UL 674

STANDARD FOR SAFETY

Electric Motors and Generators for Use in Hazardous (Classified) Locations

UL Standard for Safety for Electric Motors and Generators for Use in Hazardous (Classified) Locations, UL 674

Sixth Edition, Dated July 29, 2022

Summary of Topics

This new edition of ANSI/UL 674 dated July 29, 2022 includes the following changes in requirements:

– Revisions for the use of electronic medium for required documentation.

– Revisions to include +60 °C and -60 °C explosion testing with test factors using precompression explosion testing equipment.

– Revisions to remove errors and omissions.

– Revisions to replace the oxygen-bomb aging test with the air-oven aging test.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated July 2, 2021 and January 28, 2022.

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Second Edition

CSA Group
CSA C22.2 No. 145:22
Fourth Edition

Underwriters Laboratories Inc.
UL 674
Sixth Edition

Electric Motors and Generators for Use in Hazardous (Classified) Locations

July 29, 2022

ANSI/UL 674-2022

Commitment for Amendments

This standard is issued jointly by the Association of Standardization and Certification (ANCE), the Canadian Standards Association (operating as “CSA Group”), and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to ANCE, CSA Group, or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of ANCE, CSA Group, and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue. ANCE will incorporate the same revisions into a new edition of the standard bearing the same date of issue as the CSA Group and UL pages.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Sixth Edition. The most recent designation of ANSI/UL 674 as an American National Standard (ANSI) occurred on July 29, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

The Department of Defense (DoD) has adopted UL 674 on November 6, 1987. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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CONTENTS

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Preface

This is the harmonized ANCE, CSA Group, and UL standard for Electric Motors and Generators for Use in Hazardous (Classified) Locations. It is the second edition of NMX-J-652-ANCE, the fourth edition of CSA C22.2 No. 145, and the sixth edition of UL 674. This edition of CSA C22.2 No. 145 supersedes the previous editions published in 1972, 1986 and 2011. This edition of UL 674 supersedes the previous edition published in 2011.

This harmonized standard was prepared by the Association of Standardization and Certification (ANCE), the Canadian Standards Association (CSA), and Underwriters Laboratories Inc. (UL). The efforts and support of the CANENA Technical Harmonization Committee are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Integrated Committee on Hazardous Location Products, under the jurisdiction of the CSA Technical Committee on Industrial Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of harmonization

This standard uses the IEC format but is not based on, nor is it to be considered equivalent to, an IEC standard.

This standard is published as an equivalent standard for ANCE, CSA Group, and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Reasons for differences from IEC

This standard provides requirements for electric motors and generators in accordance with the codes of Canada, Mexico, and the US. At present there is no IEC standard for electric motors and generators for use in accordance with these codes. Therefore, this standard does not employ any IEC standard for base requirements.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

1 Scope

1.1 This standard applies to electric motors and generators or submersible and nonsubmersible sewage pumps and systems suitable for use in Class I, Division 1, Groups B, C and D, and Class II, Division 1, Groups E, F and G, hazardous (classified) locations as defined by CSA C22.1 *Canadian Electrical Code, Part I* (CE Code), the *National Electrical Code*, ANSI/NFPA 70 (NEC), and *NOM-001-SEDE*.

Note: In the US, the application “hazardous locations” is referred to as “hazardous (classified) locations”.

1.2 This standard covers the same type of electrical equipment indicated in 1.1 for installation and use in Class I, Zone 1, Groups IIA and IIB, IIB+H_2, and Zone 20 and 21 hazardous locations.

1.3 This standard also covers other rotating machinery such as, but not limited to, electric brakes, tachometers, encoders, and slip rings.

1.4 This standard does not address types of protection other than explosion-proof or dust-ignition-proof.

1.5 For Canada Only – This standard does not include Canadian energy efficiency or product performance requirements. For such requirements, see Annex A, item 19. It is possible that item 19 is referenced in whole or in part in federal, provincial, territorial, or local laws or regulations relating to energy efficiency or product performance. The appropriate governmental authorities should be consulted to confirm whether item 19 has been referenced in laws or regulations.

Note: This standard also does not include U.S. energy efficiency requirements for electric motors used in hazardous (classified) locations.

2 Conditions for Use

2.1 This standard covers motors and generators intended for use under the conditions specified in 2.2 – 2.6.

2.2 Normal ambient duty conditions are defined by the following:

a) An oxygen concentration not to exceed 21 % by volume.

b) A nominal barometric pressure of 101.4 kPa (14.7 psia) (1 atmosphere).

c) Temperature range of minus 25 °C to +40 °C.

d) Altitude not exceeding 1000 m (3281 ft).

In Canada, the normal ambient temperature is minus 50 °C to +40 °C.

2.3 Low ambient duty conditions are considered to be not less than minus 70 °C.

2.4 Products intended and marked for an ambient of lower than minus 25 °C shall be tested (e.g.: explosion pressure test) at 5 °C below the marked lower temperature.

In Canada, products intended and marked for an ambient of lower than minus 50 °C shall be tested (e.g.: explosion pressure test) at 5 °C below the marked lower temperature.

2.5 High ambient duty conditions are considered to be higher than +40 °C.

2.6 If a motor is rated for use in an ambient higher than +60 °C (+65 °C in Canada), the flame propagation test shall be performed at the marked temperature or greater.

3 Normative References

3.1 Products covered by this standard shall comply with the reference installation codes and standards noted in Annex A as appropriate for the country where the product shall be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

In Canada, general requirements are as indicated in Annex A, item 18.

4 Dated and Undated References

4.1 For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition.

5 Definitions

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

5.2 AUTOMATIC RESET PROTECTOR – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and automatically closes the circuit once the bimetal has cooled to a lower temperature.

5.3 COMPONENT – Any device which can stand alone and does not require attachment to the motor or generator to comply with hazardous location requirements.

5.4 FLAT (PLAIN, FLANGED, CYLINDRICAL) JOINT – A joint where the path is flat and is not interrupted by steps or threads.

5.5 LABYRINTH JOINT FOR SHAFTS – A joint having at least two axial paths in series, interrupted by at least one radial path having a minimum length of 1.6 mm (0.06 inch).

5.6 MANUALLY RESET PROTECTOR – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and requires manual resetting to close the motor circuit again.

5.7 OPERATING ROD (SPINDLE) – A component of circular cross section used for transmitting control movements that may be rotary or linear or a combination of the two.

5.8 PORTABLE MOTOR – A portable motor is one that can be easily moved. A portable motor incorporates a cord and a plug. A submersible sewage-pump motor, with or without a flexible cord, is not considered a portable motor.

5.9 POWER SHAFT – A component of circular cross section used for transmitting rotary motion.

5.10 RABBET (STEPPED, SPIGOT) JOINT – A joint with two or more surfaces perpendicular to each other in the direction of the path.

5.11 SINGLE-OPERATION DEVICE – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and is resettable only by cooling to 10 °C lower than the minimum rated ambient of the motor, but not greater than minus 35 °C (minus 31 °F), or lower.

In Canada, a device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and is resettable only by cooling to 10 °C lower than the minimum rated ambient of the motor, but not greater than minus 60 °C (minus 76 °F), or lower.

5.12 THERMAL CUT-OFF – A device that will open a circuit when exposed for a sufficient length of time to a temperature at or above a specified functioning temperature. A thermal cut-off functions once only and will not reverse its function when the temperature is reduced below the functioning temperature.

6 Components

6.1 Except as indicated in 6.2, a component of a product covered by this standard shall comply with the requirements for that component. See Annex B for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the ANCE, CSA, or UL Standards as appropriate for the country where the product shall be used.

6.2 A component need not comply with a specific requirement that:

a) Involves a feature or characteristic not needed in the application of the component in the product covered in this standard; or

b) Is superseded by a requirement in this standard.

7 Units of Measurement

7.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

8 Terminology

8.1 Where the term "motor" is employed in this standard, it shall be understood that the requirement also applies to a generator or a sewage pump motor.

8.2 The term sewage pump refers to both submersible and non-submersible types unless otherwise specified.

8.3 Paragraphs in this standard that apply to Class I, Class II, or Class I and II, locations are so identified by the following designations appearing after the subclause numbers: (I), (II), or (I, II).

9 Zone and Group Equivalency

9.1 Class I, Zone 1, Group IIA

9.1.1 Explosion-proof electrical equipment intended to be marked in accordance with 52.2 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group D hazardous (classified) locations.

9.2 Class I, Zone 1, Group IIB

9.2.1 Explosion-proof electrical equipment intended to be marked in accordance with 52.3 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group C hazardous (classified) locations.

9.3 Class I, Zone 1, Group IIB+H2

9.3.1 Explosion-proof electrical equipment intended to be marked in accordance with 52.4 shall comply with all the requirements for explosion-proof electrical equipment for use in Class I, Group B hazardous (classified) locations.

9.4 Zone 20 and 21

9.4.1 Dust-ignition-proof electrical equipment intended to be marked in accordance with 52.7 shall comply with all the requirements for dust-ignition-proof electrical equipment for use in Class II, Group E, F or G hazardous (classified) locations.

10 Enclosures

10.1 Material

10.1.1 (I, II) A motor enclosure shall be made of iron, steel, copper, brass, bronze, or aluminum or its alloys containing not less than 80 % aluminum. A metal such as zinc or magnesium, or their alloys, is not acceptable.

10.1.2 (I, II) To reduce the risk of percussion sparks all exposed metal parts of a portable motor or a cord-connected submersible sewage pump that can be struck by or strike against a foreign object shall be made of:

a) Brass, bronze, or aluminum for a portable motor; or

b) Brass or bronze for a cord connected submersible sewage pump motor.

10.1.3 (I, II) The shaft need not comply with this requirement.

10.1.4 (I, II) For a cord-connected submersible sewage pump provided with a guide-rail system that prevents the pump from contacting other objects while being raised or lowered into the wet pit, only metal parts that could contact the guide-rail system and plumbing are required to be made of brass or bronze.

10.2 Porosity in castings

10.2.1 (I, II) Surface porosity not in the joint surface shall not be over 2.4 mm (3/32 inch) wide and not over 1.6 mm (1/16 inch) deep. These holes are not considered as affecting the minimum thickness except that the wall from the bottom of a hole to the opposite surface shall not be less than 3.2 mm (1/8 inch).

10.2.2 (I, II) Surface porosity in joint surfaces shall not be over 1.6 mm (1/16 inch) wide or 1.6 mm (1/16 inch) deep and shall be such that the specified widths of joints are provided, not including the porosity.

10.2.3 (I, II) The porosity level shall be no greater than level 6 as specified in Annex A, item 17.

10.3 Thickness

10.3.1 (I, II) Except as noted in 10.3.4, the minimum thickness of the enclosure walls shall not be less than that specified in Table 1.

10.3.2 (I, II) A machined or a threaded joint in the walls of a cast-metal enclosure, such as at the end-shield/stator-frame joint, shall have at least the thickness specified in Table 1 through the overlap with neither section less than 1.6 mm (1/16 inch) thick.

10.3.3 (I, II) For an enclosure consisting of different materials such as a steel stator frame and cast-iron end shields, the total thickness through the overlap shall not be less than the minimum required for either of the metals. A section through the overlap shall have a thickness of not less than 1.2 mm (3/64 inch) for a sheet-steel section and not less than 1.6 mm (1/16 inch) for a cast-metal section.

10.3.4 (I, II) For a tube-cooled (totally-enclosed, air-to-air cooled) motor in which the cooling tubes form part of the explosion-proof or dust-tight enclosure, the tubes may be copper, brass, aluminum, or steel, having a wall thickness of not less than 0.76 mm (0.030 inch) if:

a) The tubes are protected against external mechanical damage by an enclosure having a minimum thickness as specified in Table 1; and

b) The tubes are protected against the risk of electrical burn through by:

1) An insulating barrier at least 0.70 mm (0.028 inch) thick between the tubes and any electrical component that is subject to arcing;

2) A grounded metal barrier that will prevent any arcs from electrical parts from reaching the tubes; or

3) Location of components so that no arc from any electrical component, including internal wiring, can contact the tubes.

10.4 Strength

10.4.1 (I, II) The fluid handling section of a canned motor pump shall withstand a pressure equal to 1.5 times the operating pressure for 10 minutes without evidence of leakage into any electrical compartment.

10.4.2 (I) The motor enclosure strength shall be sufficient to withstand the stresses resulting from the Explosion Pressure Test of Clause 36.

10.4.3 (I) The ability of a motor enclosure to withstand internal explosion pressures with sufficient safety factor shall be determined either by calculations or by the Over Pressure Test on Enclosures of Clause 37. The safety factor used for calculations shall be that specified in Table 2.

10.4.4 (I) For a line of motors being covered by tests on a representative motor or motors, the required strength shall be based on the maximum internal explosion pressure recorded during the tests, or the pressure specified in Figure 1, whichever is higher. For a single motor (one frame size with one rating), the required strength shall be based on the maximum internal explosion pressure.

10.4.5 (I) The construction of a tube-cooled motor shall be such that the tubes cannot become dislodged from the main enclosure assembly. See Pull Test on Tubes of Clause 48.

11 Joints in Enclosure

11.1 General

11.1.1 (I, II) A joint in an enclosure shall be of the metal-to-metal type, and shall be flat, rabbet (stepped), labyrinth or threaded.

11.1.2 (I, II) A metal joint surface shall have an arithmetical average roughness of not more than 0.0064 mm (250 micro-inches) in accordance with the Annex A, item 14.

11.1.3 (I, II) A feeler gauge utilized to measure the clearances specified in these requirements shall be 3.2 mm to 12.7 mm (1/8 inch to 1/2 inch) wide.

11.1.4 (I, II) The clearance shall be considered to comply with the requirement if such a feeler gauge as described in 11.1.3 will not enter the joint for a distance of more than 3.2 mm (1/8 inch) at any point.

11.1.5 (I, II) In the case of cylindrical joints, the clearance shall be considered to comply with the requirement if the difference in the average diameters of the two parts does not exceed the clearance dimensions specified elsewhere in this standard for such a joint.

Note: The diameters shall be measured at four points equally spaced over a total of 135° (0°, 45°, 90°, 135°) around the circumference of both parts and averaged.

11.1.6 (I, II) The width of a joint shall be measured with the mating parts in their most unfavorable position.

11.1.7 (I, II) Except as noted in 11.2.3.1 – 11.2.3.3 and 11.4.3.1 – 11.4.3.3, the width of a joint shall be measured:

a) From the inside of the enclosure to all places around the joint, including the nearest edge of the bolt clearance hole and elsewhere if the bolt head is outside the enclosure; and

b) From the outside of the enclosure to all places around the joint, including the nearest edge of the bolt clearance hole if the bolt head is inside the enclosure.

11.1.8 (I, II) For a rabbet joint, a maximum chamfer of 2.4 mm (3/32 inch) may be provided at the corner to accept a 1.2 mm (1/16 inch) diameter "O" ring (if such an "O" ring is provided). The chamfer shall not reduce the minimum required metal-to-metal width of the joint.

11.1.9 (I, II) Joints in a terminal box shall comply with the requirements in Annex A, items 10 and 12.

11.1.10 (I, II) Joints in a switch enclosure shall comply with the requirements in Annex A, items 10 and 12.

11.2 Groups C and D locations

11.2.1 General

11.2.1.1 (I) Except as noted in Section 36, joints in a motor enclosure shall be as specified in Table 3, Table 5, or Table 6 (informative) as applicable.

11.2.1.2 (I) The minimum joint width in flat (plain) or rabbet (spigot) joints shall be in accordance with Table 3, Table 5, or Table 6 (informative) as applicable, except that the clearance (gap) may be larger

providing the enclosure meets the flame propagation test with an additional safety factor applied to the test clearance (gap) in accordance with 36.6.

11.2.1.3 (I) The determination of free internal volume shall exclude the volume of any potting and/or sealing compound.

11.2.2 Threaded joints

11.2.2.1 (I) A threaded joint shall consist of the number of fully engaged threads specified in Table 7. Threads shall not be finer than specified in Table 7.

11.2.2.2 (I) The engagement between a threaded shaft (operating rod) and a tapped hole in an enclosure is considered to be a threaded joint.

11.2.3 Bolts in joint width

11.2.3.1 (I) A bolt may be located in the joint width provided that the requirements in Table 3, Table 5, and Table 6 (informative) as applicable, and the minimum effective joint width specified in Table 4 are met. See Figure 4.

11.2.3.2 (I) For a supplementary enclosure, such as a terminal box, device cover, and the like, or other part attached to the motor enclosure, a bolt may be located in the joint width if the joint construction complies with the requirements in 11.2.3.1. See Figure 4.

11.2.3.3 (I) The depth of tapping for the bolt mentioned in 11.2.3.1 and 11.2.3.2 shall permit nominal variations in standard bolt lengths to be accommodated. The use of washers shall be optional, but if used, the bolts shall be capable of securing the part tightly without the washers.

11.3 Group B locations

11.3.1 General

11.3.1.1 (I) The width of a joint in an enclosure having a free internal volume of not more than 0.5 dm^3 (30 cubic inches) shall not be less than 9.5 mm (3/8 inch). At a bolt hole, the width shall be measured from the inside edge to the nearest edge of the bolt clearance hole. The cover thickness at the joint flange shall not be less than 9.5 mm (3/8 inch). The clearance between the joint surfaces shall be less than 0.038 mm (0.0015 inch) or such that a 0.038 mm (0.0015 inch) feeler gauge will not enter the joint more than 3.2 mm (1/8 inch) at any point. See Figure 8.

11.3.1.2 (I) For an enclosure having a free internal volume of not more than 0.1 dm^3 (6 cubic inches), the clearance between the joint surfaces shall not be more than 0.10 mm (0.004 inch), and the cover thickness at the joint flange may be less than 9.5 mm (3/8 inch).

11.3.1.3 (I) The width of a joint in an enclosure having a free internal volume of more than 0.5 dm^3 (30 cubic inches) and not more than 1.6 dm^3 (100 cubic inches) shall not be less than 15.9 mm (5/8 inch). At a bolt hole, the width shall be measured from the inside edge to the nearest edge of the bolt clearance hole. The clearance between the joint surfaces shall be less than 0.038 mm(0.0015 inch) or such that a 0.038 mm (0.0015 inch) feeler gauge will not enter the joint more than 3.2 mm (1/8 inch) at any point. A rabbet joint shall have a total width of not less than 22.2 mm (7/8 inch), with neither section of joint being less than 9.5 mm (3/8 inch) wide. The diametrical clearance at the axial section of joint shall not be more than 0.064 mm (0.0025 inch), and the clearance at the radial or clamped section of joint shall not be more than 0.038 mm (0.0015 inch). See Figure 10.