Workshop on Below-Grade Applications of Heat Flux Transducers—*W. C. Brown and T. Bligh*

Eight people, including the moderator and recorder, took part in the discussion at various times. The calibration of heat flux transducers was discussed extensively, and the consensus of the group was that a standard method of calibration was needed. It was felt that this method should be applicable to all sensors without precluding the possibility of further calibration *in situ* if the application required it. It was also felt that there was a need for standards for instrument definition and also for application below grade.

The following items were considered important elements to be included in the standards.

Application Standard

It was recognized that use of the transducer would probably disturb (1) conduction, (2) convection, (3) radiation, and (4) moisture flow. The first three of these items are general to all applications, while the last item is probably significant in below-grade applications.

Since heat flows are generally low in below-grade applications, a transducer with a high sensitivity is needed.

The sensors are surface mounted or embedded. Embedding the sensors was recommended, but it must be remembered that, since there is a significant three-dimensional heat flow in below-grade applications, the sensor should not be buried too deeply.

Measuring heat flow is not synonomous with measuring resistance, and this is especially true in below-grade applications.

Changes in calibration due to moisture pickup and aging should be recognized as real possibilities, especially when the transducer is subjected to the relatively more severe environment encountered below grade.

Lead-in wire corrosion may be a more severe problem in below-grade application unless care is taken.

Transient response of the meter and the surface of the test area must be recognized.

The heat flow and measurement of heat flow will probably be affected by liquid water flow.

Calibration Standard

The following are some of the items that should be included in a calibration standard:

1. Calibration should be made at low flux levels.
2. Temperatures similar to the application temperature should be used.
3. Several temperature ranges should be covered.
4. Several heat fluxes should be covered.
5. Bidirectional effects should be tested.
6. The transient response should be checked.

In addition, the thermal resistance of the transducer should be measured. Note that reference should be made to the thermal resistance or conductance of the transducer, not to the thermal conductivity.

Transducer Specification

Items to be considered in the device specifications are (1) flatness, (2) the metering area size, (3) the guard size, (4) sensitivity, (5) the transducer material, and (6) the resistance (or conductance) of transducer.

It was felt that ASTM could undertake to produce each of these standards and that they would be useful additions in the area of *in situ* measurement of heat fluxes.