The Impact of the Integral Horsepower Amended Rule (1 – 500 HP Motor)

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Outline

- History of Efficiency Regulations
- Integral Horsepower Amended Motor Rule
- Motor regulation a logical progression

Motor Efficiency Regulations

Energy Policy Act of 1992

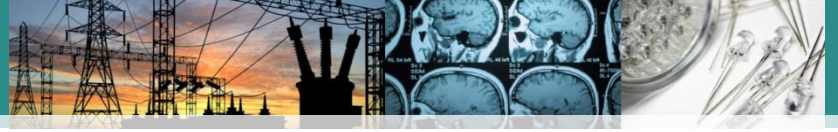
- Effective October 1997
- General Purpose 1 – 200 HP at MG 1, table 12-11 Energy Efficient

Energy Policy Act of 2005

- Raised purchases for government to table 12-12 Premium Efficient [by executive order from president]

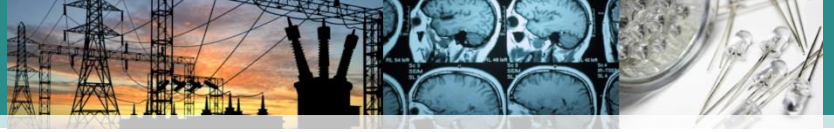
Energy Independence & Security Act of 2007

- Effective December 2010
- General Purpose 1-200 HP EPAct motors to table 12-12 Premium Efficient
- Other 1-200 HP motors at table 12-11 Energy Efficient
- 201 – 500 HP motors at 12-11 Energy Efficient



Motor Coalition Formed in 2010

- Determine the greatest energy savings potential and improve enforcement
- Agreement on action plan to achieve
  - Legislation?
  - Regulation?
- Product definitions –
  - Electrical and mechanical considerations
- Testing issues mechanical adoptions
- Metrics – nominal efficiency at 100% load
- MEPS – Minimum efficiency levels
- Timing of implementation



The Motor Coalition Members

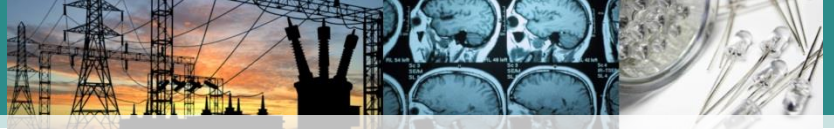
- American Council for an Energy-Efficient Economy
- Alliance to Save Energy
- Appliance Standards Awareness Project
- Earthjustice
- Natural Resources Defense Council
- Northeast Energy Efficiency Partnerships
- Northwest Energy Efficiency Alliance
- National Electrical Manufactures Association
- Pacific Gas and Electric
- Others signed letters of support

2010-11 Motor Coalition Strategy

- Determine and document a plan to improve the efficiency of the greatest number of units providing the **greatest savings impact** while **reducing potential enforcement issues** while maintaining full product utility for American industry

- Deliver a plan to DOE as a **platform for a consensus recommendation** that can be acted upon within the **least amount of time** delivering **large net benefits.**

- **Move to a final rule with the least delay to deliver results that save greatest energy as quickly as possible**



EISA 2007 required a Final IHP Rule by December 19th 2012

Motors must meet 7 standard DOE criteria

Energy Policy & Conservation Act of 1975 Factors	DOE Analysis
1. Economic impact on consumers and manufacturers	Life-cycle cost analysis Manufacturer impact analysis
2. Lifetime operating cost savings compared to increased cost for the product	Life-cycle cost analysis
3. Total projected savings	National impact analysis
4. Impact on utility or performance	Engineering analysis Screening analysis
5. Impact of any lessening of competition	Manufacturer impact analysis
6. Need for national energy conservation	National impact analysis
7. Other factors the Secretary considers relevant	Environmental assessment Utility impact analysis Employment impact analysis

AMENDED INTEGRAL HP RULE

Published May 29th 2014 DOE amends motor efficiency regulations

DEPARTMENT OF ENERGY

10 CFR Part 431

[Docket No. EERE–2010–BT–STD–0027]

RIN 1904–AC28

Energy Conservation Program: Energy Conservation Standards for Commercial and Industrial Electric Motors

Integral HP Motor Final Rule

- Replaces Energy Independence & Security Act of 2007
- Takes effect 24 months after Final Rule (June 1, 2016)
- Almost all motors will be covered at Premium Efficiency levels NEMA MG 1, Table 12-12 or Part 20, Table B (IE3)
- Simplifies enforcement and compliance
- Improved definitions and testing guidelines

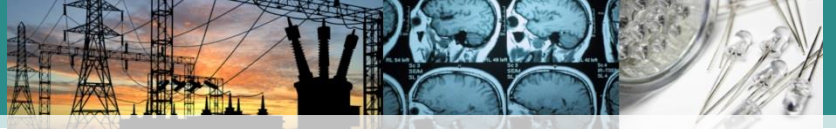
Compare Integral Rule to EISA

Motor Type	EISA	New Integral HP Rule
1-200 HP Subtype I	Premium Efficient NEMA MG 1, Table 12-12	Premium Efficient NEMA MG 1, Table 12-12
1-200 HP Subtype II	Energy Efficient NEMA MG 1, Table 12-11	Premium Efficient NEMA MG 1, Table 12-12
201-500 HP	Energy Efficient NEMA MG 1, Table 12-11	Premium Efficient NEMA MG 1, Table 12-12 & 20-B
56 Frame Enclosed	Exempt	Premium Efficient NEMA MG 1, Table 12-12
Custom Configurations	Exempt	Premium Efficient NEMA MG 1, Table 12-12
1-200 HP Fire Pump Motors	Energy Efficient NEMA MG 1, Table 12-11	Energy Efficient NEMA MG 1, Table 12-11

Motors covered under IHP Final Rule

The motors regulated under expanded scope meet the following nine characteristics:

1. Is a single speed induction motor
2. Is rated for continuous duty (MG 1) operation or for duty type S1 (IEC)
3. Contains a squirrel-cage (MG 1) or cage (IEC) rotor
4. Operated on polyphase alternating current (AC) 60-hertz sinusoidal line power
5. Has 2-, 4-, 6-, or 8-pole configuration
6. Is rated 600 volts or less
7. Have a three or four digit NEMA frame size (or IEC metric equivalent), including those designs between two consecutive NEMA frame sizes (or IEC metric equivalent) or an enclosed 56 NEMA Frame size (or IEC metric equivalent).
8. Has no more than 500 horsepower, but greater than or equal to 1 horsepower (or kilowatt equivalent)
9. Meets all the performance requirements of a NEMA design A, B or C electric motor or an IEC design N or H electric motor.



NEMA MG1, Table 12-12

Enclosed Motors

	2 Pole		4 Pole		6 Pole		8 Pole	
HP	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1	77.0	74.0	85.5	82.5	82.5	80.0	75.5	72.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5	78.5	75.5
2	85.5	82.5	86.5	84.0	88.5	86.5	84.0	81.5
3	86.5	84.0	89.5	87.5	89.5	87.5	85.5	82.5
5	88.5	86.5	89.5	87.5	89.5	87.5	86.5	84.0
7.5	89.5	87.5	91.7	90.2	91.0	89.5	86.5	84.0
10	90.2	88.5	91.7	90.2	91.0	89.5	89.5	87.5
15	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
20	91.0	89.5	93.0	91.7	91.7	90.2	90.2	88.5
25	91.7	90.2	93.6	92.4	93.0	91.7	90.2	88.5
30	91.7	90.2	93.6	92.4	93.0	91.7	91.7	90.2
40	92.4	91.0	94.1	93.0	94.1	93.0	91.7	90.2
50	93.0	91.7	94.5	93.6	94.1	93.0	92.4	91.0
60	93.6	92.4	95.0	94.1	94.5	93.6	92.4	91.0
75	93.6	92.4	95.4	94.5	94.5	93.6	93.6	92.4
100	94.1	93.0	95.4	94.5	95.0	94.1	93.6	92.4
125	95.0	94.1	95.4	94.5	95.0	94.1	94.1	93.0
150	95.0	94.1	95.8	95.0	95.8	95.0	94.1	93.0
200	95.4	94.5	96.2	95.4	95.8	95.0	94.5	93.6
250	95.8	95.0	96.2	95.4	95.8	95.0	95.0	94.1
300	95.8	95.0	96.2	95.4				
350	95.8	95.0	96.2	95.4				
400	95.8	95.0	96.2	95.4				
450	95.8	95.0	96.2	95.4				
500	95.8	95.0	96.2	95.4				

NEMA MG 1, Table 12-13
FULL-LOAD EFFICIENCIES FOR 60 HZ PREMIUM EFFICIENCY ELECTRIC MOTORS RATED 5000 VOLTS OR LESS (FORM WOUND)

Open Motors

	2 Pole		4 Pole		6 Pole		8 Pole	
HP	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
250	94.5	93.6	95.0	94.1	95.0	94.1	93.6	92.4
300	94.5	93.6	95.0	94.1	95.0	94.1		
350	94.5	93.6	95.0	94.1	95.0	94.1		
400	94.5	93.6	95.0	94.1				
450	94.5	93.6	95.0	94.1				
500	94.5	93.6	95.0	94.1				

NEMA Premium®

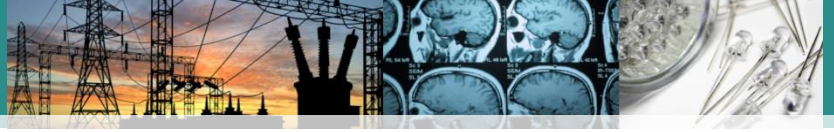
NEMA Premium® is a registered trademark licensed to motor manufacturers agreeing to meet additional testing and labeling requirements.

DOE regulations reference NEMA MG1, Table 12-12

Motors added previously not covered by EISA

What additional designs are covered:

- NEMA Design A motors from 201-500 HP
- Electric motors with moisture-resistant windings, sealed or encapsulated windings
- Partial electric motors including gearmotors
- Totally-enclosed non-ventilated (TENV) electric motors
- Immersible electric motors
- Integral or non-integral brake electric motors
- U-frame motors
- Design C motors
- IEC 100 frame, NEMA 66 frame
- Electric motors with non-standard endplates or flanges
- Electric motors with non-standard base or mounting feet
- Footless motors (C-face or D-flange less base)
- Electric motors with special shafts
- Close-coupled pump motors
- 56J Jet pump motors (Enclosed)
- Vertical hollow shaft electric motors
- Vertical medium and high thrust solid shaft electric motors
- Electric motors with sleeve bearings
- Electric motors with thrust bearings
- Pre-NEMA frame motors
- Arbor saw motors



Motors not covered under IHP final rule
Exempt Motors:

- Single phase ODP motors (may be covered by Small Motor Rule)
- Single phase Enclosed motors
- DC motors
- Two digit frames (42 – 48) (may be covered by Small Motor Rule)
- 56 frame ODP (may be covered by Small Motor Rule)
- Multi-speed motors
- Medium voltage motors
- TEAO or Open Air-over motors
- Submersible motors
- Water-cooled motors
- Intermittent duty motors (S2-S8)
- Stator-rotor sets
- Design D motors
- Motors designed for Inverter Power (MG 1, Part 31) with no line start
- Synchronous AC motors
- Permanent magnet rotor AC motors
- Servo motors

Partial (3/4 Motor) vs. Stator-Rotor Set

- Partial motors usually have the drive endplate missing and used as part of a gear motor, pump or compressor.
  - A partial motor may have an endplate installed and tested before shipment.
- A stator and rotor may or may not have a shaft or frame casting.
  - They are transformed into a motor down stream by someone other than the component manufacturer.
  - That transforming company becomes the motor manufacturer for DOE compliance.

Impact to OEMs and End Users

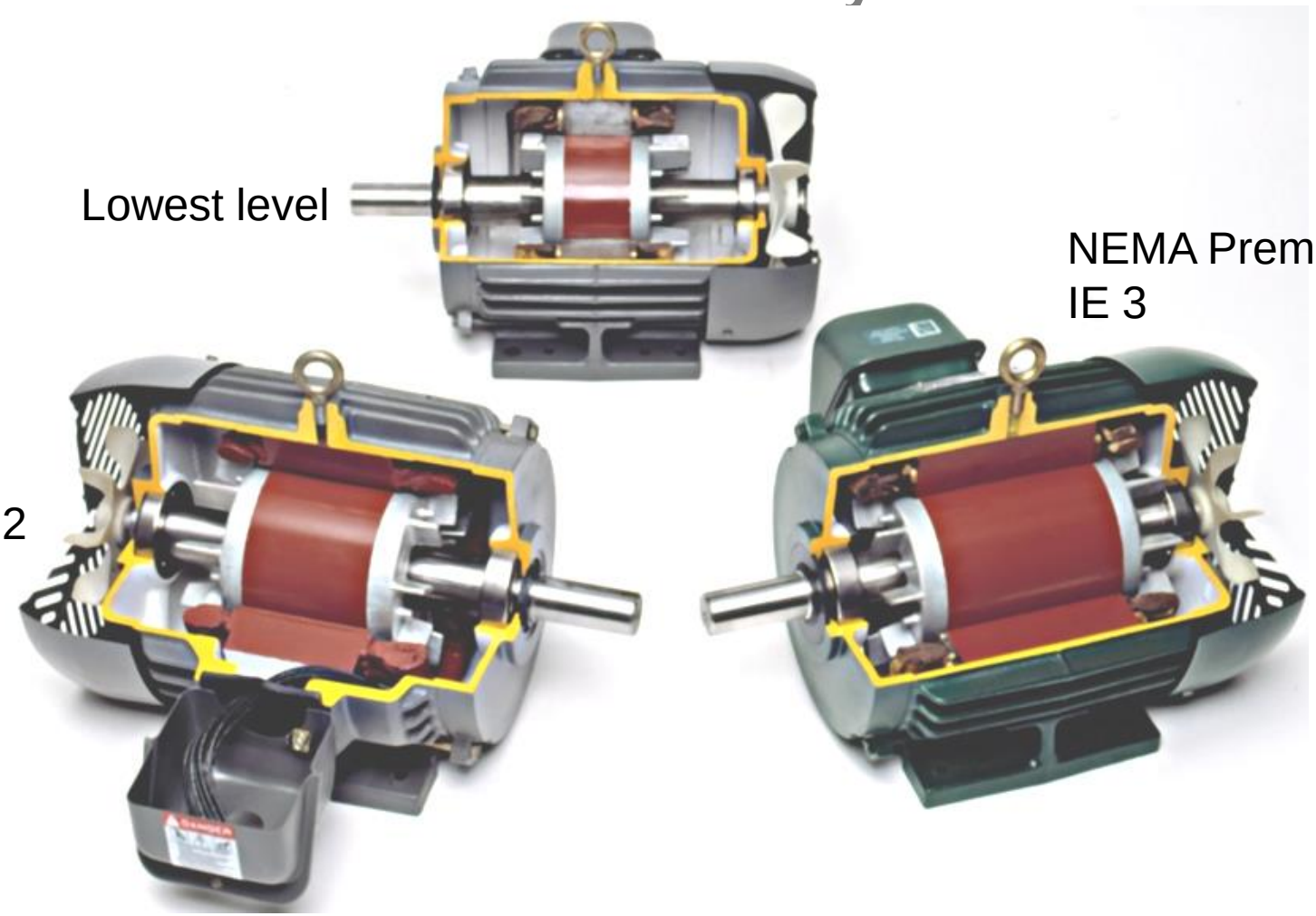
Form, Fit, Function

- Previously unregulated motors may be larger size
- Premium motors have less slip – higher speed
- Some designs may be Design A – higher inrush current
- Some designs in larger NEMA frame

Impact to OEMs and End Users

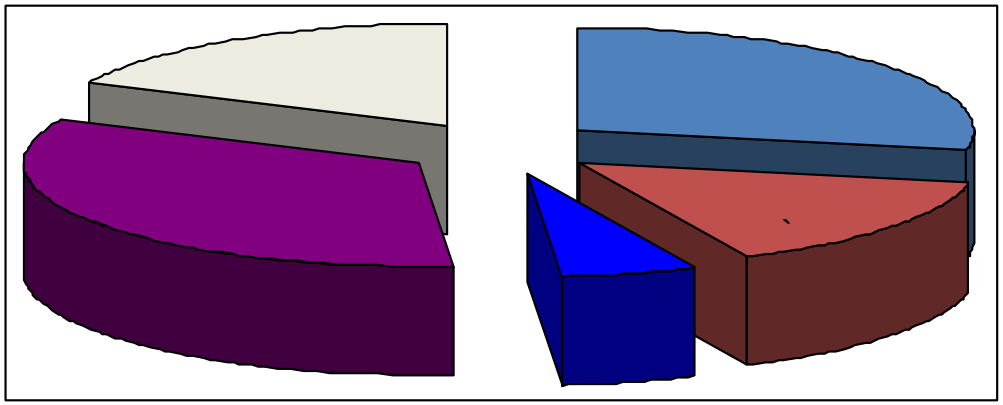
- Life Cycle Value
  - More material – additional cost for premium efficiency
  - Motor cost 2% - 97% for electricity
  - Can continue to buy and use motors built before June 1, 2016
- Remember the regulation is point of manufacture, not the end user
- Significantly adds embedded motors as covered products

Progression of Active Material Required to Increase Efficiency



Affect of Expanded Product Scope
Millions of units per year

Total 5.6 million motors sold in USA typical year



Motor rule amendment adds nearly 4 million motors in four new categories

- Type 1 and 2
- Partial & Gearmotor
- Definite & Special
- Imported motors or component
- 56 Frame

Amended rule conclusions

- Expands the definition of covered product adding over 4 million units per year to be regulated
- Reduces non-covered motors to a small number
- Saves more energy than any rule ever issued by DOE
- Reduces confusion for enforcement agencies
- Allows distributors and resellers to “work through” existing inventories of current product
- Continues to use NEMA standards and table 12-12 as minimum performance levels protecting end user and OEM product utility
- Takes affect June 1st 2016
- Continues to use NEMA standards, IEEE and CSA test methods