[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Part 430

[Docket No. EERE-2013-BT-STD-0009]

RIN 1904-AC96

Energy Conservation Program for Consumer Products: Test Procedures for Residential Furnaces and Boilers; Correction

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Final rule; technical correction.

SUMMARY: On July 10, 2013 the U.S. Department of Energy (DOE) published a final rule in the Federal Register that amended the test procedure for residential furnaces and boilers (78 FR 41265). Due to drafting errors, that document incorrectly redesignated several subsections in section 10 of the DOE test procedure regulation for those products in the Code of Federal Regulations (CFR). This final rule corrects those errors and updates related cross-references to reflect the revised section numbers in section 10.

DATES: Effective Date: [**INSERT DATE OF PUBLICATION IN THE FEDERAL REGISTER**]. The incorporation by reference of certain publications listed in the regulations was approved by the Director of the Federal Register as of November 10, 1997.

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SUPPLEMENTARY INFORMATION:

I. Background

On July 10, 2013, DOE's Office of Energy Efficiency and Renewable Energy published a test procedure final rule in the Federal Register titled, "Test Procedures for Residential Furnaces and Boilers" (hereafter referred to as the "July 2013 final rule"). 78 FR 41265. Since the publication of that final rule, it has come to DOE's attention that, due to a technical oversight, a certain part of the July 2013 final rule incorrectly redesignated the numbering of subsections within section 10 of DOE's test procedure regulations for residential furnaces and boilers found at 10 CFR, part 430, subpart B, Appendix N, "Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers." In addition, the July 2013 final rule did not include instructions to update the cross-references within Appendix N to reflect the renumbered subsections. During the development of amended test procedure for residential furnaces and boilers, DOE did not intend to redesignate the sections as indicated on page 41272 of the July

2013 final rule, and did intend to update the cross-references within Appendix N to reflect the appropriate section renumbering. Instead, these incorrect redesignations were the result of drafting errors in the final rule. Today's final rule corrects these errors by appropriately redesignating the subsections within section 10 of Appendix N and updating the internal cross-references in Appendix N to reflect the revised subsection numbering.

II. Need for Correction

As published, the identified provisions in section 10 of 10 CFR part 430, subpart B, Appendix N will potentially result in confusion regarding how to correctly conduct DOE's residential furnaces and boilers test procedure. It was clearly not DOE's intention to change or eliminate additional sections beyond those explicitly cited for revision. At no place in the July 2013 final rule (or in the February 4, 2013 notice of proposed rulemaking that preceded it (78 FR 7681)) did DOE discuss such modifications. These were inadvertent changes. Because today's final rule would simply effectuate the intended and proper renumbering of the relevant regulatory provisions without making substantive changes to those provisions, the changes addressed in this document are technical in nature. Accordingly, DOE finds that there is good cause under 5 U.S.C. 553(b)(B) to not issue a separate notice to solicit public comment on the changes contained in this document. Issuing a separate notice to solicit public comment would be impractical, unnecessary, and contrary to the public interest.

III. Procedural Requirements

DOE has concluded that the determinations made pursuant to the various procedural requirements applicable to the July 10, 2013 test procedure final rule remain unchanged for this final rule technical correction. These determinations are set forth in the July 10, 2013 final rule.

78 FR 41265, 41269-41272.

List of Subjects in 10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Issued in Washington, DC on August 23, 2013.

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Kathleen B. Hogan
Deputy Assistant Secretary for Energy Efficiency
Energy Efficiency and Renewable Energy

For the reasons stated in the preamble, DOE amends part 430 of Chapter II, subchapter D of title 10, Code of Federal Regulations as set forth below:

PART 430 – ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

1. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291-6309; 28 U.S.C. 2461 note.

2. Appendix N to subpart B of part 430 is amended by revising the introductory text after the appendix heading and sections 10.0 through 10.11 to read as follows:

Appendix N to Subpart B of Part 430 – Uniform Test Method for Measuring the Energy Consumption of Furnaces and Boilers

Note: The procedures and calculations that refer to off mode energy consumption (i.e., sections 8.6 and 10.11 of this appendix N) need not be performed to determine compliance with energy conservation standards for furnaces and boilers at this time. However, any representation related to standby mode and off mode energy consumption of these products made after July 1, 2013 must be based upon results generated under this test procedure, consistent with the requirements of 42 U.S.C. 6293(c)(2). For furnaces manufactured on or after May 1, 2013, compliance with the applicable provisions of this test procedure is required in order to determine compliance with energy conservation standards. For boilers, the statute requires that after July 1, 2010, any

adopted energy conservation standard shall address standby mode and off mode energy consumption for these products, and upon the compliance date for such standards, compliance with the applicable provisions of this test procedure will be required.

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10.0 *Calculation of derived results from test measurements.* Calculations shall be as specified in section 11 of ANSI/ASHRAE 103-1993 (incorporated by reference, see §430.3) and the October 24, 1996, Errata Sheet for ASHRAE 103-1993, except for sections 11.5.11.1, 11.5.11.2, and appendices B and C; and as specified in sections 10.1 through 10.11 and Figure 1 of this appendix.

10.1 *Annual fuel utilization efficiency.* The annual fuel utilization efficiency (AFUE) is as defined in sections 11.2.12 (non-condensing systems), 11.3.12 (condensing systems), 11.4.12 (non-condensing modulating systems), and 11.5.12 (condensing modulating systems) of ANSI/ASHRAE 103-1993 (incorporated by reference, see §430.3), except for the definition for the term $Effy_{HS}$ in the defining equation for AFUE. $Effy_{HS}$ is defined as:

$Effy_{HS}$ = heating seasonal efficiency as defined in sections 11.2.11 (non-condensing systems), 11.3.11 (condensing systems), 11.4.11 (non-condensing modulating systems), and 11.5.11 (condensing modulating systems) of ANSI/ASHRAE 103-1993, except that for condensing modulating systems sections 11.5.11.1 and 11.5.11.2 are replaced by sections 10.2 and 10.3 of this appendix. $Effy_{HS}$ is based on the assumptions that all weatherized warm air furnaces or boilers are located outdoors, that warm air furnaces which are not weatherized are installed as isolated combustion systems, and that boilers which are not weatherized are installed indoors.

10.2 *Part-Load Efficiency at Reduced Fuel Input Rate.* Calculate the part-load efficiency at the reduced fuel input rate, $Effy_{U,R}$, for condensing furnaces and boilers equipped with either step modulating or two-stage controls, expressed as a percent and defined as:

$$Effy_{U,R} = 100 - L_{L,A} + L_G - L_C - C_J L_J -$$

$$\left[\frac{t_{ON}}{t_{ON} + \left(\frac{Q_P}{Q_{IN}}\right) t_{OFF}}\right] x \left(L_{S,ON} + L_{S,OFF} + L_{I,ON} + L_{I,OFF}\right)$$

If the option in section 9.10 of ASHRAE 103-1993 (incorporated by reference, see §430.3) is employed:

$$Effy_{U,R} = 100 - L_{L,A} + L_G - L_C - C_J L_J - \left[\frac{t_{ON}}{t_{ON} + \left(\frac{Q_P}{Q_{IN}}\right) t_{OFF}}\right] (C_S)(L_{S,SS})$$

Where:

$L_{L,A}$ = value as defined in section 11.2.7 of ASHRAE 103-1993,

L_G = value as defined in section 11.3.11.1 of ASHRAE 103-1993 at reduced input rate,

L_C = value as defined in section 11.3.11.2 of ASHRAE 103-1993 at reduced input rate,

L_J = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993 at maximum input rate,

t_{ON} = value as defined in section 11.4.9.11 of ASHRAE 103-1993,

Q_P = pilot flame fuel input rate determined in accordance with section 9.2 of ASHRAE 103-1993 in Btu/h,

Q_{IN} = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993,

t_{OFF} = value as defined in section 11.4.9.12 of ASHRAE 103-1993 at reduced input rate,

$L_{S,ON}$ = value as defined in section 11.4.10.5 of ASHRAE 103-1993 at reduced input rate,

$L_{S,OFF}$ = value as defined in section 11.4.10.6 of ASHRAE 103-1993 at reduced input rate,

$L_{I,ON}$ = value as defined in section 11.4.10.7 of ASHRAE 103-1993 at reduced input rate,

$L_{I,OFF}$ = value as defined in section 11.4.10.8 of ASHRAE 103-1993 at reduced input rate,

C_J = jacket loss factor and equal to:

= 0.0 for furnaces or boilers intended to be installed indoors

= 1.7 for furnaces intended to be installed as isolated combustion systems

= 2.4 for boilers (other than finned-tube boilers) intended to be installed as isolated combustion systems

= 3.3 for furnaces intended to be installed outdoors

= 4.7 for boilers (other than finned-tube boilers) intended to be installed outdoors

= 1.0 for finned-tube boilers intended to be installed outdoors

= 0.5 for finned-tube boilers intended to be installed in internal combustion system applications

$L_{S,SS}$ = value as defined in section 11.5.6 of ASHRAE 103-1993 at reduced input rate,

C_S = value as defined in section 11.5.10.1 of ASHRAE 103-1993 at reduced input rate.

10. 3 *Part-Load Efficiency at Maximum Fuel Input Rate.* Calculate the part-load efficiency at maximum fuel input rate, $Effy_{U,H}$, for condensing furnaces and boilers equipped with two-stage controls, expressed as a percent and defined as:

$$Effy_{U,H} = 100 - L_{L,A} + L_G - L_C - C_I L_I -$$

$$\left[\frac{t_{ON}}{t_{ON} + \left(\frac{Q_P}{Q_{IN}}\right) t_{OFF}}\right] x \left(L_{S,ON} + L_{S,OFF} + L_{I,ON} + L_{I,OFF}\right)$$

If the option in section 9.10 of ASHRAE 103-1993 (incorporated by reference, see §430.3) is employed:

$$Effy_{U,H} = 100 - L_{L,A} + L_G - L_C - C_I L_I - \left[\frac{t_{ON}}{t_{ON} + \left(\frac{Q_P}{Q_{IN}}\right) t_{OFF}}\right] (C_S)(L_{S,SS})$$

Where:

$L_{L,A}$ = value as defined in section 11.2.7 of ASHRAE 103-1993,

L_G = value as defined in section 11.3.11.1 of ASHRAE 103-1993 at maximum input rate,

L_C = value as defined in section 11.3.11.2 of ASHRAE 103-1993 at maximum input rate,

L_J = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993 at maximum input rate,

t_{ON} = value as defined in section 11.4.9.11 of ASHRAE 103-1993,

Q_P = pilot flame fuel input rate determined in accordance with section 9.2 of ASHRAE 103-1993 in Btu/h,

Q_{IN} = value as defined in section 11.4.8.1.1 of ASHRAE 103-1993,

t_{OFF} = value as defined in section 11.4.9.12 of ASHRAE 103-1993 at maximum input rate,

$L_{S,ON}$ = value as defined in section 11.4.10.5 of ASHRAE 103-1993 at maximum input rate,

$L_{S,OFF}$ = value as defined in section 11.4.10.6 of ASHRAE 103-1993 at maximum input rate,

$L_{I,ON}$ = value as defined in section 11.4.10.7 of ASHRAE 103-1993 at maximum input rate,

$L_{I,OFF}$ = value as defined in section 11.4.10.8 of ASHRAE 103-1993 at maximum input rate,

C_J = value as defined in section 10.2 of this appendix,

$L_{S,SS}$ = value as defined in section 11.5.6 of ASHRAE 103-1993 at maximum input rate,

C_S = value as defined in section 11.5.10.1 of ASHRAE 103-1993 at maximum input rate.

10.4 *National average burner operating hours, average annual fuel energy consumption, and average annual auxiliary electrical energy consumption for gas or oil furnaces and boilers.*

10.4.1 *National average number of burner operating hours.* For furnaces and boilers equipped with single stage controls, the national average number of burner operating hours is defined as:

BOH_{SS} =2,080 (0.77) A DHR-2,080 B

where:

2,080=national average heating load hours

0.77=adjustment factor to adjust the calculated design heating requirement and heating load hours to the actual heating load experienced by the heating system

DHR=typical design heating requirements as listed in Table 8 (in unit of kBtu/h) of ANSI/ASHRAE Standard 103-1993, using the proper value of Q_{OUT} defined in 11.2.8.1 of ANSI/ASHRAE Standard 103-1993

A=100,000 / [341,300(y_P PE+y_{IG} PE_{IG} +yBE)+(Q_{IN} -Q_P)$Effy_{HS}$], for forced draft unit, indoors

=100,000 / [341,300(y_P PE Eff_{motor} +y_{IG} PE_{IG} +y BE)+(Q_{IN} -Q_P)$Effy_{HS}$], for forced draft unit, ICS,

=100,000 / [341,300(y_P PE(1-Eff_{motor})+y_{IG} PE_{IG} +y BE)+(Q_{IN} -Q_P)$Effy_{HS}$], for induced draft unit, indoors, and

$=100{,}000 / [341{,}300(y_{IG}\ PE_{IG} + yBE) + (Q_{IN} - Q_P)Effy_{HS}]$, for induced draft unit, ICS

$B = 2\ Q_P\ (Effy_{HS})(A) / 100{,}000$

where:

Eff_{motor} =Power burner motor efficiency provided by manufacturer,

=0.50, an assumed default power burner efficiency if not provided by manufacturer.

100,000=factor that accounts for percent and kBtu

PE=burner electrical power input at full-load steady-state operation, including electrical ignition device if energized, as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103-1993

y_P =ratio of induced or forced draft blower on-time to average burner on-time, as follows:

1 for units without post purge;

$1+(t_P /3.87)$ for single-stage furnaces with post purge;

$1+(t_P /10)$ for two-stage and step modulating furnaces with post purge;

$1+(t_P /9.68)$ for single-stage boilers with post purge; or

$1+(t_P /15)$ for two-stage and step modulating boilers with post purge.

PE_{IG} =electrical input rate to the interrupted ignition device on burner (if employed), as defined in 8.1 of this appendix

y_{IG} =ratio of burner interrupted ignition device on-time to average burner on-time, as follows:

0 for burners not equipped with interrupted ignition device;

(t_{IG} /3.87) for single-stage furnaces;

(t_{IG} /10) for two-stage and step modulating furnaces;

(t_{IG} /9.68) for single-stage boilers; or

(t_{IG} /15) for two-stage and step modulating boilers.

t_{IG} =on-time of the burner interrupted ignition device, as defined in 8.1 of this appendix

t_P =post purge time as defined in 8.2 (furnace) or 8.4 (boiler) of this appendix

=0 if t_P is equal to or less than 30 seconds.

y=ratio of blower or pump on-time to average burner on-time, as follows:

1 for furnaces without fan delay;

1 for boilers without a pump delay;

$1+(t^+ — t^-)/3.87$ for single-stage furnaces with fan delay;

$1+(t^+ — t^-)/10$ for two-stage and step modulating furnaces with fan delay;

$1+(t^+/9.68)$ for single-stage boilers with pump delay; or

$1+(t^+/15)$ for two-stage and step modulating boilers with pump delay.

BE=circulating air fan or water pump electrical energy input rate at full-load steady-state operation, as defined in ANSI/ASHRAE Standard 103-1993

Q_{IN} =as defined in 11.2.8.1 of ANSI/ASHRAE Standard 103-1993

Q_P =as defined in 11.2.11 of ANSI/ASHRAE Standard 103-1993

$Effy_{HS}$ =as defined in 11.2.11 (non-condensing systems) or 11.3.11.3 (condensing systems) of ANSI/ASHRAE Standard 103-1993, percent, and calculated on the basis of:

ICS installation, for non-weatherized warm air furnaces;

indoor installation, for non-weatherized boilers; or

outdoor installation, for furnaces and boilers that are weatherized.

2=ratio of the average length of the heating season in hours to the average heating load hours

t^+ =as defined in 9.5.1.2 of ANSI/ASHRAE Standard 103-1993 or 8.4 of this appendix

t^- =as defined in 9.6.1 of ANSI/ASHRAE Standard 103-1993

10.4.1.1 For furnaces and boilers equipped with two-stage or step modulating controls, the average annual energy used during the heating season, E_M , is defined as:

$$E_M = (Q_{IN} - Q_P)\, BOH_{SS} + (8{,}760 - 4{,}600) Q_P$$

where:

Q_{IN} =as defined in 11.4.8.1.1 of ANSI/ASHRAE Standard 103-1993

Q_P =as defined in 11.4.12 of ANSI/ASHRAE Standard 103-1993

BOH_{SS} =as defined in section 10.4.1 of this appendix, in which the weighted $Effy_{HS}$ as defined in 11.4.11.3 or 11.5.11.3 of ANSI/ASHRAE Standard 103-1993 is used for calculating the values of A and B, the term DHR is based on the value of Q_{OUT} defined in 11.4.8.1.1 or 11.5.8.1.1 of ANSI/ASHRAE Standard 103-1993, and the term (y_P PE+$y_{IG}PE_{IG}$ +yBE) in the factor A is increased by the factor R, which is defined as:

R=2.3 for two-stage controls

=2.3 for step modulating controls when the ratio of minimum-to-maximum output is greater than or equal to 0.5

=3.0 for step modulating controls when the ratio of minimum-to-maximum output is less than 0.5

$A=100,000/[341,300(y_P\ PE+y_{IG}\ PE_{IG}+y\ BE)\ R+(Q_{IN}-Q_P)\ Effy_{HS}]$, for forced draft unit, indoors

$=100,000/[341,300(y_P\ PE\ Eff_{motor}+y_{IG}\ PE_{IG}+y\ BE)\ R+(Q_{IN}-Q_P)Effy_{HS}]$, for forced draft unit, ICS,

$=100,000/[341,300(y_P\ PE(1-Eff_{motor})+y_{IG}\ PE_{IG}+y\ BE)\ R+(Q_{IN}-Q_P)\ Effy_{HS}]$, for induced draft unit, indoors, and

$=100,000/[341,300(y_{IG}\ PE_{IG}+y\ BE)\ R+(Q_{IN}-Q_P)\ Effy_{HS}]$, for induced draft unit, ICS

where:

Eff_{motor} =Power burner motor efficiency provided by manufacturer,

=0.50, an assumed default power burner efficiency if none provided by manufacturer.

$Effy_{HS}$ =as defined in 11.4.11.3 or 11.5.11.3 of ANSI/ASHRAE Standard 103-1993, and calculated on the basis of:

—ICS installation, for non-weatherized warm air furnaces

—indoor installation, for non-weatherized boilers

—outdoor installation, for furnaces and boilers that are weatherized

8,760=total number of hours per year

4,600=as specified in 11.4.12 of ANSI/ASHRAE Standard 103-1993

10.4.1.2 For furnaces and boilers equipped with two-stage or step modulating controls, the national average number of burner operating hours at the reduced operating mode is defined as:

$BOH_R = X_R E_M / Q_{IN,R}$

where:

X_R =as defined in 11.4.8.7 of ANSI/ASHRAE Standard 103-1993

E_M =as defined in section 10.4.1.1 of this appendix

$Q_{IN,R}$ =as defined in 11.4.8.1.2 of ANSI/ASHRAE Standard 103-1993

10.4.1.3 For furnaces and boilers equipped with two-stage controls, the national average number of burner operating hours at the maximum operating mode (BOH_H) is defined as:

$BOH_H = X_H E_M / Q_{IN}$

where:

X_H =as defined in 11.4.8.6 of ANSI/ASHRAE Standard 103-1993

E_M =as defined in section 10.4.1.1 of this appendix

Q_{IN} =as defined in 11.4.8.1.1 of ANSI/ASHRAE Standard 103-1993

10.4.1.4 For furnaces and boilers equipped with step modulating controls, the national average number of burner operating hours at the modulating operating mode (BOH_M) is defined as:

$BOH_M = X_H \, E_M / Q_{IN,M}$

where:

X_H =as defined in 11.4.8.6 of ANSI/ASHRAE Standard 103-1993

E_M =as defined in section 10.4.1.1 of this appendix

$Q_{IN,M} = Q_{OUT,M} / (Effy_{SS,M} / 100)$

$Q_{OUT,M}$ =as defined in 11.4.8.10 or 11.5.8.10 of ANSI/ASHRAE Standard 103-1993, as appropriate

$Effy_{SS,M}$ =as defined in 11.4.8.8 or 11.5.8.8 of ANSI/ASHRAE Standard 103-1993, as appropriate, in percent

100=factor that accounts for percent

10.4.2 *Average annual fuel energy consumption for gas or oil fueled furnaces or boilers.* For furnaces or boilers equipped with single-stage controls, the average annual fuel energy consumption (E_F) is expressed in Btu per year and defined as:

$E_F = BOH_{SS} \, (Q_{IN} - Q_P) + 8{,}760 \, Q_P$

where:

BOH_{SS} =as defined in 10.4.1 of this appendix

Q_{IN} =as defined in 11.2.8.1 of ANSI/ASHRAE Standard 103-1993

Q_P =as defined in 11.2.11 of ANSI/ASHRAE Standard 103-1993

8,760=as specified in 10.4.1.1 of this appendix

10.4.2.1 For furnaces or boilers equipped with either two-stage or step modulating controls, E_F is defined as:

$E_F = E_M + 4{,}600Q_P$

where:

E_M =as defined in 10.4.1.1 of this appendix

4,600=as specified in 11.4.12 of ANSI/ASHRAE Standard 103-1993

Q_P =as defined in 11.2.11 of ANSI/ASHRAE Standard 103-1993

10.4.3 Average annual auxiliary electrical energy consumption for gas or oil-fueled furnaces or boilers. For furnaces and boilers equipped with single-stage controls, the average annual auxiliary electrical consumption (E_{AE}) is expressed in kilowatt-hours and defined as:

$E_{AE} = BOH_{SS} (y_P PE + y_{IG} PE_{IG} + yBE) + E_{SO}$

Where:

BOH_{SS} = as defined in 10.4.1 of this appendix

PE = as defined in 10.4.1 of this appendix

y_P = as defined in 10.4.1 of this appendix

y_{IG} = as defined in 10.4.1 of this appendix

PE_{IG} = as defined in 10.4.1 of this appendix

y = as defined in 10.4.1 of this appendix

BE = as defined in 10.4.1 of this appendix

E_{SO} = as defined in 10.11 of this appendix.

10.4.3.1 For furnaces or boilers equipped with two-stage controls, E_{AE} is defined as:

$$E_{AE} = BOH_R (y_P PE_R + y_{IG} PE_{IG} + yBE_R) + BOH_H (y_P PE_H + y_{IG} PE_{IG} + y BE_H) + E_{SO}$$

Where:

BOH_R = as defined in 10.4.1.2 of this appendix

y_P = as defined in 10.4.1 of this appendix

PE_R = as defined in 9.1.2.2 and measured at the reduced fuel input rate of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3)

y_{IG} = as defined in 10.4.1 of this appendix

PE_{IG} = as defined in 10.4.1 of this appendix

y = as defined in 10.4.1 of this appendix

BE_R = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3) measured at the reduced fuel input rate

BOH_H = as defined in 10.4.1.3 of this appendix

PE_H = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3) measured at the maximum fuel input rate

BE_H = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3) measured at the maximum fuel input rate

E_{SO} = as defined in 10.11 of this appendix.

10.4.3.2 For furnaces or boilers equipped with step-modulating controls, E_{AE} is defined as:

$$E_{AE} = BOH_R (y_P PE_R + y_{IG} PE_{IG} + yBE_R) + BOH_M (y_P PE_H + y_{IG} PE_{IG} + y BE_H) + E_{SO}$$

Where:

BOH_R = as defined in 10.4.1.2 of this appendix

y_P = as defined in 10.4.1 of this appendix

PE_R = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3), measured at the reduced fuel input rate

y_{IG} = as defined in 10.4.1 of this appendix

PE_{IG} = as defined in 10.4.1 of this appendix

y = as defined in 10.4.1 of this appendix

BE_R = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3) measured at the reduced fuel input rate

BOH_M = as defined in 10.4.1.4 of this appendix

PE_H = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3) measured at the maximum fuel input rate

BE_H = as defined in 9.1.2.2 of ANSI/ASHRAE Standard 103—1993, (incorporated by reference, *see* § 430.3) measured at the maximum fuel input rate

E_{SO} = as defined in 10.11 of this appendix.

10.5 *Average annual electric energy consumption for electric furnaces or boilers.*

$E_E = 100(2{,}080)(0.77)DHR/(3.412\ AFUE) + E_{SO}$

Where:

100 = to express a percent as a decimal

2,080 = as specified in 10.4.1 of this appendix

0.77 = as specified in 10.4.1 of this appendix

DHR = as defined in 10.4.1 of this appendix

3.412 = conversion to express energy in terms of watt-hours instead of Btu

AFUE = as defined in 11.1 of ANSI/ASHRAE Standard 103—1993 (incorporated by reference, *see* § 430.3), in percent, and calculated on the basis of: ICS installation, for non-weatherized warm air furnaces; indoor installation, for non-weatherized boilers; or outdoor installation, for furnaces and boilers that are weatherized.

E_{SO} = as defined in 10.11 of this appendix.

10.6 *Energy factor.*

10.6.1 *Energy factor for gas or oil furnaces and boilers.* Calculate the energy factor, EF, for gas or oil furnaces and boilers defined as, in percent:

$$RF = \frac{(E_F - 4600\,Q_P)Effy_{HS}}{E_F + 3412\,E_{AE}}$$

where:

E_F =average annual fuel consumption as defined in 10.4.2 of this appendix.

E_{AE} =as defined in 10.4.3 of this appendix.

$Effy_{HS}$ =Annual Fuel Utilization Efficiency as defined in 11.2.11, 11.3.11, 11.4.11 or 11.5.11 of ANSI/ASHRAE Standard 103-1993, in percent, and calculated on the basis of:

ICS installation, for non-weatherized warm air furnaces;

indoor installation, for non-weatherized boilers; or

outdoor installation, for furnaces and boilers that are weatherized.

3,412=conversion factor from kilowatt to Btu/h

10.6.2 *Energy factor for electric furnaces and boilers.* The energy factor, EF, for electric furnaces and boilers is defined as:

EF=AFUE

where:

AFUE=Annual Fuel Utilization Efficiency as defined in section 10.5 of this appendix, in percent

10.7 *Average annual energy consumption for furnaces and boilers located in a different geographic region of the United States and in buildings with different design heating requirements.*

10.7.1 *Average annual fuel energy consumption for gas or oil-fueled furnaces and boilers located in a different geographic region of the United States and in buildings with different design heating requirements.* For gas or oil-fueled furnaces and boilers, the average annual fuel energy consumption for a specific geographic region and a specific typical design heating requirement (E_{FR}) is expressed in Btu per year and defined as:

$E_{FR} = (E_F - 8{,}760\ Q_P)(HLH/2{,}080) + 8{,}760\ Q_P$

where:

E_F =as defined in 10.4.2 of this appendix

8,760=as specified in 10.4.1.1 of this appendix

Q_P =as defined in 11.2.11 of ANSI/ASHRAE Standard 103-1993

HLH=heating load hours for a specific geographic region determined from the heating load hour map in Figure 1 of this appendix

2,080=as defined in 10.4.1 of this appendix

10.7.2 Average annual auxiliary electrical energy consumption for gas or oil-fueled furnaces and boilers located in a different geographic region of the United States and in buildings with different design heating requirements. For gas or oil-fueled furnaces and boilers, the average annual auxiliary electrical energy consumption for a specific geographic region and a specific typical design heating requirement (E_{AER}) is expressed in kilowatt-hours and defined as:

$$E_{AER} = (E_{AE} - E_{SO}) (HLH/2080) + E_{SOR}$$

Where:

E_{AE} = as defined in 10.4.3 of this appendix

E_{SO} = as defined in 10.11 of this appendix

HLH = as defined in 10.7.1 of this appendix

2,080 = as specified in 10.4.1 of this appendix

E_{SOR} = as specified in 10.7.3 of this appendix.

10.7.3 Average annual electric energy consumption for electric furnaces and boilers located in a different geographic region of the United States and in buildings with different design heating requirements. For electric furnaces and boilers, the average annual electric energy

consumption for a specific geographic region and a specific typical design heating requirement (E_{ER}) is expressed in kilowatt-hours and defined as:

$E_{ER} = 100(0.77)\ DHR\ HLH/(3.412\ AFUE) + E_{SOR}$

Where:

100 = as specified in 10.5 of this appendix

0.77 = as specified in 10.4.1 of this appendix

DHR = as defined in 10.4.1 of this appendix

HLH = as defined in 10.7.1 of this appendix

3.412 = as specified in 10.5 of this appendix

AFUE = as defined in 10.5 of this appendix

E_{SOR} = E_{SO} as defined in 10.11 of this appendix, except that in the equation for E_{SO} , the term BOH is multiplied by the expression (HLH/2080) to get the appropriate regional accounting of standby mode and off mode loss.

10.8 *Annual energy consumption for mobile home furnaces.*

10.8.1 *National average number of burner operating hours for mobile home furnaces (BOH* $_{SS}$ *).* BOH_{SS} is the same as in 10.4.1 of this appendix, except that the value of $Effy_{HS}$ in the calculation of the burner operating hours, BOH_{SS} , is calculated on the basis of a direct vent unit with system number 9 or 10.

10.8.2 *Average annual fuel energy for mobile home furnaces (E_F).* E_F is same as in 10.4.2 of this appendix except that the burner operating hours, BOH_{SS} , is calculated as specified in 10.8.1 of this appendix.

10.8.3 *Average annual auxiliary electrical energy consumption for mobile home furnaces (E_{AE}).* E_{AE} is the same as in 10.4.3 of this appendix, except that the burner operating hours, BOH_{SS} , is calculated as specified in 10.8.1 of this appendix.

10.9 *Calculation of sales weighted average annual energy consumption for mobile home furnaces.* In order to reflect the distribution of mobile homes to geographical regions with average HLH_{MHF} value different from 2,080, adjust the annual fossil fuel and auxiliary electrical energy consumption values for mobile home furnaces using the following adjustment calculations.

10.9.1 For mobile home furnaces, the sales weighted average annual fossil fuel energy consumption is expressed in Btu per year and defined as:

$$E_{F,MHF} = (E_F - 8{,}760\ Q_P)HLH_{MHF}/2{,}080 + 8{,}760\ Q_P$$

where:

E_F =as defined in 10.8.2 of this appendix

8,760=as specified in 10.4.1.1 of this appendix

Q_P =as defined in 11.2.11 of ANSI/ASHRAE Standard 103-1993

HLH_{MHF} =1880, sales weighted average heating load hours for mobile home furnaces

2,080=as specified in 10.4.1 of this appendix

10.9.2 For mobile home furnaces, the sales weighted average annual auxiliary electrical energy consumption is expressed in kilowatt-hours and defined as:

$E_{AE,MHF} = E_{AE}\ HLH_{MHF} / 2{,}080$

where:

E_{AE} =as defined in 10.8.3 of this appendix

HLH_{MHF} =as defined in 10.9.1 of this appendix

2,080=as specified in 10.4.1 of this appendix

10.10 *Direct determination of off-cycle losses for furnaces and boilers equipped with thermal stack dampers.*[Reserved.]

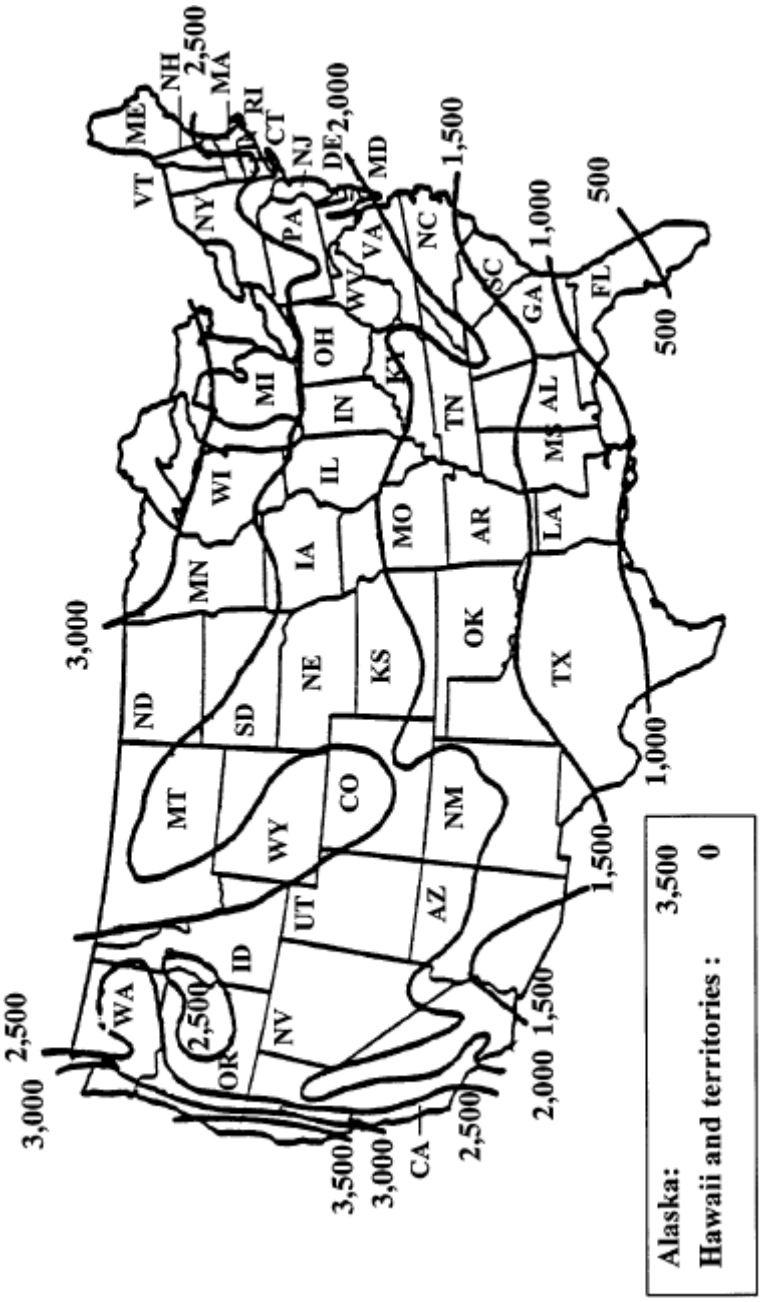

FIGURE 1- HEATING LOAD HOURS (HLH) FOR THE UNITED STATES

10.11 *Average annual electrical standby mode and off mode energy consumption.* Calculate the annual electrical standby mode and off mode energy consumption (E_{SO}) in kilowatt-hours, defined as:

$$E_{SO} = ((P_{W,SB} * (4160 - BOH)) + (P_{W,OFF} * 4600)) * K$$

Where:

$P_{W,SB}$ = furnace or boiler standby mode power, in watts, as measured in section 8.6 of this appendix

4,160 = average heating season hours per year

$P_{W,OFF}$ = furnace or boiler off mode power, in watts, as measured in section 8.6 of this appendix

4,600 = average non-heating season hours per year

K = 0.001 kWh/Wh, conversion factor for watt-hours to kilowatt-hours

BOH = total burner operating hours as calculated in section 10.4 for gas or oil-fueled furnaces or boilers. Where for gas or oil-fueled furnaces and boilers equipped with single-stage controls, BOH = BOH_{SS} ; for gas or oil-fueled furnaces and boilers equipped with two-stage controls, BOH = (BOH_R + BOH_H); and for gas or oil-fueled furnaces and boilers equipped with step-modulating controls, BOH = (BOH_R + BOH_M). For electric furnaces and boilers, BOH = 100(2080)(0.77)DHR/(E_{in} 3.412)(AFUE))

Where:

100 = to express a percent as a decimal

2,080 = as specified in 10.4.1 of this appendix

0.77 = as specified in 10.4.1 of this appendix

DHR = as defined in 10.4.1 of this appendix

3.412 = conversion to express energy in terms of KBtu instead of kilowatt-hours

AFUE = as defined in 11.1 of ANSI/ASHRAE Standard 103—1993 (incorporated by reference, *see* § 430.3) in percent

E_{in} = Steady-state electric rated power, in kilowatts, from section 9.3 of ANSI/ASHRAE Standard 103—1993 (incorporated by reference, *see* § 430.3).

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