Subject Index

A

Accuracy of HFTs (see Error rates/ratios of HFTs)
Air motion, effect on HFT measurements, 4, 14, 99, 108, 145, 152, 186
Aluminum
   carrying case for HFTs, 123
   jacket for HFTs, 100
   jacket insulation for pipes, 183
   support for HFTs, 186
   use in heat flowmeters/transducers, 177
   use in HFT installations, 116
   use in temperature reservoirs, 28
American Society of Heating, Refrigerating and Air Conditioning Engineers
   (ASHRAE), 150
Antenna effect, 241
Asbestos cement board, laboratory testing, HFTs, 14
ASTM Standards
   C 177-76: 4, 68, 151
   C 236-80: 68
   C 335-79: 100
   C 518-76: 68, 129
   C 976-82: 68
ASTM Subcommittee C16.30, 3, 4, 30, 254
   development of standards, 179

B

Basements (insulated/uninsulated), heat loss, 106
Belt-type HFTs, 172
Bibliography, annotated, applications of HFTs, 223-236
Brick walls, field tests of thermal conductivity, 203
Bridges, thermal (see Thermal bridges)
Buildings (see also Heat flux transducers, use in buildings)
   calibration of HFTs, 65, 106, 126, 141

C

Calibration of heat flowmeters, 164
Calibration of HFTs
   apparatus for, 27, 81, 131, 247
   ASTM Committee C-16 on Thermal Insulation, standards development, 254
   cold plate, 81
   1-d method, 245
   embedded method, 65, 244
   for use in basements, table, 109
   for use in building envelope subsystem, walls, roofs, 20, 65
   for use in house interiors, 126
   for use on roofs, 65, 131, 250, table, 134
   for use in soil, table, 109
   formulas, 26, 34, 37, 73, 84
   heated foil method, 20
   hot box, 68, 144, 248
   hot plate, 4, 68, 81, 247, 254
   in situ method, 246
   "intrinsic calibration value," 80
   MIT method, 26, 247
Calibration of HFTs (cont.)
MIT versus Hy-Cal Engineering values, table, 38
National Bureau of Standards method, 25, 109, 131
radiation enclosure technique, 26, 247
standardization, 3, 25, 254-256
workshop on methods, 245
Cellulose insulation, 129
Cold plate, use in HFT calibration, 81
Computer models (see Data processing; Finite difference computer models)
Concrete
thermal transmission, 53
time lag in HFT measurements, 5
use in HFT calibration, 69
Condensate, steam, heat loss measurements, pipe, 100
Conductivity, thermal (see Thermal conductivity; Thermal transmission)
Constantan, use in heat flowmeters/transducers, 167, 173
Contact thermal resistance of heat flux transducers (see Thermal resistance, HFT contact)
Convection, air (see Air motion)
Convective factor, calculation, 73, 146
Copper, use in heat flowmeters/transducers, 165, 173
Cover plates, for HFTs, 54-56, 131, 186
Cycles, diurnal (see Diurnal cycles)

Data processing
heat flow and temperature data, 141
HFT calibration data, 32, 33, 90
Deflection, heat flow (see also Isotherms)
errors in HFT measurements, 79
Distortion, heat flow
embedded HFTs, 45
formula, 47
table, 62
surface-mounted HFTs, 9, 79
Diurnal cycles, effect on thermal conductivity, 99, 184, 197, 201, 205, 217

Edge guarding (see Guard frames)
Edge spill, distortion effect on HFT measurements, 11
Electrical efficiency, HFT bimetallic junctions, 176
Electrical noise, pickup by HFTs, 241
Embedded HFTs (see Heat flux transducers, embedded)
Energy monitoring (see Thermal transducers, embedded)
Enthalpy, 117
Envelope, building (see Buildings; Walls; Roofs)
Environment effects on HFTs, 5, 11, 99, 113, 128, 184, 203
Equations
Fourier's, 46, 207
Laplace, 48
Philip's, 53
R-value, 5, 126, 135, 140, 203, 251
U-value, 203
Error rates/ratios of HFTs
application
in situ, 16, 23, 99, 109, 126, 140, 203, 210-214
laboratory tests, 79, 129, 198

calibration

*in situ* applications, 25, 37, 142–143

laboratory tests, 79, 142–143, 248

F

Felt, jacket insulation for pipes, 183

Fiberglass

boards, use in HFT calibration, 107

insulation

below-grade use, 108

roofs, 129, 184

walls, 203

Field testing of HFTs

Army base buildings, 140

basements of houses, 106

insulated pipe, 99, 179

occupied houses, 106, 122

roof decks, 75

in soil, 106

walls of various materials, 203

Finite difference computer models, 13, 45, 79

Foam

boards, use in HFT calibration, 107

insulation, 129

Foil, heated, calibration of HFTs, 20

Fourier's equation, 46, 207

G

Gel toothpaste, use for contact of surface-mounted HFTs, 150

Generic application standards for HFTs, 3

Glass

calibration of HFTs, 91

construction of HFTs, 177

Glass fiber (see Fiberglass)

Grease, thermal, 27, 31, 75

Guard frames

application of HFTs, 11, 17, 45, 56–59, 133, 145, 151, 179

 calibration of HFTs, 35, 79, 85, 89

Gypsum wallboard

calibration of HFTs, 144

insulation of basements, 107

use for laboratory testing, HFTs, 14

H

Heat flow (see Thermal conductivity; Thermal transmission)

Heat flowmeter, technical characteristics/performance, 166

Heat flux sensors (see Heat flux transducers)

Heat flux transducers (see also Heat flowmeter; Hy-Cal BI-7 sensors)

applications, 9, 65, 87, 99–203, 239, 250–256

annotated bibliography, 223–236

problems, table, 3

available U.S. products, table, 178

belt-wrap type, 172

calibration (see Calibration of HFTs)

construction of, 12, 23, 133, 141, 186, 241, 252

review, 172

embedded

 calibration method, 65, 245

comparison with surface-mounted, 142

roof tests, 251

error rate of (see Error rates/ratios of HFTs)

industrial use, 99, 172, 239–244
Heat flux transducers (cont.)
placement diagrams, 72, 74, 124-125, 132, 187
placement methods (see Heat flux transducers, embedded, sandwiched, surface-mounted)
residential use, 9, 106, 122, 252
response time, 18, 184, 188, 197, 203
sandwiched, 10
soil corrosion effect, 109
soil heat loss measurement, 106, 114-119
surface-mounted
environmental effects, 4, 45, 65, 99, 251
inside wall, Army base buildings, 140
inside wall, basement, 106
inside walls, occupied houses, 9, 106, 122, 252
intrinsic/extrinsic properties, table, 11
pipes, 99, 179, 239
plywood roof, 184
roofs, 129, 184, 251
thermal conductivity of, 25, 41, 79, 184
walls, 253
use in buildings
basements, 106
below grade, 106, 255
flat plywood deck roof, 184
metal deck roof, 73
metal deck roofs with spray-applied insulation, 129
occupied houses, New Zealand, 122
roofs of various materials, 184, 250
wall surfaces, indoor, 122, 140
walls of various materials, 203, 252
use in houses, 9, 106, 122, 252
use on pipes, 99, 179-183, 239
use on roofs, 5, 73, 129, 184
workshop, 250
use on walls, 203
workshop, 253
Heated foil, calibration of HFTs, 20
HFTs (see Heat flux transducers)
Hot box
ASTM Standards
C 236-80:68
C 976-82:68
use in HFT calibration, 68, 144, 248
Hot plate
ASTM Standard C 177-76: 4, 68
use in calibration of heat flowmeter, 166
HFTs, 4, 68, 81, 247, 254
Houses, use of HFTs
below grade basements, 106
New Zealand home insulation survey, 106
occupied, 9, 122, 252
wood frame construction, 106
Hy-Cal BI-7 sensors, 31

I

Ice water
 calibration of HFTs, 27
temperature reservoirs, 29
thermocouple reference, 186
Industrial use of HFTs (see Heat flux transducers, industrial use)
Insulating materials, thermal
aluminum, 183, 240
cellulose, 129
felt, 183
fiberglass, 108, 129, 184, 203
foam, 129
gypsum wallboard, 14, 107, 144
industrial use, 99, 129, 179-181, 184
polyurethane, 129
residential use, 106, 129, 184
spray-applied, 129
use on pipes in geyser fields, 181-183
"Insulating rug," HFT errors, 11
International Thermal Instrument, HFT, 31
Isotherms
  embedded HFTs, 51, 55, 143
  surface-mounted HFTs, 13

J
Jacket
  aluminum for HFTs, 100
  pipe insulation, 183, 240
Junctions in heat flowmeters
  coplanar, 163
  parallel plane, 163

L
Laminar air flow, calculation of
  convective heat transfer coefficient, 146-149
Laplace equation, 48

M
Masking tape (see Tape, masking)
Masonry walls, thermal transmission, 5, 107, 203
Massachusetts Institute of Technology (MIT)
  calibration values of HFTs, 25
Metal curtain walls, thermal transmission, 5
Models, computer (see Data processing; Finite difference
  computer models)
Models, thermal performance, 11, 129, 184
Moisture, effect on HFTs, 106, 184, 190, 250, 255

N
National Bureau of Standards, calibration of HFTs, 25, 109, 131
New Zealand Standards, house insulation, 122
Nickel, use in heat flowmeters, 165-167
Noise, electrical, effect on thermocouple signal, 24
North/south exposure, and below
  grade building heat loss, 113

O
n-Octadecane, temperature reservoirs, 28

P
Paint
  absorptivity of HFTs, 150
  calibration of HFTs, 75
Perspex, application testing of
  HFTs, 91
Philip's equation, 53
Photoetching, construction of heat
  flowmeters, 164
Pipe
  insulation, 99, 183, 239
  type/location, HFTs, 172, 239
Plywood deck roofs, thermal conductance, 184
Polyimide film, use in heat flowmeters/transducers, 177
Polystyrene
  application testing of HFTs, 14
  calibration of HFTs, 30, 69
  thermal resistance of HFTs, 27, 30, 69
Polyurethane insulation, 129
R.

Radiation
enclosure technique for calibration of HFTs, 26, 36, 247
heat transfer, 140
solar, 117, 253
Reservoirs, temperature, 26
Residential use of HFTs (see Heat flux transducers, residential use)
Resistance, contact, calibration of HFTs, 17, 27, 42
Resistance, thermal (see Thermal resistance)
Response time (see also Thermal lag) 18, 35, 184, 188, 197, 203
Roofs
concrete deck
thermal lag in HFT measurements, 5
thermal transmission, 5
installation of HFTs, 74, 124
metal deck
calibration of HFTs, 67, 129
thermal transmission, 73
plywood, thermal conductivity of, 184
spray-applied insulation, 129
steel deck
thermal lag in HFT measurements, 5
thermal transmission, 5
workshop on HFT applications, 250
R-values (see also Thermal resistance)
formulas, 5, 126, 135, 140, 203, 251
insulated pipes in geyser field, table, 183
insulated/uninsulated Army base buildings, 140
insulated/uninsulated walls, 203
occupied houses, 11, 122
spray-applied insulating materials, 129
S
Sandwiched HFTs, installation method, 10
Seasonal effects, 102, 103, 113, 116, 128, 184, 201
Sensors, heat (see Heat flowmeters; Heat flux transducers)
Silver, in heat flowmeters/transducers, 173
Snow, as ground insulation, 116
Soil, thermal conductivity, 114-119
Spray application of insulation, 129
Standards for HFTs
ASTM Subcommittee C16.30, 3, 254
calibration, 3, 254
development for applications, 239-256
National Bureau of Standards, 25, 109, 131
Steel, thermal transmission, 5, 53
Studs, thermal conductivity of walls, 210
Styrofoam
application testing of heat flux transducers, 91
use for thermal resistance, 27, 29
Surface air motion (see Air motion)
Surface mounting of HFTs (see Heat flux transducers, surface-mounted)
T
Tape, masking, absorptivity of, 150
Tellurium, in heat flowmeters/transducers, 173
Temperature
  air, 15, 71, 99, 115, 184, 203
  ambient and HFT measurements,
    table, 103, 104, 134-136
  dependence of HFT signal, 105
  ground surface, 115
  HFT surface, 56
  indoor, 127, 203
  insulation, 184
  pipe
    surface, 99
    temperature versus heat flow,
      table, 183
  soil, 118
  substrate surface, 71
  wall surface, 108, 203
Temperature reservoirs, 26
Thermal bridges, 123, 133, 205
Thermal conductivity (see also
  Thermal transmission; U-value)
  fiberglass, 131, 184
  flat roofs, 184
  formulas, 184
  of HFTs, 41, 45, 53, 79, 87, 142
  plywood in roofs, 184
  ratio, slope, and transfer function
    calculation methods, 184
  soil, 114
  various materials, 87, 129, 144
    table, 53, 210
Thermal efficiency of HFTs, 176
Thermal insulating materials (see
  Insulating materials, thermal)
Thermal lag, HFTs, 18, 184, 188, 197, 203
  table, 5
Thermal resistance (see also
  R-values)
  cellulose, table, 136
  fiberglass, table, 136
  HFT contact, 87, 151
  polystyrene, 27
  polyurethane, table, 135
  Styrofoam, 27
Thermal transmission (see also
  Thermal conductivity; Thermal
  resistance)
ASTM Standards
  C 177-76, 68
  C 236-80, 68
  C 518-76, 68
  C 976-82, 68
  calibration of HFTs, 68
  metal curtain walls, 5
  metal roof decks, 73
  occupied houses, 11, 106, 122
Thermocouples (see also Heat flux
  transducers, construction of)
  soil temperature measurement, 108
  thermal conductivity, roof, 184
Thermopiles, Gier-Dunkle, 173
Thickness of heat flowmeters/transducers, 164, 177 (see also
  Heat flux transducers, construction of)
Transfer function, in thermal conductivity measurements, 184
Turbulent air flow, effect on convective heat transfer coefficients, 146-149

U
  U-value
    formula, 203
    insulated/uninsulated walls, 203

V
  Vapor transport, soil, 106, 115, 117

W
  Walls
    brick, field tests of thermal conductivity, 203
Walls (cont.)
effect of material on heat flux
transducer error ratios, 87
gypsum wallboard, calibration of
HFTs, 144
heat capacity, 87
installation of HFTs, 124-125
masonry
field tests of thermal conductivity, 203
heat loss, 5, 107, 203
thermal lag in HFT measurements, 5
thermal transmission, 5
metal curtain
thermal lag in HFT measurements, 5
thermal transmission, 5
wood cavity
thermal lag in HFT measurements, 5
thermal transmission, 5, 140
workshop on HFT applications, 252
Weather (see Seasonal effects)
Wind (see also Air motion)
effect on HFT measurements, 101
Winter, effects on heat flow, 116, 128, 201
Wood walls, thermal transmission, 5, 140
Wraparound HFTs, 172

Z

Zero offset, HFTs, 241, 248