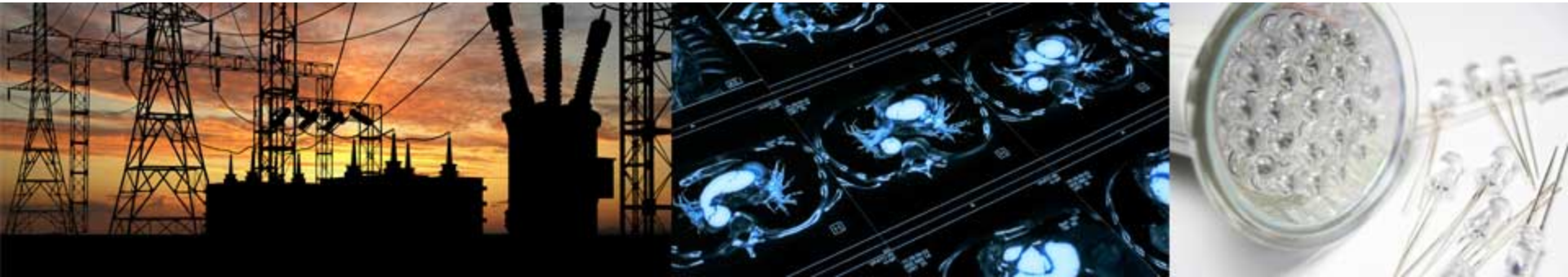


# An Alternate Efficiency Determination Method (AEDM) Can Be An Essential Part of Energy Legislation

"Motor Summit 2016, Zurich Switzerland"  
Bill Finley, Siemens Industry



National Electrical Manufacturers Association





# Agenda



- Understanding the Efficiency Conformance Process
- Massive Effort may be Required for Efficiency Determination
- Why Establish an AEDM (Alternate Efficiency Determination Method)
- The AEDM Procedure



# Conformance Process Steps

## 1. Basic Ratings/Model Covered Defined

- The Basic Model to be all Units of a given Type, Manufactured by a Single Manufacturer, with the Same Rating and with Identical Electrical Characteristics
- No Differing Physical or Functional Characteristics which Affect Energy Consumption or Efficiency

## 2. Test Procedure Must be Defined

## 3. Test Lab Requirements Must be Defined

## 4. Method for Efficiency Determination Defined

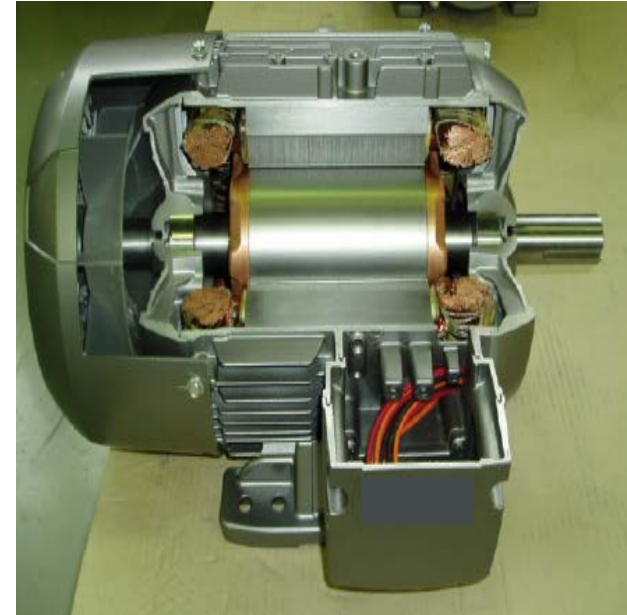
- Not Excessively Burdensome

## 5. Minimum Efficiency Performance Standards Must be Defined (Based on Steps 1-4)

## 6. Registration Process Available for Products Defined

## 7. Enforcement Policy Defined (In line with 1-5)

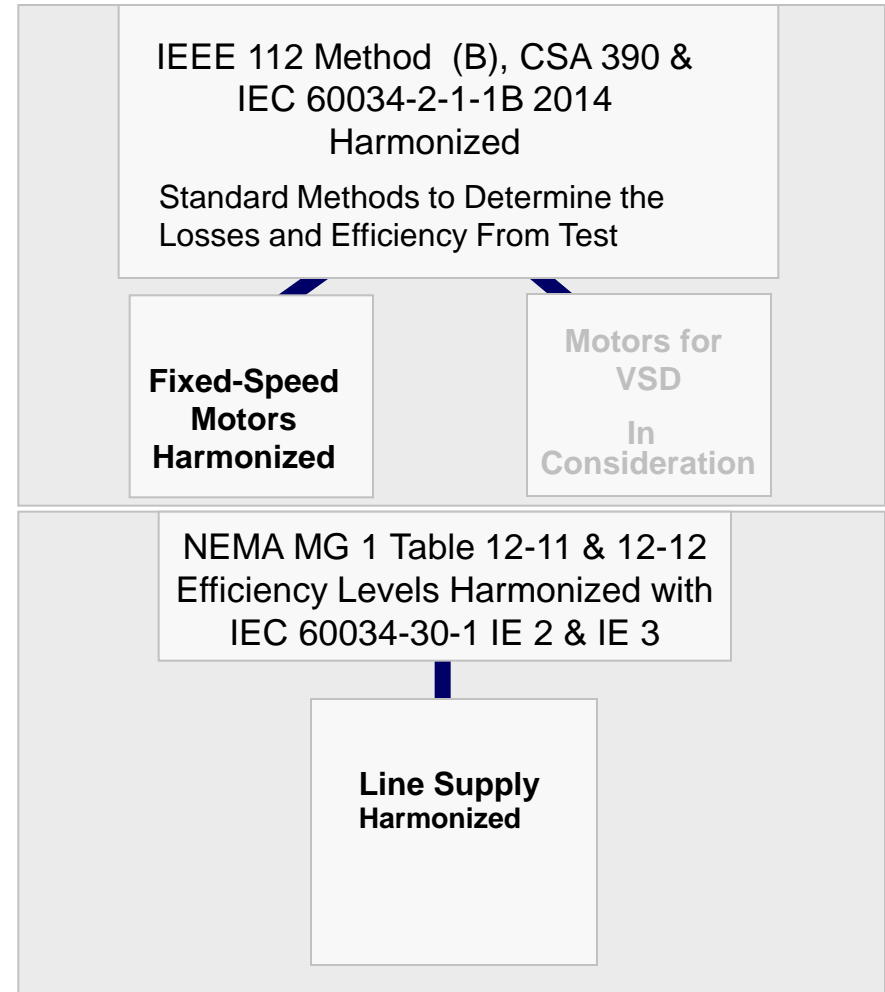
- Procedure and Penalty



# Test Method, Qualified Lab & Efficiency

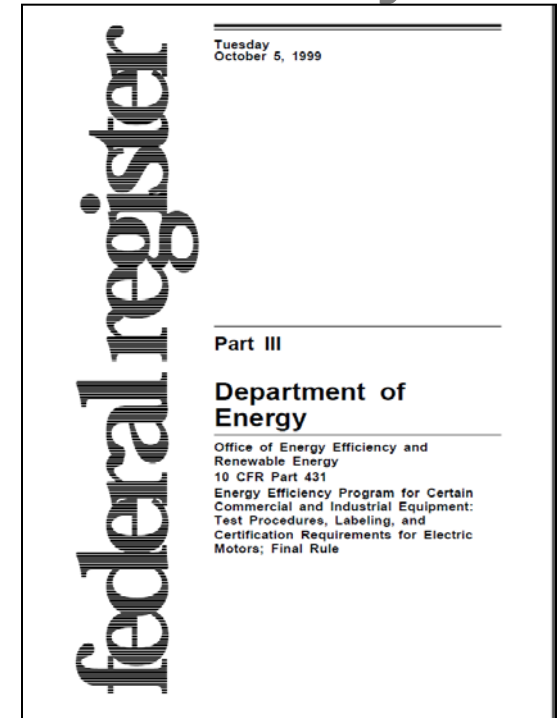
## IEEE 112 B Test Method Chosen in US (Residual Loss Method).

- **Most Accurate and Repeatable Test Method**
  - Based on the Results of Multiple Round Robin Tests Conducted
- **In Harmony with IEC 60034-2-1-1B**
- **Certified Test Lab that is in Accordance ISO 17025**
  - Manufacturers Own or a 3<sup>rd</sup> Parties
- **Efficiency Levels Established & Globally Harmonized**



# Massive Effort To Determine Efficiency

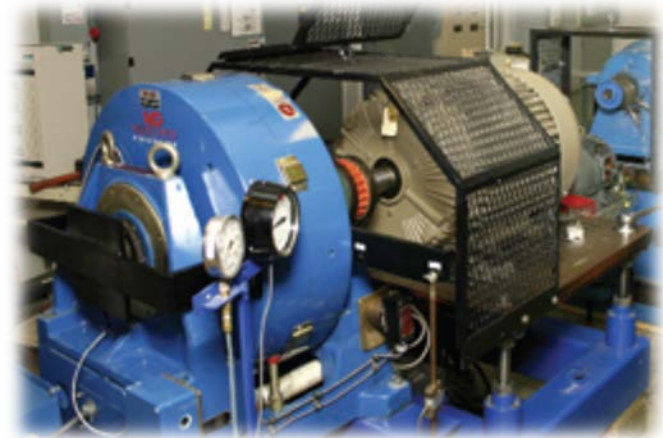
- Energy Policy Act (EPAAct) of 1992 Defined 113 Base Ratings
  - (Power, Speed, Open Or Enclosed)
  
- Regulators Determined that Efficiency Testing Would Require a Sampling of a Small Population (5 Motors of Each Model )
  - 1 Motor Exceeding Minimum Efficiency was not Adequate
  - 1 Motor Exceeding Nominal (Minimum=Nominal) would Effectively Raise Nominal Level
  - Testing Large Population not Possible
  
- Number of Ratings/Models Expanded
  - US-Energy Independence and Security Act (EISA 2007)
  - US-Energy Conservation Rule May 2014





# Massive Effort To Determine Efficiency

- At (12) Hours per Test the Base Ratings as Defined in 1990's Alone Would Require a Minimum of 900 Man Days
  - Multiple Variations of Each Base Rating Creates Multiple Models per Rating
  - With 2014 Legislation now Over 100,000 Base Models
- Regulators Determined that Testing Every Model would be Overly Burdensome
- An Alternate Method Therefore Needed



## FEDERAL REGISTER

Vol. 79 Thursday,  
No. 103 May 29, 2014

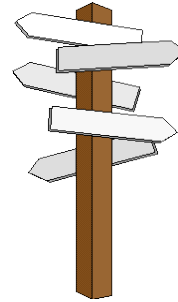
Part II

Department of Energy

10 CFR Part 431  
Energy Conservation Program: Energy Conservation Standards for  
Commercial and Industrial Electric Motors; Final Rule

# Alternate Efficiency Determination Method (AEDM)

- Since 1999 for Products Manufactured or Shipped into the USA “17 Years of Experience with Motors”
- Having only “1” Standardized Analytical Model for Motors was not Possible
  - Materials & Manufacturing Process Variations must be Considered
- Therefore Qualification of Each Manufacturers AEDM Required





# Verifying Minimum & Nominal Efficiency Not so Simple

## Definition in US:

- Nominal Efficiency is the Average Efficiency of a Large Population
- Minimum Efficiency is the Minimum Allowed Efficiency of Any Motor Tested (+20%Loss)

## 20% Tolerance Must Include:

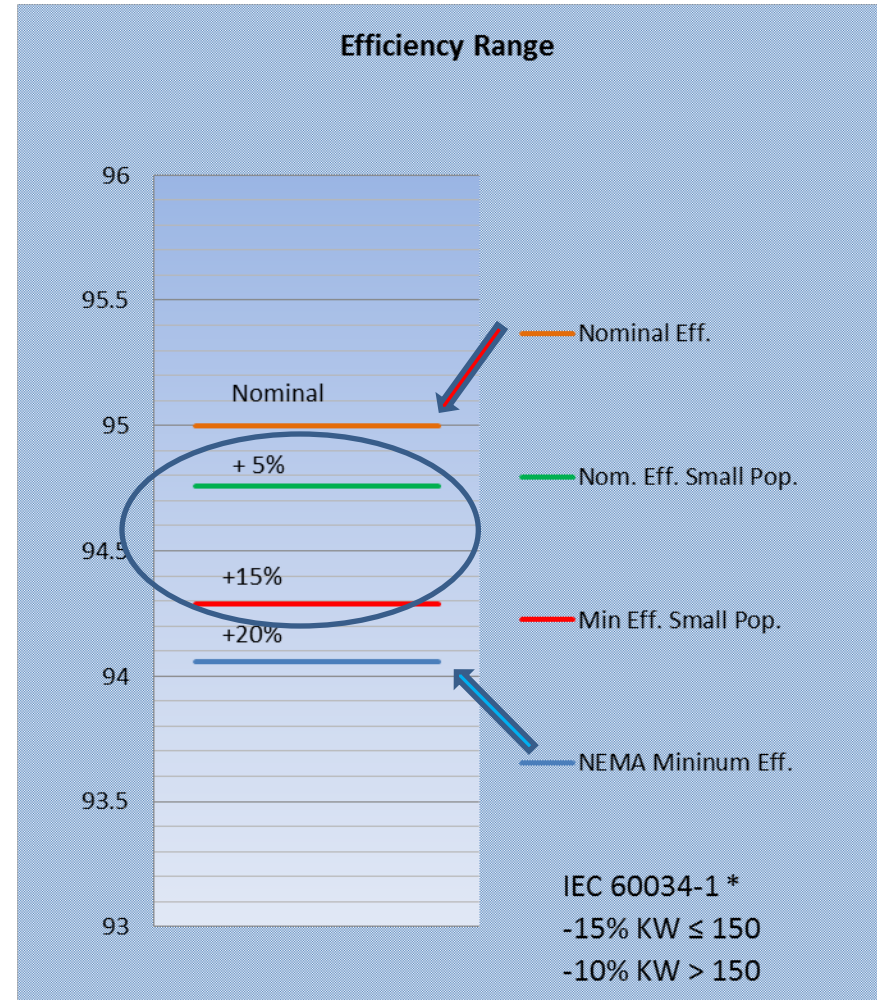
- Manufacturing & Material Variation
- Testing Uncertainties
- Differences between Labs

## How Many Motors to Test

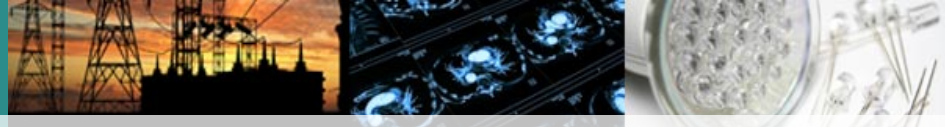
- Test One Motor
- Test Large Population (20+)
- Test Small Population (Consider 5)

## Losses of a Small Population

- Nominal(small) = Nominal(Large) + 5%
- Minimum(small) = Minimum(Large) - 5%







# Efficiency Determination Methods (Non AEDM or AEDM)



# Efficiency Determination Options

## Non AEDM Approach

- Testing Required for Every Covered Model
- 5 units of each Base Model be Tested
  - Mean loss is within 5% of the Nominal
  - Maximum Loss is within 15% of nominal

## AEDM Approach

- AEDM must be Qualified based on Test Results
- Efficiency Determined by AEDM must Exceed the Nominal Efficiency



# AEDM Qualification

- 5 Basic Models to be Selected & Tested in a Certified Lab per the following Rules:
  - Two of the Basic Models must be among the Highest Unit
  - Must be of different Horse-powers
  - Should be of different Frame Number Series
  - Should be expected to have the lowest Nominal Full Load Efficiency among the Basic Models with the same Rating
- Test 5 Motors of Each Basic Model
  - Predicted total Power Loss, Calculated by AEDM, must be within +/- Ten Percent of the Mean Total Tested Loss of that Basic Model
  - Losses from the Test on Five Motors of each Basic Model:
    - Mean loss is within 5% of the Nominal
    - Maximum Loss is within 15% of Nominal

*“Each manufacturer that has used an AEDM ... shall have available for inspection by the Department of Energy records showing: methods used; the mathematical model, the engineering or statistical analysis, computer simulation or modeling, and other analytic evaluation of performance data on which the AEDM is based; complete test data, product information”*



# What Are the Key Takeaways?

## Challenge

- Testing of Every Model would be an Excessive Burden
- Not Having an Established Determination Method Increases Risk of Non-Conformance

## Analysis

- Must Determine if the AEDM Method is right for Your Product Line

## Choices

- Utilize an AEDM?
- Test Every Motor?
- Leave it to the Manufacturer to Conform?

## Business Impact

- Using an AEDM can Add a Level of Confidence that Product Conforms without an Excess Burden to the Industry and End Users



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