



Examination Standard for Lithium-Ion Battery Off-Gas Detection

Class Number 6540

June 2024

Foreword

This standard is 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 this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

TABLE OF CONTENTS

1 INTRODUCTION	1
1.1 Purpose.....	1
1.2 Scope.....	1
1.3 Basis for Requirements	1
1.4 Basis for Certification	2
1.5 Basis for Continued Certification	2
1.6 Effective Date	2
1.7 System of Units.....	2
1.8 Normative References.....	2
1.9 Terms and Definitions.....	3
2 GENERAL INFORMATION.....	5
2.1 Product Information	5
2.2 Certification Application Requirements	5
2.3 Requirements for Samples for Examination	5
3 GENERAL REQUIREMENTS.....	6
3.1 Review of Documentation	6
3.2 Physical or Structural Features	6
3.3 Markings	6
3.4 Manufacturer's Installation and Operation Instructions	7
3.5 Calibration	8
4 PERFORMANCE REQUIREMENTS.....	9
4.1 Sensitivity Test	9
4.2 Verification of Rate of Rise Test	9
4.3 Repeatability Test (Excluding single use sensors).....	10
4.4 Functional Tests From ANSI/FM/UL 62990-1	10
4.5 Detector Without Field Calibration	11
5 MANUFACTURER'S REQUIREMENTS	12
5.1 Demonstrated Quality Control Program	12
5.2 Surveillance Audit	13
5.3 Product Modification	13
6 BIBLIOGRAPHY.....	13

1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for rate of rise gas detection instruments used in the detection of off gases from lithium-ion batteries generated in the first stage of a failing lithium-ion battery prior to thermal runaway.

Note 1: The testing and certification requirements for gas detection instruments with alarm functions based on reaching a threshold limit value for flammable gases and vapors are set out in ANSI/FM/UL 60079-29-1, Explosive Atmospheres – Part 29-1: *Gas Detectors – Performance Requirements of Detectors For Flammable Gases*.

Note 2: The testing and certification requirements for gas detection instruments with alarm functions based on reaching a threshold limit value for toxic gases and vapors are set out in ANSI/FM/UL 62990-1 - *Workplace Atmospheres – Part 1: Gas Detectors – Performance Requirements of Detectors For Toxic Gases*.

- 1.1.2 Testing and certification criteria may include performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1 This standard applies to any component intended to or for use to sense the presence of a rising concentration of battery electrolyte solvent vapor due to the off gassing of lithium-ion batteries generated in the first stage of a failing lithium-ion battery prior to thermal runaway or during thermal runaway.
- 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 This standard does not apply to gas detection instruments that provide an indication or alarm when a specific threshold value has been met.

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 organizations. The advice of manufacturers, users, trade associations, jurisdictions, and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of rate of rise gas detection instruments for the purpose of obtaining certification.
- 1.3.3 The construction, testing and marking required by this standard correspond, in general, to ANSI/FM/UL 62990-1.

1.4 Basis for Certification

Certification 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 performance of the product as specified by the manufacturer and required for certification,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product, which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified,
- the continued use of acceptable quality assurance procedures,
- compliance with the terms stipulated by the certification,
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this examination standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is the date of publication.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all their content constitutes requirements of this document. For dated references, only the cited edition applies.

ANSI 2075 - *Standard For Safety Gas and Vapor Detectors and Sensors*

ANSI/FM/UL 62990-1 - *Workplace Atmospheres – Part 1: Gas Detectors – Performance Requirements of Detectors for Toxic Gases*

ANSI/IEEE/ASTM SI 10 - *American National Standard for Metric Practice*

ANSI/ISA-61010-1 - *Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General requirements*

EN 50270 - *Electromagnetic compatibility. Electrical apparatus for the detection and measurement of combustible gases, toxic gases, or oxygen*

FM 3600 - *Examination Standard for Electrical Equipment for Use in Hazardous (Classified) Locations – General Requirements*

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Alarm - An audible, visual, or physical presentation designed to alert the instrument user that a specific rate of rise of flammable gas concentration has been reached or exceeded.

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.

Calibration gas concentration - The concentration of the flammable gas in ambient air used to set the instrument span or alarm set point.

Flammable 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 flammable liquids are NOT considered to be flammable gases.

Note: for convenience, the shorter term “gas” may be used as an abbreviation for “flammable gas or vapor” within this document.

Control unit – equipment intended to provide display indication, alarm functions, output contacts or alarm signal outputs or any combination when operated with remote sensor(s)

Dead space - An actual or potential area within a chamber where the gas is stagnant (not mixing and/or still).

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).

Fault signal - Audible, visible, or other type of output, different from the alarm signal, permitting, directly or indirectly, a warning or indication that the apparatus is not working satisfactorily.

Note: the terms fault signals and trouble signals are deemed to be synonymous.