NEMA Standards Publication No. DC 13-1979 (R1985, R1991, R1997)

Line Voltage Integrally Mounted Thermostats for Electric Heaters

Published by:

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209

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Foreword

User needs were considered in the development of this Standards Publication.

This Standards Publication defines the basic standards for the construction and performance of the line-voltage integrally mounted thermostats for electric heaters. It has been developed in the public interest and is designed to provide a better understanding between the manufacturer and the user and to assist the user in selecting and obtaining the proper thermostat for his or her particular need.

If a value for measurement as given in this Standards Publication is followed by an equivalent value in other units, the first stated value is to be regarded as the requirement. The given equivalent value may be only approximate.

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:

Vice President, Engineering
National Electrical Manufacturers Association
2101 L Street, N.W., Suite 300
Washington, DC 20037

Publication No. DC 13-1979 (R1985, R1991) revises and supersedes the NEMA Standards Publication No. DC 13-1979 (R1985) *Line-voltage Integrally Mounted Thermostats for Electric Heaters*. Prior to publication, the NEMA Standards, Suggested Standards for Future Design, and Authorized Engineering Information that appear in this publication unchanged since their appearance in DC 13-1979 (R 1985) were reaffirmed. Those that are new or have been revised are followed by their appropriate classification date.

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Scope

This Standards Publication covers line-voltage integrally mounted thermostats for electric heaters and contains definitions, ratings, construction features, performance, marking, and application information.

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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 XX (followed by the year of issue).

The development of NEMA Standards for line-voltage integrally mounted thermostats for electric heaters was prompted by a need for a basic set of standards for construction and performance that were not covered by other standards.

Action was first taken in 1963 to develop standards for line-voltage integrally mounted thermostats for electric heaters by the NEMA Subcommittee for Room Thermostats. The first publication was issued in 1964 and designated DC 13-1964.

NEMA Publication No. DC 3-1989 covers wall-mounted thermostats.

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LINE-VOLTAGE INTEGRALLY MOUNTED THERMOSTATS FOR ELECTRIC HEATERS

Section 1
REFERENCED STANDARDS AND DEFINITIONS

1.1 REFERENCED STANDARDS

In this Standards Publication reference is made to the following publications. They are available from the sources indicated.

American National Standards Institute
11 West 42nd Street
New York, NY 10036

National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269

ANSI NFPA 70-1990 — *National Electrical Code*

American National Standards Institute
1430 Broadway
New York, NY 10018

Underwriters Laboratories Inc.
333 Pfingsten Road
Northbrook, IL 60062

ANSI UL 310-1988 — *Electrical Quick-Connect Terminals*
ANSI UL 486A-1982 — *Standard for Wire Connectors and Soldering Lugs for Use with Copper Conductors*
ANSI UL 486B-1982 — *Standard for Wire Connectors for Use with Aluminum Conductors*
ANSI UL 873-1988 — *Standard for Temperature-Indicating and -Regulating Equipment*

National Electrical Manufacturers Association
2101 L Street, N.W.
Washington, DC 20037

DC 2-1982 (R 1988) — *Residential Controls - Quick Connect Terminals*
DC 3-1989 — *Wall-Mounted Room Thermostats*

1.2 DEFINITIONS

1.2.1 Control Point

The control point is the value of the mean air temperature at the thermostat under specified operating conditions.

NEMA Standard 9-6-1979.

1.2.2 Cut-In Point

The cut-in point is the air temperature at the thermostat at which it initiates action.

NEMA Standard 11-16-1972.

1.2.3 Cut-Out Point

The cut-out point is the air temperature at the thermostat at which it initiates action.

NEMA Standard 11-16-1972.

1.2.4 Differential, Mechanical

The mechanical differential is the difference in temperature set-point between the cut-in and cut-out points as determined by manually raising and lowering the thermostat setting with no electrical load.

NEMA Standard 8-28-1991.

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1.2.5 Differential,Operating

The operating differential is the difference between the cut-in and the cut-out points as measured at the thermostat under specified operating conditions.

NEMA Standard 11-16-1972.

1.2.6 Line-Voltage Integrally Mounted Thermostat for Electric Heaters

A line-voltage integrally mounted thermostat for electrical heaters is a device which acts to automatically control the temperature of the room or space in which it is installed by directly controlling the electrical load. It is factory installed or field installed within the normal wiring compartment of the heating device such as a space heater or a baseboard heater.

NEMA Standard 8-28-1991.

1.2.7 Load, Electrical

The electrical load is any load expressed in volts with appropriate:

(a) Amperes and power factor, or
(b) Horsepower, or
(c) Motor currents, full load and inrush, or
(d) Volt ampere pilot duty designation, or
(e) Non-inductive load.

NEMA Standard 8-28-1991.

1.2.8 Load, Heating

The heating load is the rate of heat loss of the space being controlled.

NEMA Standard 9-6-1979.

1.2.9 Offset

Offset is the intentional difference between the cut-in point and the temperature set-point with no electrical load.

NEMA Standard 8-28-1991.

1.2.10 Operating Range

Operating range is the temperature difference in degrees in C (degrees F) from the maximum to the minimum scale setting of the thermostat.

NEMA Standard 11-14-1985.

1.2.11 Rating, Electrical

The electrical rating is the maximum specified electrical load of the thermostat.

NEMA Standard 11-16-1972.

1.2.12 Temperature Set-Point

The temperature set-point is the indicated temperature to which the thermostat is set.

NEMA Standard 8-28-1991.

1.2.13 Sensing Element

The sensing element is the part of the thermostat that senses temperature and initiates control action.

NEMA Standard 11-16-1972.

1.2.14 Thermostat Calibration

Thermostat calibration is the temperature at the cut-in point as measured at the thermostat for a specified scale setting.

NEMA Standard 11-16-1972.

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Section 2
RATINGS AND CLASSIFICATIONS

2.1 VOLTAGE RATINGS

Thermostats shall have voltage ratings within the range of 31 to 300 volts alternating current, inclusive.

NEMA Standard 8-28-1991

2.2 CURRENT RATINGS

Thermostats shall have the following current ratings:

Volts	Amperes
120	30 or less
208	30 or less
240	30 or less
277	25 or less

All thermostats with an "off" position shall open all ungrounded conductors when set in the "off" position as required by ANSI/UL 873.

NEMA Standard 8-28-1991

2.3 FUNCTIONAL CLASSIFICATIONS

Thermostats shall be described according to their switching functions, which include all connected electrical circuits as follows:

NEMA Standard 8-28-1991

2.3.1 Single-line Break (Single-pole) Thermostat

A thermostat that opens one ungrounded conductor of a single electrical load during cycling.

NEMA Standard 8-28-1991

2.3.2 Double-line-break Disconnect Thermostat

A double-line-break disconnect thermostat is a thermostat which includes two single-pole single-throw switches which open all ungrounded conductors of a single electrical load when set in the "off" position.

NEMA Standard 8-28-1991

2.3.3 Double-line-break Cycling Thermostat

A thermostat that opens all ungronded conductors of a single electrical load during cycling.

NEMA Standard 8-28-1991

2.3.4 Two-stage Thermostat

A two-stage thermostat is a thermostat that controls two electrical loads with separate switch actions. The calibration of each action shall be separated by an appropriate amount of temperature difference.

NEMA Standard 8-28-1991

2.3.5 Two-circuit Thermostat

A two-circuit thermostat is a thermostat that controls two separate electrical loads with one switching action.

NEMA Standard 8-28-1991

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Section 3
CONSTRUCTION

3.1 CONNECTIONS

3.1.1 Terminals shall be provided and arranged so that circuit conductors or terminals will not be accidentally shorted or grounded when installed.

NEMA Standard 9-6-1979.

3.1.2 Wiring terminal spacings or external wire leads shall be in accordance with ANSI/UL 873.

NEMA Standard 9-6-1979.

3.1.3 Terminals to which field connections are made shall provide good connections without loosening during field wiring and mounting. If a wire-binding head screw is used at a wiring terminal, the screw size shall comply with ANSI/UL 873.

In the case of pressure-type connectors, terminals shall comply with ANSI/UL 486. When lead wires are furnished, the length shall be 150 mm (6 in.) or 460 mm (18 in.) unless otherwise specified.

NEMA Standard 8-28-1991.

3.1.4 Except where the sensing element is part of the dial or is mounted in such a manner as to prohibit its use, the mounting dimensions shown in Figure 3-1 shall be provided.

NEMA Standard 9-6-1979.

3.1.5 Thermostats shall be so constructed as to permit their installation in accordance with ANSI/NFPA 70.

NEMA Standard 9-6-1979.

3.2 MATERIALS

3.2.1 Thermostats shall be designed for mounting in an enclosure provided by the equipment manufacturer.

NEMA Standard 9-6-1979.

3.2.2 Strength

Thermostats shall be so designed that their calibration and operation will not be affected either when they are mounted on uneven surfaces having a projection or projections not exceeding 1.6 mm (1/16 in.) in height, or from normal handling in the mounting of the thermostat.

Parts that are intended for adjustment after the thermostat is installed shall be sufficiently rigid to provide normal means of adjustment and shall be constructed to withstand normal vibration and shock.

NEMA Standaard 8-28-1991.

3.2.3 Thermostats shall be capable of withstanding the following conditions which may be encountered during shipping and storage.

1. A temperature range of -40° to 60°C (-40° to 140°F)
2. Normal handling and high humidity.

NEMA Standard 9-6-1979.

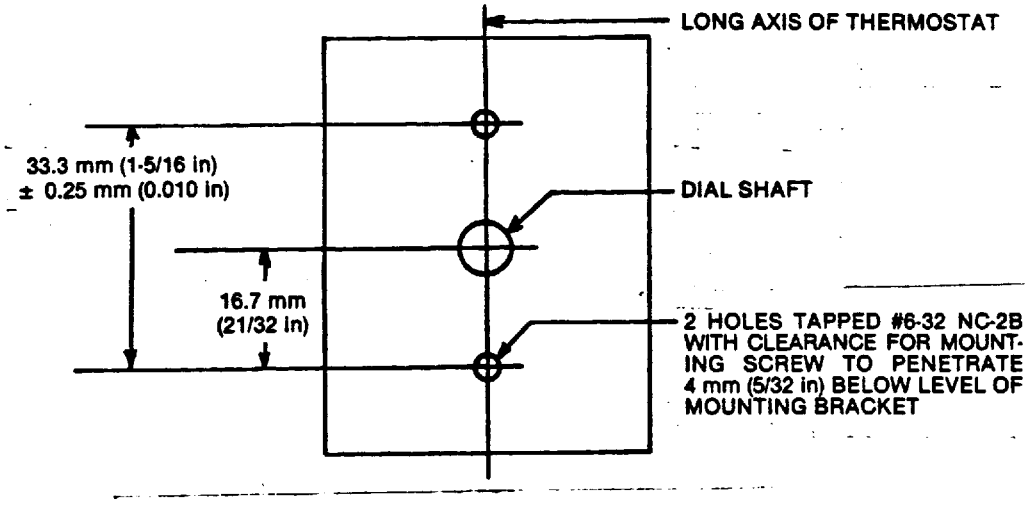


Figure 3-1
MOUNTING DIMENSIONS

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3.2.4 When the sensing element of the thermostat is a bulb with a capillary tube connecting to the body of the thermostat, the maximum outside diameter of the bulb shall be 9.5 mm (3/8 in). Thermostats shall be supplied with lengths of capillary tubing ranging from a minimum of 150 mm (6 in.) to a maximum of 1200 mm (48 in.).

NEMA Standard 9-6-1979.

3.2.5 Thermostats that are used for fixed electric space heating equipment and which indicate an "off" position shall open all ungrounded conductors when in the "off" position at all temperatures down to -40°C (-40°F).

NEMA Standard 8-28-1991.

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

NEMA Standard 8-28-1991.

3.3 ASSEMBLY

Thermostats shall be assembled in a manner that will afford normal protection to installer and user with regard to sharp edges on surfaces and adjustment means.

NEMA Standard 8-28-1991.

3.4 ADJUSTMENTS

3.4.1 Temperature Setting

Thermostats shall be provided with a temperature-setting knob or an adjustment shaft that extends from one side of the device.

NEMA Standard 9-6-1979.

3.4.2 Dial Shaft

Unless otherwise specified, the dial shaft shall be in accordance with the following:

1. Diameter of 6.350 mm (0.250 in.) plus or minus 0.007 mm (0.003 in.).
2. Length from mounting surface of 17.4 mm (11/16 in.) plus or minus 1.6 mm (1/16 in.).
3. Single flat having a minimum length of 12.7 mm (1/2 in.) and a dimension of 3.96 mm (0.156 in.) plus or minus 0.07 mm (0.003 in.), from flat to edge of shaft, shown as dimension A in Figure 3-2.

NEMA Standard 9-6-1979.

3.4.3 Temperature Range and Dial Arrangement

The temperature range shall be 4.4° to 37.8°C (40° to 100°F) or 12.8° to 40.6°C (55° to 105°F) in 180 angular degrees of rotation within a total angular rotation of 270 degrees unless other ranges are specified. The dial shall be arranged as shown in Figure 3-2.

NEMA Standard 9-6-1979.

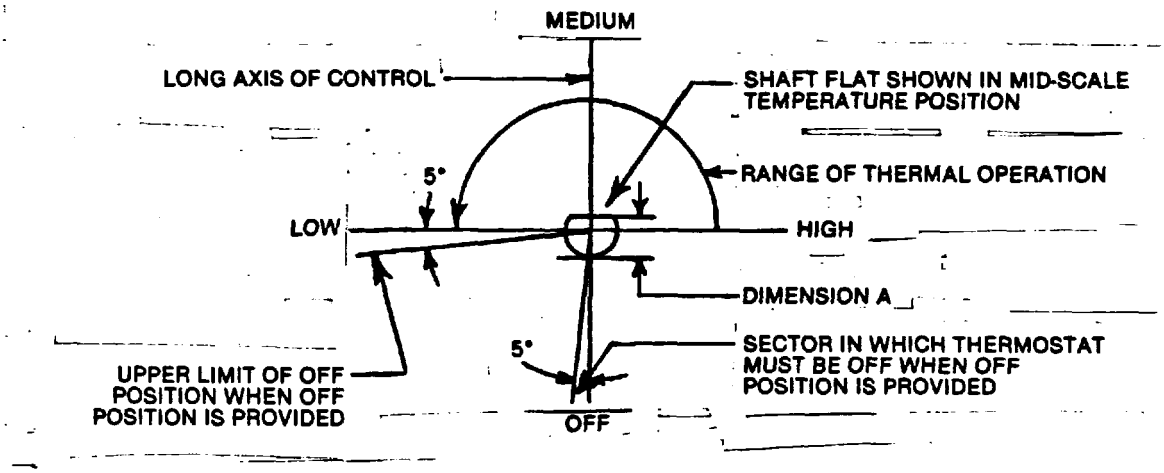


Figure 3-2
DIAL ARRANGEMENT AND DIMENSIONS

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3.4.4 Accuracy of Temperature Setting Adjustment

When a thermostat is in exact adjustment at a specific setting, the accuracy of the scale at 5.6°C (10°F) above and below this point shall be within plus or minus 1.1°C (2°F) with no connected electrical load.

NEMA Standard 8-28-1991

3.4.5 Factory Adjustment

When measured at a calibration reference point, the calibration of the thermostat shall be factory set within plus or minus 1.1°C (2°F) with no connected electrical load. Allowance shall be made for thermostats which incorporate a specified offset. For other than single-stage thermostats, the thermostat manufacturer shall specify the calibrated stage and the specific offset for other stages.

NEMA Standard 8-28-1991

3.4.6 Sealing and Locking

To discourage tampering by unqualified persons when adjustments are intended for factory use only, the parts shall be sealed or locked or shall be so made as to require special tools.

NEMA Standard 8-28-1991

3.5 PACINGS

Thermostats shall have spacings in accordance with ANSI/UL 873.

NEMA Standard 8-28-1991

3.6 LINE-VOLTAGE THERMOSTAT GROUNDING (EARTHING)

Thermostats shall be provided with means for grounding all exposed metal noncurrent-carrying parts that may become energized as the result of an electrical fault, except that small metal parts that are insulated by their location, such as nameplates and monograms, need not be grounded.

Provisions for grounding shall meet all of the requirements of ANSI/UL 873.

NEMA Standard 8-28-1991

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Section 4
TESTING AND PERFORMANCE

4.1 DIELECTRIC TESTS

All thermostats shall meet the dielectric test requirements described in ANSI/UL 873.

NEMA Standard 8-28-1991

4.2 ENDURANCE TEST

All thermostats shall meet the endurance test requirements described in ANSI/UL 873.

NEMA Standard 8-28-1991

4.3 OVERLOAD TEST

All thermostats shall meet the overload test requirements described in ANSI/UL 873.

NEMA Standard 8-28-1991

4.4 TEMPERATURE

Temperature rises and test procedures for all thermostats shall be in accordance with ANSI/UL 873.

NEMA Standard 11-16-1972

4.5 ENVIRONMENTAL TESTS

4.5.1 General Conditions

1. All tests shall be conducted with the dial set at the temperature set-point.
2. The body of the control shall be in an ambient temperature of 24°C (75°F)
3. Thermostats shall be tested at the manufacturer's specified rating.
4. The control shall be mounted with the temperature setting dial shaft in a horizontal plane.
5. Where the design of the control will not permit the use of a liquid bath, the operating differential shall be checked in a well circulated gradient-free air bath in the same manner as described in 4.5.3.

NEMA Standard 8-28-1991

4.5.2 Operating Differential

The maximum operating differential, when tested in accordance with 4.5.3 shall be 3.4°C (6°F).

NEMA Standard 8-28-1991

4.5.3 Operating Differential Test

The bulb and 76 mm (3 in.) of the capillary tubing shall be placed in a well agitated liquid bath that shall be raised, at a rate not exceeding 0.3° C (0.5° F) per minute, to the point of circuit break and lowered at the same rate to the point of circuit make.

NEMA Standard 8-28-1991

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Section 5
MARKING

5.1 MARKING

5.1.1 Thermostats shall have the following markings plainly visible:

1. A company name or trademark.
2. Catalog number or equivalent.
3. Where space permits, the electrical rating on each control.
4. As a minimum, the date of manufacture, including the year and week of manufacture.

NEMA Standard 9-6-1979.

The preferred method of marking is to indicate the date of manufacture in the form of the last two numbers of the year followed by the number of the week of manufacture.

Authorized Engineering Information 9-6-1979.

5.1.2 Markings shall be of a permanent nature.

NEMA Standard 9-6-1979.

5.1.3 Labels, stampings, or decalcomanias shall be located where they will not be exposed to mechanical damage.

NEMA Standard 9-6-1979.

5.1.4 When there are more than two wiring connections, the terminals shall be suitably marked.

NEMA Standard 9-6-1979.

5.1.5 When temperature set-point markings are not provided, the reference point for the shaft flat shall be indicated in the mid-scale temperature position.

NEMA Standard 8-28-1991.

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Section 6
APPLICATION

6.1 APPLICATION

6.1.1 Manufacturer's instructions and warnings must be followed at all times.

6.1.2 Line-voltage integrally mounted thermostats are designed to control room temperature by opening and closing circuits to heating equipment in response to temperature changes. The control point should be selected by positioning the temperature setting means to the desired comfort level.

Authorized Engineering Information 11-14-1985.

6.1.3 Thermostats should be mounted in an enclosure provided by the heating equipment manufacturer.

Authorized Engineering Information 11-14-1985.

6.1.4 Thermostats should be mounted to provide for proper temperature set-point reference.

Authorized Engineering Information 8-28-1991.

6.1.5 Thermostats should be mounted so as not to exceed the maximum ambient temperature rating of the control.

Authorized Engineering Information 11-14-1985.

6.1.6 The capillary should be supported as required and located so that it will be protected from accidental damage.

Authorized Engineering Information 11-14-1985.

6.1.7 Performance data should relate to the thermostat alone. Proper application of the thermostat within the enclosure should be necessary to achieve good temperature control.

Authorized Engineering Information 11-14-1985.

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NEMA STANDARDIZATION

The purpose of NEMA Standards, their classification and status are set forth in certain clauses of the NEMA *Standardization Policies and Procedures* manual and are referenced 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 their particular needs. 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.

(Standardization Policies and Procedures, p. 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.

(Standardization Policies and Procedures, p. 2)

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.

(Standardization Policies and Procedures, p. 8)

Categories of Standards

National Electrical Manufacturers Association Standards are of three classes:

1. NEMA Standard, which relates to a product, process or procedure 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.
3. Adoptive Standard, which is adopted in whole or in part from the standards of another organization, either domestic, regional, or international.

(Standardization Policies and Procedures, pp 7 & 16)

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, which standard has been approved by at least two-thirds of the members of the Subdivision eligible to vote on the standard.

(Standardization Policies and Procedures, pp. 7 & 16)

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, and which has been approved by at least 90 percent of the members of the Subdivision eligible to vote thereon. *(Standardization Policies and Procedures, pp 7 & 16)*

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.

July 17, 1990

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RESIDENTIAL CONTROLS SECTION
OF THE
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