

**Research Today will
Change Tomorrow**



**Terry E. Townsend, P.E., FASHRAE, LEED®AP
Presidential Member 2006-2007**

ASHRAE Research and the World

- Improves our lives
- Protects us from harm
- Protects the environment
- Saves lives



ASHRAE Research and the Industry



RESEARCH

- Improves the way HVAC&R systems work and the ways in which they are applied
- Allows development of technical information to create standards and guidelines serving as the basis for testing and design practices around the world

ASHRAE
HANDBOOK

2008 HVAC Systems and Equipment



ASHRAE
HANDBOOK

2009 FUNDAMENTALS



ASHRAE
HANDBOOK

2010 REFRIGERATION



ASHRAE
HANDBOOK

2011 HVAC Applications



2011
ASHRAE HANDBOOK

HVAC Applications

I-P Edition

Supported by ASHRAE Research

Nonresidential Cooling and Heating Load Calculations

18.9

Table 5C Recommended Rates of Radiant Heat Gain from Hooded Gas Appliances During Idle (Ready-to-Cook) Conditions

Appliance	Energy Rate, Btu/h		Rate of Heat Gain, Btu/h	Usage Factor F_U	Radiation Factor F_R
	Rated	Standby	Sensible Radiant		
Broiler: batch*	95,000	69,200	-		
Broiler: chain (conveyor)	132,000	96,700			
Broiler: overfired (upright)*	100,000	87,900			
Broiler: underfired 3 ft	96,000	73,900			
Fryer: doughnut	44,000	12,400			
Fryer: open deep-fat, 1 vat	80,000	4,700			
Fryer: pressure	80,000	9,000			
Griddle: double sided 3 ft (clamshell down)*	108,200	8,000			
Griddle: double sided 3 ft (clamshell up)*	108,200	14,700			
Griddle: flat 3 ft	90,000	20,400			
Oven: combi: combi-mode*	75,700	6,000			
Oven: combi: convection mode	75,700	5,800			
Oven: convection full-size	44,000	11,900			
Oven: conveyor (pizza)	170,000	68,300			
Oven: deck	105,000	20,500			
Oven: rack mini-rotating*	56,300	4,500			
Pasta cooker*	80,000	23,700			
Range top: top off/oven on*	25,000	7,400			
Range top: 3 burners on/oven off	120,000	60,100			
Range top: 6 burners on/oven off	120,000	120,800			
Range top: 6 burners on/oven on	145,000	122,900			
Range: wok*	99,000	87,400			
Rethermalizer*	90,000	23,300			
Rice cooker*	35,000	500			
Salamander*	35,000	33,300			
Steam kettle: large (60 gal) simmer lid down*	145,000	5,400			
Steam kettle: small (10 gal) simmer lid down*	52,000	3,300			
Steam kettle: small (40 gal) simmer lid down	100,000	4,300			
Steamer: compartment: atmospheric*	26,000	8,300			
Tilting skillet/braising pan	104,000	10,400			

*Items with an asterisk appear only in Swierczyna et al. (2009); all others appear in both Swierczyna et al. (2008) and (2009).

Table 5D Recommended Rates of Radiant Heat Gain from Hooded Solid Fuel Appliances During Idle (Ready-to-Cook) Conditions

Appliance	Energy Rate, Btu/h	Rate of Heat Gain, Btu/h		Usage Factor F_U	Radiation Factor F_R
	Rated	Standby	Sensible		
Broiler: solid fuel: charcoal	40 lb	42,000			
Broiler: solid fuel: wood (mesquite)*	40 lb	49,600			

*Items with an asterisk appear only in Swierczyna et al. (2009); all others appear in both Swierczyna et al. (2008) and (2009).

Table 5E Recommended Rates of Radiant and Convective Heat Gain from Warewashing Equipment During Idle (Standby) or Washing Conditions

Rate of Heat Gain, Btu/h

STANDARD

ANSI/ASHRAE/IES Standard 90.1-2010

(Supersedes ANSI/ASHRAE/IESNA Standard 90.1-2007)
Includes ANSI/ASHRAE/IES Addenda listed in Appendix F

Energy Standard for Buildings Except Low-Rise Residential Buildings

I-P Edition

See Appendix F for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the IES Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

STANDARD

ASHRAE



ANSI/ASHRAE Standard 62.1-2010
(Supersedes ANSI/ASHRAE Standard 62.1-2007)
Includes ANSI/ASHRAE addenda listed in Appendix J

Ventilation for Acceptable Indoor Air Quality

See Appendix J for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

© 2010 ASHRAE

ISSN 1041-2336



STANDARD



ANSI/ASHRAE Standard 55-2013

(Supersedes ANSI/ASHRAE Standard 55-2010)

Includes ANSI/ASHRAE addenda listed in Appendix M

Thermal Environmental Conditions for Human Occupancy

See Appendix M for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org) or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.



STANDARD



ANSI/ASHRAE Standard 55-2010

(Supersedes ANSI/ASHRAE Standard 55-2004)

Includes ANSI/ASHRAE addenda listed in Appendix I

WITHOUT YOUR SUPPORT!

Thermal Environmental Conditions for Human Occupancy

Figure 5.2.1.2 Predicted percentage dissatisfied (PPD) as a function of predicted mean vote (PMV).

TABLE 5.2.1.2
Acceptable Thermal Environment for General Comfort

PPD	PMV Range

radiant temperature in question along with the applicable metabolic rate, clothing insulation, air speed, and humidity. If the resulting PMV value generated by the model

Use of the PMV model in this standard is limited to

There are several computer codes available that predict PMV-PPD. The computer code in Normative Appendix D is to be used with this standard.⁴ If any other version is used,

5.2.2 Humidity Limits. When the Graphic Comfort Zone Method in is used, systems shall be

There are for thermal comfort; consequently, this standard does not

Note: Nonthermal comfort factors,

5.2.3 Elevated Air Speed. This standard allows

Limits are imposed

the starting point. When the mean radiant temperature is low and the air temperature is high,

Conversely, elevated air speed is

Thus,

in Figure 5.2.3.1 that corresponds to the

Any benefits gained by increasing air speed

Due to increases in skin wettedness, the effect of increased air speed is

Due to increased amounts of exposed skin, the effect of increased air speed is

Thus, Figure 5.2.3.1 is

Due to increased body coverage, the effect of increased air speed is

Thus, Figure 5.2.3.1 will

5.2.3.2 SET Method. Figure 5.2.3.2 represents

The model, however, is and it is acceptable to

The SET model uses a

This model enables air velocity effects on thermal comfort to be

Figure 5.2.3.2 uses Figure 5.2.1.1

Figure 5.2.1.1 is based

ANSI/ASHRAE/USGBC/IES Standard 189.1-2011
(Supersedes ANSI/ASHRAE/USGBC/IES Standard 189.1-2009)

Standard for the Design of High-Performance Green Buildings

Except Low-Rise
Residential Buildings



A Compliance Option of the International Green Construction Code™

See Appendix I for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the U.S. Green Building Council, the Illuminating Engineering Society of North America, and the American National Standards Institute.

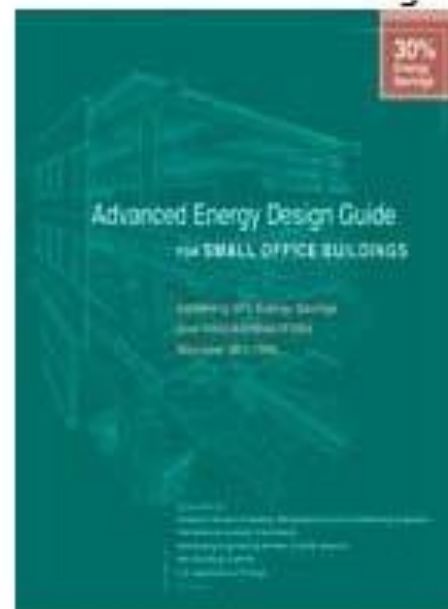
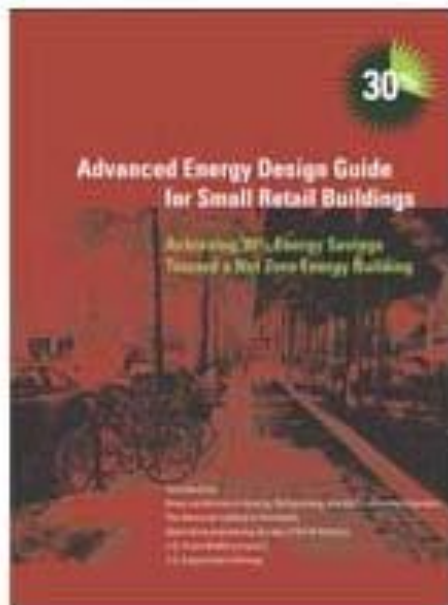
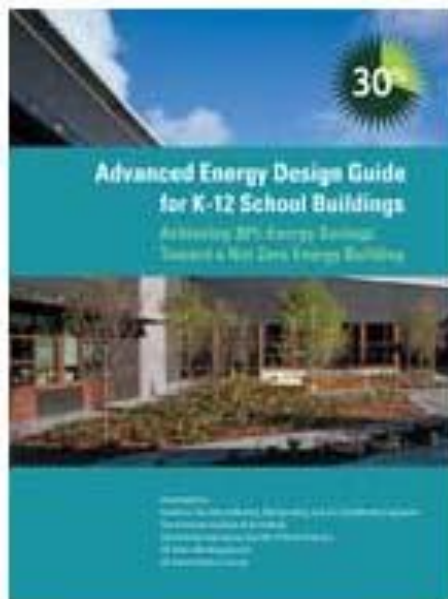
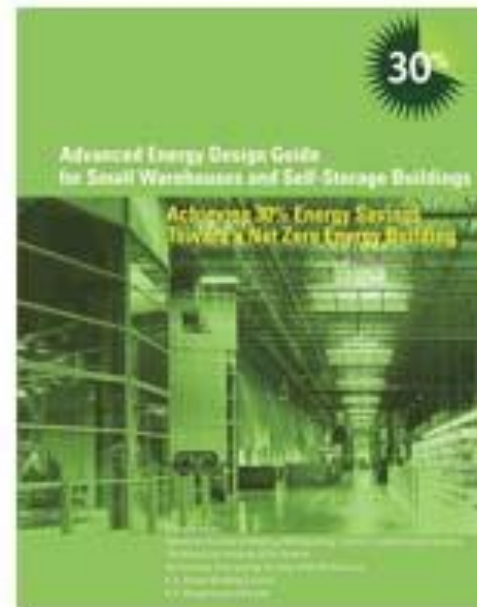
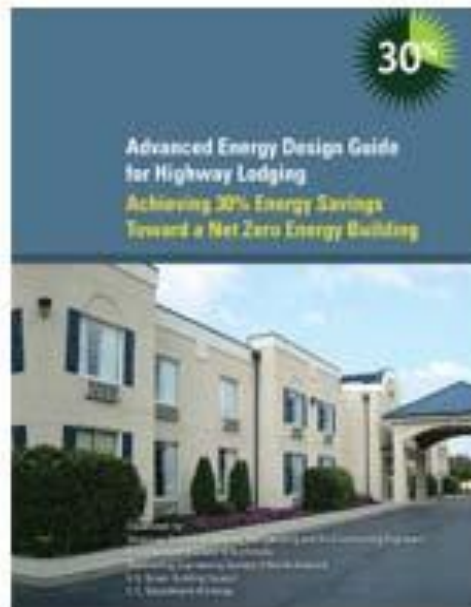
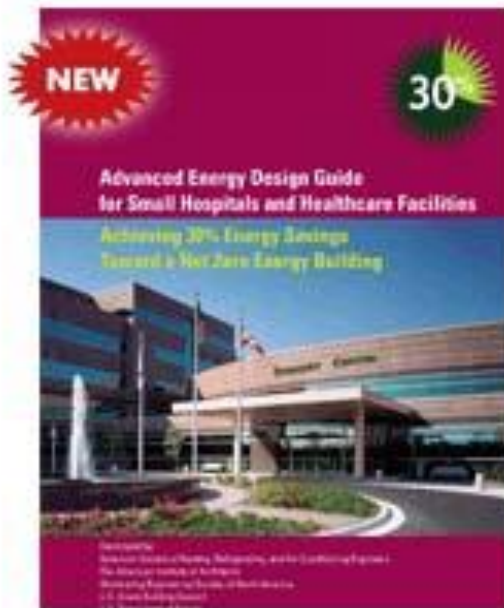
This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org), or in paper form from the ASHRAE Manager of Standards.

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305, telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in the United States and Canada), or e-mail: orders@ashrae.org. For reprint permission, go to www.ashrae.org/permissions.

© 2011 ASHRAE and U.S. Green Building Council

ISSN 1041-2336



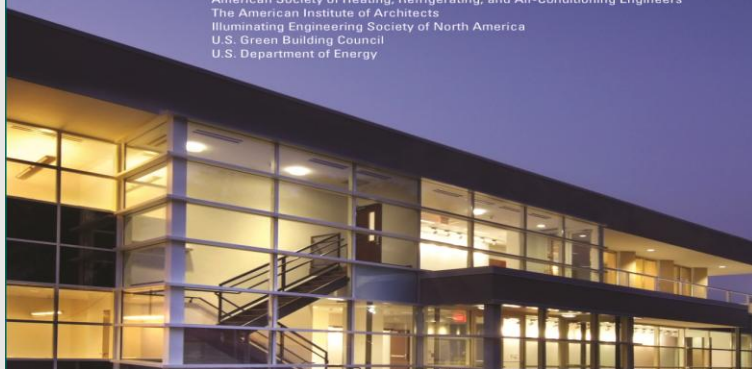




Advanced Energy Design Guide for Small to Medium Office Buildings

**Achieving 50% Energy Savings
Toward a Net Zero Energy Building**

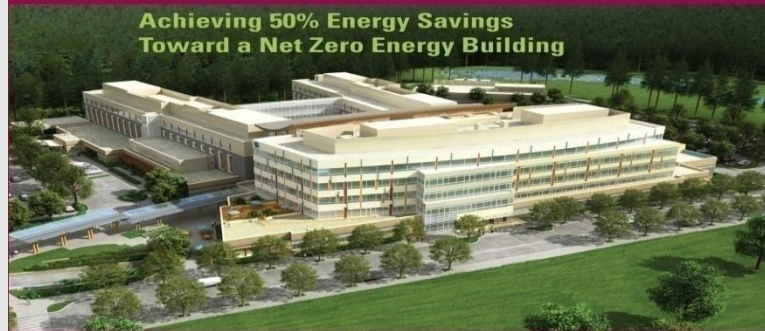
Developed by:
American Society of Heating, Refrigerating, and Air-Conditioning Engineers
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy



Advanced Energy Design Guide for Large Hospitals

**Achieving 50% Energy Savings
Toward a Net Zero Energy Building**

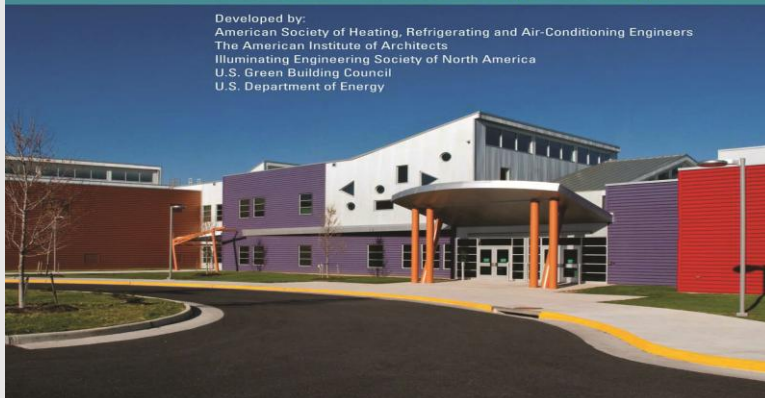
Developed by:
ASHRAE
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy



Advanced Energy Design Guide for K–12 School Buildings

**Achieving 50% Energy Savings
Toward a Net Zero Energy Building**

Developed by:
American Society of Heating, Refrigerating and Air-Conditioning Engineers
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy



Advanced Energy Design Guide for Medium to Big Box Retail Buildings

**Achieving 50% Energy Savings
Toward a Net Zero Energy Building**

Developed by:
American Society of Heating, Refrigerating and Air-Conditioning Engineers
The American Institute of Architects
Illuminating Engineering Society of North America
U.S. Green Building Council
U.S. Department of Energy



ASHRAE Vision 2020

Providing tools by 2020 that enable the building community to produce market-viable NZEBs by 2030.



Producing
Net Zero Energy
Buildings

Guiding Principles

- Not for a few but for all people
- Not for the present but for the future
- Not for development of products but for discovery of PRINCIPLES



ASHRAE's Guiding Principles

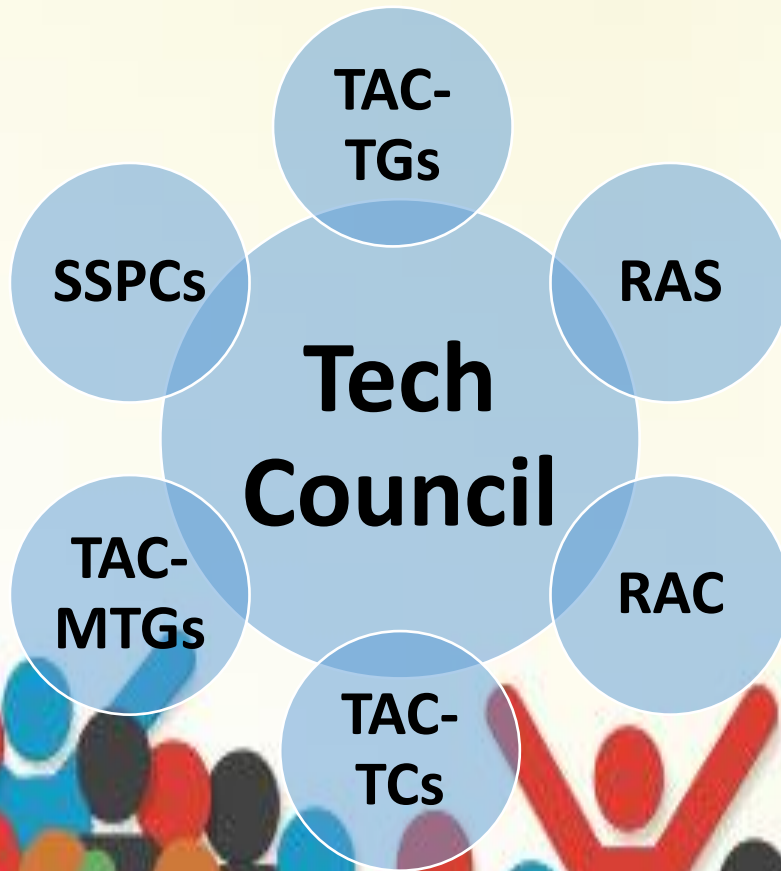
ASHRAE'S MISSION STATEMENT

To advance the arts and sciences of heating, ventilating, air conditioning, and refrigeration to serve humanity and promote a sustainable world.

ASHRAE'S VISION

ASHRAE will be the global leader, the foremost source of technical and educational information, the primary provider of opportunity of professional growth in the arts and sciences of HVAC&R

From Idea to Funded Project!



How Research Works

- Technology Council
- Research Administrative Committee (RAC)
- TAC-Technical Committees, Task Groups & Multidisciplinary Task Groups (SSPCs can also submit a research proposal)
- Work Statements
- Research Topic Acceptance Requests (RTARs)
- Project Evaluating Subcommittee
- Project Monitoring Subcommittee



Technology Council Update

RAC-Research Administration Committee

Quick RAC Facts:

- 107 TC experts volunteered to write WSs & RTARs in Year 2013-14
- \$169k & 19 months is the average cost & duration of ASHRAE Research Projects now
- 309 Technical Committee volunteers are monitoring progress on 63 active projects
- 62% of active research projects are being conducted at universities
- 864 ASHRAE Research Projects valued at \$74.7 million started since 1960



How Research Works

- **Over 100 Technical Committees (TCs), Task Groups (TGs), and Multidisciplinary Task Groups (MTGs) divided into 10 Sections that specialize in one area of HVAC&R.**
- **Standing Standards Project Committees (SSPCs)**
- **Research Topic Acceptance Request (RTAR) submitted to RAC for approval**
- **Development of Work Statements after RTAR approval**
- **TC/TG Project Evaluating Subcommittee – Evaluates bids on RAC approved Work Statements & recommends award**
- **TC/TG Project Monitoring Subcommittee – Monitors research project as it is performed for compliance with Work Statement requirements**

Your Health

- Preventing more than 700,000 surgical site infections that occur each year
- Decreasing the spread of airborne diseases
- Improving cancer treatment methods



Your Health

- **246-RP Optimization of Cryosurgical Probes for Cancer Treatment**

Improvement of Cryosurgical probes that will provide the potential of adding medical procedures for Cryosurgery.

- **1397-TRP Experimental Investigation of Hospital Operating Room (OR) Air Distribution**

Analysis of protective thermal plume above the surgical site that will reduce the deposition of infectious particles.

Results can be applied in patient protection rooms, infection isolation rooms, and industrial clean rooms

Your Health

- **1479-RTAR Evaluation of the Impact of Monochloramine Disinfection on Legionella Colonization of Institutional Service Water System and on the Incidence of Health Care Associated Legionnaires Disease**

There are 8,000 – 18,000 LD cases/yr and 35% are health care related and have a fatality rate of 40%. Up to 75% of hospitals have contaminated water systems, aerosols generated by cooling towers, service water used in showers, faucets, and respiratory therapy equipment. The research will evaluate use of monochloramine delivery device for direct introduction into water systems that will hopefully greatly reduce health care associated LD.

Your Home and School

- Exploring whether classroom upgrades to improve temperature control and air quality improve the performance of schoolwork of children
- Searching for a greater understanding of the relationship between occupant health and ventilation rates, including offices and schools
- Lessening the risk of spoiled food by evaluating how food preservation is influenced by storage conditions



Your Home and School

- **1257-TRP Indoor Environmental Effects of the Performance of School Work by Children**

Research indicates that lowering the temperature and increasing ventilation in classrooms increases student performance by 10% to 20%. The students' performance improved mainly in terms of how quickly they worked and also how many errors were made.

- **1320-RP The Impact of Household Refrigeration Storage Conditions on Shelf-Life of Fruits and Vegetables**

Typical U.S. household discard \$2/week of spoiled food → 104 million household discard \$208 million/week or \$10.8 billion/year due to spoilage. Research will determine effects of low storage humidity, fluctuations in storage temperature and moisture condensation on shelf life of fruits & veggies.

Your Office

- **It's getting hot in here – conserving energy in hot and humid climates**
- **Selecting boilers for efficient heat use**
- **Allowing drifting temperatures to save energy**



Your Office

- **Calculating The Seasonal Efficiency of Commercial Heating Systems**

Boilers account for 42% of heating energy use in commercial sectors of the U.S. Boiler selection is based solely steady-state efficiency at full load. Research will develop software that will produce a seasonal efficiency analysis of boilers for purpose of selection of systems.

- **The Effects of Indoor Temperature Fluctuation on Occupants**

1/3 of world's energy consumption is used for heating and cooling of buildings. Research will demonstrate the effects of drifting temperatures on occupants' comfort, perception of air quality and their levels of productivity in irregular temperature situations.

Your Travel

- **2.2 billion passengers fly every year**
- **250,000 people in the air every hour of the day, 365 days a year**
- **Examining the link between cabin air quality and health**



Your Travel

- **1262-RP Relate Air Quality and Other Factors to Comfort and Health Related Symptoms Reported by Passengers and Crew on Commercial Transport Aircraft**

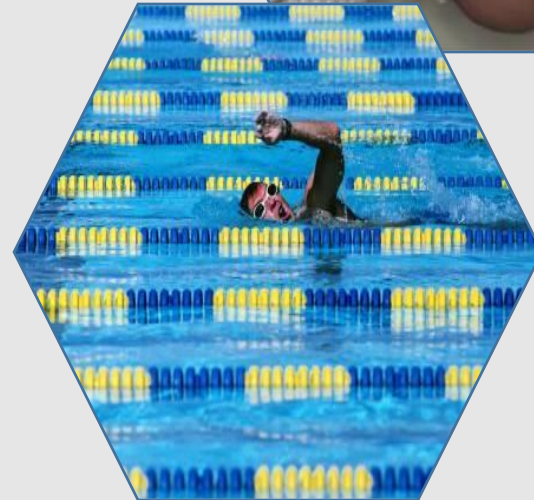
Research will examine the link between aircraft cabin air and health symptoms and discomfort experienced by passengers and crew members. Research will determine the causes of passenger and crew discomfort and use that information to make flights more comfortable.

- **1306-RP Incident-Response Monitoring Technologies for Aircraft Cabin Air Quality**

Equipment to be developed will measure the air quality on planes and may possibly be able to early detect the release of agents introduced by terrorists.

Your Other Environments

- Restaurants
- Malls
- Pools



Your Other Environments

- **1083-RP, Chemical Off-Gassing from Indoor Swimming Pools**

This project will ensure that the proper amount of ventilation air is used to remove or dilute pollutants from indoor pools because little or no data currently exists on chlorine-based chemicals. Now it is virtually impossible to design a ventilation system that addresses all pollutants generated in an indoor pool environment.

- **1376, Method of Test to Evaluate Field Performance of Commercial Kitchen Ventilation Systems**

Project will provide guidance on the use of energy efficient designs in new construction and increase energy saving modification to existing commercial kitchen ventilation systems.

Urgent Needs

- Improve equipment efficiency
- Ease of using low energy designs
- Accurately evaluate energy use
- Computer modeling



Urgent Needs

- **Increased Public Demand for Expanding the Advanced Energy Design Guides Series to More Advanced Energy Savings Objectives**
- **ASHRAE's Vision 2020 Goal of Producing Design Guidance for Affordable Net Zero Energy Buildings**
- **TRP-1457, By-Product Production from Photocatalytic Oxidation Associated with Indoor Cleaning Devices**
UV devices, in some cases, emit large amounts of unhealthy by-products such as VOCs
- **WS-1387, Thermal Energy Storage for Emergency Cooling**
Application for 911 Centers, hospitals, fire station operations after a traumatic event

Urgent Needs

- **1402-TRP, Comparison of Vertical Display Cases**
Supermarkets have one of the highest EUIs in commercial buildings. Placement of doors on these cases could save 11% -15% annual energy use but will the consumer do as much impulse purchasing with the addition of the doors?
- **1544-RP, Establishing Benchmark Levels of Commercial and Institutional Hot Water Use by End Use**
- **1604-RP, Demand Based Flow Control for Clean Rooms**
- **1180-RP, Design Guide for Duct Systems**
- **1603-RP, Role of HVAC Systems in the Transmission of Infectious Agents in Buildings and Intermodal Transportation**

Research Projects Active or Recently Completed for Region VI

- 1450-RP, Transport of Contaminants from Garage Attached or Integral to Low-Rise Residential Buildings; \$174,539, U. of Illinois-Champaign**
- 1507-RP, Binary Refrigerant Flame Boundary Concentrators; \$87,500, Safety Consulting Engineers**
- 1677-RP, Measurements and Prediction of Waterside Fouling Performance of Internally Enhanced Tubes in Cooling Tower Applications; \$169,699, U. of Illinois-Champaign**
- 1691-RP, Modeling the Impact of Residential HVAC Filtration on Indoor Particles of Outdoor Origin; \$40,988, Illinois Institute of Technology**

Research Projects Active or Recently Completed for Region VI

- **1712-RP, Development of the ASHRAE Design Guide for Dedicated Outdoor Air Systems; \$154,000, Sustainable Engineering Group**
- **GIA 13-14, Thermal Fluid Behavior of Mixed Refrigerants for Cryogenic Applications; \$10,000, U. of Wisconsin**
- **GIA 14-15, Flash Gas Bypass (FGB) for Residential Systems; \$10,000, U. of Illinois**
- **GIA 14-15, Development of Real-Time Particle Tracking Velocimetry (PTV) System for Measurement of Indoor Pollutant Transport; \$10,000, U. of Illinois**

TOTAL OF REGION VI RESEARCH & GRANTS = \$656,726

Summary of Research Promotion Funds ASHRAE and Illinois Chapter

<u>Fiscal Year</u>	<u>ASHRAE</u>	<u>Illinois Chapter</u>
2009-2010	\$2,100,000	\$31,918
2010-2011	\$2,100,000	\$22,304
2011-2012	\$2,200,000	\$29,551
2012-2013	\$2,200,000	\$35,698
2013-2014	\$2,350,000	<u>\$31,472</u>

TOTAL = \$150,943*

* Includes Matching Funds Provided by Employers

Summary of ASHRAE Research

- When FY 2014-2015 began, 62 research projects were under contract**
- Typically 20 research projects are funded each year out of a total of 40 – 50 projects having approved Work Statements**
- Grants-In-Aid – 23 were awarded last fiscal year for graduate research projects**
- The Society Research Implementation Plan has 46 projects in various stages of development (RTARs, Ws and TRPs)**
- 2014-2015 Research Budget = \$2,776,300**
- DOE is now studying the best approach to developing guidance for affordable net zero facilities (next phase of AEDGs)**

Your Role, Your Duty and Your Responsibility

“We are confronted with insurmountable opportunities”Pogo

**One Person Can Make A Difference!
(Floyd Lee & Pegasus Chow Hall
Baghdad Airport)**

HOW ABOUT YOU?

*Remember Today....For It's the
Beginning of FOREVER"*

Dante Alighieri, *Inferno*