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Overview of the Workshop for Hot Box Operators

The following five papers were presented at a Workshop for Hot Box Operators sponsored by ASTM Committee C-16 on Thermal Insulation and the Building Thermal Envelope Coordinating Council (BTECC) Research Coordinating Committee (RCC) on Heat and Mass Transfer. The Workshop was held with 31 in attendance in Colorado Springs, Colorado, on 28-29 March 1985, following the regular spring semiannual meeting of Committee C-16. Attendees represented 14 companies and organizations that maintain calibrated hot boxes (ASTM C 976) or guarded hot boxes (ASTM C 236).

The purpose of the workshop was to present a forum for discussion of preliminary results from a Hot Box Round Robin and for dissemination of information among hot box users. A survey among members of the BTECC RCC on Heat and Mass Transfer showed that an exchange of calibration and operating experiences among users was desirable. One objective of the workshop was to meet this need. The Workshop was divided into sessions on the results from the Round Robin on Hot Boxes, operating experiences, calibration, and testing applications. A discussion period following each group of papers enhanced the exchange of information.

Round Robin on Hot Boxes

Professor Erv Bales presented preliminary results of the ASTM Round Robin on Hot Boxes. Twenty-one laboratories measured the thermal resistance of 100-mm (4-in.)-thick polystyrene beadboard for at least two mean temperatures. Sixteen laboratories performed the measurements in a guarded hot box (ASTM C 236) and five laboratories used a calibrated hot box (ASTM C 976).

The Round Robin for Hot Boxes was conducted under the jurisdiction of ASTM Committee C-16 on Thermal Insulation. A task force was appointed by the chairman of Subcommittee C16.30 on Thermal Measurements to oversee the Round Robin. The main purpose of the Round Robin was to prepare precision and bias statements for the guarded and calibrated hot box test methods.

Unfortunately the paper on the results of the Round Robin for Hot Boxes is not yet available for publication. It is anticipated that these results will be published in a future issue of *Journal of Testing and Evaluation.* The planning and organization of the Round Robin are described in Refs *1* and *2*.

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Operating Experiences

Three papers presented on hot box operating experiences are included in this issue of *Journal of Testing and Evaluation.* Mr. Ronald Gerace presented a paper describing one laboratory's guarded hot box operating procedures, including specimen preparation, calibration, testing, data analysis, and reporting. Test procedures follow the general guidelines given in ASTM C 236 for guarded hot boxes. The calibration procedure accounts for variations in thermal conductance of the metering box walls. An experimentally determined setting for the thermopile electromotive force of the metering chamber is controlled during testing so that the net heat flow through the metering box walls is negligible.

The paper by Mr. Thomas Broderick describes design and calibration of a guard added to an existing hot box. A vertical heat flow hot box was used to measure heat flow through a variety of roof/ceiling insulations used in the steel bar joist and metal deck construction typical in commercial buildings. The sample support had to be nearly 1.22 m (4 ft) tall to accommodate sample heights. Extraneous energy flows through the support would be a substantial fraction of the sample energy flow for well-insulated samples. A thermal guard was built around the sample support to minimize losses through it. The guard consisted of a channel in which the sample was replicated and exposed to the same indoor temperature as the test condition. The channel temperature was maintained by an unmetered energy source.

Mr. R. Gerry Miller presented a paper summarizing 13 responses from a questionnaire on hot box operating techniques and procedures. Questions dealt with temperature measurement, hot box capabilities, instrumentation, baffle characteristics, calibration specimens, data collection techniques, and steady-state criteria. Based on survey results, Mr. Miller makes recommendations for improving ASTM C 236 and C 976.

Calibration

Two papers were presented on calibration procedures for calibrated hot boxes. Mr. Thomas Faison presented a paper, included in this issue, on steady-state calibration testing performed on the calibrated hot box at the National Bureau of Standards. Tests were performed on 100-mm (4-in.) and 200-mm (8-in.)-thick polystyrene wall specimens having independently measured thermal resistances.

Mr. David Ober presented a paper on a numerical analysis of flanking losses for a calibrated hot box. Flanking losses, or heat transfer through the specimen frame, are an important component of the metering chamber energy balance equation. Results of a

two-dimensional finite element analysis include effects of gaskets, surface skins, bulk insulation, and specimen construction. Mr. Ober's paper will be published in a future issue of *Journal of Testing and Evaluation.*

Applications

Four papers were presented on hot box testing applications not included in the current ASTM standards. Ms. Martha G. Van Geem presented a paper on measuring heat flow through wall assemblies subjected to dynamic or fluctuating outdoor chamber air temperatures. Laboratory procedures described include instrumentation of test specimens, derivation of dynamic temperature cycles, acquisition of test data, and presentation of results. Ms. Van Geem's paper is included in this issue of *Journal of Testing and Evaluation.*

Mr. William Goss presented a review of the status of window thermal performance measurement methods using guarded and calibrated hot boxes. The review was primarily based on material presented at the BTECC/ASHRAE/DOE Workshop on *U*-value Measurements held at NBS on 26-28 February 1985. Current test procedures used in the United States, Canada, and Europe to measure thermal transmittance of window and window treatment products were discussed. Also included were requirements for window thermal performance data by window manufacturers and users and building energy analysts, and a description of the research necessary to develop a consensus standard window thermal test method. Mr. Goss's paper will be included in a future issue of *Journal of Testing and Evaluation.*

A portable colorimeter for measuring the *in situ* thermal performance of building envelopes was described by Mr. Richard Grot. References *3* and *4* give further information on portable calorimeters used to measure heat flow through exterior walls of existing buildings. Mr. Grot's paper was not available for inclusion in this issue of *Journal of Testing and Evaluation.*

A hot box that can be readily shipped and reassembled was described by Mr. Michael Scheffler. All components are small enough to be placed in a moving van. The hot box can be operated in both the guarded and calibrated modes. Mr. Scheffler's paper is not available for publication.

Workshop Conclusions

It is anticipated that information from the Workshop for Hot Box Operators will be used to improve the ASTM guarded and calibrated hot box standards (ASTM C 236 and C 976, respectively.) Workshop participants agreed that periodic exchanges of information are helpful to hot box operators.

Acknowledgments

The Workshop for Hot Box Operators was planned by an organizing committee within ASTM Subcommittee C16.30 on Thermal Measurements, composed of the following members: Erv Bales, cochair, New Jersey Institute of Technology; Martha G. Van Geem, cochair, Construction Technology Laboratories; George E. Courville, Oak Ridge National Laboratory; R. Gerry Miller, Jim Walter Research Corporation; John Mumaw, Owens-Corning Fiberglas Corporation, and Ron Tye, Dynatech R/D Company. The cochairs wish to express their appreciation to the organizing committee, participants, and ASTM staff.

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[*1*] Bales, E. L., "Plan for a Round Robin of Hot Boxes," National Bureau of Standards Publication No. NBSIR 81-2443, Feb. 1982, 35 pp.

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[*3*] Brown, W. C. and Schuyler, G. D., "A Calorimeter for Measuring Heat Flow Through Walls," in *Proceedings,* ASHRAE/DOE Conference on Thermal Performance of the Exterior Envelopes of Buildings, Kissimmee, FL, American Society of Heating, Refrigerating, and Air-Conditioning Engineers, SP28, Atlanta, 1981, pp. 262-268.

[*4*] Grot, R. A., Burch, D. M., Silberstein, S., and Galowin, L. S., "Measurement Methods for Evaluation of Thermal Integrity of Building Envelopes," National Bureau of Standards Publication No. NBSIR 82-2605, Nov. 1982.