

UL 2111

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Overheating Protection for Motors

Underwriters Laboratories Inc. (UL)
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UL Standard for Safety
for
Overheating Protection for Motors, UL 2111

First Edition, Dated March 28, 1997

The new requirements are substantially in accordance with UL's Bulletin on this subject dated June 13, 1996. The bulletin is now obsolete and may be discarded.

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MARCH 28, 1997

1

UL 2111

Standard for

Overheating Protection for Motors

Prior to the first edition, the requirements for the products covered by this Standard were included in the Standard for Impedance-Protected Motors, UL 519, and the Standard for Thermal Protectors for Motors, UL 547.

First Edition

March 28, 1997

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 set of revised requirements.

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CONTENTS

FOREWORD

INTRODUCTION

1 Scope	5
2 Units of Measurement	5
3 Glossary	6
4 Application of Requirements	6

PART I – ALL MOTORS

5 General	7
-----------------	---

PART II – IMPEDANCE-PROTECTED MOTORS

CONSTRUCTION

6 General	9
-----------------	---

PERFORMANCE

7 Locked-Rotor Temperature Test	9
8 Dielectric Voltage Withstand Test	11
9 Locked-Rotor Endurance Test	11

PART III – THERMAL-DEVICE-PROTECTED MOTORS

CONSTRUCTION

10 General	11
11 Spacings	12

PERFORMANCE

12 General	14
13 Running Heating Temperature Test	15
14 Locked-Rotor Temperature Test	17
15 Dielectric Voltage-Withstand Test	19
16 Locked-Rotor Endurance Test	19

PART IV – THERMAL PROTECTORS

CONSTRUCTION

17 General	20
------------------	----

PERFORMANCE

18 Limited Short Circuit Test	22
19 Protector Insulation Test	25

PART V – MOTOR MANUFACTURING AND PRODUCTION LINE TESTS

20 Dielectric Voltage-Withstand Test 26

PART VI – MARKINGS

21 Impedance-Protected Motors (Part I) 28
22 Thermal-Device-Protected Motors (Part II) 28
23 Thermal Protectors (Part III) 30

APPENDIX A

Standards for Components A1

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 which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, 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 The requirements in this standard cover:

- a) Impedance-protected motors;
- b) Thermal-device-protected motors; and
- c) Thermal-protective devices.

1.2 The requirements in this standard apply only to motors rated 600 V or less.

1.3 The requirements in this standard do not cover:

- a) A manual device for opening the circuit;
- b) A motor intended for use in a hazardous location;
- c) Motors employing a device that serves as a motor protector and a manual motor controller;
- d) Motors employing a motor protector with contacts that control a relay coil in a motor starter;
- e) Motors protected by devices responsive to current only;
- f) Sealed (hermetic) type motor compressors;
- g) Impedance-protected motors employing an automatic-starting switch; or
- h) Thermal cutoff devices. Thermal cutoffs are covered by UL 1020, Standard for Thermal Cutoffs for Use in Electrical Appliances and Components.

1.4 The requirements in this standard are intended to evaluate a specific motor with a given protector. When either the motor or the protector is changed, a separate evaluation is required.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involve a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as required to maintain the level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard is not judged to comply with this Standard. Where appropriate, revision of requirements are proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Units of Measurement

2.1 When a value for measurement is followed by a value in other units in parentheses, the first stated value is the requirement.

3 Glossary

3.1 For the purpose of this standard, the following definitions apply.

3.2 AUTOMATICALLY RESET PROTECTOR – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and automatically closes the circuit once the device has cooled to a lower temperature.

3.3 FIELD-WIRING TERMINAL – A terminal to which connection is capable to be made in the field.

3.4 IMPEDANCE-PROTECTED MOTOR – A motor that relies solely upon the impedance of the windings alone to prevent overheating.

3.5 MANUALLY RESET PROTECTOR – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and requires manual resetting to reclose the motor circuit.

3.6 OPEN MOTOR – A motor having ventilating openings that provide for the passage of external cooling air over and around the windings.

3.7 SECONDARY (BACK-UP) PROTECTION – A protector that does not operate under normal running or locked rotor test conditions, without further stress applied to the motor by increased winding temperature, ambient temperature, or voltage.

3.8 SINGLE-OPERATION DEVICE – A device that incorporates a bimetal that is calibrated to open the motor circuit upon reaching a certain temperature and is resettable only by cooling to minus 35EC (minus 31EF), or lower.

3.9 THERMAL CUTOFF – A device that incorporates a melting alloy or other material that is calibrated to permanently open the motor circuit upon reaching a certain temperature.

3.10 THERMAL-DEVICE-PROTECTED MOTOR – A motor that relies upon a device (protector) to prevent overheating.

3.11 THERMAL PROTECTOR – A device installed integrally within a motor that is responsive to motor current and temperature or temperature only and that, when applied as intended, prevents overheating. Types are: thermal cutoff, automatically reset, manually reset and single-operation.

3.12 TOTALLY-ENCLOSED MOTOR – A motor that is enclosed to prevent the free exchange of air between the inside and outside of the winding enclosure and not so enclosed as to be airtight.

4 Application of Requirements

4.1 This standard is comprised of six parts. Part I applies to all motors. Part II applies to impedance-protected motors. Part III applies to motor/protector combinations. Part IV applies to thermal protectors employed within a motor. Part V consists of manufacturing and production tests. Part VI consists of marking requirements.

PART I – ALL MOTORS

5 General

5.1 The voltage of the supply circuit shall be as specified in Table 5.1. For motors intended for use over a range of voltages, all applicable nominal voltages shall be tested. For example, a motor rated 200 – 230 volts shall be tested at 208 volts and at 240 volts.

Exception No. 1: A motor having a voltage rating outside the ranges specified in Table 5.1 shall be tested at 100 – 105 percent of the rated voltage, and is not to be less than 100 percent.

Exception No. 2: When the motor is intended for a specific application where the source voltage is outside the range specified in Exception No. 1, the motor is able to be tested at greater than 105 percent of the intended source of supply.

Table 5.1
Test voltages

Motor nameplate rating, volts	Nominal test voltage
110 – 120	120
200 – 208	208
220 – 240	240
254 – 277	277
440 – 480	480
550 – 600	600

5.2 Thermocouples are to consist of wires not larger than No. 30 AWG (0.05 mm²). The thermocouple wire is to conform with the requirements for special thermocouples as listed in the limits of error of thermocouples given in Temperature-Measurement Thermocouples, ANSI MC96.1-1982(1991).

5.3 A minimum of 4 thermocouples are to be used to measure the temperature.

5.4 The change-in-resistance method compares the heated coil resistance to the resistance at a known (ambient) temperature and uses the following equation to determine the heated coil temperature:

$$T_2 = R_2/R_1 (K \% T_1) + K$$

in which:

T₂ is the coil temperature at the end of the test in degrees C;

R₂ is the coil resistance at the end of the test;