Variable frequency drives testing methods

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Outline

- Canadian Standard Association (CSA)
  - CSA Draft C838
  - CSA Draft C840
- Air-Conditioning Heating and Refrigeration Institute (AHRI)
  - AHRI Draft 1210P
- International Electrotechnical Commission (IEC)
  - IEC Draft 60034-2-3
CSA C838
Context

> No Recognized Standard for VFD System Efficiency (VFD +Motor)
> Difference Between System Efficiencies
> If Efficiency Mentioned, Only at Motor Full Speed and Full Load
> Need to Have Data at Different Motor Speeds and Loads
Goals

> Establishing a Testing Procedure

> Ability to Compare VFD Systems Efficiency at Different Loads and Speeds

> Inform Market about VFD System Efficiency
CSA C838

> Determining VFD, Motor, System Efficiency
> Output / Input Method
> Accuracy is Mainly Dependant of the Electric Power and the Torque Measurements
> VFD Efficiency is Mostly Constant Over Temperature
> Motor Efficiency Varies with Temperature (Speed and Load)
> Method Developed to Compensate Motor Efficiency Based on Temperatures Recorded
> Torque Measurement is an issue
  > System Efficiency
> Electrical Power Measurement is an issue
  > VFD Efficiency
CSA C840
Focus on Pool Pump Performance

- Market in Canada is Single Speed
- 500,000 Residential Pool Pumps in Province of Quebec (3 M Residential Customers, 7 M pop.)
- New Regulation in California, USA to Eliminate Single Speed Pool Pump for Two-Speed or Variable Speed (VFD)
AHRI 1210

> AHRI
  > Trade Association
  > 300 Manufacturers of Air Conditioning, Heating and Commercial Refrigeration Equipment

> Goals
  > VFD System Efficiency
  > Harmonics Generation
  > Impact of Voltage Impulse on Motor

> Standard Motor to be used (IE2 or IE3)

> Output / Input Method

> Marking

> Draft under Development
IEC 60034-2-3
IEC 60034-2-3

> VFD System incorporate Converter and Motor
  > Motors under IEC TC2 WG28
  > Converter under IEC SC22G
> IEC 60034-2-3 will cover method for determining Motor Efficiency Supplied from a Converter
> Collaboration between WG28 and SC22
IEC 60034-2-3

- Draft Proposal
  - Preferred Method → Summation of Losses
- Standard VFD to be Used (Pulse Pattern)
- Evaluation of Harmonic Losses Based on No-Load Test
  - Difference Between Sinusoidal Supply and with Converter
- Efficiency determined at Nominal Speed, Different Loads
Little Side note...
New CSA Motor Standards published

- CSA C390 – 2010 for Three-Phase Induction Motors
  - Revision of 1998 Version
  - Improved Method
  - Includes a Calculation Spreadsheet in electronic format
  - Standardization of Calculations and Report
    - Ease of Use
    - Limit errors
- CSA390 – IEEE112 – IEC 60034-2-1
  - Give Equivalent Results
New CSA Motor Standards published

- CSA C747 – 2009 for Small Motors
  - Covers Multiple Type of Motors
    - Capacitor-start or Capacitor-run
    - Split phase
    - Shaded pole
    - Reluctance
    - Small Polyphase Induction
    - Permanent Magnet
    - Brushless DC
    - Converter Driven
  - Output / Input Method
  - Calculation Spreadsheet Included
  - MEPS?
Thank You!