JOINT CANADA-UNITED STATES
NATIONAL STANDARD

ANSI/CAN/UL/ULC 30:2022

STANDARD FOR SAFETY

Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids

ANSI/UL 30-2022

SCC FOREWORD

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UL Standard for Safety for Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids, ANSI/CAN/UL/ULC 30

Tenth Edition, Dated April 29, 2022

Summary of Topics

This new edition of ANSI/CAN/UL/ULC 30 dated April 29, 2022 has been issued to reflect the latest ANSI and SCC approval dates and to incorporate the proposals dated May 28, 2021 and February 25, 2022.

The requirements are substantially in accordance with Proposal(s) on this subject dated May 28, 2021 and February 25, 2022.

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APRIL 29, 2022

ANSI/UL 30-2022

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ANSI/CAN/UL/ULC 30:2022

Standard for Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids

The First and Second editions of the Standard were titled Safety Cans.

The Third through Ninth editions of the Standard were titled Metal Safety Cans.

First Edition – May, 1930
Second Edition – February, 1954
Third Edition – March, 1970
Fourth Edition – April, 1971
Fifth Edition – October, 1974
Sixth Edition – March, 1977
Seventh Edition – March, 1985
Eighth Edition – March, 1991
Ninth Edition – August, 1995

Tenth Edition

April 29, 2022

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

The most recent designation of ANSI/UL 30 as an American National Standard (ANSI) occurred on April 29, 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 April 29, 2022.

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Preface

This is the Tenth Edition of ANSI/CAN/UL/ULC 30, Standard for Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids.

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

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

This ANSI/CAN/UL/ULC 30 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.

This joint American National Standard and National Standard of Canada is based on, and now supersedes, the Ninth Edition of UL 30 and ULC/ORD-C30-95.

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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http://www.shopulstandards.com/HowToOrder.aspx or call tollfree 1-888-853-3503.

This Edition of the Standard has been formally approved by the UL Standards Technical Panel (STP) on Metallic and Nonmetallic Safety Cans for Flammable and Combustible Liquids, STP 30.

This list represents the STP 30 membership when the final text in this standard was balloted. Since that time, changes in the membership may have occurred.

STP 30 Membership

Name	Represent	Interest Category	Region
Atkinson, Cheryl	C. L. Atkinson	General Interest	Canada
Ayers, Scott	US Consumer Product Safety Commission	Government	USA
Barker, Ann-Marie	Technical Standards & Safety Authority (TSSA)	AHJ/Regulator	Ontario
Carter, Glen	Justrite Mfg Co LLC	Producer	USA
Mailvaganam, Miles	M. Mailvaganam	General Interest	Canada
Marando, Michael	National Fire Protection Association	Non-voting member	USA
Prusko, Jeff	UL Standards	Project Manager – Non-voting	USA
Riegel, Roland	UL LLC	Testing and Stds Org	USA
Stern, Michael	Exponent	General Interest	USA
Stevick, Glen	Berkeley Engineering & Research Inc.	General Interest	USA
Trimmer, Scott	Eagle Mfg Co	Producer	USA
Wade, John A	ULC Standards	STP Chair – Non-Voting	Canada

International Classification for Standards (ICS): 75.200; 23.020.10

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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.

CETTE NORME NATIONALE DU CANADA EST DISPONIBLE EN VERSIONS FRANÇAISE ET ANGLAISE

INTRODUCTION

1 Scope

1.1 This standard sets forth minimum requirements for metallic and nonmetallic safety cans:

a) With a maximum capacity of 5.3 US gallons (20 L);

b) With a minimum capacity of 8 US fl oz (236 mL);

c) That are intended to store and handle flammable and combustible liquids;

d) That are intended for commercial and industrial applications; and

e) That are equipped with self-closing lids or valves, with flame arrester(s) in each opening or equivalent safety performance provided by flame mitigation device(s) [FMD(s)], and pressure relief devices.

1.2 These safety cans are intended for use in accordance with the following:

a) Fire Code, NFPA 1;

b) The National Fire Code of Canada, Part 4;

c) The Code for Flammable and Combustible Liquids, NFPA 30;

d) The International Fire Code (IFC);

e) OSHA CFR 29 1910.106, 1926,152, USCG CFR 46 147.45 and MSHA CFR 30 Part 56 and 57;

f) The requirements of the authority having jurisdiction.

1.3 These requirements cover the two types of safety cans, designated herein as either Type I or Type II as follows:

a) Type I safety cans are those equipped with an opening (or port) which may be adapted to both pouring and filling; or

b) Type II safety cans are those equipped with two separate openings (or ports) one for pouring and the other for filling.

1.4 This standard is not applicable to Portable Fuel Containers for consumer use that are certified to ASTM F852 or CSA B376.

1.5 These requirements are not applicable to single use or disposable containers, included those covered by ASTM F2874.

2 Units of Measurement

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

3 Undated References

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

3.2 The following documents are referenced in this standard. Users are encouraged to apply the most recent edition of the reference indicated below.

UL 797, *Electrical Metallic Tubing – Steel*

UL 969, *Marking and Labeling Systems*

ASTM A90 / A90M, *Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings*

ASTM A653/A653M, *Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process*

ASTM D638, *Standard Test Method for Tensile Properties of Plastics*

ASTM D1822, *Standard Test Method for Tensile-Impact Energy to Break Plastics and Electrical Insulating Materials*

ASTM E8/E8M, *Standard Test Methods for Tension Testing of Metallic Materials*

ASTM F839, *Standard Specification for Cautionary Labeling of Portable Gasoline, Kerosene, and Diesel Containers for Consumer Use*

ASTM F852/ F852M, *Standard Specification for Portable Gasoline, Kerosene, and Diesel Containers for Consumer Use*

ASTM G153, *Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials*

ASTM G155, *Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials*

CSA B376, *Portable Containers for Gasoline and Other Petroleum*

CSA C22.2 No. 0.15, *Adhesive Labels*

International Fire Code

National Fire Code of Canada

NFPA 1, *Fire Code*

NFPA 30, *Flammable and Combustible Liquids Code*

NFPA 69, *Standard on Explosion Prevention Systems*

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*

Code of Federal Regulations (Standards – 29 CFR)

Code of Federal Regulations Title 16, Chapter II, Subchapter C, Part 1500

Code of Federal Regulations Title 46, Shipping

Abbreviations

ASTM – American Society for Testing and Materials
CSA – CSA Group
NFPA – National Fire Protection Association

4 Glossary

4.1 For the purpose of this standard the following definitions apply.

4.2 ACTUATION HANDLE (ACTUATION TRIGGER) – A device used to open the spring-loaded lids (caps) or valves for filling and pouring operations.

4.3 CARRYING HANDLE – A handle used to grip and carry the safety can.

4.4 CLOSURE – A self-closing lid or valve capable of making a liquid-tight and vapour-tight seal on an opening.

4.5 FLAME ARRESTER – A conventional type of flame mitigation device consisting of metal mesh barrier in the safety can openings that prevents flame propagation by quenching.

4.6 FLAME MITIGATION DEVICE – a device or feature attached to, installed in, or otherwise integral to, a safety can intended to inhibit the propagation of an external flame into the safety can. A flame arrester is a commonly used type of FMD.

4.7 NOMINAL CAPACITY (RATED CAPACITY) – The marked liquid volume intended to be contained in a safety can.

4.8 POUR NOZZLE – Used on Type II safety cans at the pouring spout to direct the flow of liquid, to prevent spills and to facilitate grounding or bonding between containers. The pour nozzle may be rigid or flexible by design.

4.9 SAFETY CAN – A container of not more than 5.3 U.S. gal (20 L) capacity having a flame arrester in each fill and pour opening, or equivalent safety performance provided by FMDs, and having a spring-closing lid and spout cover designed to safely relieve internal pressure when the safety can is exposed to fire. Safety cans are further categorized as Type I and Type II, refer to the Construction Section.

4.10 SEALS – Gaskets or O-rings used in spring-loaded caps and valves, or between parts, to prevent leakage and spills.

4.11 SPOUT – A structure on the safety can top provided with a self closing valve, to facilitate filling or dispensing.

4.12 SPRING-LOADED LID or VALVE – Also referred to as a self-closing lid or valve; a closure used to protect the contents from heat sources, spills, to eliminate (when closed) the release of toxic and ignitable vapors. At least one spring-loaded lid will also function to safely relieve internal pressure when the safety can is exposed to fire.

4.13 TOTAL VOLUME – The volume equal to the nominal capacity of the safety can plus any space remaining within the can.

CONSTRUCTION

5 Sizes

5.1 The total volume of a safety can shall be sufficient to contain the nominal capacity of the can.

6 General Requirements for Metallic and Non-Metallic Safety Cans

6.1 Safety Can, Type I – A safety can with one opening used for both filling and pouring shall be classified as Type I. The spout shall be fitted with a self-closing spring-loaded cap capable of being opened manually. See Figure 6.1.

6.2 Safety Can Type II – A safety can with two openings, one for filling and one for pouring shall be classified as Type II. Both openings shall be self-closing with either a spring-loaded cap or spring-loaded valve. This may be accomplished with two individual spouts or one combination spout. The fill self-closing cap shall be capable of being opened manually. See Figure 6.1.

Figure 6.1

Examples of Type I and Type II Safety Cans

Type I
1 dual purpose spout w cap
Handle is also cap opener

Type II
1 fill fitting w cap + 1 pour spout w nozzle
Separate carry handle & pour spout actuator

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6.3 A spout opening in the body or top of a safety can shall be above the rated liquid level as marked in 24.4.

6.4 A safety can having a nominal capacity of 1.1 US quarts (0.94 L) or less shall not have more than one opening. The opening shall be adapted for pouring and filling.

6.5 A safety can shall not have more than two openings.

6.6 The separate pouring and filling spring-loaded lids or valves on a Type II safety can shall operate independently of each other.

6.7 A pouring spout shall be constructed to reduce the likelihood of spillage during pouring.

6.8 A Type II safety can shall incorporate a vent valve to permit the free discharge of liquid during a pouring operation. The vent valve shall open and close automatically and simultaneously with the opening and closing of the pouring valve.

6.9 A Type II safety can shall be affixed with a conductive nozzle for bonding between containers when dispensing.

6.10 Internal pressure ranging between 3 to 5 psig (20.7 to 34.5 kPa) shall be relieved by overcoming the spring pressure on the spring-closing, pouring- or filling- lid or valve or through an independent pressure-relief device.

6.11 The bottom surface of a safety can shall be recessed at least 1/8 in (3.2 mm) above the bottom perimeter of the sidewall to reduce the likelihood of puncturing or abrading the bottom.

6.12 The bottom edge of a metal safety can having a nominal capacity of 3 US gal (11.4 L) or more shall be reinforced or shall be provided with a metal support ring.

7 Pouring Spouts and Fill Fittings

7.1 A metallic pouring spout or fill fitting shall be of corrosion-resistant metal or of ferrous metal that is provided with a corrosion-resistant coating that complies with the requirements in Corrosion-Resistant Coatings, Section 13.

7.2 The wall of a cast pouring spout or fill fitting shall not be less than 1/8 in (3.2 mm) thick. The wall thickness of tubing or other drawn material shall not be less than 0.05 in (1.3 mm).

7.3 The internal diameter of a spout or fill fitting shall not be less than the appropriate value specified in Table 7.1.

Table 7.1
Diameter of Fill Fittings

Nominal capacity	Minimum internal diameter,	
	inch	(mm)
8 US fl oz (236 mL) to 2 US quarts (1.9 L) or less	1/2	(12.7)
Over 2 US quarts (1.9 L) to 3 US gal (11.4 L)	3/4	(19.1)
Over 3 US gal (11.4 L) to 5.3 US gal (20 L)	1	(25.4)

8 Pouring Nozzles – Type II Safety Cans

8.1 The metal used in a flexible nozzle shall not be less than 0.010 in (0.25 mm) thick. A rigid nozzle shall not be less than 0.035 in (0.89 mm) thick.

8.2 The discharge end of a flexible nozzle shall include an FMD or a flame arrester that has successfully passed Section 18, Flame Mitigation Device Effectiveness.

8.3 The valve or inlet end of a flexible nozzle shall be supported or reinforced by a closely wound external helical spring. The spring shall not be less than 3 in (76.2 mm) long and shall be secured in place.

8.4 A nozzle shall be attached to the pouring spout by a method that provides a leak-free connection and is conductive to the safety can body.

8.5 A nozzle intended for use in automotive fueling applications for pouring directly into the fuel tank of a vehicle requiring unleaded gasoline shall have a maximum outside diameter of 0.86 in (21.8 mm). When a safety can is equipped with a nozzle having an outside diameter not greater than 0.86 in (21.8 mm), the safety can may be marked in accordance with 24.3.

9 Self-Closing Caps or Valve Mechanisms

9.1 The self-closing caps or valves shall be of corrosion-resistant metal or of ferrous metal provided with a corrosion-resistant coating that complies with the requirements in Corrosion-Resistant Coatings, Section 13. Cast iron shall not be used.

9.2 A cast closure cap shall not be less than 3/32 in (2.4 mm) thick. A sheet metal cap shall not be less than 0.054 in (1.4 mm) thick.

9.3 A spring-closed lid for the pour or fil spout shall be recessed to completely overlap the edge of the seal, unless the cap or seal seat is internal and completely enclosed.

9.4 All mechanical components shall have sufficient strength to prevent bending, twisting, or subsequent damage to other components. The mechanical linkage associated with self-closing lid or valve shall have positive actuating, non-binding linkage.

10 Springs

10.1 A spring shall be of corrosion-resistant metal or of steel provided with a corrosion-resistant coating that complies with the requirements in Corrosion-Resistant Coatings, Section 13.

11 Handles

11.1 A safety can shall be provided with a carrying handle having a hand grip arranged for carrying the can. The handle shall be of corrosion-resistant metal or of steel provided with a corrosion-resistant coating that complies with the requirements in Corrosion-Resistant Coatings, Section 13.

11.2 A carrying handle shall be at least 4 in (102 mm) long, and not more than 1.5 in (38 mm) in width or diameter. The hand clearance shall not be less than 1 in (25 mm) from the handle to the safety can surface and 3.5 in (89 mm) from one handle support to the other.

11.3 Edges of a sheet metal handle shall be hemmed, rolled, or wired.

11.4 A safety can shall be provided with an actuation handle or trigger designed to open fill or pour caps or valves.

11.5 A safety can having a nominal capacity of 2 US gal (7.6 L) or more shall be provided with a bottom handle if it is not provided with a support ring or equivalent means for gripping the bottom of the can when pouring. Raised bottoms of at least 1/8 in (3.2 mm) meet the requirements of a bottom grip (see 6.12).

12 Attachment of Fittings

12.1 A pour spout or fill fitting, a handle, or any other fitting, shall be mechanically secured and shall comply with 17.4.

12.2 The head of a rivet used to attach a fitting shall be on the inside of the safety can, and the rivet shall be headed over on the outside of the safety can against the fitting. A rivet head shall be completely sweated with solder.

12.3 A flame arrester shall be of perforated sheet or wire mesh of brass, or stainless steel, or of equivalent corrosion-resistant metal.

13 Corrosion-Resistant Coatings

13.1 A coating on galvanized sheet steel shall comply with the coating designation G60 or A60 in Table I of the Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, ANSI/ASTM A653 or evaluated for equivalent corrosion resistance per 13.3. Not less than 40 % of the zinc shall be on either side, as determined by the single-spot test described in ANSI/ASTM A653. The coating shall be free from lumps, blisters, dross, and flux, and shall not flake or peel when the sheet material is formed into a component of the safety can.

13.2 The weight of a galvanized coating may be determined by any published method. However, in case of question, coating weight shall be established in accordance with the Test Method for Weight (Mass) of Coating on Iron and Steel Articles With Zinc or Zinc-Alloy Coatings, ASTM A90/A90M.

13.3 Equivalent alternate corrosion protection methods shall be determined by an evaluation of coating or plating in accordance with the method in the Standard for Electrical Metallic Tubing, UL 797, except with the visual corrosion comparison between benchmark G60 and alternate protection conducted after exposures per 20.3.3.

13.4 The interior and/or exterior surface of a safety can shall be of corrosion-resistant metal or shall be furnished with a coating of phenolic lacquer or enamel for corrosion resistance.

13.5 A metal coating that is damaged or removed during the manufacturing process shall be repaired by solder or other effective means to prevent corrosion.

14 Grounding and Bonding

14.1 Each safety can shall have means to connect to grounding or bonding wires, such as an external ground lug. For non-metallic safety cans a means to bond by either a conductive rod or via the flame arrester to the bottom of the can, that is also connected to the ground lug, shall be provided.

14.2 All conductive components of a safety can shall have an electrical continuity between them to provide a maximum resistance of resistance of 1 MΩ or less. The resistance shall be measured using a calibrated electrical multi-, megohm- or similar resistance-meter.

PERFORMANCE

15 General

15.1 Test samples

15.1.1 All performance tests shall be conducted on samples representative of production in all size and construction variations unless a “worst case” may be determined using an engineering-based rationale. Guidelines for determining worst case samples are identified below or in the specific test, if applicable.

15.1.2 For metallic safety cans, the combination of generic metal (steel, aluminum, etc.), joint type (crimp, weld, etc.) and shape (round, rectangular, etc.) used for a design series shall be evaluated. For variations in metal grade and thickness, the weakest (minimum tensile strength and thickness) is worst case.

15.1.3 For nonmetallic safety cans, the combination of generic polymer (PE, PP, FRP, etc), fabrication process (blow mold, thermo-fuse, etc.) and shape (round, rectangular, etc.) used for a design series shall be evaluated. For variations in polymer grade and thickness, the weakest (minimum tensile strength and thickness) is worst case.

15.1.4 Variations in the numbers/size of openings, safety closure, pouring spout, handle and other safety can features shall also be considered in the worst case determination with respect to each test conducted.

15.2 Test temperatures

15.2.1 Unless otherwise indicated in a specific test method, all tests shall be conducted with working fluids (air, water, and similar substances) at 21 ±6 °C (70 ±10 °F) or at normal ambient room temperatures between 10 °C and 32 °C (50 °F to 90 °F).

15.2.2 When required by a test, evaluation of the safety can at the different temperatures below shall be done after the sample, and contained liquid if applicable, has reached the specified temperature:

a) Room Temperature for metal safety cans = Within a range of 10 °C to 32 °C (50 °F to 90 °F);

b) Low Temperature for nonmetallic safety cans = At least -30 °C (-22 °F);

c) High Temperature for nonmetallic cans = At least 50 °C (122 °F).

15.3 Pressure test media

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

15.4 Test fluids

15.4.1 Water, antifreeze or other non-hazardous liquid shall be used for testing of the safety can and components except for the specific fuels and liquids identified in Section 20, Material Compatibility Tests.

16 Pressure Tests

16.1 General

16.1.1 Each test in this section shall be conducted while the sample and contained liquid are at Room Temperature, Low Temperature and high Temperature (refer to 15.2). At the manufacturer's request, multiple tests may be conducted on the same sample in the order as written.

16.1.2 The different pass/fail criteria and the methods used to determine compliance are defined as follows:

a) No Leakage = No evidence (visual exam or measured value) of fluid escaping the safety can body or closures;

b) Minor Leakage = ≤ 4 drops per min averaged over a 5 min period; and

c) No Rupture = No failure of the safety can body, joints, or closures that will result in major leakage.

16.1.3 The preferred method to determine the pass/fail criteria by visual exam is testing with liquid, so minor leakage drops can be measured. Alternatively, air pressure may be used, where either a soap solution or water bath can be used to determine no leakage, but not minor leakage.

16.1.4 Prior to conducting the Pressure Test sequence as per 16.2 – 16.5, nonmetallic cans shall be preconditioned for 12 h at 65 °C to simulate the effects of mold stress relaxation.

16.2 Pressure relief test

16.2.1 When slowly pressurized, the safety can pressure relief device shall open within a 3.0 to 5.0 psig (20.7 to 34.5 kPa) range and then reset when the pressure is relieved. The relief device, spout lid and nozzle valve are then permitted to be disabled or blocked as needed for additional testing in accordance with 16.3 and 16.4.

16.3 Leakage test

16.3.1 The safety can, when filled with water and positioned upside-down for 5 min, shall have only minor leakage from the spout, nozzle or other can closures. The safety can and closures, with the relief device, spout lid and nozzle valve disabled or blocked, shall not leak while at 5.0 psig (34.5 kPa) for 1 min in the intended upright position.

16.4 Hydrostatic strength test

16.4.1 The safety can, excluding closures, relief device, and valve seats, shall not rupture while at 25.0 psig (172.5 kPa) for 1 min.

16.5 Vacuum test

16.5.1 The safety can, including all closures, relief device and valve seats, shall not leak after a -3.54 psig (-24 kPa) vacuum is applied for at least 1 min.

Note: These are the pressure variations used in environmental testing and found to be representative of in service pressure variation.

17 Use And Abuse Tests

17.1 General

17.1.1 All tests in this section shall be conducted on a single sample for each temperature as applicable in the order as written. The method described in 16.3, Leakage test, shall be used to determine whether a sample exhibits no leakage or minor leakage, but only at room temperature.

17.1.2 Prior to conducting the Use And Abuse Test sequence as per 17.2 – 17.7, nonmetallic safety cans shall be preconditioned for 12 h at 65 °C to simulate the effects of mold stress relaxation.

17.2 Smooth pour and valve actuation

17.2.1 During any of the Section 17, Use and Abuse Tests, the required smooth spill-free safety can pour operations per 6.7, proper valve open/close actuation per 6.8 and flow rate of at least 1.5 US gal/min (5.7 L/min) shall be verified by the following test sequence:

a) Fill the safety can (maximum size in manufacturers' product family) to the rated capacity and pour the liquid into a nominal 1.0 US gal (3.8 L) bucket with a 6 – 8 in (15.24 – 20.32 cm) diameter top. With the safety can spout or nozzle at 1.0 – 1.2 ft (0.3 – 0.36 m) above the bucket, fill the bucket to approximately 3/4 capacity in 40 ±5 s in a slow transition from the stationary, vertical store position. The pour operation shall demonstrate uninhibited full opening and closing of valves and there shall be no spills.

b) Repeat (a) with the safety can filled to approximately 50 % rated capacity, pouring for 10 ±1 s or until the safety can is empty. Calculate the flow rate by measuring the 1.0 gal (3.8 L) bucket weight before and after this pour operation, converting the weight difference to a volume and dividing by the time poured. There shall be no spills and the flow rate shall be 1.5 US gal/min (5.7 L/min) or greater.

17.3 Stability test

17.3.1 The safety can, with all included accessories attached, shall not tip over when placed on a 30 ±0.5° incline at room temperature only. The test shall be conducted in the most unfavorable position for the specific safety can design, both when it is empty and then after filling to its rated capacity.

17.4 Strength test for handles, spouts and valves

17.4.1 A test force, of 2X the filled safety can weight shall be applied to the different parts identified in 17.4.2 to 17.4.4 for 1 min without any damage or leakage. The safety can shall be fixed in place to prevent lifting or moving during the force application.

17.4.2 For carrying handles, the pull force shall be applied to a 1.0 in (25.4 mm) center area of the handle grip with a strap parallel to the vertical axis of the safety can. The handle/can connection shall not crack, loosen or detach.

17.4.3 For pouring nozzles, the safety can shall then be loaded vertically by a cord loop around the end of the nozzle for 1 min. There shall be no leakage through the nozzle valve, and if the nozzle remains attached, through any part of the nozzle, except the opening.

17.4.4 For hand triggers or other valve actuating parts, 2X the force needed to initially open the valve (push, pull, twist, etc.) shall be applied by simulated hand action in the intended way to open the valve for 1 min. There shall be no leakage from the valve.

17.5 Drop test

17.5.1 The safety can, valves and closures shall operate as intended, and have no leakage from the safety can and only minor leakage from the valve or closure after being dropped 3 times (bottom, corner and sidewall) onto a concrete surface from 3.0 ft (914 mm). Each test shall be conducted at room temperature for metal safety cans, and high and low temperatures (refer to 15.2) for nonmetallic safety cans, with the can filled to rated capacity. The drop distance shall be measured from the intended impact point to the test surface. Momentary valve opening during the drop is acceptable. Any safety device intended to be fixed, such as an FMD, shall not dislodge during these tests.

17.6 Impact test

17.6.1 The safety can, valves and closures shall operate as intended, and have no leakage from the can and only minor leakage from the valve or closure after being subjected to 5.0 ft·lbf (6.8 J) impacts on the safety can sidewall and seams, and top or side of each spout closure. Each test shall be conducted at room temperature for metal safety cans, and high and low temperatures (refer to 15.2) for nonmetallic safety cans, with the safety can filled to rated capacity. The impacts shall be conducted with a 2.0 in x 1.18 lbm (50.8 mm x 0.535 kg) diameter steel ball at a 4.237 ft (1.291 m) height. A drop tube or swing pendulum may be used to impact the target area. Momentary valve opening during the impact is acceptable. Any safety device intended to be fixed, such as an FMD, shall not dislodge during these tests.

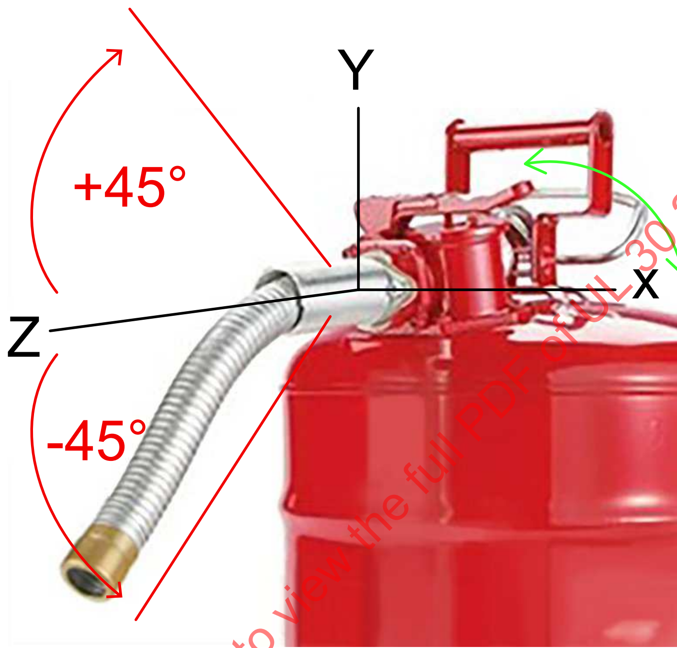
17.7 Endurance test

17.7.1 All components of the safety can that are intended to be operated or otherwise moved, such as flexible nozzles and closure valves, shall not malfunction, break or leak after being subjected to endurance cycling at a rate of 4 to 8 cycles/min. Each test shall be conducted at room temperature for metal safety cans, and high and low temperatures (refer to 15.2) for nonmetallic safety cans, and the safety can shall be fixed to prevent movement during cycling.

17.7.2 For flexible nozzles, 2500 cycles of bending through a 45 ±0.5° arc in a single plane above and below the straight position perpendicular to the safety can connection point. See Figure 17.1.

Figure 17.1

Endurance Test Bending



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17.7.3 For closure valves, 10,000 cycles of opening/closing the valve through the full range of the actuation linkage. Minor leakage from the valve gasket is permitted.

18 Flame Mitigation Device Effectiveness

18.1 General

18.1.1 This section applies to general-use safety cans or safety cans intended for use with hydrocarbon and alcohol-based flammable liquids.

18.2 FMD performance requirement

18.2.1 Each opening, when tested, shall not allow a flame to propagate into, and ignite the headspace within, the safety can. For safety cans with removeable nozzles the tests shall be performed with and without the nozzle. The safety can with the highest rated capacity in a family of similar design and construction may be used to validate all of the safety cans in the family.

18.3 Preparation for testing

18.3.1 This section only applies to safety cans with permanently installed FMDs. These safety cans shall be pre-conditioned by: filling the safety can such that approximately 50 % of the length of the FMD in the filling opening is immersed in each of the specified test liquid; then storing the safety can at 40 ±2 °C (104 ±4 °F) for a minimum of 60 days; and shaking the safety can four days per week, once per day, such that the liquid will contact the FMD.

Specified Liquids are:

a) CE25a and CE85a where the numbers indicate the percentage by volume mixture; and

b) Ethanol

where:

C = ASTM D 471 Reference Fuel “C” (50/50 mix of iso-octane and toluene)

E = Ethanol per SAE J1681 App E

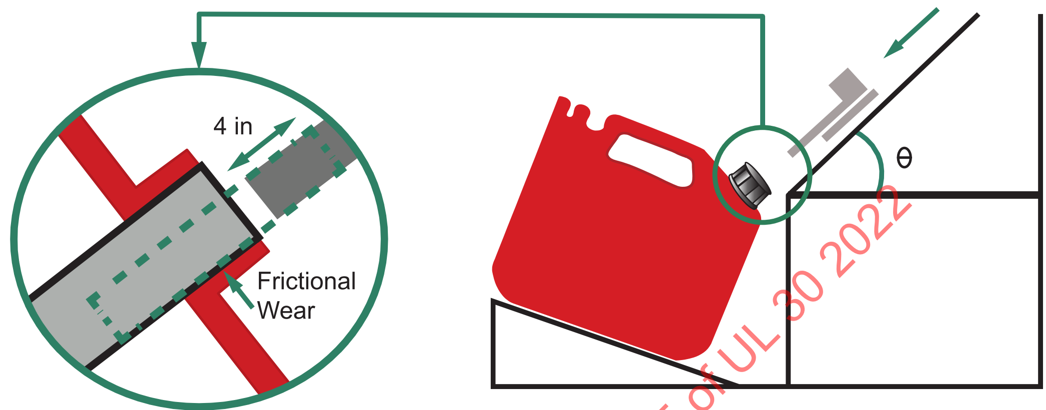
a = Aggressive components in aggressive alcohols per SAE J1681 App E

18.3.2 The safety can shall be capable of being filled to rated capacity at a pouring in rate of 9 US gpm (34.2 L/min) or greater.

18.3.3 The mechanical durability of the FMD shall be verified by allowing a commercial-type fuel dispensing nozzle [1-1/8 in (29 mm) in diameter, weighing 2.91 lb (1320 g) and approximately 7 in (18 cm) in length] positioned on a surface inclined at an angle of 45° to the horizontal, to slide into the filling opening of a safety can, which is also mounted on an inclined surface oriented perpendicular to the nozzle, 50 consecutive times. Figure 18.1 is an illustrative example of the apparatus setup for this. This procedure simulates the mechanical wear due to friction between nozzle and the FMD protecting the filling opening.

Figure 18.1

Friction Wear Test Apparatus



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18.3.4 Removable FMDs shall be removed and replaced, in accordance with the instructions provided in accordance with 27.1, at least once during the durability test of 18.3.3.

18.4 Generic FMD verification method

18.4.1 General

18.4.1.1 The test procedure in 18.4.3 – 18.4.7 shall be followed; per 18.4.7, a safety can shall pass this test if no internal explosions are detected in five consecutive tests.

18.4.2 Test apparatus

18.4.2.1 Rigidly mount the safety can with the spout or other opening under test oriented at a downward angle of 45° ±2° from horizontal. Ensure that at least the last 3 in (7.5 cm) of any flexible spout is straight. Penetrate the safety can with a fitting sealed to the safety can wall, so as to allow the controlled inflow of premixed air and gas. Protect the gas inlet with a restricted orifice or mesh opening sufficient to prevent the flashback of premixed gases back into the supply line.

NOTE: A muffler with 40 μm mesh openings has been found to be sufficient for this purpose.

18.4.2.2 To mitigate potential hazards due to explosions, install internal explosion burst vent(s) with total opening area in inches (square centimeters) equal to or greater than the safety can test volume in US gal (liters) multiplied by 25.6 (15) in the walls of the safety can.

NOTE: A single layer of aluminum foil tape of 0.0036 in (0.091 mm) nominal thickness covering the opening has been shown to be a sufficient burst vent.

18.4.2.3 Also, to mitigate the potential hazards due to an explosion, it is permissible to reduce the volume of the safety can. Do not interfere with the safety performance of the safety can, such as by making modifications that impact the spout, opening, or FMD under test.

NOTE: It is recommended to reduce the total internal volume of the test safety can to no greater than 1.0 US gal (3.8 L). A recommended best practice to reduce the safety can volume is to remove the bottom section of the safety can and attach a sealed plate thereby reducing the total internal volume.

18.4.2.4 Supply:

a) Compressed air with an inline dryer; and

b) Compressed ethane gas with a purity of at least 99.5 %;

with flow regulation and control devices capable of meeting the flow rate requirements of 18.4.3.

18.4.2.5 Install an inline valve capable of rapid cutoff of the flow of air and ethane mixture, such as a solenoid valve.

NOTE: An electronic solenoid or manual valve are sufficient for this purpose.

18.4.2.6 Verify that all connections and pressure vents are sealed, such that air and ethane only escape from the spout opening under test.

18.4.2.7 For Type II safety cans, test each opening separately, leaving the untested opening shut.

18.4.3 Gas flow rate calculation

18.4.3.1 Find the cross-sectional open area of the spout opening under test (A_{open}), disregarding the impact of any internal FMD components.

18.4.3.2 Calculate the total volumetric flow rate of air and ethane (V_{total}) as:

$$V_{\text{total}} = 1.125 \times A_{\text{open}} \times S_{\text{L}}$$

Where the laminar burning velocity (S_L) of ethane gas is 18.5 in/s (47 cm/s).

18.4.3.3 Determine the ethane gas flow rate (V_{ethane}) using a mixture fraction of 1.06 ±0.06 to the stoichiometric ratio. This corresponds to an ethane flow rate range of 5.64 % to 6.27 % by volume.

$$V_{\text{ethane}} \geq 0.0564 \times V_{\text{total}}$$

$$V_{\text{ethane}} \leq 0.0627 \times V_{\text{total}}$$

18.4.3.4 Calculate the air flow rate (V_{air}) as the balance of the total flow rate.

$$V_{\text{air}} = V_{\text{total}} - V_{\text{ethane}}$$

18.4.4 External flame source

18.4.4.1 Provide an external diffusion pilot flame 2 in (5 cm) below the inverted spout opening. Connect a metal tubular fuel line directly to the ethane gas supply (not the air and ethane mixture) with a flow control valve, such as a needle valve, to adjust the flame height to just contact the open spout. Provide a means of remotely igniting the external flame using an electronic spark or other means.

18.4.5 Procedure

18.4.5.1 Flow a mixture of ethane and air as calculated in 18.4.3 through the entire test vessel for a minimum of 4 total volume changes, based on the total volume of the safety can under test and as modified, if applicable.

NOTE: It is permissible to increase the flow rate prior to ignition testing to ensure that the volume is sufficiently filled with the proper mixture. Do not alter the ratio of ethane to air when increasing the total flow rate. Reduce the flow rate back to the values calculated in 18.4.3 before igniting any external flame or spark.

18.4.5.2 Flow ethane gas for the external flame source, and ignite the external ignition source. Maintain the external flame for a duration of 30 s. Then shut off the flow of air and ethane using the inline valve after 30 s, or if internal ignition occurs.

18.4.6 Determine explosion in trial

18.4.6.1 Use a high-speed pressure rise measurement, to determine if an explosion occurred in the safety can headspace.

NOTE: A pressure rise of more than 5 psi (35 kPa) captured every 0.01 s or less indicates an explosion has occurred.

18.4.6.2 It is permissible to determine that a safety can has failed this trial, based on another indicator of ignition, such as internal temperature rise, sound, or visual observation, but do not deem the trial a pass without confirmation from the high-speed pressure rise measurement.

18.4.6.3 If at any time, after the external diffusion pilot flame is ignited, the high-speed pressure rise indicates an ignition, deem the trial a failure.

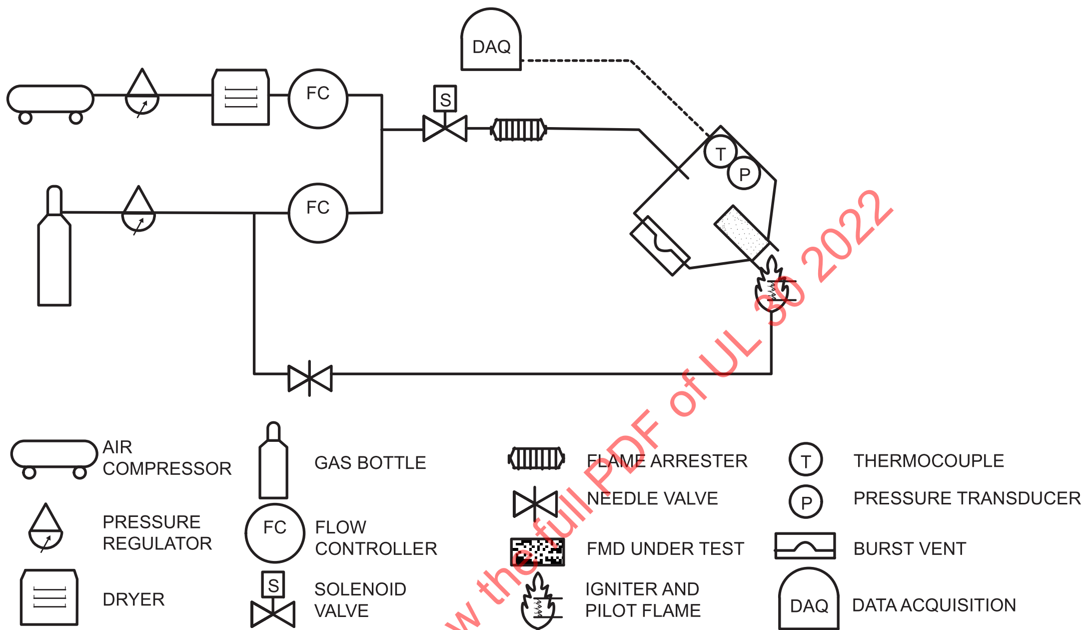
18.4.6.4 If no internal explosion is detected, the trial result shall be deemed a pass.

18.4.7 Trials

18.4.7.1 Repeat 18.4.5 and 18.4.6 so that five consecutive trials are performed.

Figure 18.2

Example Set Up Using Compressed Air, and Ethane Gas from a Bottle, a Data Acquisition System, a Thermocouple, a Pressure Transducer, a Solenoid Valve, and a Needle Valve, to Test a Safety Can Without a Spout



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18.5 Permanently installed FMD

18.5.1 General

18.5.1.1 A permanently installed FMD shall resist efforts to remove it without the use of tools as demonstrated in the following tests. The safety can may be modified as required to facilitate the test without affecting the FMD installation.

18.5.2 Push in test

18.5.2.1 The safety can shall be restrained while the FMD is subjected to an inward or pushing force of 15 lbf (67 N) applied to the FMD.

18.5.3 Pull out test

18.5.3.1 The safety can shall be restrained while the FMD is subjected to an outward or pulling force of 15 lbf (67 N) applied with a clamping fixture on the lip or other protrusion or gap in the FMD mounting. It is also acceptable to apply the force to the outside of the bottom of the FMD.

18.5.4 Expanded metal mesh

18.5.4.1 A safety can equipped with EMM shall:

a) Provide adequate clearance around internal components of the safety can.

b) Permit insertion and removal of spouts, screens, or other accessories, in conformance with the manufacturer's instructions.

c) Exhibit characteristics, determined in accordance with NFPA 69, Chapter 14, as follows:

1) Occupied percentage volume of the safety can;

2) Metal alloy composition and the composition and thickness of any coating;

3) Surface-area-to-volume-ratio for alkane/air mixtures or other flammable gases or vapors, as applicable; and

4) Pore size distribution which is smaller than the quenching distance for the gas or vapor, as applicable.

18.6 Flame arrester exception

18.6.1 Flame arrestors that pass the test in 18.7 and meet the following criteria shall not be required to pass 18.4:

a) Each opening is protected by a flame arrester that is constructed with perforated sheet or wire mesh of brass, or stainless steel, or of equivalent corrosion-resistant metal.

b) Each flame arrestor is removable and suitable instructions for inspection and maintenance shall be provided per 27.1.

18.7 Flame arrester verification tests

18.7.1 General

18.7.1.1 Install each type and size of flame arrester in a flashback test rig in accordance with 18.7.2. When tested in accordance with 18.7.4, each flame arrester shall prevent ignition in 5 consecutive trials.

18.7.2 Flashback test rig

18.7.2.1 The flashback test rig (see Figure 18.3 for the recommended design) consists of common schedule 40 threaded steel pipe and fittings arranged to house the flame arrester, to create vapor spaces above and below it, and a minimum 1.25 in (31.8 mm) diameter side port pipe below the flame arrester for attachment of the indicator bag. Size the pipe to provide at least a 0.0625 in (1.6 mm) minimum gap between the inside wall and the edge of the flame arrester. Include a seat to simulate how the flame arrester is positioned in the safety can opening or spout as part of the test rig. Wrap a 0.001 to 0.002 in (0.025 to 0.051 mm) thick clear plastic indicator bag (such as a sandwich bag) around the side pipe with the open end sealed to the side port with a rubber band so that the plastic indicator bag can expand and burst with deflagration indicating a test failure during the test procedure described in 18.7.3.

18.7.3 Flashback test rig verification

18.7.3.1 Prepare an intended-to-fail sample of the flame arrester test specimens prepared by drilling a 0.0625 in (1.6 mm) hole through it. Seat the intended-to-fail sample in the test rig. Flow an air and ethane mixture through the test rig from bottom to top. Ignite the air ethane mixture and adjust the air and ethane such that a blue flame with an average height of 7.5 ±1.5 in (191 ±38 mm) tall is burning, a small amount of red or orange flame is permissible. See Figure 18.4 and Figure 18.5 for correct and incorrect flame. Allow the flame to burn for approximately 1 min. Shut the mixture off quickly to permit the flame to backflow through the test rig and demonstrate that failure of the flame arrester causes the indicator bag to expand, burst or release. If the indicator bag does not expand, burst or release, adjust the air and ethane and repeat until the indicator bag expands, bursts or releases. (see Figure 18.6).

18.7.4 Flame arrester

18.7.4.1 Install the flame arrester test specimen (without the drilled hole) in the test rig. Flow air and ethane at the rates found in 18.7.3. Ignite the air and ethane mixture and allow to burn for approximately 1 min. Shut the mixture off quickly to permit the flame to backflow through the test rig. Repeat consecutively 4 more times with the same flame arrester, allowing the test rig and flame arrester to cool to 38 °C (100 °F) or less between each test. The flame arrester test specimen passes if the indicator bag does not expand, burst or release in 5 tests.

Figure 18.3

Recommended Test Rig

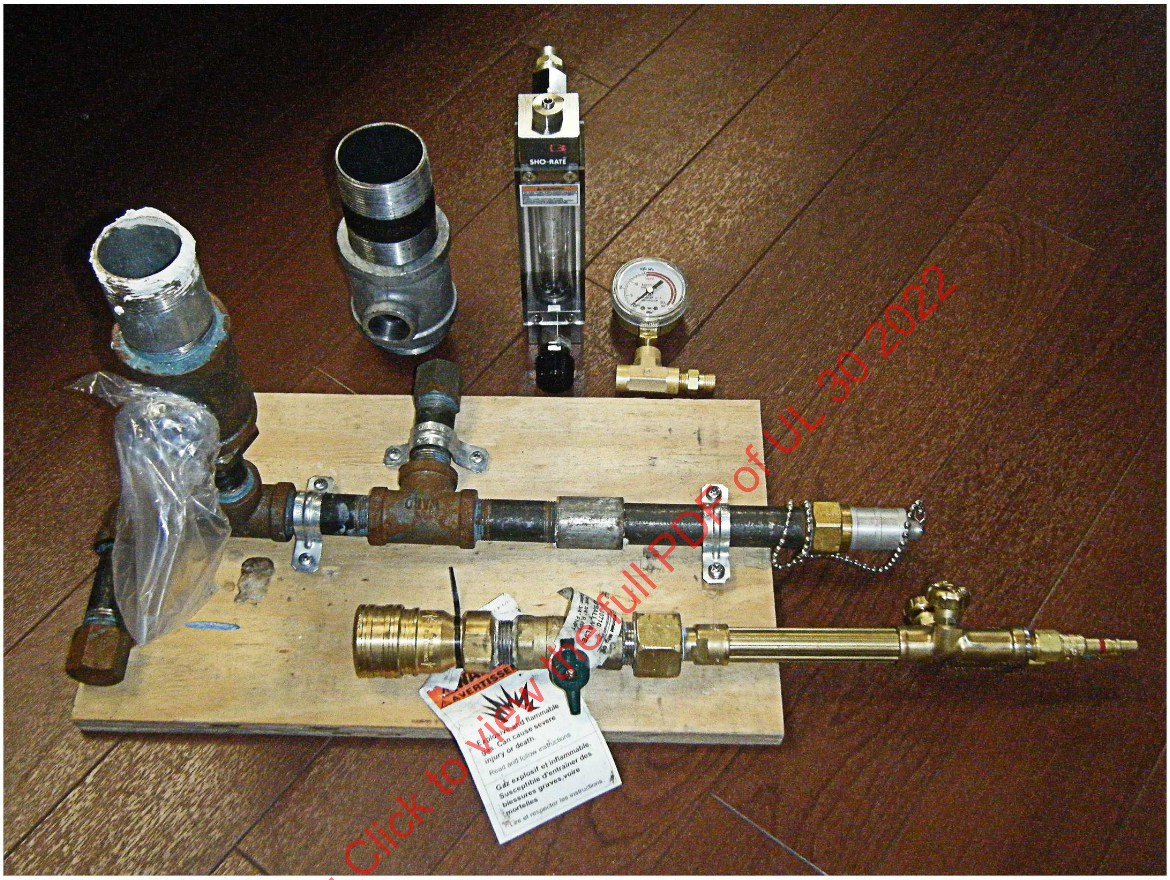

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Figure 18.4

Example of Correct Stoichiometric Flame

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Figure 18.5

Example of Incorrect Stoichiometric Flame

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