UL 913

STANDARD FOR SAFETY

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

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

Eighth Edition, Dated December 6, 2013

Summary of Topics

This revision to ANSI/UL 913 dated May 10, 2022 includes 2-WISE for Division Applications; 1.3A, 5.8, Appendix B.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated April 1, 2022.

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UL 913

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

The First edition was titled Standard for Intrinsically Safe Electrical Equipment for Use in Hazardous Locations. The Second edition was titled Standard for Intrinsically Safe Electrical Circuits and Apparatus for Use in Hazardous Locations and its Associated Apparatus.

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Second Edition – January, 1976
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December 6, 2013

This ANSI/UL Standard for Safety consists of the Eighth Edition including revisions through May 10, 2022.

The most recent designation of ANSI/UL 913 as an American National Standard (ANSI) occurred on May 10, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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INTRODUCTION

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph can be found in Appendix A.

1 Scope

1.1 * These requirements apply to apparatus or parts of apparatus for installation and use in Class I, II, or III, Division 1 hazardous (classified) locations in accordance with the requirements of the National Electrical Code, NFPA 70.

1.2 These requirements also apply to apparatus or parts of apparatus for installation and use in Zone 20, Groups IIIA, IIIB, and IIIC hazardous (classified) locations in accordance with the requirements of the National Electrical Code, NFPA 70.

1.3 * These requirements also cover associated apparatus located outside of the hazardous (classified) location whose design and construction may influence the intrinsic safety of an electrical circuit within the hazardous (classified) location.

1.3A These requirements also cover the construction, marking and documenting of apparatus, systems and installations for use with the 2-Wire Intrinsically Safe Ethernet concept (2-WISE), such as the physical layer specification for 2-Wire Ethernet 10BASE-T1L as defined in IEEE 802.3cg.

1.4 These requirements are based on consideration of ignition in locations classified as a hazardous location by the presence of flammable or combustible material under normal atmospheric conditions.

1.5 * For the purposes of this standard, normal atmospheric conditions are considered to be:

a) An ambient temperature of 40°C (104°F);

b) An oxygen concentration not greater than 21 percent by volume; and

c) A pressure of one atmosphere.

1.6 This standard does not cover apparatus based on high voltage electrostatic principles such as electrostatic paint spraying.

1.7 Where a requirement of this standard conflicts with a requirement of the applicable requirements for unclassified (ordinary) locations, the requirements of this standard shall take precedence.

2 Undated References

2.1 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 Unit of Measurement

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

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix B for a list of standards covering components generally used in the products covered by this standard.

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

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

b) Is superseded by a requirement in this standard.

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

4.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

5 General

5.1 The purpose of this standard is to provide requirements for the construction and testing of electrical apparatus, or parts of such apparatus, having circuits that are not capable of causing ignition in Division 1 Hazardous (Classified) Locations as defined in Article 500 of the National Electrical Code, ANSI/NFPA 70.

5.2 This standard is not to be considered an instruction manual for untrained persons. It is intended to promote uniformity of practice among those skilled in the field of intrinsic safety.

5.3 Except where modified by the requirements of this standard, intrinsically safe and associated apparatus shall comply with the applicable requirements for unclassified (ordinary) locations.

5.4 Enclosures for associated apparatus shall conform to the requirements of the location in which they are intended to be installed.

5.5 Intrinsically safe apparatus and associated apparatus with circuits for Class I, Division 1, Groups A and/or B locations, shall comply with all the applicable requirements in UL 60079-0 and UL 60079-11 for Group IIC, level of protection "ia".

Exception: Marking of the intrinsically safe apparatus and associated apparatus shall meet the requirements of Section 10.

5.6 Intrinsically safe apparatus and associated apparatus with circuits for Class I, Division 1, Group C locations, shall comply with all the applicable requirements in UL 60079-0 and UL 60079-11 for Group IIB, level of protection "ia".

Exception: Marking of the intrinsically safe apparatus and associated apparatus shall meet the requirements of Section 10.

5.7 Intrinsically safe apparatus for Class I, Division 1, Group D locations, shall comply with all the applicable requirements in UL 60079-0 and UL 60079-11 for Group IIA, level of protection "ia".

Exception: Marking of the intrinsically safe apparatus and associated apparatus shall meet the requirements of Section 10.

5.8 Apparatus, systems and installations for use with the 2-Wire Intrinsically Safe Ethernet concept (2-WISE) in areas classified using the Division system shall additionally comply with the applicable requirements in UL 60079-47.

6 Zone Equivalency

6.1 General

6.1.1 The following Zone equivalency details address Class II, Division 1 and Class III intrinsically safe and associated apparatus for installation and use in Zone 20 hazardous (classified) locations in accordance with the requirements of the National Electrical Code, NFPA 70.

Note: Similar Zone equivalency details for Class I, Division 1 intrinsically safe and associated apparatus for installation and use in Class I, Zone 0 hazardous (classified) locations is not included. Based on the reference to UL 60079-11 and UL 60079-0 in this standard, Class I, Division 1 intrinsically safe and associated apparatus that complies with the requirements in this standard can additionally or alternatively be marked in accordance with UL 60079-11 and UL 60079-0.

6.1.2 *Deleted*

6.2 Zone 20, Group IIIA

6.2.1 Intrinsically safe and associated apparatus intended to be marked in accordance with 11.1 shall comply with all the applicable requirements for Class III hazardous (classified) locations as applicable.

6.3 Zone 20, Group IIIB

6.3.1 Intrinsically safe and associated apparatus intended to be marked in accordance with 11.2 shall comply with all the applicable requirements for Class II, Group F, Group G or both Groups F and G hazardous (classified) locations as applicable.

6.4 Zone 20, Group IIIC

6.4.1 Intrinsically safe and associated apparatus intended to be marked in accordance with 11.3 shall comply with all the applicable requirements for Class II, Group E hazardous (classified) locations as applicable.

7 Apparatus For Class II And Class III Locations

7.1 General

7.1.1 Intrinsically safe apparatus and associated wiring for Class II and Class III locations shall comply with the requirements in Sections 1 – 5 in this standard, as applicable and shall also comply with the requirements of 7.1.2 and either 7.1.3 or 7.1.4.

Exception: Intrinsically safe apparatus and associated apparatus for Class II and Class III locations may comply with the following as applicable, except that the marking shall meet the requirements of Section 10:

a) For Class II, Division 1, Group E marking: The applicable requirements from UL 60079-0 and UL 60079-11 for Group IIIC, level of protection "ia".

b) For Class II, Division 1, Group F, Group G or both Groups F and G marking: The applicable requirements from UL 60079-0 and UL 60079-11 for Group IIIB or IIIC, level of protection "ia".

c) For Class III locations: The applicable requirements from UL 60079-0 and UL 60079-11 for Group IIIA, IIIB or IIIC, level of protection "ia", and with a temperature class of not greater than T165°C (for equipment not subject to overloading).

7.1.2 * The temperature of exposed surfaces of apparatus shall be determined when tested according to the procedures described in 9.1 – 9.3. For this requirement, "exposed" means exposed to the flammable or combustible atmosphere or material. Parts within a dust-tight enclosure are not considered exposed; the outside surfaces of the enclosure are exposed.

Exception: Temperatures of small components under fault conditions shall be permitted to exceed these limits if it is shown by test that such higher temperatures will not result in ignition or charring.

Table 7.1
Maximum apparatus surface temperatures
Table deleted

7.1.3 Except as specified in 7.1.4, intrinsically safe apparatus for use in Class II, Groups E, F, and G locations shall be enclosed in a dust-tight enclosure that complies with the requirements in 7.2.1 – 7.2.3. In addition, the apparatus shall also comply with the spark ignition requirements for Class I, Group D or for methane. See 5.7.

7.1.4 * Intrinsically safe apparatus for use in Class II, Groups E, F, and G locations not enclosed in a dust-tight enclosure complying with the requirements in 7.2.1 – 7.2.3 shall comply with the spark ignition requirements specified in 7.1.3. In this case, it is to be assumed that all spacings do not comply with the separation distance requirements specified in UL 60079-11 and that all connections between live or grounded parts and conductors are in the most unfavorable condition. The number of such connections is unlimited.

Exception: Intrinsically safe apparatus for use in Class II, Group E locations need not be enclosed in a dust-tight enclosure complying with the requirements in 7.2.1 – 7.2.3 when the apparatus complies with the UL 60079-11 requirements for total immersion, or uncontrolled dust layer thickness.

7.2 Dust-tight enclosures

7.2.1 * For the purposes of this standard, an enclosure is considered dust-tight if it:

a) Complies with the requirements in 7.2.2 or 7.2.3; or

b) Complies with the requirements in the Dust-Tight Enclosure Test, Section 8; or

c) Is dust-ignition-proof.

In addition, a portable apparatus shall be dust-tight after being subjected to the Drop Test described in UL 60079-0.

7.2.2 An enclosure is also considered dust-tight if:

a) The enclosure complies with applicable requirements for enclosures for unclassified (ordinary) locations;

b) The enclosure has no openings; and

c) All joints are either threaded with a three full-thread minimum engagement or sealed by continuous welding, brazing, soldering or fusion of glass.

7.2.3 Parts of apparatus that are encapsulated to a depth of at least 1 mm (0.04 in) and are within an enclosure that complies with the requirements for unclassified (ordinary) locations are to be considered dust-tight.

8 Dust-Tight Enclosure Test

8.1 The test is a circulating dust method conducted by using equipment in which talcum powder is maintained in suspension in a suitable closed chamber. The talcum powder used shall pass through a square-meshed sieve whose nominal wire diameter is 50 micrometers (1.97 mil) and whose nominal width between wires is 75 micrometers (2.95 mil). The amount of talcum powder used is 2 kg per cubic meter (0.125 lb/ft^3) of the test chamber volume and is not to be used for more than 20 tests.

8.2 Enclosures shall be determined to fit in one of two categories:

a) Enclosures where the normal cycle of the equipment causes a reduction in the air pressure within the enclosure below the surrounding atmosphere (for example, caused by thermal cycling effect); or

b) Enclosures where reductions in pressure below the surrounding atmospheric pressure are not caused by normal cycles of the equipment.

8.3 For enclosures of category 8.2(a), the equipment under test is to be supported inside the test chamber, and the pressure inside the equipment is to be maintained below atmospheric pressure by a vacuum pump. If the enclosure has a single drain hole, the suction connection is to be made to a hole specially provided for the purpose of the test. If there is more than one drain hole, the other drain holes are to be left open for the test. The object of the test is to draw into the equipment, if possible, a minimum of 80 times the volume of air in the enclosure without exceeding an extraction rate of 60 volumes per hour with a suitable depression. In no event shall the depression exceed 200 mm (7.87 inches) of water. If an extraction rate of 40 to 60 volumes per hour is obtained, the test is to be stopped after two hours. If, with a maximum depression of 200 mm (7.87 inches) of water, the extraction rate is less than 40 volumes per hour, the test is to be continued until 80 volumes have been drawn through, or a period of eight hours has elapsed.

8.4 For an enclosure of category 8.2(b), the equipment under test is to be supported in its normal operating position inside the test chamber, but the test chamber is not to be connected to a vacuum pump. Any drain hole normally open is to be left open for the duration of the test. The test is to continue for a period of eight hours. If it is not possible to place the complete assembly in the test chamber, one of the following procedures is be used:

a) Individual testing of separate enclosed sections of the equipment; or

b) Testing of representative parts of the equipment (such as doors, ventilating openings, joints and shaft seals), with the vulnerable parts of the equipment (such as terminals and slip rings) in position at the time of testing; or

c) Testing of smaller equipment having the same full-scale design details.

8.5 No visible dust shall be detected inside the enclosure at the end of the test.

9 Dust Blanketing Temperature Test

9.1 The apparatus is to be mounted in its normal position and covered with the dust mixture specified in 9.2 until no more will stay on the enclosure or component (see 7.1.2) or to a depth of 12 mm (0.48 inches), whichever is less.

9.2 The dust used is to be one of those specified in Table 9.1 and is to be fine enough to pass through a U.S.A. Standard 150 micron (100 mesh), except as noted, wire cloth or screen.

Table 9.1
Dust for dust blanket temperature test

For Group F, Group G, Groups F and G, or Groups E, F, and G	For Group E only
Wheat or corn dust, or a mixture of both	Magnesium dust, or aluminum oxide dust

9.3 The apparatus is to be operated under fault conditions appropriate to the apparatus in accordance with 7.1.1 – 7.1.4 until all temperatures become constant.

9.4 Temperature classifications are to be based on the temperature rise above ambient in the test chamber determined during the tests of 9.1 – 9.3 at 40°C (104°F) or higher marked ambient temperature. For Class III, the temperature of surfaces exposed to fibers and flyings shall not exceed 165°C (329°F).

Exception: Temperatures of small components under fault conditions shall be permitted to exceed the limits specified in Table 10.1 if it is shown by test that such higher temperatures will not result in ignition or charring.

MARKING

10 General

10.1 The minimum marking shall include the following:

a) Identification of the apparatus, including manufacturer's name or trademark and type or model designation;

b) Hazardous location class and group;

c) Maximum surface temperature or temperature class based on operation at 40°C (104°F) or higher ambient temperature;

Exception: Apparatus having a maximum surface temperature no greater than 100°C (212°F) need not have a marked maximum surface temperature or temperature class.

NOTE: Apparatus intended for use in more than one class, group, or division of hazardous locations may require multiple markings.

d) The ambient temperature for equipment rated for a temperature range other than minus 25 – +40°C. The marking shall include either the symbol "Ta" or "Tamb".

e) For shunt diode and similar protective barrier assemblies which are intended for field or panel installation, the maximum nonhazardous location voltage.

f) Control drawing number, except for apparatus not intended to be connected to other apparatus or circuits.

Table 10.1
Temperature marking

Maximum temperature[a]		Temperature Class
°C	(°F)	
450	(842)	T1
300	(572)	T2
280	(536)	T2A
260	(500)	T2B
230	(446)	T2C
215	(419)	T2D
200	(392)	T3
180	(356)	T3A
165	(329)	T3B
160	(320)	T3C
135	(275)	T4
120	(248)	T4A
100	(212)	T5
85	(185)	T6

[a] Based on a 40°C (104°F) or higher marked ambient.

10.2 In addition to the minimum marking specified in 10.1, the marking shall include the following. As much information as possible shall be provided on the apparatus label. It is recognized, however, that it is impractical to mark small pieces of apparatus with all the required information. If this information is not on the apparatus, it shall be included in the accompanying literature.

a) For intrinsically safe apparatus:

1) An indication that the apparatus is intrinsically safe;

2) If investigated using the entity evaluation, the maximum input voltage, maximum input current, maximum internal capacitance, maximum internal inductance, and maximum input power;

3) If repair is possible, a warning label worded "Warning – Substitution of Components May Impair Intrinsic Safety;" and

4) A reference to accompanying literature, that provides special installation, maintenance, or operating instructions. If this information is not on the apparatus, it shall be included or referenced on the control drawing.

5) Where live maintenance is possible or when the intrinsically safe apparatus is supplied from multiple associated apparatus, one of the following markings shall be provided:

A) Where the manufacturer does not specify live maintenance procedures, the word "WARNING " and the following or the equivalent "To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing."

B) Where the manufacturer specifies and provides live maintenance procedures, the word "WARNING" and the following or equivalent: "To prevent ignition of flammable or combustible atmospheres, read, understand, and adhere to the manufacturer's live maintenance procedures."

6) Apparatus or battery packs provided with external contacts for recharging the batteries shall be marked with the following, or equivalent: "CAUTION: To reduce the risk of explosion, recharge the batteries outside of the hazardous location."

Exception: Apparatus or battery packs investigated and found acceptable for recharging in the hazardous location need not be provided with this marking. In this case, the battery charger shall be investigated and the marking shall specify the acceptable charger.

b) For Associated Apparatus:

1) If investigated using the entity evaluation, the maximum output voltage, maximum output current, maximum allowed capacitance, maximum allowed inductance, and maximum output power;

2) If repair is possible, a warning worded "Warning – Substitution of Components May Impair Intrinsic Safety;"

3) Any other necessary information, in particular, an indication of any other type of protection and its characteristics; and

4) A reference to accompanying literature, that provides special installation, maintenance, or operating instructions. If this information is not on the apparatus, it shall be included or referenced on the control drawing.

5) An indication that the associated apparatus provides intrinsically safe circuits.

6) The maximum rms ac or dc Um that can be applied to terminals of non-intrinsically safe apparatus or associated apparatus.

10.3 Terminals, terminal boxes, and plugs and receptacles for connection to intrinsically safe circuits shall be clearly identified and clearly distinguishable. If color only is used to comply with this requirement, the color shall be light blue.

10.4 Battery-powered apparatus shall be marked as follows:

a) A caution statement to indicate the type, size, and voltage of batteries to be used, or indicate the specific battery by manufacturer and model number or equivalent to be used.

b) In addition, for battery assemblies with two or more replaceable batteries, the apparatus shall be marked with the following warning or equivalent:

"Warning! To reduce the risk of explosion do not mix old batteries with used batteries, or mix batteries from different manufacturers".

c) If the batteries used are not intrinsically safe, the apparatus shall be marked with the following or equivalent:

"Warning! To reduce the risk of ignition of a flammable or explosive atmosphere, batteries must be changed only in a location known to be non-hazardous."

10.5 Apparatus or battery packs provided with external contacts for recharging the batteries shall be marked with the following, or equivalent: "CAUTION: To reduce the risk of explosion, recharge the batteries outside of the hazardous location."

Exception: Apparatus or battery packs investigated and found acceptable for recharging in the hazardous location need not be provided with this marking. In this case, the battery charger shall be investigated and the marking shall specify the acceptable charger.

11 Zone Equivalency Markings

11.1 Zone 20, Group IIIA

11.1.1 Intrinsically safe apparatus that complies with all the applicable requirements for Class III hazardous (classified) locations in accordance with 6.2.1 may additionally or alternatively be marked for use in Zone 20, Group IIIA.

11.1.2 Associated apparatus that provides intrinsically safe circuits that comply with all the applicable requirements for Class III hazardous (classified) locations in accordance with 6.2.1 may additionally or alternatively be marked as providing intrinsically safe circuits for use in Zone 20, Group IIIA.

11.2 Zone 20, Group IIIB

11.2.1 Intrinsically safe apparatus that complies with all the applicable requirements for Class II, Group F, Group G or both Groups F and G hazardous (classified) locations in accordance with 6.3.1 may additionally or alternatively be marked for use in Zone 20, Group IIIB.

11.2.2 Associated apparatus that provides intrinsically safe circuits that comply with all the applicable requirements for Class II, Group F, Group G or both Groups F and G hazardous (classified) locations in accordance with 6.3.1 may additionally or alternatively be marked as providing intrinsically safe circuits for use in Zone 20, Group IIIB.

11.2.3 Apparatus marked for Group IIIB is not prohibited from also being marked for Group IIIA.

11.3 Zone 20, Group IIIC

11.3.1 Intrinsically safe apparatus that complies with all the applicable requirements for Class II, Group E hazardous (classified) locations in accordance with 6.4.1 may additionally or alternatively be marked for use in Zone 20, Group IIIC.

11.3.2 Associated apparatus that provides intrinsically safe circuits that comply with all the applicable requirements in Class II, Group E hazardous (classified) locations in accordance with 6.4.1 may additionally or alternatively be marked as providing intrinsically safe circuits for use in Zone 20, Group IIIC.

11.3.3 Apparatus marked for Group IIIC is not prohibited from also being marked for Group IIIA, Group IIIB, or both Groups IIIA and IIB.

12 Documentation

12.1 Intrinsically safe apparatus and associated apparatus shall be provided with documentation that includes all the instructional material required by this standard.

12.2 This required instructional material may be provided by electronic media under the following conditions:

a) Where all required instructional material is provided by electronic media, there shall be marking on the apparatus that contains the international symbol ⚠ (Reference No. 0434B of ISO 7000), along with the document number, revision level and location of the electronic documentation (e.g. URL, QRcode).

b) Where only some of the required instructional material is provided by electronic media and some is printed:

1) there shall be marking on the apparatus that contains the international symbol ⚠ (Reference No. 0434B of ISO 7000), along with the document number, revision level and location of the electronic documentation (e.g. URL, QRcode); and

2) the printed instructions provided with the apparatus shall clearly identify that additional information is available electronically, along with the document number, revision level and location of this electronic documentation (e.g. URL, QRcode).

Exception: For small electrical apparatus where some or all of the instructional material is to be provided by electronic media, and where there is limited space for both the international symbol ⚠ (Reference No. 0434B of ISO 7000) and the document number, revision level and location of the electronic documentation (e.g. URL, QRcode):

a) the international symbol ⚠ (Reference No. 0434B of ISO 7000) shall be marked on the apparatus; and

b) printed instructions shall be provided with the apparatus that, as a minimum, indicates the document number, revision level and location of the electronic documentation (e.g. URL, QRcode).

NOTE When electronic documentation is referenced either on the device or on the printed instructions, the location given can be the specific location for the required instructions (e.g. direct link to the specific instructions), or can be a more general location. (e.g. the URL for the overall manufacturer's website). It is the manufacturer's responsibility to assure that the location of the required instructions is accessible by the user.

12.3 Where a QRcode is used to provide the required instructional material, and the QRcode contains all the required instructional material (as opposed to merely referencing a URL that contains the required instructional material), a document number and revision level need not be indicated.

12.4 Where some or all of the required instructional material is provided by electronic media, the required instructional material shall be available in printed format upon request of the user.