



Requirements for Motor Driven Units

Motor Summit 2016

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Building Technologies Program

DOE Building Technologies Office

- The U.S. Department of Energy (DOE) Buildings Technologies Office implements minimum energy conservation standards and develops Federal Test Procedures for more than 60 categories of appliances and equipment, including electric motors and motor driven equipment such as pumps, fans, and compressors

Electric Motors

- **Scope**

- Includes a wide range of AC polyphase induction motors
 - Single speed, induction motors
 - Rated for continuous duty operation (MG1) or for S1 duty type (IEC)
 - Contains a squirrel-cage rotor (MG1) or cage rotor (IEC)
 - Operate on polyphase alternating current 60-hertz sinusoidal line power;
 - Are rated 600 volts or less;
 - Have a 2-, 4-, 6-, or 8-pole configuration,
 - Are built in a three-digit 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),
 - Produce at least one horsepower (0.746 kW) but not greater than 500 horsepower (373 kW), and
 - Meet all of the performance requirements of one of the following motor designs:
 - NEMA Design A, B, or C motor or an IEC Design N or H motor.
- And a few exemptions
 - Air over motors
 - Submersible motors
 - Inverter-only
 - Component sets

Small Electric Motors

- **Scope**
 - Based on the following definition
 - “Small electric motor means a NEMA general purpose alternating current single-speed induction motor, built in a two-digit frame number series in accordance with NEMA Standards Publication MG1-1987, including IEC metric equivalent motors”
 - “general purpose” translated into including only
 - Capacitor start induction run motors
 - Capacitor start resistance start motors
 - Certain polyphase AC induction motors

(See paragraph MG1-1.05 of NEMA MG1-1987 general purpose performance requirements)
 - And a few exemptions
 - Motors that are components of covered equipment
- **Ongoing compliance, certification, and enforcement rulemaking for electric motors and small electric motors**
 - Notice of proposed rulemaking published. 81 FR 41378 (June 24, 2016)

Electric Motors and Small Electric Motors

- **Test Procedure and Standards Update (Electric Motors)**

Most recent update	Notice of final rule published May 29, 2014
Current Standard	10 CFR 431 Subpart B – Nominal full-load Efficiency. Broadly equivalent to IE3 levels (Premium) except for fire pump electric motors (IE2 levels) (June 1, 2016)
Test Procedure	Appendix A to Subpart B of Part 431 - Based on IEEE 112-2004 Test Method B and CSA C390-10

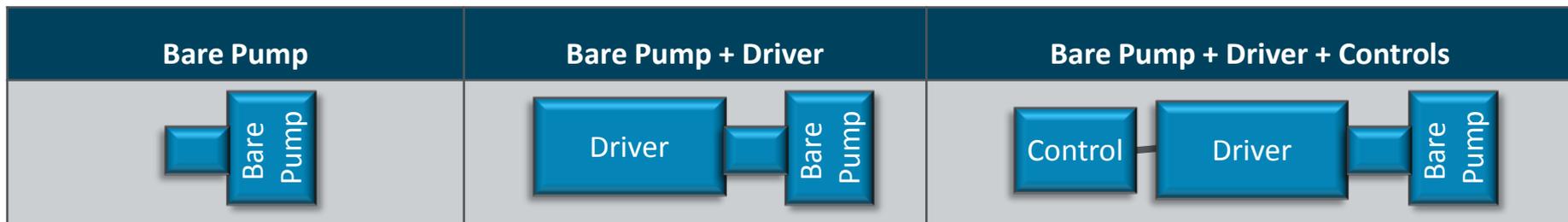
- **Test Procedure and Standards Update (Small Electric Motors)**

Most recent update	Notice of final rule published March 9, 2010
Current Standard	10 CFR 431 Subpart X – Average full-load efficiency Broadly equivalent to IE3 levels (Premium) for polyphase and to IE2 levels or above for single phase motors. (March 9, 2015)
Test Procedure	10 CFR 431 Subpart X - Based on IEEE 112-2004, IEEE 114, and CAN/CSA C747.

Commercial and Industrial Pumps

- **Scope**

- Clean water pumps of the following styles, with additional performance and design characteristics (power, flow, head, temperature)
 - End suction close-coupled
 - End suction frame mounted
 - In-line
 - Radially split, multi-stage, vertical, inline diffuser casing
 - Vertical turbine submersible
- As defined in the Code of Federal Regulations (CFR), “pump” means equipment designed to move liquids (which may include entrained gases, free solids, and totally dissolved solids) by physical or mechanical action and includes a bare pump and, if included by the manufacturer at the time of sale, mechanical equipment, driver and controls.



Commercial and Industrial Pumps

- **Test Procedure and Standard Update**

Most recent update	Notice of final rule published January 26, 2016
Current Standard	10 CFR 431 Subpart Y - Pump Energy Index (PEI) (January 27, 2020)
Test Procedure	Appendix A to Subpart Y of Part 431 - Based on HI Standard 40.6–2014

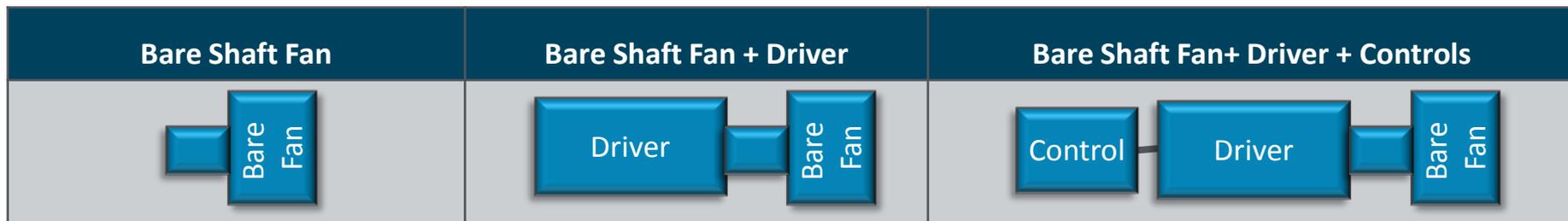
- Negotiated Rulemaking: the Appliance Standards and Rulemaking Federal Advisory Committee (ASRAC) Pumps working group met to develop recommendations for test procedure and standards
- The standard levels were established using a “C-value” representing a constant in a three dimensional logarithmic polynomial equation, expressing pump efficiency as a function of flow and specific speed (similar to the EU No 547/2012).
- For most pumps, the selected standard levels were set equivalent to the lower 25th percentile of efficiency, while others were set to the baseline (i.e. market minimum)

- **Metric approach for motor driven unit**

- “Pump Energy Index” calculated as the pump electrical input power divided by the electrical input power of a minimally compliant pump (i.e. exactly compliant with the applicable standard)
- Evaluated over a different load profile for pumps with/without controls
- The DOE test procedure provides the flexibility to either measure (1) the electrical input power to the pump, or (2) the shaft input power of the pump and provides default values to represent the performance of a baseline motor, and controls (if any), as well as algorithms to calculate the pump electrical input power.

Commercial and Industrial Fans

- **Scope (in progress)**
 - Negotiated Rulemaking: the ASRAC fans working group met to develop recommendations for fan energy conservation standards and testing
 - The fans Working Group voted on the following inclusions:
 - Axial cylindrical housed fans
 - Panel fans
 - Centrifugal housed fans
 - Inline and mixed flow fans
 - Radial housed fans
 - Power roof ventilators
 - The fans Working Group also voted a number of exemptions for fans used in some larger piece of equipment
 - Same approach as in pumps: a fan may or may not include a driver and controls



Commercial and Industrial Fans

- **Test Procedure and Standards update**

Most recent update	Term Sheet Approved September 24, 2015
Current Standard	None
Test Procedure	None - Working Group voted to use AMCA 210-16

- Based on the working group’s recommendation: the standard levels would be established using a constant in a three dimensional polynomial equation, expressing fan static or total efficiency as a function of flow and static or total pressure

- **Metric approach for motor driven unit**

- Fan Electrical Input power (based on an approach developed by AMCA)
- Evaluated at each manufacturer-declared operating point (every operating point must comply)
- The approach voted on by the working group is similar to pumps:
 - provides the flexibility to either measure (1) the electrical input power to the fan, or (2) the shaft input power of the fan and provides default values to represent the performance of a baseline motor, and controls (if any), as well as algorithms to calculate the fan electrical input power.

Compressors

- **Scope**

- Based on the proposed definition of compressor: “Air compressor means a compressor designed to compress air that has an inlet open to the atmosphere or other source of air, and is made up of a compression element (bare compressor), driver(s), mechanical equipment to drive the compressor element, and any ancillary equipment”
- DOE proposed to regulate certain categories of lubricated and lubricant-free air-cooled and water cooled compressors, with the following characteristics:
 - Is an air compressor
 - Is a positive displacement rotary or reciprocating compressor
 - Is driven by a brushless electric motor, which may be either fixed- or variable-speed
 - Is distributed in commerce with a compressor motor nominal horsepower > 1 and < or = 500 hp
 - Has a full load operating pressure (output) greater than or equal to 31 psig and < or = to 225 psig

- **Test Procedure and Standards Update**

Most recent update	Notice of proposed energy conservation standards rulemaking 81 FR 31680 (May 19, 2016)
Current Standard	None
Test Procedure	None – Proposed Test Procedure is based on ISO 1217:2009 with modifications 81 FR 27220 (May 5, 2016)

- **Metric Approach**

- Isentropic efficiency
- Evaluated at full-load or over a load profile (variable-speed)

Contact

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