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

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Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062-2096

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

Fifth Edition, Dated February 21, 1997

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FEBRUARY 21, 1997

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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

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Fifth Edition

February 21, 1997

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated February 21, 1997. 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/UL/NFPA 4913-1979, November 5, 1979
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Figures 18.1 – 18.4 and 18.8 are from British Approvals Service for Electrical Equipment in Flammable Atmospheres Certification Standard SFA 3012:1972 – Intrinsic Safety. Permission to use this Crown Copyright Material is gratefully acknowledged. Figures 18.5 and 18.6 are from "Some Aspects of the Design of Intrinsically Safe Circuits," Research Report 256 by D. W. Widgenton, Safety in Mines Research Establishment, Sheffield, England, 1968.

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 differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

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INTRODUCTION

NOTICE: The asterisk following the subsection number signifies that explanatory material on that paragraph appears in Appendix A.

1 Scope

1.1 This standard applies to:

a) Apparatus or parts of apparatus in Class I, II, or III, Division 1 locations[a];

b) Those parts of apparatus located outside of the Class I, II, or III, Division 1 location having a design and construction that may influence the intrinsic safety of an electrical circuit within the Class I, II, or III, Division 1 location;

c) Apparatus or parts of apparatus in Class I, Zone 0 or 1, Groups IIA, IIB, and IIC locations;

d) Those parts of apparatus located outside of the Class I, Zone 0 and 1, Groups IIA, IIB, or IIC location having a design and construction that may influence the intrinsic safety of an electrical circuit within the Class I, Zone 0 and 1, Group IIA, IIB, or IIC location.

[a] Section 500-3(a) of ANSI/NFPA 70-1987, National Electrical Code, states that equipment that has been approved for a Division 1 location shall be permitted in a Division 2 location of the same class and group.

1.2* These requirements are based on consideration of ignition in locations made hazardous by the presence of flammable or combustible material under normal atmospheric conditions.

1.3 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; and

c) A pressure of one atmosphere.

1.4 This standard does not cover mechanisms of ignition from external sources, such as static electricity or lightning, which are not related to the electrical characteristics of the apparatus. This standard does not cover apparatus based on high voltage electrostatic principles, such as electrostatic paint spraying apparatus.

2 Purpose

2.1 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 locations as defined in Article 500 of the National Electrical Code, ANSI/NFPA 70-1987.

2.2 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.

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3 Applicability of Other Standards

3.1 Except where modified by the requirements of this standard, intrinsically safe and associated apparatus shall comply with the applicable requirements for ordinary locations.[a]

[a] As an example of requirements for ordinary locations, see ANSI C39.5, Safety Requirements for Electrical and Electronic Measuring and Controlling Instrumentation, available from the American National Standards Institute, 1430 Broadway, New York, NY 10018.

3.2 Associated apparatus and circuits shall conform to the requirements of the location in which the apparatus and circuits are installed.[a]

[a] For guidance on installation, see ANSI/ISA RP12.6, Installation of Intrinsically Safe Systems for Class I Hazardous (Classified) Locations, available from the Instrument Society of America, 67 Alexander Drive, Research Triangle Park, North Carolina, 27709.

4 Definitions

4.1 Associated Apparatus - Apparatus in which the circuits are not necessarily intrinsically safe themselves, but which affect the energy in the intrinsically safe circuits and are relied upon to maintain intrinsic safety. Associated electrical apparatus may be either:

a) Electrical apparatus that has an alternative type of protection for use in the appropriate potentially flammable atmosphere; or

b) Electrical apparatus not so protected that shall not be used within a potentially flammable atmosphere.

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4.2 Control Drawing – A drawing or other document provided by the manufacturer of the intrinsically safe or associated apparatus that details the allowed interconnections between the intrinsically safe and associated apparatus.

4.3* Entity Evaluation – A method used to determine acceptable combinations of intrinsically safe apparatus and connected associated apparatus that have not been investigated in such combinations.

4.4 External Inductance-to-Resistance Ratio – The ratio of inductance to resistance of the intrinsically safe circuit connected to the associated apparatus.

4.5 Fault – A defect or electrical breakdown of any component, spacing, or insulation that alone or in combination with other faults may adversely affect the electrical or thermal characteristics of the intrinsically safe circuit. If a defect or breakdown leads to defects or breakdowns in other components, the primary and subsequent defects and breakdowns are considered to be a single fault.

4.6 Internal Inductance-to-Resistance Ratio – The ratio of inductance to resistance of the intrinsically safe apparatus.

4.7 Internal Wiring – Wiring and electrical connections that are made within the apparatus by the manufacturer. Within racks or panels, interconnections between separate pieces of apparatus made in accordance with detailed instructions from the apparatus' manufacturer are considered to be internal wiring.

4.8 Intrinsically Safe Apparatus – Apparatus in which all the circuits are intrinsically safe.

4.9 Intrinsically Safe Circuit – A circuit in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable, under the test conditions prescribed in this standard, of causing ignition of a mixture of flammable or combustible material in air in the mixture's most easily ignitable concentration.

4.10 Linear Output Associated Apparatus – Associated apparatus in which the output current is limited by a resistor such that the output voltage-current plot is a straight line drawn between open circuit voltage and short-circuit current.

4.11 Maximum Allowed Capacitance – The maximum value of capacitance that may be connected to the intrinsically safe circuit of the associated apparatus.

4.12 Maximum Allowed Inductance – The maximum value of inductance that may be connected to the intrinsically safe circuit of the associated apparatus.

4.13 Maximum Input Current – The maximum dc or peak ac current that can be safely applied to the terminals of the intrinsically safe apparatus. The maximum input current may be different for different terminals.

4.14 Maximum Input Voltage – The maximum dc or peak ac voltage that can be safely applied to the terminals of an intrinsically safe apparatus. The maximum input voltage may be different for different terminals.

4.15 Maximum Internal Capacitance – The total equivalent internal capacitance of the intrinsically safe apparatus that must be considered as appearing across the terminals of the intrinsically safe apparatus.

4.16 Maximum Internal Inductance – The total equivalent internal inductance of the intrinsically safe apparatus that must be considered as appearing across the terminals of the intrinsically safe apparatus.

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4.17 Maximum Nonhazardous Location Voltage – The maximum voltage that may be applied to each of the nonintrinsically safe terminals of associated apparatus without affecting intrinsic safety.

4.18 Maximum Output Current – The maximum dc or peak ac current that may be extracted from the intrinsically safe connections of the associated apparatus.

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4.19 Maximum Output Voltage – The maximum dc or peak ac open circuit voltage that can appear at the intrinsically safe connections of the associated apparatus.

4.20 Normal Operation – Intrinsically safe apparatus or associated apparatus conforming electrically and mechanically with its design specification.

4.21 Protective Component or Assembly – A component or assembly that is so unlikely to become defective in a manner that will lower the intrinsic safety of the circuit that it may be considered not subject to fault when analysis or tests for intrinsic safety are conducted.

4.22 Shunt Diode Barrier – A fuse- or resistor-protected diode barrier.

4.23 Fuse-Protected Shunt Diode Barrier – A network designed to limit current and voltage that consists of a series fuse, voltage-limiting shunt diodes, and a current-limiting resistor or other current-limiting components. The fuse is intended to protect the diodes from open-circuiting when high fault currents flow.

4.24 Resistor-Protected Shunt Diode Barrier – A network identical to a fuse-protected shunt diode barrier, except that the fuse is replaced by a resistor.

5 Class I, Zone, and Group Equivalency

5.1 Class I, zone 0 and 1, group IIA

5.1.1 Apparatus or parts of apparatus intended to be marked in accordance with 17.4 shall comply with all the requirements for apparatus for use in Class I, Group D locations.

5.2 Class I, zone 0 and 1, group IIB

5.2.1 Apparatus or parts of apparatus intended to be marked in accordance with 17.3 shall comply with all the requirements for apparatus for use in Class I, Group C locations.

5.3 Class I, zone 0 and 1, group IIC

5.3.1 Apparatus or parts of apparatus intended to be marked in accordance with 17.2 shall comply with all the requirements for apparatus for use in both Class I, Group A and Class I, Group B locations.

6 Control Drawing

6.1 A control drawing shall be provided for all intrinsically safe apparatus or associated apparatus that requires interconnection to other circuits or apparatus.

6.2 An intrinsically safe system could consist of apparatus investigated as a system or apparatus investigated under the entity concept. If the intrinsically safe and associated apparatus are investigated as a system, the control drawing shall provide information for proper connection and installation. If the intrinsically safe or associated apparatus is investigated under the entity concept, the control drawing shall include applicable electrical parameters to permit selection of apparatus for interconnection.

7 Evaluation of Intrinsic Safety

7.1 Fundamental requirements

7.1.1 Intrinsically safe apparatus and circuits shall comply with the two basic requirements specified in 7.1.2 and 7.1.3.

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7.1.2 The energy available in the hazardous location shall not be capable of igniting the flammable mixture specified in 37.3.1 through 37.3.5 due to arcing or hot surfaces during normal operation.

7.1.3 For evaluation purposes, normal operation is to include all of the following:

a) Supply voltage at maximum rated value;

b) Environmental conditions within the ratings given for the intrinsically safe apparatus or associated apparatus;

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