

Standard for Safety

UL 1437

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Electrical Analog Instruments - Panel Board Types



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Standard



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March 30, 1993

Standard for

Electrical Analog Instruments – Panel Board Types

UL 1437, Second Edition

Accompanying this transmittal notice is a copy of the Second edition of UL 1437.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

Revised and/or additional pages may be issued from time to time.

Subscribers to UL's services in the area covered by this standard will receive these revised and/or additional pages automatically. Others may receive such pages by subscribing to UL's subscription service for revisions. See UL's CATALOG OF STANDARDS FOR SAFETY for a description of the revision subscription service, the cost of the service for this standard, and ordering information.

MARCH 30, 1993

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UL 1437

Standard for

**Electrical Analog Instruments –
Panel Board Types**

First Edition – November, 1979

Second Edition

March 30, 1993

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

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 published set of revision pages.

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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.
- E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of, or reliance upon this Standard.
- F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1 Scope

1.1 These requirements cover electrical and electrically operated indicating and recording instruments of the analog type that are powered only from the measured parameter and are intended for ordinary use in panel boards and the like.

1.2 These requirements cover direct-acting or indirect-acting instruments and accessories that may contain electronic devices.

1.3 These requirements cover instruments indicating quantities of electrical analogs including all of the following:

- a) Ammeters.
- b) Voltmeters.
- c) Wattmeters.
- d) Varmeters (reactive volt-ampere meters).
- e) Frequency meters.
- f) Power-factor meters.
- g) Synchrosopes.

1.4 These requirements cover instruments constructed for special purposes such as, ultrasensitive d-c microammeters, high-resistance voltmeters, thermo-milliammeters, thermal voltmeters of the vacuum-couple type, and instruments with special and unusual ranges.

1.5 These requirements cover analog instruments that may be categorized according to use or principle of operation as follows:

- a) Use:
 - 1) Panel Type, including edgewise.
 - 2) Switchboard type, including edgewise.
- b) Principle of operation:
 - 1) Electrodynamics.
 - 2) Permanent-magnet moving coil.
 - 3) Moving iron.
 - 4) Thermocouple.
 - 5) Rectifier.

1.6 These requirements also cover auxiliary equipment and accessories designed to be used with measuring instruments as indicated in 1.1 – 1.5.

1.7 These requirements do not cover:

- a) Indicating instruments provided with arrangements for curve drawing, contact making, and the like that derive the power for the functioning of these arrangements from an external source other than the measured parameter.
- b) Instruments that use active devices such as transistors, electron tubes, and the like for amplifying the electrical quantity measured, that require a power source other than the quantity measured for operation. An example of this is a battery-powered ohmmeter. This equipment is covered by the requirements for electrical and electronic measuring and testing equipment (UL 1244).

1.8 Instruments covered by these requirements are intended for use indoors or in sheltered (from the elements) locations, as follows:

- a) Temperature – 5 – 40°C or 41 – 104°F; instruments may occasionally be used for temporary or short periods at minus 10 – plus 5°C or 14 – 41°F.
- b) Altitude – Up to 2200 meters (7218 feet).
- c) Relative Humidity – Up to 80 percent.

1.9 These requirements do not cover certain other properties of the instruments such as effectiveness, accuracy, or reliability.

1.10 Throughout this Standard the term "instrument" applies to analog indicating and recording instruments and their accessories as described in 1.1 – 1.6.

1.11 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, and that involves a risk of fire, electric shock, or injury to persons, shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this Standard.

2 Components

2.1 A component of a product covered by this standard shall comply with the requirements for that component, and shall be used in accordance with its recognized rating and other limitations of use. 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 by this standard, or
- b) Is superseded by a requirement in this standard.

3 Units of Measurement

3.1 If a value for measurement as given in these requirements is followed by an equivalent value in other units, in parenthesis, the second value may be only approximate. The first stated value is the requirement. SI units as employed are in accordance with the American National Standard for Metric Practice, ANSI/ASTM E380.

4 References

4.1 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.

5 Glossary

5.1 For the purpose of this Standard, the following definitions apply.

5.2 **ACCESSIBLE PART** – A part that can be contacted by a person either directly or by means of a probe – see Figures 8.1 and 8.2 – when the instrument is in use.

5.3 **CIRCUIT-TO-GROUND VOLTAGE** – The rated value of voltage with respect to earth ground.

5.4 **CLEARANCE DISTANCE** – The shortest distance measured through air between conductive parts.

5.5 **CREEPAGE DISTANCE** – The shortest distance measured over the surface of insulation between conductive parts, excluding gaps of less than 1.0 mm (0.039 inch).

5.6 **ELECTRONIC DEVICE** – A part or an assembly of parts in which electrons flow through a vacuum, gas, or semiconductor.

5.7 **GROUND** – A conductive connection, whether intentional or unintentional, between an electrical circuit or instrument and the earth, or to some conducting body that serves in place of the earth.

5.8 **MEASURING (CONTROL, TEST) TERMINAL** – The external terminal or connector of the instrument to which connection is made to serve the instrument's function.

5.9 **RATING** – An electric value assigned to a component or instrument in determining its application.

CONSTRUCTION

6 General

6.1 General

6.1.1 The instrument shall be constructed to provide, either in normal use or under fault conditions:

- a) protection against the risk of electric shock, personal injury, and fire, and
- b) protection of components and wiring from displacement or damage.

6.1.2 The materials and components referred to in 6.1.1 and elsewhere in this Standard are those involving risk of fire, electric shock, or personal injury and are so considered unless specifically indicated otherwise.

6.2 Component construction requirements

6.2.1 Each component shall be fastened and secured if breaking or loosening of any electrical connection can result in risk of fire, electric shock, or personal injury. Internal wiring shall be routed and protected in such a manner that its insulation is not damaged or degraded.

7 Enclosure and Insulating Materials

7.1 General

7.1.1 The enclosure shall have the strength and rigidity necessary to resist the abuses to which it may be subjected during normal use and operator servicing without a reduction of spacings, loosening or displacement of parts or other defects that may result in inability of the instrument to comply with the requirements in this standard.

7.2 Enclosure materials

7.2.1 Each polymeric enclosure material shall be classified with regard to flammability rating, resistance to hot-wire ignition, and resistance to high-current-arc ignition according to Table 7.1.

7.2.2 The construction of the enclosure shall prevent molten metal, burning insulation, flaming particles, and the like from falling upon combustible materials, including the surface upon which the instrument rests or is otherwise supported.

7.2.3 When operated at end-scale conditions (maximum normal load), the temperature rises of instrument parts shall not exceed the values indicated in Table 18.1. For an instrument having special operating conditions, such as short-term or intermittent use, this requirement applies as far as compatible with such operating conditions.

7.2.4 When operated at end-scale conditions (maximum normal load) at elevated temperatures (see the High-Ambient Temperature Evaluation, Section 19) the instrument shall be resistant to the external forces described in Sections 24 – 28.

7.3 Insulating materials

7.3.1 Materials in contact with unlimited circuitry (see Subdivision of Circuits Into Groups, Section 15) shall be classified with regard to flammability rating, resistance to hot-wire ignition, and resistance to high-current-arc ignition according to Table 7.1.

7.3.2 The instrument when operated at end-scale conditions (maximum normal load) at an elevated temperature (see the High-Ambient Temperature Evaluation, Section 19) shall retain its dielectric voltage-withstand capabilities and spacings.

Table 7.1
Material requirements^a

Application	Flammability classification ^{b,e}	Properties	
		Resistance to ignition from	
		Hot wire ^{c,e}	High-ampere arc ^{d,e}
In contact with parts conductively connected to a line-connected circuit			
(A) Enclosures and insulating materials	94HB	30 sec	60 arcs
	94V-2	30 sec	30 arcs
	94V-1	15 sec	30 arcs
	94V-0	10 sec	15 arcs
(B) Printed-wiring boards	94V-1, 94V-0	—	—
(C) Connectors	94V-2, 94V-1, 94V-0	—	—
In contact with unlimited power circuits ^g , other than line-connected circuits			
(D) Enclosures and insulating materials ^f	94HB	15 sec	30 arcs
	94V-2, 94V-1, 94V-0	—	—
(E) Printed-wiring ^f boards	94V-1, 94V-0	—	—
(F) Connectors ^f	94V-2, 94V-1, 94V-0	—	—
In contact with high-voltage circuits in which the potential exceeds 2500 V ^{peak} and the maximum power exceeds 15 watts ^{peak}			
(G) Enclosures and insulating materials ^f	94V-2, 94V-1, 94V-0	—	—
(H) Printed-wiring boards ^f	94V-1, 94V-0	—	—
(I) Connectors ^f	94V-2, 94V-1, 94V-0	—	—
(J) Enclosure materials (required parts) used in applications other than those covered in lines (A), (D), and (G) ^f	94HB	15 sec	30 arcs
	94V-2, 94V-1, 94V-0	—	—
(K) Insulating materials, printed-wiring boards and connectors used in applications other than those covered in lines (B), (C), (E), (H) and (I)	—	—	—

^a These requirements do not apply to the internal insulating systems of components or where component requirements exist.

^b The flammability classifications 94V-0, 94V-1, 94V-2, and 94HB are to be determined by the tests described in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. For enclosures, a material classified using 3.2-mm (1/8-inch) thick bar specimens can be accepted in lesser thicknesses in the end product. For other parts, a material classified using 1.6-mm (1/16-inch) thick bar specimens can be accepted in lesser thicknesses in the end product.

^c Hot-Wire Resistance to Ignition — Hot-wire ignition performance is expressed as the number of seconds needed to ignite standard specimens that are wrapped with resistance wire that dissipates a specified level of electrical energy. Bar samples are to be used for this test. For enclosures, a material classified using 3.2-mm (1/8-inch) thick bar specimens can be accepted in lesser thicknesses in the end product. For other parts, a material classified using 1.6-mm (1/16-inch) thick bar specimens can be accepted in lesser thicknesses in the end product. Refer to the requirements for polymeric materials—short-term property evaluations, UL 746A, for details of the test.

^d High-Ampere Arc-Resistance to Ignition — High-Ampere arc-ignition performance is expressed as the number of arc-rupture exposures (standardized as to electrode type and shape and electrical circuits) that are necessary to ignite a material when they are applied at a standard rate on the surface of the material. Bar samples are to be used for this test. For enclosures, a material classified using 3.2-mm (1/8-inch) thick bar specimens can be accepted in lesser thicknesses in the end product. For other parts, a material classified using 1.6-mm (1/16-inch) thick bar specimens can be accepted in lesser thicknesses in the end product. Refer to the requirements for polymeric materials—short-term property evaluations, UL 746A, for details of the test.

(Continued)

Table 7.1 (Cont'd)

^e For an assembly, samples for the test parameters according to Table 7.1 can consist of the assembly and can be tested as finished parts, or test samples can be cut from finished products. In the case of small parts that might be consumed before the test is completed, large samples of the same material can be tested provided that they represent the same or lesser thicknesses than the part in question. None of the larger samples is to be entirely consumed. Samples that consist of an assembly or a section thereof that are not flat stock samples are to be positioned in what is considered to be the worst-case position in the application.

^f The requirements that materials used in applications covered by items D–J of Table 7.1 possess certain flammability and ignition ratings do not apply to small parts. For the purpose of these requirements, a small part is one that complies with all of the following criteria:

- a) The maximum dimension of the part does not exceed 30 mm (1.18 inches).
- b) The volume of the part does not exceed 8000 mm³ (0.488 cubic inch).
- c) The part is located where it cannot act as a bridge between a source of arcing or ignition and other ignitable parts.

^g An unlimited-power circuit is one which is not limited in accordance with item A of 15.1.1.

8 Accessibility of Live Parts

8.1 General

8.1.1 Parts that are intended to be accessible after installation, including accessible parts of terminals, shall not involve the risk of electric shock.

8.1.2 Coatings, film, and fibrous materials consisting only of enamel, lacquer, oxides, anodic films, nonimpregnated paper, untreated fiber, and wood shall not be regarded as providing protection from the risk of electric shock. Such insulations that are accessible shall be removed or disregarded during the determination of accessibility of live parts.

Exception: Materials such as untreated paper, fiber, or wood may be used as a mechanical barrier if warpage or displacement does not prevent its effectiveness.

8.2 Determination of accessibility

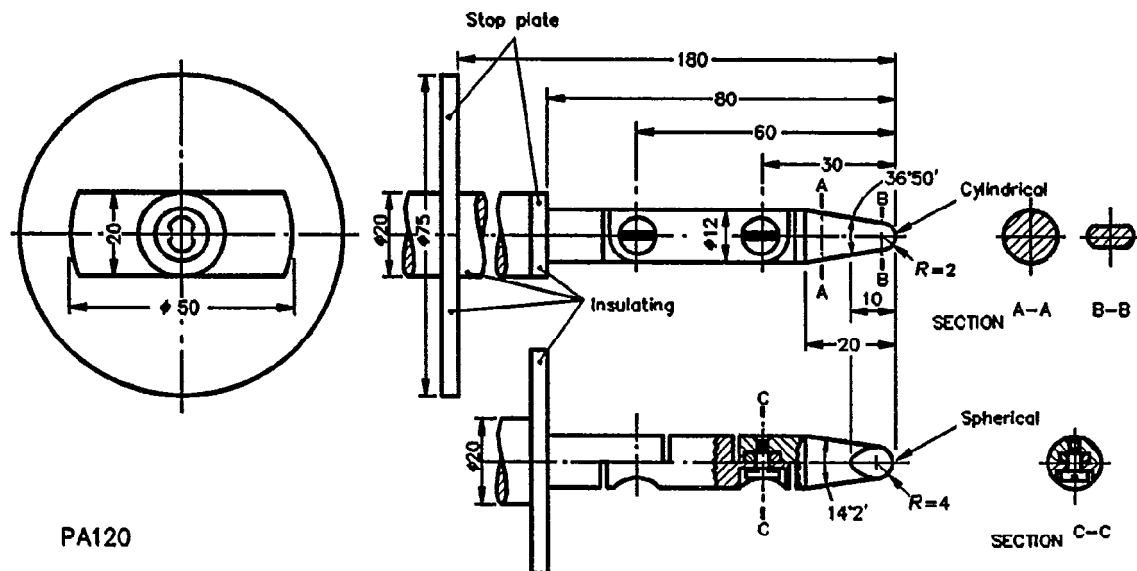
8.2.1 A part is accessible if one or both of the following conditions exist:

- a) The International Electrotechnical Commission (IEC) articulate accessibility probe with stop plate (Figure 8.1) applied in every possible position through openings in the exterior surfaces, including the bottom, touches the part.
- b) The IEC rigid accessibility probe (Figure 8.2), applied with a maximum force of 30 N (6.75 lbf), in every possible position through openings in all exterior surfaces, including the bottom, touches the part.

8.2.2 For an instrument that is insulation-encased, conductive foil shall be wrapped about the accessible surfaces of the instrument. Where the enclosure is partially insulation-encased, conductive foil shall be wrapped only about the insulating portion.

Figure 8.1
International Electrotechnical Commission (IEC)
Articulate accessibility probe with stop plate

All dimensions in millimeters



mm	2	4	10	20	30	50	60	75	80	180
INCH	5/61	5/32	25/64	25/32	1-3/16	1-31/32	2-23/64	2-61/64	3-5/32	7-3/32