as indicated in 28.4, separate tests are to be run with each sample installed in vertical, horizontal, and inverted fluid flow direction through the excess flow valve. The tests with air are to be made without piping or other restriction connected to the outlet of the test sample.

28.3 With reference to 28.2, an excess flow valve in a POL (CGA 510) fitting or a fitting having an inlet connection not greater than 1/2 in (12.6 mm) NPT is permitted to have only a vapor rating and not be subjected to this test using water.

28.4 A valve intended for installation in one position (flow direction) only may be tested only in that position.

28.5 The test with air is to be conducted by utilizing a properly designed and calibrated flowmeter connected to an air supply source of adequate capacity and pressure. A gas, other than air, may be used.

28.6 The test sample is to be connected to the outlet of the flowmeter. A manometer or calibrated pressure measuring instrument having a resolution not greater than 1/2 psi (3 kPa) is to be installed on the upstream side of the test sample to indicate the closing pressure.

28.7 The test is conducted by slowly increasing the flow of air through the flowmeter until the check valve closes. At the instant before closing, the maximum flow rate and the closing pressure are to be recorded. With some flowmeters, the rate of flow at closing must be calculated. At least two trials shall be conducted with each sample in each flow direction.

28.8 The test with water is to be conducted using a liquid flowmeter (or the equivalent) installed in a piping system having the pressure to provide the required flow. The system is to include an inlet piezometer or pipe at least one pipe size larger than the valve to be tested, with a flow control valve connected between the flowmeter and piezometer. A hose or hydrostatic relief valve, or both, may be used to reduce the effect of the pressure shock when the excess flow valve closes.

28.9 The test sample is to be connected to the outlet end of the piezometer. A manometer or calibrated pressure measuring instrument as noted in 28.6 is to be connected to a pressure take-off on the upstream side of the test sample to indicate the closing pressure. The connection may have a length of rubber hose between the pressure measuring instrument and the pressure take-off, with a valve installed at this point to permit bleeding air from the system.

28.10 Prior to the test, the excess flow valve is to be opened slightly, with the bleed valve at the pressure measuring instrument, if provided, open, to eliminate air from the system. The bleed valve is then to be closed. The test is conducted by slowly increasing the flow until the check valve closes. During the test,

the pressure measuring instrument is to be positioned at the same level as the test sample. At the instant before closing, the rate of flow and closing pressure are to be recorded. At least two trials shall be conducted with each sample in each flow direction.

29 Vibration Test

29.1 One sample of each type of engine fuel device shall be subjected to this test. The device shall be mounted on a vibration table in a normal operating position. The sample shall be subjected to a vibration of 1/8 in (3.2 mm) amplitude and a frequency of 17 Hz for 200 h. Observations are made after this test to ensure that the device is still operational.

Exception No. 1: Liquid level gauging devices and low level sensors are subjected to 30 h vibration test.

Exception No. 2: Quick-closing couplings, filters, hose assemblies, pressure gauges, container valves, and relief devices are not subjected to this test.

29.2 The sample shall meet the requirements for the Leakage Test, Section 24, following this test, except that vaporizers and vaporizer-regulators shall have a lock-up pressure not exceeding 130 % of the value determined initially during the Leakage Test.

30 Solenoid Primer Cycling Test

30.1 A vaporizer-regulator or a fuel-air mixer/carburetor that incorporates a solenoid operated primer valve shall be subjected to this test. One sample of the vaporizer-regulator is to be tested. The solenoid primer valve shall be cycled 100,000 times, at a rate of not more than six cycles per min for 1 s on and 9 s off. There shall be no sticking of the primer valve in the open position at the completion of 100,000 cycles. This test can be conducted at the same time as the Endurance Test, Section 25.

31 Freeze Test

31.1 This test shall be conducted on one sample of a vaporizer-regulator or regulator that incorporates a chamber for engine coolant. A length of 1 ft (305 mm) rubber hose is connected to the inlet and outlet ports of the coolant chamber and the coolant path is filled with water. The sample is then conditioned at the lowest temperature of its ambient temperature range in accordance with 6.3, for 24 h. The sample is then allowed to warm to room temperature and the sample shall meet the requirements of the Leakage Test, Section 24, following the warm up period, except for vaporizers and vaporizer-regulators, the lock-up pressure shall not exceed 130 % of the value determined initially during the Leakage Test. There shall be no evidence of cracking or permanent deformation of the device and there shall be no leakage after the freeze test.

32 Resistance to Impact Test – Low Level Sensor

32.1 A low level sensor with a polymeric housing shall be subjected to the Leakage, Hydrostatic Strength and Dielectric Tests after the impact.

32.2 Three samples shall be conditioned at -40 ºC ±1 °C in a chamber maintained at this temperature for 3 h. The impact is to be produced by dropping or swinging a 2-in (50.8-mm) diameter steel sphere, weighing 1.18 lbs (0.54 kg) from a height which will produce an impact of 5 ft-lbs (6.8 J). The impact shall be within 2 min from being removed from the chamber. The low level sensor is to be rigidly supported and the impact is to be made to the most vulnerable spot on the low level sensor enclosure that may be exposed to a blow during intended use. The samples were not pressurized when impacted. Upon completion of the impact, each sample shall be subjected to the Leakage, Hydrostatic Strength and Dielectric tests at room temperature. For surfaces other than the top of an enclosure, either the unit is to be supported on the side and subjected to the impact mentioned above, or the steel sphere is to be