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residential controls—

load control for use on central electric heating systems

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 155 EAST 44TH STREET, NEW YORK, N.Y. 10017

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SCOPE

This standards publication describes classifications, control modes, ratings and other characteristics of load control for use on central electric heating systems which are intended primarily for residential use.

PREFACE

This publication has been developed in the public interest and is designed to promote a better understanding between the manufacturer and the user and to assist the user in selecting and obtaining the proper regulating control for his particular need.

To assure a meaningful publication, copies were sent during the draft stage to a number of typical individuals and organizations in the public and private sector having an interest in or responsibility for the purchase, testing, application, use or inspection of these controls. The resulting comments and suggestions provided a vital user and general interest input, prior to final NEMA approval, and resulted in a number of substantive changes being made in this publication.

As future major revisions to this publication are proposed, it is intended to offer the same or similar individuals or organizations a further opportunity to participate in the development of this publication.

These standards are periodically reviewed by the Residential Controls Section of NEMA for any revisions necessary to keep them up to date with advancing technology. Proposed or recommended revisions should be submitted to:

Manager, Engineering and Safety Regulations Department
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HISTORY OF STANDARDS

The Residential Controls Section of NEMA was formed in 1940 to promote the standardization of products within the scope of the Section. These product standards cover definitions, ratings, performance, testing, and dimensions. NEMA Standards are voluntary and are designed to eliminate misunderstandings between the purchaser and the manufacturer.

This publication is one of a series sponsored by the Residential Controls Section. Other publications in this series are identified as Pub. No. DC _____ (followed by the year of issue).

The Residential Controls Section of NEMA first formed a Joint Committee with the Edison Electric Institute in 1969 to develop standards for load control for use on central electric heating systems. The deliberations of this Joint Committee resulted in the EEI-NEMA Standards for Load Control for use on Central Electric Heating Systems, NEMA Pub. No. 101-1971, EEI Pub. No. 71-43, September 1971.

This revised edition, DC 22-1977, was developed by the Residential Controls Section of NEMA after it was notified that EEI intended to withdraw from standards development activities. It is published in accordance with NEMA's policy of periodic review and revision to keep NEMA Standards contemporary with industry needs and technological advancement.

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LOAD CONTROL FOR USE ON CENTRAL ELECTRIC HEATING SYSTEMS

Part 1
DEFINITIONS

DC 22-1.01 CENTRAL ELECTRIC HOT-WATER BOILER

One or more electric heating elements within a suitable enclosure, provided with appropriate controls, and designed to be connected to a hot-water distribution system.

NEMA Standard 11-12-1970.

DC 22-1.02 CENTRAL FORCED-AIR ELECTRIC HEATER

One or more electric heating elements, with an air-moving means, provided with appropriate controls, housed within an enclosure, and designed to be connected to duct work for the transmission of heated air to various spaces.

NEMA Standard 11-12-1970.

DC 22-1.03 CONTROL MODE CATEGORIES

A. Modulating (Type M)

Provides automatic regulation of the load control between its full on and full off position, depending on the heating load requirements.

B. Sequenced (Type S)

On a call for heat from the thermostat, the load control switches on the heater elements, in increments of load in sequence according to the timing requirements prescribed in DC 22-2.04.

At the end of the call for heat, the load control switches off the heater elements instantaneously, randomly, or in sequence.

C. Not Sequenced (Type N)

On a call for heat from the thermostat, the load control switches the heater elements on and off either instantaneously or randomly, or a combination of the two.

NEMA Standard 11-11-1976.

DC 22-1.04 FAN CONTROL

A thermally actuated device which acts to control the fan that provides the circulation of air between predetermined temperatures.

NEMA Standard 11-11-1976.

DC 22-1.05 HEATING ELEMENT

The electrical conducting component which is heated by an electric current and which dissipates this heat.

NEMA Standard 11-12-1970.

DC 22-1.06 LIMIT CONTROL

A safety control responsive to changes in pressure or temperature and normally set beyond the operating range for limiting the operation of the controlled equipment.

NEMA Standard 11-12-1970.

DC 22-1.07 LOAD CONTROL

A heater may have one or more heater elements to be controlled. A load control consists of one or more load switching devices to automatically control the current flow to the heater element or elements.

NEMA Standard 11-11-1976.

DC 22-1.08 LOAD SWITCHING DEVICE

An automatic device which controls an increment of electrical load and which may have one or more poles.

NEMA Standard 11-11-1976.

DC 22-1.09 RATING, ELECTRICAL

The maximum specified electrical rating of the load control in volts and amperes, or volts and watts.

NEMA Standard 11-12-1970.

DC 22-1.10 SOLID STATE SWITCHING

A. Phase Angle

Initiation of conduction of a solid-state switching device at any point on the voltage sine wave.

B. Zero Voltage

Initiation of conduction of a solid-state switching device at the instant the voltage sine wave passes through zero.

NEMA Standard 11-12-1970.

DC 22-1.11 THERMOSTATS

A. Multiple-stage Thermostat

Controls two or more separate electrical loads from one or more temperature-sensitive elements by actuating two or more switches in the thermostat.

B. Single-stage Thermostat

Controls an electrical load from a single temperature-sensitive element by actuating a single switch in the thermostat.

NEMA Standard 11-11-1976.

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Part 2
CONTROL MODES, RATINGS, PERFORMANCE AND APPLICATION

DC 22-2.01 CONTROL MODE CATEGORIES

The following control mode categories have been established to provide for the selection of suitable load controls for the types of operation described in DC 22-1.03:

1. Type M (modulating) operation.
2. Type S (sequenced) operation.
3. Type N (nonsequenced) operation.

Authorized Engineering Information 11-11-1976.

DC 22-2.02 RATINGS OF THE LOAD CONTROL

A. Electrical Ratings

The electrical ratings of the load control shall be:

1. Voltage—208, 240 or 277 volts alternating current.
2. Frequency—50 and/or 60 hertz.
3. Maximum current per load switching pole—48 amperes. Any one load switching pole may be rated to switch a combined total load of 48 amperes. This is the sum of the noninductive load plus the full-load amperes of the motor load.

B. Ambient Temperature Ratings

The ambient temperature ratings of the load control shall be:

1. Low ratings—32°F (0°C), or -20°F (-29°C), or -40°F (-40°C).
2. High ratings—150°F (66°C) or 165°F (74°C).

NEMA Standard 11-11-1976.

DC 22-2.03 PERFORMANCE OF SOLID-STATE DEVICES—TYPE M (MODULATING) OPERATION

When solid-state devices are used for modulating control of the load, the following requirements apply:

1. At a given heating load under normal operation, one zero-voltage switching device shall switch only "one-on" and "one-off" in a 30 second period.
2. Load controls shall be designed and constructed so that equal control is applied to both the positive half and the negative half of the alternating-current wave, with no significant rectifying action on the current as seen from the supply side of the line.

NEMA Standard 11-11-1976.

NOTE—Phase angle switching is not recommended for residential applications at this time because the generated harmonics can produce interference with voice and electronic communications circuits, such as telephones, radio and television.

Authorized Engineering Information 11-11-1976.

DC 22-2.04 TIMING CHARACTERISTICS (TYPE S ONLY)

A. During normal operation, there shall be not less than a 5-second delay between the switching action for each 48-ampere (maximum) increment of load. This delay shall be measured at 77°F and at rated voltage conditions and shall apply to the "make" operation only. There are no timing restrictions on the "break" operation.

B. A multistage room thermostat which switches a maximum of 48 amperes per stage complies with the requirements of par. A without the use of specific delay devices.

C. A single-stage room thermostat which switches a maximum of 48 amperes under the majority of outdoor temperature conditions may switch an additional 48 amperes simultaneously through an outdoor thermostat under conditions involving very cold outdoor temperatures. This is considered to comply with the requirements of par. A.

D. Under the following conditions, the load control need not comply with par. A:

1. Change of temperature set point on room thermostat.
2. Start-up after power interruption.

NEMA Standard 11-11-1976.

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DC 22-2.05 OPERATION UNDER VARIABLE VOLTAGE AND AMBIENT CONDITIONS

The load control shall be capable of performing the switching functions at plus 10 percent and minus 15 percent of rated supply voltage over the ambient temperature ratings of the load control.

NEMA Standard 11-11-1976.

DC 22-2.06 SUITABILITY OF APPLICATION

Load controls shall be designed, assembled and constructed to be suitable for use with central forced-air electric heaters, hot water boilers, and auxiliary heaters as used with heat pumps in accordance with Underwriters Laboratories Inc. Safety Standards UL 559-1975 and UL 873-1975.*

The testing of these devices shall be done in accordance with UL 873-1975.*

NEMA Standard 11-11-1976.

*UL 559-1975 Heat Pumps and UL 873-1975 Temperature -Indicating and -Regulating Equipment are available from Underwriters Laboratories Inc. at 333 Pfingsten Road, Northbrook, Illinois 60062.

DC 22-2.07 INSTALLATION AND SERVICE INSTRUCTIONS

The manufacturer should supply suitable installation and service instructions covering each specific catalog series. The data supplied should also contain warnings against damaging practices.

Authorized Engineering Information 11-12-1970.

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NEMA STANDARDIZATION

The purpose of NEMA Standards, their classification and status are set forth in certain clauses of the NEMA Bylaws, which are quoted below:

Purpose of Standards

National Electrical Manufacturers Association Standards are adopted in the public interest and are designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for its particular need. Existence of a National Electrical Manufacturers Association Standard does not in any respect preclude any member or nonmember from manufacturing or selling products not conforming to the standard.

(Bylaw—Art. V, Sec. 1)

Definition of a Standard

A standard of the National Electrical Manufacturers Association defines a product, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, rating, testing, and the service for which they are designed.

(Bylaw—Art. V, Sec. 2, Subsection A)

Dimensions

Where dimensions are given for interchangeability purposes, alternate dimensions satisfying the other provisions of the standards publication may be capable of otherwise equivalent performance.

(NEMA Policy Memorandum 84-2, dated June 7, 1984)

Classes of Standards

National Electrical Manufacturers Association Standards are of two classes:

1. NEMA Standard, which relates to a product commercially standardized and subject to repetitive manufacture, which standard has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon;
2. Suggested Standard for Future Design, which may not have been regularly applied to a commercial product, but which suggests a sound engineering approach to future development, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote thereon.

(Bylaw—Art. V, Sec. 2, Subsection B)

Authorized Engineering Information

Authorized Engineering Information consists of explanatory data and other engineering information of an informative character not falling within the classification of NEMA Standard or Suggested Standard for Future Design.

(Bylaw—Art. V, Sec. 6, 1st Sentence)

Official Standards Proposal

An Official Standards Proposal is an official draft of a proposed standard which is formally recommended to an outside organization(s) for consideration, comment and/or approval.

(Bylaw—Art. V, Sec. 4, Subsection A)

Identification of Status

Standards in NEMA Standards Publications are identified in the foreword or following each standard as "NEMA Standard" or "Suggested Standard for Future Design." These indicate the status of the standard. These words are followed by a date which indicates when the standard was adopted in its present form by the Association.

The material identified as "Authorized Engineering Information" and "Official Standards Proposal" is designated similarly.

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