
SOLAR TECHNOLOGY FOR BUILDINGS PUBLICATIONS



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Holton, John K., "Critical Performance Standards for Passive Solar Buildings," **Proceedings of the Third Annual NBS/NCSCS Joint Conference on Research and Innovation in the Building Regulatory Process**, National Bureau of Standards Special Publication 552 (Washington, D.C.: National Bureau of Standards, July, 1979). GPO/SN 003-003-02091-5

Christopher, Patricia M. and Krzewick, Joan E., **Residential Solar Data Center Data Resources and Reports**, National Bureau of Standards Interagency Report 79-1762 (Washington, D.C.: National Bureau of Standards, June 1979). NTIS/PB 297582

Jones, Dennis E. and Hill, James E., **Testing of Pebble-Bed and Phase-Change Thermal Energy Storage Devices According to ASHRAE Standard 94-77**, National Bureau of Standards Interagency Report 79-1737 (Washington, D.C.: National Bureau of Standards, May, 1979). NTIS/PB 295898

Eisenhard, Robert M. and Santucci, Laura A., **State Solar Energy Legislation of 1977: A Review of Statutes Relating to Buildings**, National Bureau of Standards Interagency Report 79-1705 (Washington, D.C.: National Bureau of Standards, February, 1979). NTIS/PB 295642

Hill, James E., Jenkins, John P. and Jones Dennis E., **Experimental Verification of a Standard Test Performance for Solar Collectors**, National Bureau of Standards Building Science Series 117 (Washington, D.C.: National Bureau of Standards, January, 1979). GPO/SN003-003-02008-7.

Center for Building Technology Solar Team, **Interim Performance Criteria for Solar Heating and Cooling Systems in Residential Buildings**, Second Edition, National Bureau of Standards Interagency Report 78-1562 (Washington, D.C.: National Bureau of Standards, November, 1978). NTIS/PB 289967

Greenberg, Joseph, **Solar Bulding Regulatory Study**, Volume I, Government Contract Report 78-141-1 (Washington, D.C.: National Bureau of Standards, November, 1978). NTIS/PB 289823

Greenberg, Joseph, **Solar Building Regulatory Study**, Volume II, Government Contract Report 78-141-2 (Washington, D.C.: National Bureau of Standards, November, 1978). NTIS/PB 289824

Niessing, William J., **Laboratories Technically Qualified to Test Solar Collectors in Accordance with ASHRAE Standard 93-77: A Summary Report**, National Bureau of Standards Interagency Report 78-1535 (Washington, D.C.: National Bureau of Standards, November, 1978). NTIS/PB 289729

- Hunt, Bernie J., Richtmyer, Thomas E. and Hill, James E., **An Evaluation of ASHRAE Standard 94-77 for Testing Water Tanks for Thermal Storage**, National Bureau of Standards, Interagency Report 78-1548 (Washington, D.C.: National Bureau of Standards, October, 1978). NTIS/PB288793
- Waksman, David and Holton, John K., **Environmental and Safety Considerations for Solar Heating and Cooling Applications**, National Bureau of Standards Interagency Report 78-1532 (Washington, D.C.: National Bureau of Standards, September, 1978). NTIS/PB287772
- Streed, Elmer R., Thomas, William C., Dawson III, Aaron G., Wood, Byard D. and Hill, James E., **Results and Analysis of a Round-Robin Test Program for Liquid-Heating Flat-Plate Solar Collectors**, National Bureau of Standards Technical Note 975 (Washington, D.C.: National Bureau of Standards, August, 1978). GPO/SN003-003-01579-2
- Greenberg, Joseph, Berry, Sandra and Martinez, Ileana, **Building Regulatory Data Analysis - National Solar Heating and Cooling Program Progress Report - From Inception through September 30, 1977**, National Bureau of Standards Interagency Report 78-1489 (Washington, D.C.: National Bureau of Standards, June, 1978). Official distribution by author.
- Metz, F. Eugene and Orloski, Mary Jane, **State-of-the-Art Study of Heat Exchangers Used With Solar Assisted Domestic Hot Water Systems (Potential Contamination of Potable Water Supply)**, National Bureau of Standards Interagency Report 78-1542 (Washington, D.C.: National Bureau of Standards, June, 1978). NTIS/PB287410
- Waksman, David, Dikkers, Robert D., Niessing, William J., Streed, Elmer R. and Pielert, James H., **Plan for the Development and Implementation of Standards for Solar Heating and Cooling Applications**, National Bureau of Standards Interagency Report 78-1143A (Washington, D.C.: National Bureau of Standards, June, 1978). NTIS/PB283237 This publication supersedes NBSIR 76-1143.
- Waksman, David, Streed, Elmer R., Reichard, Thomas W. and Cattaneo, Louis E., **Provisional Flat-Plate Solar Collector Testing Procedures**, First Revision, National Bureau of Standards Interagency Report 78-1305A (Washington, D.C.: National Bureau of Standards, June, 1978). NTIS/PB283721 This publication supersedes NBSIR 77-1305.
- Steihler, Robert D., Hockman, Arthur, Embree, Edward J. and Masters, Larry W., **Solar Energy Systems - Standards for Rubber Seals**, National Bureau of Standards Interagency Report 77-1437 (Washington, D.C.: National Bureau of Standards, March, 1978). NTIS/PB280114
- Skoda, Leopold F. and Masters, Larry W., **Solar Energy Systems - Survey of Materials Performance**, National Bureau of Standards Interagency Report 77-1314 (Washington, D.C.: National Bureau of Standards, October, 1977). NTIS/PB273305
- Eisenhard, Robert M., **State Solar Energy Legislation of 1976: A Review of Statutes Relating to Buildings**, National Bureau of Standards Interagency Report 77-1297 (Washington, D.C.: National Bureau of Standards, September, 1977). NTIS/PB273899
- Waksman, David, Streed, Elmer R., Reichard, Thomas W., Leyendecker, Edgar V. and Masters, Larry W., **Provisional Flat-Plate Solar Collector Testing Procedures**, National Bureau of Standards Interagency Report 77-1305 (Washington, D.C.: National Bureau of Standards, September, 1977). This publication superseded by NBSIR 78-1305A.
- Center for Building Technology Solar Team, **Intermediate Standards for Solar Domestic Hot Water Systems/ HUD Initiative**, National Bureau of Standards Interagency Report 77-1272 (Washington, D.C.: National Bureau of Standards, July, 1977). NTIS/PB271758
- Dikkers, Robert D., "Standards for Solar Heating and Cooling Applications," **Research and Innovation in the Building Regulatory Process; Proceedings of the First NBS/NCSBCS Joint Conference**, National Bureau of Standards Special Publication 473 (Washington, D.C.: National Bureau of Standards, June, 1977). GPO/SN003-003-01806-6
- Kusuda, T. and Ishii, K., **Hourly Solar Radiation Data for Vertical and Horizontal Surfaces on Average Days in the United States and Canada**, National Bureau of Standards Building Science Series 96, (Washington, D.C.: National Bureau of Standards, April, 1977). GPO/SN003-003-01698-5
- Center for Building Technology Solar Team, **Proposed Technical Data Requirements for the National Solar Heating and Cooling Demonstration Program**, National Bureau of Standards Interagency Report 77-1247 (Washington, D.C.: National Bureau of Standards, April, 1977). NTIS/PB 280182

Center for Building Technology Solar Team, **Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems**, National Bureau of Standards Interagency Report 77-1226 (Washington, D.C.: National Bureau of Standards, March, 1977). Official distribution by author. This publication supersedes NBSIR 76-1059 and is superseded by HUD's "Intermediate Minimum Property Standards Supplement - Solar Heating and Domestic Hot Water Systems," 1977 Edition, Number 4930.2.

Center for Building Technology Solar Team, **Interim Performance Criteria for Solar Heating and Cooling Systems in Commercial Buildings**, National Bureau of Standards Interagency Report 76-1187 (Washington, D.C.: National Bureau of Standards, November, 1976). NTIS/PB262114

Ruegg, Rosalie T., **Evaluating Incentives for Solar Heating**, National Bureau of Standards Interagency Report 76-1127 (Washington, D.C.: National Bureau of Standards, September, 1976). Official distribution by author.

Waksman, David, Pielert, James H., Dijkers, Robert D. and Streed, Elmer R., **Plan for the Development and Implementation of Standards for Solar Heating and Cooling Applications**, National Bureau of Standards Interagency Report 76-1143 (Washington, D.C.: National Bureau of Standards, August, 1976). This publication superseded by NBSIR 78-1143A.

Streed, Elmer R., McCabe, Michael E., Waksman, David, Hebrank, Jack and Richtmyer, Thomas E., **Thermal Data Requirements and Performance Evaluation Procedures for the National Solar Heating and Cooling Demonstration Program**, National Bureau of Standards Interagency Report 76-1137 (Washington, D.C.: National Bureau of Standards, August, 1976). NTIS/PB257770

Center for Building Technology Solar Team, **Intermediate Minimum Property Standards for Solar Heating and Domestic Hot Water Systems**, National Bureau of Standards Interagency Report 76-1059 (Washington, D.C.: National Bureau of Standards, April, 1976). This publication superseded by NBSIR 77-1226.

Eisenhard, Robert M., **A Survey of State Legislation Relating to Solar Energy**, National Bureau of Standards Interagency Report 76-1082 (Washington, D.C.: National Bureau of Standards, April, 1976). NTIS/PB258235

Kusuda, Tamami, Liu, Stanley T., Bean, John W. and Barnett, James P., **Analysis of Solar Energy System for the GSA Demonstration Office Building at Manchester, New Hampshire**, National Bureau of Standards Interagency Report 76-1056 (Washington, D.C.: National Bureau of Standards, March, 1976). NTIS/PB 254179

Hill, James E., Streed, Elmer R., Kelly, George E., Geist, Jon C. and Kusuda, Tamami, **Development of Proposed Standards for Testing Solar Collectors and Thermal Storage Devices**, National Bureau of Standards Technical Note 899 (Washington, D.C.: National Bureau of Standards, February, 1976). GPO/SN003-003-01579-2

Hill, James E. and Richtmyer, Thomas E., **Retrofitting a Residence for Solar Heating and Cooling - The Design and Construction of the System**, National Bureau of Standards Technical Note 892 (Washington, D.C.: National Bureau of Standards, November, 1975). GPO/SN003-003-01549-1

Ruegg, Rosalie T., **Solar Heating and Cooling in Buildings: Methods of Economic Evaluation**, National Bureau of Standards Interagency Report 75-712 (Washington, D.C.: National Bureau of Standards, July, 1975). NTIS/COM 75-11070

Hill, James E. and Kelly, George E., **Method of Testing for Rating Thermal Storage Devices Based on Thermal Performance**, National Bureau of Standards Interagency Report 74-634 (Washington, D.C.: National Bureau of Standards, April, 1975). NTIS/COM 75-10685.

Hill, James E. and Kusuda, Tamami, **Method of Testing for Rating Solar Collectors Based on Thermal Performance**, National Bureau of Standards Interagency Report 74-635 (Washington, D.C.: National Bureau of Standards, December, 1974). NTIS/COM 75-10276

OUTSIDE PUBLICATIONS and PAPERS

- Hill, James E., "Chapter 7: Standard Procedures for Collector Performance Testing," **Solar Energy Technology Handbook**, Volume I, Part 2 (New York: Marcel Dekker, Inc., 1979).
- Jones, Dennis E. and Hill, James E., "An Evaluation of ASHRAE Standard 94-77 for Testing Pebble-Bed and Phase-Change Thermal Energy Storage Devices," **ASHRAE Transactions**, Volume 85, Part II, 1979.
- Hunt, Bernie J., Richtmyer, Thomas E. and Hill, James E., "Testing of Water Tanks for Thermal Storage According to ASHRAE Standard 94-77," **ASHRAE Transactions**, Volume 85, Part I, 1979.
- Liu, Stanley T. and Hill, James E., "A Proposed Technique for Correlating the Performance of Solar Domestic Water Heating Systems," **ASHRAE Transactions**, Volume 85, Part I, 1979.
- Masters, Larry W., Seiler, James F. and Roberts, Willard E., "Development of Standards for Evaluating Solar Absorptive Coatings," **Proceedings of the American Chemical Society/Chemical Society of Japan Chemical Congress Organic Coatings and Plastic Chemistry Subsection**, Volume 40, Honolulu, Hawaii, April 1979.
- Streed, Elmer R., Thomas, William C., Dawson III, Aaron G., Wood, Byard D. and Hill, James E., "Results and Analysis of a Round Robin Test Program for Liquid-Heating Flat-Plate Solar Collectors," **Solar Energy**, Volume 22, Number 3, March, 1979.
- Hill, James E., Jenkins, John P. and Jones, Dennis E., "Testing of Solar Collectors According to ASHRAE Standard 93-77," **ASHRAE Transactions**, Volume 84, Part II, 1978.
- Hill, James E. and Jenkins, John P., "The Application of ASHRAE Standard 93-97 to Concentrating Collectors," **Proceedings of the Conference on Concentrating Solar Collectors**, September 26-28, 1977 (Atlanta, Georgia: Georgia Tech, 1978).
- Hill, James E., "Report of the Working Group on Testing and Standards, **Proceedings of the Conference on Concentrating Solar Collectors**, September 26-28, 1977 (Atlanta, Georgia: Georgia Tech, 1978).
- Dickers, Robert D., "Solar Energy System Performance Standards and Criteria - NBS Activities," **Proceedings of the Second Solar Heating and Cooling Commercial Demonstration Program Contractors' Review** (Washington, D.C.: Department of Energy, December, 1978).
- Clark, Elizabeth J., "Development of Standards for Materials in Solar Heating and Cooling Applications," (Abstract) **Proceedings of the Second National Conference on Standards for Solar Energy Use**, New York, N.Y., September 13-15, 1978.
- Dickers, Robert D., "The ANSI Steering Committee on Solar Standards Development," (Abstract) **Proceedings of the Second National Conference on Standards for Solar Energy Use**, New York, N.Y., September 1978.
- Hill, James E., "Results and Analysis of a Round Robin Test Program for Liquid-Heating Flat-Plate Solar Collectors," (Abstract) **Proceedings of the Second National Conference on Standards for Solar Energy Use**, New York, N.Y., September, 1978.
- Streed, Elmer R., "ASTM Standards on Durability and Reliability," (Abstract) **Proceedings of the Second National Conference on Standards for Solar Energy Use**, New York, N.Y., September, 1978.
- Waksman, David, "Environmental and Safety Considerations for Solar Heating and Cooling Applications," (Abstract) **Proceedings of the Second National Conference on Standards for Solar Energy Use**, New York, N.Y., September, 1978.
- Holton, John K., "Updating Solar Performance Criteria and Standards, **Proceedings of the Seventh Annual Meeting, American Section, International Solar Energy Society**, Volume 2.1, Denver, Colorado, August, 1978.
- Stiehler, Robert D., Hockman, Arthur, Embree, Edward J. and Masters, Larry W., "Existing Standards Inadequate for Solar Collector Use," **Solar Engineering**, Volume 3, Number 8, August, 1978.

- Streed, Elmer R., "A Comparison of Flat-Plate Solar Collector Thermal Performance Data Obtained Indoors and Outdoors," **Proceedings of the Seventh Annual Meeting, American Section, International Solar Energy Society, Volume 2.1**, Denver, Colorado, August, 1978.
- Streed, Elmer R. and Waksman, David, "The NBS Solar Collector Durability/Reliability Program," **Proceedings of the First International Conference on Durability and Reliability of Building Materials and Components**, Ottawa, Canada, August, 1978.
- Liu, Stanley T., Shih, James K. and Wood, Byard D., "Experimental Validation of the Solar Simulation Program TRNSYS for a Solar Domestic Hot Water Heating System," **Proceedings of the U.S. Department of Energy Conference on System Simulation and Economic Analysis for Solar Heating and Cooling**, San Diego, California, June, 1978.
- Sav, G. Thomas, "Economics Optimization of Solar Energy and Energy Conservation in Commercial Buildings," **Proceedings of the U.S. Department of Energy Conference on Systems Simulation and Economic Analysis for Solar Heating and Cooling**, San Diego, California, June, 1978.
- Abouelezz, Mohamed, Masters, Larry W. and Waters, Paul F., "Degradation of Poly(methylmethacrylate) by Radiation," **Proceedings of the Institute of Environmental Sciences Seminar on Testing Solar Energy Materials and Systems** (Washington, D.C.: National Bureau of Standards, May 22-24, 1978).
- Skoda, Leopold F. and Masters, Larry W., "Solar Energy Systems Survey of Materials Performance," **Proceedings of the Institute of Environmental Sciences Seminar on Testing Solar Energy Materials and Systems** (Washington, D.C.: National Bureau of Standards, May 22-24, 1978).
- Ducas, William, Streed, Elmer R., Holton, John K. and Angel, William, "Thermal Data Requirements and Performance Evaluation Procedures for Passive Buildings," **Proceedings of the Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems**, Washington, D.C., April, 1978.
- Richtmyer, Thomas E., "The Use of Computer-Controlled Data Acquisition Systems in Determining Solar Heating and Cooling System Performance," **Proceedings of the Conference on Performance Monitoring Techniques for Evaluation of Solar Heating and Cooling Systems**, Washington, D.C., April, 1978.
- Ducas, William, Streed, Elmer R., Holton, John D. and Angel, William, "Thermal Data Requirements and Performance Evaluation Procedures for Passive Buildings," **Proceedings of the Second National Conference on Passive Solar Heating and Cooling**, Philadelphia, Pennsylvania, March, 1978.
- Holton, John K., "Critical Performance Standards for Passive Solar Buildings," **Proceedings of the Second National Conference on Passive Solar Heating and Cooling**, Philadelphia, Pennsylvania, March, 1978.
- Jenkins, John P. and Hill, James E., "Testing of Water-Heating Collectors According to ASHRAE Standard 93-77," **Proceedings of the International Solar Energy Society 1978 Meeting; SUN: Mankind's Future Source of Energy**, New Dehli, India, January 16-21, 1978.
- Hill, James E. and Streed, Elmer R., "Chapter 10: Testing and Rating of Solar Collectors,": **Applications of Solar Energy for Heating and Cooling of Buildings**, American Society of Heating, Refrigerating and Air-Conditioning Engineers, 1977.
- Hill, James E., Kelly, George E. and Peavy, Bradley A., "A Method of Testing for Rating Thermal Storage Devices Based on Thermal Performance," **Solar Energy**, Volume 19, Number 6, 1977.
- Holton, John D., "Establishing Technical Standards for Solar Installations," **Idea**, Volume 19, Number 1 (Manchester, New Hampshire: Franklin Pierce Law Center, 1977).
- Dikkers, Robert D., "Performance Standards and Criteria for Solar Heating and Cooling Systems,:" **Proceedings of Solar Heating and Cooling Demonstration Program Contractors' Review** (Washington, D.C.: Department of Energy, December, 1977).
- Holton, John K., "Establishing Technical Standards for Solar Installations," **Proceedings of Solar Energy Business Conference**, Washington, D.C., August, 1977.

- Center for Building Technology Solar Team, **HUD Intermediate Minimum Property Standards Supplement, 4930.2, Solar Heating and Domestic Hot Water Systems**, 1977 Edition (Washington, D.C.: National Bureau of Standards for the Department of Housing and Urban Development, July, 1977).
- Jones, Dennis E. and Hill, James E., "Testing of Flat-Plate Air Heaters According to ASHRAE Standard 93-77," **Proceedings of the American Section, International Solar Energy Society 1977 Annual Meeting; A Solar World**, Orlando, Florida, June, 1977.
- Streed, Elmer R., "Results of a Round Robin Flat-Plate Collector Test Program," **Proceedings of the Flat-Plate Solar Collector Conference**, Orlando, Florida, February, 1977.
- Hill, James E., Richtmyer, Thomas E. and Jenkins, John P., "Initial Test Results for a Solar Cooled Townhouse in the Mid-Atlantic Region," **ASHRAE Transactions**, Volume 82, Part II, 1976.
- Hill, James E. and Streed, Elmer R., "A Method of Testing for Rating Solar Collectors Based on Thermal Performance," **Solar Energy**, Volume 18, Number 5, 1976.
- Ruegg, Rosalie T., "Life-Cycle Costs and Solar Energy," **ASHRAE Journal**, November, 1976.
- Dickers, Robert D., "Development and Implementation of Standards for Solar Heating and Cooling Applications," **Sharing the Sun - Solar Technology in the Seventies; Proceedings, Joint Conference of American Society of International Solar Energy Society and Solar Energy Society of Canada**, Winnipeg, Manitoba, Canada, August, 1976.
- Holton, John K., "Establishing Communications Between NBS Solar Standards Research Program and the Building Community," **Sharing the Sun - Solar Technology in the Seventies; Proceedings, Joint Conference of American Society of International Solar Energy Society and Solar Energy Society of Canada**, Winnipeg, Manitoba, Canada, August, 1976.
- Hill, James E., "Report of the Working Group on Heat Pump and Storage System Interaction," **Proceedings of the Workshop on Solar Heat Energy Heat Pump Systems for Heating and Cooling of Buildings**, June 12-14, 1975, ERDA Report (State College, Pennsylvania: Penn State University, 1976).
- Streed, Elmer R., "A Brief Review of Material Property Measurements for Solar Collectors," **ASTM Standardization News**, August, 1975.
- Hill, James E., "Laboratory Based Activities in Solar Energy at the National Bureau of Standards," **ASTM Standardization News**, August, 1975.
- Hill, James, E., "Prospects for Solar Heating and Cooling of Buildings in the USA," **Proceedings of the U.S. - Australian Seminar on Energy Conservation in Buildings** (Durham, North Carolina: Duke University, June 9-11, 1975).
- Hill, James E., "Proposed method of Testing for Rating Solar Collectors Based on Thermal Performance," **Proceedings of the Workshop on Solar Collectors for Heating and Cooling of Buildings**, National Science Foundation Report NSF-RA-N-75-019, New York, New York, May, 1975.
- Hill, James E., "Proposed Method of Testing for Rating Thermal Storage Devices Based on Thermal Performance," **Proceedings of the Workshop on Solar Energy Storage Subsystems for Heating and Cooling of Buildings**, National Science Foundation Report NSF-RA-N-75-041, Charlottesville, Virginia, April, 1975.
- Center for Building Technology Solar Team, **Interim Performance Criteria for Solar Heating and Combined Heating and Cooling Systems and Dwellings**, (Washington, D.C.: National Bureau of Standards for the Department of Housing and Urban Development, January, 1975). GPO/SN003-003-01388-9
- Streed, Elmer R., "A Summary of Material Property Measurements for Solar Collector Components," **Proceedings of the Workshop on Solar Collectors for Heating and Cooling of Buildings**, New York, New York,, November, 1974.