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Heat Transfer in a Compact Heat Exchanger Containing Rectangular Channels and Using Helium Gas

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Nomenclature

a - coefficient of Re in Nu vs Re and Pr correlation
A - inlet manifold location
A_c - channel normal area - $h_c w_c$
A_f - flow normal area - $n h_c w_c$
A_n - specimen normal area - $L \cdot W$
A_w - wetted wall area (total wall area exposed to fluid) - $2n(w_c+h_c)L$
b - coefficient of Pr in Nu vs Re and Pr correlation
B - outlet manifold location
c - leading coefficient in Nu vs Re and Pr correlation
c_p - specific heat at constant pressure
D_h - specimen hydraulic diameter - $2w_c h_c/(w_c+h_c)$
f - friction factor
f_q - heat flux distribution function
G - mass flow rate per unit flow normal area in channel - $\dot{m}_c/A_c = \rho V$
h - heat transfer coefficient
h - enthalpy
h_c - height of channel
k - thermal conductivity
L - heated length of specimen
$\dot{m}$ - mass flow rate
$\dot{m}_c$ - mass flow rate per channel
n - number of channels
Nu - Nusselt number - $h \cdot D_h/k$
Nu_m - modified Nusselt number - $Nu \cdot (T_w/T_f)^{0.55}$
P - pressure
Pr - Prandtl number - $\mu \cdot c_p/k$
q_n - local normal heat flux
Q_{px} - fraction of total heat flow on specimen added up to position x
- integration of furnace calibration function f_q, 0 to x
Q_T - total heat transfer to specimen
q_w - local heat flux (heat flow per unit area) into the cooling fluid based on total wetted-wall area of the specimen
r - recovery factor - $Pr^{1/3}$ for turbulent flow
Re - Reynolds number - $\rho V D_h/\mu$
T - temperature
T_{aw} - cooling fluid adiabatic wall temperature
T_f - local bulk fluid temperature
T_w - specimen wall temperature
V - velocity
V_f - heater voltage
W - width of specimen
w_c - width of channel
W_f - uncertainty in friction factor
W_h - uncertainty in heat transfer coefficient
W_{nu} - uncertainty in Nusselt number
W_{qt} - uncertainty in total heat transfer
W_{re} - uncertainty in Reynolds number
W_{tf} - uncertainty in fluid temperature
W_{tw} - uncertainty in wall temperature

x - position coordinate parallel to flow direction
y - position coordinate perpendicular to flow direction

β - coefficient of thermal expansion
μ - dynamic viscosity
ν - kinematic viscosity
ρ - density

0 - location where heating begins (x/L=0)
1 - location where heating ends (x/L=1)

Heat Transfer in a Compact Heat Exchanger Containing Rectangular Channels And Using Helium Gas

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Abstract

We have constructed a compact heat exchanger consisting of 12 parallel, rectangular channels in a flat piece of commercially pure nickel. This channel specimen was radiatively heated on the top side at heat fluxes of up to 77 W/cm^2, insulated on the back side, and cooled with helium gas flowing in the channels at 3.5 to 7.0 MPa and Reynolds numbers of 1400 to 28 000. The measured friction factor was lower than that of the accepted correlation for fully developed turbulent flow, although our uncertainty was high due to uncertainty in the channel height and a high ratio of dynamic pressure to pressure drop. The measured Nusselt number, when modified to account for differences in fluid properties between the wall and the cooling fluid, agreed with past correlations for fully developed turbulent flow in channels. Flow nonuniformity from channel-to-channel was as high as 12% above and 19% below the mean flow.

Key words: apparatus; compact heat exchanger; convection heat transfer; friction factor; high temperature; National Aerospace Plane; radiative furnace; rectangular channel; turbulent flow; variable property effects.

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1. Introduction

Development of a National Aerospace Plane (NASP), which will fly at hypersonic speeds, requires novel cooling techniques to manage the anticipated high heat fluxes on various components (Shore, 1986). The problem that motivates this work is cooling of the engine struts. Due to aerodynamic heating associated with the combustion of the hydrogen fuel, along with thermal radiation from the fuel combustion, the engine struts are expected to receive a normal heating load in excess of 2000 W/cm^2 (Scotti et al., 1988). NASA plans to cool the struts by attaching a cooling jacket heat exchanger to the surface facing the high heat flux. Hydrogen gas will flow through the cooling jacket and absorb the heat before entering the engine. The anticipated conditions are that the hydrogen gas will enter the heat exchangers at 56 K and 6.9 MPa (1000 psi), and exit at 890 K and 4.8 MPa (700 psi). The heat exchangers are expected to be thin (6 mm or less) perpendicular to the flow direction to add minimal weight and thickness to the struts. Small flow passages will also produce high rates of convective heat transfer, which will reduce the exchanger temperatures. Reynolds numbers are expected to be in the range 10 000 to 30 000, with the variation due to the flow rate and the specific design of the flow passage.

In order to test heat exchangers developed by NASA, we constructed an apparatus which can provide helium gas flow and a well-characterized heat flux to a heat exchanger specimen (Olson, 1989). This apparatus was first used to test a "tube specimen", which consisted of 20 nickel tubes, 1 mm ID, lying in parallel on a nickel base plate (Olson and Glover, 1990). For turbulent flow in the tube specimen and normal heat flux of up to 54 W/cm^2, the Nusselt numbers we measured were in good agreement with the Nusselt numbers for flow in a single tube with well-characterized boundary conditions. In this work we present the experimental results of a second possible heat exchanger configuration for the NASP cooling jacket. We also describe a modification to the flow apparatus, namely a new furnace, which reduced the experimental time constant. The specimen tested here has 12 parallel rectangular channels through which the helium flows. A rectangular channel has been proposed as a possible configuration for the NASP cooling jacket (Scotti, et al., 1988); the flow passage geometry of our specimen was chosen for ease of fabrication and instrumentation rather than for optimal thermal performance. The length and width of the specimen, flow manifold connections, and instrumentation were identical to those of the specimens to be constructed by NASA.

2. Description of experimental apparatus

The description which follows is based on Olson (1989) and Olson and Glover (1990). The apparatus was designed to test a subset of the conditions required for the NASP application. Those conditions are (1) a heating rate of 0 to 80 W/cm^2; (2) an inlet temperature of 300 K; (3) a cooling-gas pressure of up to 6.9 MPa at the inlet; and (4) an outlet temperature of 810 K or less. We chose helium as the coolant gas because of the similarities in specific heat, thermal conductivity, and dynamic viscosity to the corresponding properties of hydrogen. In addition, helium does not have the explosive hazard of hydrogen. Because of the property similarities, the Reynol number, Prandtl number, and temperature rise from specimen inlet to outlet can be matched between helium and hydrogen.

ı ·, apparatus

The helium flow apparatus is shown in figure 1, with the details of the specimen furnace section in figure 2. Helium gas at 17 MPa (2500 psi) or less was supplied from a tube trailer outside the laboratory. The tube trailer contained 1100 m^3 of gas (STP). With valves 1 and 2 open, gas flowed from the trailer, through the inlet piping, and was filtered before entering the dome-loaded pressure regulator (valve 3). The regulator set the flow pressure downstream of the regulator to the value of an external control pressure, either 7 MPa or 3.5 MPa (500 psi) for these experiments.

Within the furnace (fig. 2), the gas flowed into an inlet distribution manifold which directed it to the heat exchanger specimen. A similar distribution manifold collected the gas exiting the specimen and directed it to the outlet tubing. Gas pressure was measured at the pressure taps as shown at location 0 (start of heated zone) and at location 1 (end of heated zone). The specimen was located in the target area of the furnace (7.8 cm wide by 15.2 cm long), which delivered radiant heat to the specimen and raised the temperature of the helium as it flowed through the specimen.

The furnace consisted of a high-intensity infrared radiant heater, surrounded by highly reflective walls which reflected the heat from the heater to the specimen. The reflective walls were made of 6.4 mm thick aluminum plates, polished on the inner surface, with a water-cooled cooling jacket soldered to the outside. This "reflective furnace" replaced the furnace of refractory walls which had been used for tests on the tube specimen (Olson and Glover, 1990). The heater contained six high-temperature infrared lamps mounted in an aluminum housing. A phase-angle power controller which used 480 VAC, single phase, and 75 A at maximum voltage powered the heater.

Downstream of the furnace section, the hot gas flowed through a cooling coil immersed in a water bath. The rate of gas flow was manually adjusted at the bath outlet by valve 4, which also dropped the gas pressure to atmospheric pressure. Beyond the valve, we measured helium flow rate with a heated-tube thermal mass flow meter. After exiting the flow meter the gas was vented outside the laboratory.

2.2 Channel pecimen

The channel specimen is shown in figure 3. It consisted of 12 parallel flow channels milled in a lower plate of commercially pure nickel (UNS 02200), with a cover plate of the same nickel brazed to it. The gas was directed into the channels by the inlet manifold, flowed down the channels, and was collected in the outlet manifold. Heating was from the top in figure 3. The channel width and height were 3.18 mm and 0.56 mm, respectively. The ridge between channels was 3.18 mm wide. The lower plate was 3.12 mm thick and the cover plate was 1.93 mm thick, for a total thickness of 5.05 mm. The specimen was 7.86 cm wide and 19.1 cm long. The pressure taps were tubes, 1.5 mm OD and 1.0 mm ID, brazed into holes penetrating one of the channels.

The cover and base plate were cut to size and the channels milled at NIST. The cover plate was brazed to the base plate at NASA Langley Research Center in a vacuum oven using a braze alloy foil of 50% gold, 25% palladium, and 25% nickel (AMS-4784, 1394 K liquidus). Prior to brazing, the inner facing surface of both plates was lapped to a flatness of ±0.01 mm. Figure 4 shows a sketch of an x-ray of the specimen after brazing. The figure shows that large braze fillets formed in 4 of the 12 channels, which partially occluded the flow passages.

The assembled specimen was brazed to slots in the inlet and outlet manifolds using a braze alloy of 82% gold and 18% nickel (AMS-4787, 1223 K liquidus). The pressure tap tubes were brazed to the specimen during the same braze cycle. We pressurized the manifold and specimen to 10.3 MPa (1500 psi) prior to installing the instrumentation, and there were no leaks. We painted the top side of the specimen (the cover plate side) a flat black over the 15.2 cm length, to establish a uniform and highly absorptive surface over the heated area. The paint was rated to 1000 K (1350 °F).

2.3 Instrumentation

We measured the temperature of the gas in the inlet and outlet manifolds, gas pressure in the specimen, specimen temperatures, and the aforementioned gas flow rate. The measurement technique and uncertainties, along with the gas property uncertainties, are summarized in table 1.

We determined the distribution of heat flux on the specimen by calibrating the furnace prior to inserting the specimen. The heat flux distribution was defined as the local, normal (perpendicular) heat flux as a function of position over the furnace target. The heat flux was constant in the direction perpendicular to flow (y), and varied by no more than ±7% in the direction parallel to flow (x) except within 6% of the end walls. Details of the furnace calibration are found in appendix A.

The gas inlet and outlet temperatures were measured with platinum resistance thermometers (PRTs), 4.8 mm diameter, inserted in the gas manifolds at locations A and B of figure 2. We measured the gas pressure at location 0 in the specimen with a variable-reluctance pressure transducer which had an output of 8.6 MPa full scale. Difference in pressure between locations 0 and 1 in the specimen was measured with a differential pressure transducer, also a variable-reluctance type with an output of 140 kPa (20 psi) full scale.

We measured specimen temperatures with thermocouples made from type-N wire, with a wire diameter of 0.25 mm. We spot-welded 25 thermocouples to the side opposite the radiant heat flux (insulated-side). The heated-side temperature was measured at 7 locations with type-N thermocouples mounted as shown in figure 3. Two holes, 0.33 mm diameter, were drilled 1.27 mm on-center through the ridge between the channels. The holes were back-drilled to within 0.20 mm of the surface with a 0.57 mm diameter drill. We spot-welded each wire of the pair to the heated surface, with the lead extending out the hole on the insulated side. The thermocouple circuit was completed by the specimen material between the two wires. A quartz sleeve, 0.48 mm outer diameter, was inserted over the wire into the hole to electrically insulate the wire from the wall of the hole. Because a portion of the specimen was removed and replaced by wire plus quartz, both of which had a thermal conductivity lower than that of the specimen, mounting the thermocouple locally increased the specimen temperature. We estimated the magnitude of this temperature rise from a finite-element analysis as 2-5 K at a radiant heat flux of 50 W/cm². Temperatures measured with the insulated-side thermocouples were used to determine the heat transfer coefficient, as the installation technique did not disturb the specimen temperatures and conduction errors were insignificant.

All thermocouples were connected to an isothermal reference box. We measured the temperature of the reference box with a platinum resistance thermometer. Copper conductor wire connected the reference box to the data scanner. The connector box introduced negligible error in the temperature measurement (Olson, 1989).

All instrument signals were multiplexed through an automated scanner and measured with a digital voltmeter. The scanner and voltmeter were controlled with a personal computer through an IEEE-488 bus. Raw signals were stored on a hard disk and copied to floppy disk for backup. Signals were converted to SI units and the data analyzed at the completion of an experimental run. Some signal readings were converted immediately to SI units and displayed on the video terminal to assist in monitoring and operating the experiment. We have included the measurement uncertainties introduced by the data acquisition system in the stated uncertainties of each sensor.

3. Description of experiments and analysis techniques

3.1 Experiments conducted

A conditions for the nine experiments conducted with the channel specimen in the helium flow apparatus are summarized in table 2. Also listed are the values for the geometrical parameters required for the data analysis. Table 3 lists values for all the measured and calculated parameters at each data point for each experiment. Tests were conducted at system pressures of either 3.5 MPa (500 psi) or 7.0 MPa (1000 psi). In experiments 1 and 2, we tested a range of helium flow rates, without heating the specimen, to determine the friction factor. In experiments 3 to 9, we varied the heater lamp voltage to vary the rate of specimen heating; at each heating rate a range of helium flow rates was tested up to 41 kg/h. The range in Reynolds number was 1400 to 28 000, while the range in normal heat flux was 0 to 77 W/cm^2 (68 Btu/(s·ft^2)). The minimum inlet gas temperature was 291 K (64°F), while the maximum gas outlet temperature was 710 K (818°F). The maximum specimen temperature we measured was 784 K (951°F).

Because of the high heat fluxes generated by the furnace, we carefully followed a procedure to prevent overheating the specimen during experimental set-up, run, and shut-down. With inadequate helium flow to cool the specimen, the furnace is capable of heating the specimen beyond the melting point of the brazing alloy and the nickel; with an internal pressure of 3.5 MPa or greater this could easily rupture the specimen. We always started helium flow before turning on the furnace, and we maintained helium flow after the furnace was turned off. To set an experimental point, we closed valves 1 and 2, set the control pressure on valve 3, and cracked open valve 4 (see fig. 2). We opened valve 1 and verified that the tube trailer pressure was at least 25% above the desired system pressure. Then, we slowly opened valve 2 to full open to establish the helium flow. Valve 4 was adjusted to set a flow rate of at least 5 kg/h. Next, we turned on the furnace heater lamp to a low voltage (10%) while monitoring temperatures. The lamp voltage was then turned up to the desired setting, and the helium flow was increased if necessary to provide sufficient cooling.

Before taking the first data point, we waited at least 15 minutes with the heater lamp at steady power to allow the specimen and manifolds to reach thermal steady-state. The reflective furnace reached thermal steady-state in about 5 min, but the outlet manifold had a longer time constant due to its large thermal capacitance. We scanned the sensors at least twice at each setting. After sampling all the sensors, we changed the helium flow rate by adjusting valve 4. At each new flow rate, we waited a minimum of 5 min to establish thermal steady-state before taking data, because a change of flow rate also affected gas, specimen, and manifold temperatures. After we finished taking data at one heater setting, we turned off the heater and reduced the helium flow to 5 kg/h or less. We turned off the helium flow when the furnace had cooled sufficiently, usually after about 10 min.

An unsteady experimental setting could translate into errors in the calculated performance parameters. In the data analysis to follow, we have assumed the settings were sufficiently steady to ignore thermal transients. A steady setting was established by maintaining constant helium flow, gas pressure, furnace heating, and gas inlet temperature. All were held steady to within the uncertainty in the calibrations of the measurements. In the tube specimen tests (Olson and Glover, 1990), we observed the inlet gas temperature to decrease due to gas expansion. Because the present experiments were conducted in summer, the tubing between the helium supply trailer and the laboratory provided sufficient heat transfer to maintain a constant gas inlet temperature.

For the experiments conducted, we analyzed the data to determine the heat transfer coefficient, h, and the friction factor, f. The heat transfer coefficient was expressed as a dimensionless number, the Nusselt number, Nu. A modified Nusselt number, Nu_m, was calculated to include the effects of variations in thermophysical properties, which we found to be significant in the tube specimen experiments. Nu and Nu_m were correlated with the Reynolds number, Re. The parameters h, Re, and Nu were calculated at each location of an insulated-side thermocouple.

3.2 Friction factor

The friction factor results from an integration of the one-dimensional momentum equation in the flow direction:

$$P_0 - P_1 = G^2(1/\rho_1 - 1/\rho_0) + (2G^2/D_h)\int_0^1 (f/\rho)dx, \qquad (1)$$

where P = pressure;
G = mass flow rate in channel where pressure taps are located per unit flow normal area
$= \dot{m}_c/A_c = \rho V$;
$\dot{m}_c$ = mass flow rate in channel;
ρ = density;
A_c = channel normal area $= h_c w_c$;
V = velocity;
D_h = hydraulic diameter;
n = number of channels;
0 = location of upstream pressure tap ($x/L = 0$);
1 = location of downstream pressure tap ($x/L = 1$).

The first term on the right hand side of the equation is the pressure change due to flow acceleration, and the second term is the pressure drop due to frictional effects. Temperatures measured perpendicular to the flow direction for experiments with heating indicated that the flow was not evenly distributed in the 12 channels. The flow in the channel with the pressure taps was determined by the method described in appendix B.

If the change in density is small compared to the absolute density, and the pressure drop through the specimen is linear, then the integral can be approximated as a constant and the resulting equation for f is

$$f = \frac{P_0 - P_1 - G^2(1/\rho_1 - 1/\rho_0)}{2(G^2/\rho)\cdot(L/D_h)}, \tag{3}$$

with $\rho = (\rho_0 + \rho_1)/2$.

The density-change criterion was met when there was no heating, but when the specimen was heated the exit density was as small as half the entrance density, and eq (3) was not valid. Hence, the friction factor was determined for the tests with no heating as a function of Reynolds number, where

$$Re = \rho V D_h/\mu. \tag{4}$$

To determine whether specimen heating had an effect on the friction factor, eq (1) was integrated in a summation form from the inlet to outlet to predict the pressure drop $P_0 - P_1$, for the experiments with specimen heating. The integral was evaluated at each location where wall temperature was measured, with f found from the f-vs-Re correlation of experiments 1 and 2 and the local density found from the gas temperature and pressure. This predicted pressure drop was compared with the measured pressure drop.

3.3 Heat transfer coefficient

The heat transfer coefficient, h, is defined through the equation

$$q_w = h\cdot(T_w - T_{aw}), \tag{5}$$

where q_w = local heat flux (heat flow per unit area) into the cooling

fluid based on total wetted-wall area of the specimen;
h - heat transfer coefficient;
T_w - specimen wall temperature;
T_{aw} - adiabatic wall temperature of the cooling fluid.

The adiabatic wall temperature is used in gas flows whenever the kinetic energy is significant compared to enthalpy changes (Rohsenow and Choi, 1961). Friction can cause the local wall temperature to exceed the bulk fluid temperature for an adiabatic specimen, and the adiabatic wall temperature approximates this effect. It is defined as

$$T_{aw} = T_f + rV^2/(2c_p), \tag{6}$$

where T_f = local bulk fluid temperature;
r = recovery factor = $Pr^{1/3}$ for turbulent flow.

Adiabatic heating was as much as 2 K, and was greatest for the low pressure experiments at high flow rate and high heating rate. The local heat flux in eq (5) is expressed in terms of the total heat transfer to the specimen, Q_T, the total wetted wall area, and the furnace calibration function, f_q (Olson, 1989), which is a dimensionless expression of the local normal heat flux:

$$q_w = (Q_T/A_n) \cdot f_q \cdot (A_n/A_w), \tag{7}$$

with A_w = wetted wall area = $2n(w_c+h_c)L$;
A_n = specimen heated normal area = $L \cdot W$.

The function f_q is on the order of 1, and if the heat flux were constant then f_q would be 1 everywhere. The wall temperature used in eq (5) was measured with the thermocouples on the insulated side of the specimen. We have assumed that wall conduction was negligible both in the flow direction (x) and perpendicular to the flow direction (y), and thus that at each position the heat incident on the specimen is all convected into the fluid.

The heat transfer coefficient, h, is defined in terms of the temperature of the insulated wall, because that temperature was measured with the least uncertainty. We desire to compare our results to the literature where h is defined in terms of a solid-fluid interface temperature. Because the specimen was heated from one side only and the solid thermal conductivity was finite, specimen temperatures will vary between the heated side, the insulated side, and the solid-fluid interface. However, because the Biot number (ratio of wall conduction resistance to fluid convection resistance) was less than 1, temperature variations in the specimen should be much less than the temperature difference between the wall and the fluid. A finite-element conduction analysis using anticipated values of the heat transfer coefficient indicated that the wall temperature (at the solid-fluid interface) varied from 6.5 K greater than to 9.5 K less than the insulated side temperature (for 50 W/cm^2 hot side heat flux and $h = 6400\ W/(m^2 \cdot K)$). This compares with a temperature difference between the wall and bulk fluid of at least 67 K for the same conditions. No attempt was made to extrapolate the measured insulated-side temperature to a solid-fluid interface temperature.

Combining eqs (5), (6) and (7) and rearranging, we get

$$h = \frac{(Q_T/A_w)\cdot f_q}{\{T_w-[T_f+(rV^2)/(2c_p)]\}}. \tag{8}$$

The flow-direction energy equation was used to calculate Q_T (to follow). Gas temperature T_f was calculated using the flow-direction energy equation along with the furnace calibration (also to follow).

The total heat absorbed by the specimen was calculated from the temperatures of the gas inlet and outlet, the helium flow rate, and the gas pressure drop. It was not necessary to adjust for a heat leak to or from the furnace, as the low temperatures of the reflective furnace made the term negligible. In our previous work with the tube specimen, the heat leak was 2 to 5% (Olson and Glover, 1990).

$$Q_T = \dot{m}(h_B-h_A), \tag{9}$$

where h = enthalpy;
A = location in inlet manifold of PRT;
B = location in outlet manifold of PRT.

We neglected kinetic energy changes from A to B because they were insignificant compared to the uncertainties of the temperature measurement. The change in enthalpy is given by

$$h_B-h_A = c_p\cdot(T_B-T_A) + \int_A^B[(1-\beta T)/\rho]dP, \tag{10}$$

where β = coefficient of thermal expansion.

The specific heat is constant for helium for the range of conditions tested. The pressure term was included to account for the slight divergence from the ideal gas state for helium at these temperatures and pressures. The pressure at A and B is estimated by assuming a linear drop along the specimen and extrapolating the pressure from 0 and 1. This assumption introduces less than 0.1% error in Q_T. The integral was evaluated using the virial equation of state for the gas (McCarty, 1973). Combining eqs (9) and (10) yields for Q_T:

$$Q_T = \dot{m}\cdot\{c_p\cdot(T_B-T_A) + \int_A^B[(1-\beta T)/\rho]dP\}. \tag{11}$$

The fluid temperature, T_f, was calculated by integrating the flow energy equation from the inlet manifold up to the location of interest (designated as x), now including kinetic energy:

$$T_{fx} = T_A + \frac{Q_T/n\cdot Q_{px}}{\dot{m}_c\cdot c_p} + \frac{\int_A^x[(1-\beta T)/\rho]dP}{c_p} - \frac{V_x^2}{2c_p}, \tag{12}$$

where Q_{px} = fraction of total heat flow on specimen added up to position x;
= integration of furnace calibration function f_q, 0 to x.

Since the transverse temperature measurements for heated experiments indicate the flow has not split evenly into the 12 channels, we calculate a local channel flow rate according to appendix B. The fluid temperature requires the velocity at x, given by

$$V_x = \dot{m}_c/(A_c \rho_x). \tag{13}$$

The density is given by the equation of state (McCarty, 1973) as

$$\rho_x = \rho_x(T_{fx}, P_x). \tag{14}$$

We assume the pressure varies linearly between 0 and 1:

$$P_x = P_0 - (P_0 - P_1)\cdot x/L. \tag{15}$$

The maximum error in T_f introduced by our assumption of a linear pressure variation is less than 0.02 K.

With eq (15) substituted into eq (12) to evaluate the pressure term, eqs (12), (13), and (14) form a system of three equations in the unknowns of temperature, velocity, and density. They were solved through iteration.

With T_f and V determined at location x, the heat transfer coefficient was calculated using eq (8). The Nusselt number, Prandtl number, and Reynolds number were then calculated, with the transport properties evaluated at the bulk fluid temperature, T_f:

$$Nu = h\cdot D_h/k,$$
$$Pr = \mu\cdot c_p/k. \tag{16}$$

Transport properties were calculated from the functions given in McCarty (1972). The Nu, Pr, and Re performance parameters assume constant fluid properties at the location x. Due to the large wall-to-fluid temperature difference, viscosity and thermal conductivity varied between the wall and the fluid (variation was as much as 26% for the lowest helium flow in experiment 8). We used the temperature ratio method of Rohsenow and Hartnett (1973) to correlate the data by calculating:

$$Nu_m = Nu\cdot(T_w/T_f)^{0.55}. \tag{17}$$

Nu_m was then correlated with Re.

3.4 Uncertainty analysis

Uncertainties for the calculated quantities were obtained by Taylor-series error propagation as described by ASME (1986) This technique generally produces the same level of confidence in a calculated result as the level of confidence in the measurements which contribute to the result (Kline and McClintock, 1953). A summary of the uncertainties in the data analysis parameters and in the calculated quantities is listed in table 4. Actual values at the experimental points are included in table 3. The largest contributor to the uncertainties in T_f, h, and Nu was the flow distribution uncertainty (that is, whether or not the flow had split evenly into the 12 channels), particularly near the exit of the channels. Due to the approximate nature of determining the channel-to-channel flow distribution (appendix B), we assume there is still an uncertainty of ±5% after the adjustment is made.

4. Results of experiments

4.1 Friction factor

Experiments 1 and 2 (no heating) were conducted to determine the variation of the friction factor with Reynolds number (eq 3). Figure 5 shows the variation in f with Re along with a least-squares correlation of the data (for Re > 5000). We have adjusted the flowrate in the channel where the pressure taps were located, according to the method described in appendix B. There was no dependence of f on the pressure level. We show the Karman-Nikuradse relation for fully developed turbulent flow in a smooth tube, which according to Hartnett et al. (1962) is applicable to turbulent flow in rectangular channels. We also show the correlation for the results from the tube specimen (Olson and Glover, 1990). These channel specimen data are correlated with

$$f = 0.05058 \cdot Re^{-0.2397}. \tag{18}$$

The standard deviation of the difference between the measured and correlated values is 1.26%. The points for Re < 5000 were not included in the correlation because the flow was either laminar or transitional.

Our measured values for f were about 27-30% lower than those of the accepted smooth-tube correlation. The estimated uncertainty in the measured friction factor was 17-18% for Re > 4000. Below Re = 4000 the uncertainty increased due to the small pressure drop and large relative uncertainty of the pressure measurement. The are several possible explanations why our data is lower than the accepted correlation. The uncertainty analysis indicates that $f \propto h_c^3$; hence the uncertainty in f is proportional to 3 times the uncertainty in h_c. Without sectioning the channel specimen and rendering it unusable for future tests, it was not possible to measure the channel height after the specimen was brazed together. We have assumed an uncertainty in h_c of 0.025 mm; if h_c was larger by twice the uncertainty, then f would be 27-30% greater.

Although a greater channel height could explain the discrepancy in f, it is more likely f is in error due to the "shortness" of the specimen from a measurement point of view. For the channel, $L/D_h = 160$, and $4fL/D_h \approx 3$. The dynamic head, $\rho V^2/2$, is 23-36% of the total pressure drop. If there were a slight burr or protrusion of the pressure tap tube into the channel, the measured pressure could easily be shifted by one or more times the dynamic head. This would explain the difference between our measured f and the accepted value. For an accurate measurement of f, we would like $4fL/D_h >> 1$. The uncertainty in f due to the large relative dynamic head was not included in the uncertainty analysis.

Another possible explanation for our discrepancy in f is that we have neglected an entrance length in calculating f. Hartnett et al. (1962) show that for turbulent flow in a rectangular channel, the entrance length is about 20 hydraulic diameters. In that region, f is actually <u>less</u> than the fully developed f. Including this effect in our data analysis would tend to increase our predicted f in the fully developed region ($L/D_h > 20$).

We used the friction factor correlation developed for the tests without heat transfer to predict the pressure drop when the specimen was heated. Figure 6 compares the error between the predicted pressure drop and the measured pressure drop, plotted as a function of helium flow rate. For low flow rates with Re < 2000, the laminar correlation of Rohsenow and Hartnett (1973) was used for f. The error is less than 10% for most of the points, and is evenly scattered about the 0% line. This is within the uncertainty of the measured friction factor.

4.2 Temperature distributions and heat transfer

In experiments 3 to 9 we heated the channel specimen to determine the heat transfer performance. A typical plot of temperatures in the helium gas and along the specimen is shown in figure 7. The data are from the lowest flow rate of experiment 8, which corresponded to the largest inlet-to-outlet temperature rise in the helium. The measured specimen temperatures along the y centerline ($y/W = 0.08$ for the hot side, $y/W = -0.04$ for the insulated side), are shown from the inlet to the outlet. The calculated gas temperature is also plotted (eq 12) for the locations of an insulated-side thermocouple. The gas temperature increased approximately linearly from the inlet to the outlet. The heated-side temperatures were 38-44 K higher than the insulated-side temperatures over most of the specimen. Specimen temperatures on both sides increased steadily from the inlet to the outlet, except that the temperature decreased near the outlet.

The temperature difference between the heated and insulated sides correlates well with the incident normal heat flux. As the heat flux increases, the above temperature difference increases almost linearly. Higher helium flow reduces the temperature difference, because higher flows reduce specimen temperatures and therefore increase the nickel thermal conductivity. Compared to the tube specimen tested previously (Olson and Glover, 1990), this temperature difference was about 4 times greater for the same heat flux. The material thickness between the coolant channel and the heated surface was 3.8 times greater for the channel specimen, which produced the larger temperature difference.

Because the temperature increased from the inlet to the outlet, other fluid properties changed significantly also. Both thermal conductivity and dynamic viscosity increase with temperature, so they increased from the inlet to the outlet. Fluid density decreased from the inlet to the outlet, due primarily to the temperature increase but also to the pressure drop. Because density decreased, fluid velocity increased from the inlet to the outlet; for the conditions shown in the figure, the specimen inlet velocity was 18 m/s and the specimen outlet velocity was 38 m/s.

Temperatures at locations perpendicular to the flow direction (y-variation) for the conditions of figure 7 are shown in figure 8. Here, at each x-location we have plotted temperature on the insulated side as a function of y-position. Temperatures were lowest near the middle of the specimen, and highest near both outer edges. The temperature at $x/L = 0.5$ and $y/W = 0.44$ was 67 K higher than the temperature at $x/L = 0.5$ and $y/W = -0.04$. We believe maldistribution of flow (flow in the center channels greater than the flow in the outer channels) was the most likely cause of these variations in temperature. If the flow in a channel were less than the average, the fluid would heat up more as it flowed down the specimen. Also, the lower fluid velocity would produce a smaller heat transfer coefficient, and the wall-to-fluid temperature difference would have to be greater to accommodate the heat flux. These two effects would cause higher wall temperatures for regions with flow lower than average; similarly, regions with flow higher than average would have lower wall temperatures.

Table 5 lists the results for the analysis which calculates the channel flow rate based on the measured wall temperatures. For the experiment shown in figure 8, we predict the helium flow in the middle channels is 7.3% greater than the average, while the helium flow in the outer channels is 8.2% less than the average ($y/W = 0.363$ to 0.500). The outer channels likely have lower helium flow due to the partial blockage of the channels shown in figure 4. Anomalies in the inlet and outlet manifolds could also cause non-uniform flow. The analysis to determine the flow distribution also indicated that flow maldistribution increased with mass flow, which is consistent with the non-linearity of pressure drop vs flow rate. The relative helium flow in the middle channel ranged from 3.2% above the average for low flow, experiment 3, to 11.8% above average for high flow, experiment 6. The lowest relative flow was 19.0% below average for the outer channel in experiment 6 with a high average flow. If we had not used the wall temperature measurements to adjust for the channel flow, the gas temperatures would be calculated incorrectly, which would propagate as an error to both Re and Nu. For example, for no flow adjustment, in the center channel of the specimen T_f and Nu would be too high, and Re would be too low.

In figure 9 we show the heat transfer coefficient and wall-to-fluid temperature difference for the same conditions as those for figure 7 (experiment 8, 13.8 kg/h helium flow). Shown are points along $y/W = -0.04$, from the inlet to the outlet. h was calculated directly from the temperature difference, with the appropriate heat flux (eq 8); to first order the trends in $T_w - T_f$ and h are mirrored. The temperature difference increases over the first 60% of the specimen and decreases over the last 40%, with the largest percentage change near the furnace end walls ($x/L = 0$ and 1). We believe the cause of the drop-off near the end walls was heat conduction through the specimen wall to the inlet and outlet manifolds. The temperatures of the manifolds were the same as the inlet and outlet gas temperatures, which were lower than the specimen wall temperature at $x/L = 0$ and 1. We estimated the effect of wall conduction using a 1-dimensional model of the specimen as a "fin" (Rohsenow and Choi, 1961) assuming: (1) constant heat flux from $0 \le x/L \le 1$ with zero heat flux for $x/L < 0$ and $x/L > 1$; (2) constant fluid temperature for $x/L < 0$, increasing linearly from $0 \le x/L \le 1$, and constant for $x/L > 1$; and (3) constant heat transfer coefficient. The results showed that in the initial 20% and final 20% of the heated zone for this specimen, wall temperatures were significantly influenced by conduction to the manifolds. In these regions, h and therefore Nu cannot be calculated from eq (8), because the amount of heat convected into the fluid was not the same as that incident on the specimen.

Figure 10 shows the variation of Re, Nu_m, and Nu with x for the same experimental conditions as above. We have plotted Nu and Nu_m along the entire heated length, although because of conduction effects the values are accurate only for $0.2 < x/L < 0.8$. The Reynolds number decreased from the inlet to the outlet, due to the increase in viscosity caused by the temperature increase. Nu and Nu_m also decreased from the inlet to the outlet, within the $0.2 < x/L < 0.8$ region of accuracy. Nu_m was 14-20% higher than Nu for experiment 8.

The trends in temperature distributions, Re, and Nu with position did not change qualitatively for the other helium flow rates for experiment 8, nor did they change for the other heat flux rates tested. Figures 7 to 10 are representative of the variations for all runs.

Figure 11 shows the modified Nusselt number plotted against the Reynolds number for all experiments for data points at $y/W = -0.04$ and $0.2 < x/L < 0.8$. Also plotted is a correlation from the literature for fully developed turbulent flow in circular tubes (Rohsenow and Hartnett, 1973), along with the correlation for the tube specimen (Olson and Glover, 1990).

Rohsenow and Hartnett (1973): $$Nu = 0.022 \cdot Re^{0.8} \cdot Pr^{0.6}, \quad (19)$$

Olson and Glover (1990): $$Nu = 0.0420 \cdot Re^{0.7385} \cdot Pr^{0.6}. \quad (20)$$

Rohsenow and Hartnett (1973) recommend using the circular tube correlation for turbulent flow in rectangular channels, with the appropriate hydraulic diameter. The data scatter for past investigators about the correlation curve is often ±30% (e.g., see Ede, 1961). We have shown the correlation for our data for Re > 10 000, which is the fully turbulent region. This is

$$Nu_m = 0.0298 \cdot Re^{0.7685} \cdot Pr^{0.6}, \quad (21)$$

or in terms of Nu,

$$Nu = 0.0298 \cdot Re^{0.7685} \cdot Pr^{0.6} \cdot (T_w/T_f)^{-0.55}. \quad (22)$$

The standard deviation between our data and correlation is 2.6% (Re > 10 000). We have assumed a 0.6 power variation on Pr, and the leading coefficient was calculated based on that variation. The Prandtl number was 0.662 to 0.666. The Reynolds number power and the leading coefficient were calculated from a least-squares fit.

Our data agreed very well with the past correlations, when we accounted for the effect of variable properties in the temperature ratio as suggested by Rohsenow and Hartnett (1973). The temperature ratio for these experiments varied from 1.06 to 1.41, producing a difference between Nu and Nu_m of 3% to 21% (Nu_m being higher). Without accounting for the effect of variable properties in the temperature ratio, our data fell below the accepted correlations by 20% at the highest temperature ratio. The uncertainty in the measured Nu and Nu_m was 7.6% to 13.8%; the lower uncertainties occurred closer to the inlet, and the higher uncertainties occurred closer to the outlet (due to the contribution from the uncertainty in flow distribution). Nu_m calculated from the channel specimen correlation is 7.3% lower than Nu_m calculated from the tube specimen correlation at Re = 10 000, and 4.3% lower at Re = 30 000. However, data for the tube specimen was not adjusted for the effects of flow maldistribution as was the channel specimen data. We estimate Nu and Nu_m for the tube specimen would be about 4% lower if flow maldistribution were included. The two correlations therefore agree to within the uncertainty band, and both agree with the accepted smooth-tube correlation within the uncertainty band.

5. Summary and conclusions

We have constructed a thin, compact heat exchanger specimen consisting of parallel rectangular channels in a base plate with a cover plate brazed to it. The specimen was made of commercially pure nickel. The specimen was tested in an apparatus which radiatively heated it on one side at a heat flux of up to 77 W/cm^2 (68 $Btu/(s \cdot ft^2)$), and cooled the specimen with helium gas at 3.5 to 7.0 MPa (500 to 1000 psi) and Re of 1400 to 28 000. Helium gas temperatures ranged from 291 K (64°F) to 710 K (818°F); the peak specimen temperature was 784 K (951°F). Measurements showed the friction factor of the channel specimen was lower than that of a circular tube with fully developed turbulent flow. The discrepancy is attributed to measurement errors arising from the high ratio of dynamic head to frictional pressure drop of the specimen, and to neglecting the entrance region. The measured Nusselt number, when modified to account for the effects of variable properties, agreed with past correlations for fully developed turbulent flow in circular tubes. It also agreed within experimental uncertainty with the Nusselt number for a tube specimen tested earlier. At these temperatures and pressures, there were no unusual effects due to using helium as a heat transfer fluid. Conduction to the end manifolds was important in the first 20% and last 20% of the heated portion of the specimen. The flow in the outer channels was as much as 19% lower than the average flow in the specimen. We anticipate that a specimen which is optimized for heat transfer performance, by making the channels smaller in height and width, would produce a higher pressure drop and also more evenly distributed flow, assuming the brazing operation did not occlude the channels.

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Appendices

A. Heat flux distribution in reflective furnace

A new furnace was installed in the flow apparatus for the experiments on the channel specimen. This furnace had reflective aluminum walls which were water-cooled. The heat flux distribution from the furnace on the target area occupied by the specimen was calibrated using the same procedure described in Olson (1989). In this method, a calibration specimen was placed in the furnace target area. This specimen was a water-cooled copper plate with 3 heat flow meters (1.59 cm by 1.59 cm) soldered to it. With the infrared lamps at steady heating, the calibration specimen with the heat flow meters was traversed over the target area, and the relative heat flow through the meters was measured.

The data were analyzed to convert the measured heat flow to a heat flux function. This function, f_q, is defined such that when multiplied by the total incident heat flow and divided by the normal area, it gives the local normal heat flux. Or,

$$q_n = f_q \cdot Q_T / A_n. \tag{A.1}$$

The method for determining f_q are described in Olson (1989) and will not be repeated here. The method assumes that the heat flux from the furnace is not dependent on the specimen which is placed in the apparatus.

Calibration experiments were performed at furnace voltage settings of 21.0%, 35.5%, 50.5%, 62.7%, and again at 36.0% of full scale. Except close to the furnace end walls ($x/L = 0$ and $x/L = 1$), the meter heat flow, normalized by the heat flow at $x/L = 0.5$, is very similar to the calibration function f_q. Therefore examining the raw data indicates very accurately the furnace performance. Figure A.1 shows the normalized meter heat flow as a function of x/L for a furnace voltage of 36%. This is a scan at $y/W = 0.12$. x/L is the coordinate of the center of the meter. Because of the finite width of the meter, it begins to be shaded by the furnace walls when it is closer than $x/L = 0.052$ from the furnace walls (shown as the dashed line on the figure).

There are minima in the heat flow near $x/L = 0.21$ and $x/L = 0.79$. The heat flow reaches maxima at $x/L = 0.08$, 0.50, and 0.92. The distribution is symmetric about the location $x/L = 0.5$. This distribution with x/L was the same for all heating levels tested. The previous furnace, which had refractory walls, had a symmetric distribution below 29% of full scale voltage, and an asymmetric distribution above 29% of full scale voltage. For the new reflective furnace, there was no variation in heat flux in the y direction.

The uncertainty in the heat flux distribution is ±4%; the major source of uncertainty is the heat flow meter uncertainty.

B. Method of calculating flow distribution in specimen

For experiments where the specimen is heated, we found wall temperatures to vary in the y-direction, perpendicular to the helium flow. If the heat flux were constant over the specimen and the flow in each channel were the same, the temperatures should not vary in the y direction. Since we know from the furnace calibration that heat flux is not a function of y, it is most likely that the flow varies from channel to channel. The x-ray (fig. 4) of the assembled specimen shows regions of partial flow blockage which could contribute to the non-uniform flow. To calculate fluid temperatures we need to know the flow per channel, and assuming uniform flow will produce errors in Re and Nu. It is likely that the non-uniform channel flow also exists when the specimen is unheated, so assuming uniform flow will also produce an error in f.

We calculate a channel flow distribution by assuming the wall temperature variations in the y direction are due solely to variations in flow per channel. We neglect solid conduction in the y-direction, which is less than 3% of the incident heat flux in the worst case. We use the wall temperature measurements at $x/L = 0.5$, because these probes extend furthest in the + and - y directions; there were 5 probes at this location. The identity for the wall temperature at x and y is

$$T_{wx,y} = T_0 + (T_{fx,y}-T_0) + (T_{wx,y}-T_{fx,y}). \tag{B.1}$$

The first term in parentheses on the right hand side is the temperature difference due to enthalpy rise of the fluid, while the second term is the temperature difference due to local heat transfer from the solid to the fluid.

We now define an "average" fluid temperature as the temperature of the fluid if the helium flow were equal in each channel. The actual channel fluid temperature and helium flow can be related to the average through the equation

$$\dot{m}_c c_p(T_{fx,y}-T_0) = (\dot{m}/n)c_p(T_{fx,ave}-T_0). \tag{B.2}$$

Each side of the equation is obtained by setting it equal to the heat flux added by the furnace up to x. We have canceled out the kinetic energy term and the term due to deviations from the non-ideal gas, as both are small and insignificant in making the flow rate adjustment. Rearranging we get

$$(T_{fx,y}-T_0) = (\dot{m}/n)/(\dot{m}_c)\cdot(T_{fx,ave}-T_0). \tag{B.3}$$

To find the wall-to-fluid temperature difference, we write the local heat transfer equation

$$T_{wx,y}-T_{awx,y} = q_w/h. \tag{B.4}$$

We define an "average" wall temperature as that temperature the wall would attain if the flow were uniform:

$$T_{wx,ave}-T_{awx,ave} = q_w/h_{ave}. \tag{B.5}$$

h_{ave} is also the heat transfer coefficient for uniform flow. Because the heat flux does not depend on the channel flow, B.4 and B.5 can be combined:

$$T_{wx,y}-T_{fx,y} = (T_{wx,ave}-T_{fx,ave})\cdot(h_{ave}/h). \tag{B.6}$$

Here we have neglected the kinetic energy term in the adiabatic wall temperature, as variations in it due to flow non-uniformity are not significant.

The heat transfer coefficient, h, can be related to the Nusselt number, which is correlated with the Reynolds number and Prandtl number, by

$$h = k/D_h\cdot Nu = k/D_h\cdot c\cdot Re^a\cdot Pr^b. \tag{B.7}$$

The ratio of heat transfer coefficients is

$$h_{ave}/h = (k_{ave}/k)\cdot[(\dot{m}/n)/(\dot{m}_c)]^a\cdot(\mu/\mu_{ave})^a. \tag{B.8}$$

We have expressed Re in terms of the flow rate and viscosity. There are no variations in Pr with temperature, so it cancels. The geometry (D_h and A_f) cancels, since it does not depend on the flow distribution. Note also that the leading coefficient on the Nu vs Re correlation cancels; we do not need to know the magnitude of Nu for this correction, only the exponent of variation with Re.

We now <u>assume</u> $a = 1$. For turbulent flow in a tube, $a \approx 0.8$. Because μ increases with temperature, μ increases if $\dot{m}_c$ is less than $\dot{m}/n$, and including the viscosity ratio in the flow ratio effectively makes $a > 0.8$. k also increases with temperature, so including it with the flow ratio would decrease <u>a</u> again. Letting $a = 1$ greatly simplifies the mathematics of the calculation. The error introduced in the adjusted Nu by using $a = 1.0$ instead of $a = 0.8$ is less than 1%. Setting $a = 1$ and including the k and μ ratios in with the flow ratio, we find that

$$T_{wx,y}-T_{fx,y} = (T_{wx,ave}-T_{fx,ave})\cdot(\dot{m}/n)/(\dot{m}_c). \tag{B.9}$$

Substituting eqs (B.9) and (B.3) into (B.1) and simplifying, we get

$$\dot{m}_c = (\dot{m}/n)\cdot(T_{wx,ave}-T_0)/(T_{wx,y}-T_0). \tag{B.10}$$

The unknowns in this equation are $T_{wx,ave}$ and $\dot{m}_c$. We measured the total helium flow rate, wall temperatures at $x/L = 0.5$, and helium inlet temperature. A second equation comes from integrating eq (B.10) across the specimen in the y direction, as the sum of all flows in the individual channels must equal the total measured flow. Or,

$$W = (T_{wx,ave} - T_0) \int_{-W/2}^{+W/2} \frac{dy}{(T_{wx,y} - T_0)} . \qquad (B.11)$$

The integral is approximated as a sum, using the wall temperatures measured at 5 different y/W locations for x/L = 0.5. Equation (B.11) is then solved for $T_{wx,ave}$ at x/L = 0.5. The helium flows in the channels are then solved from eq (B.10). Because the wall temperatures are known only at five points, we split the specimen into five regions, with the boundaries between regions at the midpoints between the locations of the 5 temperature probes. Within each region, the flow per channel is considered to be the same.

Since flow from one channel could not penetrate into another channel, the flow per channel (calculated for x/L = 0.5) is constant from x/L = 0 to x/L = 1. We performed the distribution calculations for each flow rate at each heat flux setting (except for zero heat flux). Table 5 lists the results. For experiment 8, the flow distribution is plotted vs y/W in figure B.1. Lines connect the points where the wall temperature is measured and the channel flow is calculated; these are drawn for ease in seeing the trends of flow vs y/W and do not imply continuous variation. The channel flow peaks near the center of the specimen and is lower at the outer edges. In addition, the maldistribution accentuates as the total flow increases. These trends were observed for all the heat flux levels tested.

We found the flow distribution was not a function of the level of heat flux. It is likely the same distribution was present when the heat flux was zero, although the wall temperatures were uniform and could not be used to calculate the distribution. To measure the friction factor, we need the flow in the channel near the middle of specimen (where the pressure taps are located), which exceeds $\dot{m}/n$. We correlated $\dot{m}_c/(\dot{m}/n)$ in the center channel vs $\dot{m}$ using the results from experiments 3-9, then used that correlation to find $\dot{m}_c$ for the friction factor experiments. The correlation had a standard deviation of 0.45%.

Table 1. Uncertainties in experimental measurements and gas properties at a 95% confidence interval

Measurement or Property	Technique	Major Source of Uncertainty	Magnitude of Uncertainty
Gas Flow Rate	Thermal Mass Flow Meter	Meter Calibration	±1%
Heat Flux	Calibration of Furnace	Heat Flow Meter	±4%
Gas Inlet and Outlet Temperatures	Platinum Resistance Thermometer	Radiation	±0.5 K
Gas Pressure	Pressure Transducer	Calibration	±0.25%
Gas Differential Pressure	Pressure Transducer	Calibration	greater of ±0.5% or ±137 Pa
Specimen Temperature	Type-N Thermocouple	Wire Calibration, Installation	greater of ±0.4% of T(C) or ±1.1 K
Gas Density	Thermodynamic Function	Function Accuracy	±0.1%
Gas Enthalpy	Thermodynamic Function	Function Accuracy	±0.2%
Gas Specific Heat	Thermodynamic Function	Function Accuracy	±5%
Gas Viscosity	Thermodynamic Function	Function Accuracy	±10%
Gas Thermal Conductivity	Thermodynamic Function	Function Accuracy	±3%

Table 2. Summary of geometrical parameters and experimental conditions for channel specimen

Number of Channels $n = 20$
Channel Height, $h_c = 0.559$ mm
Channel Width, $w_c = 3.175$ mm
Channel Hydraulic Diameter, $D_h = 0.9503$ mm
Specimen Heated Length, $L = 15.24$ cm
Specimen Width, $W = 7.86$ cm
Specimen Heated Normal Area, $A_n = 119.2$ cm^2
Specimen Wetted Wall Area, $A_w = 136.6$ cm^2
Flow Normal Area, $A_f = 0.2129$ cm^2

Expt. #	Date	Inlet Pressure (kPa)	Heater Voltage (%)	Normal Heat Flux (W/cm^2)	Helium Flow Rate (kg/h)	Reynolds Number
1	7/23/90	3560	0.0	0.0	2.8-40.3	1800-28 000
2	8/06/90	7250	0.0	0.0	2.4-39.9	1500-27 500
3	8/06/90	3450	26.1	21.3	4.1-39.8	1500-28 000
4	7/20/90	3580	50.0	42.6	10.2-40.0	4000-28 000
5	8/08/90	3545	75.4	60.9	13.3-40.6	5000-28 000
6	8/10/90	6950	25.3	20.3	3.8-41.0	1400-28 000
7	8/09/90	6960	50.8	42.2	9.3-40.9	3500-28 000
8	8/13/90	7000	76.3	63.9	13.8-40.9	5100-28 000
9	8/14/90	7010	94.3	77.3	17.9	6800-12 000

Table 3. Data tables for all experiments

Channel Specimen
Experiment 1
Date: 23 July [illegible]
Time: 09:51:03

T	TB	M	PO	PO-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
292.73	292.79	[illegible] 81	3581.4	0.75	0.00	0.00936	25.04

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	292.53
2.540	0.655	292.53
5.080	0.655	292.53
7.620	0.655	292.50
10.160	0.655	292.49
12.700	0.655	292.46
13.653	0.655	292.48

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	292.64	292.73	3581.4	6.57	1832	0.665	1.10	0.50	11.27
1.270	-0.318	292.61	292.69	3581.4	6.57	1833	0.665	1.10	0.50	11.27
2.527	-0.330	292.57	292.65	3581.3	6.57	1833	0.665	1.10	0.50	11.27
3.810	-0.318	292.57	292.62	3581.3	6.57	1833	0.665	1.10	0.50	11.27
5.080	-0.318	292.57	292.58	3581.2	6.57	1833	0.665	1.10	0.50	11.27
6.363	-0.318	292.53	292.55	3581.1	6.57	1833	0.665	1.10	0.50	11.27
7.620	-0.330	292.54	292.51	3581.1	6.57	1833	0.665	1.10	0.50	11.27
8.903	-0.305	292.53	292.47	3581.0	6.57	1833	0.665	1.10	0.50	11.27
10.160	-0.318	292.55	292.44	3580.9	6.56	1834	0.665	1.10	0.50	11.27
11.430	-0.318	292.53	292.40	3580.9	6.56	1834	0.665	1.10	0.50	11.27
12.700	-0.305	292.51	292.36	3580.8	6.56	1834	0.665	1.10	0.50	11.27
13.970	-0.318	292.49	292.33	3580.8	6.56	1834	0.664	1.10	0.50	11.27
15.240	-0.953	292.44	292.29	3580.7	6.56	1834	0.664	1.10	0.50	11.27
2.527	-2.223	292.61	292.65	3581.3	6.57	1833	0.665	1.10	0.50	11.27
5.080	-2.235	292.51	292.58	3581.2	6.57	1833	0.665	1.10	0.50	11.27
7.607	-2.235	292.55	292.51	3581.1	6.57	1833	0.665	1.10	0.50	11.27
10.173	-2.223	292.56	292.44	3580.9	6.56	1834	0.665	1.10	0.50	11.27
12.700	-2.223	292.52	292.36	3580.8	6.56	1834	0.665	1.10	0.50	11.27
2.540	[illegible].197	292.57	292.65	3581.3	6.57	1833	0.665	1.10	0.50	11.27
5.080	2.223	292.56	292.58	3581.2	6.57	1833	0.665	1.10	0.50	11.27
7.620	2.223	292.53	292.51	3581.1	6.57	1833	0.665	1.10	0.50	11.27
10.147	2.223	292.54	292.44	3580.9	6.56	1834	0.665	1.10	0.50	11.27
12.713	2.223	292.52	292.36	3580.8	6.56	1834	0.664	1.10	0.50	11.27
7.607	-3.493	292.58	292.51	3581.1	6.57	1833	0.665	1.10	0.50	11.27
7.633	3.493	292.53	292.51	[illegible]	[illegible]	1833	0.665	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 09:55:51

TA	TB	M	PO	PO-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
293.26	292.88	6.07	3576.2	2.61	0.00	0.00683	17.90

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	293.11
2.540	0.655	293.11
5.080	0.655	293.12
7.620	0.655	293.10
10.160	0.655	293.11
12.700	0.655	293.09
13.653	0.655	293.08

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	293.25	293.26	3576.2	14.39	3995	0.665	1.10	0.50	11.27
1.270	-0.318	293.19	293.21	3575.9	14.39	3996	0.665	1.10	0.50	11.27
2.527	-0.330	293.20	293.18	3575.7	14.39	3996	0.665	1.10	0.50	11.27
3.8'0	-0.318	293.18	293.15	3575.5	14.38	3996	0.665	1.10	0.50	11.27
5.080	-0.318	293.17	293.12	3575.3	14.38	3996	0.665	1.10	0.50	11.27
6.353	-0.318	293.16	293.09	3575.1	14.38	3997	0.665	1.10	0.50	11.27
7.620	-0.330	293.17	293.06	3574.9	14.38	3997	0.665	1.10	0.50	11.27
8.903	-0.305	293.17	293.03	3574.6	14.38	3997	0.665	1.10	0.50	11.27
10.160	-0.318	293.17	293.00	3574.4	14.38	3998	0.665	1.10	0.50	11.27
11.430	-0.318	293.15	292.97	3574.2	14.38	3998	0.665	1.10	0.50	11.27
12.700	-0.305	293.15	292.94	3574.0	14.38	3998	0.665	1.10	0.50	11.27
13.970	-0.318	293.14	292.91	3573.8	14.38	3998	0.665	1.10	0.50	11.27
15.240	-0.953	293.13	292.88	3573.6	14.38	3999	0.665	1.10	0.50	11.27
2.527	-2.223	293.24	293.18	3575.7	14.39	3996	0.665	1.10	0.50	11.27
5.0?0	-2.235	293.09	293.12	3575.3	14.38	3996	0.665	1.10	0.50	11.27
7.607	-2.235	293.19	293.06	3574.9	14.38	3997	0.665	1.10	0.50	11.27
10.173	-2.223	293.20	293.00	3574.4	14.38	3998	0.665	1.10	0.50	11.27
12.700	-2.223	293.19	292.94	3574.0	14.38	3998	0.665	1.10	0.50	11.27
2.540	2.197	293.15	293.18	3575.7	14.39	3996	0.665	1.10	0.50	11.27
5.080	2.223	293.18	293.12	3575.3	14.38	3996	0.665	1.10	0.50	11.27
7.620	2.223	293.14	293.06	3574.9	14.38	3997	0.665	1.10	0.50	11.27
10.147	2.223	293.15	293.00	3574.4	14.38	3998	0.665	1.10	0.50	11.27
12.713	2.223	293.12	292.94	3574.0	14.38	3998	0.665	1.10	0.50	11.27
7.607	-3.493	293.23	293.06	3574.9	14.38	3997	0.665	1.10	0.50	11.27
7.633	3.493	293.14	293.06	3574.9	14.38	3997	0.665	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:00:46

TA	TB	M	PO	PO-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
293.60	293.47	9.78	3572.1	6.35	0.00	0.00623	17.25

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	293.52
2.540	0.655	293.50
5.080	0.655	293.50
7.620	0.655	293.50
10.160	0.655	293.51
12.700	0.655	293.50
13.653	0.655	293.52

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	293.58	293.54	3572.1	23.48	6502	0.665	1.10	0.50	11.27
1.270	-0.318	293.53	293.53	3571.5	23.48	6502	0.665	1.10	0.50	11.27
2.527	-0.330	293.52	293.52	3571.0	23.48	6502	0.665	1.10	0.50	11.27
3.810	-0.318	293.51	293.51	3570.5	23.49	6502	0.665	1.10	0.50	11.27
5.080	-0.318	293.53	293.50	3570.0	23.49	6502	0.665	1.10	0.50	11.27
6.363	-0.318	293.52	293.49	3569.4	23.49	6503	0.665	1.10	0.50	11.27
7.620	-0.330	293.53	293.48	3568.9	23.49	6503	0.665	1.10	0.50	11.27
8.903	-0.305	293.51	293.47	3568.4	23.50	6503	0.665	1.10	0.50	11.27
10.160	-0.318	293.53	293.46	3567.8	23.50	6503	0.665	1.10	0.50	11.27
11.430	-0.318	293.52	293.45	3567.3	23.50	6503	0.665	1.10	0.50	11.27
12.700	-0.305	293.52	293.45	3566.8	23.50	6503	0.665	1.10	0.50	11.27
13.970	-0.318	293.51	293.[illegible]	3566.3	23.51	6503	0.665	1.10	0.50	11.27
15.240	-0.953	293.52	293.43	3565.7	23.51	6504	0.665	1.10	0.50	11.27
2.527	-2.223	293.54	293.52	3571.0	23.48	6502	0.665	1.10	0.50	11.27
5.080	-2.235	293.[illegible]3	29[illegible].50	3570.0	23.49	6502	0.665	1.10	0.50	11.27
7.607	-2.235	293.51	293.48	3568.9	23.49	6503	0.665	1.10	0.50	11.27
10.173	-2.223	293.52	293.46	[illegible]7.8	23.50	6503	0.665	1.10	0.50	11.27
12.700	-2.223	293.50	293.45	3566.8	23.50	6503	0.665	1.10	0.50	11.27
2.540	2.197	293.47	293.52	3571.0	23.48	6502	0.665	1.10	0.50	11.27
5.080	2.223	293.47	293.50	3570.0	23.49	6502	0.665	1.10	0.50	11.27
7.620	2.223	293.47	293.48	3568.9	23.49	6503	0.665	1.10	0.50	11.27
10.147	2.223	293.46	293.46	3567.9	23.50	6503	0.665	1.10	0.50	11.27
12.713	2.223	293.47	293.45	3566.8	23.50	6503	0.665	1.10	0.50	11.27
7.607	-3.493	293.54	293.48	3568.9	23.49	6503	0.665	1.10	0.50	11.27
7.633	3.493	293.46	293.48	3568.9	23.49	6503	0.665	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:05:29

TA	TB	M	P0	P0-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
292.75	292.94	15.39	3566.6	14.41	0.00	0.00554	17.14

Hot-Side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	292.72
2.540	0.655	292.77
5.080	0.655	292.73
7.620	0.655	292.77
10.160	0.655	292.76
12.700	0.655	292.76
13.653	0.655	292.76

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	292.77	292.63	3566.6	37.40	10395	0.665	1.10	0.50	11.27
1.270	-0.318	292.71	292.64	3565.4	37.41	10394	0.665	1.10	0.50	11.27
2.527	-0.330	292.71	292.66	3564.2	37.42	10394	0.665	1.10	0.50	11.27
3.810	-0.318	292.74	292.67	3563.0	37.44	10394	0.665	1.10	0.50	11.27
5.080	-0.318	292.73	292.68	3561.8	37.45	10393	0.665	1.10	0.50	11.27
6.363	-0.318	292.72	292.70	3560.6	37.47	10393	0.665	1.10	0.50	11.27
7.620	-0.330	292.73	292.71	3559.4	37.48	10393	0.665	1.10	0.50	11.27
8.903	-0.305	292.76	292.73	3558.2	37.50	10393	0.665	1.10	0.50	11.27
10.160	-0.318	292.71	292.74	3557.0	37.51	10392	0.665	1.10	0.50	11.27
11.430	-0.318	292.73	292.75	3555.8	37.53	10392	0.665	1.10	0.50	11.27
12.700	-0.305	292.73	292.77	3554.6	37.54	10392	0.665	1.10	0.50	11.27
13.970	-0.318	292.75	292.78	3553.4	37.55	10391	0.665	1.10	0.50	11.27
15.240	-0.953	292.71	292.79	3552.2	37.57	10391	0.665	1.10	0.50	11.27
2.527	-2.223	292.67	292.66	3564.2	37.42	10394	0.665	1.10	0.50	11.27
5.080	-2.235	292.75	292.68	3561.8	37.45	10393	0.665	1.10	0.50	11.27
7.607	-2.235	292.71	292.71	3559.4	37.48	10393	0.665	1.10	0.50	11.27
10.173	-2.223	292.70	292.74	3557.0	37.51	10392	0.665	1.10	0.50	11.27
12.700	-2.223	292.67	292.77	3554.6	37.54	10392	0.665	1.10	0.50	11.27
2.540	2.197	292.68	292.66	3564.2	37.43	10394	0.665	1.10	0.50	11.27
5.080	2.223	292.72	292.68	3561.8	37.45	10393	0.665	1.10	0.50	11.27
7.620	2.223	292.67	292.71	3559.4	37.48	10393	0.665	1.10	0.50	11.27
10.147	2.223	292.70	292.74	3557.0	37.51	10392	0.665	1.10	0.50	11.27
12.713	2.223	292.69	292.77	3554.6	37.54	10392	0.665	1.10	0.50	11.27
7.607	-3.493	292.65	292.71	3559.4	37.48	10393	0.665	1.10	0.50	11.27
7.633	3.493	292.67	292.71	3559.4	37.48	10393	0.665	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:09:54

TA	TB	M	PO	PO-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
292.06	292.21	20.17	3561.1	23.59	0.01	0.00517	17.13

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	292.06
2.540	0.655	292.08
5.080	0.655	292.12
7. 20	0.655	292.10
10.160	0.655	292.11
12.700	0.655	292.11
13.653	0.655	292.11

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	292.11	291.83	3561.1	49.44	13783	0.664	1.10	0.50	11.27
1.270	-0.318	292.08	291.84	3559.1	49.47	13783	0.664	1.10	0.50	11.27
2.527	-0.330	292.08	291.85	3557.2	49.50	13783	0.664	1.10	0.50	11.27
3.810	-0.318	292.09	291.86	3555.2	49.53	13783	0.664	1.10	0.50	11.27
5.080	-0.318	292.10	291.88	3553.2	49.56	13782	0.664	1.10	0.50	11.27
6.363	-0.318	292.07	291.89	3551.2	49.59	13782	0.665	1.10	0.50	11.27
7.620	-0.330	292.09	291.90	3549.3	49.62	13782	0.665	1.10	0.50	11.27
8.903	-0.305	292.10	291.91	3547.3	49.64	13781	0.665	1.10	0.50	11.27
10.160	-0.318	292.09	291.92	3545.4	49.67	13781	0.665	1.10	0.50	11.27
11.430	-0.318	292.08	291.93	3543.4	49.70	13781	0.665	1.10	0.50	11.27
12.700	-0.305	292.09	291.94	3541.4	49.73	13780	0.665	1.10	0.50	11.27
13.970	-0.318	292.10	291.95	3539.5	49.76	13780	0.665	1.10	0.50	11.27
15.240	-0.953	292.07	291.96	3537.5	49.79	13780	0.665	1.10	0.50	11.27
2.527	-2.223	292.08	291.85	3557.2	49.50	13783	0.664	1.10	0.50	11.27
5.080	-2.235	292.14	291.88	3553.2	49.56	13782	0.664	1.10	0.50	11.27
7.607	-2.235	292.08	291.90	3549.3	49.62	13782	0.665	1.10	0.50	11.27
10.173	-2.223	292.08	291.92	3545.3	49.67	13781	0.665	1.10	0.50	11.27
12.700	-2.223	292.08	291.94	3541.4	49.73	13780	0.665	1.10	0.50	11.27
2.540	2.197	292.09	291.85	3557.1	49.50	13783	0.664	1.10	0.50	11.27
5.080	2.223	292.10	291.88	3553.2	49.56	13782	0.664	1.10	0.50	11.27
7.620	2.223	292.07	291.90	3549.3	49.62	13782	0.665	1.10	0.50	11.27
10.147	2.223	292.06	291.92	3545.4	49.67	13781	0.665	1.10	0.50	11.27
12.713	2.223	292.11	291.94	3541.4	49.73	13780	0.665	1.10	0.50	11.27
7.607	-3.493	292.05	291.90	3549.3	49.62	13782	0.665	1.10	0.50	11.27
7.633	3.493	292.10	291.90	3549.3	49.62	13782	0.665	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:14:27

TA	TB	M	PO	PO-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
291.81	291.92	24.92	3554.3	34.7[illegible]	0.00	0.00489	17.13

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	291.81
2.540	0.655	291.79
5.080	0.655	291.81
7.620	0.655	291.80
10.160	0.655	291.81
12.700	0.655	291.82
13.653	0.655	291.81

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	291.86	291.45	3554.3	61.61	17180	0.664	1.10	0.50	11.27
1.270	-0.318	291.82	291.46	3551.4	61.66	17180	0.664	1.10	0.50	11.27
2.527	-0.330	291.80	291.46	3548.5	61.71	17179	0.664	1.10	0.50	11.27
3.810	-0.318	291.82	291.47	3545.6	61.76	17179	0.664	1.10	0.50	11.27
5.080	-0.318	291.82	291.48	3542.7	61.81	17179	0.664	1.10	0.50	11.27
6.363	-0.318	291.81	291.49	3539.8	61.87	17179	0.664	1.10	0.50	11.27
7.620	-0.330	291.81	291.49	3536.9	61.92	17179	0.664	1.10	0.50	11.27
8.903	-0.305	291.79	291.50	3534.0	61.97	17178	0.664	1.10	0.50	11.27
10.160	-0.318	291.82	291.51	3531.1	62.02	17178	0.665	1.10	0.50	11.27
11.430	-0.318	291.82	291.52	3528.2	62.07	17178	0.665	1.10	0.50	11.27
12.700	-0.305	291.83	291.53	3525.3	62.12	17178	0.665	1.10	0.50	11.27
13.970	-0.318	291.84	291.53	3522.4	62.17	17178	0.665	1.10	0.50	11.27
15.240	-0.953	291.82	291.54	3519.5	62.23	17177	0.665	1.10	0.50	11.27
2.527	-2.223	291.80	291.46	3548.5	61.71	17179	0.664	1.10	0.50	11.27
5.080	-2.235	291.87	291.48	3542.7	61.81	17179	0.664	1.10	0.50	11.27
7.607	-2.235	291.86	291.49	3536.9	61.92	17179	0.664	1.10	0.50	11.27
10.173	-2.223	291.80	291.51	3531.1	62.02	17178	0.665	1.10	0.50	11.27
12.700	-2.223	291.83	291.53	3525.3	62.12	17178	0.665	1.10	0.50	11.27
2.540	2.197	291.83	291.46	3548.5	61.71	17179	0.664	1.10	0.50	11.27
5.080	2.223	291.81	291.48	3542.7	61.81	17179	0.664	1.10	0.50	11.27
7.620	2.223	291.82	291.49	3536.9	61.92	17179	0.664	1.10	0.50	11.27
10.147	2.223	291.83	291.51	3531.1	62.02	17178	0.665	1.10	0.50	11.27
12.713	2.223	291.85	291.53	3525.3	62.12	17178	0.665	1.10	0.50	11.27
7.607	-3.493	291.80	291.49	3536.9	61.92	17179	0.664	1.10	0.50	11.27
7.633	3.493	291.87	291.49	3536.9	61.92	17179	0.664	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:18:44

TA	TB	M	PO	PO-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
291.64	291.75	30.62	3544.0	51.14	0.00	0.00466	17.13

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	291.61
2.540	0.655	291.63
5.080	0.655	291.60
7.620	0.655	291.63
10.160	0.655	291.63
12.700	0.655	291.64
13.653	0.655	291.67

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	291.68	291.08	3544.0	76.38	21282	0.664	1.10	0.51	11.27
1.270	-0.318	291.63	291.09	3539.7	76.47	21282	0.664	1.10	0.51	11.27
2.527	-0.330	291.61	291.09	3535.5	76.56	21282	0.664	1.10	0.51	11.27
3.810	-0.318	291.66	291.10	3531.2	76.65	21282	0.664	1.10	0.51	11.27
5.080	-0.318	291.61	291.11	3527.0	76.75	21282	0.664	1.10	0.51	11.27
6.363	-0.318	291.64	291.11	3522.7	76.84	21281	0.664	1.10	0.51	11.27
7.620	-0.330	291.65	291.12	3518.4	76.93	21281	0.664	1.10	0.51	11.27
8.903	-0.305	291.64	291.13	3514.1	77.03	21281	0.664	1.10	0.51	11.27
10.160	-0.318	291.62	291.14	3509.9	77.12	21281	0.665	1.10	0.51	11.27
11.430	-0.318	291.63	291.14	3505.7	77.21	21281	0.665	1.10	0.51	11.27
12.700	-0.305	291.64	291.15	3501.4	77.31	21280	0.665	1.10	0.51	11.27
13.970	-0.318	291.67	291.16	3497.1	77.40	21280	0.665	1.10	0.51	11.27
15.240	-0.953	291.64	291.16	3492.9	77.50	21280	0.665	1.10	0.51	11.27
2.527	-2.223	291.62	291.09	3535.5	76.56	21282	0.664	1.10	0.51	11.27
5.080	-2.235	291.71	291.11	3527.0	76.75	21282	0.664	1.10	0.51	11.27
7.607	-2.235	291.65	291.12	3518.5	76.95	21281	0.664	1.10	0.51	11.27
10.173	-2.223	291.64	291.14	3509.9	77.12	21281	0.665	1.10	0.51	11.27
12.700	-2.223	291.63	291.15	3501.4	[illegible]	21280	0.665	1.10	0.51	11.27
2.540	2.197	291.65	291.09	3535.5	[illegible]	21282	0.664	1.10	0.51	11.27
5.080	2.223	291.63	[illegible]	[illegible]	76.75	21282	0.664	1.10	0.51	11.27
7.620	2.223	291.66	[illegible]	[illegible]	76.93	21281	0.664	1.10	0.51	11.27
10.147	2.223	291.64	[illegible]	[illegible]	77.12	21281	0.665	1.10	0.51	11.27
12.713	2.223	291.68	291.15	[illegible]	77.31	21280	0.665	1.10	0.51	11.27
7.607	-3.493	291.65	[illegible]	[illegible]	76.93	21281	0.664	1.10	0.51	11.27
7.633	3.493	291.65	291.12	[illegible]	76.93	21281	0.664	1.10	0.51	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:23:06

TA	TB	M	PO	PO-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
291.46	291.61	40.31	3524.9	86.53	0.00	0.00442	17.13

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	291.38
2.540	0.655	291.41
5.080	0.655	291.41
7.620	0.655	291.42
10.160	0.655	291.38
12.700	0.655	291.44
13.653	0.655	291.46

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	291.46	290.48	3524.9	101.57	28248	0.664	1.10	0.52	11.27
1.270	-0.318	291.40	290.48	3517.7	101.77	28248	0.664	1.10	0.52	11.27
2.527	-0.330	291.42	290.49	3510.6	101.98	28248	0.664	1.10	0.52	11.27
3.810	-0.318	291.41	290.50	3503.3	102.19	28248	0.664	1.10	0.52	11.27
5.080	-0.318	291.41	290.51	3496.1	102.40	28248	0.664	1.10	0.52	11.27
6.363	-0.318	291.42	290.51	3488.8	102.61	28248	0.664	1.10	0.52	11.27
7.620	-0.330	291.42	290.52	3481.7	102.82	28248	0.664	1.10	0.52	11.27
8.903	-0.305	291.44	290.52	3474.4	103.03	28248	0.665	1.10	0.52	11.27
10.160	-0.318	291.39	290.53	3467.2	103.25	28248	0.665	1.10	0.52	11.27
11.430	-0.318	291.43	290.54	3460.0	103.46	28248	0.665	1.10	0.52	11.27
12.700	-0.305	391.43	290.54	3452.8	[illegible]	28248	0.665	1.10	0.52	11.27
13.970	-0.318	291.45	290.55	3445.6	103.89	28248	0.665	1.10	0.52	11.27
15.240	-0.953	291.45	290.56	3438.4	104.11	2824C	0.665	1.10	0.52	11.27
2.527	-2.223	291.43	290.49	3510.6	101.98	28248	0.664	1.10	0.52	11.27
5.080	-2.235	291.47	290.51	3496.1	102.40	28248	0.664	1.10	0.52	11.27
7.607	-2.235	291.44	290.52	3481.7	102.82	28248	0.664	1.10	0.52	11.27
10.173	-2.223	291.43	290.53	3467.2	103.25	28248	0.665	1.10	0.52	11.27
12.700	-2.223	291.44	290.54	3452.8	103.67	28248	0.665	1.10	0.52	11.27
2.540	2.197	291.43	290.49	3510.5	101.98	28248	0.664	1.10	0.52	11.27
5.080	2.223	291.43	290.51	3496.1	102.40	28248	0.664	1.10	0.52	11.27
7.620	2.223	291.41	[illegible]	3481.7	102.8[illegible]	28248	0.664	1.10	0.52	11.27
10.147	2.223	291.41	29[illegible].53	3467.3	103.24	28248	0.665	1.10	0.52	11.27
12.713	2.223	291.43	290.54	3452.7	103.68	28248	0.665	1.10	0.52	11.27
7.607	-3.493	291.43	290.52	3481.7	102.82	28248	0.664	1.10	0.52	11.27
7.633	3.493	291.42	290.52	3481.6	102.82	28248	0.664	1.10	0.52	11.27

Table 3 (continued)

Channel Specimen
Experiment 1
Date: 23 July 1990
Time: 10:26:33

TA	TB	[illegible]	PO	PO-P1	Vf	f	df
K	K	kg/h	kPa	kPa	%		%
291.56	291.60	16.[illegible]7	3586.9	16.84	0.00	0.00547	17.14

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	291.57
2.540	0.655	291.59
5.080	0.655	291.58
7.620	0.655	291.58
10.160	0.655	291.58
12.700	0.655	291.60
13.653	0.[illegible]5	291.61

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	291.65	291.41	3586.9	40.48	11393	0.664	1.10	0.50	11.27
1.270	-0.318	291.59	291.41	3585.4	40.50	11392	0.664	1.10	0.50	11.27
2.527	-0.330	291.61	291.41	3584.1	40.51	11392	0.664	1.10	0.50	11.27
3.810	-0.318	291.61	291.42	3582.6	40.53	11392	0.664	1.10	0.50	11.27
5.080	-0.318	291.60	291.42	3581.2	40.55	11392	0.664	1.10	0.50	11.27
6.363	-0.318	291.61	291.42	3579.8	40.56	11392	0.664	1.10	0.50	11.27
7.620	-0.330	291.63	291.42	3578.4	40.58	11392	0.664	1.10	0.50	11.27
8.903	-0.305	291.61	291.43	3577.0	40.50	11392	0.664	1.10	0.50	11.27
10.160	-0.318	291.60	291.43	3575.6	40.61	11392	0.664	1.10	0.50	11.27
11.430	-0.318	291.60	291.43	3574.2	40.63	11392	0.664	1.10	0.50	11.27
12.700	-0.305	291.61	291.43	3572.8	40.64	11392	0.664	1.10	0.50	11.27
13.970	-0.318	291.64	291.44	3571.[illegible]	40.66	11392	0.666	1.10	0.50	11.27
15.240	-0.953	291.63	291.44	3570.0	40.67	11392	0.664	1.10	0.50	11.27
2.527	-2.223	291.61	291.41	3584.1	40.51	11392	0.664	1.10	0.50	11.27
5.080	-2.235	291.63	291.42	3581.2	40.55	11392	0.664	1.10	0.50	11.27
7.607	-2.235	291.64	291.42	3578.4	40.58	11392	0.664	1.10	0.50	11.27
10.173	-2.223	291.62	291.43	3575.6	40.6[illegible]	11392	0.664	1.10	0.50	11.27
12.700	-2.223	291.62	291.43	3572.8	[illegible]	11392	0.664	1.10	0.50	11.27
2.540	2.197	291.63	291.41	3584.0	[illegible]	11392	0.664	1.10	0.50	11.27
5.080	2.223	291.64	291.42	3581.2	40.55	11392	0.664	1.10	0.50	11.27
7.620	2.223	291.61	291.42	3578.4	40.58	11392	0.664	1.10	0.50	11.27
10.147	2.223	291.61	291.43	3575.6	40.[illegible]	11392	0.664	1.10	0.50	11.27
12.713	2.223	291.63	291.43	3572.8	40.64	11392	0.664	1.10	0.50	11.27
7.607	-3.493	291.63	291.42	3578.4	40.58	11392	0.664	1.10	0.50	11.27
7.633	3.493	291.64	291.42	3578.4	40.58	11392	0.664	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:02:08

TA	TB	[illegible]	PO	PO-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
296.73	296.0[illegible]	2.37	7219.3	0.33	-0.02	0.01132	44.97

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	296.40
2.540	0.655	296.41
5.080	0.655	296.37
7.620	0.655	296.32
10.160	0.655	296.29
12.700	0.655	296.27
13.653	0.655	296.25

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	296.50	296.73	7219.3	2.83	1523	0.661	1.10	0.50	11.27
1.270	-0.318	296.44	296.68	7219.3	2.83	1523	0.661	1.10	0.50	11.27
2.527	-0.330	296.45	296.63	7219.2	2.83	1523	0.661	1.10	0.50	11.27
3.810	-0.318	296.40	296.57	7219.2	2.83	1523	0.661	1.10	0.50	11.27
5.080	-0.318	296.39	296.52	7219.2	2.83	1523	0.661	1.10	0.50	11.27
6.363	-0.318	296.36	296.47	7219.2	2.83	1523	0.661	1.10	0.50	11.27
7.620	-0.330	296.36	296.42	7219.1	2.83	1524	0.661	1.10	0.50	11.27
8.903	-0.305	296.33	296.36	7219.1	2.83	1524	0.661	1.10	0.50	11.27
10.160	-0.318	296.34	296.31	7219.1	2.83	1524	0.661	1.10	0.50	11.27
11.430	-0.318	296.31	296.26	7219.0	2.83	1524	0.661	1.10	0.50	11.27
12.700	-0.305	296.28	296.20	7219.0	2.83	1524	0.661	1.10	0.50	11.27
13.970	-0.318	296.[illegible]6	296.15	7219.0	2.83	1524	0.661	1.10	0.50	11.27
15.240	-0.953	296.22	296.10	7219.0	2.83	1525	0.661	1.10	0.50	11.27
2.527	-2.223	296.48	296.63	7219.2	2.83	1523	0.661	1.10	0.50	11.27
5.080	-2.235	296.32	296.52	7219.2	2.83	1523	0.661	1.10	0.50	11.27
7.607	-2.235	296.37	296.42	7219.1	2.83	1524	0.661	1.10	0.50	11.27
10.173	-2.223	296.36	296.31	7219.1	2.83	1524	0.661	1.10	0.50	11.27
12.700	-2.223	296.29	296.20	7219.0	2.83	1524	0.661	1.10	0.50	11.27
2.540	2.[illegible]97	296.42	296.63	7219.2	2.83	1523	0.661	1.10	0.50	11.27
5.080	2.223	296.37	296.52	7219.2	2.83	1523	0.661	1.10	0.50	11.27
7.620	2.223	296.35	296.42	7219.1	2.83	1524	0.661	1.10	0.50	11.27
10.147	2.223	296.33	296.31	7219.1	2.83	1524	0.661	1.10	0.50	11.27
12.713	2.223	296.28	296.20	7219.0	2.83	1524	0.661	1.10	0.50	11.27
7.607	-3.493	296.40	296.42	7219.1	2.83	1524	0.661	1.10	0.50	11.27
7.633	3.493	296.36	296.41	7219.1	2.83	1524	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time. 09:06:38

TA	TB	M	PO	PO-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
296.28	297.22	5.27	7210.7	1.02	-0.02	0.00697	21.73

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.[illegible]88	0.655	297.83
2.540	0.655	297.82
5.080	0.655	297.78
7.620	0.655	297.76
10.160	0.655	297.73
12.700	0.655	297.68
13.653	0.655	297.67

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.[illegible]65	297.96	298.28	7210.7	6.38	3398	0.661	1.10	0.50	11.27
1.270	-0.318	297.98	298.20	7210.6	6.38	3399	0.661	1.10	0.50	11.27
2.527	-0.330	297.91	298.11	7210.5	6.38	3400	0.661	1.10	0.50	11.27
3.810	-0.318	297.85	298.03	7210.4	6.38	3400	0.661	1.10	0.50	11.27
5.080	-0.318	297.85	297.94	7210.3	6.38	3401	0.661	1.10	0.50	11.27
6.363	-0.318	297.86	297.86	7210.2	6.37	3401	0.661	1.10	0.50	11.27
7.620	-0.330	297.85	297.77	7210.2	6.37	3402	0.661	1.10	0.50	11.27
8.903	-0.305	297.81	297.69	7210.1	6.37	3403	0.661	1.10	0.50	11.27
10.160	-0.318	297.83	297.60	7210.0	6.37	3403	0.661	1.10	0.50	11.27
11.430	-0.318	297.81	297.52	7209.9	6.37	3404	0.661	1.10	0.50	11.27
12.700	-0.305	297.79	297.43	7209.8	6.36	3405	0.661	1.10	0.50	11.27
13.970	-0.318	297.74	297.35	7209.7	6.36	3405	0.661	1.10	0.50	11.27
15.240	-0.953	297.69	297.26	7209.6	6.36	3406	0.661	1.10	0.50	11.27
2.527	-2.223	298.04	298.11	7210.5	6.38	3400	0.661	1.10	0.50	11.27
5.080	-2.235	297.64	297.94	7210.3	6.38	3401	0.661	1.10	0.50	11.27
7.607	-2.235	297.86	297.77	72[illegible]0.2	6.37	3402	0.661	1.10	0.50	11.27
10.173	-2.[illegible]3	297.89	297.60	7210.0	6.37	3403	0.661	1.10	0.50	11.27
12.700	-2.223	297.86	297.43	7209.8	6.36	3405	0.661	1.10	0.50	11.27
2.540	2.197	297.86	298.11	7210.5	6.38	3400	0.661	1.10	0.50	11.27
5.080	2.223	297.86	297.94	7210.3	6.38	3401	0.661	1.10	0.50	11.27
7.620	2.223	297.82	297.77	7210.2	6.37	3402	0.661	1.10	0.50	11.27
10.147	2.223	297.81	297.60	7210.0	6.37	3403	0.661	1.10	0.50	11.27
12.713	2.223	297.77	297.43	7209.8	6.36	3405	0.661	1.10	0.50	11.27
7.607	-3.493	297.98	297.77	7210.2	6.37	3402	0.661	1.10	0.50	11.27
7.533	3.493	297.81	297.77	7210.2	6.37	3402	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:11:11

TA	TB	M	P0	P0-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
299.61	299.05	10.23	7212.6	3.51	-0.01	0.00613	17.56

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	299.32
2.540	0.655	299.34
5.080	0.655	299.31
7.620	0.655	299.25
10.160	0.655	299.26
12.700	0.655	299.24
13.653	0.655	299.23

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	299.41	299.60	7212.6	12.63	6678	0.661	1.10	0.50	11.27
1.270	-0.318	299.36	299.55	7212.3	12.63	6678	0.661	1.10	0.50	11.27
2.527	-0.330	299.36	299.51	7212.0	12.62	6679	0.661	1.10	0.50	11.27
3.810	-0.318	299.31	299.46	7211.7	12.62	6680	0.661	1.10	0.50	11.27
5.080	-0.318	299.31	299.42	7211.4	12.62	6680	0.661	1.10	0.50	11.27
6.363	-0.318	299.33	299.38	7211.2	12.62	6681	0.661	1.10	0.50	11.27
7.620	-0.330	299.31	299.33	7210.9	12.62	6682	0.661	1.10	0.50	11.27
8.903	-0.305	299.29	299.29	7210.6	12.62	6682	0.661	1.10	0.50	11.27
10.160	-0.318	299.30	299.24	7210.3	12.62	6683	0.661	1.10	0.50	11.27
11.430	-0.318	299.30	299.20	7210.0	12.61	6684	0.661	1.10	[illegible]	11.27
12.700	-0.305	299.29	299.16	7209.7	12.61	6684	0.661	1.10	0.50	11.27
13.970	-0.318	299.27	299.11	7209.4	12.61	6685	0.661	1.10	0.50	11.27
15.240	-0.953	299.26	299.07	7209.1	12.61	6685	0.661	1.10	0.50	11.27
2.527	-2.223	299.40	299.51	7212.0	12.62	6679	0.661	1.10	0.50	11.27
5.080	-2.235	299.04	299.42	7211.4	12.62	6680	0.661	1.10	0.50	11.27
7.607	-2.235	299.27	299.33	7210.9	12.62	6682	0.661	1.10	0.50	11.27
10.173	-2.223	299.33	299.24	7210.3	12.62	6683	0.661	1.10	0.50	11.27
12.700	-2.223	299.32	299.16	7209.7	12.61	6684	0.661	1.10	0.50	11.27
2.540	2.197	299.23	299.51	7212.0	12.62	6679	0.661	1.10	0.50	11.27
5.080	2.223	299.18	299.42	7211.4	12.62	6680	0.661	1.10	0.50	11.27
7.620	2.223	299.19	299.33	7210.9	12.62	6682	0.661	1.10	0.50	11.27
10.147	2.223	299.22	[illegible]	7210.3	12.62	6683	0.661	1.10	0.50	11.27
12.713	2.223	299.17	299.16	7209.7	12.61	6684	0.661	1.10	0.50	11.27
7.607	-3.493	299.36	299.33	7210.9	12.62	6682	0.661	1.10	0.50	11.27
7.633	3.493	299.13	299.33	7210.9	12.62	6682	0.661	1.10	0.50	[illegible]

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:16:06

TA	TB	M	P0	P0-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
298.75	299.03	14.54	7224.6	6.57	0.00	0.00557	17.26

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.500	0.655	298.65
2.540	0.655	298.66
5.000	0.655	298.64
7.620	0.655	299.62
10.160	0.655	298.62
12.700	0.655	298.61
13.653	0.655	298.61

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	UTw	UTf	URe
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	298.63	298.72	7224.6	18.06	9613	0.661	1.10	0.50	11.27
1.270	-0.318	298.61	298.73	7224.1	18.06	9612	0.667	1.10	0.50	11.27
2.527	-0.330	298.59	298.73	7223.5	18.06	9612	0.661	1.10	0.50	11.27
3.810	-0.318	298.58	298.74	7223.0	18.07	9612	0.661	1.10	0.50	11.27
5.000	-0.318	298.57	298.75	7222.4	18.07	9612	0.661	1.10	0.50	11.27
6.363	-0.318	298.58	298.75	7221.9	18.07	9612	0.661	1.10	0.50	11.27
7.620	-0.330	298.58	298.76	7221.4	18.07	9612	0.661	1.10	0.50	11.27
8.903	-0.305	298.55	298.76	7220.8	18.07	9612	0.661	1.10	0.50	11.27
10.160	-0.318	298.53	298.77	7720.3	18.07	9612	0.661	1.10	0.50	11.27
11.430	-0.318	298.53	298.77	7219.7	18.08	9612	0.661	1.10	0.50	11.27
12.700	[illegible]	298.54	298.78	7219.2	18.08	9611	0.661	1.10	0.50	11.27
13.970	-0.318	298.53	298.79	7218.6	18.08	9611	0.661	1.10	0.50	11.27
15.240	-0.953	298.55	298.79	7218.1	18.08	9611	0.661	1.10	0.50	11.27
2.527	-2.223	298.52	298.73	7223.5	18.06	9612	0.661	1.10	0.50	11.27
5.000	-2.235	298.41	298.75	7222.4	18.07	9612	0.661	1.10	0.50	11.27
7.607	-2.235	298.51	298.76	7221.6	18.07	9612	0.661	1.10	0.50	11.27
10.173	-2.223	298.48	298.77	7220.3	18.07	9612	0.661	1.10	0.50	11.27
12.700	-2.223	298.48	298.78	7219.2	18.08	9611	0.661	1.10	0.50	11.27
2.540	2.197	298.45	298.73	7223.5	18.06	9612	0.661	1.10	0.50	11.27
5.000	2.223	298.45	298.75	7222.4	18.07	9612	0.661	1.10	0.50	11.27
7.620	2.223	298.46	298.76	7221.4	18.07	9612	0.661	1.10	0.50	11.27
10.147	2.223	298.47	298.77	7220.3	18.07	9612	0.661	1.10	0.50	11.27
12.713	2.223	298.45	298.78	7219.2	18.08	9611	0.661	1.10	0.50	11.27
7.607	-3.495	298.45	298.76	7221.4	18.07	9612	0.661	1.10	0.50	11.27
7.635	3.495	298.41	298.76	7221.3	18.07	9612	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:20:41

TA	TB	M	P0	P0-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
297.61	297.76	20.12	7244.1	11.76	-0.02	0.00511	17.16

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.500	0.655	297.53
2.540	0.655	297.61
5.080	0.655	297.60
7.620	0.655	297.59
10.160	0.655	297.58
12.706	0.655	297.60
13.653	0.655	297.58

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- UTw	UTf	URe
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	297.58	297.55	7244.1	25.12	13487	0.661	1.10	0.50	11.27
1.270	-0.318	297.58	297.56	7243.2	25.12	13487	0.661	1.10	0.50	11.27
2.527	-0.330	297.54	297.57	7242.2	25.12	13486	0.661	1.10	0.50	11.27
3.810	-0.318	297.55	297.58	7241.2	25.13	13486	0.661	1.10	0.50	11.27
5.080	-0.318	297.54	297.60	7240.2	25.13	13486	0.661	1.10	0.50	11.27
6.363	-0.318	297.55	297.61	7239.2	25.14	13485	0.661	1.10	0.50	11.27
7.620	-0.330	297.55	297.62	7238.3	25.14	13485	0.661	1.10	0.50	11.27
8.905	-0.305	297.55	297.63	7237.3	25.15	13485	0.661	1.10	0.50	11.27
10.160	-0.318	297.53	297.64	7236.3	25.15	13484	0.661	1.10	0.50	11.27
11.430	-0.318	297.53	297.65	7235.3	25.15	13484	0.661	1.10	0.50	11.27
12.700	-0.305	297.52	297.67	7234.4	25.16	13484	0.661	1.10	0.50	11.27
13.970	-0.318	297.54	297.68	7233.4	25.16	13483	0.661	1.10	0.50	11.27
15.240	-0.953	297.53	297.69	7232.4	25.17	13483	0.661	1.10	0.50	11.27
2.527	-2.225	297.53	297.57	7242.2	25.12	13486	0.661	1.10	0.50	11.27
5.080	-2.235	297.49	297.60	7240.2	25.13	13486	0.661	1.10	0.50	11.27
7.607	-2.235	297.51	297.62	7238.3	25.14	13485	0.661	1.10	0.50	11.27
10.173	-2.225	297.52	297.64	7236.3	25.15	13484	0.661	1.10	0.50	11.27
12.700	-2.225	297.49	297.67	7234.4	25.16	13484	0.661	1.10	0.50	11.27
2.540	2.197	297.55	297.57	7242.2	25.12	13486	0.661	1.10	0.50	11.27
5.080	2.225	297.54	297.60	7240.2	25.13	13486	0.661	1.10	0.50	11.27
7.620	2.223	297.52	297.62	7238.3	25.14	13485	0.661	1.10	0.50	11.27
10.147	2.225	297.53	297.64	7236.3	25.15	13484	0.661	1.10	0.50	11.27
12.713	2.225	297.55	297.67	7234.3	25.16	13484	0.661	1.10	0.50	11.27
7.607	-3.495	297.49	297.62	7238.3	25.14	13485	0.661	1.10	0.50	11.27
7.633	3.495	297.52	297.62	7238.3	25.14	13485	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:24:57

TA	TB	M	P0	P0-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
297.14	297.26	25.60	7253.4	18.03	-0.01	0.00476	17.14

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.500	0.655	297.10
2.540	0.655	297.07
5.080	0.655	297.10
7.620	0.655	297.09
10.160	0.655	297.07
12.700	0.655	297.09
13.653	0.655	297.08

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	%	%
0.000	-0.965	297.07	297.05	7253.4	32.17	17341	0.661	1.10	0.50	11.27
1.270	-0.318	297.04	297.05	7251.8	32.17	17340	0.661	1.10	0.50	11.27
2.527	-0.330	297.04	297.06	7250.4	32.18	17340	0.661	1.10	0.50	11.27
3.810	-0.318	297.04	297.07	7248.8	32.19	17340	0.661	1.10	0.50	11.27
5.080	-0.318	297.05	297.08	7247.3	32.19	17340	0.661	1.10	0.50	11.27
6.363	-0.318	297.02	297.09	7245.8	32.20	17339	0.661	1.10	0.50	11.27
7.620	-0.330	297.01	297.10	7244.3	32.21	17339	0.661	1.10	0.50	11.27
8.905	-0.305	297.05	297.11	7242.8	32.22	17339	0.661	1.10	0.50	11.27
10.160	-0.318	297.03	297.11	7241.3	32.22	17338	0.661	1.10	0.50	11.27
11.430	-0.318	297.03	297.12	7239.8	32.23	17338	0.661	1.10	0.50	11.27
12.700	-0.305	297.02	297.13	7238.3	32.24	17338	0.661	1.10	0.50	11.27
13.970	-0.318	297.03	297.14	7236.8	32.25	17338	0.661	1.10	0.50	11.27
15.240	-0.953	297.04	297.15	7235.3	32.25	17337	0.661	1.10	0.50	11.27
2.527	-2.223	297.01	297.06	7250.4	32.18	17340	0.661	1.10	0.50	11.27
5.080	-2.235	297.01	297.08	7247.3	32.19	17340	0.661	1.10	0.50	11.27
7.607	-2.235	297.00	297.10	7244.4	32.21	17339	0.661	1.10	0.50	11.27
10.173	-2.223	296.99	297.12	7241.3	32.22	17338	0.661	1.10	0.50	11.27
12.700	-2.223	296.97	297.13	7238.3	32.24	17338	0.661	1.10	0.50	11.27
2.540	2.197	297.01	297.06	7250.3	32.18	17340	0.661	1.10	0.50	11.27
5.080	2.225	296.99	297.08	7247.3	32.19	17340	0.661	1.10	0.50	11.27
7.620	2.223	297.00	297.10	7244.3	32.21	17339	0.661	1.10	0.50	11.27
10.147	2.223	296.98	297.11	7241.3	32.22	17338	0.661	1.10	0.50	11.27
12.713	2.223	297.01	297.13	7238.3	32.24	17338	0.661	1.10	0.50	11.27
7.607	-3.495	296.96	297.10	7244.4	32.21	17339	0.661	1.10	0.56	11.27
7.633	3.495	296.97	297.10	7244.3	32.21	17339	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:29:52

TA	TB	M	P0	P0-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
296.23	296.38	29.87	7262.5	26.85	-0.01	0.00679	17.13

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	296.18
2.540	0.655	296.18
5.083	0.655	296.17
7.620	0.655	296.18
10.160	0.655	296.18
12.700	0.655	296.18
13.653	0.655	296.19

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	P	V	RE	PR	--Uncertainties-- Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	296.14	296.10	7262.5	37.57	20384	0.661	1.10	0.50	11.27
1.270	-0.318	296.11	296.11	7260.6	37.58	20383	0.661	1.10	0.50	11.27
2.527	-0.330	296.12	296.12	7258.4	37.60	20383	0.661	1.10	0.50	11.27
3.810	-0.318	296.14	296.13	7256.3	37.61	20383	0.661	1.10	0.50	11.27
5.080	-0.318	296.13	296.14	7254.2	37.62	20382	0.661	1.10	0.50	11.27
6.363	-0.318	296.10	296.15	7252.1	37.63	20382	0.661	1.10	0.50	11.27
7.620	-0.330	296.10	296.16	7250.1	37.64	20381	0.661	1.10	0.50	11.27
8.903	-0.305	296.10	296.17	7248.0	37.65	20381	0.661	1.10	0.50	11.27
10.160	-0.318	296.09	296.18	7245.9	37.67	20381	0.661	1.10	0.50	11.27
11.430	-0.318	296.11	296.20	7243.8	37.68	20380	0.661	1.10	0.50	11.27
12.700	-0.305	296.10	296.21	7241.8	37.69	20380	0.661	1.10	0.50	11.27
13.970	-0.318	296.10	296.22	7239.7	37.70	20379	0.661	1.10	0.50	11.27
15.240	-0.953	296.59	296.23	7237.6	37.71	20379	0.661	1.10	0.50	11.27
2.527	-2.223	296.07	296.12	7258.4	37.66	20383	0.661	1.10	0.50	11.27
5.080	-2.235	296.13	296.14	7254.2	37.62	20382	0.661	1.10	0.50	11.27
7.607	-2.235	296.10	296.16	7250.1	37.64	20381	0.661	1.10	0.50	11.27
10.173	-2.223	296.06	296.18	7245.9	37.67	20381	0.661	1.10	0.50	11.27
12.700	-2.223	296.06	296.21	7241.8	37.69	20380	0.661	1.10	0.50	11.27
2.540	2.197	296.09	296.12	7258.3	37.60	20383	0.661	1.10	0.50	11.27
5.080	2.223	296.08	296.14	7254.2	37.62	20382	0.661	1.10	0.50	11.27
7.620	2.223	296.07	296.16	7250.1	37.64	20381	0.661	1.10	0.50	11.27
10.147	2.223	296.11	296.18	7245.9	37.67	20381	0.661	1.10	0.50	11.27
12.713	2.223	296.07	296.21	7241.7	37.69	20380	0.661	1.10	0.50	11.27
7.607	-3.493	296.02	296.16	7250.1	37.64	20381	0.661	1.10	0.50	11.27
7.633	3.493	296.06	296.16	7250.0	37.64	20381	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:34:35

TA	TB	M	P0	P0-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
295.19	295.35	39.85	7268.2	40.65	-0.01	0.00434	17.13

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	295.13
2.540	0.655	295.14
5.080	0.655	295.13
7.620	0.655	295.14
10.160	0.655	295.13
12.700	0.655	295.16
13.653	0.655	295.15

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	295.12	294.94	7268.2	50.27	27463	0.661	1.10	0.50	11.27
1.270	-0.318	295.07	294.95	7264.8	50.29	27462	0.661	1.10	0.50	11.27
2.527	-0.330	295.08	294.97	7261.5	50.31	27461	0.661	1.10	0.50	11.27
3.810	-0.318	295.11	294.98	7258.1	50.34	27461	0.661	1.10	0.50	11.27
5.080	-0.318	295.09	294.99	7254.7	50.37	27460	0.661	1.10	0.50	11.27
6.363	-0.318	295.08	295.00	7251.3	50.39	27460	0.661	1.10	0.50	11.27
7.620	-0.330	295.07	295.02	7247.9	50.41	27459	0.661	1.10	0.50	11.27
8.903	-0.305	295.09	295.03	7244.5	50.44	27459	0.661	1.10	0.50	11.27
10.160	-0.318	295.07	295.04	7241.1	50.46	27458	0.661	1.10	0.50	11.27
11.430	-0.318	295.06	295.05	7237.7	50.49	27458	0.661	1.10	0.50	11.27
12.700	-0.305	295.07	295.06	7234.4	50.51	27457	0.661	1.10	0.50	11.27
13.970	-0.318	295.08	295.08	7231.0	50.54	27456	0.661	1.10	0.50	11.27
15.240	-0.953	295.08	295.09	7227.6	50.56	27456	0.661	1.10	0.50	11.27
2.527	-2.223	295.04	294.97	7261.5	50.31	27461	0.661	1.10	0.50	11.27
5.080	-2.235	295.20	294.99	7254.7	50.37	27460	0.661	1.10	0.50	11.27
7.607	-2.235	295.10	295.02	7247.9	50.41	27459	0.661	1.10	0.50	11.27
10.173	-2.223	295.05	295.04	7241.1	50.46	27458	0.661	1.10	0.50	11.27
12.700	-2.223	[illegible]	[illegible]	7234.4	50.51	27457	0.661	1.10	0.50	11.27
2.540	2.197	295.04	294.97	[illegible]	50.31	27461	0.661	1.10	0.50	11.27
5.080	2.223	295.07	294.99	7254.7	[illegible]	[illegible]	0.661	1.10	0.50	11.27
7.620	2.223	295.06	295.02	7247.9	50.41	27459	0.661	1.10	[illegible]	11.27
10.147	2.223	295.06	295.04	7241.2	50.46	27458	0.661	1.10	0.50	11.27
12.713	2.223	295.07	295.06	7234.3	50.51	27457	0.661	1.10	0.50	11.27
7.607	-3.493	295.01	295.02	7247.9	[illegible]	27459	0.661	1.10	0.50	11.27
7.633	3.493	295.06	295.02	7247.9	[illegible]	27459	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:39:03

TA	TB	M	PO	PO-P1	Vf	f	Uf
K	K	kg/h	kPa	kPa	%		%
294.68	294.81	16.59	7326.4	8.10	-0.01	0.00537	17.20

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.508	0.655	294.74
2.540	0.655	294.75
5.080	0.655	294.72
7.620	0.655	294.74
10.160	0.655	294.73
12.700	0.655	294.75
13.653	0.655	294.78

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Utw	Utf	Ure
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	294.73	294.64	7326.4	20.15	11111	0.661	1.10	0.50	11.27
1.270	-0.318	294.71	294.65	7325.8	20.15	11111	0.661	1.10	0.50	11.27
2.527	-0.330	294.71	294.66	7325.1	20.15	11110	0.661	1.10	0.50	11.27
3.810	-0.318	294.73	294.67	7324.4	20.16	11110	0.661	1.10	0.50	11.27
5.080	-0.318	294.71	294.68	7323.7	20.16	11110	0.661	1.10	0.50	11.27
6.363	-0.318	294.71	294.69	7323.1	20.16	11110	0.661	1.10	0.50	11.27
7.620	-0.330	294.71	294.70	7322.4	20.16	11109	0.661	1.10	0.50	11.27
8.903	-0.305	294.73	294.71	7321.7	20.17	11109	0.661	1.10	0.50	11.27
10.160	-0.318	294.72	294.72	7321.0	20.17	11109	0.661	1.10	0.50	11.27
11.430	-0.318	294.71	294.73	7320.4	20.17	11109	0.661	1.10	0.50	11.27
12.700	-0.305	294.71	294.74	7319.7	20.17	11109	0.661	1.10	0.50	11.27
13.970	-0.318	294.73	294.75	7319.0	20.18	11108	0.661	1.10	0.50	11.27
15.240	-0.953	294.74	294.76	7318.3	20.18	11108	0.661	1.10	0.50	11.27
2.527	-2.223	294.70	294.66	7325.1	20.15	11110	0.661	1.10	0.50	11.27
5.080	-2.235	294.80	294.68	7323.7	20.16	11110	0.661	1.10	0.50	11.27
7.607	-2.235	294.72	294.70	7322.4	20.16	11109	0.661	1.10	0.50	11.27
10.173	-2.223	294.72	294.72	7321.0	20.17	11109	0.661	1.10	0.50	11.27
12.700	-2.223	294.68	294.74	7319.7	20.17	11109	0.661	1.10	0.50	11.27
2.540	2.197	294.76	294.66	7325.1	20.15	11110	0.661	1.10	0.50	11.27
5.080	2.223	294.74	294.68	7323.7	20.16	11110	0.661	1.10	0.50	11.27
7.620	2.223	294.74	294.70	7322.4	20.16	11109	0.661	1.10	0.50	11.27
10.147	2.223	294.73	294.72	7321.0	20.17	11109	0.661	1.10	0.50	11.27
12.713	2.223	294.75	294.74	7319.7	20.17	11109	0.661	1.10	0.50	11.27
7.607	-3.493	294.71	294.70	7322.4	20.16	11109	0.661	1.10	0.50	11.27
7.633	3.493	294.76	294.70	7322.4	20.16	11109	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 2
Date: 6 August 1990
Time: 09:42:20

TA	TB	M	PO	PO-P1	Vf	f	Wf
K	K	kg/h	kPa	kPa	%		%
294.62	294.74	7.78	7343.6	2.03	-0.01	0.00641	18.40

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	294.67
2.540	0.655	294.68
5.080	0.655	294.68
7.620	0.655	294.70
10.160	0.655	294.68
12.700	0.655	294.67
13.653	0.655	294.69

Insulated-Side Temperatures and Calculated Data:

								--Uncertainties--		
X	Y	Tw	Tf	P	V	RE	PR	Wtw	Wtf	Wre
cm	cm	K	K	kPa	m/s			K	K	%
0.000	-0.965	294.65	294.61	7343.6	9.22	5098	0.661	1.10	0.50	11.27
1.270	-0.318	294.66	294.62	7343.4	9.22	5098	0.661	1.10	0.50	11.27
2.527	-0.330	294.66	294.63	7343.3	9.23	5098	0.661	1.10	0.50	11.27
3.810	-0.318	294.69	294.64	7343.1	9.23	5098	0.661	1.10	0.50	11.27
5.080	-0.318	294.66	294.65	7342.9	9.23	5098	0.661	1.10	0.50	11.27
6.363	-0.318	294.67	294.66	7342.8	9.23	5098	0.661	1.10	0.50	11.27
7.620	-0.330	294.66	294.67	7342.6	9.23	5098	0.661	1.10	0.50	11.27
8.903	-0.305	294.66	294.68	7342.4	9.23	5098	0.661	1.10	0.50	11.27
10.160	-0.318	294.67	294.69	7342.2	9.23	5098	0.661	1.10	0.50	11.27
11.430	-0.318	294.64	294.70	7342.1	9.23	5097	0.661	1.10	0.50	11.27
12.700	-0.305	294.66	294.71	7341.9	9.23	5097	0.661	1.10	0.50	11.27
13.970	-0.318	294.67	294.72	7341.7	9.23	5097	0.661	1.10	0.50	11.27
15.240	-0.953	294.67	294.73	7341.6	9.23	5097	0.661	1.10	0.50	11.27
2.527	-2.223	294.66	294.63	7343.3	9.23	5098	0.661	1.10	0.50	11.27
5.080	-2.235	294.71	294.65	7342.9	9.23	5098	0.661	1.10	0.50	11.27
7.607	-2.235	294.67	294.67	7342.6	9.23	5098	0.661	1.10	0.50	11.27
10.173	-2.223	294.67	294.69	7342.2	9.23	5098	0.661	1.10	0.50	11.27
12.700	-2.223	294.66	294.71	7341.9	9.23	5097	0.661	1.10	0.50	11.27
2.540	2.197	294.68	294.63	7343.3	9.23	5098	0.661	1.10	0.50	11.27
5.080	2.223	294.69	294.65	7342.9	9.23	5098	0.661	1.10	0.50	11.27
7.620	2.223	294.70	294.67	7342.6	9.23	5098	0.661	1.10	0.50	11.27
10.147	2.223	294.68	294.69	7342.3	9.23	5096	0.661	1.10	0.50	11.27
12.713	2.223	294.70	294.71	7341.9	9.23	5097	0.661	1.10	0.50	11.27
7.607	-3.493	294.64	294.67	7342.6	9.23	5098	0.661	1.10	0.50	11.27
7.633	3.493	294.70	294.67	7342.6	9.23	5098	0.661	1.10	0.50	11.27

Table 3 (continued)

Channel Specimen
Experiment 3
Date: 6 August 1990
Time: 15:01:28

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
299.70	699.35	4.06	3443.6	3.92	26.13	2342.0	1.04

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	486.71
2.540	0.655	519.83
5.080	0.655	599.49
7.620	0.655	669.22
10.160	0.655	727.07
12.700	0.655	769.69
13.653	0.655	778.98

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	---------Uncertainties--------- Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² · K)			K	K	%	%	%
0.000	-0.965	387.89	299.70	299.70	3443.6	10.06	2597	0.665	1552	9.44	10.88	1.10	2.16	11.27	11.60	12.60
1.270	-0.318	455.51	333.01	333.02	3443.3	11.15	2418	0.665	1531	8.67	10.30	1.10	3.47	11.27	5.00	7.02
2.527	-0.330	505.10	366.25	365.27	3443.0	12.25	2266	0.665	1223	6.[illegible]0	7.76	1.10	4.59	11.27	5.54	7.41
3.810	-0.318	547.83	397.94	397.95	3442.7	13.30	2141	0.666	1109	5.56	6.63	1.10	6.12	11.27	6.06	7.81
5.080	-0.318	585.29	429.63	429.65	3442.3	14.34	2031	0.666	1097	5.22	6.19	1.25	7.80	11.27	6.67	8.29
6.363	-0.318	621.45	462.33	462.35	3442.0	15.42	1931	0.666	1085	4.91	5.78	1.39	9.57	11.27	7.43	8.9[illegible]
7.620	-0.330	654.47	494.45	494.48	3441.7	16.48	1843	0.666	1077	4.65	5.43	1.52	11.32	11.27	[illegible].33	9.[illegible]7
8.903	-0.305	685.24	527.18	527.21	3441.4	17.56	1763	0.666	1088	4.50	5.20	1.65	12.71	11.27	9.18	10.41
10.160	-0.318	713.25	559.03	559.05	3441.0	18.62	1693	0.666	1098	4.36	4.99	1.76	14.15	11.27	10.[illegible]	11.35
11.430	-0.318	736.90	590.41	590.44	3440.7	19.65	1630	0.666	1122	4.29	4.85	1.86	15.64	11.27	11.65	12.64
12.700	-0.305	757.29	621.38	621.42	3440.4	20.68	1573	0.666	1234	4.55	5.07	1.94	17.18	11.27	13.47	14.35
13.970	-0.318	767.11	654.51	654.55	3440.[illegible]	21.77	1517	0.666	1640	5.83	6.36	1.98	18.91	11.27	17.37	18.05
15.240	-0.953	754.41	686.86	686.90	3439.7	22.84	1466	0.666	1897	6.52	6.87	1.92	20.48	11.27	33.00	33.37
2.527	-2.223	512.47	368.16	368.17	3443.0	11.97	2195	0.666	1177	6.23	7.47	1.10	4.59	11.27	5.46	7.35
5.080	-2.235	589.97	433.35	433.37	3442.3	14.06	1963	0.666	1090	5.16	6.11	1.27	7.80	11.27	6.65	8.27
7.607	-2.235	664.29	499.68	499.70	3441.7	16.19	1779	0.666	1047	4.49	5.25	1.57	11.30	11.27	8.15	9.5[illegible]
10.173	-2.223	727.11	566.78	566.80	3441.0	18.35	1630	0.666	1056	4.15	4.76	1.82	14.17	11.27	9.92	11.07
12.700	-2.223	770.75	630.58	630.62	3440.4	20.40	1513	0.666	1196	4.36	4.87	1.99	17.18	11.27	13.11	14.01
2.540	2.197	513.52	369.02	369.03	3443.0	11.91	2175	0.666	1175	6.20	7.44	1.10	4.60	11.27	5.47	7.36
5.080	2.223	595.89	434.37	434.39	3442.3	13.99	1945	0.666	1057	4.99	5.94	1.29	7.80	11.27	6.53	8.18
7.620	2.223	667.40	501.55	501.58	3441.7	16.13	1761	0.666	1039	4.45	5.21	1.58	11.32	11.27	8.12	9.49
10.147	2.223	725.17	568.14	568.17	3441.0	18.25	1615	0.666	1079	4.23	4.84	1.81	14.14	11.27	10.07	11.21
12.713	2.223	766.30	633.45	633.48	3440.4	20.33	1497	0.666	1263	4.59	5.10	1.97	17.20	11.27	13.77	14.62
7.607	-3.493	672.38	504.12	504.14	3441.7	15.98	1730	0.666	1024	4.37	5.12	1.60	11.30	11.27	8.02	9.41
7.633	3.493	683.86	510.78	510.80	3441.7	15.73	1666	0.666	996	4.21	4.94	1.64	11.34	11.27	7.88	9.29

Table 3 (continued)

Channel Specimen
Experiment 3
Date: 6 August 1990
Time: 15:10:52

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
298.61	513.76	8.41	3437.8	8.59	26.13	2608.0	1.07

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	404.89
2.540	0.655	420.92
5.080	0.655	458.73
7.620	0.655	497.67
10.160	0.655	534.76
12.700	0.655	551.60
13.653	0.655	557.13

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties----------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² · K)			K	K	%	%	%
0.000	-0.965	344.89	298.57	298.61	3437.8	21.26	5515	0.665	3295	20.08	21.74	1.10	1.24	11.27	11.83	12.81
1.270	-0.318	384.19	316.08	316.12	3437.1	22.49	5307	0.665	3070	18.01	20.05	1.10	1.91	11.27	5.17	7.14
2.527	-0.330	408.25	333.56	333.61	3436.4	23.72	5117	0.665	2535	14.34	16.03	1.10	2.49	11.27	5.71	7.54
3.810	-0.318	428.63	350.21	350.27	3435.7	24.89	4950	0.665	2363	12.93	14.45	1.10	3.31	11.27	6.28	7.98
5.080	-0.318	446.82	366.88	366.93	3434.9	26.06	4795	0.666	2380	12.62	14.07	1.10	4.21	11.27	6.96	8.53
6.363	-0.318	465.42	384.06	384.12	3434.2	27.26	4648	0.666	2365	12.16	13.52	1.10	5.16	11.27	7.78	9.20
7.620	-0.330	484.05	400.95	401.02	3433.5	28.45	4513	0.666	2312	11.54	12.80	1.10	6.10	11.27	8.61	9.92
8.903	-0.305	503.79	418.15	418.23	3432.8	29.67	4384	0.666	2239	10.86	12.03	1.10	6.85	11.27	9.18	10.41
10.160	-0.318	519.72	434.89	434.97	3432.1	30.84	4267	0.666	2226	10.51	11.59	1.10	7.63	11.27	10.08	11.22
11.430	-0.318	532.90	451.39	451.47	3431.4	32.01	4159	0.666	2248	10.34	11.33	1.10	8.43	11.27	11.36	12.38
12.700	-0.305	542.26	467.67	467.76	3430.6	33.15	4059	0.666	2507	11.26	12.21	1.10	9.26	11.27	13.28	14.16
13.970	-0.318	547.46	485.08	485.18	3429.9	34.38	3958	0.666	3302	14.46	15.45	1.10	10.19	11.27	16.95	17.65
15.240	-0.953	536.48	502.08	502.19	3429.2	35.58	3864	0.666	4160	17.79	18.45	1.10	11.03	11.27	34.73	35.08
2.527	-2.223	414.71	335.35	335.39	3436.4	22.68	4851	0.665	2385	13.45	15.12	1.10	2.49	11.27	5.57	7.43
5.080	-2.235	459.30	370.36	370.41	3434.9	25.03	4534	0.666	2139	11.27	12.69	1.10	4.21	11.27	6.54	8.18
7.607	-2.235	493.32	405.99	406.05	3433.5	27.41	4257	0.666	2199	10.89	12.12	1.10	6.09	11.27	8.29	9.64
10.173	-2.223	527.78	442.02	442.10	3432.1	29.82	4015	0.666	2201	10.28	11.33	1.10	7.63	11.27	10.00	11.15
12.700	-2.223	551.80	476.29	476.38	3430.6	32.12	3814	0.666	2475	10.98	11.91	1.12	9.26	11.27	13.13	14.03
2.540	2.197	414.37	336.04	336.08	3436.4	22.42	4778	0.665	2415	13.59	15.25	1.10	2.50	11.27	5.61	7.46
5.080	2.223	454.92	371.36	371.41	3434.9	24.75	4463	0.666	2277	11.98	13.39	1.10	4.21	11.27	6.78	8.38
7.620	2.223	496.21	407.67	407.73	3433.5	27.15	4187	0.666	2169	10.71	11.93	1.10	6.10	11.27	8.22	9.58
10.147	2.223	530.94	443.66	443.73	3432.1	29.52	3950	0.666	2164	10.08	11.13	1.10	7.62	11.27	9.84	11.01
12.713	2.223	550.08	478.95	479.03	3430.6	31.86	3747	0.666	2630	11.62	12.54	1.11	9.27	11.27	13.86	14.7[illegible]
7.607	-3.493	501.51	410.50	410.56	3433.5	26.59	4055	0.666	2111	10.37	11.58	1.10	6.09	11.27	8.05	9.43
7.633	3.493	510.99	415.94	415.99	3433.5	25.78	3845	0.666	2021	9.84	11.02	1.10	6.11	11.27	7.82	9.24

Table 3 (continued)

Channel Specimen
Experiment 3
Date: 6 August 1990
Time: 15:17:37

TA	TB	M	PO	PO-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
297.87	419.79	14.96	3441.3	20.86	26.14	2625.0	1.17

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	364.10
2.540	0.655	372.15
5.080	0.655	392.15
7.620	0.655	413.26
10.160	0.655	429.28
12.700	0.655	443.74
13.653	0.655	450.48

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			$W/(m^2 \cdot K)$			K	K	%	%	%
0.000	-0.965	322.86	297.73	297.86	3441.3	38.31	9995	0.665	6140	37.48	39.19	1.10	0.81	11.27	12.54	13.47
1.270	-0.318	347.35	307.47	307.60	3439.5	39.56	9782	0.665	5291	31.62	33.81	1.10	1.15	11.27	5.70	7.53
2.527	-0.330	360.31	317.19	317.33	3437.8	40.81	9578	0.665	4431	25.93	27.81	1.10	1.46	11.27	6.12	7.86
3.810	-0.318	371.12	326.45	326.60	3436.1	42.01	9393	0.665	4186	24.03	25.79	1.10	1.90	11.27	6.65	8.27
5.080	-0.318	380.62	335.71	335.87	3434.3	43.20	9216	0.665	4277	24.09	25.81	1.10	2.41	11.27	7.35	8.84
6.363	-0.318	390.57	345.27	345.43	3432.6	44.44	9042	0.665	4288	23.70	25.36	1.10	2.94	11.27	8.18	9.55
7.620	-0.330	400.57	354.66	354.83	3430.8	45.65	8878	0.665	4225	22.93	24.52	1.10	3.47	11.27	9.06	10.31
8.903	-0.305	410.96	364.22	364.41	3429.1	46.88	8719	0.666	4142	22.07	23.59	1.10	3.89	11.27	9.71	10.88
10.160	-0.318	417.83	373.53	373.72	3427.4	48.09	8570	0.666	4305	22.56	23.99	1.10	[illegible]	11.27	11.04	12.09
11.430	-0.318	425.34	382.70	382.90	3425.6	49.28	8429	0.666	4342	22.37	23.71	1.10	4.79	11.27	12.42	13.36
12.700	-0.305	433.26	391.75	391.97	3423.9	50.45	8295	0.666	4551	23.08	24.39	1.10	5.26	11.27	13.75	14.60
13.970	-0.318	440.02	401.43	401.66	3422.1	51.71	8157	0.666	5396	26.91	28.30	1.10	5.78	11.27	15.88	16.63
15.240	-0.953	433.95	410.89	411.12	3420.4	52.94	8028	0.666	6291	30.88	31.82	1.10	6.26	11.27	30.62	31.01
2.527	-2.223	364.38	318.65	318.77	3437.8	38.18	8891	0.665	4175	24.36	26.22	1.10	1.46	11.27	5.96	7.73
5.080	-2.235	392.60	338.55	338.68	3434.3	40.56	8533	0.665	3549	19.88	21.57	1.10	2.41	11.27	6.56	8.20
7.607	-2.235	408.07	358.79	358.95	3430.9	42.99	8202	0.665	3933	21.18	22.73	1.10	3.46	11.27	8.57	9.88
10.173	-2.223	425.35	379.27	379.44	3427.3	45.46	7897	0.666	4135	21.44	22.84	1.10	4.34	11.27	10.69	11.77
12.700	-2.223	441.04	398.74	398.93	3423.9	47.80	7631	0.666	4463	22.36	23.63	1.10	5.26	11.27	13.51	14.38
2.540	2.197	364.73	318.75	318.87	3437.8	38.19	8889	0.665	4149	24.20	26.06	1.10	1.46	11.27	5.95	7.72
5.080	2.223	386.84	338.54	338.68	3434.3	40.56	8533	0.665	3974	22.26	23.95	1.10	2.41	11.27	7.01	8.57
7.620	2.223	408.15	358.89	359.05	3430.8	43.01	8201	0.665	3934	21.18	22.73	1.10	3.47	11.27	8.58	9.89
10.147	2.223	424.62	379.06	379.23	3427.4	45.43	7900	0.666	4184	21.70	23.10	1.10	4.33	11.27	10.77	11.84
12.713	2.223	440.54	398.83	399.02	3423.9	47.82	7630	0.666	4530	22.69	23.97	1.10	5.26	11.27	13.70	14.55
7.607	-3.493	417.61	364.10	364.23	3430.9	40.15	7473	0.665	3620	19.30	20.81	1.10	3.46	11.27	8.06	9.45
7.633	3.493	419.11	365.06	365.19	3430.8	39.81	7379	0.666	3583	19.07	20.57	1.10	3.47	11.27	8.02	9.41

Table 3 (continued)

Channel Specimen
Experiment 3
Date: 6 August 1990
Time: 15:22:37

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
297.80	387.89	20.00	3447.3	33.13	26.15	2597.0	1.29

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	351.35
2.540	0.655	356.94
5.080	0.655	371.58
7.620	0.655	387.22
10.160	0.655	399.16
12.700	0.655	410.28
13.653	0.655	415.78

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² ·K)			K	K	%	%	%
0.000	-0.965	316.30	297.55	297.77	3447.3	51.66	13514	0.665	8194	50.04	51.75	1.10	0.69	11.27	13.29	14.17
1.270	-0.318	335.98	304.67	304.91	3444.5	52.92	13301	0.665	6695	40.26	42.49	1.10	0.90	11.27	6.14	7.87
2.527	-0.330	345.50	311.78	312.03	3441.8	54.17	13096	0.665	5628	33.32	35.26	1.10	1.11	11.27	6.45	8.11
3.810	-0.318	353.49	318.55	318.81	3439.0	55.37	12907	0.665	5317	31.03	32.86	1.10	1.43	11.27	6.87	8.45
5.080	-0.318	360.42	325.33	325.60	3436.2	56.58	12724	0.665	5436	31.28	33.09	1.10	1.80	11.27	7.47	8.95
6.363	-0.318	367.73	332.32	332.60	3433.4	57.82	12542	0.665	5450	30.91	32.68	1.10	2.18	11.27	8.21	9.57
7.620	-0.330	375.12	339.18	339.48	3430.7	59.04	12369	0.665	5363	30.00	31.71	1.10	2.58	11.27	8.98	10.24
8.903	-0.305	382.95	346.18	346.49	3427.9	60.29	12198	0.665	5230	28.85	30.50	1.10	2.89	11.27	9.53	10.72
10.160	-0.318	387.99	352.99	353.31	3425.2	61.50	12037	0.665	5415	29.48	31.05	1.10	3.21	11.27	10.74	11.81
11.430	-0.318	393.77	359.70	360.03	3422.4	62.71	11884	0.665	5400	29.03	30.51	1.10	3.55	11.27	11.90	12.88
12.700	-0.305	399.84	366.32	366.66	3419.7	63.89	11737	0.666	5602	29.74	31.21	1.10	3.89	11.27	13.00	13.90
13.970	-0.318	405.37	373.39	373.75	3416.9	65.16	11585	0.666	6478	33.95	35.52	1.10	4.28	11.27	14.59	15.40
15.240	-0.953	400.15	380.31	380.68	3414.1	66.41	11440	0.666	729	37.76	38.83	1.10	4.64	11.27	27.59	28.03
2.527	-2.223	348.65	313.06	313.27	3441.8	50.03	12012	0.665	5325	31.44	33.36	1.10	1.11	11.27	6.27	7.97
5.080	-2.235	371.72	327.80	328.03	3436.2	52.43	11643	0.665	4334	24.81	26.59	1.10	1.80	11.27	6.52	8.17
7.607	-2.235	381.79	342.79	343.05	3430.7	54.87	11295	0.665	4933	27.40	29.07	1.10	2.57	11.27	8.43	9.76
10.173	-2.223	394.29	357.95	358.23	3425.2	57.35	10967	0.665	5207	28.08	29.61	1.10	3.21	11.27	10.41	11.51
12.700	-2.223	406.38	372.37	372.67	3419.7	59.73	10675	0.666	5515	28.96	30.39	1.10	3.89	11.27	12.82	13.73
2.540	2.197	348.98	312.95	313.17	3441.7	50.61	12159	0.665	5256	31.04	32.96	1.10	1.12	11.27	6.24	7.94
5.080	2.223	365.33	327.43	327.67	3436.2	53.00	11792	0.665	5027	28.80	30.59	1.10	1.80	11.27	7.11	8.65
7.620	2.223	380.86	342.33	342.58	3430.7	55.46	11441	0.665	4993	27.76	29.44	1.10	2.58	11.27	8.51	9.83
10.147	2.223	393.73	357.08	357.36	3425.2	57.90	11117	0.665	5167	27.91	29.45	1.10	3.21	11.27	10.32	11.43
12.713	2.223	405.93	371.55	371.86	3419.6	60.31	10820	0.666	5460	28.71	30.14	1.10	3.90	11.27	12.71	13.63
7.607	-3.493	391.66	348.16	348.37	3430.7	49.86	10002	0.665	4415	24.26	25.88	1.10	2.57	11.27	7.79	9.21
7.633	3.493	390.45	347.60	347.81	3430.7	50.51	10158	0.665	4482	24.66	26.29	1.10	2.58	11.27	7.88	9.29

Table 3 (continued)

Channel Specimen
Experiment 3
Date: 6 August 1990
Time: 15:27:56

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
297.58	358.53	29.39	3449.5	62.41	26.17	2580.0	1.55

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	338.81
2.540	0.655	342.26
5.080	0.655	352.06
7.620	0.655	362.66
10.160	0.655	370.67
12.700	0.655	378.30
13.653	0.655	382.52

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² · K)			K	K	%	%	%
0.000	-0.965	310.12	297.01	297.51	3449.5	76.77	20155	0.665	11959	73.12	74.88	1.10	0.59	11.27	15.05	15.83
1.270	-0.318	324.85	301.75	302.27	3444.3	78.09	19943	0.665	9154	55.40	57.69	1.10	0.70	11.27	7.12	8.66
2.527	-0.330	331.26	306.49	307.02	3439.2	79.41	19735	0.665	7721	46.24	48.26	1.10	0.81	11.27	7.24	8.75
3.810	-0.318	336.69	310.99	311.54	3433.9	80.68	19541	0.665	7285	43.21	45.14	1.10	1.01	11.27	7.49	8.96
5.080	-0.318	341.27	315.51	316.07	3428.7	81.95	19352	0.665	7464	43.84	45.77	1.10	1.25	11.27	7.97	9.36
6.363	-0.318	346.15	320.16	320.74	3423.5	83.27	19161	0.665	7486	43.54	45.45	1.10	1.50	11.27	8.56	9.87
7.620	-0.330	351.14	324.73	325.33	3418.3	84.56	18978	0.665	7356	42.38	44.24	1.10	1.76	11.27	9.18	10.42
8.903	-0.305	356.68	329.38	330.00	3413.1	85.88	18796	0.665	7102	40.52	42.33	1.10	1.97	11.27	9.55	10.74
10.160	-0.318	359.8[illegible]	333.91	334.55	3407.9	87.18	18623	0.665	7390	41.78	43.53	1.10	2.19	11.27	10.69	11.77
11.430	-0.318	363.83	338.38	339.04	3402.7	88.46	18456	0.665	7303	40.92	42.59	1.10	2.42	11.27	11.66	12.65
12.700	-0.305	367.92	342.78	343.46	3397.5	89.72	18294	0.665	7550	41.94	43.60	1.10	2.65	11.27	12.60	13.52
13.970	-0.318	372.16	347.49	348.19	3392.3	91.08	18125	0.665	8490	46.72	48.52	1.10	2.92	11.27	13.68	14.54
15.240	-0.953	367.85	352.09	352.81	3387.1	92.40	17963	0.665	9386	51.20	52.45	1.10	3.16	11.27	25.64	26.11
2.527	-2.223	333.40	307.59	308.02	3439.2	72.14	17822	0.665	7376	44.07	46.07	1.10	0.81	11.27	7.04	8.59
5.080	-2.235	352.09	317.56	318.03	3428.7	74.66	17442	0.665	5521	32.29	34.18	1.10	1.25	11.27	6.62	3.25
7.607	-2.235	356.70	327.70	328.20	3418.4	77.24	17075	0.665	6663	38.15	39.97	1.10	1.76	11.27	8.52	9.84
10.173	-2.223	364.54	337.96	338.49	3407.9	79.86	16721	0.665	7162	40.16	41.87	1.10	2.19	11.27	10.43	11.53
12.700	-2.223	372.83	347.71	348.28	3397.5	82.38	16401	0.665	7523	41.38	43.00	1.10	2.65	11.27	12.56	13.49
2.540	2.197	333.80	307.36	307.82	3439.1	73.86	18270	0.665	7198	43.03	45.03	1.10	0.82	11.27	6.95	8.51
5.080	2.223	344.86	317.04	317.53	3428.7	76.38	17891	0.665	6883	40.30	42.21	1.10	1.25	11.27	7.55	9.01
7.620	2.223	355.33	326.99	327.51	3418.3	78.97	17521	0.665	6827	39.15	40.98	1.10	1.76	11.27	8.68	9.98
10.147	2.223	364.18	336.85	337.41	3408.0	81.56	17171	0.665	6972	39.19	40.91	1.10	2.19	11.27	10.19	11.32
12.713	2.223	372.67	346.52	347.11	3397.5	84.12	16844	0.665	7233	39.88	41.51	1.10	2.65	11.27	12.14	13.10
7.607	-3.493	366.44	332.88	333.27	3418.4	67.36	14507	0.665	5725	32.43	34.19	1.10	1.76	11.27	7.66	9.11
7.633	3.493	363.32	331.30	331.71	3418.3	70.32	15265	0.665	6008	34.15	35.93	1.10	1.76	11.27	7.93	9.33

Table 3 (continued)

Channel Specimen
Experiment 3
Date: 6 August 1990
Time: 15:32:39

TA	TB	M	PO	PO-P1	Vf	Gt	Wgt
K	K	kg/h	kPa	kPa	%	W	%
297.08	341.84	39.79	3447.6	105.75	26.17	2564.0	[illegible].88

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.500	0.355	331.08
2.540	0.655	333.33
5.080	0.655	340.55
7.620	0.655	348.32
10.160	0.655	354.08
12.700	0.655	359.61
13.653	0.655	363.11

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tmw	P	V	RE	PR	h	NU	NUo	Utw	Utf	Ure	Uh	Unu
												----------Uncertainties----------				
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	306.32	296.02	296.95	3447.6	104.87	27668	0.665	15994	98.00	99.86	1.10	0.55	11.27	17.38	18.06
1.270	-0.318	317.9[illegible]	299.45	300.40	3438.8	106.33	27459	0.665	11682	71.06	73.45	1.10	0.60	11.27	8.33	9.68
2.527	-0.330	322.67	302.87	303.85	3430.1	107.79	27250	0.665	9879	59.65	61.76	1.10	0.66	11.27	8.26	9.61
3.810	-0.318	326.72	306.13	307.13	3421.1	109.21	27054	0.665	9294	55.71	57.74	1.10	0.79	11.27	8.35	9.69
5.080	-0.318	330.01	309.39	310.42	3412.3	110.63	26862	0.663	9539	56.78	58.83	1.10	0.95	11.27	8.72	10.01
6.363	-0.318	333.54	312.75	313.81	3403.4	112.10	26666	0.665	9576	56.58	58.62	1.10	1.13	11.27	9.19	10.43
7.620	-0.330	337.19	316.05	317.14	3394.7	113.55	26478	0.665	9411	55.22	57.22	1.10	1.31	11.27	9.69	10.87
8.903	-0.305	341.47	319.42	320.53	3385.8	115.04	26289	0.665	8990	52.37	54.33	1.10	1.47	11.27	9.87	11.03
10.160	-0.318	343.51	322.69	323.83	3377.1	116.50	26108	0.665	9423	54.53	56.44	1.10	1.63	11.27	11.00	12.05
11.430	-0.316	346.48	325.91	327.08	[illegible]	117.94	25933	0.665	9276	53.32	55.15	1.10	1.79	11.27	11.83	12.81
12.700	-0.305	349.67	329.09	330.29	3359.5	119.39	25763	0.665	9568	54.64	56.48	1.10	1.97	11.27	12.65	13.58
13.970	-0.318	352.90	332.50	333.73	3350.7	120.91	25584	0.665	10543	59.79	61.78	1.10	2.16	11.27	13.39	14.26
15.240	-0.953	369.26	335.82	337.08	3341.8	122.42	25412	0.665	11513	64.85	66.26	1.10	2.34	11.27	24.80	25.28
2.527	-2.223	324.21	303.92	304.70	3430.1	96.56	24271	0.665	9535	57.44	59.52	1.10	0.66	11.27	8.06	9.45
5.080	-2.235	340.44	311.23	312.06	3412.3	99.35	23804	0.665	6587	39.05	41.02	1.10	0.95	11.27	6.88	8.46
7.607	-2.235	341.97	318.67	319.55	3394.8	10[illegible].20	23506	0.665	8616	49.11	51.0[illegible]	1.10	1.31	11.27	8.90	10.17
10.173	-2.222	347.11	326.20	327.13	3377.0	105.11	23158	0.665	9277	53.29	55.14	1.10	1.63	11.27	10.87	11.93
12.700	-2.223	353.21	333.35	334.33	3359.5	107.94	22800	0.665	9721	55.03	56.81	1.10	1.97	11.27	12.83	13.74
2.540	2.197	324.40	303.61	304.45	3436.0	100.06	25192	0.665	[illegible]	55.60	57.68	1.10	0.66	11.27	7.89	9.30
5.080	2.223	332.73	310.62	311.51	3412.3	102.85	24807	0.665	8807	52.28	54.29	1.10	0.95	11.27	8.24	9.60
7.620	2.223	340.39	317.8[illegible]	318.77	3394.7	105.73	24426	0.663	8727	51.01	52.97	1.10	1.31	11.27	9.15	10.38
10.147	2.223	346.80	324.97	325.96	3377.[illegible]	[illegible].62	24062	0.665	88[illegible]4	51.05	52.92	1.10	1.62	11.27	10.45	11.55
12.713	2.223	353.14	331.97	333.01	3359.4	[illegible]11.50	23717	0.665	9126	51.81	53.60	1.10	1.97	11.27	12.15	13.11
7.607	-3.493	351.36	32[illegible].64	326.31	3394.8	[illegible]	19237	0.665	6973	40.26	42.12	1.10	1.31	11.27	7.80	9.22
7.633	3.493	347.25	321.56	322.[illegible]	3394.6	92.40	20936	0.645	7556	43.82	45.71	1.10	1.32	11.27	8.25	9.60

Table 3 (continued)

Channel Specimen
Experiment 4
Date: [illegible]3 July 1990
Time: 15:06:08

TA	TB	M	P0	P0-P1	VF	QT	Uqt
K	K	kg/h	kPa	kPa	%	W	%
295.67	634.88	10.16	3595.6	14.28	49.93	4970.0	1.06

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	477.48
2.540	0.655	506.02
5.080	0.655	566.52
7.620	0.655	629.08
10.160	0.655	695.42
12.700	0.655	726.55
13.653	0.655	732.35

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUo	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	370.86	295.61	295.66	3595.6	26.60	6779	0.665	3865	23.69	26.86	1.10	1.86	11.27	11.63	12.63
1.270	-0.318	438.77	322.93	322.97	3594.4	26.86	6387	0.665	3439	19.87	23.52	1.10	2.96	11.27	4.86	6.92
2.527	-0.330	479.63	350.19	350.26	3593.2	29.08	6065	0.665	2787	15.25	18.13	1.10	3.90	11.27	5.38	7.29
3.810	-0.318	511.87	376.17	376.25	3592.0	31.21	5757	0.665	2602	13.56	16.06	1.10	5.28	11.27	5.91	7.69
5.090	-0.318	540.81	402.15	402.25	3590.9	33.35	5500	0.666	2615	13.02	15.32	1.10	6.63	11.27	6.50	8.15
6.363	-0.318	570.66	428.96	429.07	3589.6	35.55	5261	0.666	2587	12.33	14.43	1.19	8.13	11.27	7.21	8.73
7.620	-0.330	601.10	455.30	455.42	3588.5	37.72	5050	0.666	2511	11.48	13.38	1.31	9.61	11.27	7.92	9.32
8.903	-0.305	633.89	482.14	482.27	3587.3	39.93	4854	0.666	2467	10.58	12.30	1.44	10.79	11.27	8.37	9.70
10.160	-0.318	662.23	508.24	508.39	3586.1	42.08	4680	0.666	2337	9.90	11.45	1.56	12.02	11.27	9.30	10.26
11.430	-0.318	686.38	533.97	534.13	3584.9	44.20	4522	0.666	2291	9.38	10.77	1.65	13.28	11.27	9.86	11.02
12.700	-0.305	704.59	559.36	559.54	3583.7	46.30	4379	0.666	2453	9.73	11.05	1.72	14.59	11.27	11.05	12.10
13.970	-0.318	712.79	586.51	586.71	3582.5	48.54	4237	0.666	3108	11.93	13.28	1.76	16.05	11.27	13.44	14.31
15.240	-0.953	689.08	613.03	613.25	3581.3	50.73	6108	0.666	3585	13.34	14.23	1.66	17.38	11.27	26.29	26.76
2.527	-2.223	495.96	354.07	354.13	3593.2	27.45	5603	0.665	2578	14.00	16.81	1.10	3.98	11.27	5.25	7.20
5.080	-2.235	560.70	409.72	409.80	3590.9	31.72	5071	0.666	2401	11.80	14.02	1.15	6.63	11.27	6.21	7.92
7.607	-2.235	622.45	466.34	466.45	3588.5	36.07	4638	0.666	2345	10.55	12.37	1.40	9.60	11.27	7.55	9.01
10.173	-2.223	680.92	523.61	523.75	3586.1	40.47	4281	0.666	2287	9.49	10.97	1.63	12.03	11.27	8.87	10.14
12.700	-2.223	726.45	578.07	578.26	3583.7	44.67	3996	0.666	2400	9.30	10.55	1.81	14.59	11.27	10.86	11.92
2.540	2.197	488.17	354.01	354.08	3593.2	27.61	5636	0.665	2687	14.59	17.61	1.10	3.91	11.27	5.33	7.25
5.080	2.223	551.96	409.06	409.15	3590.9	31.85	5106	0.666	2537	12.49	14.73	1.12	6.63	11.27	6.39	8.07
7.620	2.223	620.86	465.65	465.76	3588.5	36.22	4670	0.666	2358	10.62	12.44	1.39	9.61	11.27	7.59	9.06
10.147	2.223	683.42	521.73	521.87	3586.1	40.56	4316	0.666	2226	9.26	10.76	1.64	12.90	11.27	8.67	9.97
12.713	2.223	720.26	576.73	576.90	3583.7	44.82	4026	0.666	2483	9.66	10.89	1.79	14.60	11.27	11.17	12.21
7.607	-3.493	645.02	478.16	478.26	3588.5	34.38	4265	0.666	2193	9.72	11.44	1.49	9.50	11.27	7.23	8.76
7.635	3.495	648.99	480.53	480.63	3588.5	34.42	4209	0.666	2172	9.57	11.29	1.50	9.62	11.27	7.28	8.72

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 20 July 1990
Time: 15:11:13

TA	TB	Q	P0	P0-P1	VF	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
295.25	533.90	14.90	3591.4	26.67	40.94	5128.0	1.86

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.308	0.655	420.33
2.540	0.655	444.46
5.080	0.655	486.10
7.620	0.655	526.70
10.160	0.653	558.40
12.700	0.655	586.03
13.653	0.695	600.46

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tau	P	V	RE	PR	h	NU	NUo	Uncertainties: UTw	UTf	URe	Uh	UNu
cm	cm	K	K	K	kPa	m/s			W/(m²-K)			K	K	%	%	%
0.000	-0.965	345.55	295.1	295.26	3591.4	36.22	9995	0.465	5900	36.57	30.08	1.10	1.35	11.27	11.79	17.76
1.270	-0.318	394.50	314.26	314.38	3586.4	38.55	9503	0.465	5127	30.18	36.20	1.10	2.11	11.27	5.00	7.00
2.527	-0.330	420.06	333.35	333.40	3587.3	40.87	9097	0.465	4250	24.00	27.31	1.10	2.76	11.27	5.55	7.42
3.810	-0.318	441.76	351.54	351.69	3585.4	43.00	8801	0.465	4063	22.87	25.6	1.10	3.67	11.27	6.14	7.87
5.080	-0.318	460.55	369.73	369.90	3583.3	45.31	8500	0.465	4126	21.75	24.54	1.10	4.67	11.27	6.84	8.42
6.363	-0.318	486.14	388.36	388.49	3581.2	47.60	8245	0.465	4136	21.08	23.48	1.10	5.72	11.27	7.40	9.12
7.620	-0.330	500.16	406.96	407.15	3579.2	49.86	8055	0.466	4058	20.06	22.45	1.10	6.77	11.27	8.53	9.85
8.903	-0.305	519.96	425.73	425.96	3577.1	52.16	7790	0.466	4006	19.19	21.42	1.10	7.30	11.27	9.23	10.46
10.160	-0.318	536.08	444.01	444.26	3575.1	54.40	7540	0.466	4129	19.21	21.28	1.10	8.46	11.27	10.45	11.55
11.430	-0.318	547.90	462.02	462.29	3573.1	56.61	7363	0.466	4200	19.01	21.01	1.10	9.35	11.27	11.86	12.86
12.700	-0.305	563.60	479.80	480.09	3571.0	58.79	7176	0.466	4306	19.30	21.11	1.16	10.27	11.27	13.15	14.06
13.970	-0.318	577.34	498.81	499.12	3569.0	61.13	6983	0.466	5157	22.14	24.91	1.22	11.30	11.27	15.05	15.86
15.240	-0.953	565.42	517.38	517.71	3566.9	63.42	6800	0.466	5879	26.61	25.14	1.17	12.36	11.27	28.72	29.14
2.527	-2.223	430.45	335.95	336.06	3587.3	38.59	8985	0.465	3903	22.13	25.37	1.10	2.76	11.27	5.30	7.30
5.080	-2.235	477.31	374.77	374.92	3583.3	43.03	7967	0.465	3681	19.60	21.70	1.10	4.67	11.27	6.30	8.06
7.307	-2.235	513.76	414.25	414.47	3579.2	47.55	7638	0.466	3802	18.55	20.88	1.10	6.76	11.27	8.12	9.50
10.173	-2.223	550.71	454.26	454.47	3575.1	52.14	6901	0.466	3853	17.65	19.62	1.11	8.47	11.27	9.80	11.06
12.700	-2.223	580.20	482.26	482.51	3571.0	56.51	6606	0.466	4106	18.14	19.86	1.23	10.27	11.27	12.66	13.53
2.540	2.197	429.96	336.56	336.60	3587.3	38.26	8604	0.465	4026	22.62	25.05	1.10	2.77	11.27	5.44	7.34
5.900	2.223	471.91	375.60	375.75	3583.3	42.60	7873	0.465	3000	20.20	22.90	1.10	4.67	11.27	6.61	8.26
7.626	2.223	516.19	415.72	415.91	3579.2	47.22	7344	0.466	3706	18.32	20.64	1.10	6.77	11.27	8.07	9.45
10.147	2.223	546.75	455.40	455.71	3575.1	51.76	6806	0.466	4075	18.63	20.60	1.10	8.45	11.27	10.33	11.44
12.713	2.223	578.00	494.40	494.75	3571.0	56.18	6516	6	4413	19.06	20.77	1.22	10.28	11.27	13.20	14.09
7.647	-3.403	527.91	422.02	422.28	3579.2	45.48	6897	0.466	3570	17.20	19.45	1.10	6.76	11.27	7.77	9.20
7.633	3.403	536.30	427.95	428.12	3579.1	44.21	6540	0.466	3425	16.35	18.55	1.10	6.78	11.27	7.57	9.02

Table 3 (continued)

Channel Specimen
Experiment 4
Date: 20 July [illegible]
Time: 15:16:44

TA	TB	M	P0	P0-P1	VF	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
294.88	470.79	20.34	3585.6	30.35	40.96	5150.0	1.10

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	400.79
2.540	0.655	411.90
5.000	0.655	440.42
7.620	0.655	471.15
10.160	0.655	494.35
12.700	0.655	516.23
13.653	0.655	527.78

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² · K)			K	K	%	%	%
0.000	-0.965	331.79	294.66	294.85	3585.6	49.86	13700	0.665	8163	50.15	53.53	1.10	1.05	11.27	12.00	12.97
1.270	-0.318	379.06	308.61	308.84	3582.4	52.20	13348	0.665	6751	40.23	44.45	1.10	1.58	11.27	5.12	7.10
2.527	-0.330	388.96	322.55	322.80	3579.3	54.57	12955	0.665	5457	32.73	36.28	1.10	2.05	11.27	5.63	7.48
3.810	-0.318	404.09	335.86	336.11	3576.0	56.85	12605	0.665	5307	30.33	33.50	1.10	2.72	11.27	6.19	7.90
5.000	-0.318	417.68	349.13	349.42	3572.8	59.00	12277	0.665	5509	30.21	33.34	1.10	3.45	11.27	6.85	8.44
6.363	-0.318	431.88	362.86	363.16	3569.6	61.43	11959	0.665	5533	29.56	32.53	1.10	4.22	11.27	7.67	9.11
7.620	-0.330	446.21	376.31	376.65	3566.5	63.73	11665	0.665	5457	28.44	31.23	1.10	4.99	11.27	8.52	9.83
8.985	-0.305	460.51	390.05	390.40	3563.2	66.08	11303	0.665	5485	27.47	30.10	1.10	5.60	11.27	9.21	10.44
10.160	-0.318	471.05	403.38	403.77	3560.1	68.37	11126	0.666	5515	27.56	30.01	1.10	6.24	11.27	10.38	11.49
11.430	-0.318	482.22	416.53	416.95	3556.9	70.63	10881	0.666	5546	26.96	29.22	1.10	6.80	11.27	11.60	12.60
12.700	-0.305	494.29	429.52	429.96	3553.7	72.87	10654	0.666	5739	27.32	29.51	1.10	7.57	11.27	12.70	13.62
13.970	-0.318	505.54	443.40	443.88	3550.5	75.26	10423	0.666	6506	30.72	33.02	1.10	8.33	11.27	14.23	15.05
15.240	-0.953	495.29	456.96	457.46	3547.3	77.61	10200	0.666	7657	34.82	35.56	1.10	9.02	11.27	27.17	27.61
2.527	-2.223	396.32	324.88	325.10	3579.3	50.79	11916	0.665	5253	30.24	33.73	1.10	2.05	11.27	5.48	7.36
5.000	-2.235	433.96	353.64	353.90	3572.8	55.31	11249	0.665	4697	25.53	28.57	1.10	3.45	11.27	6.27	7.97
7.607	-2.235	458.48	382.90	383.20	3566.5	59.92	10655	0.665	5043	25.97	28.67	1.10	4.99	11.27	8.03	9.42
10.173	-2.223	486.44	412.50	412.85	3560.0	64.61	10125	0.666	5209	25.50	27.85	1.10	6.24	11.27	9.88	11.03
12.700	-2.223	508.39	440.63	441.06	3553.7	69.07	9676	0.666	5481	25.64	27.76	1.10	7.57	11.27	12.20	13.15
2.540	2.197	395.75	324.81	325.03	3579.2	51.14	12003	0.665	5287	30.44	33.95	1.10	2.06	11.27	5.50	7.38
5.000	2.223	427.08	353.22	353.48	3572.8	55.64	11338	0.665	5109	27.79	30.85	1.10	3.45	11.27	6.56	8.20
7.620	2.223	457.46	382.43	382.73	3566.5	60.28	10740	0.665	5000	26.18	28.89	1.10	4.99	11.27	8.08	9.46
10.147	2.223	482.54	411.37	411.72	3560.1	64.89	10216	0.666	5269	25.86	28.21	1.10	6.23	11.27	9.95	11.10
12.713	2.223	506.78	439.75	440.15	3553.6	69.43	9758	0.666	5545	25.97	28.08	1.10	7.58	11.27	12.32	13.27
7.607	-3.495	473.50	391.06	391.32	3566.5	56.06	9619	0.665	4619	23.45	26.05	1.10	4.99	11.27	7.55	9.02
7.633	3.495	476.21	392.71	392.97	3566.4	55.52	9463	0.666	4560	23.08	25.66	1.10	5.00	11.27	7.50	8.97

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 20 July 1990
Time: 15:21:44

TA	TB	M	PO	PO-P1	VF	QE	Wqt
K	K	kg/h	kPa	kPa	%	W	%
296.40	412.50	30.30	3567.6	70.45	49.98	5152.0	1.18

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	375.14
2.540	0.655	381.82
5.080	0.655	400.85
7.620	0.655	421.43
10.160	0.655	437.13
12.700	0.655	452.10
13.653	0.655	460.76

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tav	P	V	RE	PR	h	NU	NUn	-----	-----Uncertainties	-----	-----	-----
												UTw	UTf	URe	Uh	UNu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.905	319.46	295.95	294.42	3567.6	75.31	20706	0.665	12034	74.06	77.31	1.10	0.00	11.27	12.52	13.45
1.270	-0.318	347.51	305.19	305.70	3561.8	77.76	20360	0.665	9419	56.00	61.23	1.10	1.12	11.27	5.41	7.31
2.527	-0.330	359.99	312.47	312.95	3555.9	80.21	19952	0.665	7945	46.96	50.77	1.10	1.41	11.27	5.83	7.63
3.810	-0.318	370.23	321.20	321.77	3550.0	82.56	19582	0.665	7549	43.00	47.36	1.10	1.85	11.27	6.27	7.98
5.080	-0.318	379.23	329.99	330.39	3544.1	84.92	19227	0.665	7722	43.99	47.49	1.10	2.33	11.27	6.86	8.44
6.363	-0.318	388.60	339.05	339.60	3538.2	87.36	18876	0.665	7766	43.44	46.82	1.10	2.85	11.27	7.59	9.06
7.620	-0.330	398.14	347.96	348.64	3532.4	89.76	18546	0.665	7660	42.10	45.36	1.10	3.36	11.27	8.35	9.69
8.903	-0.305	408.27	357.05	357.75	3526.5	92.22	18226	0.665	7690	40.65	43.55	1.10	3.77	11.27	8.80	10.16
10.160	-0.318	415.02	365.86	366.61	3520.7	94.62	17923	0.665	7608	40.00	43.03	1.10	4.19	11.27	9.97	11.12
11.430	-0.318	422.77	374.55	375.35	3514.8	97.00	17630	0.665	7625	39.86	42.61	1.10	4.63	11.27	11.00	12.05
12.700	-0.305	430.94	383.16	383.97	3508.9	99.35	17367	0.666	7852	40.42	43.12	1.10	5.09	11.27	11.95	12.92
13.970	-0.318	439.40	392.32	393.19	3503.0	101.66	17088	0.666	8775	44.65	47.31	1.10	5.60	11.27	12.99	13.89
15.240	-0.953	430.90	401.28	402.19	3497.2	104.33	16825	0.666	9817	48.97	50.93	1.10	6.06	11.27	24.94	25.42
2.527	-2.223	364.92	314.33	314.78	3555.9	73.48	18896	0.665	7454	43.88	47.63	1.10	1.41	11.27	5.58	7.51
5.080	-2.235	384.80	333.64	334.16	3544.1	78.18	17378	0.665	6185	34.97	38.37	1.10	2.33	11.27	6.08	7.83
7.607	-2.235	400.22	353.29	353.87	3532.5	82.97	14715	0.665	6976	37.95	41.09	1.10	3.35	11.27	7.88	9.22
10.173	-2.223	426.75	373.16	373.81	3520.6	87.06	16105	0.665	7313	38.33	41.16	1.10	4.20	11.27	9.58	10.77
12.700	-2.223	441.32	392.05	392.77	3508.9	92.55	15560	0.666	7597	38.50	41.09	1.10	5.09	11.27	11.62	12.62
2.540	2.197	365.08	314.05	314.52	3555.9	..71	18626	0.665	7388	43.51	47.27	1.10	1.42	11.27	5.67	7.50
5.080	2.223	386.19	332.94	333.47	3544.1	79.30	17710	0.665	7126	40.34	43.77	1.10	2.33	11.27	6.55	8.19
7.620	2.223	406.34	352.34	352.94	3532.4	84.21	17061	0.665	7100	38.78	41.86	1.10	3.36	11.27	7.91	9.31
10.147	2.225	423.80	371.37	372.26	3520.7	89.03	16434	0.665	7217	37.96	40.79	1.10	4.19	11.27	9.46	10.67
12.713	2.223	448.56	390.42	391.17	3508.9	95.79	15888	0.666	7671	37.97	40.58	1.10	5.09	11.27	11.45	12.47
7.607	-3.465	421.45	360.31	360.79	3532.5	75.79	14776	0.665	6251	33.56	36.58	1.10	3.35	11.27	7.25	8.76
7.633	3.465	421.97	360.72	361.20	3532.3	75.67	14726	0.665	6239	33.46	36.47	1.10	3.36	11.27	7.25	8.76

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 20 July 1990
Time: 15:26:54

TA	TB	M	P0	P0-P1	VF	Ec	Uqt
K	K	kg/h	kPa	kPa	%	V	%
296.23	382.70	40.06	3550.7	111.52	49.98	5183.0	1.3[illegible]

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	361.63
2.540	0.655	366.18
5.080	0.655	380.59
7.620	0.655	396.23
10.160	0.655	407.95
12.700	0.655	419.17
13.653	0.655	426.33

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tam	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
												----------Uncertainties----------				
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	313.23	295.26	296.11	3550.7	100.62	27747	0.665	15606	96.17	99.72	1.10	0.68	11.27	13.17	14.[illegible]
1.270	-0.318	335.73	300.11	301.00	3541.4	103.19	27520	0.665	11770	71.48	76.03	1.10	0.80	11.27	5.78	7.[illegible]
2.527	-0.330	345.06	306.94	307.88	3532.2	105.77	26916	0.665	9960	59.58	63.56	1.10	1.10	11.27	6.10	7.8[illegible]
3.810	-0.318	352.86	313.45	314.43	3522.8	108.25	26537	0.665	9420	55.61	59.35	1.10	1.41	11.27	6.66	8.12
5.080	-0.318	359.50	319.95	320.99	3513.5	110.75	26171	0.665	9659	56.19	59.91	[illegible]10	1.76	11.27	6.96	8.52
6.363	-0.318	366.53	326.67	327.75	3504.1	113.33	25806	0.665	9609	55.66	59.20	1.[illegible]	2.14	11.27	7.59	9.06
7.620	-0.330	373.73	333.26	3[illegible].39	3494.9	115.80	25458	0.665	9547	54.05	57.55	1.[illegible]	2.53	11.27	8.25	9.61
8.903	-0.305	381.57	339.98	341.16	3485.5	118.50	25116	0.665	9276	51.78	55.17	1.10	2.83	11.27	8.69	9.99
10.160	-0.318	386.42	346.51	347.75	3476.3	121.06	24793	0.665	9542	52.60	55.85	1.10	3.15	11.27	9.70	10.88
11.430	-0.318	392.38	352.95	354.26	3467.0	123.58	24485	0.665	9387	51.11	54.18	1.10	3.48	11.27	10.59	11.58
12.700	-0.305	398.69	359.30	360.64	3457.7	126.12	24180	0.665	9649	51.90	54.96	1.10	3.82	11.27	11.43	12.45
13.970	-0.318	405.50	366.10	367.40	3448.4	128.81	23882	0.665	10587	56.23	59.48	1.10	4.21	11.27	12.17	13.12
15.240	-0.953	388.11	372.73	374.18	3439.1	131.46	23591	0.666	11665	61.20	63.46	1.10	4.56	11.27	23.35	23.86
2.527	-2.223	348.76	308.63	309.60	3532.2	95.87	26175	0.665	9606	56.06	59.96	1.10	1.10	11.27	5.96	7.72
5.080	-2.235	376.27	323.09	323.95	3513.5	100.81	23638	0.665	7392	42.72	46.32	1.10	1.76	11.27	6.03	7.78
7.607	-2.235	382.36	337.80	338.76	3495.0	105.87	22742	0.665	8613	48.30	51.71	1.10	2.52	11.27	7.67	9.11
10.173	-2.223	394.05	352.67	353.71	3476.2	111.05	22085	0.665	9145	49.81	52.96	1.10	3.15	11.27	9.39	10.60
12.700	-2.223	406.60	366.81	367.96	3457.7	116.06	21502	0.665	9626	50.00	52.92	1.10	3.82	11.27	11.21	12.24
2.540	2.197	340.26	308.32	309.13	3532.1	98.01	26757	0.665	9220	54.99	58.09	1.10	1.10	11.27	5.90	7.68
5.080	2.223	365.22	322.37	323.26	3513.5	102.96	26022	0.665	8865	51.31	54.96	1.10	1.76	11.27	6.62	8.25
7.620	2.223	380.40	336.81	337.79	3494.9	108.05	23319	0.665	8814	49.53	52.96	1.10	2.53	11.27	7.80	9.22
10.167	2.223	393.76	351.12	352.20	3476.4	113.14	22660	0.665	8887	48.55	51.71	1.10	3.15	11.27	9.17	10.40
12.713	2.223	406.36	365.15	366.32	3457.6	118.22	22072	0.665	9130	48.57	51.51	1.10	3.83	11.27	10.91	11.97
7.607	-3.493	396.05	343.93	344.69	3495.0	95.14	19833	0.665	7608	42.15	45.42	1.10	2.52	11.27	7.08	8.62
7.633	3.493	395.99	344.00	344.76	3494.8	95.35	19869	0.665	7629	42.26	45.53	1.10	2.53	11.27	7.10	8.64

Table 3 (continued)

Channel Specimen
Experiment 5
Date: 8 August 1990
Time: 15:05:29

TA	TB	M	P0	P0-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
300.34	672.82	13.33	3525.0	26.79	75.33	7160.0	1.06

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	512.20
2.540	0.655	540.21
5.080	0.655	605.45
7.620	0.655	675.81
10.160	0.655	734.67
12.700	0.655	756.64
13.653	0.655	777.11

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Tau	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² K)			K	K	%	%	%
0.000	-0.965	379.29	300.23	300.33	3525.0	33.68	8873	0.665	5301	32.19	36.61	1.10	2.03	11.27	11.64	12.66
1.270	-0.318	459.42	329.98	330.10	3522.7	36.98	[illegible]	0.665	4435	25.27	30.31	1.10	3.24	11.27	4.81	6.88
2.527	-0.330	503.36	359.67	359.81	3520.5	40.28	7850	0.665	3618	19.44	23.39	1.10	4.38	11.27	5.35	7.27
3.810	-0.318	536.95	387.96	388.12	3518.3	43.43	7454	0.666	3415	17.43	20.84	1.10	5.70	11.27	5.90	7.68
5.080	-0.318	567.53	416.26	416.45	3516.1	46.58	7102	0.666	3455	16.80	19.92	1.18	7.28	11.27	6.52	8.17
6.363	-0.318	599.29	445.45	445.66	3513.8	49.84	6779	0.666	3436	15.95	18.78	1.30	8.92	11.27	7.26	8.77
7.620	-0.330	632.49	474.14	[illegible]	3511.6	53.06	6493	0.666	3332	14.82	17.37	1.44	10.55	11.27	7.98	9.38
8.903	-0.305	666.52	503.36	503.63	3509.3	56.31	6230	0.666	3228	13.77	16.07	1.57	11.85	11.27	8.50	9.82
10.160	-0.318	691.69	531.78	532.08	3507.1	59.49	5997	0.666	3244	13.33	15.40	1.67	13.19	11.27	9.40	10.61
11.430	-0.318	709.75	559.79	560.13	3504.9	62.63	5787	0.666	3358	13.31	15.17	1.75	14.58	11.27	10.78	11.85
12.700	-0.305	727.34	587.44	587.81	3502.7	65.76	5596	0.666	3673	14.00	15.84	1.82	16.02	11.27	12.37	13.31
13.970	-0.318	745.64	617.01	617.41	3500.4	69.06	5408	0.666	4403	16.31	18.10	1.89	17.62	11.27	14.41	15.22
15.240	-0.953	727.34	645.88	646.32	3498.2	72.31	5238	0.666	4833	17.34	18.51	1.82	19.09	11.27	26.85	27.29
2.527	-2.223	519.55	363.77	363.89	3520.5	38.11	7288	0.665	3337	17.79	21.64	1.10	4.28	11.27	5.22	7.17
5.080	-2.235	593.93	424.26	424.43	3516.1	44.41	6559	0.666	3079	14.78	17.78	1.28	7.28	11.27	6.14	7.87
7.607	-2.235	655.02	485.80	486.02	3511.6	50.84	5974	0.666	3118	13.64	16.08	1.53	10.54	11.27	7.62	9.07
10.173	-2.223	716.34	548.04	548.32	3507.1	57.35	5495	0.666	3081	12.39	14.36	1.77	13.21	11.27	9.05	10.30
12.700	-2.223	747.44	607.22	607.56	3502.7	63.56	5117	0.666	3444	13.72	15.38	1.90	16.02	11.27	12.35	13.29
2.540	2.197	[illegible]	365.52	365.64	3520.5	37.46	7105	0.665	3436	18.26	22.09	1.10	4.29	11.27	5.27	7.21
5.080	2.223	585.99	427.05	427.21	3516.1	43.72	6387	0.666	3287	15.71	18.70	1.25	7.28	11.27	6.35	8.03
7.620	2.223	663.26	490.29	490.50	3511.6	50.18	5806	0.666	3050	13.25	15.65	1.56	10.55	11.27	7.52	8.98
10.147	2.223	716.84	552.97	553.26	3507.1	56.59	5342	0.666	3166	12.66	14.60	1.77	13.18	11.27	9.22	10.45
12.713	2.223	747.15	614.43	614.76	3502.6	52.90	4964	0.666	3874	14.39	16.02	1.90	16.03	11.27	12.97	13.87
7.607	-3.493	670.50	493.91	494.12	3511.6	49.52	5660	0.666	2987	12.92	15.29	1.59	10.54	11.27	7.41	8.89
7.633	3.493	701.50	510.56	510.75	3511.6	47.28	5111	0.666	2762	11.67	13.90	1.71	10.57	11.27	7.06	8.61

Table 3 (continued)

Channel Specimen
Experiment 5
Date: 8 August [illegible]
Time: 15:13:[illegible]

TA	TB	[illegible]	PO	PO-P1	Mf	Q	Uqt
K	K	[illegible]	kPa	kPa	%	W	%
300.08	592.34	[illegible]	3535.4	38.03	75.43	7291.0	1.05

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	473.94
2.540	0.655	493.94
5.080	0.655	542.82
7.620	0.655	595.95
10.160	0.655	633.09
12.700	0.655	664.45
13.653	0.655	682.45

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
												---------Uncertainties----------				
cm	cm	K	K	K	kPa	m/s			W/(m² · K)			K	K	%	%	%
0.000	-0.965	360.30	299.90	300.06	3535.4	43.75	11580	0.665	7019	42.64	47.20	1.10	1.62	11.27	11.72	12.71
1.270	-0.318	425.53	323.12	323.30	3532.2	47.12	11011	0.665	5713	33.01	38.41	1.10	2.56	11.27	4.86	6.92
2.527	-0.330	458.30	346.29	346.50	3529.1	50.49	10505	0.665	4731	26.09	30.44	1.10	3.37	11.27	5.41	7.31
3.810	-0.318	483.60	368.37	368.61	3525.9	53.70	10072	0.665	4501	23.80	27.64	1.10	4.48	11.27	5.97	7.74
5.080	-0.318	506.54	390.45	390.73	3522.7	56.92	9679	0.666	4589	23.32	26.91	1.10	5.71	11.27	6.63	8.26
6.363	-0.318	530.42	413.23	413.54	3519.5	60.25	9310	0.666	4598	22.48	25.79	1.10	7.00	11.27	7.42	8.91
7.620	-0.330	554.60	435.61	435.95	3516.4	63.53	8978	0.666	4522	21.32	24.35	1.13	8.28	11.27	8.25	9.60
8.903	-0.305	578.50	458.42	458.79	3513.2	66.88	8668	0.666	4473	20.36	23.14	1.22	9.30	11.27	8.93	10.20
10.160	-0.318	594.83	480.60	481.01	3510.1	70.14	8389	0.666	4633	20.4[illegible]	22.95	1.29	10.35	11.27	10.15	11.28
11.430	-0.318	611.15	502.45	502.91	3506.9	73.36	8135	0.666	4727	20.20	22.50	1.35	11.44	11.27	11.54	12.55
12.700	-0.305	629.81	524.03	524.52	3503.7	76.54	7901	0.666	4957	20.57	22.76	1.43	12.57	11.27	12.80	13.72
13.970	-0.318	647.73	547.09	547.63	3500.5	79.95	7669	0.666	5744	23.13	25.38	1.50	13.83	11.27	14.48	15.29
15.240	-0.953	632.35	569.62	570.21	3497.4	83.28	7456	0.666	6416	25.13	26.62	1.44	14.98	11.27	27.33	27.77
2.527	-2.223	471.27	349.65	349.85	3529.1	47.55	9736	0.665	4356	23.86	28.12	1.10	3.37	11.27	5.26	7.20
5.080	-2.235	529.00	397.01	397.25	3522.7	53.99	3927	0.666	4034	20.27	23.74	1.10	5.71	11.27	6.18	7.90
7.607	-2.235	572.69	445.18	445.48	3516.4	60.55	8251	0.666	4218	19.59	22.50	1.20	8.27	11.27	7.84	9.26
10.173	-2.223	616.32	493.89	494.27	3510.0	67.22	7680	0.666	4320	18.68	21.10	1.37	10.36	11.27	9.61	10.80
12.700	-2.223	650.78	540.21	540.67	3503.7	73.59	7217	0.666	4740	19.26	21.34	1.51	12.57	11.27	12.32	13.27
2.540	2.197	470.00	350.71	350.90	3529.1	46.93	9561	0.665	4437	24.26	28.50	1.10	3.38	11.27	5.30	7.23
5.080	2.223	523.02	398.58	398.82	3522.7	53.33	8761	0.666	4280	21.44	24.90	1.10	5.71	11.27	6.38	8.05
7.620	2.223	577.33	447.79	448.09	3516.4	59.94	8087	0.666	4152	19.21	22.09	1.22	8.28	11.27	7.77	9.20
10.147	2.223	613.14	496.55	496.92	3510.1	66.50	7530	0.666	4539	19.55	21.95	1.36	10.34	11.27	9.98	11.12
12.713	2.223	650.30	544.36	544.81	3503.7	72.97	7065	0.666	4951	20.01	22.07	1.51	12.58	11.27	12.80	13.71
7.607	-3.493	592.41	455.72	456.00	3516.4	57.79	7572	0.666	3934	17.98	20.77	1.28	8.27	11.27	7.48	8.96
7.633	3.493	610.14	465.52	465.78	3516.4	55.73	7045	0.666	3717	16.74	19.43	1.35	8.29	11.27	7.23	8.74

Table 3 (continued)

Channel Specimen
Experiment 5
Date: 8 August 1990
Time: 15:20:16

TA	TB	M	P0	P0-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
299.87	513.32	23.81	3547.9	59.13	75.48	7326.0	1.07

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	438.77
2.540	0.655	452.11
5.080	0.655	487.20
7.620	0.655	525.03
10.160	0.655	552.10
12.700	0.655	576.65
13.653	0.655	591.26

Insulated-Side Temperatures and Calculated Data:

												Uncertainties				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.945	344.35	299.52	299.83	3547.9	60.40	16076	0.665	9622	58.50	63.16	1.10	1.23	11.27	11.87	12.85
1.270	-0.316	394.80	316.32	316.67	3543.0	63.82	15495	0.665	7511	44.03	49.74	1.10	1.89	11.27	4.91	6.95
2.527	-0.330	416.13	333.09	333.47	3538.1	67.23	14962	0.665	6278	35.54	40.27	1.10	2.47	11.27	5.43	7.33
3.810	-0.318	436.39	349.07	349.48	3533.2	70.50	14495	0.665	5985	32.82	37.11	1.10	3.28	11.27	5.96	7.73
5.080	-0.318	452.90	365.05	365.50	3528.2	73.78	14057	0.665	6111	32.51	36.60	1.10	4.18	11.27	6.57	8.21
6.343	-0.318	470.17	381.52	382.03	3523.3	77.17	13640	0.665	6127	31.63	35.48	1.10	5.12	11.27	7.33	8.82
7.620	-0.330	487.41	397.72	398.26	3518.4	80.51	13257	0.666	6048	30.35	33.94	1.10	6.05	11.27	8.13	9.50
8.903	-0.305	504.90	414.21	414.81	3513.4	83.92	12893	0.666	5971	29.14	32.49	1.10	6.79	11.27	8.77	10.05
10.160	-0.318	516.78	430.26	430.90	3508.5	87.25	12560	0.666	6170	29.34	32.45	1.10	7.57	11.27	9.91	11.07
11.430	-0.318	529.59	446.07	446.76	3503.6	90.54	12252	0.666	6207	28.79	31.64	1.10	8.36	11.27	11.12	12.16
12.700	-0.305	543.42	461.67	462.41	3498.7	93.80	11965	0.666	6474	29.33	32.08	1.10	9.18	11.27	12.25	13.20
13.970	-0.318	557.42	478.36	479.15	3493.7	97.29	11675	0.666	[illegible]	32.62	35.48	1.14	10.10	11.27	13.61	14.48
15.240	-0.953	544.40	494.65	495.50	3488.8	100.70	11408	0.666	[illegible]	35.40	37.32	1.10	10.94	11.27	25.82	26.29
2.527	-2.223	427.74	336.04	336.37	3538.1	62.45	13694	0.663	[illegible]	32.73	37.37	1.10	2.47	11.27	5.29	7.23
5.080	-2.235	474.51	370.76	371.16	3528.2	68.98	12807	0.665	[illegible]	27.21	31.16	1.10	4.18	11.27	6.02	7.78
7.607	-2.235	503.39	406.08	406.56	3518.4	75.67	12034	[illegible]	[illegible]	[illegible]	31.01	1.10	6.04	11.27	7.66	9.10
10.173	-2.223	533.72	441.80	442.37	3508.5	82.46	11356	0.666	[illegible]	[illegible]	30.05	1.10	7.57	11.27	9.45	10.65
12.700	-2.223	560.64	475.75	476.42	3498.7	88.97	10791	0.666	[illegible]	[illegible]	30.24	1.15	9.18	11.27	11.85	12.83
2.540	2.197	427.50	336.10	336.43	3538.1	62.66	13737	0.665	[illegible]	[illegible]	37.45	1.10	2.48	11.27	5.31	7.24
5.080	2.223	466.12	370.53	370.93	3528.2	69.17	12854	0.665	5610	[illegible]	33.53	1.10	4.18	11.27	6.27	7.97
7.620	2.223	502.89	405.91	406.40	3518.4	75.88	12076	0.666	5588	27.65	31.11	1.10	6.05	11.27	7.69	9.13
10.147	2.223	532.36	440.98	441.55	3508.6	82.58	11407	0.666	5836	27.29	30.27	1.10	7.56	11.27	9.47	10.67
12.713	2.223	560.20	475.35	476.02	3496.6	89.19	10832	0.666	6234	27.68	30.30	1.15	9.19	11.27	11.86	12.84
7.607	-3.493	525.87	417.94	418.35	3518.4	70.11	10626	0.666	5015	24.33	27.61	1.10	6.04	11.27	7.15	8.68
7.633	3.493	530.12	420.42	420.82	3518.3	69.32	10402	0.666	4933	23.83	27.07	1.10	6.06	11.27	7.08	8.63

Table 3 (continued)

Channel Specimen
Experiment 5
Date: 8 August 1990
Time: 15:26:11

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
299.66	463.95	31.08	3554.0	87.01	75.49	7358.0	1.11

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	416.43
2.540	0.655	425.88
5.080	0.655	452.86
7.620	0.655	481.88
10.160	0.655	502.86
12.700	0.655	521.95
13.653	0.655	533.78

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	---------Uncertainties--------- Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	334.05	299.06	299.59	3554.0	79.34	21205	0.665	12483	75.97	80.74	1.10	1.00	11.27	12.07	13.04
1.270	-0.318	375.26	311.84	312.42	3546.8	82.83	20615	0.665	9379	55.51	61.46	1 10	1.49	11.27	5.00	7.01
2.527	-0.330	392.95	324.60	325.23	3539.6	86.33	20064	0.665	7881	45.40	50.43	1.10	1.92	11.27	5.48	7.36
3.810	-0.318	407.13	336.76	337.43	3532.3	89.70	19569	0.665	7495	42.12	46.75	1.10	2.54	11.27	5.96	7.73
5.080	-0.318	419.67	348.91	349.64	3525.0	93.07	19103	0.665	7660	42.03	46.52	1.10	3.22	11.27	6.52	8.17
6.363	-0.318	432.91	361.45	362.23	3517.7	96.56	18649	0.665	7674	41.11	45.40	1.10	3.95	11.27	7.21	8.73
7.620	-0.330	446.18	373.77	374.61	3510.5	100.00	18228	0.665	7566	39.61	43.66	1.10	4.66	11.27	7.96	9.36
8.903	-0.305	460.18	386.31	387.21	3503.2	103.53	17821	0.666	7405	37.91	41.74	1.10	5.23	11.27	8.50	9.82
10.160	-0.318	469.05	[illegible]	399.48	3496.0	106.97	17445	0.666	7650	38.34	41.93	1.10	5.83	11.27	9.58	10.77
11.430	-0.318	479.17	410.54	411.57	3488.8	110.38	17093	0.666	7639	37.51	40.84	1.10	6.44	11.27	10.65	11.73
12.700	-0.305	489 92	422.41	423.50	3481.5	113.76	16762	0.666	7930	38.19	41.43	1.10	7.07	11.27	11.66	12.65
13.970	-0.318	501 57	435.10	436.26	3474.3	117.38	16424	0.666	8884	41.92	45.33	1.10	7.78	11.27	12.71	13.63
15.240	-0.953	[illegible]	447.48	448.71	3467.0	120.93	16110	0.666	9739	45.17	47.48	1.10	8.43	11.27	24.20	24.70
2.527	-2.223	400.37	327.20	327.73	3539.6	79.31	18187	0.665	7349	42.11	47.05	1.10	1.92	11.27	5.35	7.27
5.080	-2.235	441.41	353.90	354.52	3525.0	86.02	17243	0.665	6174	33.55	37.89	1.10	3.22	11.27	5.85	7.64
7.607	-2.235	460.30	381.05	381.78	3510.6	92.89	16395	0.666	6896	35.63	39.53	1.10	4.66	11.27	7.46	8.94
10.173	-2.223	482.80	408.51	409.35	3496.0	99.91	15632	0.666	7243	35.69	39.13	1.10	5.83	11.27	9.19	10.42
12.700	-2.223	504.11	434.61	435.56	3481.5	106.64	14981	0.666	7683	36.28	39.36	1.10	7.07	11.27	11.35	12.37
2.540	2.197	400.65	327.02	327.56	3539.5	80.14	18394	0.665	7297	41.83	46.77	1.10	1.93	11.27	5.34	7.26
5.080	2.223	430.48	353.29	353.92	3525.0	86.82	17453	0.665	7007	38.12	42.50	1.10	3.22	11.27	6.22	7.93
7.620	2.223	458.68	380.28	381.02	3510.5	93.73	16598	0.666	6973	36.08	40.00	1.10	4.66	11.27	7.52	8.99
10.147	2.223	481.97	407.03	407.88	3496.1	100.64	15843	0.666	7135	35.49	38.95	1.10	5.82	11.27	9.11	10.35
12.713	2.223	503.74	433.25	434.22	3481.5	107.48	15178	0.666	7582	35.88	38.98	1.10	7.08	11.27	11.22	12.25
7.607	-3.493	483.63	393.14	393.72	3510.6	83.66	14015	0.666	6023	30.47	34.15	1.10	4.66	11.27	6.84	8.43
7.633	3.493	482.50	392.74	393.34	3510.5	84.21	14130	0.666	6073	30.74	34.42	1.10	4.67	11.27	6.89	8.47

Table 3 (continued)

Channel Specimen
Experiment 5
Date: 8 August 1990
Time: 15:32:06

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
299.19	424.49	40.64	3561.3	131.64	75.55	7335.0	1.17

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	397.64
2.540	0.655	404.16
5.080	0.655	424.73
7.620	0.655	446.93
10.160	0.655	462.97
12.700	0.655	477.46
13.653	0.655	487.30

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Tav	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m² · K)			K	K	%	%	%
0.000	-0.965	325.62	298.15	299.07	3561.3	104.26	28062	0.665	16154	98.50	103.39	1.10	0.83	11.27	12.42	13.36
1.270	-0.318	359.04	307.77	308.75	3550.4	107.89	27470	0.665	11685	69.77	75.94	1.10	1.17	11.27	5.17	7.13
2.527	-0.330	372.40	317.37	318.42	3539.5	111.53	26906	0.665	9856	57.65	62.95	1.10	1.49	11.27	5.59	7.45
3.810	-0.318	383.37	326.52	327.63	3528.4	115.06	26394	0.665	9342	53.60	58.55	1.10	1.95	11.27	6.00	7.76
5.080	-0.318	392.82	335.66	336.84	3517.4	118.58	25904	0.665	9553	53.80	58.66	1.10	2.47	11.27	6.50	8.16
6.363	-0.318	402.83	345.09	346.35	3506.4	122.24	25421	0.665	9573	52.92	57.62	1.10	3.02	11.27	7.14	8.67
7.620	-0.330	412.98	354.35	355.69	3495.5	125.85	24967	0.665	9423	51.16	55.65	1.10	3.56	11.27	7.81	9.23
8.903	-0.305	424.22	363.79	365.20	3484.4	129.56	24526	0.665	9127	48.68	52.97	1.10	4.00	11.27	8.25	9.60
10.160	-0.318	430.53	372.96	374.46	3473.6	133.19	24110	0.666	9461	49.61	53.69	1.10	4.45	11.27	9.27	10.50
11.430	-0.318	438.47	382.00	383.58	3462.6	136.80	23719	0.666	9378	48.38	52.19	1.10	4.91	11.27	10.22	11.34
12.700	-0.305	446.66	390.92	392.58	3451.6	140.38	23347	0.666	9709	49.31	53.06	1.10	5.40	11.27	11.12	12.16
13.970	-0.318	456.38	400.46	402.21	3440.7	144.22	22965	0.666	10677	53.34	57.32	1.10	5.94	11.27	11.88	12.86
15.240	-0.953	446.19	409.77	411.61	3429.7	147.99	22606	0.666	11602	57.05	59.79	1.10	6.43	11.27	22.74	23.27
2.527	-2.223	378.07	319.69	320.55	3539.5	[illegible]	24142	0.665	9251	53.84	59.04	1.10	1.49	11.27	5.46	7.35
5.080	-2.235	414.02	340.01	340.99	3517.4	[illegible]	23154	0.665	7322	40.88	45.56	1.10	2.47	11.27	5.72	7.54
7.607	-2.235	425.29	360.66	361.79	3495.6	[illegible]	22243	0.665	8501	45.61	49.94	1.10	3.56	11.27	7.28	8.79
10.173	-2.225	441.40	381.55	382.82	3473.5	122.82	21405	0.666	9053	46.74	50.64	1.10	4.45	11.27	8.98	10.24
12.700	-2.223	457.96	401.40	402.82	3451.6	129.93	20674	0.666	9521	47.48	51.05	1.10	5.40	11.27	10.94	12.00
2.540	2.197	378.80	319.36	320.26	3539.4	103.09	24613	0.665	9083	52.90	58.11	1.10	1.50	11.27	5.43	7.33
5.080	2.223	401.64	339.19	340.21	3517.4	110.06	23628	0.665	8705	48.68	53.42	1.10	2.47	11.27	6.19	7.91
7.620	2.223	423.05	359.57	360.73	3495.5	117.29	22708	0.665	8662	46.56	50.92	1.10	3.56	11.27	7.38	8.87
10.147	2.223	441.08	379.75	381.06	3473.7	124.54	21878	0.666	8841	45.80	49.73	1.10	4.44	11.27	8.80	10.08
12.713	2.223	457.79	399.54	401.00	3451.5	131.77	21130	0.666	9252	46.29	49.89	1.10	5.40	11.27	10.68	11.76
7.607	-3.493	448.18	372.34	373.20	3495.6	100.85	18423	0.665	7200	37.80	41.86	1.10	3.56	11.27	6.58	8.22
7.633	3.493	443.77	370.25	371.15	3495.4	103.50	19063	0.665	7434	39.18	43.28	1.10	3.57	11.27	6.71	8.32

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 10 August 1990
Time: 14:04:43

TA	TB	M	PO	PO-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
300.87	709.80	3.78	6942.2	1.88	25.24	2226.0	1.03

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	486.16
2.540	0.655	521.26
5.080	0.655	601.04
7.620	0.655	671.32
10.160	0.655	729.72
12.700	0.655	772.87
13.653	0.655	782.61

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties----------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	390.13	300.87	300.87	6942.2	4.73	2394	0.662	1458	8.74	10.08	1.10	2.21	11.27	11.60	12.60
1.270	-0.318	457.45	334.94	334.94	6942.0	5.24	2228	0.662	1455	8.13	9.65	1.10	3.55	11.27	5.04	7.04
2.527	-0.330	506.94	368.93	368.94	6941.9	5.76	2087	0.663	1170	6.13	7.30	1.10	4.69	11.27	5.60	7.45
3.810	-0.318	549.63	401.34	401.34	6941.7	6.25	1972	0.663	1066	5.28	6.23	1.11	6.26	11.27	6.16	7.88
5.080	-0.318	587.29	433.75	433.75	6941.6	6.74	1870	0.664	1057	4.97	5.87	1.26	7.99	11.27	6.81	8.40
6.363	-0.318	623.88	467.18	467.19	6941.4	7.25	1777	0.664	1047	4.68	5.49	1.40	9.79	11.27	7.63	9.08
7.620	-0.330	657.24	500.04	500.04	6941.3	7.75	1696	0.664	1042	4.45	5.17	1.54	11.59	11.27	8.58	9.89
8.903	-0.305	688.29	533.51	533.52	6941.1	8.26	1622	0.664	1056	4.31	4.96	1.6[illegible]	13.01	11.27	9.50	10.69
10.160	-0.318	716.85	566.08	566.08	6940.9	8.75	1557	0.665	1068	4.18	4.76	1.77	14.48	11.27	10.61	11.70
11.430	-0.318	740.95	598.17	598.18	6940.8	9.24	1498	0.665	1094	4.13	4.65	1.87	16.00	11.27	12.14	13.10
12.700	-0.305	761.79	629.85	629.86	6940.6	9.72	1446	0.665	1208	4.39	4.87	1.96	17.58	11.27	14.12	14.95
13.970	-0.318	772.04	663.72	663.73	6940.5	10.24	1394	0.665	1620	5.69	6.18	2.00	19.35	11.27	18.41	19.06
15.240	-0.953	760.84	696.81	696.82	6940.3	10.74	1347	0.665	1901	6.45	6.77	1.95	20.95	11.27	35.23	35.57
2.527	-2.223	514.23	370.81	370.81	6941.9	5.63	2025	0.663	1126	5.88	7.04	1.10	4.69	11.27	5.52	7.39
5.080	-2.235	591.54	437.40	437.41	6941.6	6.62	1809	0.664	1053	4.92	5.81	1.27	7.99	11.27	6.80	8.39
7.607	-2.235	666.71	505.17	505.17	6941.3	7.62	1639	0.664	1014	4.30	5.01	1.57	11.57	11.27	8.40	9.74
10.173	-2.223	730.84	573.71	573.72	6940.9	8.63	1501	0.665	1024	3.98	4.55	1.83	14.50	11.27	10.27	11.39
12.700	-2.223	775.44	638.89	638.90	6940.6	9.60	1393	0.665	1167	4.21	4.68	2.01	17.58	11.27	13.70	14.55
2.540	2.197	515.65	371.96	371.96	6941.9	5.59	1997	0.663	1123	5.85	7.00	1.10	4.71	11.27	5.52	7.4[illegible]
5.080	2.223	598.69	438.98	438.98	6941.6	6.57	1785	0.664	1016	4.74	5.62	1.50	7.99	11.27	6.66	8.28
7.620	2.223	671.25	507.87	507.88	6941.3	7.57	1615	0.664	1003	4.23	4.93	1.59	11.59	11.27	8.34	9.68
10.147	2.223	729.88	576.16	576.16	6940.9	8.57	1480	0.665	1048	4.05	4.61	1.83	14.47	11.27	10.44	11.54
12.[illegible]3	2.223	771.80	643.13	643.14	6940.6	9.55	1371	0.665	1239	4.45	4.92	2.00	17.60	11.27	14.46	15.27
7.607	-3.493	674.40	509.45	509.45	6941.3	7.53	1596	0.664	993	4.18	4.88	1.61	11.57	11.27	8.27	9.63
7.633	3.493	688.21	517.53	517.54	6941.3	7.38	1525	0.664	960	4.00	4.68	1.66	11.60	11.27	8.09	9.47

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 10 August 1990
Time: 14:16:47

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
299.11	537.41	7.08	6944.5	3.43	25.26	2433.0	1.06

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	419.18
2.540	0.655	438.39
5.080	0.655	483.43
7.620	0.655	527.77
10.160	0.655	570.34
12.700	0.655	599.82
13.653	0.655	604.14

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	352.77	299.11	299.11	6944.5	9.00	4602	0.661	2651	15.96	17.48	1.10	1.35	11.27	11.73	12.72
1.270	-0.318	397.34	318.55	318.55	6944.2	9.56	4413	0.662	2473	14.29	16.14	1.10	2.10	11.27	5.03	7.04
2.527	-0.330	425.83	337.95	337.95	6943.9	10.13	4241	0.662	2008	11.16	12.67	1.10	2.76	11.27	5.53	7.40
3.810	-0.318	450.08	356.44	356.45	6943.6	10.67	4092	0.663	1844	9.89	11.24	1.10	3.66	11.27	6.02	7.78
5.063	-0.318	471.89	374.93	374.94	6943.3	11.20	3954	0.663	1829	9.48	10.76	1.10	4.66	11.27	6.57	8.21
6.363	-0.318	493.82	394.01	394.02	6943.0	11.76	3824	0.663	1797	9.01	10.20	1.10	5.71	11.27	7.24	8.75
7.620	-0.330	515.12	412.76	412.77	6942.8	12.31	3704	0.664	1749	8.50	9.60	1.10	6.76	11.27	7.95	9.35
8.903	-0.305	536.99	431.86	431.87	6942.5	12.86	3592	0.664	1699	8.01	9.03	1.10	7.58	11.27	8.46	9.79
10.160	-0.318	555.95	450.44	450.46	6942.2	13.41	3490	0.664	1668	7.64	8.58	1.13	8.44	11.27	9.18	10.41
11.430	-0.318	572.49	468.76	468.77	6941.9	13.93	3396	0.664	1646	7.34	8.19	1.20	9.33	11.27	10.11	11.25
12.700	-0.305	585.96	486.83	486.85	6941.6	14.46	3309	0.664	1757	7.63	8.45	1.25	10.25	11.27	11.52	12.35
13.970	-0.318	591.16	506.17	506.18	6941.3	15.02	3221	0.664	2257	9.55	10.40	1.27	11.28	11.27	13.97	14.81
15.240	-0.953	574.90	525.04	525.07	6941.0	15.57	3141	0.664	2670	11.02	11.58	1.21	12.22	11.27	27.71	28.14
2.527	-2.223	433.26	340.18	340.19	6943.9	9.64	3993	0.663	1896	10.49	11.98	1.10	2.76	11.27	5.42	7.32
5.080	-2.235	483.26	379.29	379.30	6943.3	10.72	3710	0.663	1706	8.78	10.03	1.10	4.66	11.27	6.32	8.01
7.607	-2.235	527.31	419.08	419.10	6942.8	11.81	3467	0.664	1654	7.96	9.03	1.10	6.75	11.27	7.64	9.08
10.173	-2.223	563.78	459.34	459.35	6942.2	12.92	3256	0.664	1684	7.62	8.53	1.16	8.45	11.27	9.26	10.49
12.700	-2.223	594.62	497.62	497.64	6941.6	13.97	3082	0.664	1795	7.69	8.48	1.29	10.25	11.27	11.54	12.54
2.540	2.197	432.49	340.18	340.19	6943.9	9.69	4012	0.663	1910	10.57	12.06	1.10	2.76	11.27	5.44	7.34
5.080	2.223	480.28	378.91	378.92	6943.3	10.76	3731	0.663	1749	9.01	10.26	1.10	4.66	11.27	6.41	8.08
7.620	2.223	526.43	418.71	418.73	6942.8	11.86	3486	0.664	1662	8.00	9.07	1.10	6.76	11.27	7.67	9.11
10.147	2.223	566.98	458.17	458.19	6942.2	12.95	3278	0.664	1618	7.33	8.24	1.17	8.44	11.27	8.96	10.22
12.713	2.223	595.26	496.87	496.88	6941.6	14.02	3100	0.664	1771	7.59	8.38	1.29	10.26	11.27	11.41	12.43
7.607	-3.493	539.80	425.65	425.66	6942.8	11.37	3253	0.664	1568	7.47	8.51	1.10	6.75	11.27	7.37	8.86
7.633	3.493	541.48	426.74	426.75	6942.8	11.34	3230	0.664	1560	7.42	8.46	1.10	6.75	11.27	7.36	8.85

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 10 August 1990
Time: 14:25:15

TA	TB	M	PO	PO-P1	Vf	Q"	Uqt
K	K	kg/h	kPa	kPa	%	W	%
298.22	425.81	13.61	6950.0	9.28	25.27	2503.0	1.16

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	367.00
2.540	0.655	375.62
5.080	0.655	396.82
7.620	0.655	419.16
10.160	0.655	435.80
12.700	0.655	450.41
13.653	0.655	457.23

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utv	Utf	Ure	Uh	Unu
												---------Uncertainties---------				
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	324.71	298.19	298.21	6950.0	17.53	9017	0.661	5524	33.32	34.92	1.10	0.84	11.27	12.43	13.37
1.270	-0.318	350.24	308.41	308.44	6949.3	18.11	8818	0.662	4797	28.31	30.36	1.10	1.19	11.27	5.61	7.46
2.527	-0.330	363.[illegible]	318.62	318.65	6948.5	18.70	8628	0.662	4010	23.16	24.92	1.10	1.52	11.27	6.05	7.80
3.810	-0.318	375.34	328.35	328.38	6947.7	19.25	8456	0.662	3784	21.43	23.07	1.10	1.99	11.27	6.58	8.21
5.080	-0.318	385.49	338.08	338.11	6946.9	19.81	8292	0.662	3852	21.40	23.00	1.10	2.52	11.27	7.25	8.76
6.363	-0.318	396.06	348.12	348.15	6946.2	20.38	8131	0.663	3851	20.98	22.52	1.10	3.07	11.27	8.06	9.45
7.620	-0.330	406.67	357.98	358.02	6945.4	20.94	7979	0.663	3786	20.25	21.72	1.10	3.63	11.27	8.91	10.18
8.903	-0.305	417.48	368.03	368.07	6944.6	21.51	7831	0.663	3720	19.53	20.93	1.10	4.07	11.27	9.57	1[illegible]
10.160	-0.318	424.73	377.81	377.85	6943.8	22.07	7693	0.663	3861	19.92	21.24	1.10	4.55	11.27	10.87	11.93
11.430	-0.318	432.3[illegible]	387.44	387.48	6943.1	22.62	7563	0.663	3915	19.86	21.09	1.10	5.01	11.27	12.28	13.23
12.700	-0.305	440.41	396.95	397.00	6942.3	23.17	7440	0.663	4127	20.60	21.81	1.10	5.50	11.27	13.67	14.53
13.970	-0.318	447.22	407.12	407.17	6941.5	23.75	7313	0.664	4928	24.18	25.46	1.10	6.05	11.27	15.90	16.64
15.240	-0.953	441.26	417.05	417.10	6940.7	24.31	7193	0.664	5668	27.36	28.22	1.10	6.55	11.27	30.30	30.70
2.527	-2.223	368.20	320.03	320.05	6948.5	17.57	8051	0.662	3771	21.72	23.46	1.10	1.52	11.27	5.88	7.67
5.080	-2.235	396.99	340.82	340.85	6946.9	18.68	7718	0.663	3250	17.96	19.53	1.10	2.52	11.27	6.55	8.19
7.607	-2.235	414.02	361.98	362.01	6945.4	19.81	7411	0.663	3542	18.8[illegible]	20.24	1.10	3.62	11.27	8.47	9.79
10.173	-2.223	432.33	383.38	383.42	6943.8	20.95	7128	0.663	3700	18.90	20.19	1.10	4.54	11.27	10.51	11.60
12.700	-2.223	448.32	403.73	403.78	6942.3	22.04	6882	0.663	4022	19.85	21.03	1.10	5.50	11.27	13.36	14.24
2.540	2.197	368.45	320.23	320.26	6948.5	17.50	8011	0.662	3765	[illegible].68	23.42	1.10	1.52	11.27	5.89	7.67
5.080	2.223	391.91	341.02	341.05	6946.9	18.61	7680	0.663	3587	19.81	21.39	1.10	2.52	11.27	6.94	8.50
7.620	2.223	414.64	362.38	362.41	6945.4	19.74	7372	0.663	3527	18.71	20.15	1.10	3.63	11.27	8.45	9.78
10.147	2.223	431.37	383.55	383.59	6943.8	20.87	7094	0.663	3790	19.36	20.65	1.10	4.53	11.27	10.69	11.77
12.713	2.223	447.68	404.32	404.36	6942.3	21.97	6844	0.663	4139	20.41	21.59	1.10	5.51	11.27	13.71	14.56
7.607	-3.493	423.34	367.12	367.15	6945.4	18.59	6794	0.663	3[illegible]78	17.24	18.65	1.10	3.62	11.27	8.00	[illegible].40
7.633	3.493	425.86	368.64	368.66	6945.4	18.32	6652	0.663	3221	16.89	18.29	1.10	3.63	11.27	7.92	9.32

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 10 August 1990
Time: 14:31:22

TA	TB	M	P3	P0-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
298.45	38[illegible].31	19.90	69[illegible].2	16.79	25.27	2492.0	1.30

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	350.58
2.540	0.655	355.99
5.080	0.655	370.11
7.620	0.655	385.14
10.160	0.655	396.47
12.700	0.655	406.89
15.653	0.655	412.13

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUn	---------Utw	Utf	Uncertainties U.e	Uh	Unu---------
cm	cm	K	K	K	kPa	m/s			W/(m² K)			K	K	%	%	%
0.000	-0.965	316.43	298.38	298.44	6956.2	25.96	13351	0.661	8095	48.80	50.40	1.10	0.68	11.27	13.39	14.26
1.270	-0.318	335.40	305.25	305.31	6954.8	26.55	13152	0.662	6589	39.1[illegible]	4[illegible].26	1.10	0.88	11.27	6.20	7.91
2.527	-0.330	344.78	312.11	312.17	6953.4	[illegible].13	12958	0.662	5542	32.45	34.28	1.10	1.08	11.27	6.49	8.14
3.810	-0.318	352.46	318.65	3[illegible]8.7[illegible]	6952.0	27.68	12780	0.662	5261	30.27	32.30	1.10	1.38	11.27	6.90	8.48
5.080	-0.318	359.22	325.19	325.25	6950.6	28.26	12608	0.662	5348	30.48	32.20	1.10	1.73	11.27	7.48	8.95
6.363	-0.316	366.29	331.93	332.00	6949.2	28.81	12435	0.662	5357	30.12	31.80	1.10	2.11	11.27	8.19	9.55
7.620	-0.330	373.40	338.56	338.63	6947.8	29.33	12271	0.662	5274	29.27	30.89	1.10	2.48	11.27	8.95	10.21
8.903	-0.305	380.94	345.3[illegible]	345.39	6946.4	29.95	12109	0.663	5146	28.19	29.75	1.10	2.78	11.27	9.48	10.68
10.160	-0.318	385.76	351.88	351.96	6945.0	30.51	11957	0.663	5331	28.84	30.	1.10	3.10	11.27	10.62	11.76
11.430	-0.318	391.18	358.35	358.43	6943.6	31.06	11811	0.663	5340	29.54	29.95	1.10	3.42	11.27	11.88	12.85
12.700	-0.305	396.88	364.74	364.83	6942.2	31.60	11670	0.663	5[illegible]63	29.39	30.79	1.10	3.76	11.27	13.01	13.91
13.970	-0.318	402.21	371.57	371.66	6940.8	32.[illegible]	11525	0.663	6432	33.55	35.04	1.10	4.13	11.27	14.60	15.41
15.240	-0.953	397.33	378.25	378.34	6939.4	32.75	11387	0.663	7174	3[illegible].98	37.99	1.10	4.48	11.27	27.39	27.83
2.527	-2.223	347.86	313.32	313.37	6953.4	25.04	[illegible]988	0.662	5241	30.61	32.42	1.10	1.08	11.27	6.31	8.00
5.080	-2.235	370.28	327.5[illegible]	327.59	6950.6	26.[illegible]5	11540	0.662	4255	24.14	25.82	1.10	[illegible].73	11.27	6.52	8.17
7.607	-2.235	379.87	342.00	342.06	6947.8	27.28	11210	0.663	4850	26.74	28.[illegible]3	1.10	2.48	11.27	8.40	9.73
10.[illegible]73	-2.223	391.80	356.63	356.70	6945.0	28.43	10898	0.663	5133	27.52	28.95	1.10	3.10	11.27	10.37	11.47
12.700	-2.223	403.26	370.55	370.62	6942.2	29.52	10620	0.663	5464	28.56	29.92	1.10	3.76	11.27	12.81	13.72
2.540	2.197	348.15	313.21	313.26	6953.4	25.34	12038	0.662	5176	30.24	32.05	1.10	1.08	11.27	6.27	7.97
5.080	2.223	343.98	327.18	327.24	6950.6	26.45	1[illegible]491	0.662	[illegible]	28.07	29.76	1.10	1.73	11.27	7.11	8.65
7.620	2.223	378.54	341.54	341.60	6947.8	27.58	11359	0.663	4911	27.10	28.69	1.10	2.48	11.27	8.48	9.81
10.147	2.223	391.13	355.77	355.84	6945.0	28.71	11051	0.663	5109	27.44	28.91	1.10	3.09	11.27	10.31	11.42
12.713	2.223	402.78	369.73	369.81	6942.2	29.82	10767	0.663	5413	28.33	29.70	1.10	3.76	11.27	12.71	13.63
7.607	-3.495	389.89	347.38	347.43	6947.8	24.67	9879	0.663	4319	23.56	25.10	1.10	2.48	11.27	7.74	9.17
7.633	3.495	388.35	346.64	346.70	6947.8	25.08	10076	0.663	4402	24.05	25.60	1.10	2.49	11.27	7.85	9.26

Table 3 (continued)

Channel Specimen
Experiment 6
Date: 10 August 1990
Time: 17:36:47

TA	TB	M	P0	P0-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
298.61	358.80	28.62	6061.6	50.17	25.28	2482.0	1.56

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.580	0.655	339.50
2.540	0.655	342.80
5.080	0.655	352.57
7.620	0.655	36[illegible].95
10.160	0.655	370.69
12.700	0.655	377.89
13.653	0.655	382.00

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NU/No	Utw	Utf	Ure	Uh	Unu
												---Uncertainties				---
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	311.15	298.48	298.60	6061.6	37.81	19448	0.661	11560	69.48	71.29	1.10	0.59	11.27	15.08	15.86
1.270	-0.318	325.78	303.18	303.30	6058.9	38.40	19269	0.662	8045	52.78	54.91	1.10	0.69	11.27	7.14	8.67
2.527	-0.330	332.08	307.86	307.99	6056.4	38.99	19053	0.662	7474	44.16	46.06	1.10	0.81	11.27	7.25	8.76
3.810	-0.318	337.42	312.33	312.46	6053.9	39.55	18871	0.662	7062	41.33	43.12	1.10	1.08	11.27	7.51	8.98
5.080	-0.318	341.99	316.88	316.96	6051.4	40.11	18695	0.662	7221	41.87	43.67	1.10	1.23	11.27	7.97	9.36
6.363	-0.318	346.86	321.41	321.55	6048.8	40.69	18513	0.662	7236	41.56	43.34	1.10	1.48	11.27	8.54	9.96
7.620	-0.330	351.71	325.94	326.08	6046.3	41.26	18346	0.662	7126	40.56	42.29	1.10	1.76	11.27	9.18	10.41
8.903	-0.305	357.19	330.56	330.70	6043.8	41.86	18166	0.662	6882	38.81	40.50	1.10	1.95	11.27	9.54	10.73
10.160	-0.318	360.20	[illegible]	335.20	6041.3	42.41	18005	0.662	7180	40.13	41.76	1.10	2.16	11.27	10.70	11.78
11.430	-0.318	364.65	339.47	339.63	6038.8	42.97	17867	0.662	7132	39.51	41.06	1.10	2.39	11.27	11.71	12.70
12.700	-0.305	368.03	343.84	344.00	6036.3	43.52	17696	0.663	7396	40.62	42.17	1.10	2.62	11.27	12.68	13.60
13.970	-0.318	372.15	348.51	348.67	6033.8	44.10	17534	0.663	8338	45.40	47.07	1.10	2.88	11.27	13.81	14.66
15.240	-0.953	368.09	353.07	353.26	6031.3	44.68	17381	0.663	9141	49.34	50.48	1.10	3.12	11.27	25.67	26.14
2.527	-2.223	334.27	308.87	308.98	6056.4	35.41	17211	0.662	7120	41.98	43.86	1.10	0.81	11.27	7.04	8.59
5.080	-2.235	352.76	318.73	318.86	6051.4	36.53	16853	0.662	5340	30.86	32.61	1.10	1.23	11.27	6.62	8.25
7.607	-2.235	357.22	328.79	328.91	6046.4	37.67	16506	0.662	6452	36.51	38.21	1.10	1.76	11.27	8.51	9.93
10.173	-2.223	364.77	338.95	339.08	6041.3	38.82	16173	0.662	6986	38.76	40.34	1.10	2.16	11.27	10.47	11.57
12.700	-2.223	372.83	348.62	348.75	6036.3	39.92	15870	0.663	7377	40.16	41.67	1.10	2.62	11.27	12.66	13.58
2.540	2.197	334.57	308.65	308.77	6056.4	36.30	17666	0.662	6976	41.13	42.99	1.10	0.81	11.27	6.97	8.53
5.080	2.223	345.49	318.23	318.35	6051.4	37.42	17309	0.662	6666	38.56	40.32	1.10	1.23	11.27	7.55	9.01
7.620	2.223	355.79	328.07	328.20	6046.3	38.56	16960	0.662	6621	37.52	39.23	1.10	1.76	11.27	8.68	9.98
10.147	2.223	364.29	337.83	337.96	6041.3	39.70	16630	0.662	6819	37.90	39.51	1.10	2.16	11.27	10.25	11.37
12.713	2.223	372.51	347.39	347.53	6036.3	40.82	16320	0.663	7119	38.86	40.36	1.10	2.62	11.27	12.27	13.22
7.607	-3.493	367.14	333.95	334.06	6046.4	32.71	13972	0.662	5519	30.91	32.56	1.10	1.76	11.27	7.63	9.08
7.633	3.493	363.66	332.21	332.31	6046.3	34.33	14793	0.662	5827	32.75	34.42	1.10	1.76	11.27	7.95	9.33

Table 3 (continued)

Channel: Specimen
Experiment 6
Date: 16 August 1990
Time: 14:41:44

TA	TB	m	P0	P0-P1	VF	QE	Wqe
K	K	kg/h	kPa	kPa	%	W	%
298.50	340.38	40.98	6066.2	55.92	25.34	2447.0	1.98

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	331.19
2.540	0.655	333.25
5.080	0.655	338.95
7.620	0.655	347.15
10.160	0.655	352.33
12.7[illegible]	0.655	357.29
13.653	0.655	360.51

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUo	Wtw	Wtf	Wre	Wh	Wnu
												---------Uncertainties	----------			
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.985	307.38	298.30	298.55	6066.2	54.80	28276	0.661	16335	98.49	100.13	1.10	0.55	11.27	17.98	18.64
1.270	-0.318	318.40	301.51	301.77	6061.6	55.40	28000	0.662	11818	70.78	72.95	1.10	0.58	11.27	8.63	9.93
2.527	-0.330	322.86	304.71	304.98	6057.0	56.10	27885	0.662	10616	59.59	61.51	1.10	0.64	11.27	8.52	9.86
3.810	-0.318	326.64	307.77	308.04	6052.3	56.68	27808	0.662	9616	55.64	57.40	1.10	0.75	11.27	8.58	9.80
5.080	-0.318	329.71	310.82	311.10	6047.6	57.26	27517	0.662	9461	56.72	58.39	1.10	0.90	11.27	8.92	10.19
6.363	-0.318	332.97	313.97	314.25	6042.9	57.86	27332	0.662	9714	56.46	58.52	1.16	1.06	11.27	9.37	10.58
7.620	-0.330	336.38	317.07	317.35	6038.3	58.45	27154	0.662	9545	55.32	57.15	1.10	1.23	11.27	9.83	11.00
8.905	-0.305	340.39	320.22	320.51	6033.6	59.05	26975	0.662	9[illegible]14	52.48	54.27	1.10	1.38	11.27	9.99	11.13
10.160	-0.318	342.21	323.29	323.59	6029.0	59.64	26808	0.662	9586	54.86	56.58	1.10	1.52	11.27	11.13	12.16
11.43[illegible]	-0.318	344.89	326.31	[illegible]26.62	6024.3	60.22	26636	0.662	9677	53.98	55.57	1.10	1.48	11.27	11.99	12.96
12.700	-0.305	34[illegible]	329.38	329.61	6019.6	60.79	26475	0.662	9809	55.45	57.13	1.10	1.86	11.27	12.83	13.75
13.970	-0.318	359.81	332.40	33[illegible].81	6015.0	61.40	26306	0.662	10087	60.70	62.52	1.10	2.05	11.27	13.55	14.4[illegible]
15.240	-0.953	347.48	335.61	335.93	6010.3	62.00	26140	0.662	11608	65.21	66.47	1.10	2.20	11.27	24.82	25.30
2.527	-2.223	324.36	305.58	305.79	6057.0	50.01	26730	0.662	9637	57.21	59.12	1.10	0.64	11.27	8.30	9.65
5.080	-2.235	340.22	312.45	312.67	6047.6	51.16	26375	0.662	6528	38.20	40.03	1.10	0.90	11.27	6.93	8.50
7.607	-2.235	341.87	319.46	319.67	6038.3	52.33	26017	0.662	8487	48.95	50.75	1.10	1.23	11.27	8.99	10.25
10.17[illegible]	-2.225	345.35	326.[illegible]2	326.76	6028.9	53.53	25668	0.662	9404	53.97	55.68	1.10	1.53	11.27	11.05	12.09
12.700	-2.223	351.12	333.25	333.38	6019.6	54.6[illegible]	25346	0.662	10022	56.21	57.85	1.10	1.86	11.27	13.08	13.97
2.540	2.177	326.49	305.30	305.53	6056.[illegible]	52.0[illegible]	25772	0.662	9535	55.46	57.37	1.10	0.64	11.27	8.13	9.50
5.080	2.223	332.32	311.87	312.[illegible]1	6047.6	53.17	25409	0.662	8808	52.13	53.98	1.10	0.90	11.27	8.41	9.75
7.620	2.223	330.42	318.63	318.87	6038.3	54.35	25048	0.662	8837	51.05	52.86	1.10	1.23	11.27	9.27	10.49
10.147	2.223	345.28	325.32	325.58	6029.0	55.53	24702	0.662	9057	51.61	53.33	1.10	1.52	11.27	10.62	11.70
12.713	2.223	351.01	331.88	332.15	6019.6	56.60	24374	0.662	9348	52.60	54.34	1.10	1.85	11.27	12.34	13.28
7.607	-3.493	350.68	324.38	324.46	6038.3	43.31	19591	0.662	6024	39.53	41.2[illegible]	1.10	1.23	11.27	7.80	9.[illegible]2
7.633	3.493	345.96	321.97	322.16	6038.2	47.35	21452	0.662	7628	43.76	45.52	[illegible].10	1.26	11.27	8.34	9.68

Table 3 (continued)

Chevron Specimen
Experiment 7
Date: 9 August 1990
Time: 14:34:42

TA	TB	M	P0	P0-P1	V/	Qt	Hgt
K	K	kg/h	kPa	kPa	%	W	%
299.11	665.42	9.27	6056.4	6.81	53.71	4800.0	1.94

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	495.77
2.540	0.655	525.72
5.080	0.655	595.97
7.620	0.655	664.19
10.160	0.655	732.79
12.700	0.655	770.08
13.653	0.655	783.58

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tav	P	V	RE	PR	h	NU	NUe	UTw	UTf	URe	Uh	UNu
												---------Uncertainties---------				
cm	cm	K	K	K	kPa	m/s			W/(m²-K)			K	K	%	%	%
0.000	-0.965	381.04	299.10	299.11	6056.4	11.87	6078	0.661	3605	21.04	26.04	1.10	1.99	11.27	11.61	12.61
1.270	-0.318	455.45	328.73	328.74	6055.8	13.90	5707	0.662	3006	17.52	20.96	1.10	3.19	11.27	4.82	6.80
2.527	-0.330	501.13	358.30	358.32	6055.3	14.14	5306	0.663	2483	13.30	16.00	1.10	4.21	11.27	5.33	7.26
3.810	-0.318	537.67	386.48	386.50	6054.7	15.22	5117	0.663	2300	11.60	14.02	1.10	5.61	11.27	5.82	7.62
5.080	-0.318	570.24	414.68	414.70	6054.1	16.30	4878	0.664	2295	11.12	13.25	1.19	7.16	11.27	6.36	8.04
6.365	-0.316	603.71	443.76	443.78	6053.6	17.42	4657	0.664	2257	10.45	12.38	1.32	8.77	11.27	7.01	8.56
7.620	-0.330	637.71	472.33	472.36	6053.0	18.51	4462	0.664	2100	9.67	11.41	1.46	10.38	11.27	7.65	9.10
8.905	-0.305	672.79	501.45	501.48	6052.4	19.63	4282	0.664	2099	8.94	10.51	1.60	11.65	11.27	8.10	9.67
10.160	-0.318	705.37	529.77	529.80	6051.9	20.72	4123	0.664	2041	8.37	9.78	1.72	12.97	11.27	8.71	10.00
11.430	-0.316	729.94	557.68	557.72	6051.3	21.79	3979	0.664	1956	7.90	9.16	1.83	14.34	11.27	9.31	10.71
12.700	-0.305	751.34	585.23	585.28	6050.7	22.85	3849	0.665	2111	8.08	9.27	1.91	15.75	11.27	10.53	11.62
13.970	-0.318	758.92	614.70	614.74	6050.2	23.98	3720	0.665	2679	9.91	11.13	1.96	17.33	11.27	12.76	13.68
15.240	-0.953	728.54	643.47	643.53	6049.6	25.09	3605	0.665	3151	11.30	12.10	1.82	18.77	11.27	25.55	26.52
2.527	-2.223	517.10	362.92	362.95	6055.3	13.28	4953	0.663	2304	12.21	14.83	1.10	4.21	11.27	5.21	7.16
5.080	-2.235	592.53	423.70	423.71	6054.1	15.44	4499	0.664	2115	10.10	12.15	1.28	7.16	11.27	6.18	7.84
7.607	-2.235	663.79	485.52	485.55	6053.0	17.64	4062	0.664	2022	8.80	10.45	1.56	10.36	11.27	7.27	8.78
10.173	-2.223	722.25	548.07	548.10	6051.9	19.87	3736	0.664	2033	8.15	9.49	1.80	12.99	11.27	8.70	9.99
12.700	-2.223	771.36	607.55	607.59	6050.7	21.99	3479	0.665	2141	7.99	9.11	1.99	15.75	11.27	10.66	11.74
2.540	2.197	509.39	361.72	361.74	6055.3	13.56	5084	0.663	2404	12.77	15.42	1.10	4.22	11.27	5.28	7.22
5.080	2.223	580.47	420.76	420.78	6054.1	15.71	4588	0.664	2236	10.73	12.81	1.23	7.16	11.27	6.27	7.97
7.620	2.223	655.52	481.44	481.47	6053.0	17.92	4184	0.664	2071	9.07	10.75	1.53	10.38	11.27	7.40	8.88
10.147	2.223	722.61	541.59	541.63	6051.9	20.11	3858	0.664	1958	7.91	9.27	1.80	12.96	11.27	8.44	9.77
12.713	2.223	767.47	600.59	600.63	6050.7	22.27	3591	0.665	2103	7.91	9.05	1.98	15.77	11.27	10.50	11.60
7.607	-3.493	685.30	496.52	496.54	6053.0	17.83	3777	0.664	1910	8.19	9.78	1.65	10.36	11.27	7.02	8.57
7.633	3.493	683.60	496.03	496.05	6053.0	17.11	3802	0.664	1921	8.24	9.83	1.64	10.39	11.27	7.06	8.60

Table 3 (continued)

Channel Specimen
Experiment 7
Date: 9 August 1990
Time: 14:42:56

TA	TB	M	P0	P0-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
299.44	521.66	15.90	6950.9	14.27	50.78	5096.0	1.07

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.500	0.655	426.44
2.540	0.655	441.36
5.080	0.655	477.80
7.620	0.655	517.14
10.160	0.655	543.65
12.700	0.655	570.98
13.653	0.655	584.19

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tav	P	V	RE	PR	h	NU	NUo	UTw	UTf	URe	Uh	Unu
												---------Uncertainties---------				
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	345.77	299.40	299.44	6950.9	20.58	10515	0.662	5429	38.68	41.87	1.10	1.27	11.27	11.84	12.82
1.270	-0.318	392.93	317.21	317.25	6949.7	21.76	10118	0.662	5392	31.26	35.14	1.10	1.97	11.27	5.01	7.02
2.527	-0.336	417.38	334.97	335.02	6948.5	22.94	9755	0.662	4467	25.08	28.31	1.10	2.57	11.27	5.55	7.42
3.810	-0.318	436.77	351.91	351.96	6947.3	24.07	9436	0.663	4264	23.07	25.98	1.10	3.42	11.27	6.13	7.86
5.080	-0.318	454.27	368.85	368.90	6946.1	25.20	9142	0.663	4350	22.91	25.58	1.10	4.35	11.27	6.81	8.40
6.363	-0.318	472.43	386.32	386.37	6944.9	26.37	8860	0.663	4363	22.18	24.78	1.10	5.33	11.27	7.64	9.09
7.620	-0.330	490.79	403.49	403.53	6943.7	27.51	8602	0.663	4297	21.21	23.62	1.10	6.30	11.27	8.50	9.82
8.903	-0.305	509.12	420.98	421.05	6942.5	28.68	8356	0.664	4267	20.37	22.62	1.10	7.07	11.27	9.19	10.63
10.160	-0.318	521.60	437.99	438.07	6941.4	29.82	8133	0.664	4406	20.58	22.66	1.10	7.88	11.27	10.46	11.56
11.430	-0.318	536.66	454.76	454.85	6940.2	30.95	7927	0.664	4481	20.40	22.30	1.10	8.70	11.27	11.87	12.85
12.700	-0.305	548.83	471.32	471.40	6939.0	32.06	7735	0.664	4709	20.92	22.75	1.10	9.56	11.27	13.20	14.08
13.970	-0.318	561.58	489.02	489.11	6937.8	33.22	7541	0.664	5543	24.02	25.92	1.15	10.52	11.27	15.16	15.94
15.240	-0.953	590.64	506.31	506.41	6936.6	34.38	7363	0.664	6300	26.65	27.91	1.11	11.39	11.27	28.82	29.24
2.527	-2.223	426.43	337.51	337.55	6948.5	21.58	9061	0.662	4158	23.12	26.29	1.10	2.57	11.27	5.40	7.31
5.080	-2.235	470.79	373.79	373.84	6946.1	23.84	8658	0.663	3850	19.90	22.59	1.10	4.35	11.27	6.34	8.02
7.667	-2.235	506.23	410.71	410.76	6943.8	26.13	7934	0.664	4011	19.56	21.90	1.10	6.29	11.27	8.07	9.45
10.173	-2.223	537.34	448.05	448.11	6941.3	28.46	7676	0.664	4128	18.99	20.99	1.10	7.88	11.27	9.93	11.08
12.700	-2.223	564.60	483.56	483.64	6939.0	30.67	7095	0.664	4499	19.64	21.39	1.17	9.56	11.27	12.68	13.60
2.540	2.197	425.17	337.79	337.83	6948.5	21.54	9033	0.662	4228	23.50	26.67	1.10	2.58	11.27	5.44	7.33
5.080	2.223	465.13	373.98	374.03	6946.1	23.79	8634	0.663	4076	21.17	23.87	1.10	4.35	11.27	6.56	8.20
7.620	2.223	506.92	411.18	411.24	6943.7	26.10	7908	0.664	4002	19.50	21.82	1.10	6.30	11.27	8.07	9.45
10.167	2.223	533.67	448.05	448.12	6941.4	28.39	7657	0.664	4318	19.86	21.86	1.10	7.87	11.27	10.28	11.40
12.713	2.223	562.00	486.21	486.29	6939.0	30.66	7071	0.664	4696	20.48	22.23	1.15	9.57	11.27	13.17	14.06
7.607	-3.493	518.68	418.56	418.61	6943.8	24.87	7317	0.664	3767	18.04	20.30	1.10	6.29	11.27	7.69	9.13
7.633	3.493	525.98	422.77	422.82	6943.7	24.34	7043	0.664	3634	17.38	19.60	1.10	6.31	11.27	7.55	9.01

Table 3 (continued)

Channel Specimen
Experiment 7
Date: 9 August 1990
Time: 14:49:58

TA	TB	M	P0	P0-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
299.11	440.12	21.95	6063.6	23.25	50.00	5095.0	1.11

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	400.02
2.540	0.655	410.01
5.080	0.655	436.21
7.620	0.655	464.28
10.160	0.655	485.08
12.700	0.655	504.25
13.653	0.655	514.57

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tb	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
												Uncertainties				
cm	cm	K	K	K	kPa	m/s			W/(m² K)			K	K	%	%	%
0.000	-0.965	332.73	299.03	299.10	6063.6	28.60	14469	0.661	8856	53.32	56.55	1.10	0.99	11.27	12.10	13.06
1.270	-0.318	360.50	311.80	311.87	6061.7	29.78	14267	0.662	7021	41.49	45.55	1.10	1.46	11.27	5.14	7.11
2.527	-0.330	386.80	326.54	326.62	6059.7	30.97	13890	0.662	5935	33.87	37.31	1.10	1.89	11.27	5.62	7.47
3.810	-0.318	400.76	336.69	336.77	6057.8	32.10	13552	0.662	5652	31.48	34.65	1.10	2.49	11.27	6.15	7.88
5.080	-0.318	413.28	348.86	348.95	6055.8	33.23	13232	0.663	5771	31.40	34.47	1.10	3.16	11.27	6.78	8.37
6.363	-0.318	426.37	361.37	361.47	6053.9	34.40	12921	0.663	5786	30.75	33.68	1.10	3.87	11.27	7.54	9.00
7.620	-0.330	439.47	373.68	373.79	6052.0	35.55	12632	0.663	5708	29.67	32.44	1.10	4.57	11.27	8.35	9.70
8.903	-0.305	452.88	386.23	386.34	6050.0	36.72	12352	0.663	5622	28.58	31.20	1.10	5.13	11.27	8.99	10.25
10.160	-0.318	462.02	398.43	398.55	6048.1	37.86	12096	0.663	5805	28.98	31.35	1.10	5.71	11.27	10.15	11.28
11.430	-0.318	472.06	410.46	410.59	6046.2	38.99	11852	0.664	5818	28.39	30.66	1.10	6.31	11.27	11.35	12.37
12.700	-0.305	482.65	422.33	422.47	6044.2	40.10	11623	0.664	6059	29.08	31.21	1.10	6.93	11.27	12.48	13.42
13.970	-0.318	492.82	435.03	435.17	6042.3	41.28	11391	0.664	6968	32.69	35.01	1.10	7.63	11.27	13.98	14.82
15.240	-0.953	483.54	447.43	447.58	6040.3	42.44	11176	0.664	7748	35.66	37.22	1.10	8.26	11.27	26.42	26.85
2.527	-2.223	395.63	326.71	326.78	6059.7	28.76	12750	0.662	5528	31.41	34.80	1.10	1.89	11.27	5.48	7.36
5.080	-2.235	429.41	353.06	353.14	6055.8	31.00	12102	0.663	4870	26.28	29.27	1.10	3.16	11.27	6.17	7.90
7.607	-2.253	451.22	379.87	379.97	6052.0	33.31	11518	0.663	5262	27.05	29.76	1.10	4.57	11.27	7.87	9.28
10.173	-2.223	476.54	406.99	407.10	6048.1	35.64	10991	0.663	5442	26.81	29.17	1.10	5.72	11.27	9.68	10.8[illegible]
12.700	-2.223	495.69	432.78	432.90	6044.2	37.86	10540	0.664	5807	27.34	29.46	1.10	6.93	11.27	12.03	13.30
2.540	2.197	393.15	326.54	326.61	6059.7	29.05	12897	0.662	5550	31.55	34.96	1.10	1.89	11.27	5.49	7.37
5.080	2.2[illegible]	422.10	352.46	352.55	6055.8	31.30	12251	0.663	5340	28.85	31.86	1.10	3.16	11.27	6.48	8.14
7.620	2.223	449.66	379.11	379.21	6052.0	33.61	11662	0.663	5322	27.39	30.09	1.10	4.57	11.27	7.96	9.34
10.147	2.223	472.36	405.53	405.64	6048.1	35.91	11141	0.663	5524	27.17	29.55	1.10	5.71	11.27	9.74	10.92
12.713	2.223	495.88	431.43	431.55	6044.2	38.17	10681	0.664	5863	27.66	29.79	1.10	6.94	11.27	12.13	13.09
7.607	-3.495	467.61	388.59	388.67	6052.0	30.74	10240	0.663	4750	26.05	26.63	1.10	4.57	11.27	7.34	8.84
7.633	3.495	467.88	388.92	389.00	6051.9	30.76	10232	0.663	4753	24.05	26.62	1.10	4.58	11.27	7.36	8.85

Table 3 (continued)

Channel Specimen
Experiment 7
Date: 9 August 1990
Time: 14:56:11

TA	TB	M	P0	P0-P1	VF	Qt	UQt
K	K	kg/h	kPa	kPa	%	W	%
299.45	412.15	31.35	6051.1	40.17	50.81	5092.0	1.20

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.508	0.655	379.86
2.540	0.655	385.42
5.080	0.655	403.60
7.620	0.655	423.38
10.160	0.655	437.96
12.700	0.655	451.40
13.653	0.655	459.46

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Tav	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	323.05	299.29	299.43	6051.1	41.47	21285	0.662	12609	75.88	79.14	1.10	0.78	11.27	12.64	13.57
1.270	-0.318	351.15	308.11	308.26	6047.7	42.67	20800	0.662	9511	56.16	60.35	1.10	1.07	11.27	5.42	7.32
2.527	-0.330	363.15	316.91	317.07	6044.6	43.87	20412	0.662	8017	46.48	53.10	1.10	1.36	11.27	5.82	7.62
3.810	-0.318	372.95	325.30	325.47	6041.0	45.01	20089	0.662	7615	43.39	46.78	1.10	1.77	11.27	6.25	7.96
5.080	-0.318	381.62	333.69	333.87	6037.7	46.16	19719	0.662	7775	43.57	46.91	1.10	2.23	11.27	6.79	8.39
6.363	-0.318	390.69	342.35	342.54	6034.3	47.34	19383	0.663	7796	42.95	46.19	1.10	2.72	11.27	7.47	8.94
7.620	-0.330	399.78	350.86	351.05	6031.0	48.51	19065	0.663	7601	41.69	44.79	1.10	3.21	11.27	8.20	9.56
8.903	-0.305	400.77	359.52	359.73	6027.6	49.69	18754	0.663	7673	39.85	42.82	1.10	3.60	11.27	8.68	9.98
10.160	-0.318	415.60	367.95	368.17	6024.3	50.85	18462	0.663	7750	40.70	43.52	1.10	4.01	11.27	9.79	10.95
11.430	-0.318	422.89	376.26	376.49	6021.0	51.99	18186	0.663	7702	39.85	42.49	1.10	4.43	11.27	10.81	11.88
12.700	-0.305	436.33	384.46	384.70	6017.6	53.12	17922	0.663	7987	40.73	43.33	1.10	4.86	11.27	11.80	12.79
13.970	-0.318	430.35	395.23	395.48	6014.3	54.35	17650	0.663	8950	44.96	47.73	1.10	5.35	11.27	12.85	13.76
15.240	-0.953	430.53	401.80	402.05	6010.9	55.50	17393	0.663	9700	48.42	50.30	1.10	5.79	11.27	24.29	24.78
2.527	-2.223	367.92	318.68	318.82	6044.4	40.16	18509	0.662	7523	43.45	47.02	1.10	1.36	11.27	5.67	7.51
5.080	-2.235	396.88	337.13	337.28	6037.7	42.43	17824	0.662	6229	34.67	37.93	1.10	2.23	11.27	6.04	7.79
7.607	-2.235	409.60	355.80	356.06	6031.0	44.76	17186	0.663	6999	37.58	40.60	1.10	3.20	11.27	7.67	9.11
10.173	-2.223	425.85	374.87	375.05	6024.3	47.13	16593	0.663	7366	38.21	40.94	1.10	4.01	11.27	9.41	10.62
12.700	-2.223	440.17	392.92	393.12	6017.6	49.38	16073	0.663	7747	38.95	41.44	1.10	4.26	11.27	11.50	12.51
2.540	2.197	368.06	318.41	318.55	6044.4	40.86	18868	0.662	7456	43.09	46.66	1.10	1.36	11.27	5.66	7.50
5.080	2.223	388.67	336.42	336.58	6037.7	43.16	18185	0.662	7153	39.97	43.15	1.10	2.23	11.27	6.48	8.14
7.620	2.223	407.66	354.95	355.11	6031.0	45.49	17541	0.663	7132	38.36	41.40	1.10	3.21	11.27	7.77	9.20
10.147	2.223	423.98	373.28	373.47	6024.3	47.81	16954	0.663	7294	37.96	40.66	1.10	4.00	11.27	9.32	10.54
12.713	2.223	439.25	391.27	391.48	6017.6	50.10	16421	0.663	7637	38.49	41.02	1.10	4.87	11.27	11.36	12.38
7.607	-3.493	425.51	364.10	364.23	6031.0	39.99	14790	0.663	6116	32.34	35.23	1.10	3.20	11.27	7.02	8.57
7.633	3.493	423.16	363.01	363.15	6031.0	40.69	15122	0.663	6244	33.09	36.00	1.10	3.21	11.27	7.12	8.66

Table 3 (continued)

Channel Specimen
Experiment 7
Date: 9 August 1990
Time: 15:01:22

TA	TB	M	P0	P0-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
298.73	385.01	40.86	6972.9	61.[illegible]6	50.85	5000.0	1.31

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.508	0.655	366.17
2.540	0.655	370.55
5.080	0.655	386.48
7.620	0.655	399.61
10.160	0.655	418.57
12.700	0.655	420.71
13.653	0.655	427.46

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUo	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	316.89	298.45	298.70	6972.9	54.26	27946	0.661	16325	98.48	101.70	1.10	0.68	11.27	13.34	14.22
1.270	-0.318	339.79	305.14	305.40	6967.8	55.45	27540	0.662	11832	70.31	74.59	1.10	0.87	11.27	5.79	7.60
2.527	-0.330	348.89	311.81	312.08	6962.8	56.67	27146	0.662	10011	58.65	62.39	1.10	1.07	11.27	6.10	7.84
3.810	-0.318	356.51	318.17	318.45	6957.6	57.83	26783	0.662	9476	54.78	58.32	1.10	1.38	11.27	6.45	8.11
5.080	-0.318	363.07	324.53	324.82	6952.5	58.99	26430	0.662	9681	55.25	58.77	1.10	1.72	11.27	6.92	8.49
6.363	-0.318	369.87	331.08	331.39	6947.4	60.18	26078	0.662	9731	54.81	58.25	1.10	2.09	11.27	7.53	9.00
7.620	-0.330	376.81	337.53	337.85	6942.4	61.36	25763	0.662	9595	53.36	56.69	1.10	2.47	11.27	8.19	9.55
8.903	-0.305	384.88	344.10	344.43	6937.2	62.57	25412	0.663	9222	50.64	53.86	1.10	2.77	11.27	8.55	9.87
10.160	-0.318	388.96	350.49	350.83	6932.2	63.76	25099	0.663	9635	52.26	55.34	1.10	3.08	11.27	9.64	10.83
11.430	-0.318	[illegible]	356.78	357.14	6927.1	64.98	24800	0.663	9523	51.05	53.96	1.10	3.40	11.27	10.56	11.65
12.700	-0.305	[illegible]	362.99	363.36	6922.0	66.06	24512	0.663	9083	52.37	55.25	1.10	3.73	11.27	11.49	12.50
13.970	-0.318	406.79	369.64	370.02	6916.9	67.26	24214	0.663	10093	57.03	60.11	1.10	4.11	11.27	12.28	13.23
15.240	-0.953	399.98	376.13	376.52	6911.8	68.46	23930	0.663	11064	61.29	63.40	1.10	4.65	11.27	23.29	23.81
2.527	-2.223	[illegible]	313.33	313.55	6962.8	51.32	26390	0.662	9473	55.33	59.03	1.10	1.07	11.27	5.95	7.72
5.080	-2.235	377.55	327.44	327.68	6952.5	53.63	23682	0.662	7625	42.13	45.56	1.10	1.72	11.27	6.01	7.77
7.607	-2.235	385.29	341.80	342.06	6942.4	55.99	23009	0.663	8650	47.78	50.95	1.10	2.46	11.27	7.61	9.06
10.173	-2.223	396.26	356.32	356.61	6932.1	58.38	22373	0.663	9264	49.70	52.69	1.10	3.08	11.27	9.36	10.58
12.700	-2.223	407.93	370.13	370.44	6922.0	60.67	21886	0.663	9708	50.74	53.33	1.10	3.73	11.27	11.31	12.33
2.540	2.197	352.95	313.04	313.27	6962.7	52.52	24998	0.662	9278	54.22	57.92	1.10	1.08	11.27	5.90	7.68
5.080	2.223	368.70	326.76	326.99	6952.5	54.82	24291	0.662	8879	50.45	53.92	1.10	1.72	11.27	6.58	8.22
7.620	2.223	383.30	340.83	341.11	6942.4	57.19	23613	0.663	8861	48.96	52.23	1.10	2.47	11.27	7.75	9.18
10.147	2.223	395.84	354.80	355.09	6932.2	59.55	22983	0.663	9019	48.53	51.54	1.10	3.07	11.27	9.15	10.39
12.713	2.223	407.50	368.49	368.81	6922.0	61.87	22403	0.663	9406	49.35	52.16	1.10	3.73	11.27	11.02	12.07
7.607	-3.493	400.25	349.36	349.54	6942.4	46.77	19534	0.663	7376	40.09	43.28	1.10	2.44	11.27	6.88	8.46
7.633	3.493	396.87	347.76	347.97	6942.3	50.29	20086	0.663	7645	41.68	44.82	1.10	2.47	11.27	7.04	8.59

Table 3 (continued)

Channel Specimen
Experiment 8
Date: 13 August 1990
Time: 15:46:12

TA	TB	M	PO	PO-P1	VF	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
296.57	676.53	13.84	6984.0	13.66	76.15	7579.0	1.06

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	513.79
2.540	0.655	542.00
5.080	0.655	607.21
7.620	0.655	677.95
10.160	0.655	737.99
12.700	0.655	762.47
13.653	0.655	784.03

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	377.50	296.54	296.56	6984.0	17.65	9201	0.661	5475	33.13	37.83	1.10	2.06	11.27	11.63	12.63
1.270	-0.318	459.61	326.99	327.02	6982.8	19.40	8622	0.662	4579	26.00	31.35	1.10	3.30	11.27	4.80	6.88
2.527	-0.330	506.26	357.39	357.42	6981.7	21.15	8122	0.663	3744	20.05	24.23	1.10	4.36	11.27	5.34	7.26
3.810	-0.318	537.86	386.36	386.40	6980.6	22.82	7704	0.663	3533	18.05	21.65	1.10	5.82	11.27	5.90	7.68
5.080	-0.318	568.63	415.33	415.38	6979.4	24.49	7335	0.664	3610	17.47	20.76	1.18	7.42	11.27	6.54	8.19
6.363	-0.318	600.29	445.22	445.28	6978.3	26.21	6995	0.664	3604	16.64	19.61	1.31	9.10	11.27	7.31	8.81
7.620	-0.330	633.86	474.59	474.66	6977.1	27.91	6695	0.664	3504	15.49	18.16	1.44	10.77	11.27	8.06	9.44
8.903	-0.305	668.24	504.51	504.59	6976.0	29.63	6419	0.664	3401	14.42	16.83	1.58	12.08	11.27	8.60	9.90
10.160	-0.318	694.02	533.62	533.70	6974.9	31.31	6176	0.664	3419	13.95	16.12	1.68	13.46	11.27	9.51	10.71
11.430	-0.318	712.80	562.31	562.40	6973.7	32.97	5956	0.664	3537	13.92	15.86	1.76	14.87	11.27	10.91	11.97
12.700	-0.305	751.82	590.63	590.73	6972.6	34.60	5757	0.665	3845	14.63	16.46	1.84	16.34	11.27	12.46	13.40
13.970	-0.318	751.17	620.91	621.02	6971.5	36.35	5560	0.665	4592	16.88	18.74	1.91	17.98	11.27	14.47	15.29
15.240	-0.953	732.40	650.48	650.60	6970.3	38.06	5383	0.665	5068	18.04	19.26	1.84	19.47	11.27	27.06	27.51
2.527	-2.223	520.76	361.39	361.42	6981.7	20.07	7565	0.663	3450	18.34	22.42	1.10	4.36	11.27	5.21	7.17
5.080	-2.235	593.98	423.13	423.18	6979.4	23.40	6796	0.664	3235	15.46	18.63	1.28	7.42	11.27	6.17	7.90
7.607	-2.235	655.67	485.96	486.02	6977.2	26.80	6182	0.664	3288	14.31	16.87	1.53	10.75	11.27	7.70	9.14
10.173	-2.223	7.3.38	549.51	549.58	6974.9	30.24	5679	0.664	3247	12.98	15.04	1.78	13.47	11.27	9.15	10.39
12.700	-2.223	753.05	609.94	610.03	6972.6	33.51	5283	0.665	3793	14.12	15.86	1.92	16.34	11.27	12.32	13.27
2.540	2.197	517.19	363.06	363.09	6981.7	19.75	7387	0.663	3565	18.89	22.95	1.10	4.38	11.27	5.27	7.21
5.080	2.223	585.97	425.77	425.81	6979.4	23.07	6630	0.664	3450	16.42	19.57	1.25	7.42	11.27	6.38	8.06
7.620	2.223	663.44	490.23	490.29	6977.1	26.48	6019	0.664	3221	13.93	16.45	1.56	10.77	11.27	7.60	9.06
10.147	2.223	717.93	554.12	554.20	6974.9	29.87	5531	0.664	3349	13.32	15.36	1.78	13.44	11.27	9.36	10.57
12.7[illegible]	2.223	751.76	616.78	616.87	6972.[illegible]	33.19	5136	0.665	4025	14.86	16.57	1.91	16.35	11.27	12.98	13.89
7.607	-3.493	670.86	493.97	494.03	6977.2	26.13	5864	0.664	3154	13.57	16.06	1.59	10.75	11.27	7.49	8.96
7.633	3.493	701.26	510.41	510.46	6977.1	24.99	5311	0.664	2923	12.30	14.65	1.71	10.78	11.27	7.15	8.68

Table 3 (continued)

Channel Specimen
Experiment 8
Date: 13 August 1990
Time: 15:53:27

TA	TB	M	PO	PO-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
296.56	585.58	18.46	6984.7	20.05	76.24	7690.0	1.05

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	470.10
2.540	0.655	489.31
5.080	0.655	536.85
7.620	0.655	588.64
10.160	0.655	625.27
12.700	0.655	657.67
13.653	0.655	676.21

Insulated-Side Temperatures and Calculated Data:

												-------- Uncertainties ----------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	356.84	296.51	296.55	6984.7	23.68	12352	0.661	7458	45.13	49.97	1.10	1.60	11.27	11.72	12.71
1.270	-0.318	421.22	319.52	319.58	6983.1	25.47	11755	0.662	6060	34.94	40.67	1.10	2.53	11.27	4.86	6.91
2.527	-0.330	453.37	342.49	342.56	6981.4	27.25	11220	0.663	5034	27.72	32.34	1.10	3.33	11.27	5.40	7.31
3.810	-0.318	478.03	364.39	364.46	6979.7	28.94	10761	0.663	4807	25.41	29.50	1.10	4.43	11.27	5.98	7.74
5.080	-0.318	500.33	386.29	386.36	6978.1	30.64	10344	0.663	4919	25.00	28.82	1.10	5.65	11.27	6.65	8.27
6.363	-0.318	523.56	408.87	408.96	6976.4	32.39	9952	0.664	4967	24.20	27.73	1.10	6.93	11.27	7.47	8.94
7.620	-0.330	547.12	431.07	431.17	6974.7	34.11	9600	0.664	4881	23.04	26.27	1.10	8.19	11.27	8.32	9.66
8.903	-0.305	570.50	453.68	453.79	6973.0	35.87	9270	0.664	4839	22.06	25.02	1.19	9.19	11.27	9.03	10.28
10.160	-0.318	586.54	475.68	475.80	6971.4	37.58	8973	0.664	5023	22.18	24.89	1.25	10.24	11.27	10.28	11.40
11.430	-0.318	603.05	497.36	497.49	6969.7	39.26	8703	0.664	5113	21.90	24.35	1.32	11.31	11.27	11.68	12.68
12.700	-0.305	621.98	518.76	518.91	6968.0	40.92	8454	0.664	5340	22.22	24.55	1.39	12.43	11.27	12.92	13.82
13.970	-0.318	640.34	541.65	541.80	6966.4	42.70	8205	0.664	6154	24.86	27.26	1.47	13.68	11.27	14.54	15.35
15.240	-0.953	624.89	564.00	564.16	6964.7	44.44	7979	0.665	6927	27.21	28.79	1.41	14.81	11.27	27.59	28.03
2.527	-2.223	466.21	345.77	345.82	6981.4	25.68	10409	0.663	4634	25.36	29.89	1.16	3.33	11.27	5.26	7.20
5.080	-2.235	521.61	392.67	392.74	6978.1	29.07	9552	0.663	4350	21.87	25.57	1.10	5.65	11.27	6.22	7.93
7.607	-2.235	564.69	440.39	440.48	6974.7	32.52	8833	0.664	4557	21.[illegible]	24.31	1.17	8.18	11.27	7.91	9.32
10.173	-2.223	607.22	488.66	488.77	6971.4	36.02	8225	0.664	4694	20.35	22.93	1.34	10.25	11.27	9.75	10.92
12.700	-2.223	643.41	534.56	534.69	6968.0	39.35	7732	0.664	5063	20.64	22.85	1.48	12.43	11.27	12.34	13.28
2.540	2.197	464.77	346.66	346.72	6981.4	25.41	10256	0.663	4722	25.80	30.31	1.10	3.34	11.27	5.30	7.23
5.080	2.223	516.06	393.94	394.01	6978.1	28.78	9407	0.663	4593	23.04	26.73	1.10	5.65	11.27	6.40	8.07
7.620	2.223	568.43	442.53	442.62	6974.7	32.25	8690	0.664	4499	20.86	23.94	1.18	8.19	11.27	7.85	9.27
10.147	2.223	604.85	490.70	490.80	6971.4	35.70	8095	0.664	4878	21.09	23.66	1.33	10.23	11.27	10.04	11.18
12.713	2.223	643.13	537.93	538.06	6968.0	39.08	7598	0.664	5243	21.28	23.48	1.48	12.44	11.27	12.72	13.64
7.607	-3.493	584.31	450.92	451.00	6974.7	31.01	8099	0.664	4246	19.44	22.42	1.25	8.18	11.27	7.54	9.01
7.633	3.493	600.74	460.07	460.14	6974.7	29.97	7568	0.664	4026	18.18	21.05	1.31	8.20	11.27	7.30	8.80

Table 3 (continued)

Channel Specimen
Experiment 8
Date: 13 August 1990
Time: 15:59:43

TA	TB	M	P0	P0-P1	Vf	Qt	Uqt
K	K	kg/h	kPa	kPa	%	W	%
296.23	507.94	25.23	6985.1	30.76	76.28	7699.0	1.07

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	435.27
2.540	0.655	448.08
5.080	0.655	482.55
7.620	0.655	519.60
10.160	0.655	546.40
12.700	0.655	571.06
13.653	0.655	585.94

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
												---------Uncertainties---------				
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	340.54	296.13	296.22	6985.1	32.61	17040	0.661	10157	61.51	66.42	1.10	1.22	11.27	11.87	12.85
1.270	-0.318	390.88	312.84	312.94	6982.6	34.40	16434	0.662	7913	46.26	52.29	1.10	1.88	11.27	4.91	6.95
2.527	-0.330	413.84	329.52	329.63	6980.0	36.18	15872	0.662	6632	37.47	42.47	1.10	2.46	11.27	5.43	7.33
3.810	-0.318	431.86	345.42	345.54	6977.4	37.89	15378	0.663	6332	34.68	39.21	1.10	3.26	11.27	5.96	7.73
5.080	-0.318	447.99	361.32	361.45	6974.9	39.60	14918	0.663	6485	34.47	38.80	1.10	4.15	11.27	6.58	8.22
6.363	-0.318	464.90	377.72	377.86	6972.3	41.36	14477	0.663	6521	33.64	37.71	1.10	5.08	11.27	7.35	8.84
7.620	-0.330	481.80	393.83	393.99	6969.8	43.09	14072	0.663	6453	32.37	36.17	1.10	6.01	11.27	8.17	9.54
8.903	-0.305	499.16	410.25	410.42	6967.2	44.85	13687	0.664	6371	31.10	34.64	1.10	6.74	11.27	8.82	10.10
10.160	-0.318	510.87	426.22	426.41	6964.6	46.57	13335	0.664	6593	31.36	34.65	1.10	7.50	11.27	9.98	11.13
11.430	-0.318	523.60	441.96	442.16	6962.1	48.27	13009	0.664	6634	30.79	33.80	1.10	8.29	11.27	11.20	12.24
12.700	-0.305	537.39	457.50	457.71	6959.5	49.94	12705	0.664	6916	31.36	34.26	1.10	9.11	11.27	12.34	13.28
13.970	-0.318	551.67	474.12	474.34	6956.9	51.73	12398	0.664	7851	34.74	37.76	1.11	10.02	11.27	13.66	14.52
15.240	-0.953	538.61	490.34	490.58	6954.4	53.48	12114	0.664	8769	37.92	39.93	1.10	10.86	11.27	26.02	26.48
2.527	-2.223	423.34	332.37	332.47	6980.0	33.63	14546	0.662	6146	34.53	39.44	1.10	2.46	11.27	5.29	7.23
5.080	-2.235	468.95	366.87	366.99	6974.9	37.04	13610	0.663	5504	28.96	33.15	1.10	4.15	11.27	6.04	7.79
7.607	-2.235	497.40	401.97	402.11	6969.8	40.51	12792	0.663	5947	29.43	33.09	1.10	5.99	11.27	7.70	9.14
10.173	-2.223	527.23	437.48	437.64	6964.6	44.03	12075	0.664	6214	29.04	32.18	1.10	7.51	11.27	9.53	10.73
12.700	-2.223	554.72	471.23	471.42	6959.5	47.38	11475	0.664	6616	29.40	32.16	1.13	9.11	11.27	11.88	12.86
2.540	2.197	423.07	332.44	332.53	6980.0	33.74	14589	0.662	6164	34.63	39.54	1.10	2.46	11.27	5.30	7.24
5.080	2.223	460.80	366.65	366.77	6974.9	37.13	13657	0.663	5969	31.42	35.63	1.10	4.15	11.27	6.29	7.99
7.620	2.223	496.94	401.83	401.97	6969.8	40.63	12835	0.663	5966	29.53	33.19	1.10	6.01	11.27	7.73	9.16
10.147	2.223	526.16	436.69	436.85	6964.6	44.09	12127	0.664	6237	29.18	32.33	1.10	7.50	11.27	9.54	10.73
12.713	2.223	554.40	470.87	471.06	6959.5	47.49	11517	0.664	6618	29.42	32.18	1.13	9.12	11.27	11.88	12.86
7.607	-3.493	519.05	413.38	413.50	6969.8	37.59	11332	0.664	5369	26.07	29.55	1.10	5.99	11.27	7.20	8.72
7.437	3.493	523.50	415.97	416.09	6969.7	37.13	11078	0.664	5275	25.51	28.95	1.10	6.01	11.27	7.13	8.66

Table 3 (continued)

Channel Specimen
Experiment 8
Date: 13 August 1990
Time: 16:05:21

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
296.08	459.15	32.68	6987.0	44.67	76.33	7682.0	1.11

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	413.10
2.540	0.655	422.19
5.080	0.655	448.85
7.620	0.655	477.41
10.160	0.655	498.13
12.700	0.655	517.01
13.653	0.655	529.13

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	330.45	295.91	296.06	6987.0	42.61	22299	0.661	13060	79.13	84.08	1.10	0.99	11.27	12.07	13.04
1.270	-0.318	371.63	308.65	308.82	6983.3	44.40	21689	0.662	9796	57.78	63.99	1.10	1.48	11.27	4.99	7.01
2.527	-0.330	389.15	321.37	321.55	6979.6	46.19	21111	0.662	8244	47.35	52.61	1.10	1.91	11.27	5.47	7.36
3.810	-0.318	403.17	333.49	333.69	6975.8	47.91	20594	0.662	7849	43.99	48.83	1.10	2.52	11.27	5.95	7.72
5.080	-0.318	415.59	345.62	345.82	6972.1	49.62	20106	0.663	8027	43.94	48.63	1.10	3.20	11.27	6.51	8.16
6.363	-0.318	428.60	358.12	358.34	6968.3	51.39	19630	0.663	8061	43.10	47.58	1.10	3.92	11.27	7.21	8.73
7.620	-0.330	441.64	370.41	370.65	6964.6	53.13	19187	0.663	7964	41.63	45.86	1.10	4.63	11.27	7.97	9.36
8.903	-0.305	455.62	382.93	383.18	6960.9	54.90	18760	0.663	7788	39.82	43.81	1.10	5.20	11.27	8.50	9.83
10.160	-0.318	464.26	395.11	395.38	6957.2	56.63	18366	0.663	7367	40.38	44.13	1.10	5.78	11.27	9.60	10.79
11.430	-0.318	474.29	407.11	407.40	6953.5	58.34	17996	0.663	8059	39.54	43.01	1.10	6.39	11.27	10.68	11.76
12.700	-0.305	484.98	418.96	419.26	6949.8	60.03	17648	0.664	8367	40.27	43.65	1.10	7.02	11.27	11.69	12.68
13.970	-0.318	496.83	431.62	431.95	6946.0	61.83	17293	0.664	9335	44.03	47.57	1.10	7.72	11.27	12.70	13.62
15.240	-0.953	485.36	443.99	444.33	6942.3	63.59	16962	0.664	10241	47.38	49.76	1.10	8.37	11.27	24.16	24.66
2.527	-2.223	396.61	323.84	323.99	6979.6	42.48	19172	0.662	7674	43.85	49.02	1.10	1.91	11.27	5.34	7.26
5.080	-2.235	436.13	350.40	350.50	6972.1	45.90	18183	0.663	6546	35.51	40.05	1.10	3.20	11.27	5.87	7.66
7.607	-2.235	455.42	377.43	377.64	6964.7	49.39	17293	0.663	7269	37.52	41.60	1.10	4.62	11.27	7.47	8.95
10.173	-2.223	477.65	404.77	405.01	6957.2	52.93	16491	0.663	7646	37.66	41.25	1.10	5.79	11.27	9.22	10.45
12.700	-2.223	499.26	430.77	431.03	6949.8	56.30	15806	0.664	8059	38.06	41.28	1.10	7.02	11.27	11.32	12.35
2.540	2.197	396.86	323.71	323.86	6979.5	42.86	19358	0.662	7628	43.61	48.78	1.10	1.92	11.27	5.34	7.26
5.080	2.223	426.21	349.89	350.07	6972.1	46.27	18372	0.663	7355	39.94	44.52	1.10	3.20	11.27	6.21	7.93
7.620	2.223	454.06	376.81	377.02	6964.6	49.78	17475	0.663	7339	37.93	42.03	1.10	4.63	11.27	7.53	8.99
10.147	2.223	477.06	403.48	403.72	6957.2	53.26	16683	0.663	7578	37.40	41.01	1.10	5.78	11.27	9.13	10.37
12.713	2.223	499.01	429.64	429.91	6949.7	56.68	15983	0.664	7963	37.68	40.91	1.10	7.03	11.27	11.2	12.24
7.607	-3.493	477.53	388.79	388.95	6964.7	44.65	14885	0.663	6383	32.30	36.17	1.10	4.62	11.27	6.88	8.46
7.633	3.493	477.56	388.99	389.16	6964.6	44.72	14897	0.663	6396	32.35	36.21	1.10	4.64	11.27	6.90	8.47

Table 3 (continued)

Channel Specimen
Experiment 8
Date: 13 August 1990
Time: 16:11:03

TA	TB	M	PO	PO-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
295.76	425.69	40.88	6991.9	63.11	76.23	7654.0	1.16

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	397.39
2.540	0.655	403.94
5.080	0.655	425.32
7.620	0.655	448.20
10.160	0.655	464.66
12.700	0.655	479.60
13.653	0.655	489.94

Insulated-Side Temperatures and Calculated Data:

												---------Uncertainties---------				
X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	KUm	Wtw	Wtf	Wre	Wh	Wnu
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	323.38	295.49	295.73	6991.9	53.60	28133	0.661	16190	98.18	103.17	1.10	0.85	11.27	12.35	13.29
1.270	-0.318	357.98	305.56	305.82	6986.7	55.40	27523	0.662	11753	69.78	76.13	1.10	1.21	11.27	5.12	7.10
2.527	-0.330	371.82	315.61	315.88	6981.5	57.20	26935	0.662	9926	57.70	63.14	1.10	1.54	11.27	5.56	7.42
3.810	-0.316	383.12	325.18	325.48	6976.2	58.93	26402	0.662	9427	53.73	58.80	1.10	2.02	11.27	5.98	7.75
5.080	-0.318	392.97	334.76	335.07	6970.9	60.65	25893	0.662	9638	53.89	58.86	1.10	2.56	11.27	6.49	8.14
6.363	-0.318	403.26	344.64	344.97	6965.6	62 43	25392	0.663	9680	53.09	57.88	1.10	3.13	11.27	7.14	8.67
7.620	-0.330	413.63	354.35	354.69	6960.4	64.19	24971	0.663	9558	51.46	56.03	1.10	3.69	11.27	7.84	9.25
8.903	-0.305	425.27	364.24	364.60	6955.1	65.97	24463	0.663	9265	48.98	53.34	1.10	4.14	11.27	8.29	9.64
10.160	-0.318	431.71	373.86	374.24	6949.9	67.72	24035	0.663	9633	50.05	54.17	1.10	4.61	11.27	9.35	10.56
11.430	-0.318	439.94	383.34	383.74	6944.6	69.44	23631	0.663	9559	48.84	52.68	1.10	5.10	11.27	10.31	11.43
12.700	-0.305	448.33	392.70	393.12	6939.4	71.14	23248	0.663	9923	49.89	53.66	1.10	5.60	11.27	11.25	12.28
13.970	-0.318	458.44	402.70	403.15	6934.1	72.96	22853	0.663	10915	53.95	57.94	1.10	6.16	11.27	12.04	13.00
15.240	-0.953	448.21	412.47	412.94	6928.8	74.74	22483	0.664	11871	57.73	60.43	1.10	6.67	11.27	22.99	23.51
2.527	-2.223	377.64	317.77	317.99	6981.5	52.14	24278	0.662	9309	53.87	59.24	1.10	1.54	11.27	5.43	7.33
5.080	-2.235	412.79	338.92	339.18	6970.9	55.58	23252	0.662	7581	42.04	46.86	1.10	2.56	11.27	5.77	7.58
7.607	-2.235	425.84	360.45	360.75	6960.4	59.09	22307	0.663	8654	46.07	50.49	1.10	3.69	11.27	7.32	8.82
10.173	-2.223	442.63	382.23	382.55	6949.8	62.65	21439	0.663	9212	47.16	51.12	1.10	4.62	11.27	9.04	10.29
12.700	-2.223	460.04	402.93	403.30	6939.4	66.05	20685	0.663	9655	47.71	51.32	1.10	5.60	11.27	11.00	12.05
2.540	2.197	376.30	317.54	317.77	6981.4	52.89	24655	0.662	9165	53.06	58.42	1.10	1.55	11.27	5.41	7.31
5.080	2.223	401.84	338.27	338.54	6970.9	56.31	23632	0.662	8816	48.95	53.81	1.10	2.56	11.27	6.19	7.91
7.620	2.223	424.01	359.59	359.89	6960.4	59.84	22679	0.663	8786	46.85	51.29	1.10	3.69	11.27	7.40	8.89
10.147	2.223	442.62	380.72	381.05	6949.9	63.35	21820	0.663	8994	46.17	50.16	1.10	4.61	11.27	8.86	10.13
12.713	2.223	460.06	401.43	401.81	6939.3	66.80	21049	0.663	9413	46.63	50.26	1.10	5.61	11.27	10.77	11.84
7.607	-3.493	447.30	371.24	371.47	6960.4	52.20	18772	0.663	7429	38.78	42.97	1.10	3.69	11.27	6.66	8.28
7.633	3.493	445.11	370.30	370.54	6960.3	52.91	19104	0.663	7553	39.49	43.70	1.10	3.70	11.27	6.74	8.34

Table 3 (continued)

Channel Specimen
Experiment 8
Date: 13 August 1990
Time: 16:20:46

TA	TB	M	P0	P0-P1	Vf	Qt	Wqt
K	K	kg/h	kPa	kPa	%	W	%
295.73	582.37	18.38	7035.5	19.84	76.31	[illegible]	1.05

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.588	0.655	469.16
2.540	0.655	488.41
5.080	0.655	536.05
7.620	0.655	587.93
10.160	0.655	624.52
12.700	0.655	657.03
13.653	0.655	675.56

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Taw	P	V	RE	PR	h	NU	NUm	Wtw	Wtf	Wre	Wh	Wnu
												---------Uncertainties---------				
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.000	-0.965	355.86	295.68	295.73	7035.5	23.34	12311	0.661	7384	44.75	49.55	1.10	1.59	11.27	11.72	12.71
1.270	-0.318	420.37	318.53	318.58	7033.8	25.09	11719	0.662	5978	34.53	40.22	1.10	2.51	11.27	4.84	6.90
2.527	-0.330	452.69	341.33	341.39	7032.2	26.83	11188	0.662	4951	27.32	31.91	1.10	3.30	11.27	5.38	7.29
3.810	-0.318	477.22	363.07	363.14	7030.5	28.49	10733	0.663	4727	25.04	29.10	1.10	4.40	11.27	5.95	7.72
5.080	-0.318	499.68	384.81	384.88	7028.8	30.16	10318	0.663	4824	24.58	28.38	1.10	5.60	11.27	6.59	8.23
6.365	-0.318	523.01	407.23	407.32	7027.2	31.88	9929	0.663	4840	23.74	27.24	1.10	6.87	11.27	7.38	8.87
7.620	-0.330	546.67	429.27	429.36	7025.5	33.56	9579	0.664	4766	22.56	25.77	1.10	8.12	11.27	8.20	9.56
8.903	-0.305	569.77	451.71	451.82	7023.9	35.28	9250	0.664	4729	21.62	24.56	1.19	9.12	11.27	8.90	10.17
10.160	-0.318	586.23	473.55	473.67	7022.2	36.96	8956	0.664	4881	21.61	24.30	1.25	10.15	11.27	10.08	11.22
11.430	-0.318	602.72	495.08	495.20	7020.6	38.61	8686	0.664	4958	21.30	23.73	1.32	11.22	11.27	11.42	12.44
12.700	-0.305	621.64	516.32	516.46	7018.9	40.24	8439	0.664	5169	21.58	23.90	1.39	12.33	11.27	12.60	13.53
13.970	-0.318	639.94	539.04	539.19	7017.3	41.99	8191	0.664	5945	24.09	26.47	1.47	13.56	11.27	14.14	14.97
15.240	[illegible]	624.93	561.22	561.39	7015.6	43.69	[illegible]	0.664	6538	25.77	27.34	1.41	14.69	11.27	26.46	26.92
2.527	-2.223	465.69	344.54	344.59	7032.2	25.31	[illegible]	0.663	4550	24.96	29.46	1.10	3.30	11.27	5.24	7.19
5.080	-2.235	520.76	391.05	391.12	7028.8	28.63	9539	0.663	4288	21.61	25.28	1.10	5.60	11.27	6.19	7.90
7.607	-2.235	564.00	438.38	438.46	7025.6	32.02	8825	0.664	4453	20.78	23.87	1.16	8.11	11.27	7.81	9.23
10.173	-2.223	607.11	486.24	486.35	7022.2	35.45	8220	0.664	4548	19.78	22.35	1.34	10.16	11.27	9.54	10.74
12.700	-2.223	643.17	531.76	531.89	7018.9	38.71	7728	0.664	4886	19.99	22.19	1.48	12.33	11.27	12.00	12.97
2.540	2.197	464.03	345.46	345.52	[illegible]	25.02	10230	0.663	4646	25.44	29.92	1.10	3.31	11.27	5.28	7.22
5.080	2.223	515.47	392.39	392.45	7028.8	28.33	9386	0.663	4501	22.64	26.31	1.10	5.60	11.27	6.35	[illegible]
7.620	2.223	567.97	440.62	440.70	7025.5	31.74	8673	0.664	4393	20.43	23.49	1.18	8.12	11.27	7.75	9.18
10.147	2.223	604.12	488.43	488.53	7022.3	35.11	8082	0.664	4754	20.61	23.17	1.32	10.14	11.27	9.86	11.02
12.713	2.223	642.20	535.31	535.43	7018.9	38.43	7587	0.664	5097	20.75	22.94	1.48	12.34	11.27	12.45	13.39
7.607	-3.493	583.17	448.58	448.66	7025.6	30.56	8108	0.664	4156	19.09	22.05	1.24	8.11	11.27	7.46	8.93
7.633	3.493	599.39	457.53	457.61	7025.5	29.54	7583	0.664	3943	17.87	20.73	1.30	8.13	11.27	7.22	8.74

Table 3 (continued)

Inconel Specimen
Experiment 9
Date: 14 August 1990
Time: 14:02:28

TA	TS	M	P0	P0-P1	Vf	Qt	Wgt
K	K	kg/h	[illegible]	kPa	%	W	%
296.79	654.80	17.96	[illegible]	20.53	94.40	[illegible]1.0	1.06

Hot-side Temperatures:

X	Y	Tw
cm	cm	K
1.500	0.655	513.66
2.540	0.655	538.75
5.000	0.655	597.72
7.620	0.655	662.71
10.160	0.655	706.93
12.700	0.655	743.45
13.653	C.655	766.01

Insulated-Side Temperatures and Calculated Data:

X	Y	Tw	Tf	Tew	P	V	RE	PR	h	NU	NUm	Utw	Utf	Ure	Uh	Unu
												-------- uncertainties				----------
cm	cm	K	K	K	kPa	m/s			W/(m²·K)			K	K	%	%	%
0.410	0.965	371.99	296.73	296.78	7006.7	2?.02	12029	0.661	7199	43.54	49.30	1.10	1.95	11.27	?1.66	?.55
1.270	-0.3	453.06	325.18	325.26	7005.0	25.16	?1319	0.662	5805	33.08	39.70	1.10	3.12	11.27	6.78	6.96
2.5?7	-0.330	493.98	353.58	353.64	7003.3	27.30	10700	0.56?	4787	25.81	31.02	?.10	4.11	11.27	5.33	7.25
3.810	-0.318	524.17	380.64	380.71	7001.6	29.33	10180	0.663	4583	23.52	28.05	.10	5.48	11.27	5.90	7.68
5.080	-0.318	551.68	407.70	407.78	6999.8	31.37	9716	0.663	4692	23.00	27.16	1.11	6.99	11.27	6.55	8.19
6.363	-0.318	580.43	435.62	435.71	6998.1	33.47	9286	0.664	4717	22.11	25.89	1.23	8.57	11.?7	7.36	8.85
7.620	-0.330	[illegible].22	463.05	463.16	6996.4	35.53	8?06	0.664	4634	20.86	24.26	1.35	10.16	11.27	8.17	9.5?
8.903	-0.305	640.54	49?.00	491.12	6994.7	37.64	8555	0.664	4551	19.64	22.76	1.47	11.79	11.27	8.80	10.08
10.160	-0.318	661.29	518.19	518.32	6993.0	39.69	8243	0.664	4685	19.51	22.31	1.55	12.58	11.27	9.94	11.09
11.430	-0.318	680.7?	544.98	?45.13	6991.3	41.71	796?	0.664	4734	19.28	21.79	1.63	14.01	11.27	11.32	12.35
12.700	-0.305	[illegible]	571.43	571.59	6989.6	43.71	7704	0.665	5017	19.53	21.90	1.72	15.39	11.27	12.53	13.46
13.970	-0.318	725.46	599.71	599.89	6987.9	45.84	7450	0.665	5816	21.90	24.32	1.81	16.94	11.27	14.16	14.99
15.2??	[illegible]	707.29	627.34	627.53	6986.2	47.93	7221	0.665	6350	23.18	24.76	1.74	18.35	11.27	26.35	26.81
2.527	-2.?23	510.10	[illegible]	357.57	7003.3	25.81	9933	0.663	4405	23.57	28.?6	1.10	4.11	11.27	5.19	7.15
5.080	-2.235	576.?7	?15.3?	415.46	6999.8	29.88	8972	0.664	4.88	20.27	24.28	1.21	6.99	11.27	6.17	7.89
7.607	2.235	631.??	474.27	474.37	6996.4	34.02	8194	0.664	4334	19.17	22.44	1.43	10.13	11.27	7.79	9.21
10.173	-2.2?3	687.59	533.83	533.95	6993.0	38.22	7553	0.664	4358	17.78	20.44	1.66	12.69	11.27	9.40	10.61
12.7?0	-2.223	778.98	590.46	590.6?	6989.6	42.22	704?	0.665	?791	18.?3	20.47	1.?2	15.39	11.27	12.35	1?.01
2.540	2.?77	508.84	359.52	359.?7	7003.3	25.24	9627	0.663	4497	23.98	29.03	1.1?	4.13	11.27	5.23	7.18
?.??0	2.223	57? 16	418.70	418.77	6999.8	29.29	8682	0.664	4401	21.19	25.16	1.20	6.99	11.27	6.33	8.02
7.620	2.223	641.25	479.53	479.63	6996.4	33.46	7912	0.664	4217	18.52	21.73	1.47	10.14	11.27	7.65	9.10
10.147	2.223	683.42	539.82	539.94	6993.0	37.59	7292	0.664	4676	18.93	21.5?	1.64	12.67	11.27	9.92	11.07
12.713	2.223	[illegible].19	598.95	?99.10	6989.6	41.65	6785	0.665	5139	19.37	21.?7	1.82	15.41	11.27	12.8?	13.72
7.607	-3.493	651 10	?84.59	484.68	6996.4	32.84	7651	0.664	4096	?7.85	21.00	1.51	10.13	11.27	7.50	8.97
7.633	?.493	682.24	501 51	501.60	6996.4	31.26	6861	0.664	3773	16.07	19.03	1.64	10.16	11.27	7.1?	8.66

Table 4. Uncertainties in data analysis parameters and calculated quantities

Uncertainty Parameter	Major Source of Uncertainty	Magnitude of Uncertainty	Estimated or Calculated
Channel Width and Height	Measurement	0.025 mm	Estimated
Length of Heated Zone	Measurement	1 mm	Estimated
Location of Temperature Probe	Measurement	1 mm	Estimated
Channel Flow Rate	Specimen Uniformity	5%	Estimated
Fluid Temperature	Channel Flow Rate	0.5-21.0 K	Calculated
Total Heat Flow	Inlet and Outlet Temperature	1.0-2.0%	Calculated
Fluid Velocity	Channel Flow Rate	6.9-7.5%	Calculated
Friction Factor	Channel Height, Pressure Taps	17-18% for Re > 4000	Calculated
Heat Transfer Coefficient	Channel Flow Rate	5.9-12.9%, $0.2<x/L<0.8$	Calculated
Reynolds Number	Viscosity Function, Channel Flow Rate	11.3%	Calculated
Nusselt Number	Channel Flow Rate	7.6-13.8%, $0.2<x/L<0.8$	Calculated

Table 5. Predicted flow distribution in heat transfer experiments using method of Appendix B

Region	Boundaries (y/W)	Location of Temp. Probe (y/W)
1	-0.500 , -0.364	0.4442
2	-0.364 , -0.163	0.2842
3	-0.163 , +0.120	0.0420
4	+0.120 , +0.363	+0.2827
5	+0.363 , +0.500	+0.4442

Expt. #	$\dot{m}$ (kg/h)	$\dot{m}_c \cdot n/\dot{m}$ for each region 1	2	3	4	5
3	4.06	0.9817	1.0034	1.0321	0.9958	0.9539
3	8.41	0.9650	1.0055	1.0568	0.9917	0.9235
3	14.94	0.9223	1.0021	1.0762	1.0022	0.9123
3	20.00	0.8942	0.9992	1.0864	1.0112	0.9072
3	29.39	0.8562	0.9971	1.1015	1.0217	0.8981
3	39.79	0.8226	0.9946	1.1141	1.0316	0.8913
4	10.16	0.9329	0.9973	1.0680	1.0031	0.9240
4	14.90	0.9442	1.0054	1.072[illegible]	0.9950	0.9052
4	20.34	0.9156	0.9996	1.0815	1.0067	0.9033
4	30.30	0.8929	0.9966	1.0944	1.0142	0.8904
4	40.04	0.8785	0.9951	1.1037	1.0183	0.8802
5	13.33	0.9651	1.0072	1.07[illegible]	0.9851	0.8919
5	17.31	0.9410	1.0090	1.0816	0.9930	0.8885
5	23.81	0.9042	1.0040	1.0904	1.0073	0.8838
5	31.08	0.8763	1.0034	1.1009	1.0144	0.8828
5	40.64	0.8487	1.0027	1.1120	1.0215	0.8757
6	3.78	0.9845	1.0051	1.0328	0.9937	0.9510
6	7.08	0.9456	0.9974	1.0546	1.00[illegible]1	0.9407
6	13.61	0.9295	1.0042	1.0732	0.9997	0.9126
6	19.90	0.8904	0.9998	1.0870	1.0122	0.9069
6	28.62	0.8528	0.9970	1.1013	1[illegible]	0.8997
6	40.98	0.8104	0.9939	1.1178	1.0[illegible]45	0.8922

Table 5. (Continued)

Expt. #	$\dot{m}$ (kg/h)	$\dot{m}_c \cdot n/\dot{m}$ for each region 1	2	3	4	5
7	9.27	0.9317	0.9866	1.0635	1.0104	0.9372
7	15.90	0.9363	1.0023	1.0736	0.9998	0.9075
7	21.95	0.9026	0.9998	1.0843	1.0110	0.9025
7	31.35	0.8733	0.9994	1.0980	1.0181	0.8912
7	40.86	0.8519	0.9990	1.1083	1.0233	0.8823
8	13.84	0.9663	1.0071	1.0732	0.9866	0.8951
8	18.46	0.9397	1.0084	1.0799	0.9953	0.8902
8	25.23	0.9064	1.0039	1.0891	1.0070	0.8899
8	32.68	0.8815	1.0037	1.0996	1.0131	0.8825
8	40.88	0.8614	1.0034	1.1082	1.0185	0.8752
8	18.38	0.9412	1.0084	1.0789	0.9945	0.8922
9	17.94	0.9568	1.0123	1.0824	0.9849	0.8808

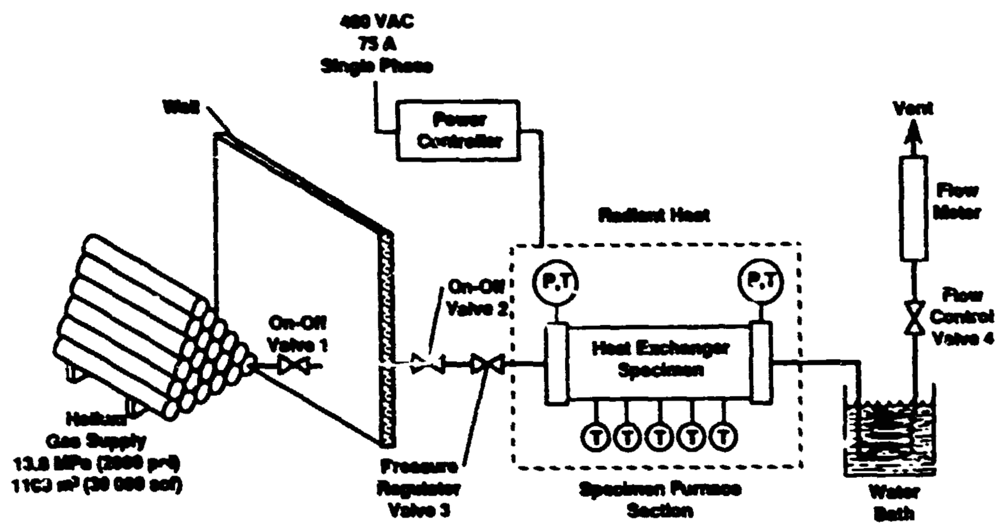

Figure 1. Helium flow apparatus.

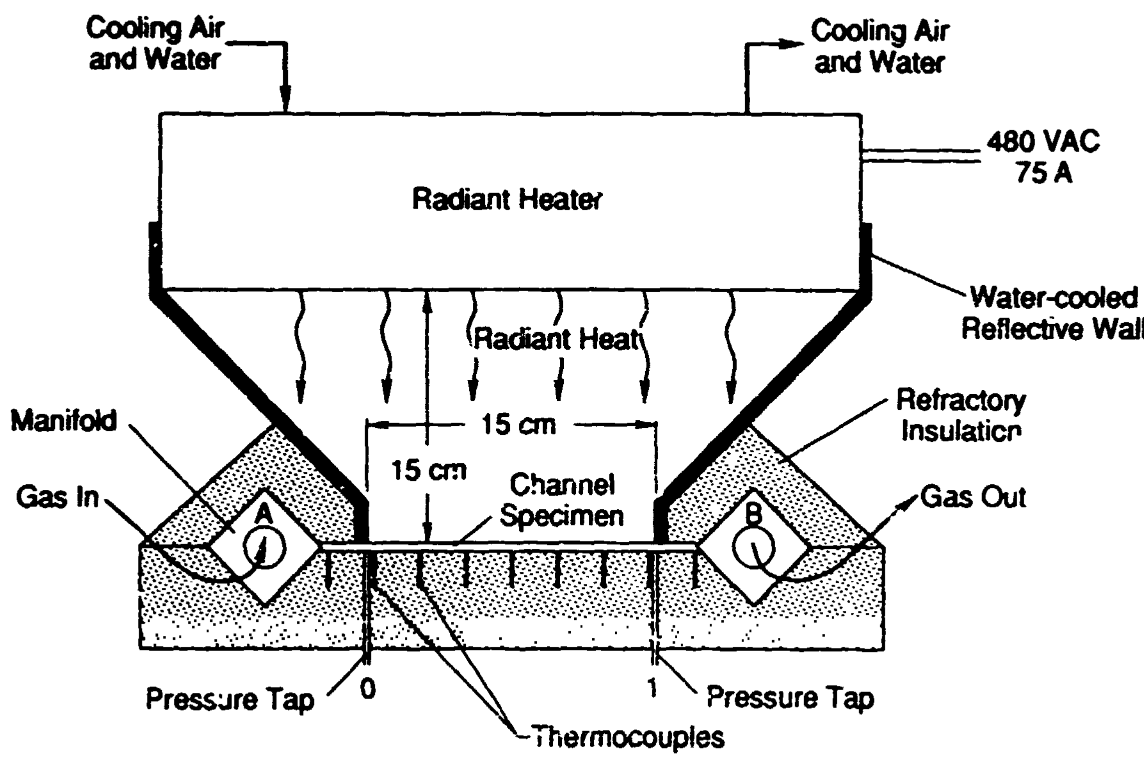

Figure 2. Specimen furnace, showing location of inlet gas temperature (A), upstream pressure (0), outlet gas temperature (B), and downstream pressure (1).

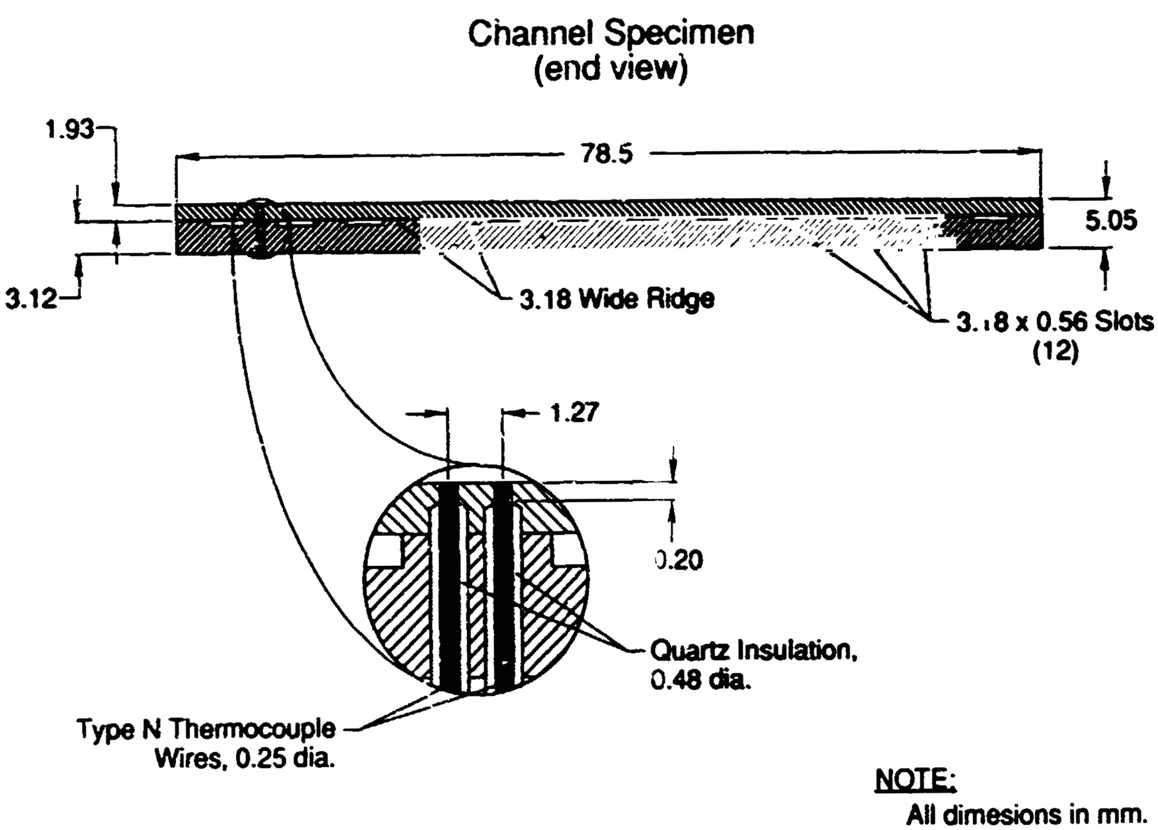

Figure 3. Channel specimen.

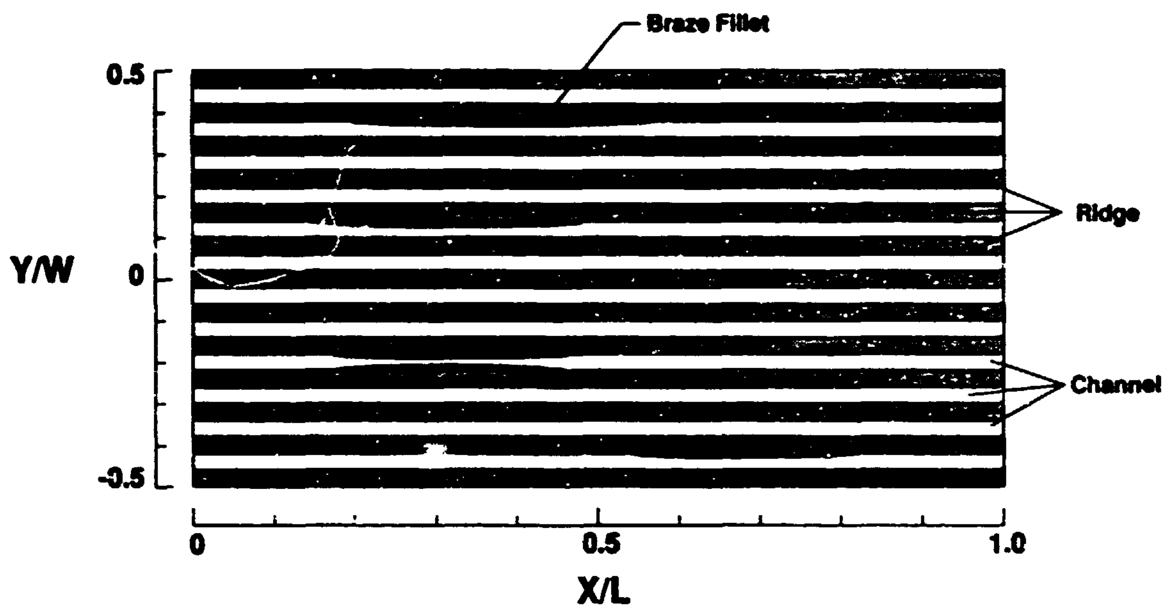

Figure 4. Top view of channel specimen showing locations of blockage in flow channels due to braze fillets.

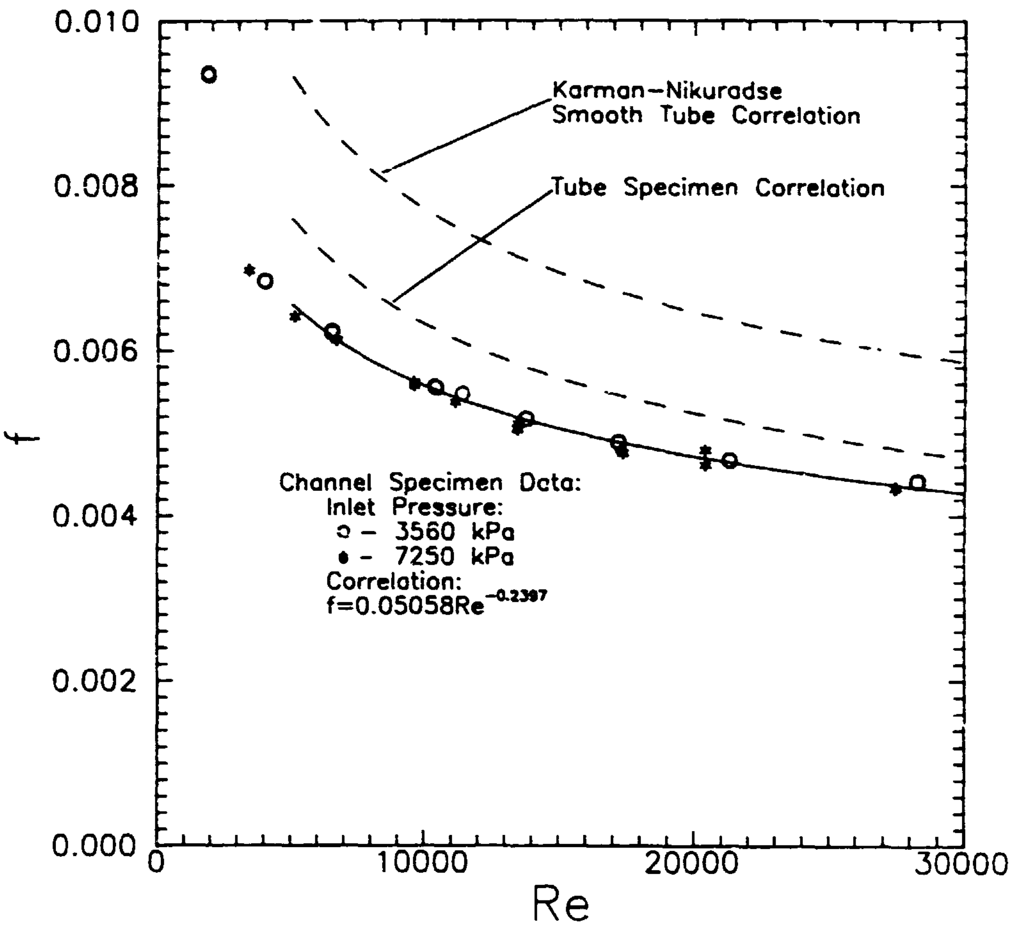

Figure 5. Friction factor (f) as a function of Reynolds number (Re) for experiments 1 and 2, no heating, compared to tube specimen correlation and smooth tube correlation.

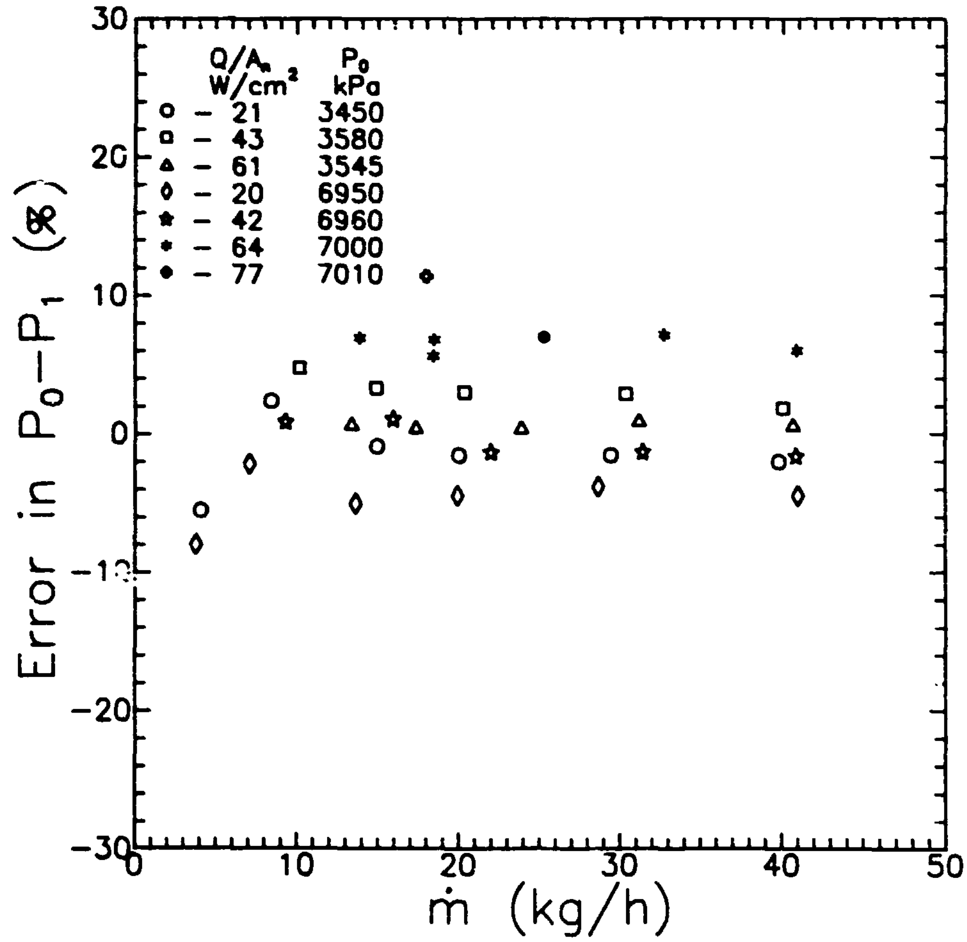

Figure 6. Percent difference between predicted and measured pressure drop (P_0-P_1) as a function of helium flow rate ($\dot{m}$) for heat transfer experiments.

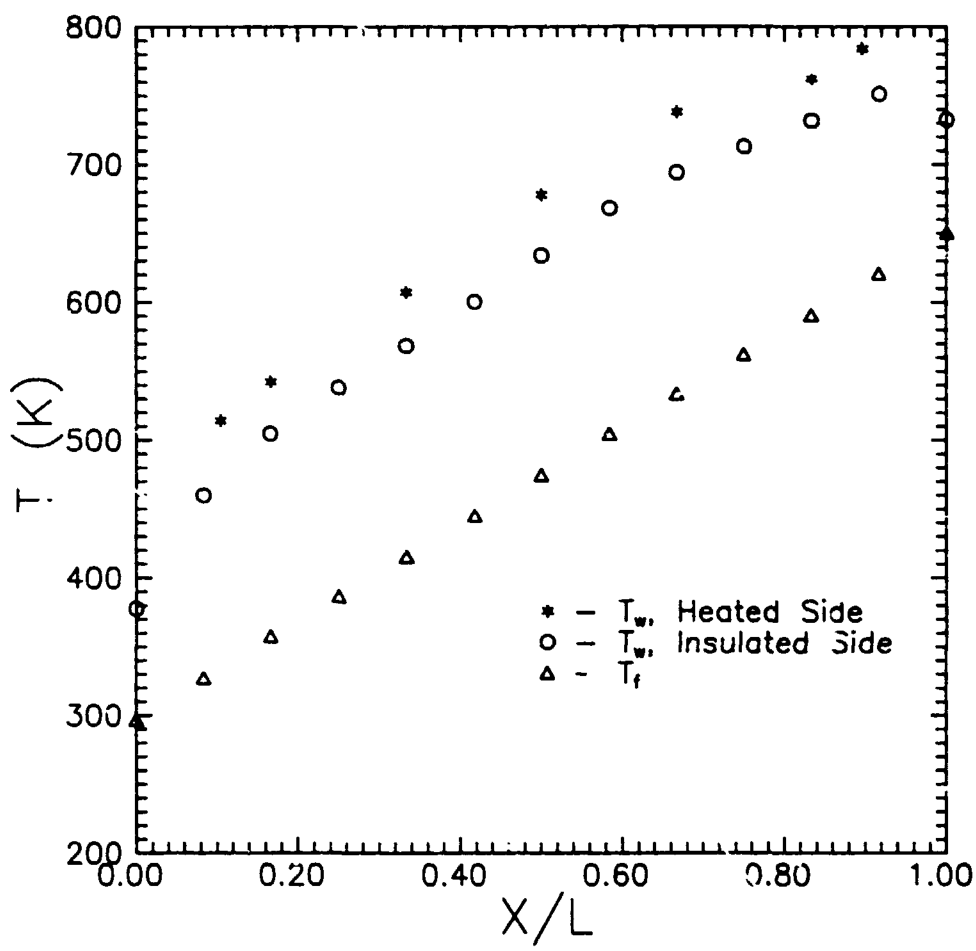

Figure 7. Wall (T_w) and gas (T_f) temperatures as a function of x/L; experiment 8, 13.8 kg/h helium flow, and y/W = -0.04.

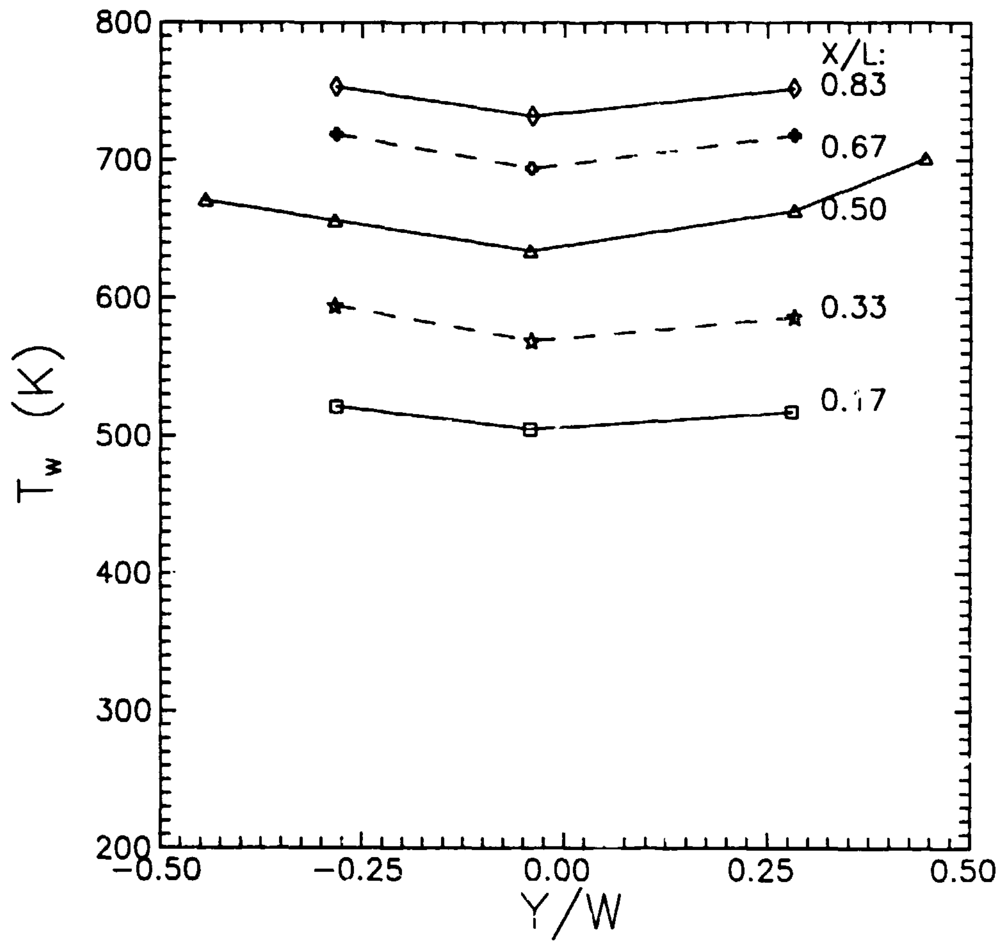

Figure 8. Wall temperature (T_w) as a function of y/W at several x/L locations; experiment 8, 13.8 kg/h helium flow

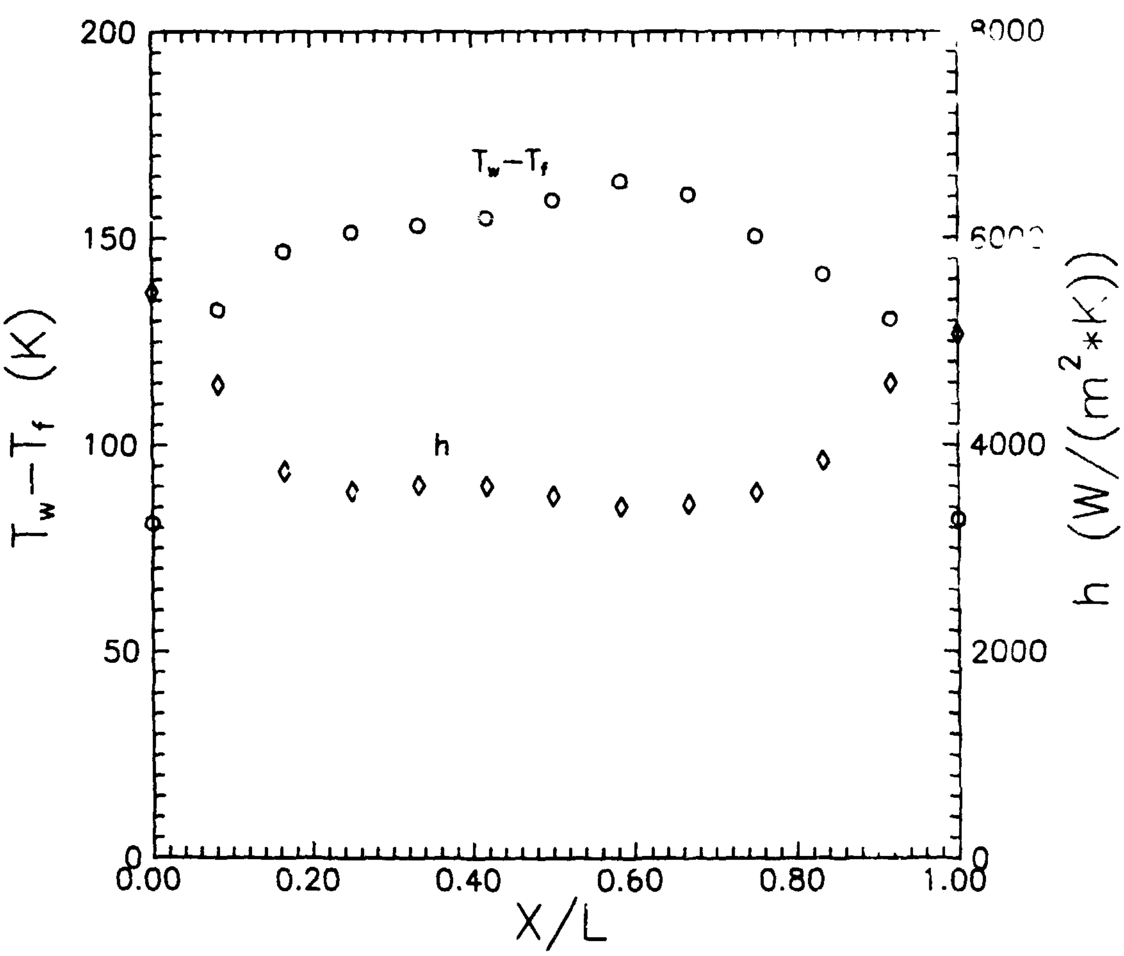

Figure 9. Wall-to-gas temperature difference (T_w-T_f) and heat transfer coefficient (h) as a function of x/L; experiment 8, 13.8 kg/h helium flow and y/W = -0.04.

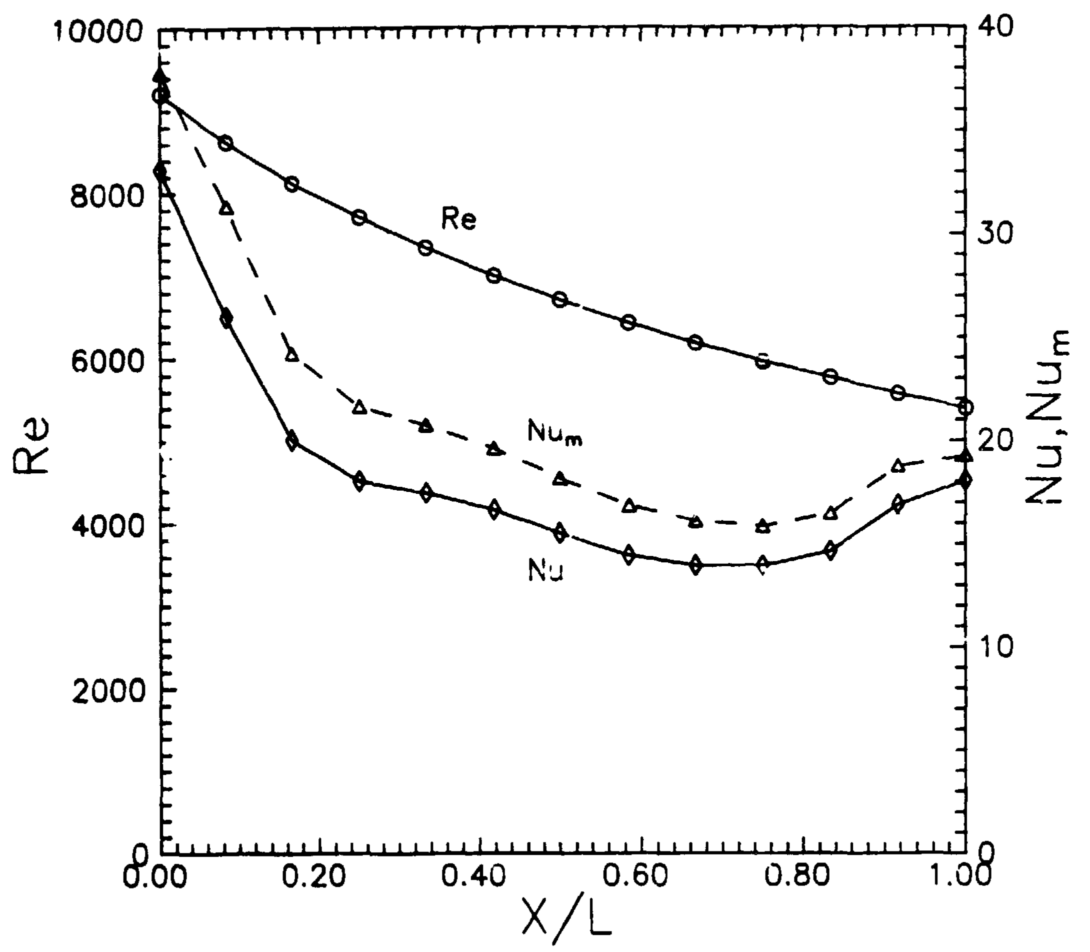

Figure 1C. Reynolds number (Re), Nusselt number (Nu), and modified Nusselt number (Nu_m) as a function of x/L; experiment 8, 13.8 kg/h helium flow and y/W = -0.04.

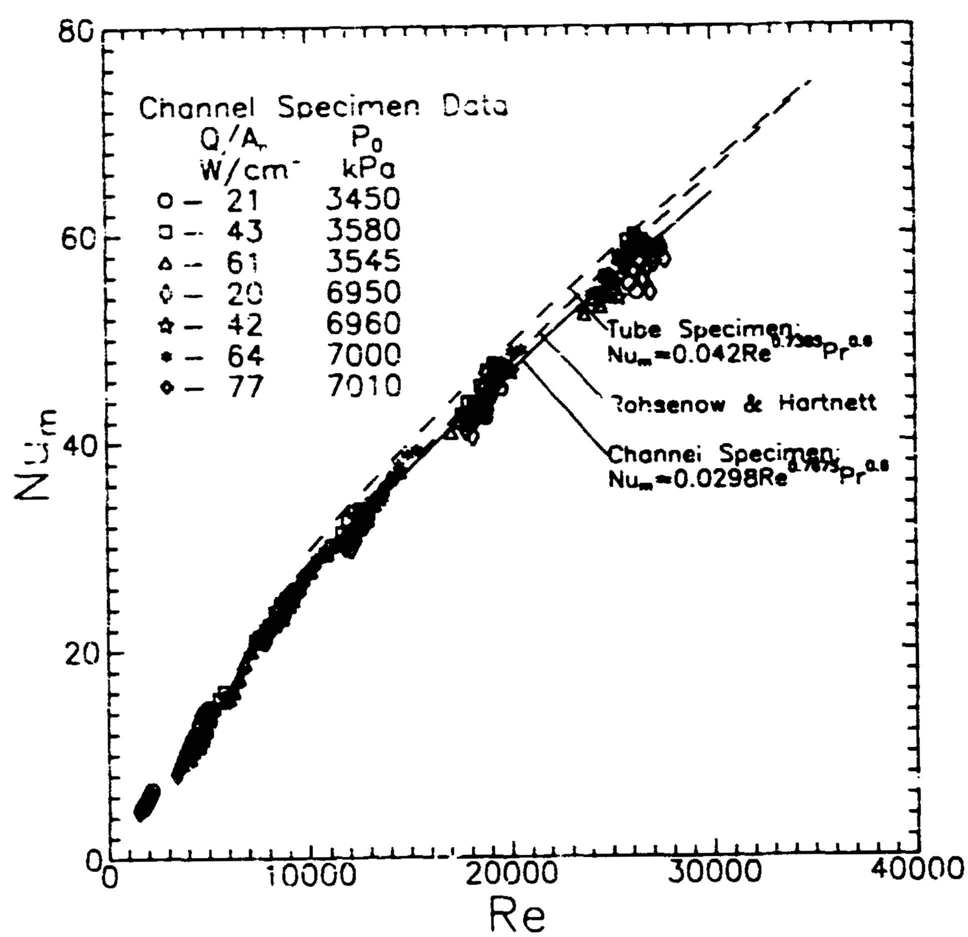

Figure 11. Modified Nusselt number (Nu_m) as a function of Reynolds number (Re); all heated experiments with $0.2 < x/L < 0.8$ and $y/W = -0.04$.

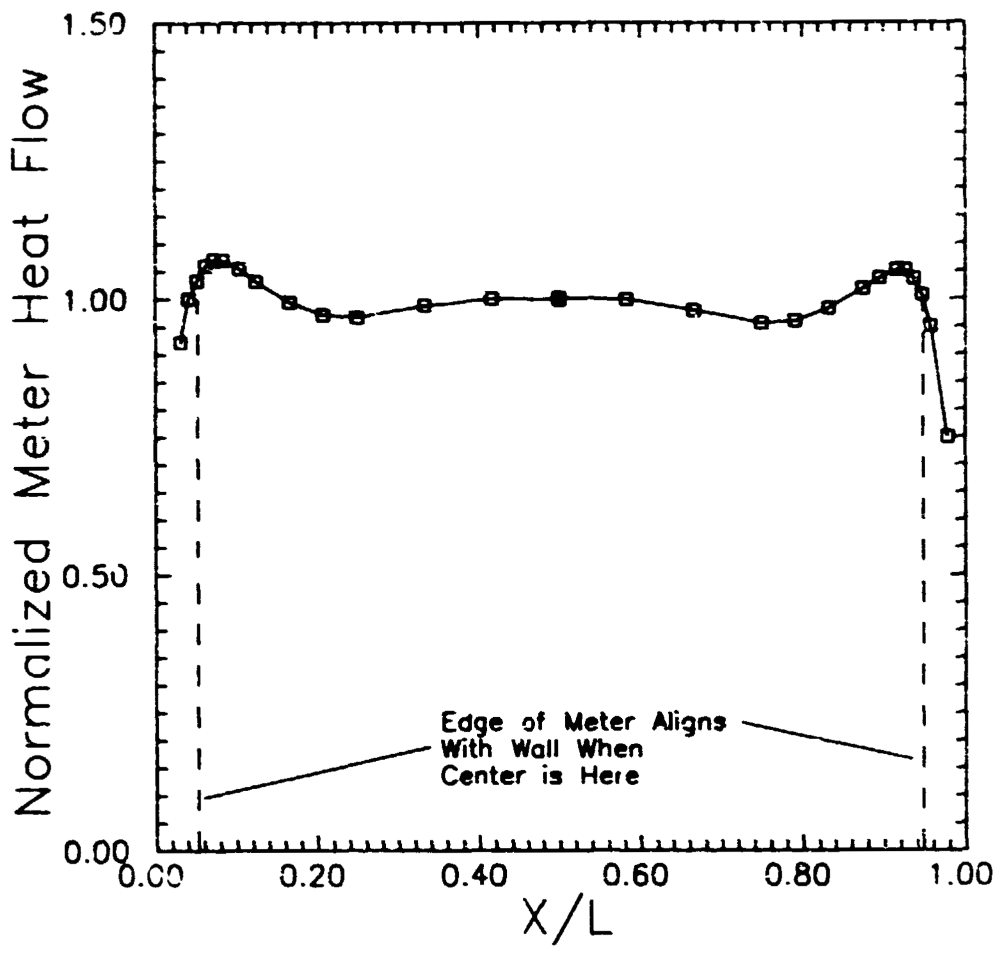

Figure A.1. Normalized meter heat flow as a function of x/L for y/W = 0.12, 36% voltage, reflective furnace calibration.

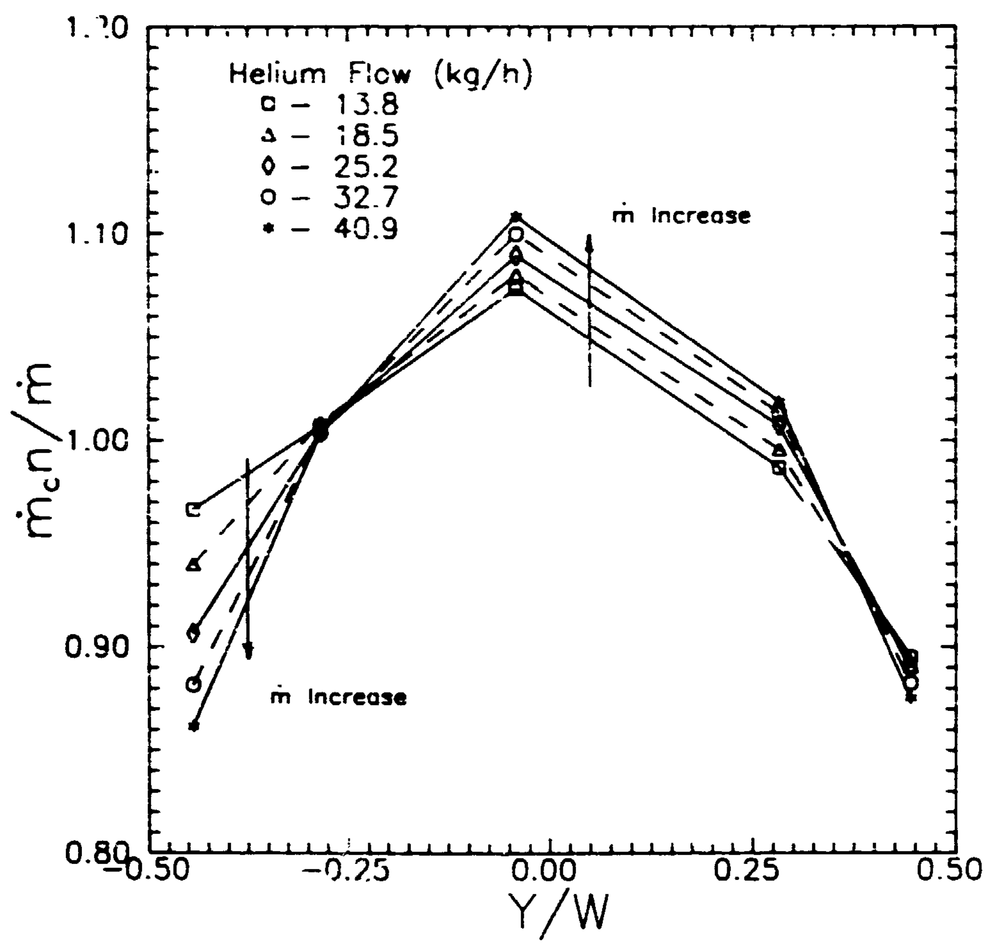

Figure B.1. Ratio of predicted channel flow to average channel flow, as a function of y/W at several total flow rates for experiment 8.

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Douglas A. Olson

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11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE)

We have constructed a compact heat exchanger consisting of 12 parallel, rectangular channels in a flat piece of commercially pure nickel. This channel specimen was radiatively heated on the top side at heat fluxes of up to 77 W/cm^2 insulated on the back side, and cooled with helium gas flowing in the channels at 3.5 to 7.0 MPa and Reynolds numbers of 1400 to 28 000. The measured friction factor was lower than that of the accepted correlation for fully developed turbulent flow, although our uncertainty was high due to uncertainty in the channel height and a high ratio of dynamic pressure to pressure drop. The measured Nusselt number, when modified to account for differences in fluid properties between the wall and the cooling fluid, agreed with past correlations for fully developed turbulent flow in channels. Flow nonuniformity from channel-to-channel was as high as 12% above and 19% below the mean flow.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)

apparatus; compact heat exchanger; convection heat transfer; friction factor; high temperature; National Aerospace Plane; radiative furnace; rectangular channel; turbulent flow; variable property effects.

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