



**BSR/ASHRAE/IES Addendum CV
to ANSI/ASHRAE/IES Standard 90.1-2013**

Public Review Draft

**Proposed Addendum cv to Standard
90.1-2013, *Energy Standard for
Buildings Except Low-Rise
Residential Buildings***

**First Public Review (December 2015)
(Draft shows Proposed Changes to Current Standard)**

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FOREWORD

This proposal updates the motor efficiency standards that are currently shown in Section 6. New federal standards will go into effect on June 1, 2016. Due to the expansion of the scope of federal energy efficiency standards for large motors, this proposal updates the tables to show the expanded scope of federal energy efficiency standards for large (1-500 hp) motors. The energy efficiency standards for fire pump motors do not change from their current levels.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and strikethrough (for deletions) unless the instructions specifically mention some other means of indicating the changes. Only these changes are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed substantive changes.

Addendum CV to 90.1-2013

Revise the Standard as follows (IP and SI Units)

IP Version

Revise Section 3 as follows:

...

~~general purpose electric motor (subtype I):~~ a general purpose electric motor that

- a. ~~is a single speed induction motor;~~
- b. ~~is rated for continuous duty (MG1) operation or for duty type SI (IEC);~~
- c. ~~contains a squirrel cage (MG1) or cage (IEC) rotor;~~
- d. ~~has foot mounting that may include foot mounting with flanges or detachable feet;~~
- e. ~~is built in accordance with NEMA T frame dimensions or their IEC metric equivalents, including a frame size that is between two consecutive NEMA frame sizes or their IEC metric equivalents;~~
- f. ~~has performance in accordance with NEMA Design A (MG1) or B (MG1) characteristics, or equivalent designs, such as IEC Design N (IEC);~~
- g. ~~operates on polyphase alternating current 60 Hz sinusoidal power and~~
 1. ~~is rated at 230 or 460 V (or both), including motors rated at multiple voltages that include 230 or 460 V (or both) or~~
 2. ~~can be operated on 230 or 460 V (or both); and~~
- h. ~~includes, but is not limited to, explosion proof construction.~~

~~**general purpose electric motor (subtype II):** any general purpose electric motor that incorporates the design elements of a general purpose electric motor (subtype I) and that is configured in one or more of the following ways:~~

- ~~a. Is built in accordance with NEMA U frame dimensions, as described in NEMA MG 1-1967, or in accordance with the IEC metric equivalents, including a frame size that is between two consecutive NEMA frame sizes or their IEC metric equivalents~~
- ~~b. Has performance in accordance with NEMA Design C characteristics, as described in MG1, or an equivalent IEC design(s) such as IEC Design H~~
- ~~c. Is a close-coupled pump motor~~
- ~~d. Is a footless motor~~
- ~~e. Is a vertical, solid-shaft normal thrust motor (as tested in a horizontal configuration) built and designed in a manner consistent with MG1~~
- ~~f. Is an 8-pole motor (900 rpm)~~
- ~~g. Is a polyphase motor with voltage rating of not more than 600 V, is not rated at 230 or 460 V (or both), and cannot be operated on 230 or 460 V (or both)~~

IEC Design H motor: An electric motor that

- a. Is an induction motor designed for use with three-phase power;
- b. Contains a cage rotor;
- c. Is capable of direct-on-line starting
- d. Has 4, 6, or 8 poles;
- e. Is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz; and
- f. Conforms to sections 8.1, 8.2, and 8.3 of the IEC 60034-12 edition 2.1 requirements for starting torque, locked rotor apparent power, and starting.

IEC Design N motor: An electric motor that:

- a. Is an induction motor designed for use with three-phase power;
- b. Contains a cage rotor;
- c. Is capable of direct-on-line starting;
- d. Has 2, 4, 6, or 8 poles;
- e. Is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz; and
- f. Conforms to sections 6.1, 6.2, and 6.3 of the IEC 60034-12 edition 2.1 requirements for torque characteristics, locked rotor apparent power, and starting.

...

NEMA Design A motor: A squirrel-cage motor that:

- a. Is designed to withstand full-voltage starting and developing locked-rotor torque as shown in NEMA MG 1-2009, paragraph 12.38.1;
- b. Has pull-up torque not less than the values shown in NEMA MG 1-2009, paragraph 12.40.1;
- c. Has breakdown torque not less than the values shown in NEMA MG 1-2009, paragraph 12.39.1;
- d. Has a locked-rotor current higher than the values shown in NEMA MG 1-2009, paragraph 12.35.1 for 60 hertz and NEMA MG 1-2009, paragraph 12.35.2 for 50 hertz; and
- e. Has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA Design B motor: A squirrel-cage motor that is:

- a. Designed to withstand full-voltage starting;
- b. Develops locked-rotor, breakdown, and pull-up torques adequate for general application as specified in sections 12.38, 12.39 and 12.40 of NEMA MG1-2009;
- c. Draws locked-rotor current not to exceed the values shown in section 12.35.1 for 60 hertz and 12.35.2 for 50 hertz of NEMA MG1-2009; and
- d. Has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA Design C motor: A squirrel-cage motor that:

- a. Is Designed to withstand full-voltage starting and developing locked-rotor torque for high-torque applications up to the values shown in NEMA MG1-2009, paragraph 12.38.2 (incorporated by reference, see §431.15);
- b. Has pull-up torque not less than the values shown in NEMA MG1-2009, paragraph 12.40.2;
- c. Has breakdown torque not less than the values shown in NEMA MG1-2009, paragraph 12.39.2;
- d. Has a locked-rotor current not to exceed the values shown in NEMA MG1-2009, paragraphs 12.35.1 for 60 hertz and 12.35.2 for 50 hertz; and
- e. Has a slip at rated load of less than 5 percent.

...

Revise Section 10.4.1 as follows:

10.4.1 Electric Motors. Electric motors manufactured alone or as a component of another piece of equipment with a power rating of 1 hp or more, and less than or equal to 500 hp, shall comply with the requirements of ~~the Energy Independence and Security Act of 2007~~, as shown in Table 10.8-1 for ~~general purpose electric motors (subtype I)~~ NEMA Design A motors, NEMA Design B motors, and IEC Design N motors and Table 10.8-2 for ~~general purpose electric motors (subtype II)~~ NEMA Design C motors and IEC Design H motors.

~~General purpose electric motors with a power rating of more than 200 hp, but no more than 500 hp, shall have a minimum nominal full-load efficiency that is not less than as shown in Table 10.8-3.~~

Fire-pump electric motors shall have a minimum nominal full-load efficiency that is not less than that shown in Table 10.8-65.

~~Motors that are not included in the scope of the Energy Independence and Security Act of 2007, Section 313, have no performance requirements in this section.~~

Exceptions to 10.4.1: The standards in this section do not apply to the following exempt electric motors:

1. Air-over electric motors
2. Component sets of an electric motor
3. Liquid-cooled electric motors
4. Submersible electric motors
5. Inverter-only electric motors

(Delete the current Table 10.8-1 and replace with the new table below)

TABLE 10.8-1 ~~Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype I), Except Fire-Pump Electric Motors^a~~

Full-Load Efficiency, %						
Number of Poles ⇒	Open Drip-Proof Motors			Totally Enclosed Fan-Cooled Motors		
	2	4	6	2	4	6
Synchronous Speed (RPM) ⇒	3600	1800	1200	3600	1800	1200
Motor Horsepower						
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7
20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5
100	93.6	95.4	95.0	94.1	95.4	95.0
125	94.1	95.4	95.0	95.0	95.4	95.0
150	94.1	95.8	95.4	95.0	95.8	95.8
200	95.0	95.8	95.4	95.4	96.2	95.8

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

Table 10.8-1 Minimum Nominal Full-Load Efficiency for NEMA Design A, NEMA Design B and IEC Design N Motors (Excluding Fire Pump Electric Motors) at 60 Hz^{a,b}

Motor horsepower (standard kilowatt equivalent)	Nominal full-load efficiency (%) as of June 1, 2016							
	2 Pole		4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open	Enclosed	Open
1 (0.75)	77.0	77.0	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	84.0	84.0	86.5	86.5	87.5	86.5	78.5	77.0
2 (1.5)	85.5	85.5	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	86.5	85.5	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	88.5	86.5	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	89.5	88.5	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	90.2	89.5	91.7	91.7	91.0	91.7	89.5	90.2
15 (11)	91.0	90.2	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	91.0	91.0	93.0	93.0	91.7	92.4	90.2	91.0
25 (18.5)	91.7	91.7	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	91.7	91.7	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	92.4	92.4	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	93.0	93.0	94.5	94.5	94.1	94.1	92.4	92.4
60 (45)	93.6	93.6	95.0	95.0	94.5	94.5	92.4	93.0
75 (55)	93.6	93.6	95.4	95.0	94.5	94.5	93.6	94.1
100 (75)	94.1	93.6	95.4	95.4	95.0	95.0	93.6	94.1
125 (90)	95.0	94.1	95.4	95.4	95.0	95.0	94.1	94.1
150 (110)	95.0	94.1	95.8	95.8	95.8	95.4	94.1	94.1
200 (150)	95.4	95.0	96.2	95.8	95.8	95.4	94.5	94.1
250 (186)	95.8	95.0	96.2	95.8	95.8	95.8	95.0	95.0
300 (224)	95.8	95.4	96.2	95.8	95.8	95.8		
350 (261)	95.8	95.4	96.2	95.8	95.8	95.8		
400 (298)	95.8	95.8	96.2	95.8				
450 (336)	95.8	96.2	96.2	96.2				
500 (373)	95.8	96.2	96.2	96.2				

- a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.
- b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:
- (1) A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers;
- (2) A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers; or
- (3) A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kilowatt = (1/0.746) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with paragraph (1) or (2), whichever applies.

(Delete the current Table 10.8-2 and replace with the new table below)

TABLE 10.8-2 Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype II), Except Fire-Pump Electric Motors^a

	Full-Load Efficiency, %								
	Open Drip-Proof Motors				Totally Enclosed Fan-Cooled Motors				
	Number of Poles ⇒	2	4	6	8	2	4	6	8
Synchronous Speed (RPM) ⇒	3600	1800	1200	900	3600	1800	1200	900	
Motor Horsepower									
1	NR	82.5	80.0	74.0	75.5	82.5	80.0	74.0	
1.5	82.5	84.0	84.0	75.5	82.5	84.0	85.5	77.0	
2	84.0	84.0	85.5	85.5	84.0	84.0	86.5	82.5	
3	84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0	
5	85.5	87.5	87.5	87.5	87.5	87.5	87.5	85.5	
7.5	87.5	88.5	88.5	88.5	88.5	89.5	89.5	85.5	
10	88.5	89.5	90.2	89.5	89.5	89.5	89.5	88.5	
15	89.5	91.0	90.2	89.5	90.2	91.0	90.2	88.5	
20	90.2	91.0	91.0	90.2	90.2	91.0	90.2	89.5	
25	91.0	91.7	91.7	90.2	91.0	92.4	91.7	89.5	

30	91.0	92.4	92.4	91.0	91.0	92.4	91.7	91.0
40	91.7	93.0	93.0	91.0	91.7	93.0	93.0	91.0
50	92.4	93.0	93.0	91.7	92.4	93.0	93.0	91.7
60	93.0	93.6	93.6	92.4	93.0	93.6	93.6	91.7
75	93.0	94.1	93.6	93.6	93.0	94.1	93.6	93.0
100	93.0	94.1	94.1	93.6	93.6	94.5	94.1	93.0
125	93.6	94.5	94.1	93.6	94.5	94.5	94.1	93.6
150	93.6	95.0	94.5	93.6	94.5	95.0	95.0	93.6
200	94.5	95.0	94.5	93.6	95.0	95.0	95.0	94.1

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.
 NR — No requirement

Table 10.8-2 Minimum Nominal Full-Load Efficiency for NEMA Design C and IEC Design H Motors at 60 Hz^{a,b}

Motor horsepower (standard kilowatt equivalent)	Nominal full-load efficiency (%) as of June 1, 2016					
	4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
1 (0.75)	85.5	85.5	82.5	82.5	75.5	75.5
1.5 (1.1)	86.5	86.5	87.5	86.5	78.5	77.0
2 (1.5)	86.5	86.5	88.5	87.5	84.0	86.5
3 (2.2)	89.5	89.5	89.5	88.5	85.5	87.5
5 (3.7)	89.5	89.5	89.5	89.5	86.5	88.5
7.5 (5.5)	91.7	91.0	91.0	90.2	86.5	89.5
10 (7.5)	91.7	91.7	91.0	91.7	89.5	90.2
15 (11)	92.4	93.0	91.7	91.7	89.5	90.2
20 (15)	93.0	93.0	91.7	92.4	90.2	91.0
25 (18.5)	93.6	93.6	93.0	93.0	90.2	91.0
30 (22)	93.6	94.1	93.0	93.6	91.7	91.7
40 (30)	94.1	94.1	94.1	94.1	91.7	91.7
50 (37)	94.5	94.5	94.1	94.1	92.4	92.4

60 (45)	<u>95.0</u>	<u>95.0</u>	<u>94.5</u>	<u>94.5</u>	<u>92.4</u>	<u>93.0</u>
75 (55)	<u>95.4</u>	<u>95.0</u>	<u>94.5</u>	<u>94.5</u>	<u>93.6</u>	<u>94.1</u>
100 (75)	<u>95.4</u>	<u>95.4</u>	<u>95.0</u>	<u>95.0</u>	<u>93.6</u>	<u>94.1</u>
125 (90)	<u>95.4</u>	<u>95.4</u>	<u>95.0</u>	<u>95.0</u>	<u>94.1</u>	<u>94.1</u>
150 (110)	<u>95.8</u>	<u>95.8</u>	<u>95.8</u>	<u>95.4</u>	<u>94.1</u>	<u>94.1</u>
200 (150)	<u>96.2</u>	<u>95.8</u>	<u>95.8</u>	<u>95.4</u>	<u>94.5</u>	<u>94.1</u>

- a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.
 b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:

(1) A horsepower at or above the midpoint between the two consecutive horsepower shall be rounded up to the higher of the two horsepower;

(2) A horsepower below the midpoint between the two consecutive horsepower shall be rounded down to the lower of the two horsepower; or

(3) A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula 1 kilowatt = (1/0.746) horsepower. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with paragraph (1) or (2), whichever applies.

(Delete Table 10.8-3, as requirements have been moved into the new tables above)

TABLE 10.8-3 Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype I and II), Except Fire-Pump Electric Motors^a

Number of Poles ⇒	Full-Load Efficiency, %							
	Open Drip-Proof Motors				Totally Enclosed Fan-Cooled Motors			
	2	4	6	8	2	4	6	8
Synchronous Speed (RPM) ⇒	3600	1800	1200	900	3600	1800	1200	900
Motor Horsepower								
250	94.5	95.4	95.4	94.5	95.4	95.0	95.0	94.5
300	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
350	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
400	95.4	95.4	NR	NR	95.4	95.4	NR	NR
450	95.8	95.8	NR	NR	95.4	95.4	NR	NR
500	95.8	95.8	NR	NR	95.4	95.8	NR	NR

^a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

NR—No requirement

(Renumber the following tables)

Table 10.8-43 Minimum Average Full-Load Efficiency for Polyphase Small Electric Motors^a

Table 10.8-54 Minimum Average Full-Load Efficiency for Capacitor-Start Capacitor-Run and Capacitor-Start Induction-Run Small Electric Motors^a

(Renumber the following table, and add the footnote shown below)

Table 10.8-65 Minimum Nominal Full-Load Efficiency for Fire-Pump Electric Motors^{a,b}

.... (table is unchanged)

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

NR—No requirement

b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a horsepower or kilowatt rating between two horsepower or two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed horsepower or kilowatt rating, determined as follows:

(1) A horsepower at or above the midpoint between the two consecutive horsepowers shall be rounded up to the higher of the two horsepowers;

(2) A horsepower below the midpoint between the two consecutive horsepowers shall be rounded down to the lower of the two horsepowers; or

(3) A kilowatt rating shall be directly converted from kilowatts to horsepower using the formula $1 \text{ kilowatt} = (1/0.746) \text{ horsepower}$. The conversion should be calculated to three significant decimal places, and the resulting horsepower shall be rounded in accordance with paragraph (1) or (2), whichever applies.

SI Version

Revise Section 3 as follows:

...

~~**general purpose electric motor (subtype I):** a general purpose electric motor that~~

- ~~a. is a single-speed induction motor;~~
- ~~b. is rated for continuous duty (MG1) operation or for duty type SI (IEC);~~
- ~~c. contains a squirrel-cage (MG1) or cage (IEC) rotor;~~
- ~~d. has foot mounting that may include foot mounting with flanges or detachable feet;~~
- ~~e. is built in accordance with NEMA T frame dimensions or their IEC metric equivalents, including a frame size that is between two consecutive NEMA frame sizes or their IEC metric equivalents;~~
- ~~f. has performance in accordance with NEMA Design A (MG1) or B (MG1) characteristics, or equivalent designs, such as IEC Design N (IEC);~~
- ~~g. operates on polyphase alternating current 60 Hz sinusoidal power and
 - ~~1. is rated at 230 or 460 V (or both), including motors rated at multiple voltages that include 230 or 460 V (or both) or~~
 - ~~2. can be operated on 230 or 460 V (or both); and~~~~
- ~~h. includes, but is not limited to, explosion-proof construction.~~

~~**general purpose electric motor (subtype II):** any general purpose electric motor that incorporates the design elements of a general purpose electric motor (subtype I) and that is configured in one or more of the following ways:~~

- ~~a. Is built in accordance with NEMA U frame dimensions, as described in NEMA MG-1-1967, or in accordance with the IEC metric equivalents, including a frame size that is between two consecutive NEMA frame sizes or their IEC metric equivalents~~
- ~~b. Has performance in accordance with NEMA Design C characteristics, as described in MG1, or an equivalent IEC design(s) such as IEC Design H~~
- ~~c. Is a close-coupled pump motor~~
- ~~d. Is a footless motor~~
- ~~e. Is a vertical, solid shaft normal thrust motor (as tested in a horizontal configuration) built and designed in a manner consistent with MG1~~
- ~~f. Is an 8-pole motor (900 rpm)~~
- ~~g. Is a polyphase motor with voltage rating of not more than 600 V, is not rated at 230 or 460 V (or both), and cannot be operated on 230 or 460 V (or both)~~

IEC Design H motor: An electric motor that

- a. Is an induction motor designed for use with three-phase power;
- b. Contains a cage rotor;
- c. Is capable of direct-on-line starting
- d. Has 4, 6, or 8 poles;
- e. Is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz; and
- f. Conforms to sections 8.1, 8.2, and 8.3 of the IEC 60034-12 edition 2.1 requirements for starting torque, locked rotor apparent power, and starting.

IEC Design N motor: An electric motor that:

- a. Is an induction motor designed for use with three-phase power;
- b. Contains a cage rotor;
- c. Is capable of direct-on-line starting;
- d. Has 2, 4, 6, or 8 poles;
- e. Is rated from 0.4 kW to 1600 kW at a frequency of 60 Hz; and
- f. Conforms to sections 6.1, 6.2, and 6.3 of the IEC 60034-12 edition 2.1 requirements for torque characteristics, locked rotor apparent power, and starting.

...

NEMA Design A motor: A squirrel-cage motor that:

- a. Is designed to withstand full-voltage starting and developing locked-rotor torque as shown in NEMA MG 1-2009, paragraph 12.38.1;
- b. Has pull-up torque not less than the values shown in NEMA MG 1-2009, paragraph 12.40.1;
- c. Has breakdown torque not less than the values shown in NEMA MG 1-2009, paragraph 12.39.1;
- d. Has a locked-rotor current higher than the values shown in NEMA MG 1-2009, paragraph 12.35.1 for 60 hertz and NEMA MG 1-2009, paragraph 12.35.2 for 50 hertz; and
- e. Has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA Design B motor: A squirrel-cage motor that is:

- a. Designed to withstand full-voltage starting;
- b. Develops locked-rotor, breakdown, and pull-up torques adequate for general application as specified in sections 12.38, 12.39 and 12.40 of NEMA MG1-2009;
- c. Draws locked-rotor current not to exceed the values shown in section 12.35.1 for 60 hertz and 12.35.2 for 50 hertz of NEMA MG1-2009; and
- d. Has a slip at rated load of less than 5 percent for motors with fewer than 10 poles.

NEMA Design C motor: A squirrel-cage motor that:

- a. Is Designed to withstand full-voltage starting and developing locked-rotor torque for high-torque applications up to the values shown in NEMA MG1-2009, paragraph 12.38.2 (incorporated by reference, see §431.15);
- b. Has pull-up torque not less than the values shown in NEMA MG1-2009, paragraph 12.40.2;
- c. Has breakdown torque not less than the values shown in NEMA MG1-2009, paragraph 12.39.2;
- d. Has a locked-rotor current not to exceed the values shown in NEMA MG1-2009, paragraphs 12.35.1 for 60 hertz and 12.35.2 for 50 hertz; and
- e. Has a slip at rated load of less than 5 percent.

...

Revise Section 10.4.1 as follows:

10.4.1 Electric Motors. Electric motors manufactured alone or as a component of another piece of equipment with a power rating of ~~1 hp~~ 0.75 kW or more, and less than or equal to ~~500 hp~~ 373 kW, shall

comply with the requirements of the ~~Energy Independence and Security Act of 2007~~, as shown in Table 10.8-1 for ~~general purpose electric motors (subtype I)~~ *NEMA Design A motors, NEMA Design B motors, and IEC Design N motors* and Table 10.8-2 for ~~general purpose electric motors (subtype II)~~ *NEMA Design C motors and IEC Design H motors.*

~~General purpose electric motors with a power rating of more than 200 hp, but no more than 500 hp, shall have a minimum nominal full-load efficiency that is not less than as shown in Table 10.8-3.~~

~~Fire-pump electric motors shall have a minimum nominal full-load efficiency that is not less than that shown in Table 10.8-65.~~

~~Motors that are not included in the scope of the Energy Independence and Security Act of 2007, Section 313, have no performance requirements in this section.~~

Exceptions to 10.4.1: The standards in this section do not apply to the following exempt electric motors:

1. Air-over electric motors
2. Component sets of an electric motor
3. Liquid-cooled electric motors
4. Submersible electric motors
5. Inverter-only electric motors

(Delete the current Table 10.8-1 and replace with the new table below)

TABLE 10.8-1 ~~Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype I), Except Fire-Pump Electric Motors^a~~

Number of Poles ⇒	Full-Load Efficiency, %					
	Open Drip-Proof Motors			Totally Enclosed Fan-Cooled Motors		
	2	4	6	2	4	6
Synchronous Speed (RPM) ⇒	3600	1800	1200	3600	1800	1200
Motor Horsepower						
1	77.0	85.5	82.5	77.0	85.5	82.5
1.5	84.0	86.5	86.5	84.0	86.5	87.5
2	85.5	86.5	87.5	85.5	86.5	88.5
3	85.5	89.5	88.5	86.5	89.5	89.5
5	86.5	89.5	89.5	88.5	89.5	89.5
7.5	88.5	91.0	90.2	89.5	91.7	91.0
10	89.5	91.7	91.7	90.2	91.7	91.0
15	90.2	93.0	91.7	91.0	92.4	91.7

20	91.0	93.0	92.4	91.0	93.0	91.7
25	91.7	93.6	93.0	91.7	93.6	93.0
30	91.7	94.1	93.6	91.7	93.6	93.0
40	92.4	94.1	94.1	92.4	94.1	94.1
50	93.0	94.5	94.1	93.0	94.5	94.1
60	93.6	95.0	94.5	93.6	95.0	94.5
75	93.6	95.0	94.5	93.6	95.4	94.5
100	93.6	95.4	95.0	94.1	95.4	95.0
125	94.1	95.4	95.0	95.0	95.4	95.0
150	94.1	95.8	95.4	95.0	95.8	95.8
200	95.0	95.8	95.4	95.4	96.2	95.8

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

Table 10.8-1 Minimum Nominal Full-Load Efficiency for NEMA Design A, NEMA Design B and IEC Design N Motors (Excluding Fire Pump Electric Motors) at 60 Hz^{a,b}

<u>Motor kilowatts</u>	<u>Nominal full-load efficiency (%) as of June 1, 2016</u>							
	<u>2 Pole</u>		<u>4 Pole</u>		<u>6 Pole</u>		<u>8 Pole</u>	
	<u>Enclosed</u>	<u>Open</u>	<u>Enclosed</u>	<u>Open</u>	<u>Enclosed</u>	<u>Open</u>	<u>Enclosed</u>	<u>Open</u>
<u>0.75</u>	<u>77.0</u>	<u>77.0</u>	<u>85.5</u>	<u>85.5</u>	<u>82.5</u>	<u>82.5</u>	<u>75.5</u>	<u>75.5</u>
<u>1.1</u>	<u>84.0</u>	<u>84.0</u>	<u>86.5</u>	<u>86.5</u>	<u>87.5</u>	<u>86.5</u>	<u>78.5</u>	<u>77.0</u>
<u>1.5</u>	<u>85.5</u>	<u>85.5</u>	<u>86.5</u>	<u>86.5</u>	<u>88.5</u>	<u>87.5</u>	<u>84.0</u>	<u>86.5</u>
<u>2.2</u>	<u>86.5</u>	<u>85.5</u>	<u>89.5</u>	<u>89.5</u>	<u>89.5</u>	<u>88.5</u>	<u>85.5</u>	<u>87.5</u>
<u>3.7</u>	<u>88.5</u>	<u>86.5</u>	<u>89.5</u>	<u>89.5</u>	<u>89.5</u>	<u>89.5</u>	<u>86.5</u>	<u>88.5</u>
<u>5.5</u>	<u>89.5</u>	<u>88.5</u>	<u>91.7</u>	<u>91.0</u>	<u>91.0</u>	<u>90.2</u>	<u>86.5</u>	<u>89.5</u>
<u>7.5</u>	<u>90.2</u>	<u>89.5</u>	<u>91.7</u>	<u>91.7</u>	<u>91.0</u>	<u>91.7</u>	<u>89.5</u>	<u>90.2</u>
<u>11</u>	<u>91.0</u>	<u>90.2</u>	<u>92.4</u>	<u>93.0</u>	<u>91.7</u>	<u>91.7</u>	<u>89.5</u>	<u>90.2</u>
<u>15</u>	<u>91.0</u>	<u>91.0</u>	<u>93.0</u>	<u>93.0</u>	<u>91.7</u>	<u>92.4</u>	<u>90.2</u>	<u>91.0</u>
<u>18.5</u>	<u>91.7</u>	<u>91.7</u>	<u>93.6</u>	<u>93.6</u>	<u>93.0</u>	<u>93.0</u>	<u>90.2</u>	<u>91.0</u>
<u>22</u>	<u>91.7</u>	<u>91.7</u>	<u>93.6</u>	<u>94.1</u>	<u>93.0</u>	<u>93.6</u>	<u>91.7</u>	<u>91.7</u>
<u>30</u>	<u>92.4</u>	<u>92.4</u>	<u>94.1</u>	<u>94.1</u>	<u>94.1</u>	<u>94.1</u>	<u>91.7</u>	<u>91.7</u>
<u>37</u>	<u>93.0</u>	<u>93.0</u>	<u>94.5</u>	<u>94.5</u>	<u>94.1</u>	<u>94.1</u>	<u>92.4</u>	<u>92.4</u>

<u>45</u>	<u>93.6</u>	<u>93.6</u>	<u>95.0</u>	<u>95.0</u>	<u>94.5</u>	<u>94.5</u>	<u>92.4</u>	<u>93.0</u>
<u>55</u>	<u>93.6</u>	<u>93.6</u>	<u>95.4</u>	<u>95.0</u>	<u>94.5</u>	<u>94.5</u>	<u>93.6</u>	<u>94.1</u>
<u>75</u>	<u>94.1</u>	<u>93.6</u>	<u>95.4</u>	<u>95.4</u>	<u>95.0</u>	<u>95.0</u>	<u>93.6</u>	<u>94.1</u>
<u>90</u>	<u>95.0</u>	<u>94.1</u>	<u>95.4</u>	<u>95.4</u>	<u>95.0</u>	<u>95.0</u>	<u>94.1</u>	<u>94.1</u>
<u>110</u>	<u>95.0</u>	<u>94.1</u>	<u>95.8</u>	<u>95.8</u>	<u>95.8</u>	<u>95.4</u>	<u>94.1</u>	<u>94.1</u>
<u>150</u>	<u>95.4</u>	<u>95.0</u>	<u>96.2</u>	<u>95.8</u>	<u>95.8</u>	<u>95.4</u>	<u>94.5</u>	<u>94.1</u>
<u>186</u>	<u>95.8</u>	<u>95.0</u>	<u>96.2</u>	<u>95.8</u>	<u>95.8</u>	<u>95.8</u>	<u>95.0</u>	<u>95.0</u>
<u>224</u>	<u>95.8</u>	<u>95.4</u>	<u>96.2</u>	<u>95.8</u>	<u>95.8</u>	<u>95.8</u>		
<u>261</u>	<u>95.8</u>	<u>95.4</u>	<u>96.2</u>	<u>95.8</u>	<u>95.8</u>	<u>95.8</u>		
<u>298</u>	<u>95.8</u>	<u>95.8</u>	<u>96.2</u>	<u>95.8</u>				
<u>336</u>	<u>95.8</u>	<u>96.2</u>	<u>96.2</u>	<u>96.2</u>				
<u>373</u>	<u>95.8</u>	<u>96.2</u>	<u>96.2</u>	<u>96.2</u>				

- a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.
- b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a kilowatt rating between two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed kilowatt rating, determined as follows:
 - (1) A kilowatt rating at or above the midpoint between the two consecutive kilowatts shall be rounded up to the higher of the two kilowatts;
 - (2) A kilowatt rating below the midpoint between the two consecutive kilowatts shall be rounded down to the lower of the two kilowatts.

(Delete the current Table 10.8-2 and replace with the new table below)

TABLE 10.8-2 Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype II), Except Fire-Pump Electric Motors^a

	Full-Load Efficiency, %							
	Open Drip-Proof Motors				Totally Enclosed Fan-Cooled Motors			
	2	4	6	8	2	4	6	8
Number of Poles ⇒								
Synchronous Speed (RPM) ⇒	3600	1800	1200	900	3600	1800	1200	900

Motor Horsepower

1	NR	82.5	80.0	74.0	75.5	82.5	80.0	74.0
1.5	82.5	84.0	84.0	75.5	82.5	84.0	85.5	77.0
2	84.0	84.0	85.5	85.5	84.0	84.0	86.5	82.5
3	84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0
5	85.5	87.5	87.5	87.5	87.5	87.5	87.5	85.5
7.5	87.5	88.5	88.5	88.5	88.5	89.5	89.5	85.5
10	88.5	89.5	90.2	89.5	89.5	89.5	89.5	88.5
15	89.5	91.0	90.2	89.5	90.2	91.0	90.2	88.5
20	90.2	91.0	91.0	90.2	90.2	91.0	90.2	89.5
25	91.0	91.7	91.7	90.2	91.0	92.4	91.7	89.5
30	91.0	92.4	92.4	91.0	91.0	92.4	91.7	91.0
40	91.7	93.0	93.0	91.0	91.7	93.0	93.0	91.0
50	92.4	93.0	93.0	91.7	92.4	93.0	93.0	91.7
60	93.0	93.6	93.6	92.4	93.0	93.6	93.6	91.7
75	93.0	94.1	93.6	93.6	93.0	94.1	93.6	93.0
100	93.0	94.1	94.1	93.6	93.6	94.5	94.1	93.0
125	93.6	94.5	94.1	93.6	94.5	94.5	94.1	93.6
150	93.6	95.0	94.5	93.6	94.5	95.0	95.0	93.6
200	94.5	95.0	94.5	93.6	95.0	95.0	95.0	94.1

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

NR—No requirement

Table 10.8-2 Minimum Nominal Full-Load Efficiency for NEMA Design C and IEC Design H Motors at 60 Hz^{a,b}

Motor kilowatts	Nominal full-load efficiency (%) as of June 1, 2016					
	4 Pole		6 Pole		8 Pole	
	Enclosed	Open	Enclosed	Open	Enclosed	Open
<u>0.75</u>	<u>85.5</u>	<u>85.5</u>	<u>82.5</u>	<u>82.5</u>	<u>75.5</u>	<u>75.5</u>
<u>1.1</u>	<u>86.5</u>	<u>86.5</u>	<u>87.5</u>	<u>86.5</u>	<u>78.5</u>	<u>77.0</u>
<u>1.5</u>	<u>86.5</u>	<u>86.5</u>	<u>88.5</u>	<u>87.5</u>	<u>84.0</u>	<u>86.5</u>
<u>2.2</u>	<u>89.5</u>	<u>89.5</u>	<u>89.5</u>	<u>88.5</u>	<u>85.5</u>	<u>87.5</u>

<u>3.7</u>	<u>89.5</u>	<u>89.5</u>	<u>89.5</u>	<u>89.5</u>	<u>86.5</u>	<u>88.5</u>
<u>5.5</u>	<u>91.7</u>	<u>91.0</u>	<u>91.0</u>	<u>90.2</u>	<u>86.5</u>	<u>89.5</u>
<u>7.5</u>	<u>91.7</u>	<u>91.7</u>	<u>91.0</u>	<u>91.7</u>	<u>89.5</u>	<u>90.2</u>
<u>11</u>	<u>92.4</u>	<u>93.0</u>	<u>91.7</u>	<u>91.7</u>	<u>89.5</u>	<u>90.2</u>
<u>15</u>	<u>93.0</u>	<u>93.0</u>	<u>91.7</u>	<u>92.4</u>	<u>90.2</u>	<u>91.0</u>
<u>18.5</u>	<u>93.6</u>	<u>93.6</u>	<u>93.0</u>	<u>93.0</u>	<u>90.2</u>	<u>91.0</u>
<u>22</u>	<u>93.6</u>	<u>94.1</u>	<u>93.0</u>	<u>93.6</u>	<u>91.7</u>	<u>91.7</u>
<u>30</u>	<u>94.1</u>	<u>94.1</u>	<u>94.1</u>	<u>94.1</u>	<u>91.7</u>	<u>91.7</u>
<u>37</u>	<u>94.5</u>	<u>94.5</u>	<u>94.1</u>	<u>94.1</u>	<u>92.4</u>	<u>92.4</u>
<u>45</u>	<u>95.0</u>	<u>95.0</u>	<u>94.5</u>	<u>94.5</u>	<u>92.4</u>	<u>93.0</u>
<u>55</u>	<u>95.4</u>	<u>95.0</u>	<u>94.5</u>	<u>94.5</u>	<u>93.6</u>	<u>94.1</u>
<u>75</u>	<u>95.4</u>	<u>95.4</u>	<u>95.0</u>	<u>95.0</u>	<u>93.6</u>	<u>94.1</u>
<u>90</u>	<u>95.4</u>	<u>95.4</u>	<u>95.0</u>	<u>95.0</u>	<u>94.1</u>	<u>94.1</u>
<u>110</u>	<u>95.8</u>	<u>95.8</u>	<u>95.8</u>	<u>95.4</u>	<u>94.1</u>	<u>94.1</u>
<u>150</u>	<u>96.2</u>	<u>95.8</u>	<u>95.8</u>	<u>95.4</u>	<u>94.5</u>	<u>94.1</u>

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.

b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a kilowatt rating between two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed kilowatt rating, determined as follows:

(1) A kilowatt rating at or above the midpoint between the two consecutive kilowatts shall be rounded up to the higher of the two kilowatts;

(2) A kilowatt rating below the midpoint between the two consecutive kilowatts shall be rounded down to the lower of the two kilowatts.

(Delete Table 10.8-3, as requirements have been moved into the new tables above)

TABLE 10.8-3 Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype I and II), Except Fire-Pump Electric Motors^a

Full-Load Efficiency, %	
Open Drip-Proof Motors	Totally Enclosed Fan-Cooled Motors

Number of Poles ⇒	2	4	6	8	2	4	6	8
Synchronous Speed (RPM) ⇒	3600	1800	1200	900	3600	1800	1200	900
Motor Horsepower								
250	94.5	95.4	95.4	94.5	95.4	95.0	95.0	94.5
300	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
350	95.0	95.4	95.4	NR	95.4	95.4	95.0	NR
400	95.4	95.4	NR	NR	95.4	95.4	NR	NR
450	95.8	95.8	NR	NR	95.4	95.4	NR	NR
500	95.8	95.8	NR	NR	95.4	95.8	NR	NR

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.
 NR—No requirement

(Renumber the following tables)

Table 10.8-43 Minimum Average Full-Load Efficiency for Polyphase Small Electric Motors^a

Table 10.8-54 Minimum Average Full-Load Efficiency for Capacitor-Start Capacitor-Run and Capacitor-Start Induction-Run Small Electric Motors^a

(Renumber the following table, and add the footnote shown below)

Table 10.8-65 Minimum Nominal Full-Load Efficiency for Fire-Pump Electric Motors^{a,b}

.... (table is unchanged)

a. Nominal efficiencies shall be established in accordance with DOE 10 CFR 431.
 NR—No requirement

b. For purposes of determining the required minimum nominal full-load efficiency of an electric motor that has a kilowatt rating between two kilowatt ratings listed in this table, each such motor shall be deemed to have a listed kilowatt rating, determined as follows:

(1) A kilowatt rating at or above the midpoint between the two consecutive kilowatts shall be rounded up to the higher of the two kilowatts;

(2) A kilowatt rating below the midpoint between the two consecutive kilowatts shall be rounded down to the lower of the two kilowatts.

BSR/ASHRAE/IES Addendum CV to ANSI/ASHRAE/IESNA Standard 90.1-2013, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
First Public Review Draft