TC Cover Sheet
TC 6.3, Central Heating and Cooling

June 29, 2004

Attendance (ending year of membership)

Members Present
James Cummings (07)
Chuck Gaston (05)
Paul Haydock (04)
Roger Hedrick (05)
Michael Lubliner (04)
Gary Nelson (07)
Mark Olsen (06)
William Rittelmann (07)
Jeff Siegel (07)
Arun Vohra (07)

Members Absent
Martin Petchul (06)
Bryan Rocky (07)
Steven Tice (07)
Edward Vineyard (06)

Corresponding Members Present
John Andrews
Evelyn Baskin
Paul Francisco
Diane Griffiths
Eli Howard
Frank Jakob
Steve Kowalski
Mark Modera
Cyrus Nasseri
Harvey Sachs
Keith Temple

Guests
Charles Wayne Frazell
Lixing Gu
Byron Horak
Diane Jakobs
Birol Kilkis
John Talbott
Iain Walker
Craig Wray

Distribution

All entries shown on committee roster

ASHRAE TC6.3
Central Forced Air Heating and Cooling

Minutes of Meeting
June 29, 2004
Nashville, Tennessee

Call to Order

The meeting began at 1:03 p.m. in the Cheekwood G room of the Opryland Hotel. A quorum was not present until 1:15 p.m.

Announcements

ANSI sent a list of standards to ASHRAE which were discussed at the TC Chair's breakfast. These include a standard on standards development, UL 181-2000x on closure systems for flexible ducts, and an Agricultural Engineers' standard on nomenclature.

ASHRAE has an FAQ page on the web now.

Rosters are now electronic, and ASHRAE is working on methods of email distribution of TC documents, particularly with regard to spam blockers.

TC6.3 should be proud that they are the only TC which had both a symposium and a seminar at this meeting. Kudos to Keith Temple and previous program chairs.

The TAC Section 6 representative, Birol Kilkis, spoke briefly to the meeting. He commended the TC on its active program activity. TAC is also soliciting for members from the TC.

Minutes of Last Meeting

Minutes of the Anaheim meeting were distributed for review. Moved by Roger Hedrick and seconded by Arun Vohra to accept the minutes. Motion passed 9-0.

Subcommittee Reports

Programs

Keith Temple distributed a program plan (Attachment 1). The symposium held in Anaheim was described briefly. There were three papers on "Factors Influencing the Energy Performance of Forced-Air Systems."

In Nashville, there was a symposium on Monday, "Forced Air Distribution System Performance," which was well attended (62 officially, 70 by John Andrews' unofficial count). A symposium to be held Wednesday was briefly described by Jim Cummings, "Best Choice Cooling System Airflow Rates for Different Climates."

There are three programs planned for Orlando, a seminar and two forums. The seminar is "What do we know about Standard 152?" Paul Francisco will be the chair, and he described the planned speakers. They are: Mark Modera, John Andrews, Larry Palmiter, and Paul Francisco. There was discussion of the best sequence of the four speakers. Hedrick moved, Siegel second to put forward the seminar, approved 9-0.

The first forum will be "What Often-Ignored Factors Affect Performance of Residential Forced-Air Systems" to be chaired by Chuck Gaston. Moved by Andrews, second by Seigel, to approve the forum, approved 9-0.

The second forum is "How Should Thermal Distribution System Efficacy be Defined?" to be chaired by Arun Vohra. There was a discussion of the process by which programs are selected and scheduled by ASHRAE. Moved by Gaston, second by Hedrick, to approve the Forum, approved 9-0.

Prioritization was moved by Seigel, second by Olsen, to be as listed in the handout. Approved 10-0.

For Denver, there were two symposia discussed. The first was "Managing Return Air in Residential and Small Commercial Buildings" to be chaired by Paul Francisco. He currently has four speakers confirmed, 2 residential and 2 commercial. He would like to get a fifth speaker. The four confirmed topics were described. Motion by Gaston, second by Rittlemann, to move the proposed symposium forward was approved 10-0.

The other was "HVAC Systems and Performance in Building America Homes" to be chaired by Arun Vohra. Mike Lubliner described the planned symposium. Papers are planned to be prepared by different Building America teams. Motion by Hedrick, second by Haydock, to move the proposed symposium forward was approved 10-0.

Research

John Andrews reported on the Monday Research Subcommittee meeting. He feels that the TC is beginning to get a new direction now that Standard 152 has been published. Four themes have been identified: system performance degradation, both as installed and over time; system design options to provide good humidity control; impact of IAQ requirements on energy efficient system design; impact of room air distribution requirements on energy efficient system design.

John would like the TC to set up a committee to provide input to a project being conducted by Northwest Energy Efficiency Alliance on heat pump performance. Utilities in the Northwest US provide rebates for purchase of heat pumps, and the project is investigating whether these programs provide the energy savings expected. The committee would provide peer review of the project, currently being bid. John asked for a motion that the TC ask for the concurrence and blessing of RAC to establish the committee. Harvey Sachs stated that the BOD has a thrust of pushing decisions to the lowest-possible level within ASHRAE, and that we may not need to bother RAC. The response was that the TC wants to bring this to other interested TCs. It was decided that someone will talk to Mike Vaughn telling him what we plan to do, and asking for direction on other actions, such as submission of an RTAR, that might be appropriate. A motion supporting the plan to move forward on the issue by Gaston, second by Olsen, was approved 10-0.

Another proposed project was research on the effect of parameters such as equipment size, refrigerant charge, airflow, duct characteristics and control strategy on the performance of forced air heat pumps in the heating mode. There is no RTAR prepared as yet, but John asked for a motion to approve development of an RTAR, possibly for subsequent letter ballot.

Another project on the efficiency and life-cycle cost of latent load control options was proposed. Advanced humidity control systems was another possibility. It was stated that NETL just approved a project that covers these areas. A description of the NETL project will be sent to

Mike Lubliner so that we can avoid duplication of effort. Mike Lubliner mentioned that there would be a Building America meeting on Wednesday and Thursday which covers these topics. John and Mike will move forward with development of RTARS.

A past Work Statement on the impacts of ceiling space configuration in small commercial buildings was turned down by RAC, and a motion by Siegel, second by Gaston, to table the work statement pending the completion of related work was approved 10-0.

Jeff Siegel described a work statement on Energy Implications of Air Filters prepared for TC2.4 that will be sent out to TC 6.3 for possible letter balloting. TC 2.4 is looking for co-sponsorship from TC 6.3 on the project.

TC 1.2 is putting out an RTAR on measurement of air change rates in occupied houses.

John Andrews mentioned that TC 7.5, Smart Building Systems, is starting a project on rooftop performance, which has a representative from TC 6.3 on the PMS.

Standards

Mark Modera reported on the Sunday meeting of the Standards Subcommittee meeting.

Standard 152 is now published and available for sale.

The possibility of having some sort of standard on distribution system efficacy was discussed. As a precursor, a standard for the measurement of airflow from residential inlets and outlets was proposed. This would be a necessary first step to determination of efficacy. The proposed TPS is included as Attachment 3. TC 7.7 is a potential co-sponsor. The TC expressed support for development of such a standard.

SPC 103, MOT for AFUE, was out for public review, and the SPC is dealing with comments. Changes to the standard are expected, so additional ISC public reviews can be anticipated.

Harvey Sachs and Cyrus Nasseri described government activities regarding efficiency rating of air conditioners, furnaces and boilers, commercial heat pumps, and other appliances.

Web Site

Stephen Kowalski reported nothing new on the website, although there is space available for additional material.

Handbook

Mike Lubliner discussed recent additions to the Systems Handbook from the TC. The TC should look at what should be added related to Standard 152 that could go into the electronic versions that are released annually.

ASHRAE Learning Institute

Chuck Gaston reported that ASHRAE Learning Institute will be a designation of all ASHRAE educational materials.

New Business

TC 9.5, Residential and Small Building Applications has been working closely with TC 6.3. They have been supportive of activities of TC 6.3. TC 9.5 is attempting to develop one page items to convey ASHRAE information to the general public. The relationship may become more formal in the future.

Chairman Lubliner invited everyone to attend a meeting with DOE and Building America on Wednesday and Thursday relating to humidity control.

Adjournment

The meeting adjourned at 3:28 p.m.

Post Meeting Actions

A letter ballot was distributed to the committee by email on July 20, 2004, with a motion to approve an attached research plan, and a secondary motion as to which of two RTARs should be designated as priority 1. The motion to approve the research plan carried 12-0-0. The motion on prioritization was 9-3 in favor of designating RTAR A, "Effect of Equipment Parameters on Residential Forced-Air System Performance in the Heating Mode" as priority 1, and RTAR B, "Energy Efficiency and Cost Assessment of Latent Cooling Options" will be designated as priority 2. The approved research plan and both RTARs are included as Attachment 3.

ATTACHMENT 1a

TC 6.3 – Program Plan
June 2004

Meeting	Symposium	Seminar	Forum
Nashville June 2004	Forced Air Distribution System Performance (5 speakers - Andrews) Monday 10:15 60 attendees	Best Choice Cooling System Airflow Rates for Different Climates (5 speakers - Cummings) Wednesday 10:15	
Orlando February 2005 program due 8/6/04		***Proposed Priority 1:*** *What do we know about Standard 152?* *(4 speakers - Francisco)*	***Proposed Priority 2:*** *What Often-Ignored Factors Affect Performance of Residential Forced-Air Systems (Gaston)* ***Proposed Priority 3:*** *How Should Thermal Distribution System Efficacy be Defined? (Vohra)*
Denver June 2005 papers due 9/16/04 program due 2/10/05	*Managing Return Air in Residential and Small Commercial Buildings (4 potential authors - Francisco)*	*How Should Thermal Distribution System Efficacy be Defined? (Rittelmann)*	*Do we need a Thermal Distribution System Efficiency MOT for Small Commercial Buildings? (Modera?)*
	HVAC Systems and Performance in Building America Homes (5 potential authors - Vohra)		
Chicago January 2006 papers due 4/1/05 program due 8/5/05	*Advanced Air Distribution Systems (Vohra)*	*Residential Zoning (Rittelmann)*	
	Consequences of Oversizing Forced Air Heating and Cooling Systems (Proctor)		
Quebec City June 2006 papers due 9/23/05 program due 2/10/06	*HVAC System Improvements in Manufactured Housing (Lubliner)*		
	Field Degradation of HVAC System Performance (Vohra)		

ATTACHMENT 1b

TC 6.3 – Past Programs

Meeting	Symposium	Seminar	Forum
Dallas February 2000		Advancing the State of the Art in Duct Leakage - 45 attendees	
Minneapolis June 2000	Field Validation of ASHRAE Standard 152P (Andrews) 21 attendees	Depressurization and Venting Issues for Residences (Hemphill) 44 attendees	Residential HVAC in Cold Climates (Jakob) 11 attendees
Atlanta January 2001		Exploring Alternative Energy Efficiency Factors (Temple) 30 attendees	Residential Cooling and Dehumidification in Hot and Humid Climates (Jakob) 35 attendees
Cincinnati June 2001		Update on Standards for Residential and Light Commercial Central Systems (Haydock) 50 attendees	Experiences with Residential HVAC in HUD-Code Manufactured Homes (Lubliner) 22 attendees
Atlantic City January 2002	Depressurization and Venting Issues for Residences (Jakob) 37 attendees		
Honolulu June 2002		Uncontrolled Airflows in Small Commercial Buildings (Kweller) 50 attendees	
Chicago January 2003	Advances and Issues in Residential Thermal Distribution System Efficiency (5 speakers - Andrews) 35 attendees		What should the "Design of Small Forced Air Systems" Chapter of the Handbook include on Duct Design? (Temple) 7 attendees
Kansas City June 2003	Advances and Issues in Residential Thermal Distribution Efficiency (5 speakers - Temple) 35 attendees	Impacts of Duct Systems on Indoor Air Quality (5 speakers - Siegel) 50 attendees	
Anaheim January 2004	Factors Influencing the Energy Performance of Forced-Air Systems (3 speakers -Lubliner) 60 attendees		

Method of Testing for Rating Devices Used to Measure Airflow through Air Inlets and Outlets

1. Purpose

1.1 This standard provides a method of testing for rating devices used to measure airflows through air inlets and outlets that terminate ducted systems for air distribution in residential and small commercial buildings.

1.2 This standard rates the measurement equipment based on the precision and bias at the specified test conditions.

2. Scope

2.1 This standard applies to airflow measurement devices that are intended for field applications on heating, cooling, and ventilation air distribution systems.

2.2 This standard is for use in the laboratory and is not intended for field calibration of airflow measurement devices.

2.3 This standard addresses the effects of non-uniform flows through air inlets and outlets. It also addresses the effect of the device on the air flow to be measured.

2.4 This standard establishes performance specifications for equipment required to test measurement devices, describes the air inlets and outlets and their test configurations, defines methods of calculating and reporting the results obtained using the test, and establishes a reporting system that can be applied to devices covered by this standard.

Rationale:

Detailed studies by LBNL published in ASHRAE Transactions (Walker and Wray 2003[1]) including field and laboratory testing, have shown that there is a large range of uncertainty for airflow measurement devices in field applications to measure airflow through HVAC system air inlets and outlets, despite having similar accuracy specifications provided in manufacturers literature. Some devices perform very well and have accuracies better than 5% of flow over a wide range of conditions and could be used in a wide range of field applications (e.g., ensuring individual air outlet flows meet design specifications). However, other devices had errors of 50% and are essentially useless for any field application. Many users have reported similar errors.

Mostly, these problems have arisen when measuring airflows at air outlets with vanes that direct the airflow in specific directions, and airflow does not enter the flow capture device in a uniform manner. Other problems occur when the size of the air inlet or outlet is different compared to the

[1] Walker, I.S. and Wray, C.P. (2003). "Evaluation of Flow Capture techniques for Measuring HVAC Grille Airflows". ASHRAE Transactions. ASHRAE Atlants, GA. LBNL 51550 (http://epb1.lbl.gov/Publications/lbnl-51550.pdf).

size of the measurement device inlet, and when flows in the distribution system are not uniform upstream of an air outlet. Manufacturers' calibration techniques create uniform airflows entering the measurement device and do not reveal the device's sensitivity to flow non-uniformity found in field applications. Consequently, current accuracy specifications reported by manufacturers do not allow equipment users to determine if a device is appropriate for their field application.

TC 6.3 is concerned with central forced air systems used for heating and cooling of residential and small-commercial buildings. Demand is increasing for measuring airflows through air inlets and outlets of these system types, that exhibit the measurement difficulties discussed above. A few examples of the increasing demand are:

- TC 6.3 has just completed ASHRAE Standard 152 "Method of Test for Determining the Design and Seasonal Efficiencies of Residential Thermal Distribution Systems". The next steps for the TC are to look at efficacy and this will require measurement of all system airflows to check that they meet design requirements.
- The State of California is considering requirements for measuring residential air outlet flows to show compliance with energy code design. Compliance testing in residential buildings is becoming more common and will be used much more in the future (e.g., home energy raters).
- Builders need to know that the system they specified was installed correctly.
- Contractors need tools they can trust to prevent callbacks and complaints and that can be used for troubleshooting.
- Utility programs that specify HVAC performance requirements need to be able to measure system airflows.

Testing and balancing in all buildings will be better served by having improved specifications for the rating of airflow measurement devices. Better rating specifications will ensure that test and balance activities can better determine system performance, which will lead to fewer callbacks to resolve problems.

Keeping it simple:

The test method will use simple, well-established laboratory airflow measurement methods. A selection of air inlet and outlet types, measurement device placement options, upstream ducting geometries for outlets, and airflow rates will be specified based on already completed research and field experience. We anticipate that a set of about 20 configurations will exercise the performance parameters sufficiently.

Other possible issues:

Insertion losses. Some measurement devices add airflow resistance, which results in a lower airflow than if the device was not in place. Most devices use a simple calibration (often called the K factor) to correct for this effect. However, the actual correction required strongly depends on the duct system layout, airflow pattern, and airflow rate. If a particular branch is being measured using a device that changes the flow resistance of that branch, then the flow through that branch will be reduced and the flows in other branches will increase. Particularly in multi-branch residential systems, the insertion losses can be very large (50% or more). Addressing the effects of insertion losses in this standard would require a more complex method of test.

Progress to date:

The lead authors of this proposed standard are Iain Walker and Craig Wray of LBNL. They met informally on Sunday January 25th at the Anaheim meeting with ASHRAE Technical Committee and manufacturers' representatives: Andy Nolfo (National Environmental Balancing Bureau, TC 7.9 Building Commissioning), Gary Nelson and Frank Spevak (The Energy Conservatory), and Charlie Wright (TSI, TC 1.2 Instrumentation). Others were invited, but were unable to attend: David John, TC 5.3 Room Air Distribution; Jim Reardon, TC 5.12 Ventilation Requirements and Infiltration; Mike Lubliner, TC 6.3 Central Forced Air Heating and Cooling Systems; Gerry Kettler, TC 7.7 Testing and Balancing; and Larry Spielvogel, TC 9.5 Residential and Small Building Applications.

A follow-on meeting was held during the TC 6.3 Standards Subcommittee meeting on January 25 for two hours. Most of the Subcommittee (approximately 20 people) agreed that there is a need for the standard (Iain Walker, Frank Spevak, and Charlie Wright also attended this meeting).

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ATTACHMENT 3

RESEARCH PLAN

TC 6.3 – CENTRAL FORCED-AIR HEATING AND COOLING SYSTEMS
July 27, 2004

Introduction

Over the past thirty years, much effort has gone into improving the energy efficiency of space heating and cooling equipment. National standards have focused almost exclusively on equipment efficiency.

The performance of equipment as part of a system has received increasing attention in recent years. It is now universally recognized that equipment, thermal distribution, and the building envelope are all intimately connected both in terms of energy efficiency and the degree to which each element serves the purpose for which it is intended.

Despite this renewed focus on systems, however, there is an emerging consensus that equipment and systems, as installed, often do not perform as well as would be expected on the basis of manufacturers' specifications and standardized ratings.

There is less agreement on the frequency and extent of many types of performance shortfalls. The situation today with most of these concerns is reminiscent of the status of duct energy losses in the 1980's. At that time, an expanding body of research was pointing to duct losses as a significant factor in the annual energy use for space heating and cooling in small buildings. The conventional wisdom, however, was that, because of the low pressures generally used in residential ductwork, these losses could not be very great. With additional analysis, field research, and discussion among stakeholders, consensus was reached among industry, the research community, and government energy agencies that duct losses are a cause of energy losses comparable to the energy losses in furnaces and boilers thirty years ago.

The major issues with regard to system performance today group themselves into two broad categories:

1. as-installed energy use relative to what is expected
2. delivered air quality and thermal comfort relative to what is defined as acceptable by applicable codes, standards, and guidelines.

In each of these areas, it is important to achieve greater understanding of which perceived issues are truly significant, which are real but misdiagnosed, and which may not warrant much emphasis.

In recognition of these concerns, the members of ASHRAE's Technical Committee 6.3, Central Forced Air Heating and Cooling Systems, have selected as an overarching theme for its research plan the need to bring as-installed performance in line with what would be expected on the basis of test data.

This theme complements efforts by manufacturers, the U.S. Department of Energy, and others to improve the baseline performance of the individual system elements themselves. It is also in line with the Research Strategic Plan being developed by ASHRAE's Research Advisory Panel (RAP). That panel has identified eight preliminary "Research Opportunities" that could provide a structure for ASHRAE's Strategic Plan. These are:

1. Integrated Design for the Building's Life Span
2. Alternative Cooling Technologies

3. Simulation and Design Tools
4. Comfort, Health, and Productivity
5. Sensors
6. Renewable Energy Applications
7. Refrigeration
8. Building Operation

Of these eight issues, all but 6 and 7 are directly related to TC6.3's research plan.

Closing the Gaps

Within the overarching theme of "closing the gaps" between expected and as-installed system performance, TC 6.3 has identified several specific areas where it believes ASHRAE research can make an important difference in the coming decades. These fall in two broad subareas, depending on whether the perceived performance deficiency is mainly one of lower than expected energy efficiency or lower than expected delivered thermal comfort and air quality to the homeowner or small-commercial building occupant. The following outline provides an overview of TC 6.3's vision.

Main Theme: Bringing As-Installed System Performance in Line with Expected Performance

I. Energy Efficiency Performance
    A. System energy efficiency at the time of installation
    B. Energy efficiency degradation over time

II. Delivered Health and Comfort Performance
    A. Humidity management
    B. Meeting indoor air quality requirements
    C. Meeting room air distribution requirements

In each of these areas, TC 6.3 recognizes the need to provide industry, government, and the research community with a sound technical basis for raising or lowering the level of concern about any specific issue. The consequences of ignoring a truly significant problem must be weighed against the economic inefficiencies and wasted effort associated with raising false flags of concern. This is a responsibility that the members of this committee take seriously.

A Special Project

TC 6.3 is planning to establish a Peer Review Committee to give technical advice on a project being funded by the Northwest Energy Efficiency Alliance (NEEA). This is being undertaken at the request of NEEA for ASHRAE involvement. (It involves no cost to ASHRAE, hence it is not the subject of an RTAR.) The NEEA project is expected to provide significant field data on as-installed heat-pump system performance parameters in the two main climate zones in the Pacific Northwest, i.e., the cool, wet region west of the Cascade Mountains and the hot, dry zone east of this range. The project will obtain information on equipment parameters such as sizing, airflow, charge, and duct characteristics and also on as-installed control strategies that can affect system efficiency, e.g., how and when electric resistance backup heat is called upon.

ASHRAE participation in the project on an advisory basis will provide it with the experience and knowledge to enable a decision on whether to pursue (most likely in coordination with state, regional and/or federal agencies) similar research in other climate zones and/or other equipment types. This will be useful in any case, but it also fits in with one of the two RTARs being submitted by TC6.3.

Proposed ASHRAE Research for 2005

TC 6.3 is proposing two areas of research for 2005. These are described in detail in RTARs being submitted in the August 2004 cycle. Summary descriptions are given here.

Effect of Equipment Parameters on Residential Forced-Air System Performance in the Heating Mode. (TC 6.3 Research Plan Category I-A, System energy efficiency at the time of installation.) This project is intended to add value to the NEEA project described in the preceding section by characterizing the impact of equipment parameters on actual system performance more precisely than is now known. The NEEA project will gather data on what these parameters are in the field, but only sparse data exist on the impact of these parameters on system performance in the heating mode. This contrasts with the cooling mode, in which more definitive information is available. As an example, it is well known that oversizing of air conditioners and heat pumps in the cooling mode contributes to excessive cycling, leading to degradation of both efficiency and dehumidification performance. The situation in the heating mode is less clear. The argument has been made that, at least in climates where cooling is secondary to heating, "oversizing" of heat pumps may be a good thing because it lowers the balance point and reduces the amount of electric resistance backup heat required. No consensus has yet been reached on the degree to which arguments like this may be valid. This proposed project will use laboratory and field data together with simulations to answer as many of these questions as possible.

Energy Efficiency and Cost Assessment of Latent Cooling Options. (TC 6.3 Research Plan Category II-A, Humidity management.) There is a general consensus that improvements in building envelope thermal integrity have adversely affected the ability of conventionally designed air conditioners to provide adequate dehumidification in residential and small commercial buildings. There is less agreement on the extent of the problem and the degree to which non-traditional design options may be needed to overcome it. These themes were brought out at a recent "experts' meeting" sponsored by the U.S. Department of Energy's Building America Program. The need exists for a credible study, with guidance provided equally by representatives of the HVAC industry and the research community, that could serve as a blueprint for future research, development, and system design efforts aimed at maintaining, in a cost-effective and energy efficient manner, humidity levels consistent with thermal comfort, health, and building structural integrity. The design and management of such a study must be such that it will be used confidently by both government agencies and private-sector firms in planning their future development and marketing strategies.

Forward Planning: Revision of Standard 103

The SPC 103 committee deliberated on the public comments to the SPC 103 Standard on

June 30, 2004 at the ASHRAE meeting in Nashville. The following research topics were

identified during the course of the meeting. Responding to certain comments requires more research and investigation than the committee itself is capable of. TC6.3 therefore plans to consider the following areas as future research topics to be accomplished before the next revision of the Standard five years from now. There would be possible collaboration with other TC's.

- The efficacy of an input/output test versus the current flue-loss measurement test for furnaces and boilers.
- The static pressure for operating forced-air furnaces in the field.
- The relationship between appliance efficiency and the vent categorization.
- The basis of the "K" and "C" values relating to jacket heat loss in Standard 103.
- The thermostat cycling rate for fixed and modulating equipment installed in the field.
- The origin of the Design Heating Requirement (DHR) and methods for standardization for comparing common equipment installed in the field.

Research Topic Acceptance Requests

The following Research Topic Acceptance Requests are included in the TC 6.3 Research Plan for 2005.

ATTACHMENT 3

RESEARCH TOPIC ACCEPTANCE REQUEST

TC/TG: 6.3 Central Forced-Air Heating and Cooling Systems

Title: Effect of Equipment Parameters on Residential Forced-Air System Performance in the Heating Mode

Research Category: Energy Conservation and Indoor Air Quality

Research Classification: Basic/Applied

TC Vote: Mail Ballot: 12 Yes, 0 No, 0 Abstaining

TC/TG Priority: 1

Estimated Cost: $120,000

Other Interested TC/TGs: TBD

Possible Co-funding Organizations: TBD

Application of Results: Handbook Chapters 9, 16, and 45 of HVAC Systems and Equipment, and Chapter 1 of HVAC Applications.

State-of-the-Art (Background): There is evidence[1] that the performance of forced-air heating systems with heat pumps may differ markedly from what would be expected on the basis of standardized tests, and that these differences are usually in the direction of lower-than-expected efficiency. Factors contributing to these differences include energy losses from duct systems, inappropriate sizing of equipment, incorrect refrigerant charge, inadequate airflow, and inefficient control strategies that cause resistance backup heat to be used when it is not needed. A detailed field study has been funded by the Northwest Energy Efficiency Alliance (NEEA) to quantify the extent of these problems as they relate specifically to the Pacific Northwest.

Advancement to the State-of-the-Art: This project will quantify the impact on system efficiency of performance factors in heat pumps in the heating mode, for which little data is available. It will use information from an ongoing project funded by another agency to assess the impact on energy use within a region. It will assess whether similar research is needed for other equipment types and/or climate zones, comparing the value of the information that is likely to be obtained with the expected cost of the research.

Justification and Value to ASHRAE: The project will bring the state of knowledge for the heating mode, concerning the impacts of various performance related factors, closer to that which now exists in the cooling mode. It will apply this information to the data obtained from the NEEA project, to give a more precise picture of the energy-use implications of that project's findings. It will also provide a logical and credible basis for ASHRAE and cooperating funding agencies to determine whether to proceed with similar research for other equipment types and climate zones.

Objective: Use laboratory results and computer modeling to assess the relative importance of various energy performance issues affecting heat pumps in the heating mode. Apply these results to the data acquired in a project funded by the Northwest Energy Efficiency Alliance to obtain field data on system-performance related parameters on forced-air heating systems using

heat pumps in Washington State. Perform analysis to assess the need for similar work on other equipment types and/or climate zones.

Reference: 1. Francisco, P.W., D. Baylon, B. Davis, and L. Palmiter 2004. Heat Pump Performance in Northern Climates. ASHRAE Transactions, Vol. 110, Pt. 1.

ATTACHMENT 3

RESEARCH TOPIC ACCEPTANCE REQUEST

TC/TG: 6.3 Central Forced-Air Heating and Cooling Systems

Title: Energy Efficiency and Cost Assessment of Latent Cooling Options

Research Category: Energy Conservation and Indoor Air Quality

Research Classification: Basic/Applied

TC Vote: Mail Ballot: 12 Yes, 0 No, 0 Abstaining

TC/TG Priority: 2

Estimated Cost: $150,000

Other Interested TC/TGs: TBD

Possible Co-funding Organizations: TBD

Application of Results: Handbook Chapters 9, 16, 28, and 45 of HVAC Systems and Equipment, Chapter 1 of HVAC Applications, Chapters 9 and 12 of Fundamentals.

State-of-the-Art (Background): A consensus exists that forced-air cooling systems, as installed, sometimes permit the indoor relative humidity to vary outside of an acceptable range. The definition of acceptable includes both thermal comfort and the inhibition of insects, fungi, and other biological growths harmful to human health and/or building structural integrity. There is less agreement on what humidity levels should be considered acceptable and on the extent to which current generation equipment and systems fall short. Proposals to improve the ability of systems to control humidity include use of stand-alone dehumidifiers, dehumidifiers embedded within the ductwork, reduction of airflow to lower the delivered sensible heat ratio, and advanced technology options such as heat pipes or other runaround systems, condenser subcooling, desiccant dehumidification, cooling of ventilation air before mixing with return air, and capacity variation to reduce cycling. Except for the first option, which if used for many hours of the year detracts significantly from a system's overall energy efficiency, none of these choices have penetrated the American market to any significant extent.

Advancement to the State-of-the-Art: This project will provide a comprehensive analysis backed up by field data, across system options, climate zones, and building thermal integrity levels, that will quantify the humidity levels achievable by various system choices, with consisderation of each one's vulnerability to "off-spec" installation.

Justification and Value to ASHRAE: The need exists for a comprehensive study of humidity control in small-building air-conditioning systems that will not only provide valid information but that will have sufficient credibility with major stakeholders (industry, government, researchers) that they will use it in planning their future activities. The content of the Work Statement and the composition of the Project Monitoring Subcommittee will be designed to achieve this.

Objective: Perform analytical studies of humidity control in small buildings as a function of system type, building envelope thermal integrity level, and climate zone. Validate against field data from Building America homes and perhaps other sources. Develop cost estimates for each system option studied and estimate the cost-to-savings ratio for each, relative to a baseline system. Assess benefits of each system option other than energy efficiency in a manner that

would permit their inclusion in an economic evaluation, once the economic value of each benefit is set..

Reference: 1. Presentations at the "expert meeting" sponsored by the U.S. Dept. of Energy's Building America Program, Nashville, TN, June 30 – July 1, 2004.