

**AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS, INC.**

1791 Tullie Circle, N.E./Atlanta, GA 30329

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TC/TG/TRG MINUTES COVER SHEET

**(Minutes of all TC/TG/TRG Meetings are to be distributed to all persons listed below within 30
days following the meeting.)**

DRAFT #5

**"These draft minutes have not been approved and are not the official, approved record until
approved by this (council/committee)."**

TC/TG/TRG NO.: TC 1.11 DATE:

TC/TG/TRG TITLE: Electric Motors and Motor Controls

DATE OF MEETING: January 29, 2013 LOCATION: Dallas

Sheraton- Majestic (8)

Voting Members for TC 1.11

| | Position | Affiliation | FY2012 | FY2013 | FY2014 |
|--|-----------------------|---------------------|---------------|---------------|---------------|
| Terry Davies | Chair | Danfoss | XX | XX | XX |
| Ken Fonstad | Vice Chair | ABB | | | |
| Robert Richard | Secretary | Honeywell | XX | | |
| Tom Lowery | Handbook | Schneider Electric | | XX | XX |
| John Tolbert | Programs & Membership | Bristol | XX | XX | XX |
| Rick Heiden | Standards & Research | Trane | XX | | |
| Rick Bunch | ALI | RLBunch Enterprises | XX | XX | XX |
| Alex Lifson | Member | Carrier | XX | XX | XX |
| Robert Helt | Member | RHConsulting | XX | XX | XX |
| Armin Hauer | Member | EBM-Papst | XX | XX | XX |
| Kurt Vega | Member | Collier County | XX | | |
| Derrick Vigil | Member | Baldor | XX | XX | XX |
| Mike Todd | Member | Johnson Controls | XX | XX | XX |
| Daryl Showalter | Member | FAFCO IceStor | XX | | |
| Total Voting Members (Except Intl. Members) | | | 9 | 12 | |
| | | | FY2012 | FY2013 | FY2014 |
| | | | Past | NOW | Slated |
| International Members (Non-Quorum) | | | | | |
| Hermann Renz | Member | Bitzer | Constant CM? | | |
| Rainer Grosse-Kracht | Member | Bitzer | XX | XX | XX |
| Total International Members | | | 1 | 1 | 1 |
| Total Voting + Intl. Members | | | 10 | 13 | |

Corresponding Members

NOW

7/1/2013

| | | | | |
|------------------|--|--|------|----|
| Charles Arnold | | HDR | 2002 | CM |
| Rudy Chervil | | Johnson Controls | 2007 | CM |
| Jim Chmielewski | | Emerson | 2004 | CM |
| Robert Coleman | | Trane | 2008 | CM |
| Charles Culp | | Texas A & M | 2011 | CM |
| Phillip Johnson | | Carrier | 2006 | CM |
| Paul McCabe | | Rockwell | 2006 | CM |
| Riyaz Papar | | Hudson Tech | 2008 | CM |
| Donald Perry | | Ideal Electric | 2006 | CM |
| Hermann Renz | | Bitzer | 2009 | CM |
| Billy Rheinhardt | | Baldor | 2010 | CM |
| Harold Schnetzka | | Fairchild Controls | 2011 | CM |
| Colin Talt | | E. H. Price Ltd. | 2010 | CM |
| William Tinsley | | TME | 2002 | CM |
| Peter Walter | | ABB | 2006 | CM |
| Thomas Watson | | McQuay Intn'l | 2006 | CM |
| Kurt Vega | | Collier County | | CM |
| Daryl Showalter | | FAFCO Icetor | | CM |
| Craig Wray | | Lawrence Berkeley National Laboratory | | CM |
| Rupal Choksi | | AHRI | | CM |

DISTRIBUTION:

ALL MEMBERS OF THE TC/TG/TRG

TAC SECTION HEAD: Victor Penar

CHAPTER TECHNOLOGY TRANSFER: Steven L. Rosen

LIAISONS:

RAC RESEARCH LIAISON: Sriram Somasundaram Arthur Giesler - effective 7-1-2011

ALI/PDC: John H. Nix, II

SPECIAL PUBS: William S. Fleming

STANDARDS: Michael Woodford

MANAGER OF STANDARDS: Stephanie C. Reiniche

STAFF RESEARCH & TECHNICAL SERVICES: Michael R. Vaughn

ADDITIONAL DISTRIBUTION: All corresponding members.

ASHRAE TC/TG/TRG ACTIVITIES SHEET

DATE: January 29, 2013

TC/TG/TRG NO.: TC 1.11 TC/TG/TRG TITLE: Electric Motors and Motor Controls

CHAIRMAN: Terry Davies VICE CHAIRMAN: Tom Lowery

SECRETARY: Ken Fonstad -- Acting Secretary for this meeting: Tom Lowery

| TC/TG/TRG MEETING SCHEDULE | | | |
|--|---|--|--|
| Location-Past 12 Months | Date | Location-Planned Next 12 Months | Date |
| Orlando, FL Las Vegas, NV Chicago San Antonio | 1/2010 2/1/2011 1/ 24/2012 6/29/2012 | Dallas Denver New York Seattle Chicago | 1/26-30 2013 6/22-26 2013 1/18-22 2014 6/28-7-2 2014 1/24-28 2015 |
| TC/TG/TRG SUBCOMMITTEES | | | |
| Function | | | Chairman |
| Standards Research Program Co-Chairs Handbook Web-master Membership ALI coordinator (ASHRAE learning institute) | | | Armin Hauer Rick Heiden Armin Hauer & Derrick Vigil Tom Lowery Terry Davies John Tolbert Rick Bunch |
| RESEARCH PROJECTS-CURRENT | | | |
| Project Title | Contractor | Monitoring Comm. Chpt. | Report Made At Meeting |
| none | | | |
| | | | |
| LONG RANGE RESEARCH PLAN | | | |
| Rank Title | W/S Written | Approved | To RAC |
| 1. PM Motor Application Survey 2. Issues with Poor Power Quality Electric Supply | No | | |
| STANDARDS ACTIVITIES-List and Describe Subjects | | | |
| SPC 41.11 Standard for Power Measurement, TC 1.11 members participating on SPC AHRI Standard 1210P Performance Rating of Variable Frequency Drives, MOT will become new ASHRAE standard once AHRI has developed | | | |
| TECHNICAL PAPERS from Sponsored Research-Title, when presented (past 3 yrs. present & planned) | | | |
| | | | |
| TC/TG Sponsored Transactions-Title, when presented (past 3 yrs. Present & planned) | | | |

| |
|--|
| 06/08 Motor Bearing Currents – Cause, Effect and Mitigation |
| TC/TG Sponsored Seminars-Title when present (past 3 yrs. present & planned) |
| 6/10 Seminar - Variable Speed Comparison: Induction vs. Permanent Magnet Motors 6/10 Seminar - Starters and drives - selection criteria, performance standards, longevity 1/11 Seminar 50 - Residential Power Factor and EMI (FCC) Requirements for VSDs 6/11 Seminar 8 - Role of Technology in Shaping the History of the United States 6/13 Seminar 6 – Smart Methods to prevent Electrical Harmonics in Buildings |
| TC/TG Sponsored Forums-Title, when presented (past 3 yrs. Present & planned) |
| 1/09 Variable Speed Drives (VSPD) and Residential Power Factor 1/11 Forum - VFD Standards, what’s in place, what’s coming and what’s needed 6/12 Seminar - Variable Frequency Drive Performance: What Is It and How Does It Relate to AHRI 1210-2011? |
| JOURNAL PUBLICATIONS, when published (past 3 yrs. present & planned) |
| |

**ASHRAE Technical Committee 1.11
Electric Motors and Motor Controls
Agenda for Dallas Meeting
January 29, 2013 – Tuesday 1:00 to 3:30 PM
Sheraton Dallas – Majestic 8, 37th Floor**

Call to Order – Terry Davies

- Welcome

Meeting Called to Order by Terry Davies at 1:05

- Introduction of Members and guests
- Additions to agenda

No additions

- Quorum confirmation
- Minutes from San Antonio meeting were approved by email vote prior to this meeting.
- Minutes from August 24, 2012 teleconference were approved by email vote prior to this meeting.

7 of 9 voting members present, Quorum confirmed for this meeting

- Attendance Sheet

Circulated for completion

Chairman's Report – Terry Davies

Section One Meeting Report {Terry to Add}

Subcommittee Reports

Programs – Armin Hauer chair, Derrick Vigil vice chair

Sunday morning Session 6 had 48 guests in attendance

Very good question and answer session at conclusion of this Seminar – Potential material for future programs as Harmonics topic seems very relevant to ASHRAE members.

Potential Topics:

Bearing Currents {Denver annual Meeting}

Forum “Does every VFD driven Motor have Bearing Current Issues?”

Moderated by Tom Lowery

Potential Panel Members: Mike Olson to obtain speaker/Derrick Vigil to obtain speaker/Filter Mfg?

----- Conference Call conducted 2/6/13 resulting in submittal for Denver 6/13 Conference Seminar ---

**ASHRAE
2013 Annual Conference
Denver, Colorado June 22-26**

Proposed Seminar for: Mile High Efficiency & Equipment Track

Title: “VFD Generated Motor Bearing Currents got your equipment screaming? Understand how to design, detect and mitigate variable speed motor applications where bearing currents can cause premature equipment failure.”

Session ID 9902

Sponsor: TC1.11 Electric Motors and Motor Control
Co-Sponsor: TC8.1 Positive Displacement Compressors

Moderator: Tom Lowery, TC1.11 Vice-Chairman, Schneider Electric

Speakers: Mike Olson, Sr. Application Engineer, ABB Inc
Mike Melfi, Advanced Technology Labs, Baldor
Adam Willworth, Sales Manager, Electro Static Technologies
Sylvain Humbert, Global Manager – Strategic Industries & HVAC, SKF

Seminar Abstract: Even a single motor failure due to VFD induced bearing currents can cause costly downtime in critical HVAC/R systems, negating all the energy savings and revenue increase from energy efficient designs. Often before the motors fail, bearing noise is often evident causing users to question the technology advancements in variable speed driven HVAC fans and pumps. Depending on the air handler, cooling tower or pump motor’s location, failures and subsequent removal and replacement can be very difficult and expensive maintenance problems. This session will present three critical aspects to the issue 1) System designs that can mitigate the potential problem from the onset 2) Field measurement techniques to detect if the motor bearings are doomed to fail. And 3) Mitigation devices that can be installed to eliminate potential bearing currents from developing in the motor. The session will also include an extensive panel discussion where our four expert speakers will answer audience questions about VFD induced motor bearing currents..

Seminar Topics:

“Proper VFD Installation is the Best Way to Avoid Motor Bearing Issues”

Abstract: This presentation addresses the fact that there are a number of mechanisms that can cause bearing currents – even within the application subset of inverter-fed motors – and each of the mechanisms may require its own specific corrective action to mitigate the failure risk. The actual mechanisms for bearing damage due to current flow are often misunderstood. This presentation clarifies the physics of these damage mechanisms. Aside from currents in the bearings of motors, it should be understood that other machinery - typically machinery coupled to the motor – may be susceptible to similar bearing currents.

“The Physics of Motor Bearing Currents”

Abstract: While papers have been written on the subject of bearing currents from various perspectives, this discussion addresses the fact that there are a number of mechanisms that can cause bearing currents – even within the application subset of inverter-fed motors – and each of the mechanisms can require its own specific corrective action to mitigate the damage. The actual mechanisms for bearing damage due to current flow have often been misunderstood. This presentation attempts to clarify the physics of these damage mechanisms. While this discussion addresses currents in the bearings of motors, it should be understood that other machinery- typically machinery coupled to the motor – may be susceptible to similar bearing currents.

“Testing Procedures for Detection of Motor Bearing Currents”

Abstract: One might think that placement of a digital meter or other measurement device on the rotating motor shaft is acceptable to determine if an electrical charge is present. Yet, the detection of possible bearing currents is not that simple. This presentation will cover suitable equipment and methods of testing for users or installers to determine if the potential for damaging electrical voltage and subsequent current flow through the rotating bearing are present in sufficient levels to cause concern.

“Protection of Bearings against Damaging Currents”

Abstract: Electrically eroded motor bearing races will be examined. Guidance to detection and mitigation methods will be presented for bearing design considerations, detection of potentially damaging electrical potential and preventative measures against electrical discharge across the bearings.

At the conclusion of our four presentations we will open the session for audience questions.

Total Time: 90 minute presentation and panel discussion

Speaker Time: (4) 15 minute each for 60 Minute Total

Panel Discussion: 30 minute time allotted for audience questions to our panel of experts on bearing current subject.

Q1. What caused motor bearing currents in VFD driven motors?

A1. High frequency switching performed by the drive power transistors can result in capacitive coupling between the motor stator windings and shaft. This induced shaft voltage builds until the potential is high enough to discharge across the motor bearings resulting in current flow to ground through the motor frame.

Q2. What is the best way to avoid the potential for damaging motor bearing currents?

A2. While there is no optimal single solution for all cases, the fundamentals of system design and installation practices help minimize the risk of motor failure due to bearing currents.

Q3. Can I perform any measurements after installation to determine if my application may be at risk of motor bearing currents?

A3. Yes, the seminar will present methods of test to determine likelihood of failure due to bearing currents.

Q4. Do I need special testing equipment to perform these tests?

A4. Yes, since we are measuring the voltage level on the motors rotating shaft, some special test leads will be required to obtain an accurate reading.

Q5. Once I get a shaft voltage measurement, how do I know if it is high enough to possible create currents in my motor bearings?

A5. Extensive research studies have determined the maximum level of voltage that can be present on a motor shaft before bearing currents begin. This information will be presented during the seminar and is published in ASHRAE Handbook Chapter 45.

Q6. If I measure a high enough level of voltage on my motor shaft to warrant concern, how can I mitigate the risk of motor failure?

A6. Several mitigation methods are available to users that measure shaft voltages above recommended values. These will be presented offering cost/benefit advantages for each.

Q7. What is the first sign that I may have a problem with a motor?

A7. If motor bearings and associated raceways begin to conduct current, usually the first sign of a problem is noise generated from the pitting and arc traces inside the bearing?

Q8. How do I know the noise is caused by bearing currents and not a mechanical problem?

A8. The high frequency tonal patterns of bearings beginning to fail due to currents is very unique distinguishing it from mechanical wear issues.

Q9. Does this problem exist in all VFD driven motors?

A9. No, during the seminar we will present design considerations that when followed can mitigate the risk of motor failures due to bearing currents.

Q10. Is anything special found in "Inverter Duty Motors" to protect against this potential problem of motor bearing failures?

A10. Sometimes. While no standard exists covering the technical requirements for inverter motors, manufacturers are recognizing that a protection system build into a motor to protect it against motor bearing currents may be required.

Denver Track 6 HVAC&R Systems and Equipment Seminar "TBD"

Topics

- (1) EMI/RFI – Mike Olson to provide potential paper
- (2) Power Line Carriers

Future Program Topics

AHRI Standard 1210 Certification

"How can users apply the standard?"

"Is it drive only or drive/motor combined efficiency?"

"Is their measurable efficiency gains by replacing old operational drives with new"?

Standards – Armin Hauer

AHRI 1210/1211 – Vote 7-0 to request ASHRAE standard to replace Appedix C currently in this standard. At this time, TC1.11 does not recommend expanding from as published. Have Standards only apply to currently covered VFD sizes.

TC 1.11 standards subcommittee report

2013-01-29

Ashrae SPC 41.11 - Standard Methods for Power Measurement

- Ongoing development, standard is urgently needed.
- Indeed, there seems to be no outside electrical standard readily available.
- IEC 60034-2-3 (TC2 WG28)
http://www.iec.ch/dyn/www/f?p=103:14:0:::FSP_ORG_ID,FSP_LANG_ID:1482,25

AHRI 1210/1211 – Performance Rating of Variable Frequency Drives

- Proposal of new Ashrae standard pending with standards chair, after I received advice from PPIS on 1/25/2013. That standard would replace MOT in appendix of AHRI 1210.
- Operation Manual for certification is due in Q3/2013
- IEC 52800 is work in progress; report from AHRI liaison to Europe?

CSA C838 – ? “efficiency of VFDs”?

- Publication expected in March 2013
- It is said to not cover motor stress and not cover harmonic current emissions. For the efficiency aspect it allegedly separates out VFDs and motors.
- Are there conflicts between CSA C838 and AHRI 1210?!
- Scope? (Performance range and voltage range?)

IEEE 1836 / 1837 - Harmonics

Negotiations between Canadian utilities and manufacturers associations.

Armin Hauer

Research – Rick Heiden

Relevant topics as approved by TC can submit without RTAR

Cannot use “Guidelines” in Research project titles as this is reserved for use only by Standards

TC 1.11 – Research Subcommittee Report, Dallas January 2013

Research subcommittee report (Rick Heiden)

Members - Heiden, Tolbert, Rhinehardt, Hauer

Action Items

- Subcommittee meeting before Denver via teleconference
- Schedule research subcommittee meeting for Denver
- Draft RTAR’s ready for Denver sub-committee meeting

Active Research Projects

- None

Active Work Statements

- None

Proposed RTAR's

- Quantify standby power consumption in HVAC applications utilizing CSA MOT C393 and outline methods to reduce
 - Evaluate standby power consumption in 5-1500kW HVAC equipment
 - Pareto power consumption by application, climate and size
 - Summarize state of the art reduction methods
- Survey available literature and databases used for motor-VFD performance modeling in HVAC design
 - Motor-VFD performance rating updates for DOE MotorMaster Plus Database

Ideas

- Power quality trends by region and technology (surges, sags, etc)
- Data Center trends (i.e. 600 VDC ABB case) maybe a seminar
- Effects of motor type on VFD efficiency. How does the MOT for VFD need to be changed for motors other than asynchronous.

Completed Projects Sponsored by TC 1.11

RP-1078 -- Early Detection of Insulation Degradation in Low Voltage Motors
RP-1076 -- Diagnostic Test and Analytical Methods for Resolving Fan/Motor Vibration Problems in Air-Conditioning Units
RP-1095 -- Measurements of Electrical Power Inputs to Variable Speed Motors and Their Solid State Power Converters: Phase I
RP-667 -- Measurements of Electrical Power Inputs to Variable Speed Motors and Their Solid State Converters
RP-685 -- Test and Analysis Methods for Resolving Fan/Motor Vibration Problems in Air-Conditioning Units
RP-770 -- Measurement of Electrical Power Inputs to Variable Speed Motors and Their Solid State Power Converters

Membership – John Tolbert

Roster Review & Revisions

Now have 26 CM's on TC1.11 Roster

Those CM's wanting to become voting members should contact John, minimum of 2 years attendance as CM required to be nominated to voting member.

Copy of meeting sign in sheet TC 1_11 Dallas Attendance 1-29-2013.jpg

Handbook – Tom Lowery

TC1.11 is responsible for Chapter 45 found in HVAC Systems and Equipment Volume

Updates published via e-mail to voting members last month. Approved as submitted.

Add Reference to SPC 41.11 Standard Methods for Power Measurement – Rick/Armin to send placement for reference

NEMA Liaison & UL Liaison - Terry Davies

Tom Lowery has volunteered to be TC1.11 Liaison to NEMA and UL Meetings
Hydraulic Institute is looking for marketing data and input on course material.

UL508 is being harmonized with IEC.

Paul Lin from Regal-Beloit commented that Nema is requesting a motor ASHRAE representative to attend annual meeting week of March 20 in New Orleans.

Web Site – Terry Davies <http://tc111.ashraetcs.org/>

Old Business – None

New Business – None

Adjourn;

John Tolbert made motion to adjourn at 3:15; motion was seconded by Robert Helt and approved by all voting members.