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NEMA STANDARDS PUBLICATION/NO. DC 12

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Hot-water Immersion Controls

NEMA

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION ■ 2101 L STREET N.W., WASHINGTON, D.C. 20037

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NEMA DC 12-1985

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HOT-WATER IMMERSION CONTROLS

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Foreword

This Standards 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 hot-water immersion control for his particular need.

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 Department
National Electrical Manufacturers Association
2101 L Street, N. W.
Washington, D. C. 20037

Publication No. DC 12-1985 revises and supersedes the NEMA Standards Publication for *Hot-water Immersion Controls*, Publication No. DC 12-1979. Prior to publication, the NEMA Standards, Suggested Standards for Future Design, and Authorized Engineering Information which appear in this publication unchanged since their appearance in DC 12-1979 were reaffirmed. Those which have been revised are followed by the appropriate classification and the date "11-14-1985."

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Scope

This Standards Publication covers the operating range, differential, electrical ratings, and dimensions of electric-switch-type hot-water immersion controls intended primarily for application to hot-water boilers and heaters used in residential heating systems.

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 Publication No. DC XX - (followed by the year of issue).

About 23 years ago, the Technical Committee of the Residential Controls Section of NEMA formed a subcommmittee to develop standards for hot-water immersion controls. The deliberations of this Committee resulted in the issuance of the NEMA Standards Publication for *Hot-water Immersion Controls*, DC 12-1963, which was later revised and superseded first by DC 12-1972, and then by DC 12-1979.

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HOT-WATER IMMERSION CONTROLS

Section 1

REFERENCED STANDARDS AND DEFINITIONS

1.1 REFERENCED STANDARDS

In this publication, reference is made to the standards listed below. Copies are available from the indicated sources.

I
American National Standards Institute
1430 Broadway
New York, NY 10018

ANSI/UL 353-1974 *Standard for Limit Controls*
ANSI/UL 873-1981 *Standard for Temperature-Indicating and -Regulating Equipment*

II
National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, D.C. 20037

DC 3-1984 *Wall Mounted Room Thermostats*

1.2 DEFINITIONS

1.2.1 Control, Circulator

A control which is intended to prevent the circulation of water when the water is below a minimum temperature.

NEMA Standard 5-16-1963.

1.2.2 Control, Combination

A control which combines one or more of the functions of low-limit, high-limit, and circulator controls with other control functions.

NEMA Standard 5-16-1963.

1.2.3 Control, Dual

A control having two switching functions and combining any two of the following controls: low-limit, high-limit, and circulator.

A dual control shall be permitted to have a single temperature sensor.

NEMA Standard 11-14-1985.

1.2.4 Control, High-Limit

A control which is intended to prevent the water from exceeding a predetermined temperature.

NEMA Standard 5-16-1963.

1.2.5 Control, Hot-Water Immersion

A control having a temperature-sensitive element intended for well or direct immersion and normally used to provide high- or low-limit control of the water temperature or control of a water circulator or valves, or combination thereof.

NEMA Standard 9-20-1972.

1.2.6 Control, Low-Limit

A control which is intended to prevent the water from going below a predetermined temperature.

NEMA Standard 5-16-1963.

1.2.7 Control, Triple

A control which combines all of the functions of the following controls: low-limit, high-limit and circulator.

A triple control shall be permitted to have a single temperature sensor.

NEMA Standard 11-14-1985.

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1.2.8 Differential

The difference in the water temperature at the sensing element in degrees C (degrees F) between the temperature value at which the control initiates action and the temperature value at which the control terminates action.

NEMA Standard 11-14-1985.

1.2.9 Immersion, Direct

The sensing element is immersed directly in the water, without a well.

NEMA Standard 5-16-1963.

1.2.10 Immersion, Well

The sensing element is inserted in a well which is immersed in the water.

NEMA Standard 5-16-1963.

1.2.11 Range, Operating

The difference in degrees C (degrees F) between the minimum and the maximum temperature settings.

NEMA Standard 11-14-1985.

1.2.12 Range Setting Stop

The means which prevents the user from adjusting the control beyond a specified temperature setting(s).

NEMA Standard 11-14-1985.

1.2.13 Scale Markings

The temperature settings marked on the control in degrees C (degrees F).

NEMA Standard 11-14-1985.

1.2.14 Temperature Setting

The temperature to which the control is set.

NEMA Standard 11-14-1985.

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Section 2

RATINGS AND CLASSIFICATIONS

2.1 RATINGS

Hot-water immersion controls may have one or more of the following ratings:

Volts AC	Amperes Full Load	Amperes Locked Rotor
120	7.4	44.5
	8	48
	10	60
	14	84
240	3.7	22.2
	4	24
	5	30
	6	36
	7	42
24	6 amperes maximum or 50 volt-amperes pilot duty	
0.250 to 12 volts DC	1 ampere maximum	
120 to 240 Volts ac pilot duty	125 volt-amperes	

Authorized Engineering Information 11-14-1985.

2.2 SCALE MARKINGS

The scale markings on hot-water immersion controls shall be within a minimum of 37.8 °C (100 °F) and a maximum of 143.3 °C (290 °F).

NEMA Standard 11-14-1985.

The scale markings may comprise a single value within these limits.

Authorized Engineering Information 11-14-1985.

2.3 DIFFERENTIAL

The differential shall be:

1. Adjustable — within 2.8 °C (5 °F) minimum, 25 °C (45 °F) maximum; or
2. Fixed — 5.6 °C (10 °F) or less.

NEMA Standard 11-14-1985.

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Section 3

CONSTRUCTION

3.1 DIMENSIONS

Dimensions for direct- and well-immersion-type hot-water immersion controls shall be in accordance with Table 3-1.

NEMA Standard 9-20-1972.

3.2 MOUNTING

The control mounting means shall be sufficiently rigid to withstand the normal vibration and shock encountered in the shipping of a boiler or heater.

NEMA Standard 11-14-1985.

3.3 CONNECTIONS

3.3.1 Terminals

Terminals shall be of a type which meets the requirements of UL 873 and UL 353.

NEMA Standard 11-14-1985.

3.3.2 Wiring

If external lead wires are provided as a part of the control, the size of wire shall be in accordance with UL 873 and UL 353.

NEMA Standard 11-14-1985.

3.4 MATERIALS

3.4.1 Corrosion Protection

Iron and steel parts (except in the case of bimetals, bearings, etc., where such protection is impracticable) shall be suitably protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

Parts made of copper alloy, except for the threaded fitting of a well immersion or direct immersion control, which come in contact with boiler water, shall resist dezincification.

NEMA Standard 11-14-1985.

3.4.2 Strength

Hot-water immersion controls shall be so designed that installation stresses will not affect their calibration.

NEMA Standard 4-16-1978.

3.4.3 Enclosures

Enclosures for hot-water immersion controls shall be in accordance with UL 873 and UL 353.

NEMA Standard 11-14-1985.

3.5 ASSEMBLY

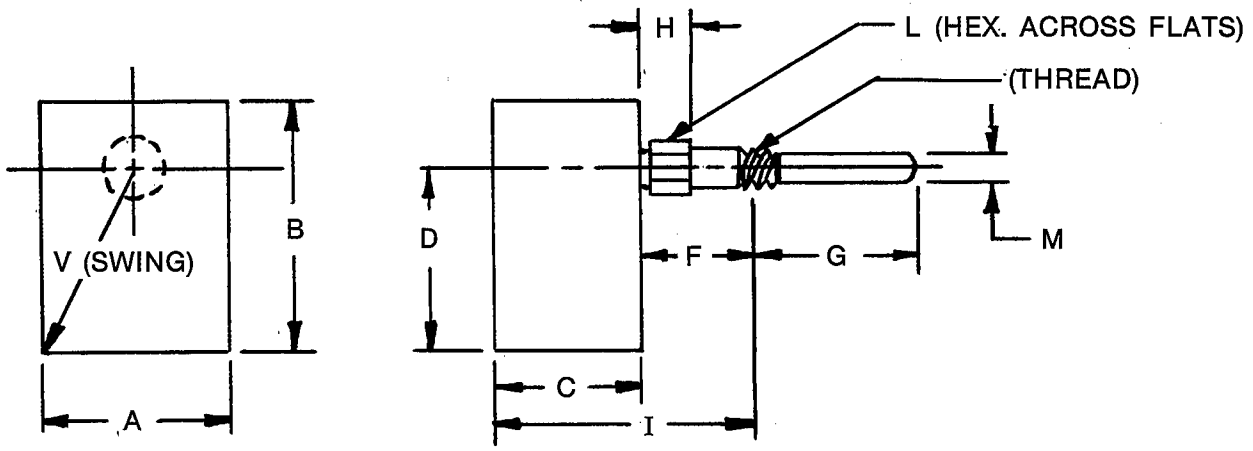
Hot-water immersion controls shall be assembled in a manner so as to afford normal protection to the installer and user with regard to sharp edges, surfaces, adjusting means, and so forth.

NEMA Standard 11-14-1985.

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Table 3-1
DIMENSIONS FOR DIRECT- AND WELL-IMMERSION-TYPE HOT-WATER IMMERSION CONTROLS



NOTE—F, G and I dimensions are to the fifth thread.

TYPE OF CONTROL	A MAX.	B MAX.	C MAX.*	D MAX.	F MIN.	G MAX.	H MIN.	I MAX.	L NOM.	M NOM.	V	THREAD
Single	86 (3-3/8)	152.5 (6)	76.5 (3)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	140 (5-1/2)	22.5 (7/8)	13 (1/2)	127 (5)	1/2 NPT
	86 (3-3/8)	152.5 (6)	76.5 (3)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	140 (5-1/2)	27 (1-1/16)	22.5 (7/8)	127 (5)	3/4 NPT
Dual	108 (4-1/4)	152.5 (6)	76.5 (3)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	140 (5-1/2)	22.5 (7/8)	13 (1/2)	140 (5-1/2)	1/2 NPT
	108 (4-1/4)	152.5 (6)	76.5 (3)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	140 (5-1/2)	27 (1-1/16)	22.5 (7/8)	140 (5-1/2)	3/4 NPT
Triple	108 (4-1/4)	152.5 (6)	76.5 (3)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	140 (5-1/2)	22.5 (7/8)	13 (1/2)	140 (5-1/2)	1/2 NPT
	108 (4-1/4)	152.5 (6)	76.5 (3)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	140 (5-1/2)	27 (1-1/16)	22.5 (7/8)	140 (5-1/2)	3/4 NPT
Combination, Vertical Case (B greater than A)	143 (5-5/8)	181 (7-1/8)	102 (4)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	171.5 (6-3/4)	22.5 (7/8)	13 (1/2)	...	1/2 NPT
	143 (5-5/8)	181 (7-1/8)	102 (4)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	171.5 (6-3/4)	27 (1-1/16)	22.5 (7/8)	...	3/4 NPT
Combination, Horizontal Case (A greater than B)	181 (7-1/8)	143 (5-5/8)	102 (4)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	171.5 (6-3/4)	22.5 (7/8)	13 (1/2)	...	1/2 NPT
	181 (7-1/8)	143 (5-5/8)	102 (4)	124 (4-7/8)	38 (1-1/2)	87.5 (3-7/16)	13 (1/2)	171.5 (6-3/4)	27 (1-1/16)	22.5 (7/8)	...	3/4 NPT

All dimensions in mm (inches).
*Including all protrusions.

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Section 4

PERFORMANCE

4.1 GENERAL

Hot-water immersion controls shall meet the appropriate requirements specified in UL 353 and UL 873.

NEMA Standard 11-14-1985.

4.2 DIFFERENTIAL TESTS

The bulb and 76.5 millimeters (3 inches) of capillary tubing shall be placed in a well agitated liquid bath which shall be raised at a rate not to exceed 0.56°C (1°F) per minute to the point of switch operation and lowered at the same rate to again effect switch operation.

The body of the control shall be in an ambient temperature of (23.9 ± 2.8)°C, (75 ± 5)°F.

The operating differential shall be within the limits specified by the manufacturer.

NEMA Standard 11-14-1985.

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Section 5

MARKING

5.1 CONTROL MARKINGS

5.1.1 Hot-water immersion controls shall have the following minimum markings:

1. Company name or trademark
2. Catalog number or the equivalent
3. Voltage rating and the ampere, wattage, or pilot duty rating
4. Control function (on combination controls and on dual and triple controls)
   a. High limit
   b. Circulator
   c. Low limit
5. Date of manufacture (preferably by indicating the last two digits of the calendar year, followed by the number of the week of manufacture)

NEMA Standard 11-14-1985.

5.1.2 Labels, stampings or decalcomanias shall be of a permanent nature and located where they will not be exposed to mechanical damage.

NEMA Standard 11-14-1985.

5.1.3 Markings shall be visible after installation. Markings which are on the base or inside of a cover and which are exposed when the cover is removed shall be considered to be visible after installation.

NEMA Standard 11-14-1985.

Section 6

APPLICATION

6.1 GENERAL

The manufacturer should supply suitable installation and service instructions and, in addition, warnings against damaging practices.

Authorized Engineering Information 9-20-1972.

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September 1984

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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