## CONTENTS

Host Chapter, Baltimore ......................................................... viii
Program Committee and Transactions Staff ......................... viii
Keynote Address ..................................................................... xiii
Technical Program Abstracts ................................................ xvi

## TECHNICAL PAPERS

<table>
<thead>
<tr>
<th>Paper No.</th>
<th>Title</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3598</td>
<td>Experimental Performance of an Indirect Evaporative Cooler (RP-563)</td>
<td>J.L. Peterson and B.D. Hunn</td>
<td>15</td>
</tr>
<tr>
<td>3600</td>
<td>Efficiency of Odd-Tube-Pass Heat Exchangers</td>
<td>N.Y. Vaidya, N.M. Subramanian, V. Subramanian, and V.D. Rane</td>
<td>40</td>
</tr>
<tr>
<td>3601</td>
<td>Nucleate Boiling Heat Transfer of Lithium Bromide/Water Solution on a Low Finned Tube</td>
<td>M. Hou and S. Tan</td>
<td>44</td>
</tr>
<tr>
<td>3603</td>
<td>Flow of R-22 through Short-Tube Restrictors</td>
<td>S.J. Kuehl and V.W. Goldschmidt</td>
<td>59</td>
</tr>
<tr>
<td>3604</td>
<td>Measurement and Correlations of Frost Properties with Airflow Over a Flat Plate</td>
<td>Y. Mao, R.W. Besant, and K.S. Rezkallah</td>
<td>65</td>
</tr>
<tr>
<td>3605</td>
<td>Dynamic Response Factor Estimation: A Point Algebraic Method</td>
<td>A.D. Irving</td>
<td>79</td>
</tr>
<tr>
<td>3606</td>
<td>An Experimental Study of Tube-Side Fouling Resistance in Water-Chiller-Flooded Evaporators (RP-560)</td>
<td>S.I. Haider, R.L. Webb, and A.K. Meitz</td>
<td>86</td>
</tr>
<tr>
<td>3607</td>
<td>The Impact of Comfort Control on Air Conditioner Energy Use in Humid Climates</td>
<td>H.I. Henderson, Jr., K. Rengarajan, and D.B. Shirey, III</td>
<td>104</td>
</tr>
<tr>
<td>3608</td>
<td>Decentralized Control Systems for HVAC</td>
<td>M. Zaheer-uddin</td>
<td>114</td>
</tr>
<tr>
<td>3609</td>
<td>Particulars of Air Conditioning in Hot Climates</td>
<td>M.A. Abdelrahman</td>
<td>127</td>
</tr>
<tr>
<td>3610</td>
<td>Research and Development of a Home Use VAV Air-Conditioning System</td>
<td>T. Okada, T. Yoshikawa, Y. Seshimo, and H. Igarashi</td>
<td>133</td>
</tr>
<tr>
<td>3611</td>
<td>Transfer Efficiency Measures for the Study of Indoor Air Quality</td>
<td>B.A. Rock, M.J. Brandemuehl, and R. Anderson</td>
<td>140</td>
</tr>
<tr>
<td>3613</td>
<td>Market Potential Estimates and R&amp;D Planning for Advanced Absorption Systems for Large Commercial Buildings</td>
<td>J.M. MacDonald, P.J. Hughes, and H.A. McLain</td>
<td>156</td>
</tr>
<tr>
<td>3614</td>
<td>A Performance Model of an Instantaneous, Condensing, Gas-Fired Hot Water Boiler</td>
<td>S.A. Idem, A.M. Jacobi, G.M. Maxwell, and V.W. Goldschmidt</td>
<td>165</td>
</tr>
<tr>
<td>3615</td>
<td>Modeling and Simulation of a Superheat-Controlled Water-to-Water Heat Pump</td>
<td>N.B.M. Stefanuk, J.D. Aplevich, and M. Renksibulat</td>
<td>172</td>
</tr>
<tr>
<td>3616</td>
<td>Coefficient of Performance of an Ideal Absorption Cycle</td>
<td>J. Wang, X. Hu, and C. Liu</td>
<td>185</td>
</tr>
<tr>
<td>3617</td>
<td>An Analytical Screening of Alternatives for R-502 in Low-Temperature Refrigerating Applications</td>
<td>S.K. Fischer</td>
<td>188</td>
</tr>
<tr>
<td>3621</td>
<td>Absorption of HCFC-123 and CFC-11 by Epoxy Motor Varnish</td>
<td>R.G. Doerr</td>
<td>227</td>
</tr>
</tbody>
</table>
SYMPOSIUM PAPERS

BA-92-1 Air Quality and Quantity in Laboratory Animal Facilities
Animal Facility Ventilation Air Quality and Quantity by E L Besch ........................................................................ 239
A Survey of Laboratory Rat Environments by Y Zhang, L L Christianson, G L Riskowski, B. Zhang, G Taylor, H W Gonyou, and PC Harrison ........................................... 247
Conversion of a Single Floor in a High-Rise Office Building into an Animal Research Facility by RT Ellis ........................................... 254
Air Quality Evaluations of Animal Room Facilities Utilized for the Production of Laboratory Mice by W A Turner, FT McKnight, R B Jones, J M Barth, B J Paigen, J L Ohman, and M R MacDonald ........................................... 262
Evaluation of Ventilation Rates through Four Types of Rat Cages by Y Zhang, L L Christianson, and G L Riskowski ........................................... 272

BA-92-2 Airflow in Realistic Rooms—CFD and Physical Data
Correlation of Residual Velocity with Throw and Terminal Velocity from a Louver-Faced Unidirectional Diffuser by H H Yousoufian ........................................................................ 285
Isothermal Airflow Characteristics in a Ventilated Room with a Slot Inlet Opening by Y Jin and J R Ogilvie ........................................... 296
Full-Scale Experimental Results on the Mean and Turbulent Behavior of Room Ventilation Flows by J S Zhang, G J Wu, and L L Christianson ........................................... 307
Simulation of Airflow through Large Openings in Buildings by A Schaelin, J van der Maas, and A Moser ........................................... 319
Development of Three-Dimensional Thermal Airflow Analysis Computer Program and Verification Test by T Mizuno and M J Warfield ........................................... 329

BA-92-3 Measured Energy Performance of HVAC Components in Commercial Buildings
Monitored Air Handler Performance and Comparison with a Simplified System Model by S Katipamula and D E Claridge ........................................... 341
Analysis of the Dynamic Energy Performance of an HVAC System by Combining Simulations and Measurements by I Lyungkrona, E Abel, and E Isfält ........................................................................ 363
Measured Energy Consumption of Variable-Air-Volume Fans under Inlet Vane and Variable-Speed-Drive Control by D M Lorenzetti and L K Norford ........................................... 371

BA-92-4 Recent Advances in Enhanced Heat and Mass Transfer—Part I
Heat Transfer Enhancement Using Tangential Injection by VK Dhir and F Chang ........................................... 383
Air-Side Performance of Enhanced Brazed Aluminum Heat Exchangers by R L Webb and S H Jung ........................................... 391
Flow Boiling Enhancement of R-22 and a Nonazeotropic Mixture of R-143a and R-124 Using Perforated Foils by J C Conklin and E A Vineyard ........................................... 402
Convective Vaporization of Refrigerants in Tube Banks by N S Gupte and R L Webb ........................................... 411

BA-92-5 Recent Advances in Enhanced Heat and Mass Transfer—Part II
EHD Enhancement of Shell-Side Boiling Heat Transfer Coefficients of R-123/Oil Mixture by M M Ohadi, R A Papar, T L Ng, M A Faani, and R Radermacher ........................................... 427
Boiling Heat Transfer Enhancement in Tube-Bundle Evaporators Utilizing Electric Field Effects by J Ogata, Y Iwafuji, Y Shimada, and T Yamazaki ........................................... 435
Practical Design Aspects of EHD Heat Transfer Enhancement in Evaporators by P Cooper ........................................... 445
Experimental Study of Electrohydrodynamically (EHD) Enhanced Evaporator for Nonazeotropic Mixtures by A Yabe, T Taketani, H Maki, K Takahashi, and Y Nakadai ........................................... 455
EHD Boiling Enhancement in Shell-and-Tube Evaporators and Its Application in Refrigeration Plants by C Damianidis, T G Karayiannis, R K Al-Dadah, R W James, M W Colline, and P H G Allen ........................................... 462

BA-92-6 Measurement of Moisture Properties in Building Materials
Water Vapor Sorption Measurements of Common Building Materials by R F Richards, D M Burch, and WC Thomas ........................................... 475
Water Vapor Permeability Measurements of Common Building Materials by D M Burch, WC Thomas, and A H Fanney ........................................... 486
Measurement of the Heat of Adsorption for a Typical Fibrous Insulation by Y X Tao, R W Besant, and C J Simonson ........................................... 495
Apparatus for Studying Transient Heat and Moisture Transfer in Fiberglass Batt Insulation by R J Couvillion, J S Hawisa, and G J Tatge ........................................... 502
The Measurement of Moisture and Humidity
A New Moisture Permeability Measurement Method and Representative Test Data by J.S. Douglas, T.H. Kuehn, and J.W. Ramsey ................................................................. 513
Optical Noncontact Hygrometer Technology by L. D. Nelson and A. M. Kahan ......................... 520
Humidity Sensors in Heating, Ventilating, and Air-Conditioning (HVAC) Systems by R. M. Thomas ................................................................. 529

Control System Commissioning
Commissioning Building Mechanical Systems by K. M. Elovitz ................................................................. 543
DCS Commissioning for a Microelectronics Factory by P. J. Naughton ................................................................. 561
Commissioning by Committee by E. E. Friberg, M. A. Smith, and F. J. Reid ................................................................. 572

Ground-Source Heating and Cooling Systems
Large Tonnage Groundwater Heat Pumps—Experiences with Two Systems by K. D. Rafferty ................................................................. 587
An Energy-Efficient HVAC System at a High School by R. B. Stolz and R. L. Hanson ................................................................. 593
Using Existing Standards to Compare Energy Consumption of Ground-Source Heat Pumps with Conventional Equipment by S. P. Kavanaugh ................................................................. 599
Field Test of a Vertical Ground-Coupled Heat Pump in Alabama by S. P. Kavanaugh ................................................................. 607

Thermal Resistance of Fenestration Systems and Test Procedures and Uncertainty Analysis
Method of Measuring Nighttime U-Values Using the Mobile Window Thermal Test Facility by J. H. Klems ................................................................. 619
Heat Transmission and R-Value of Fenestration Systems Using IRC Hot Box. Procedure and Uncertainty Analysis by A. H. Elmahdy ................................................................. 630
Uncertainties in the Evaluation of Window SHGC and U-Values Measured Using an Indoor Solar Simulator Facility by S. J. Harrison and F. M. Dubruss ................................................................. 638

New Horizons in Refrigeration Load Calculations
Latent Heat, Equipment-Related Load, and Applied Psychrometrics at Freezer Temperatures by G. R. Smith ................................................................. 649
Calculating Refrigeration Loads on an Hour-by-Hour Basis: Part I—Building Envelope by R. N. Ballard ................................................................. 658
Calculating Refrigeration Loads on an Hour-by-Hour Basis: Part II—Infiltration and Internal Heat Sources by R. N. Ballard ................................................................. 664

SOCIETY BUSINESS

1991-92 ASHRAE Officers, Directors, Committee Members, and Staff ................................................................. 673
ASHRAE Chapter Officers ................................................................. 677
ASHRAE Technical Committees and Task Groups ................................................................. 679
ASHRAE Standards Project Committees ................................................................. 693
ASHRAE Past Meetings ................................................................. 699
Society Presidents ................................................................. 700
ASHRAE Honors and Awards ................................................................. 701
ASHRAE Intersociety Representatives ................................................................. 710
SHRAE International Associates ................................................................. 711
In Memoriam ................................................................. 712
Index of Technical and Symposium Papers, Volume 98, Part 2 ................................................................. 715