UL 900

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Air Filter Units

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety for Air Filter Units, UL 900

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Revisions: This Standard contains revisions through and including October 4, 1999.

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The revisions dated October 4, 1999 include a reprinted title page (page1) for this Standard.

The revisions dated October 4, 1999 were issued for editorial corrections. These corrections include any combination of the following: Updated Foreword (item D); Updated Scope; title changes to UL 489 and/or UL 1950; Withdrawn standards, UL 519 and UL 547, being replaced by UL 2111; Removal of the ″94″ flammability classification. These revisions may also include other miscellaneous editorial corrections.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a ″SUPERSEDED REQUIREMENTS″ notice.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this Standard including those requirements with a specified future effective date, unless the applicant specifically requests that the product be judged under the current requirements. However, if

the applicant elects this option, it should be noted that compliance with all the requirements in this Standard will be required as a condition of continued Listing and Follow-Up Services after the effective date, and understanding of this should be signified in writing.

This Standard consists of pages dated as shown in the following checklist:

No Text on This Page

American National Standard

NOVEMBER 28, 1994 **ANSI/UL 900-1995**

(Title Page Reprinted: October 4,1999)

1

UL 900

Standard for Air Filter Units

The First, Second and Third editions were titled ″Air Filter Units.″ The Fourth and Fifth editions were titled ″Test Performance of Air Filter Units.″

First Edition – September, 1965
Second Edition – August, 1971
Third Edition – June, 1975
Fourth Edition – June, 1977
Fifth Edition – January, 1987

Sixth Edition

November 28, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated November 28, 1994 . These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Approved as ANSI B124.1-1971, April 7, 1971
Approved as ANSI/UL 900-1977, April 18, 1977
Approved as ANSI/UL 900-1982, June 28, 1982
Approved as ANSI/UL 900-1987, August 3, 1987
Approved as ANSI/UL 900-1995, September 11, 1995

Revisions of this Standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revised requirements.

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FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover tests to determine combustibility and the amount of smoke generated for air filter units of both washable and throwaway types used for removal of dust and other airborne particles from air circulated mechanically in equipment and systems installed in accordance with the Standards for Installation of Air Conditioning and Ventilating Systems, NFPA 90A (Other Than Residence Type), and for Installation of Warm Air Heating and Air Conditioning Systems, NFPA 90B (Residence Type).

1.2 Since the combustibility and smoke generation of an air filter unit, after a period of service, will depend upon the nature and quantity of the material collected by the filter, the test requirements of this standard, for classification purposes, apply only to air filter units in a clean condition. Consequently, when filters are susceptible to the accumulation of combustible deposits, it is intended that maintenance and inspection practices should be followed as proposed in Appendix B of NFPA 90A.

1.3 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements to determine that the level of safety as originally anticipated by the intent of this standard is maintained. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard shall not be judged to comply with this standard. Where appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.3 revised October 4, 1999

2 Classifications

2.1 Air filter units covered by this standard are classified as follows:

a) Class 1 Units – Those that, when clean, do not contribute fuel when attacked by flame and emit only negligible amounts of smoke.

b) Class 2 Units – Those that, when clean, burn moderately when attacked by flame or emit moderate amounts of smoke, or both.

3 General

3.1 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

3.2 Air filter units shall not contain unbonded asbestos fiber materials.

PERFORMANCE

4 Performance Requirements

4.1 A Class 1 air filter unit shall not produce flame or sparks when subjected to the Flame-Exposure Test, Section 5. During the flame-exposure test, the Class 1 air filter unit shall not cause the development of an area of more than 16.1 cm^2(2-1/2 square inches) as measured below the smoke-density time curve.

4.1 revised April 5, 1996

4.1.1 When tested as specified in Section 6, Spot-Flame Test, the upstream face of a Class 1 filter shall not continue to flame after removal of the test flame.

6.1 revised and relocated as 4.1.1 April 5, 1996

4.2 Revised and relocated as 6.1.1 April 5, 1996

4.3 A Class 2 air filter unit shall not produce flame or extensive (25 or more) sparks which are sustained beyond the discharge end of the test duct when subjected to the flame-exposure test and shall not cause the development of an area of more than 58 cm^2 (9 square inches) as measured below the smoke-density time curve.

4.4 An adhesive material used for coating the filtering medium or other part of an air filter unit shall have a flash point of not less than 163°C (325°F) as determined by the the Test Method for Flash and Fire Points by Cleveland Open Cup, ASTM D92-1990.

5 Flame-Exposure Test

5.1 The flame-exposure test apparatus is to consist of an air duct provided with means for supporting a sample air filter unit and to expose the air filter unit to an igniting flame under controlled conditions of air velocity. The apparatus is to provide means for observation of the sample filter while under test and to measure and observe the production of flame, sparks, and smoke resulting from the application of the flame.

5.2 The general arrangement of the test apparatus is illustrated in Figure 5.1.

5.2.1 The test apparatus is to be located in an environmentally controlled test room so as not to be adversely affected by wind, heat, cold, or other environmental factors. The air is to be drawn from the room in which the air filter unit is installed and discharged into the test room. The minimum distance from the end of the duct to any obstruction is to be 0.91 m (3 feet). An exhaust hood is to be located at the discharge end of the test apparatus and maintained so that the test apparatus discharge air velocity with the exhaust system on does not exceed the test apparatus discharge air velocity with the exhaust system off.

5.2.1 added April 5, 1996

5.2.2 The temperature of the room is to be in the range of 15°C and 32°C (60°F and 90°F) with a relative humidity of less than 65 percent at the beginning of the flame exposure test.

5.2.2 added April 5, 1996

5.2.3 The minimum time between test exposures during the flame exposure test is to be 5 minutes.

5.2.3 added April 5, 1996

5.3 The duct is to be constructed of steel with a minimum thickness of 1.6 mm (1/16 inch). The duct section is to be 533 by 533 mm (21 by 21 inches) to accommodate filters having nominal face dimensions of 500 by 500 mm (20 by 20 inches). If filters of other dimensions up to a nominal 600 by 600 mm (24 by 24 inches) are to be tested, an adapter section is to be inserted at the proper location. The length of any such adapter section is to be sufficient to accommodate the depth of the filter under test. The length of the discharge end of the duct is to be 2.4 m (8 feet) ±0.1 m (4 inches) measured from the downstream face of the filter to the discharge end of the duct. The duct is not to be insulated and all joints are to be gasketed to prevent leakage.

5.3 revised April 5, 1996

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5.4 There is to be a distance of 1.8 m (71 inches) from the upstream face of a filter, as installed in the apparatus, and the discharge end of a fan scroll or transition piece connected to the duct. The upstream duct section is to be equipped with means for assuring a uniformly distributed air flow in the duct immediately ahead of the filter location.

5.4 revised April 5, 1996

5.5 The apparatus is to include a blower capable of overcoming the resistance to flow offered by the filter under test and the duct system. The means for controlling the discharge from the blower is not to include dampers or orificing devices placed on the discharge side of the blower.

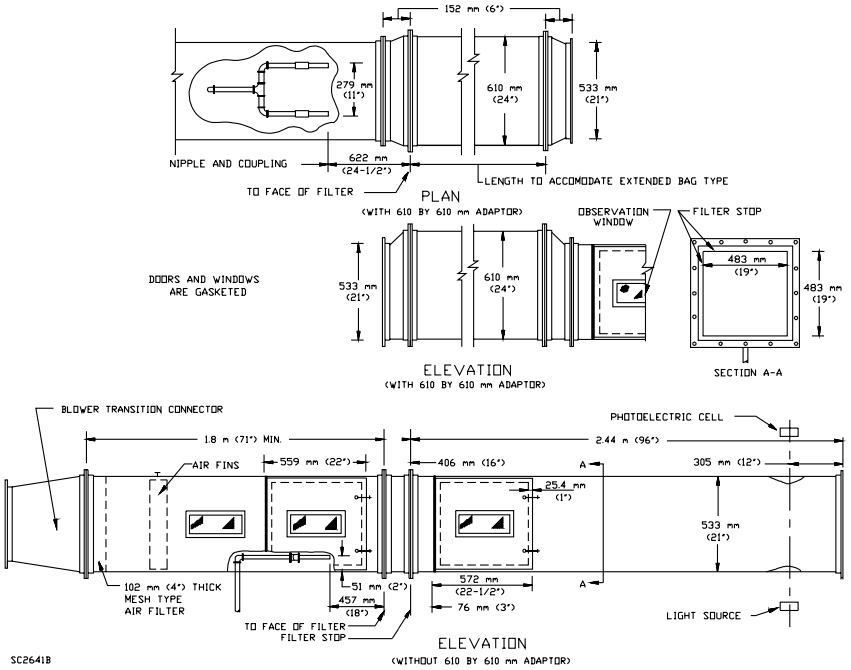
5.6 The means for mounting and securing the frame of an air filter is to be rigid and of a nature providing for a reasonably tight seal to prevent bypassing of the air stream around the filtering media. Flanges or other devices are not to project beyond the inside dimensions of the filter frame or to cover the upstream or downstream faces of the frame to an extent which would materially disturb the uniformly distributed air flow or which would insulate more than 50 percent of any combustible frame material from exposure to the igniting flame.

5.7 Access doors and observation windows are to be provided in the duct sidewall to facilitate the insertion and mounting of a filter for test and the observance of the ignition flame and its effects on both faces of the filtering media. The doors and windows are to be gasketed, and the doors are to be insulated.

5.7 revised April 5, 1996

Figure 5.1
Flame exposure test apparatus

Figure 5.1 revised April 5, 1996



5.8 The igniting flame is to be that resulting from the burning of unpremixed natural gas discharged at low velocity into the air stream at a rate liberating 70.3 kW (4000 Btu per minute) ±5 percent. The gas-burner nozzles are to consist of two malleable-iron pipe elbows or couplings, 1 inch USA Pipe Size, ANSI/ASME B36.10 M-1985, Welded and Seamless Wrought Steel Pipe, the outlets of which are to be located 457 mm (18 inches) upstream from the face of a nominal 500 by 500 mm (20 by 20 inch) filter and 622 mm (24-1/2 inches) upstream from the face of a nominal 600 by 600 mm (24 by 24 inch) filter. The nozzles are to be arranged to discharge gas downstream parallel to the flow of air. The gas nozzles are to be connected, using nipples to a tee located on the center line of the duct. The tee is to be connected through a control valve to the source of gas. The two nozzles are to be spaced 279 mm (11 inches) apart, as measured between their center lines, and are to be positioned 51 mm (2 inches) above the bottom of the test duct as measured to their center lines. The vertical position of each nozzle above the floor of the test duct may be varied as much as 25.4 mm (1 inch) to provide for two patterns of flame impingement on the test filter.

5.8 revised April 5, 1996

5.9 A flowmeter is to be employed to measure the gas input to the igniting flame.

5.10 Gas pilots are to be limited to an input of 2 percent or less of the input to the main-burner nozzles.

5.11 A means for measuring the relative amount of smoke developed by the application of the igniting flame to the air filter under test is to be mounted on the test duct. This apparatus is to consist of a photoelectric cell mounted above a 114 mm (4-1/2 inch) diameter hole cut in the top of the duct on the duct center line and 305 mm (12 inches) upstream from the discharge end. A light source, stabilized for constant light intensity, is to be mounted below the bottom of the test duct. A hole, 114 mm (4-1/2 inches) in diameter, is to be cut in the bottom of the duct so as to line up with the hole in the top of the duct for the photoelectric cell[a].

[a]Components found acceptable for this purpose are a Weston Instruments No. 856BB photronic cell and a 12 volt sealed beam, clear lens, auto spot lamp, with an overall light-to-cell path length of 914 ±51 mm (36 ±2 inches).

5.12 Means for adjusting voltage impressed on the light source and for reading or recording the microamperes developed by the photocell are to be furnished.

5.13 A means is to be provided for calibration of the smoke density apparatus. Such means shall be equivalent to the placing of Wratten gelatin air filters of known light obscuration over the face of the photocell after adjusting the output of the light source to develop 400 microamperes. See 5.25 and 5.28. If the microampere readings taken with the gelatin filter(s) in place differ from those initially established as the base output measurements, corrections shall be made in plotting the smoke density curve.

5.14 Some smoke and gases developed in the test duct will tend to discharge through the holes in the duct and impinge on the photocell and light source. To minimize the effects of such contamination, a provision for discharging a small stream of air across the openings is to be made. The air streams are to be just sufficient to dissipate the external effects of the smoke and gases.

5.15 Each style, type, or configuration of an air filter unit is to be considered separately for classification based on the flame-exposure test.

5.16 Samples are to be clean, unused filters selected on the basis of 5.17, and are to be subjected to a minimum of 2 hours of conditioning in the test room.

5.16 revised April 5, 1996

5.17 For the purposes of these requirements, filters are categorized into two types:

a) Panel type filters are characterized by their flat, shallow assemblies in which the velocity of the air stream in the duct approaches the velocity through the filter media. For filters of this type, the face size of the samples is to be a nominal 500 by 50 mm (20 by 20 inches) or a nominal 600 by 600 mm (24 by 24 inches). Five samples having the maximum thickness in which the model or style is to be made are to be subjected to this test. If a particular model or style is made in more than one thickness, an additional three samples having the minimum thickness dimension are also to be subjected to this test.

b) Extended surface filters are characterized by pleated or pocket configurations of the media wherein the approach velocity of the air stream in the duct at the vertical plane of the filter face is substantially greater than the velocity through the filter media. Five samples having a face size of a nominal 500 by 500 mm (20 by 20 inches) are to be subjected to this test. The samples are to have the largest amount of media per rated air flow present in the model or style to be covered. The depth or number of pleats or pockets may be reduced to provide the approximate amount of media representative of the test flow rate to which it will be subjected [17.3 m^3/min. (612 ft^3/minute) for a nominal 500 by 500 mm (20 by 20 inches) unit and 24.9 m^3/min. (880 ft^3/minute) for a nominal 600 by 600 mm (24 by 24 inches) unit.] See 5.24.

5.17 revised April 5, 1996

5.18 For air filter units manufactured in sizes smaller than a nominal 500 by 500 mm (20 by 20 inches), multiple samples of the filters are to be assembled in a metal adapter plate such that the total face area of the combined filters is a minimum of 2000 cm^2 (310 in^2).

5.18 revised April 5, 1996

5.19 A sample is to be mounted in the test duct to effectively seal the cross-sectional area of the duct. An adapter may be inserted for this purpose. Any clips, wedges, or other securing means are to be of metal. No combustible tapes or cements are to be employed.

5.20 A test filter is to be used as-received, except that a sample of a type intended to be recoated in the field is to be totally immersed in the adhesive coating prepared in accordance with the manufacturer's directions, and allowed to drain when mounted in a vertical position for 24 hours before testing.

5.21 Extended filtering media is to be internally supported by metal ribs or wire when the air velocity employed for the test is insufficient to support the media in its expanded position.

5.21 revised April 5, 1996

5.22 Gas pilots or other lighting means are to be readied for effective and prompt ignition of the main burners.

5.23 The air velocity in the test duct is to be determined by averaging velocities measured at the discharge end of the 533 mm (21 inch) square test duct. At least nine velocity measurements are to be taken, one at the center of each square area formed by dividing the area of the test duct into nine equal parts. Adjustments for establishing an average air velocity are to be made prior to the ignition of any main igniting flames, with the test air filter in place, and at nominal ambient temperatures.

5.24 The test air flow is to be adjusted (by restricting the blower inlet) so that the average approach velocity in the duct at the face of the filter is 1.12 m/s (220 feet per minute), 17.3 m^3/min. (612 cubic feet per minute), for a nominal 500 by 500 mm (20 by 20 inches) filter and 24.9 m^3/min. (880 cubic feet per minute) for a nominal 600 by 600 mm (24 by 24 inches) filter. This is to be accomplished by adjusting the flow so that the average discharge velocity, as measured in meters per second at the discharge end of the 530 by 530 mm (21 by 21 inches) duct, is 1 m/s (3.3 ft/sec) for a nominal 500 by 500 mm (20 by 20 inch) filter and 1.4 m/s (4.6 ft/sec) for a nominal 600 by 600 mm (24 by 24 inch) filter.

5.24 revised April 5, 1996

5.25 The light source of the smoke-density apparatus is to be adjusted to develop a photocell output of 400 microamperes following the necessary calibration test described in 5.13.

5.26 The main gas flame is to be ignited and adjusted to the required input. The ignition apparatus is to be constructed such that it does not affect the shape of the flame.

5.26 revised April 5, 1996

5.27 Duration of the test or firing period is to be 3 minutes. The following observations are to be made and recorded:

a) Condition of both faces of the air filter and its components;

b) The density, duration, and character of the products of combustion in the downstream section of the test duct; and

c) The extent of travel of any flame or sparks within and beyond the end of the duct.

5.28 Microampere readings are to be observed and recorded at least every 5 seconds during the first minute and every 10 seconds during the subsequent time. The readings are to be plotted against the time recorded, using a graph paper having vertical and horizontal scales of 40 microamperes and 40 seconds per 25 mm (1 inch), respectively. A smoke-density curve versus time is to be developed from the plotted data, and the area in m^2/1550 (square inches) under the curve is to be measured by a planimeter. As an alternate, the area under the curve may be calculated mathematically without plotting, or may be measured by an electronic smoke integrator. The area thus developed is to be represented as a measure of smoke developed during the test.

5.29 A spark indicator, as described in 5.30 and 5.31, may be used, if required, for a Class 2 air filter unit to determine if the number of sparks sustained beyond the end of the test duct exceed the 25 spark limit for Class 2 units.

5.30 If the number of sparks produced is undetermined following the flame-exposure test on the first Class 2 filter sample, the remaining samples are to be tested with the downstream outlet of the test duct covered with a spark indicator consisting of one layer of cheesecloth.

5.31 The cloth is to be bleached cheesecloth 914 mm (36 inches) wide, running 28 – 30 m/kg (14 – 15 yards per pound-mass), and having what is known in the trade as a ″count of 32 x 38″, that is, for any 25 by 25 mm (1 by 1 inch) square, 32 threads in one direction and 38 threads in the other direction.

6 Spot-Flame Test

6.1 Revised and relocated as 4.1.1 April 5, 1996

6.1.1 The spot flame test is to be conducted on Class 1 air filter units and components (frame material, sealants, gaskets, and the like) of filters larger than a nominal 500 by 500 mm (20 by 20 inches) since these components are not directly exposed to the test flames during the flame exposure test in the test duct.

4.2 revised and relocated as 6.1.1 April 5, 1996

6.2 The upstream section of the duct specified in 5.2 is to be equipped with a ring stand and clamps for supporting a Bunsen Burner. The sample (see 5.17) is to be mounted in the test duct and the air flow is to be adjusted to the air flows specified in 5.24. A gas flame from a Bunsen burner is to be directed against the upstream face of the sample. The Bunsen burner is to be adjusted to produce a flame having a blue cone 64 mm (2-1/2 inches) long and a tip temperature of 954 ±27°C (1750 ±50°F), as measured by a thermocouple inserted in the flame. The tip of the blue cone is to be applied so that it touches the surface of the filter medium at a distance of not less than 51 mm (2 inches) from the frame.

6.2 revised April 5, 1996

6.3 The Bunsen burner flame is to be directed into a top corner of the sample so that the tip of the blue cone contacts the frame, filter pack, and sealing materials. The flame is to be applied for 1 minute. The test is to be repeated on the other top corner of the sample and also in a third location which was not directly exposed to the test flames during the flame-exposure test.

6.3 effective July 14, 1995

6.4 Deleted effective July 14, 1995

6.5 Deleted effective July 14, 1995

MARKING

7 General

7.1 Each air filter unit shall be marked with the following:

a) The manufacturer’s or private labeler’s name or identifying symbol;

b) Distinctive model designation or the equivalent; and

c) The Classification of the filter unit (Class 1 or Class 2).

7.2 If a manufacturer produces air filter units at more than one factory, each filter unit shall have a distinctive marking to identify it as the product of a particular factory.

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CANADIAN REQUIREMENTS COMPARISON GUIDE CRG 900

UL AND CANADIAN STANDARDS FOR AIR FILTER UNITS

c UL Underwriters Laboratories Inc.®

Product Category: Air Filters
UL Category Control Number: AJZV

UL Standard:

Standard for Air Filter Units
UL 900
Sixth Edition

Canadian Standard:

Standard Method of Fire Tests for Air Filter Units
ULC-S111 (1995)
Third Edition

This Canadian Requirement Comparison Guide is only intended to identify Canadian requirements that must be applied in addition to the requirements in the UL Standard to obtain a c-UL Mark. The guide is not intended to replace a through review and comparison of the requirements applicable to the product category as contained in the applicable UL and Canadian Standards. Where requirements are not specifically addressed, compliance with the requirements in the UL Standard satisfy the requirements in the Canadian Standard.

The actual requirements applied for a c-UL product investigation may differ from those identified in this guide based on the specific features, characteristics, components, materials, or systems used in the product.

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Issue No.: 1
Issue Date: April 11, 1997

Revisions of this guide will be made by issuing revised or additional pages bearing their date of issue. A Canadian Requirement Comparison Guide is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest set of revision pages for the Guide.

The following outlines the requirements contained in ULC-S111 (1995) that are in addition to the requirements in UL 900 that must be met in order for a product to bear the appropriate UL Marking. UL provides a certification program for products that meet the Canadian requirements. The C-UL Mark is the manufacturers assurance that products as evaluated by UL, continue to comply with the appropriate Canadian requirements.

Requirements Topics	ULC Clause	Comparison
Class 2 Air Filters – Performance Testing	3.1.14	Surgical gauze is to be laid horizontally from the discharge end of the duct and on the same plane as the bottom of the duct.
	5.2	The gauze shall not ignite from sparks or flames discharged from the end of the test duct.
Panel Type Filters – Performance Testing	3.2.3	Five samples having the maximum depth, and the largest amount of media per cubic meter in the particular style being evaluated, are to be tested.
	3.3.7	Panel type filters whose maximum rated capacity does not exceed 0.4 m^3 per second are to be tested such that the average air discharged velocity at the end of the duct is 1.12 m/s.
Extended Surface Filters – Performance Testing	3.3.8	Extended surface filters and high capacity panel filters are to be tested at the nominal (maximum) rated capacity of the filter as measured in meters per second at the discharge end of the duct.
Smoke Micro-ampere Readings	3.3.12	Smoke micro-ampere readings are to be observed at least every second during the Flame Exposure Test.
Spot Flame Test	4.2.3	When conducting the Spot Flame Test, five samples of each component having the maximum thickness are to be exposed to the flame for 60 seconds.

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