

Approval Standard

for

Combustible Gas Detectors

Class Number 6310, 6320

January 2001

Based in part on ANSI/ISA-12.13.01-2000, Performance Requirements for Combustible Gas Detectors.

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Foreword

FM Approvals are intended to verify that the products and services described will meet stated conditions of performance, safety and quality useful to the ends of property conservation. The purpose of FM Approval Standards is to present the criteria for FM Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approval Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. FM Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, FM Approval Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Approval agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard provides minimum requirements for combustible gas detection instruments for FM Approval.
- 1.1.2 FM Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard is concerned with the details of construction, performance and testing of portable, mobile and stationary electrical instruments that sense the presence of combustible gas or vapor concentrations in air. Based on associated requirements specified in Section 3, this standard considers the suitability of the instruments or parts thereof for use in Class I, hazardous (classified) locations as defined by the National Electrical Code® (ANSI/NFPA 70).

NOTE: IT IS STRESSED THAT ALTHOUGH COMBUSTIBLE GAS DETECTORS WARN OF AN EXPLOSION, THEY DO NOT NECESSARILY WARN OF TOXIC GAS RELEASES. IT IS ALSO STRESSED THAT FINAL AND LONG-TERM EFFECTIVENESS OF ANY COMBUSTIBLE GAS DETECTION EQUIPMENT DEPENDS HEAVILY UPON THE USER, WHO MUST BE RESPONSIBLE FOR ITS PROPER APPLICATION, INSTALLATION, USE, AND REGULAR MAINTENANCE.

- 1.2.2 This standard applies to line-voltage operated instruments rated at 250V nominal or less, and to portable, mobile, or stationary-type instruments supplied by battery of a non-rechargeable (primary) type or a rechargeable (secondary) type.
- 1.2.3 For intrinsically safe instruments, this standard applies only to systems which utilize defined associated intrinsically safe apparatus (protective barrier assemblies). “Entity” concept does not apply to the performance Approval of combustible gas detectors.
- 1.2.4 This standard addresses combustible gas detection instruments intended to provide an indication or alarm, the purpose of which is to give warning of potential hazard.
- 1.2.5 This standard does not address gas detection instruments of the laboratory or scientific type used for analysis or measurement, instruments used for process control and process monitoring purposes, open path (line of sight) area monitors, or instruments used for residential purposes.
- 1.2.6 This standard is written for gas detection instruments that are intended to detect gas concentrations in air in the range from zero up to the lower flammable limit (LFL), since this is the most commonly used range for instruments intended to measure or monitor the degree of explosion hazard. This does not preclude instruments intended for higher concentration ranges, such as those intended to warn of a drop in concentration from a high value down to the upper flammable limit (UFL).
- 1.2.7 For instruments used for sensing the presence of oxygen, non-flammable toxic gases, and flammable gases or vapor concentrations in air, this standard applies only to the portion of the instrument sensing the flammable gases or vapor concentrations in air.

- 1.2.8 FM Approval is limited to instrument applications where: (a) calibration is performed using either the gas to be monitored or another gas for which response conversion data appears in the instruction manual; and (b) the instrument alarm set point is within 10% LFL of the calibration concentration of the gas to be monitored, e.g. for an alarm set point value of 50% LFL, the calibration concentration must be between 40% LFL and 60% LFL.

NOTE 1: INSTRUMENT PERFORMANCE TESTING ON COMBUSTIBLE GAS DETECTORS DURING A FM APPROVAL EXAMINATION IS CONDUCTED USING A SINGLE GAS, AS SPECIFIED IN SECTION 3.9.

NOTE 2: IT IS THE RESPONSIBILITY OF THE INSTRUMENT MANUFACTURER TO DEMONSTRATE THE VALIDITY OF RESPONSE CONVERSION DATA DURING THE APPROVAL EXAMINATION PER SECTION 1.3.3.

1.3 Basis for Requirements

- 1.3.1 The requirements of this Standard are based on experience, research and testing, and/or the standards of other national and international organizations. The advice of manufacturers, users, trade associations, jurisdictions and/or loss control specialists has also been considered.
- 1.3.2 The construction, testing and marking required by this standard correspond, in general, to ISA S12.13.01, Part I — 2000, “Performance Requirements, Combustible Gas Detectors”.
- 1.3.3 The requirements of this standard reflect tests and practices used to examine characteristics of combustible gas detectors for the purpose of obtaining FM Approval. These requirements are intended primarily as guides, and strict conformity is not always mandatory. Combustible gas detectors having characteristics not anticipated by this standard may be Approved if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, gas detectors which do meet all the requirements identified in this standard may not be Approved if other conditions which adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for FM Approval

FM Approval is based upon satisfactory evaluation of the product and the manufacturer in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate
- the suitability of the product
 - the proper operation and performance of the product as specified by the manufacturer and required by FM Approvals; and as far as practical,
 - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures shall be made to evaluate the manufacturer’s ability to produce a product identical to that which was examined and tested, and the marking procedures used to identify the product. These examinations are repeated as part of FM Approvals’ product follow-up program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval Agreement; and
- examination of production samples for continued conformity to requirements.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products Approved under a previous edition shall comply with the new version by the effective date or forfeit Approval.

The effective date of this Standard is January 1, 2005 for compliance with all requirements.

1.7 System of Units

Units of measurement in this standard are International System (SI) units. Appendix B lists conversion formulas for equivalents in United States (U.S.) Customary units.

1.8 Applicable Standards

1.8.1 This standard is intended to be used in conjunction with FM Approval Standard 3600 which includes the general requirements that apply to all types of protection for hazardous (classified) locations.

1.8.2 Any portion of a gas detection instrument that is intended for installation or use in a location where gas or vapor concentration is to be detected shall be suitable for use in Class I, Division 1 or 2 or Class I, Zone 0, 1 or 2 hazardous locations in accordance with the group classification of the gas. See FM Approval Standard 3600.

NOTE 1: IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE® (ANSI/NFPA 70), ONLY INSTRUMENTS WHICH UTILIZE INTRINSIC SAFETY (ia) CAN BE APPROVED FOR USE IN CLASS I, ZONE 0. INSTRUMENTS WHICH UTILIZE FLAMEPROOF (d) EITHER ENTIRELY OR IN CONJUNCTION WITH INTRINSIC SAFETY, CANNOT BE APPROVED FOR USE IN CLASS I, ZONE 0.

1.9 Definitions

For purposes of this standard, the following terms apply:

1.9.1 **Alarm:** An audible, visual or physical presentation designed to alert the instrument user that a specific level of combustible gas concentration has been reached or exceeded.

- 1.9.2 **Alarm only instrument:** An instrument providing an alarm(s), but which does not have an integral meter or other readout device indicating current combustible gas concentration levels.
- 1.9.3 **Alarm set-point:** The selected gas concentration level(s) at which an indication, alarm, or other output function is initiated.
- 1.9.4 **Calibration:** The act of adjusting an instrument to “zero” and setting the desired “span”. This procedure is repeated frequently by the instrument user and included in certain tests called for in this standard. It verifies that the response of an instrument to a known gas concentration is within performance requirements of this standard. This may necessitate adjustment of zero, span, and alarm set point.
- 1.9.5 **Calibration gas concentration:** The concentration of the combustible gas in ambient air used to set the instrument span or alarm set point.
- 1.9.6 **Clean air:** Air that is free of combustible gases, vapors or contaminating substances.
- 1.9.7 **Class 6310:** FM Approvals designation for all portable gas detectors.
- 1.9.8 **Class 6320:** FM Approvals designation for all stationary gas detectors.
- 1.9.9 **Combustible gas:** Any flammable gas or vapor that, in sufficient concentration by volume in air, can become the fuel for an explosion or fire hazard. Materials that cannot produce sufficient gas or vapor to form a flammable mixture at ambient or operating temperatures and mists formed by the mechanical atomization of combustible liquids are NOT considered to be combustible gases.
- NOTE:** FOR CONVENIENCE, THE SHORTER TERM “GAS” MAY BE USED AS AN ABBREVIATION FOR “COMBUSTIBLE GAS OR VAPOR” WITHIN THIS DOCUMENT.
- 1.9.10 **Control unit:** That portion of a gas detection instrument that is not directly responsive to the combustible gas, but which responds to the electrical signal obtained from one or more detector heads. This unit produces the output function when such gas is present at the detector head location.
- 1.9.11 **Detector head:** The gas responsive portion of a gas detection instrument located in the area where sensing the presence of gas is desired. It may be integral with or removed from its control unit.
- NOTE:** THE DETECTOR HEAD MAY INCORPORATE, IN THE SAME HOUSING, CIRCUITRY SUCH AS SIGNAL PROCESSING AND AMPLIFYING COMPONENTS IN ADDITION TO THE GAS SENSING ELEMENT (SENSOR).
- 1.9.12 **Diffusion:** A method by which an atmosphere being monitored gains access to the gas sensing element by nature of molecular movement or natural convection.
- 1.9.13 **Flammable range:** The range of flammable vapor concentrations or gas-air mixtures in which propagation of flame will occur on contact with a source of ignition.
- NOTE 1:** THE TERMS “LOWER FLAMMABLE LIMIT (LFL)” AND “LOWER EXPLOSIVE LIMIT (LEL)” ARE DEEMED TO BE SYNONYMOUS. THE TERMS “UPPER FLAMMABLE LIMIT (UFL)” AND “UPPER EXPLOSIVE LIMIT (UEL)” ARE DEEMED TO BE SYNONYMOUS. FOR EASE OF REFERENCE, THE TWO ABBREVIATIONS “LFL” AND “UFL” ARE USED HEREINAFTER TO DENOTE THESE TWO SETS OF TERMS. IT SHOULD BE RECOGNIZED THAT PARTICULAR AUTHORITIES HAVING JURISDICTION MAY PREFER THE USE OF ONE OF THE SETS OF TERMS AND NOT THE OTHER.

NOTE 2: THE ACTUAL GAS CONCENTRATION CORRESPONDING TO THE LOWER FLAMMABLE LIMIT OF THE SPECIFIC GAS SHALL BE THE VALUE SHOWN FOR THAT GAS IN THE LATEST EDITION OF NATIONALLY RECOGNIZED DOCUMENTS, FOR EXAMPLE, NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) 325, FLAMMABILITY CHARACTERISTICS OF COMBUSTIBLE GASES OR VAPORS.

- 1.9.14 **Full-scale gas concentration:** The gas concentration that equals maximum scale indication.
- 1.9.15 **Gas detection instrument:** An assembly of electrical and mechanical components (either a single integrated unit or a system comprised of two or more physically separate but interconnected component parts) which senses the presence of combustible gas and responds by providing an indication, alarm, or other output function.
- NOTE:** FOR CONVENIENCE, THE TERM “INSTRUMENT” IS USED AS AN ABBREVIATION FOR “GAS DETECTION INSTRUMENT” WITHIN THIS DOCUMENT.
- 1.9.16 **Gas-sensing element (sensor):** The primary element in the gas detection system that responds to the presence of a combustible gas — including any reference or compensating unit, where applicable.
- 1.9.17 **Latching alarms:** Alarms that once actuated require intentional manual action to reset.
- 1.9.18 **Mobile instrument:** A continuously monitoring instrument mounted on a vehicle such as, but not limited to, a mining machine or fork lift truck.
- 1.9.19 **Portable, continuous-duty instrument:** A battery-operated portable or transportable instrument intended to operate continuously for 8 hours or more.
- 1.9.20 **Portable, continuous-duty, personal instrument:** Gas detection instrument refers to a battery-operated, alarm only instrument intended to be operator-worn and to operate continuously for 8 hours or more.
- 1.9.21 **Portable, intermittent-duty instrument:** A battery-operated portable or transportable instrument intended for operation during periods of only a few minutes at irregular intervals.
- 1.9.22 **Range:** The operable concentration region of the instrument or a selected subdivision of that region.
- 1.9.23 **Response conversion data:** Information, supplied and explained in the instrument instruction manual, enabling the instrument user to determine the concentration of the gas to be monitored that will produce the same response as a known concentration of another gas used for calibration.
- 1.9.24 **Sample draw:** Method by which the atmosphere being monitored is made to flow to the gas sensing element. This may involve a manual aspirator, an electrical pump or some other means.
- 1.9.25 **Span:** The algebraic difference between the upper and lower values of a range.
- 1.9.26 **Stand-alone control unit:** Control unit that is utilized with unspecified stand-alone detector head(s).
- 1.9.27 **Stand-alone detector head:** Detector head that is utilized with unspecified control apparatus. Such instruments are intended to be interfaced to separate control unit, signal processing data acquisition, central monitoring, or other similar systems in which the instrument provides a conditioned electronic signal or output indication to systems of the aforementioned type that typically process information from various locations and sources including, but not limited to, gas detection instruments.
- 1.9.28 **Stationary instrument:** A gas detection instrument intended for permanent installation in a fixed location.
- 1.9.29 **Zero:** The lower calibration value, normally clean air.