

Motor Efficiency Testing & Standards: Status of International Practices

**R. Neal Elliott, Ph.D., P.E.
American Council for an
Energy-Efficient Economy**

Motor Summit 2007, Zurich 10 April 2007



Places with Motor Efficiency Standards

- Australia
- Brazil
- Canada
- China
- Chinese Taipei
- EU (voluntary)
- Malaysia
- Mexico
- New Zealand
- Thailand (pending)
- U.S.

Focus of activities has been poly-phase motors. Much less activity on single-phase and small motors



Main Groupings of Approaches

EU/Australia/China

- Uses IEC-34 test procedure (Australia also uses IEC-61972)
- Minimum efficiency (but EU uses nominal)
- Used **eff1**, **eff2** - moving to IEC star labeling

North America/Brazil

- Uses IEEE 112b test procedure
- Nominal (average efficiency)
- Uses NEMA standards

* With use of IEC 61972 and minimum efficiency, Australian approach fairly close to the America's

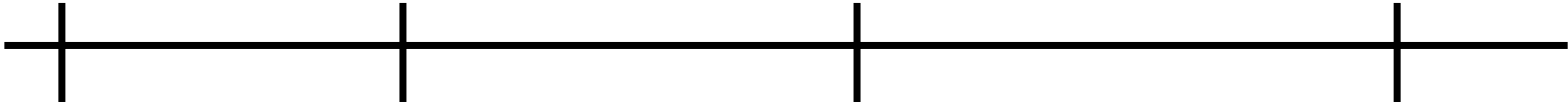


Approaches as a Continuum



Loose

Tight



EU

China

Australia/NZ

Americas



IEC vs. IEEE B Test Procedure

IEC 34

- Assumes stray-load losses are 0.5%

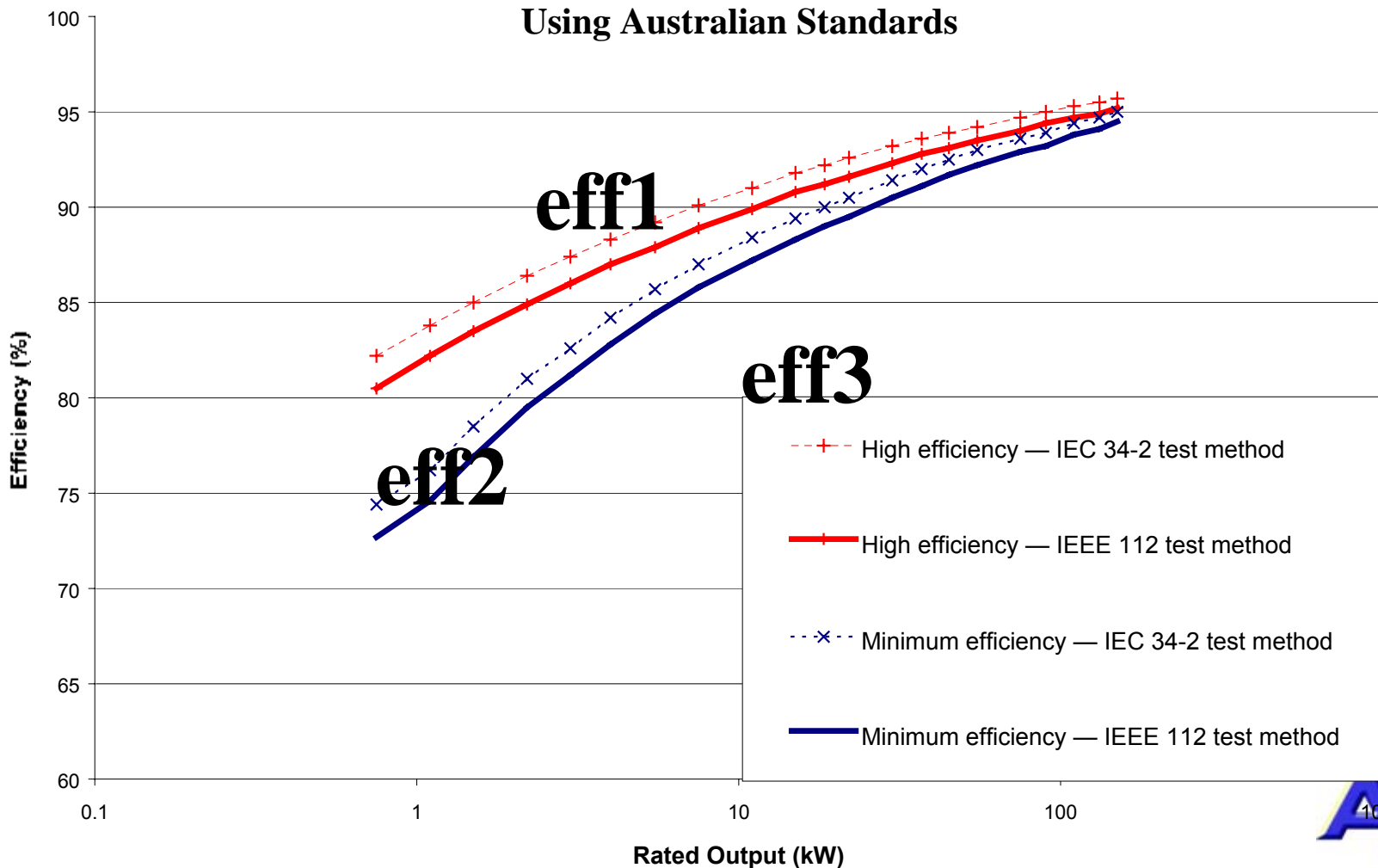
IEC 61972

- Either measure losses or use default stray-load losses of 10th percentile products
- Similar to IEEE B

IEEE B

- Measures losses using a dynamometer

Comparison of Motor Test Procedure Results



North American Standards

- EPA Act enacted in 1992 – set mandatory motor efficiency standard effective 1997 for most products
- Canada and Mexico have adopted same standards
- Higher voluntary standard – NEMA Premium
- NEMA & ACEEE Have proposed raising mandatory levels



Approaches to Meeting Efficiency Targets

In North American markets manufacturers have used three approaches to achieving higher efficiencies:

1. Optimization of motor designs
2. Shift to precision manufacturing technologies and practices that reduce variation
3. Increased use of reactive materials (e.g., better magnetic steel and more copper)



Single-Phase and Small Motor Standards in North America

- Small and fractional motors numerous
- Various designs with widely varying performance and efficiency
- IEEE & CSA standards exist, but not widely accepted by industry
- Testing costly and has significant uncertainty
- U.S. rulemaking underway for almost decade – approach and outcome uncertain

Summary and Discussion: Mandatory Poly-Phase Standards

- North American mandatory poly-phase standard similar to eff1 as a guaranteed minimum.
- Australia/NZ making **eff1** mandatory as a guaranteed minimum; China taking the same step, ~2010.
- New Chinese Taipei standard close to this level.
- Europe should consider following suit



Summary and Discussion: Voluntary Standards

- Australian and NEMA premium specifications similar.
- Australian premium specification could be used as a voluntary spec in other countries.
- Europe should consider upgrading its program to include the new Australian premium specification

Summary and Discussion: Testing

- Gradually world is moving to IEC 61972/IEEE 112B – more accurate and harder to manipulate.
- Australia gives option of IEC 34 and 61972 standards – other countries should think of doing the same as part of their transition strategies.

Summary and Discussion: Beyond Premium Efficiency

- Current standards are based on improving efficiency within existing design-specifications
- Approaching limits of designs – types
- New designs may be needed to advance efficiency
- Renewed focus on motor system efficiency beyond prime-mover will be needed



Summary and Discussion: Fractional and Small Motors

- Important area of future work
- Need further work on test procedures and implementation – consider manufacturer round-robin testing protocol
- Mandatory standards premature in ACEEE's opinion
- Area for voluntary standards development – model of *NEMA Premium*

Contact Information

R. Neal Elliott, Ph.D., P.E.

Industrial Program Director

ACEEE

1001 Conn. Ave, NW, Suite 801

Washington, DC 20036

USA

202-429-8873

rne Elliott@aceee.org

For more information visit:

<http://aceee.org/energy>

