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FORCED-CONVECTION SUBCOOLED CRITICAL HEAT FLUX

D_2O AND H_2O COOLANT WITH ALUMINUM AND STAINLESS STEEL HEATERS

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by

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ABSTRACT

Forced-convection critical heat flux data and correlations are presented for both heavy water (D_2O) and light water (H_2O) coolant. The data were obtained with stainless steel and aluminum heaters which formed the inner wall of an annular channel. The critical heat flux for D_2O was determined to be 16% greater than that for H_2O at the same coolant velocity and subcooling. The critical heat flux for aluminum heaters was determined to be at least 20% higher than that for stainless steel at the same coolant velocity and subcooling. A brief discussion of possible mechanisms for the difference is included. A combined improvement of 40% in the burnout heat flux is shown for aluminum heaters with D_2O coolant over that for stainless steel heaters with H_2O coolant. The results are for ideal heaters. When using the equations discussed in this report, factors must be applied for nonidealities such as the effect of spacer ribs.

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INTRODUCTION

A reactor at the Savannah River Plant has operated at the highest neutron flux ever achieved in a nuclear reactor, $\sim 6.1 \times 10^{15}$ n/(cm^2-sec). This neutron flux was attained by operating at heat fluxes in excess of 2.66 million Btu/(hr-ft^2).

The Savannah River Laboratory and Columbia University have been engaged in studies to define the critical heat flux for subcooled nucleate boiling. The results of these studies are used in optimization of the fuel assembly design and in developing specifications for components required to achieve the very high power densities. Initial efforts were aimed at relating the heat flux to the usual variables of velocity, temperature, pressure, and geometry. In addition, the effect of many nonidealities which lower the burnout heat flux, e.g., spacer ribs and local hot spots, were also studied.[1-4]

The Savannah River fuel geometry consists of annuli through which D_2O flows past the bounding fuel surfaces. Coolant conditions range up to velocities of 70 ft/sec, pressures of $\sim$150 psia, and effluent temperatures of about 180°F.[1]

Most of the experimental studies before 1967 were made with stainless steel or copper-nickel heaters because of power and current limitations at SRL, even though coextruded aluminum-clad, uranium-aluminum alloy fuel tubes are used in the Savannah River Plant reactors. Also, light water (H_2O) was used as a coolant in place of D_2O.

More recent studies (after 1967) have been concerned with the accuracy of critical heat flux data, effect of coolant, and effect of heater material. The initial mathematical correlation based on improved data obtained with stainless steel heaters and H_2O coolant was presented earlier.[5] This report presents the data used in the earlier correlation along with recent critical heat flux results obtained with stainless steel heaters with D_2O, aluminum heaters with H_2O, and aluminum heaters with D_2O. Correlation of these groups of data is presented. A generalized empirical correlation of all the data is also presented.

SUMMARY

Empirical correlations of the critical heat flux are presented for individual data groups (stainless steel heaters - H_2O coolant; stainless steel heaters - D_2O coolant; aluminum heaters - H_2O coolant; and aluminum heaters - D_2O coolant). These correlations are applicable to subcoolings greater than 45°F and should not be extrapolated beyond coolant conditions shown in Table I; however, the results can be applied to surfaces longer than 24 inches. The critical heat flux for D_2O is 16% greater than for H_2O at constant coolant subcooling and velocity. The critical heat flux of aluminum heaters is a minimum of 20% greater than for stainless steel. The combined effect of D_2O coolant and aluminum surfaces is a 40% increase in critical heat flux compared to that for H_2O coolant and stainless steel surfaces.

The results presented in this report are for ideal surfaces and do not include allowances for nonideal effects such as spacer ribs on the critical heat flux. Studies concerning the presence of ribs and other nonideal effects are in progress.

DISCUSSION

EXPERIMENTAL EQUIPMENT AND PROCEDURE

Experimental data were obtained at the Columbia University Heat Transfer Facility and the Savannah River Heat Transfer Laboratory. The ranges of test conditions are summarized in Table I.

TABLE I

Summary of Test Conditions[a]

	Heater			Coolant		
Laboratory	Material	Diameter or Width, inches	Length, inches	Material	Equivalent Diameter, inches	Geometry
Savannah River	Stainless Steel	0.5	24	H_2O	0.375	annular
Savannah River	Stainless Steel	0.5	24	D_2O	0.375	annular
Savannah River	Stainless Steel	2.0	20	H_2O	0.4 - 0.5	rectangular
Columbia	Stainless Steel	2.125	24	H_2O	0.4	annular
Columbia	Stainless Steel	0.75	24	H_2O	0.4	annular
Columbia	Stainless Steel	0.75	24	D_2O	0.4	annular
Columbia	Aluminum	0.75	24	H_2O	0.4	annular
Columbia	Aluminum	0.75	24	D_2O	0.4	annular
Columbia	Aluminum	1.00	24	H_2O	0.4	annular

---

[a] Range of Test Conditions:

Coolant velocity	15-60 ft/sec
Coolant subcooling	7-160°F[b]
Critical heat flux	1-6.5 x 10^6 Btu/(hr-ft^2)
Pressure	30-95 psia

Burnout Detection:

SRL – visual observation of incandescent spot
CU – bridge-type detector or physical failure

[b] Data below 45°F subcooling not used in correlations (See Figure 6)

SRL Test Loop

The flow loop and test section cross section at SRL are shown schematically in Figure 1. The loop consists of a pump, deionizer, surge tank, heat exchanger, and the test section. The loop was filled with distilled water. The water was deionized and degassed at the beginning of each day of testing. Flow is measured with a Potter turbine flow meter. Maximum flow rate is 60 gpm. Water enters the top of the test section and flows downward past the heater. Both inlet and outlet temperatures are recorded. Outlet pressure and pressure drop across the test

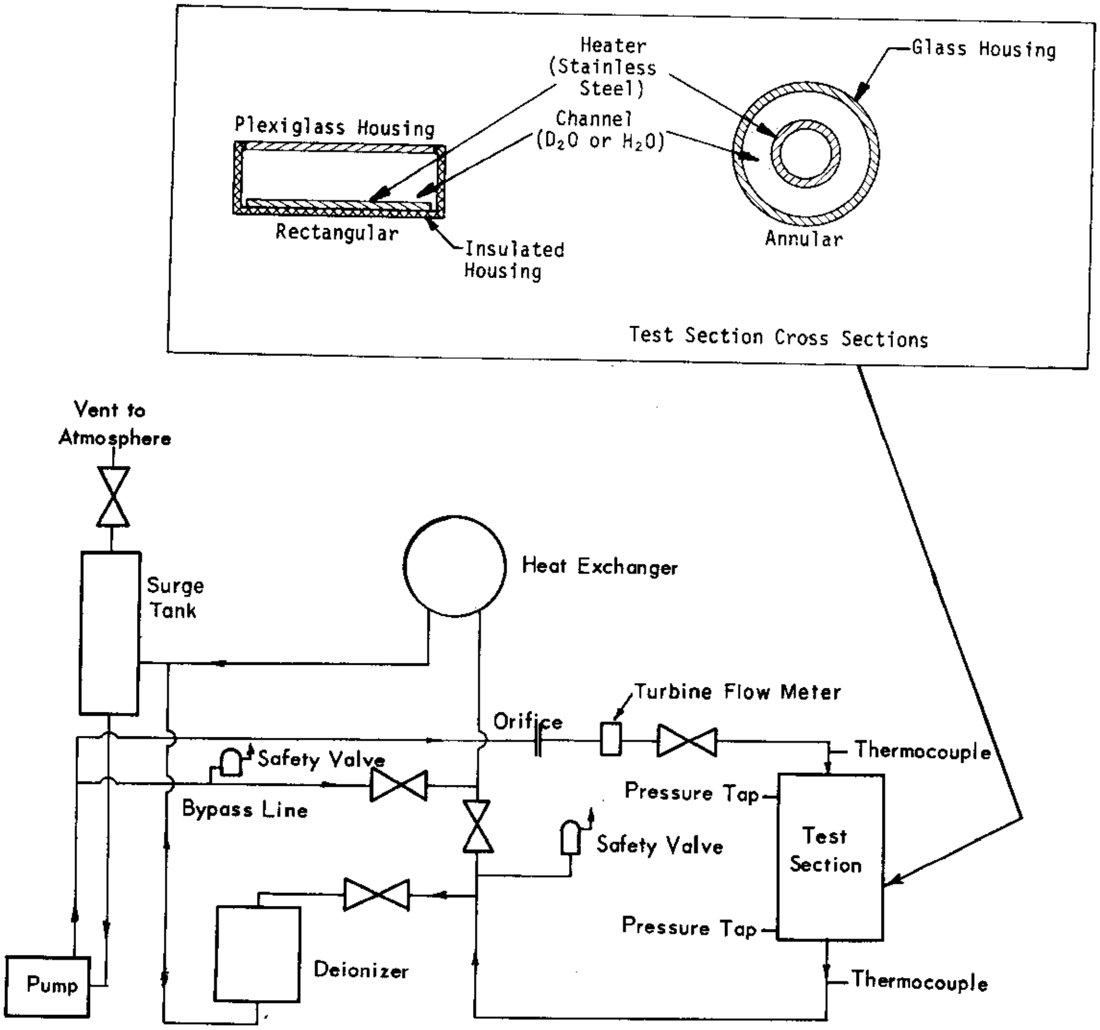

FIG. 1 Schematic of SRL Flow Loop

section are also recorded. Heat is generated by resistance heating with DC power. Eight welding generators connected in parallel provide 320 KW at 8000 amp DC.[6]

Tests are made at constant power and flow by increasing the bulk temperature to the point of burnout (point at which the critical heat flux is exceeded). By interrupting a test when a spot on the heater glowed red (before physical burnout), multiple, reproducible tests could be made on the same heater. As-drawn annealed stainless steel tubing was used to fabricate the heaters. No special precautions were taken to ensure uniform surface finish on the test sections, except that heaters with circumferential scratches or marks were not used.

An initial check test was run on each heater. This check test was repeated after approximately every five tests. If the check test varied by more than 5% from the original check test, the heater was discarded. A change in critical heat flux for the same experimental conditions was usually caused by bowing of the heater. Alignment of the heater and housing was one of the most important factors in obtaining reproducible data. The heaters have four alignment pins, 2.5 inches from the end of the heated length on either end.

Columbia University Test Facility

The Columbia University Heat Transfer Facility has a 3.5 MW DC power supply from two motor generator sets. The generators are connected in parallel and can supply a maximum of 20,000 amp at 175 volts. This power source was used to heat test elements under simulated reactor conditions.

The Columbia test loop (Figure 2) has a maximum pressure rating of 250 psig and consisted of two centrifugal pumps, three shell and tube heat exchangers, a deionizer, a piston pump to control pressure, connecting piping, and a housing section to accommodate test sections. Two pumps connected in series are capable of providing 200 gpm at 350 ft differential head. The loop piping is stainless steel, but aluminum and copper did contact the water as part of the test section. The water was deionized and deaerated before each series of tests.

The flow rate was measured by a Potter turbine flow meter, and the inlet and outlet temperatures to the test section were measured by iron-constantan thermocouples and a temperature sensor. The inlet and exit pressures were measured by Bourdon-tube pressure gages, and the pressure drop across the heated length of a simulated fuel rod was measured with a U-tube manometer.

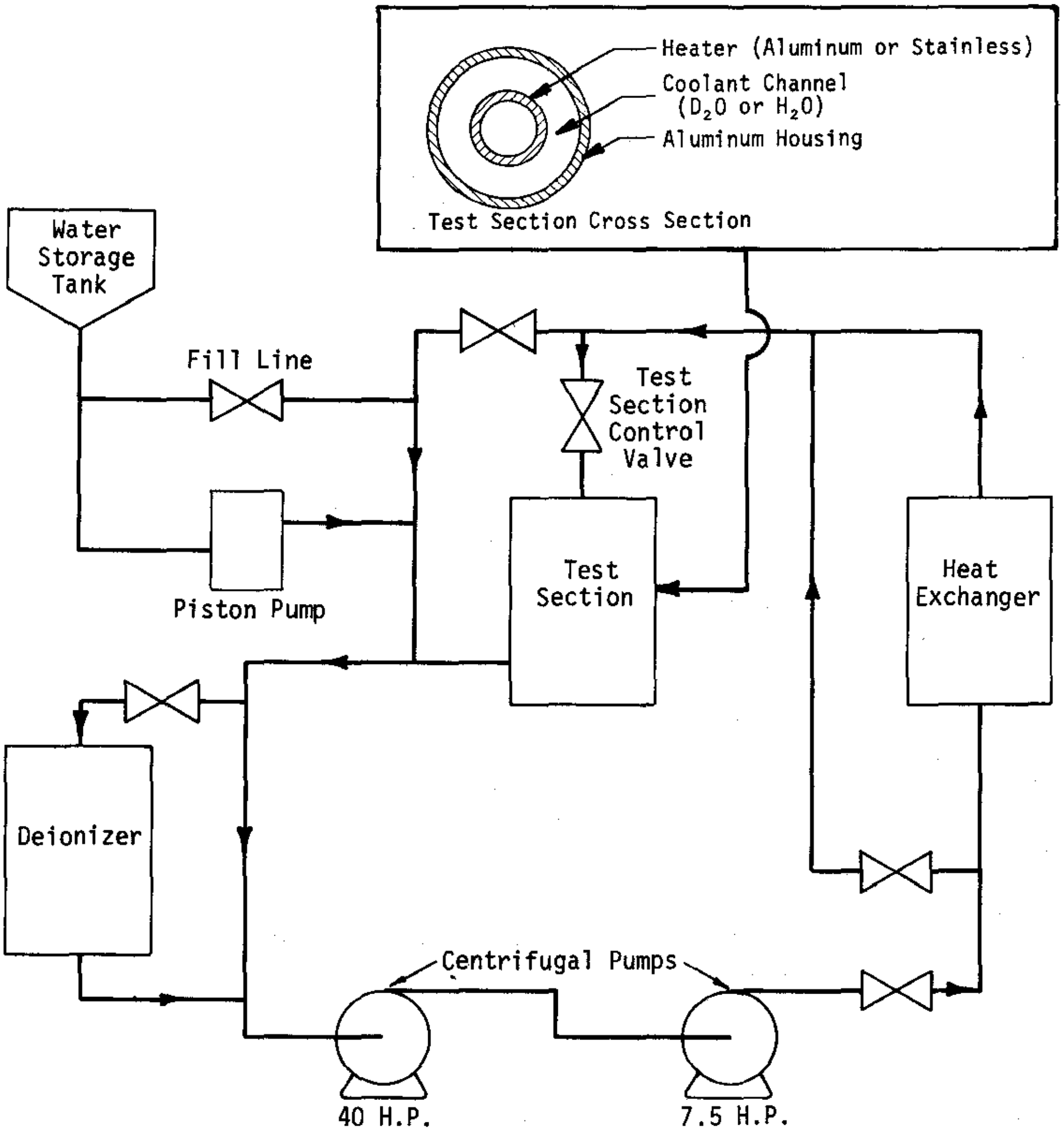

FIG. 2 Schematic of Columbia University Low Pressure Loop

The aluminum heaters were constructed of Type 5052 aluminum drawn over ceramic spacers. The heaters were installed vertically with the cooling water flowing downward. The test sections had a heated length of 2 ft and an overall length of 6 ft. The heater formed the inner wall of the coolant annulus. The outer wall was constructed of aluminum sleeves designed to give the desired equivalent diameter. The extension pieces which comprised most of the length of the test section were either Type 6061 aluminum, nickel 200, or electrolytic copper. The electrical connectors at the ends of the test section were silver-plated copper.

Thermal expansion of the test section was permitted by "O"-ring seals on the top and bottom. Counterweighting the heavy bus connectors prevented large tensile or compressive forces on the test section and also increased the reliability of the joints of the test section.

The concentricity of the heater tube in the annulus was maintained by three sets of spacer pins mounted in the wall of the outer annular surface. Three asbestos phenolic pins in each set were spaced at 120° intervals. The pins contacted the heater with a concave surface, which matched the curvature of the heater tube. Six sets of three pins each were used in later tests to improve concentricity.

Tests were conducted at constant flow and exit bulk temperature. The inlet temperature was decreased as the power (heat flux) was increased to the point of burnout. Multiple tests could be made on a stainless steel heater by using a resistance bridge burnout detector to terminate the test before heater destruction. Some test conditions were recorded as safe operating points with aluminum heaters to avoid heater destruction. (The low melting point of the aluminum and high power density made use of a burnout detector impractical.)

RESULTS

H_2O Coolant and Stainless Steel Heaters

The SRL H_2O results (Figure 3 and Table B-1) are correlated by the following empirical equation:*

$$\left.\frac{Q}{A}\right|_{Cr} = 153{,}600\ (1 + 0.0515\ V)(1 + 0.069\ T_{sub}) \qquad (1)$$

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* The nomenclature is given on page 31.

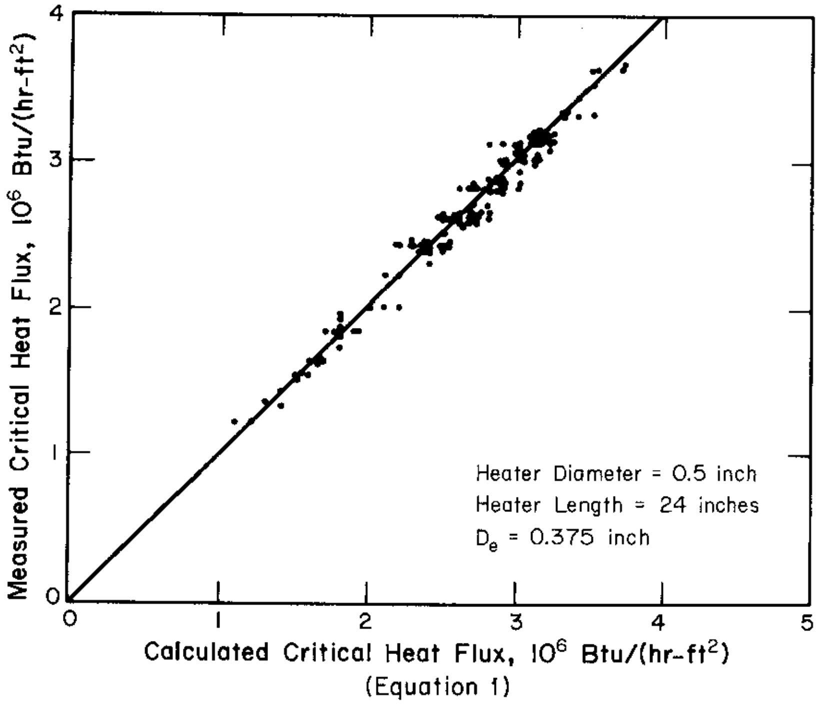

FIG. 3 SRL Critical Heat Flux Results With Stainless Steel Surfaces and H_2O Coolant

The correlation is based on 132 experimental burnout points (through test 835 in Table B-1) obtained with 10 different heaters. The standard deviation was 3.5%. The correlation has been verified by an additional 106 points obtained on 10 additional heaters (tests after 835 in Table B-1). The tests before test 619 were used to develop data acquisition techniques and to determine control required to obtain reproducible data. After test 619, all data were recorded on recorders. The correlation of the additional 106 points had a standard deviation of 4.4%. The magnitude of the standard deviation and the maximum deviation (10%) indicate that the scatter in the data can be attributed to experimental errors. Data for subcooling below 45°F subcooling were not used in the correlation because of additional void effects below this subcooling. Data obtained on bowed heaters, on heaters with fabrication defects, or in tests with poor heat balances were excluded from the analysis. Equation 1 was based on SRL data for one geometry, i.e., annular downward flow with ½-inch-OD x 24-inch-long heaters and a 0.875-inch-ID housing.

However, the Columbia University data (Figure 4, Table B-2) on both 3/4-inch and 2.1-inch-OD heaters agree well with Equation 1, although the scatter of these results is more than with the SRL results. Approximately 200 tests were conducted at Columbia University. The first tests (138 total) were conducted using an inflexible mandrel-type heater design. Acceptable data were not obtained with this design (large scatter and no reproducibility); therefore, all these results were discarded. Other results were discarded because of heater defects, poor alignment, or poor heat balances. The remaining 27 points are shown in Figure 4.

Critical heat flux data were obtained by Thorgerson[7] at SRL with a 2-inch-wide rectangular channel heated from one side. These data (68 points), shown in Figure 5 and Table B-3, agree very well with Equation 1. Thorgerson's data for gap thicknesses of 0.2 to 0.24 inches had a standard deviation of 5.9% and a maximum deviation of 14% from Equation 1.

The improved correlation of data over previous studies[2-4] can be attributed to better data acquisition. Furthermore, by limiting the correlations to subcoolings greater than 45°F, the correlations are even better. As shown in Figure 6, there is a distinct break below 45°F in the curve of critical heat flux as a function of subcooling at constant mass velocity or linear velocity based on inlet volumetric flow rate. The break in the curve can be accounted for by increased vapor volume at the critical condition, which causes an increase in the local velocities for uniformly heated tubes; hence, the increased critical heat fluxes.

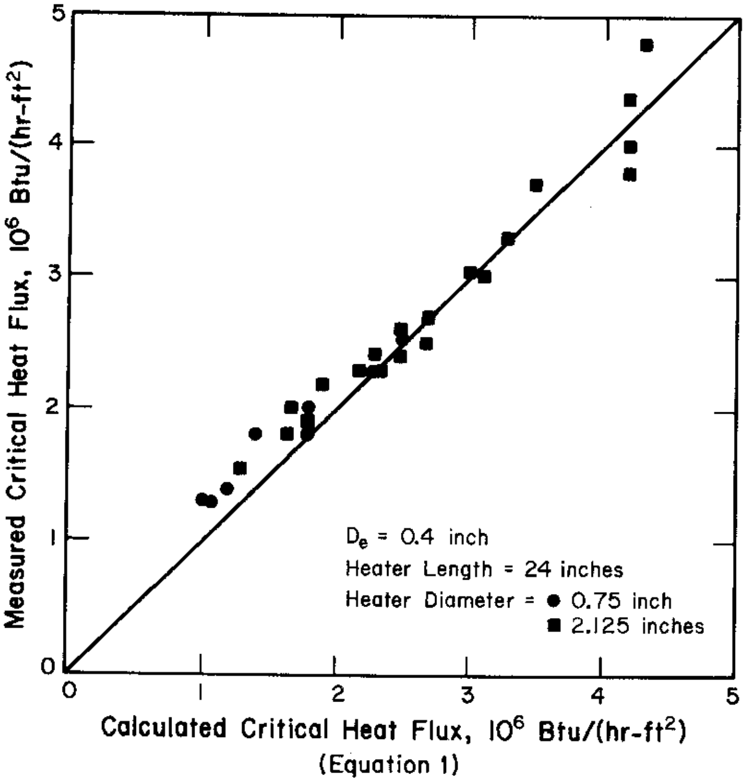

FIG. 4 Columbia University Critical Heat Flux Results With Stainless Steel Heaters and H_2O Coolant

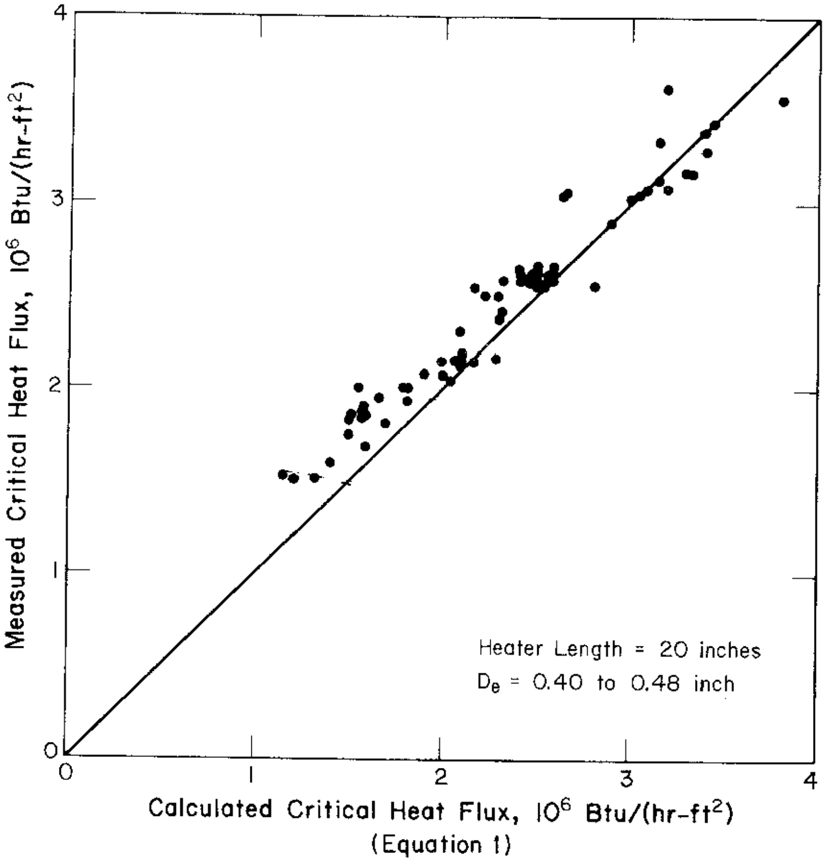

FIG. 5 SRL Critical Heat Flux With 2-inch-wide Rectangular Channel With Stainless Steel Heaters and H_2O Coolant

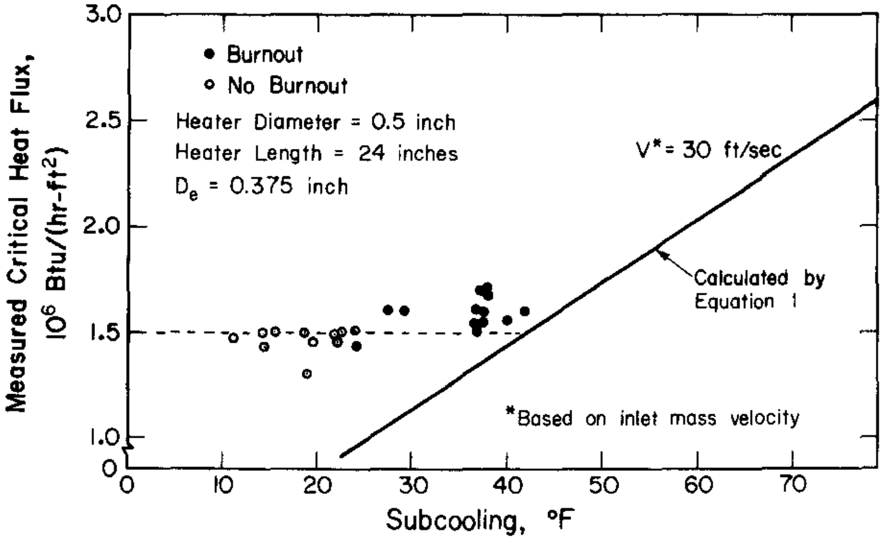

FIG. 6 Critical Heat Flux at Low Subcooling With Stainless Steel Heaters and H_2O Coolant

The results presented in Figures 3, 4, and 5 were obtained at pressures of 30, 55, and 95 psia. No pressure effect was apparent for subcoolings greater than 45°F. However, at lower subcoolings (<45°F) there was a pressure effect, but additional data are required to verify the extent of the effect.

Equation 1 has been compared with a number of other critical heat flux correlations by Gambill.[5] He compared his correlation with Equation 1, Mirshak and Towell,[4] Provarnin and Semonov,[8] and Griffel.[9] The critical heat fluxes agreed reasonably well. However, both Mirshak and Towell and Griffel developed correlations applicable to subcoolings below and above 45°F, which accounts for some of the differences between those correlations and Equation 1. Equation 1 predicts critical heat fluxes about 41% higher than the correlation in Reference 2 at 135°F subcooling, 50 psia, and 25 ft/sec, and about 23% lower at 45°F subcooling, 50 psia, and 25 ft/sec. The data in Figure 3 have been correlated quite well with Reynolds' analogy.[7]

D_2O Coolant and Stainless Steel Heaters

The critical heat fluxes for D_2O are correlated by the following equation and are summarized in Figure 7 and Tables B-4 and B-5.

$$\left.\frac{Q}{A}\right|_{Cr} = 178{,}000\ (1 + 0.0515\ V)(1 + 0.069\ T_{sub}) \qquad (2)$$

The data include 37 points obtained at SRL and 6 points obtained at Columbia University. The standard deviation from the correlation is less than 4%.

Because of the possibility that critical heat fluxes for D_2O might be higher than for H_2O, studies were initiated to better define the critical heat flux with D_2O coolant. Because of the high cost of D_2O (∿$30/lb), special precautions were taken to reduce losses. The D_2O used at SRL was 93% D_2O and 7% H_2O. Similarly, data at Columbia University were obtained with 90% D_2O and 10% H_2O. Because the SRL data for D_2O were obtained with the same apparatus and type of heaters as used for the H_2O data, the comparison of these data should indicate quite accurately differences in the critical heat flux due to coolant. The critical heat flux for D_2O measured in the tests is 16% higher than that for H_2O at the same velocity and approximately 8.5% higher at the same mass velocity. The critical heat flux is estimated to be 1% higher for 99.97% D_2O (linear extrapolation).

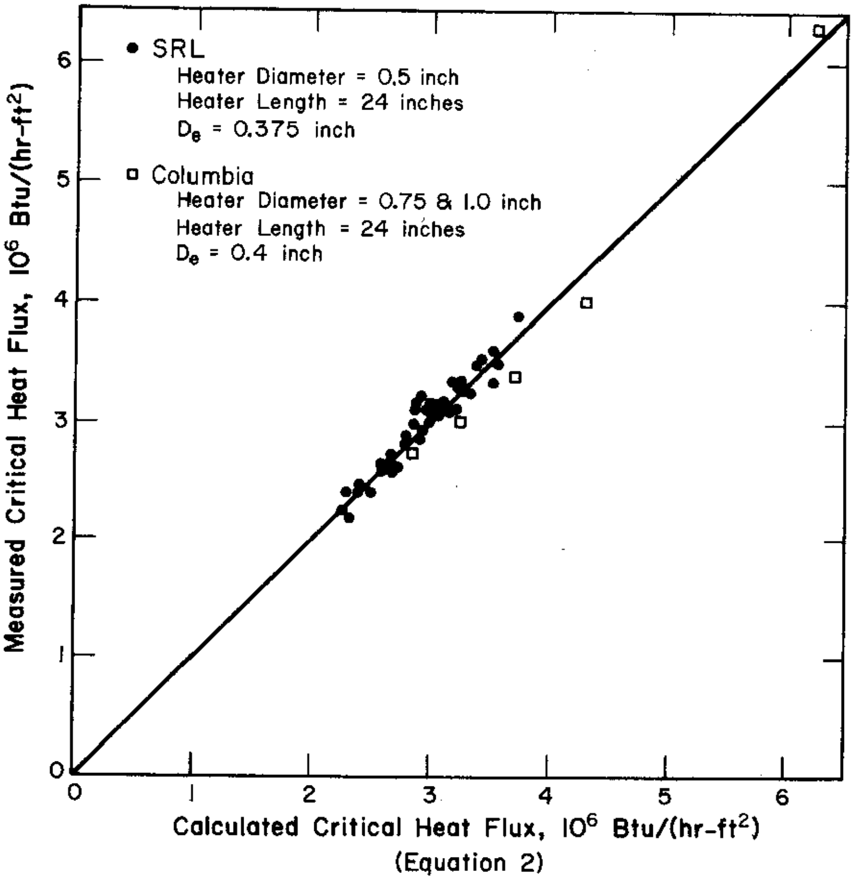

FIG. 7 Critical Heat Flux Results With Stainless Steel Heaters and D_2O Coolant

Aluminum Surface and H_2O Coolant

Background

The effect of heater material on the critical heat flux has been investigated with pool boiling conditions.[10,11] Tests indicated that although stainless steel and copper had equivalent critical heat fluxes, critical heat fluxes for aluminum were up to 20% greater. Because the thermal properties of copper are much better than those of aluminum and because the critical heat fluxes for copper agree with those for stainless steel, the higher critical heat flux for aluminum at pool boiling conditions cannot be attributed to the thermal properties.

Previous work at Savannah River Laboratory indicated that critical heat fluxes for aluminum with forced convection cooling were higher than those for stainless steel. These tests were limited by the power supply at SRL. In 1966, a program was begun at Columbia University to measure the burnout heat fluxes with aluminum surfaces over a broader range. Initial heater designs at Columbia University contained an indirectly heated aluminum tube two inches in diameter (stainless steel heater electrically insulated from an outer aluminum sheath). Thermal expansion and assembly problems limited operation to heat fluxes below about 1.5×10^6 Btu/(hr-ft^2). Higher heat fluxes were subsequently obtained with direct resistance heating of aluminum heaters with diameters of 0.75- and 1.0-inch.

Results

The critical heat flux results for aluminum heaters and H_2O coolant included 18 tests with physical burnout, 22 tests with safe operating points with critical heat fluxes more than 20% greater than stainless steel at equivalent coolant conditions, and 20 tests with safe operating points with critical heat fluxes between 15 and 20% greater than stainless steel heaters. These results are correlated by the following equation and are shown in Figure 8 and Table B-6.

$$\left.\frac{Q}{A}\right|_{Cr} = 188{,}000\ (1 + 0.0515\ V)(1 + 0.069\ T_{sub}) \qquad (3)$$

Deviations from the correlation ranged from -6.6% to +16% for heater thicknesses of 0.020, 0.028, and 0.035 inches.

Critical heat fluxes were also determined for aluminum-oxide-coated aluminum heaters. The oxide coatings were formed either

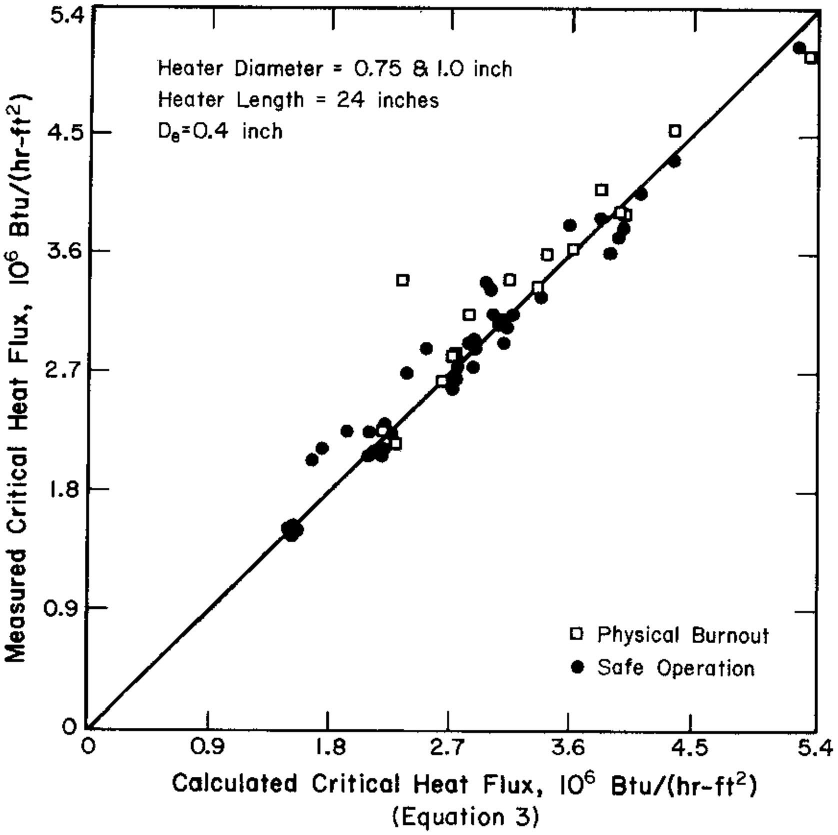

FIG. 8 Critical Heat Flux Results for Aluminum Heaters and H_2O Coolant

by a commercial anodizing process or by steam autoclaving at SRL. The anodized heaters obtained from the first vendor had a specified oxide thickness of 1 mil. After several tests, the oxide was measured to be a minimum of 2.4 mils thick. The oxide layers formed by autoclaving at SRL were up to 0.6-mil thick, and the anodized heaters from a second vendor had a maximum oxide thickness of 1.4 mils. There were significant differences in the thermal conductivity of the oxides [0.4 to 0.7 Btu/(hr-ft-°F)]. The thermal conductivities were calculated from the known oxide thickness, the heat flux at failure, an estimated surface temperature of 360°F based on some special surface temperature measurements at SRL, and the internal surface temperature equal to the melting point of aluminum at the time of failure. The oxide thickness was determined by metallographic sectioning and measurement of the oxide thickness on a 1000X photograph of the section.

Test sections that operated at heat fluxes corresponding to internal temperatures in excess of 1100°F failed by internal melting instead of local burnout. Internal melting was verified in several tests by an internal thermocouple. The results of these tests are summarized in Figure 9 and Table B-7. The oxide did not directly affect the critical heat flux, but did limit the operating heat flux when the large temperature gradients across the oxide layer caused internal melting.

Aluminum Surface and D_2O Coolant

Several tests conducted with aluminum heaters and D_2O coolant are summarized in Table B-8. The observed critical heat fluxes are correlated by the following equation, which predicts critical heat fluxes 40% greater than for H_2O and stainless surfaces:

$$\left.\frac{Q}{A}\right|_{Cr} = 218{,}000\ (1 + 0.0515\ V)(1 + 0.069\ T_{sub}) \qquad (4)$$

Data shown in Figure 10 are compared to Equation 4 and verify the independent increase in critical heat flux of 20% for aluminum over stainless steel surfaces and of 16% for D_2O over H_2O coolant discussed earlier.

CORRELATION OF DATA

The correlation of all the data presented for D_2O, H_2O, stainless steel, and aluminum based on a least squares regression analysis is:

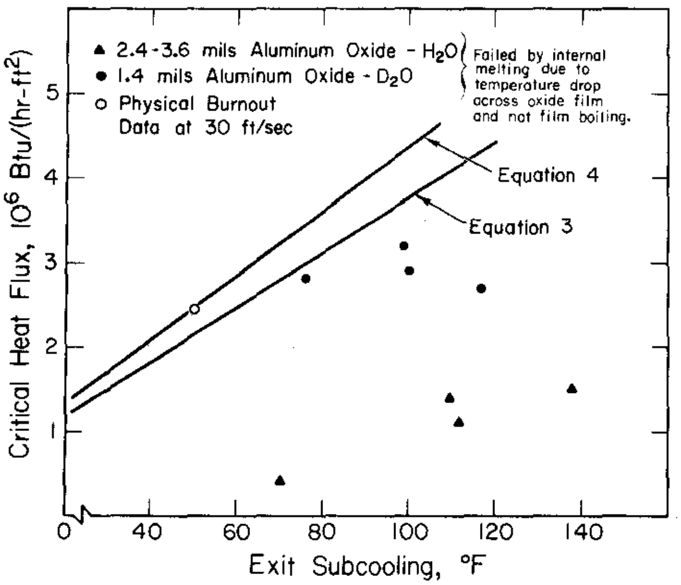

FIG. 9 Effect of Aluminum Oxide on the Critical Heat Flux

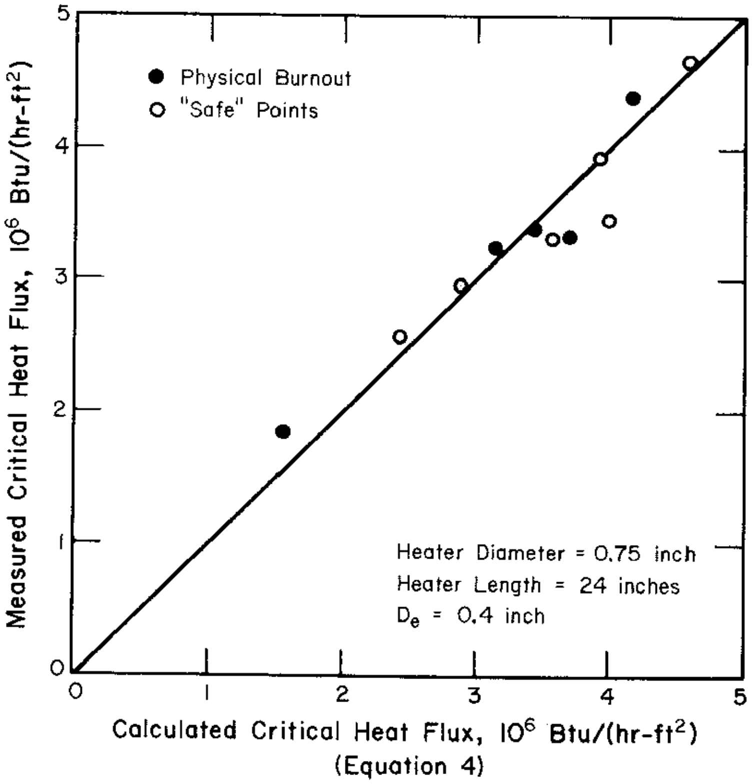

FIG. 10 Critical Heat Flux With Aluminum Heaters and D_2O Coolant

$$\frac{Q}{A}\Bigg|_{Cr} = 1360\left(\frac{We}{Re}\right)_C^{0.573}\left(\rho Cp\ T_{sub}\right)_C^{0.759}\left(\rho Cp\right)_H^{0.621}\left(k\right)_H^{0.190} \quad (5)$$

This empirical correlation fits the data with a standard deviation of 4.8% and a maximum deviation of 16%. The data are compared with this equation in Figure 11.

The most striking differences in physical properties between H_2O and D_2O at 262°F are density, viscosity, and heat of vaporization as indicated in Table II. Although the density affects the volumetric heat capacity, and the viscosity represents a measure of the shear stress in the laminar sublayer, factors containing only density and viscosity have not been applied quantitatively with success to correlate critical heat flux data.

TABLE II

Properties of Light Water and Heavy Water

Property	Evaluated Temperature	H_2O Value	D_2O Value	% D_2O Contribution
T_{sat}, °F	-	312	313	+ 0.321
T_{bulk}, °F	-	212	213	+ 0.472
$\bar{T}$, °F	-	262	263	+ 0.382
μ, $lb_m/(ft\text{-}hr)$	$\bar{T}$	0.5082	0.5566	+ 9.52
σ, lb_f/ft	$\bar{T}$	0.3542×10^{-2}	0.3501×10^{-2}	- 1.16
(We/Re)	$\bar{T}$	0.0372	0.0411	+10.4
ρ, lb_m/ft^3	$\bar{T}$	58.5	64.9	+10.9
c_p, $Btu/(lb_m\text{-}°F)$	$\bar{T}$	1.02	0.994	- 2.55
ρc_p, $Btu/(ft^3\text{-}°F)$	$\bar{T}$	59.7	64.5	+ 8.04
ρ, lb_m/ft^3	T_{sat}	57.0	63.1	+10.7
λ, Btu/lb_m	T_{sat}	901	824	- 8.55
$\rho\lambda$, Btu/ft^3	T_{sat}	51,300	52,000	+ 1.36
k, $(Btu\text{-}ft)/(hr\text{-}ft^2\text{-}°F)$	$\bar{T}$	0.396	0.371	- 6.31

The ratio of the Weber and Reynolds numbers in Equation 5 can be interpreted as the ratio of viscous forces to surface tension forces acting on a bubble at the surface. The viscous forces are attempting to remove the bubble (delaying burnout), and the surface tension forces are attempting to retain the bubble on the surface. The choice of the ratio of Weber and Reynolds Numbers is based on

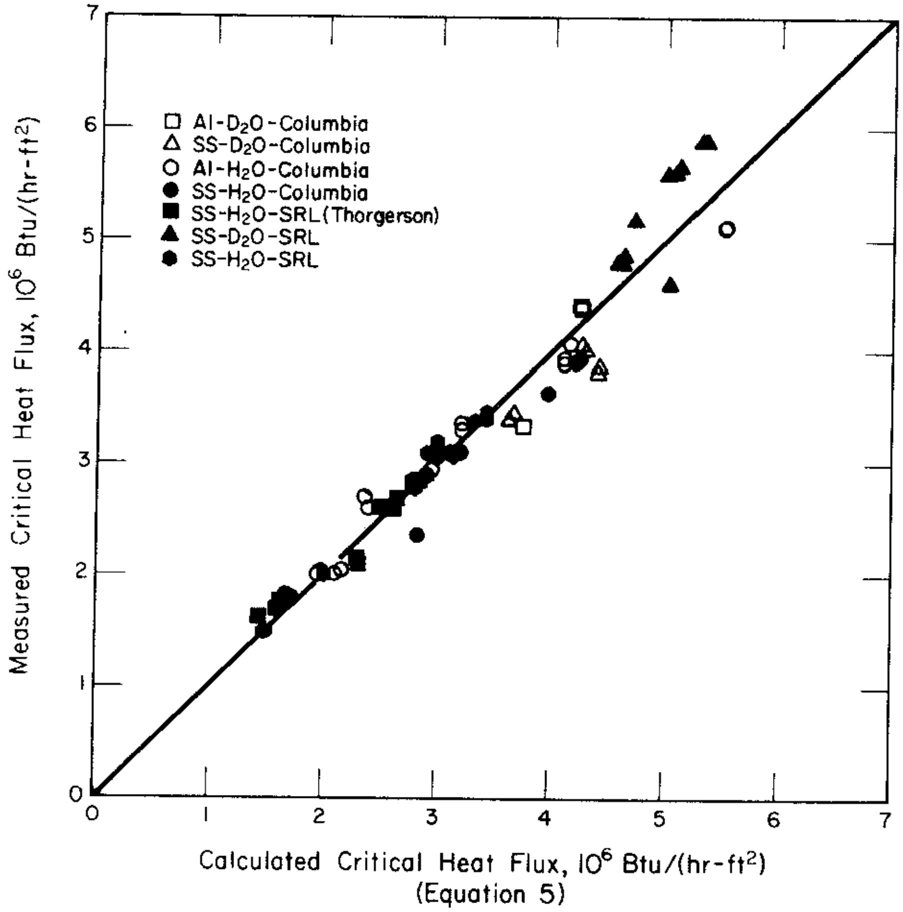

FIG. 11 Comparison of Generalized Correlation With All Critical Heat Flux Data

Chang's analysis.[13] The second term in Equation 5 $(\rho Cp\ T_{sub})_C$ expresses the heat removal capacity of the coolant on a unit volume basis. This term includes both the effects of coolant subcooling and of variation in the volumetric heat capacity of the coolant.

The third term $(\rho Cp)_H$ and fourth term $(k)_H$ in the correlation are the volumetric heat capacity and thermal conductivity of the heater, respectively. These terms express the ability of the heater surface to absorb heat and to fin heat away from hot spots on the surface. Unlike pool boiling behavior previously discussed, the thermal properties of the heater are important at forced flow conditions. The differences in the properties of stainless steel and aluminum are summarized in Table III.

TABLE III

Properties of Stainless Steel and Aluminum

Property	Stainless Steel Value	Aluminum Value	Aluminum Contribution, %
k, (Btu-ft)/(hr-ft^2-°F)	10.0	117.0	+1070.0
ρ, lb$_m$/ft^3	501.0	167.0	- 66.7
c_p, Btu/(lb$_m$-°F)	0.120	0.245	+ 104.0
ρc_p, Btu/(ft^3-°F)	60.1	40.9	- 31.9

Equation 5 was also compared with some earlier critical heat flux data obtained with Cu-Ni heaters and H_2O coolant (Figure 12).[2] The average deviation of these data from Equation 5 is ∿16%. This error could be decreased by including these data in the correlation. However, the functional dependence of Equation 5 on heater properties would still at best be empirical.

Because of the limited range of data used in Equation 5, the functional dependence of the critical heat flux on coolant and heater physical properties can be very misleading. This is apparent in the comparison with Cu-Ni data of Figure 12. Hence, Equation 5 is applicable only to the range of data, coolant types, and heater materials summarized in Table I.

The data in Figure 13 indicate an effect of heater thickness on the critical heat flux. Available data[10,12] for thin stainless steel heaters also indicate that the critical heat flux is a

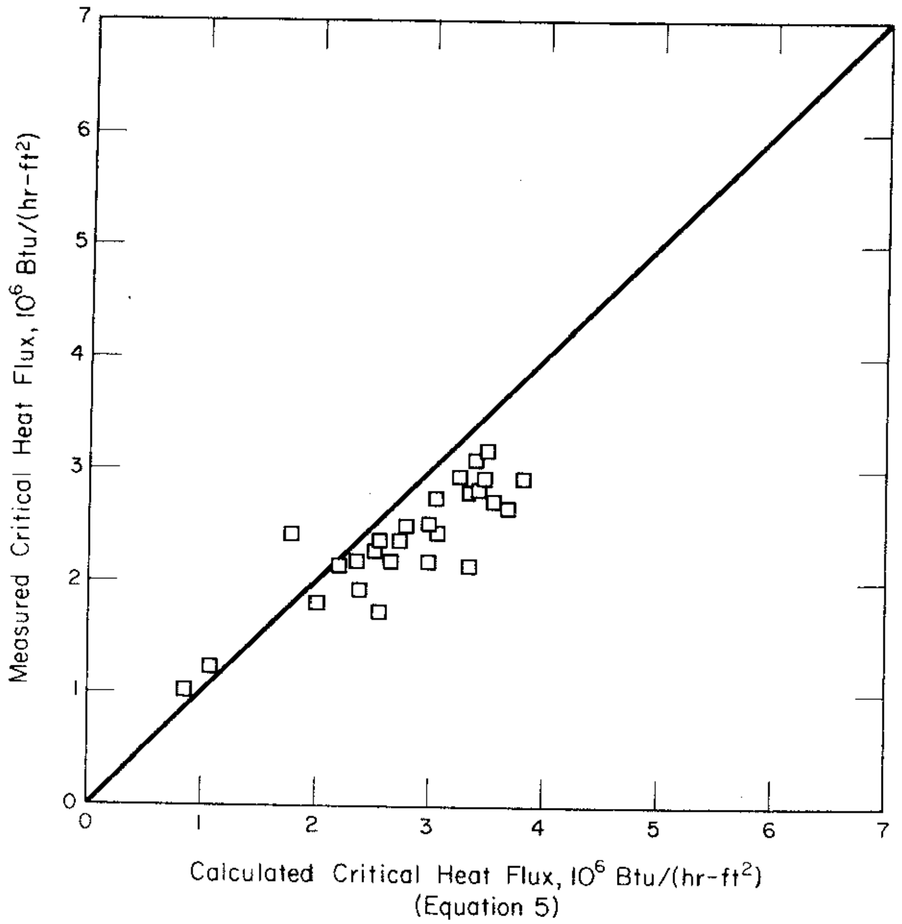

FIG. 12 Comparison of Equation 5 With Cu-Ni Critical Heat Flux Data

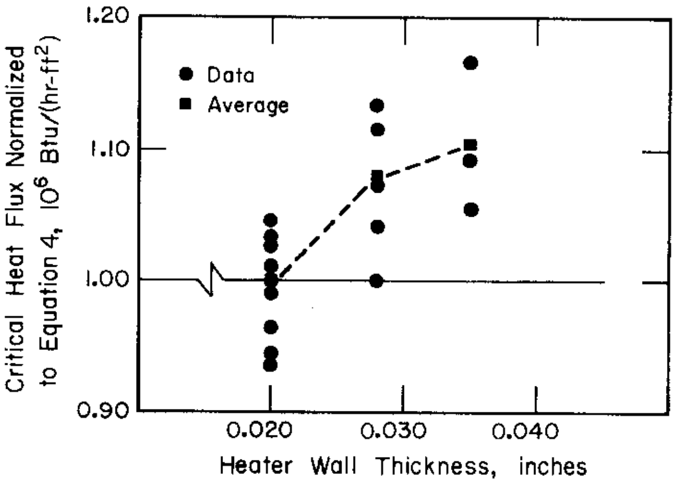

FIG. 13 Effect of Aluminum Heater Thickness on The Critical Heat Flux

function of heater thickness. For stainless steel, this effect disappears at a thickness of 0.004 inch. Because of the factor of 12 difference in thermal conductivities, the critical heat flux for aluminum would approach an asymptotic value at about 0.050 inches which is verified by the trend shown in Figure 13.

In an attempt to understand the increased critical heat fluxes for aluminum versus stainless steel, an analytical model was developed for computer analyses. The model accounted for internal conduction and used surface heat transfer coefficients as a function of surface temperature. Burnout was initiated on the surface by decreasing the heat transfer coefficient at a local area to one-tenth the steady state value. This reduction represents placement of a vapor film on the surface. The heat transfer coefficient was held constant for some fixed time and was then allowed to follow the temperature dependence model. The surface then either recovered or melted. The time which represented the point between recovery or melting was a function of hydrodynamic conditions. This dynamic model did indicate that stainless steel should not have as high a critical heat flux as aluminum, but this analysis could not indicate magnitudes. The result of this theoretical study indicated that the difference was due to the time scale of burnout and the finning ability of that portion of the heater with temperatures below the Leidenfrost point. Note that a heater material effect based on thermal properties would not be applicable at pool boiling conditions, where the vapor films are large, and the buoyancy forces and vapor residence times are controlling.

The equations presented in this report are applicable only to ideal surfaces. Preliminary studies at Savannah River Laboratory to determine the effect of a 60-mil spacer rib contacting a stainless steel or aluminum heater indicate as much as a 40% reduction in the respective critical heat flux predicted by the ideal correlations. The reduction in heat flux by the rib is a function of the subcooling and velocity.

APPENDIX A

NOMENCLATURE

$\frac{Q}{A}\Big|_{Cr}$ = critical heat flux, Btu/(hr-ft^2)

$\frac{We}{Re}$ = ratio of the Weber Number to the Reynolds Number, $\mu V/\sigma g_c$

We = Weber Number, $\frac{V^2 D\rho}{\sigma g_c}$ *

Re = Reynolds Number, $\frac{V\rho D}{\mu}$

$\bar{T}$ = film temperature, $(T_{sat} + T_{bulk})/2$, °F

T_{sub} = coolant subcooling $(T_{sat} - T_{bulk})$, °F

T_{sat} = coolant saturation temperature, °F

T_{bulk} = bulk coolant temperature, °F

D = diameter of bubble on heater surface, ft

D_e = coolant channel equivalent diameter, in

V = coolant velocity, ft/sec

g_c = gravitational constant, $(lb_m\text{-}ft)/(lb_f\text{-}sec^2)$

c_p = specific heat capacity, $Btu/(lb_m\text{-}°F)$

k = thermal conductivity, (Btu-ft)/(hr-ft^2-°F)

μ = coolant viscosity, $lb_m/(ft\text{-}sec)$

σ = surface tension, lb_f/ft

λ = heat of vaporization, Btu/lb_m

ρ = density, lb_m/ft^3

Subscripts: C = coolant
H = heater

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* All coolant properties except heat of vaporization were evaluated at film temperature; heat of vaporization was evaluated at saturation temperature. Heater properties were evaluated at saturation temperature.

APPENDIX B

CRITICAL HEAT FLUX DATA

The following data are tabulated in this appendix.

Run Number

Heater ID — identification, if known

Length, inch
Dia. — diameter or width of rectangular channel, inch
Thick. — thickness, inch

Coolant Channel Equivalent diameter, inch

Pressure drop, psi

Conditions at point of burnout

Pressure, psia
Velocity, ft/sec
Subcooling, °F

Critical heat flux, Btu/hr-ft^2

Comments pertinent to test data exclusion from correlations

1. Subcooling less than 45°F
2. No burnout
3. Heater bowed or damaged during previous test
4. Flaws in heater fabrication
5. Poor heat balance
6. Safe operating point — flux too low to validate appropriate correlation
7. Pressure effect — observed only at 95 psia and velocity of 15 ft/sec

TABLE B-1
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER   SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
619	D7	24.0	0.500	0.120	0.375	7.85	55.38	30.08	95.17	3.076	
620	D7	24.0	0.500	0.120	0.375	7.85	54.39	29.91	88.22	2.878	
621	D7	24.0	0.500	0.120	0.375	7.46	55.93	29.80	72.70	2.421	
622	D7	24.0	0.500	0.120	0.375	7.24	55.31	29.74	51.57	1.856	
623	D7	24.0	0.500	0.120	0.375	7.12	54.81	29.75	53.05	1.865	
624	D7	24.0	0.500	0.120	0.375	7.61	53.87	29.76	37.35	1.667	(5)
625	D7	24.0	0.500	0.120	0.375	8.59	56.10	29.58	28.04	1.490	(1)
626	D7	24.0	0.500	0.120	0.375	8.10	29.97	29.33	40.63	1.847	(1)
627	D7	24.0	0.500	0.120	0.375	11.41	32.50	29.32	30.35	1.678	(1)
628	D7	24.0	0.500	0.120	0.375	17.49	28.71	29.30	12.58	1.510	(2)
629	D7	24.0	0.500	0.120	0.375	2.45	30.60	14.64	85.07	1.850	
630	D7	24.0	0.500	0.120	0.375	2.58	29.79	14.94	77.60	1.636	
631	D7	24.0	0.500	0.120	0.375	2.58	29.72	14.62	71.59	1.516	
632	D7	24.0	0.500	0.120	0.375	5.64	31.23	14.53	63.50	1.355	
633	D7	24.0	0.500	0.120	0.375	5.64	30.24	14.76	54.52	1.210	
634	D7	24.0	0.500	0.120	0.375	7.88	35.29	14.32	17.26	1.084	(2)
635	D7	24.0	0.500	0.120	0.375	7.88	56.86	30.00	101.50	3.087	
636	D7	24.0	0.500	0.120	0.375	7.78	54.98	29.97	94.81	2.866	
637	D7	24.0	0.500	0.120	0.375	2.45	93.17	15.20	115.60	2.486	
638	D7	24.0	0.500	0.120	0.375	2.31	94.66	14.94	107.39	2.243	
639	D7	24.0	0.500	0.120	0.375	2.40	93.60	15.08	86.02	1.865	
640	D7	24.0	0.500	0.120	0.375	2.99	94.00	14.68	62.41	1.494	(7)
641	D7	24.0	0.500	0.120	0.375	3.04	94.81	14.10	54.31	1.355	(7)
642	D7	24.0	0.500	0.120	0.375	3.68	93.86	14.25	36.29	1.364	(6)
643	D7	24.0	0.500	0.120	0.375	2.31	55.04	14.67	89.60	1.766	(3)
644	D7	24.0	0.500	0.120	0.375	2.94	56.34	14.54	59.04	1.345	(3)
645	D7	24.0	0.500	0.120	0.375	2.94	55.78	14.93	56.12	1.204	(3)
646	D7	24.0	0.500	0.120	0.375	7.85	56.55	30.13	110.70	3.121	(3)
647	D6	24.0	0.500	0.120	0.375	8.74	59.07	30.26	95.47	3.114	(4)
648	D6	24.0	0.500	0.120	0.375	6.39	57.07	30.22	86.72	2.853	(4)
649	D6	24.0	0.500	0.120	0.375	8.15	55.86	30.19	71.19	2.435	(4)
650	D6	24.0	0.500	0.120	0.375	8.74	56.31	30.14	48.33	1.850	(4)
651	D6	24.0	0.500	0.120	0.375	9.86	57.58	30.15	39.89	1.688	(4)
652	D6	24.0	0.500	0.120	0.375	13.40	56.47	29.97	20.25	1.508	(4)
653	D6	24.0	0.500	0.120	0.375	9.42	104.58	28.90	47.90	1.840	(4)
654	D6	24.0	0.500	0.120	0.375	8.98	28.95	29.71	43.99	1.969	(4)
655	D6	24.0	0.500	0.120	0.375	9.77	29.41	30.10	37.69	1.852	(4)
656	D6	24.0	0.500	0.120	0.375	18.35	29.58	30.10	15.82	1.690	(4)
657	D6	24.0	0.500	0.120	0.375	15.90	55.47	45.13	67.25	3.107	(4)
658	D6	24.0	0.500	0.120	0.375	15.66	55.46	45.18	62.51	2.873	(4)
659	D6	24.0	0.500	0.120	0.375	18.85	54.02	44.61	35.69	2.486	(4)
660	D6	24.0	0.500	0.120	0.375	26.99	54.06	44.68	18.67	2.137	(4)
661	D6	24.0	0.500	0.120	0.375	8.69	54.42	30.27	90.90	3.197	(4)
662	D6	24.0	0.500	0.120	0.375	8.54	55.50	30.25	87.17	3.006	(4)
663	D6	24.0	0.500	0.120	0.375	8.29	29.39	29.89	70.40	2.484	(4)
664	D6	24.0	0.500	0.120	0.375	8.24	29.39	29.88	66.96	2.311	(4)
665	D6	24.0	0.500	0.120	0.375	9.03	29.35	29.88	46.84	2.079	(4)
666	D6	24.0	0.500	0.120	0.375	16.15	55.89	45.23	76.88	3.447	(4)
667	D6	24.0	0.500	0.120	0.375	15.90	55.38	45.21	69.08	3.206	(4)
668	D6	24.0	0.500	0.120	0.375	15.70	55.66	45.19	63.25	2.966	(4)

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6BTU/HR-SQFT	COMMENTS
669	D6	24.0	0.500	0.120	0.375	15.70	56.64	45.34	59.58	2.813	(4)
670	D6	24.0	0.500	0.120	0.375	15.80	58.63	45.19	66.04	2.932	(4)
671	D6	24.0	0.500	0.120	0.375	16.59	55.43	44.89	35.53	2.522	(4)
672	D6	24.0	0.500	0.120	0.375	15.58	56.34	44.93	55.53	2.759	(4)
673	D6	24.0	0.500	0.120	0.375	24.78	56.65	44.87	25.40	2.351	(4)
674	D6	24.0	0.500	0.120	0.375	2.94	55.17	14.63	85.95	1.939	(4)
675	D6	24.0	0.500	0.120	0.375	3.31	55.88	14.84	78.14	1.771	(4)
676	D6	24.0	0.500	0.120	0.375	3.46	55.93	14.59	64.35	1.589	(4)
677	D6	24.0	0.500	0.120	0.375	4.05	56.00	14.58	53.62	1.451	(4)
678	D6	24.0	0.500	0.120	0.375	4.81	55.84	14.91	39.01	1.291	(4)
679	D6	24.0	0.500	0.120	0.375	7.68	55.93	14.58	9.59	1.091	(4)
680	D6	24.0	0.500	0.120	0.375	8.91	55.33	30.57	96.17	3.164	(4)
681	D6	24.0	0.500	0.120	0.375	8.74	55.51	30.33	89.69	2.992	(4)
682	D6	24.0	0.500	0.120	0.375	2.92	97.85	15.52	119.84	2.581	(4)
683	D6	24.0	0.500	0.120	0.375	2.85	97.85	15.44	110.14	2.392	(4)
684	D6	24.0	0.500	0.120	0.375	3.24	98.21	15.02	71.05	1.890	(4)
685	D6	24.0	0.500	0.120	0.375	3.51	99.13	14.38	62.82	1.627	(4)
686	D6	24.0	0.500	0.120	0.375	3.71	107.03	13.89	45.40	1.420	(4)
687	D6	24.0	0.500	0.120	0.375	8.64	59.35	30.39	108.58	3.233	(4)
688	D8	24.0	0.500	0.120	0.375	8.12	56.60	30.06	95.44	3.002	
689	D8	24.0	0.500	0.120	0.375	8.05	56.00	29.97	89.01	2.817	
690	D8	24.0	0.500	0.120	0.375	8.00	56.49	29.88	80.95	2.628	
691	D8	24.0	0.500	0.120	0.375	7.95	56.29	29.87	75.26	2.455	
692	D8	24.0	0.500	0.120	0.375	8.00	56.09	29.85	65.23	2.245	
693	D8	24.0	0.500	0.120	0.375	8.49	56.27	30.38	54.90	1.998	
694	D8	24.0	0.500	0.120	0.375	8.44	55.81	30.12	52.92	1.922	
695	D8	24.0	0.500	0.120	0.375	9.18	56.60	30.14	41.78	1.688	(1)
696	D8	24.0	0.500	0.120	0.375	17.72	54.94	28.80	8.44	1.478	(2)
697	D8	24.0	0.500	0.120	0.375	15.70	56.36	44.88	84.71	3.460	
698	D8	24.0	0.500	0.120	0.375	15.66	56.86	45.12	75.55	3.139	
699	D8	24.0	0.500	0.120	0.375	15.56	56.55	45.34	70.76	3.001	
700	D8	24.0	0.500	0.120	0.375	15.41	56.94	44.99	63.23	2.709	
701	D8	24.0	0.500	0.120	0.375	15.12	56.71	45.11	59.09	2.529	
702	D8	24.0	0.500	0.120	0.375	20.42	55.87	45.27	37.53	2.228	(2)
703	D8	24.0	0.500	0.120	0.375	2.50	55.44	14.22	96.25	2.070	
704	D8	24.0	0.500	0.120	0.375	2.60	56.05	14.04	86.54	1.789	
705	D8	24.0	0.500	0.120	0.375	3.12	57.00	13.98	73.19	1.521	
706	D8	24.0	0.500	0.120	0.375	3.04	56.09	14.48	65.38	1.422	
707	D8	24.0	0.500	0.120	0.375	5.59	56.49	13.98	32.89	1.199	(1)
708	D8	24.0	0.500	0.120	0.375	7.66	55.56	30.09	112.18	3.101	(3)
709	D9	24.0	0.500	0.120	0.375	6.54	56.74	30.21	104.20	2.966	(6)
710	D9	24.0	0.500	0.120	0.375	8.34	56.92	30.21	97.47	2.772	(4)
711	D9	24.0	0.500	0.120	0.375	7.80	56.53	29.39	91.12	2.549	(4)
712	D9	24.0	0.500	0.120	0.375	7.66	56.16	29.38	82.53	2.425	(4)
713	D9	24.0	0.500	0.120	0.375	7.56	56.45	29.05	73.80	2.225	(4)
714	D9	24.0	0.500	0.120	0.375	8.20	57.61	29.73	64.96	2.016	(4)
715	D9	24.0	0.500	0.120	0.375	8.64	55.73	29.72	54.25	1.831	(4)
716	D5	24.0	0.500	0.120	0.375	8.17	56.06	29.98	100.75	3.103	
717	D5	24.0	0.500	0.120	0.375	7.93	54.81	30.24	84.62	2.857	
718	D5	24.0	0.500	0.120	0.375	7.56	55.60	29.40	83.16	2.642	

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
719	D5	24.0	0.500	0.120	0.375	7.53	55.53	28.83	74.52	2.446	
720	D5	24.0	0.500	0.120	0.375	8.04	59.51	30.05	102.29	3.076	
721	D5	24.0	0.500	0.120	0.375	7.92	58.43	30.22	91.84	2.853	
722	D5	24.0	0.500	0.120	0.375	7.81	58.08	30.21	82.30	2.619	
723	D5	24.0	0.500	0.120	0.375	7.74	56.91	30.17	78.50	2.419	
724	D5	24.0	0.500	0.120	0.375	7.96	58.89	30.31	100.10	3.105	
725	D5	24.0	0.500	0.120	0.375	7.97	56.51	30.18	97.81	2.873	
726	D5	24.0	0.500	0.120	0.375	7.90	59.38	30.19	89.10	2.650	
727	D5	24.0	0.500	0.120	0.375	7.84	57.22	30.17	79.31	2.439	
728	D4	24.0	0.500	0.120	0.375	7.87	58.38	30.08	92.34	3.109	
729	D4	24.0	0.500	0.120	0.375	7.62	58.46	30.32	85.10	2.873	
730	D4	24.0	0.500	0.120	0.375	7.63	57.74	30.23	78.37	2.659	
731	D4	24.0	0.500	0.120	0.375	7.58	57.75	30.21	68.87	2.453	
732	D4	24.0	0.500	0.120	0.375	7.84	59.21	30.23	97.65	3.098	
733	D4	24.0	0.500	0.120	0.375	7.80	58.38	30.24	95.49	3.087	
734	D11	24.0	0.500	0.120	0.375	7.69	58.08	29.85	94.19	3.098	
735	D11	24.0	0.500	0.120	0.375	7.58	58.98	30.07	88.97	2.869	
736	D11	24.0	0.500	0.120	0.375	7.51	58.29	30.22	80.21	2.641	
737	D11	24.0	0.500	0.120	0.375	7.46	58.41	30.19	72.92	2.443	
738	D11	24.0	0.500	0.120	0.375	7.78	58.99	30.40	98.89	3.105	
739	D11	24.0	0.500	0.120	0.375	9.54	58.89	30.36	82.64	2.642	
740	D10	24.0	0.500	0.120	0.375	7.95	57.45	30.33	95.38	3.116	
741	D10	24.0	0.500	0.120	0.375	8.06	59.17	30.45	103.55	3.121	
742	D10	24.0	0.500	0.120	0.375	7.94	58.93	30.52	95.22	2.887	
743	D10	24.0	0.500	0.120	0.375	7.88	58.70	30.52	86.62	2.680	
744	D10	24.0	0.500	0.120	0.375	7.82	58.93	30.50	75.74	2.457	
745	D10	24.0	0.500	0.120	0.375	8.06	58.94	30.54	102.29	3.130	
746	D10	24.0	0.500	0.120	0.375	7.89	59.49	30.50	85.99	2.666	
747	D5	24.0	0.500	0.120	0.375	8.10	56.07	30.22	100.87	3.105	
748	D5	24.0	0.500	0.120	0.375	7.90	56.01	30.20	93.47	2.862	
749	D5	24.0	0.500	0.120	0.375	7.75	56.46	30.18	85.84	2.650	
750	D5	24.0	0.500	0.120	0.375	7.66	56.45	30.16	76.81	2.428	
751	D5	24.0	0.500	0.120	0.375	2.77	55.61	15.74	100.89	2.030	
752	D5	24.0	0.500	0.120	0.375	2.75	55.61	15.48	89.28	1.865	
753	D5	24.0	0.500	0.120	0.375	2.65	56.04	14.98	78.89	1.672	
754	D5	24.0	0.500	0.120	0.375	2.63	55.92	14.97	71.73	1.517	
755	D5	24.0	0.500	0.120	0.375	8.02	56.29	29.43	99.47	3.110	
756	D5	24.0	0.500	0.120	0.375	16.17	56.61	46.24	78.88	3.332	
757	D5	24.0	0.500	0.120	0.375	16.37	57.65	46.18	90.04	3.607	
758	D5	24.0	0.500	0.120	0.375	15.88	56.36	46.22	74.47	3.110	
759	D5	24.0	0.500	0.120	0.375	15.63	56.95	46.26	69.32	2.880	
760	D5	24.0	0.500	0.120	0.375	15.36	57.30	46.29	63.77	2.668	
761	D5	24.0	0.500	0.120	0.375	15.14	56.91	46.29	55.44	2.441	
762	D5	24.0	0.500	0.120	0.375	8.05	56.45	30.03	110.14	3.128	(6)
763	D5	24.0	0.500	0.120	0.375	8.05	56.37	30.04	106.97	3.103	(6)
764	D5	24.0	0.500	0.120	0.375	7.68	55.99	30.02	88.65	2.641	(6)
765	D5	24.0	0.500	0.120	0.375	7.51	55.46	30.12	56.36	1.849	(6)
766	D4	24.0	0.500	0.120	0.375	8.39	55.48	30.06	97.49	3.092	
767	D4	24.0	0.500	0.120	0.375	8.17	55.04	30.05	92.47	2.880	
768	D4	24.0	0.500	0.120	0.375	8.05	55.29	30.04	83.95	2.650	

TABLE 8-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
769	D4	24.0	0.500	0.120	0.375	7.95	55.38	30.02	74.57	2.425	
770	D4	24.0	0.500	0.120	0.375	8.39	55.41	30.07	100.33	3.110	
771	D4	24.0	0.500	0.120	0.375	16.91	55.96	45.37	90.49	3.609	
772	D4	24.0	0.500	0.120	0.375	16.73	56.38	45.34	83.14	3.359	
773	D4	24.0	0.500	0.120	0.375	16.54	55.73	45.99	74.30	3.114	
774	D4	24.0	0.500	0.120	0.375	16.29	55.69	46.12	67.88	2.880	
775	D4	24.0	0.500	0.120	0.375	15.92	55.90	46.03	62.44	2.686	
776	D4	24.0	0.500	0.120	0.375	15.68	55.65	45.92	54.43	2.437	
777	D4	24.0	0.500	0.120	0.375	8.64	54.96	30.13	104.20	3.110	(3)
778	D11	24.0	0.500	0.120	0.375	8.24	55.87	30.13	100.13	3.020	
779	D11	24.0	0.500	0.120	0.375	8.05	55.97	30.11	91.24	2.869	
780	D11	24.0	0.500	0.120	0.375	7.95	55.62	30.19	83.12	2.651	
781	D11	24.0	0.500	0.120	0.375	7.85	56.07	30.26	74.45	2.435	
782	D11	24.0	0.500	0.120	0.375	16.81	56.86	46.18	85.50	3.616	
783	D11	24.0	0.500	0.120	0.375	16.49	56.71	46.23	80.06	3.355	
784	D11	24.0	0.500	0.120	0.375	16.32	56.93	46.21	74.54	3.112	
785	D11	24.0	0.500	0.120	0.375	16.12	56.45	46.10	67.84	2.871	
786	D11	24.0	0.500	0.120	0.375	15.88	56.33	46.10	61.27	2.655	
787	D11	24.0	0.500	0.120	0.375	15.92	56.33	46.61	52.74	2.327	
788	D11	24.0	0.500	0.120	0.375	8.15	55.40	29.96	105.75	3.127	
789	D11	24.0	0.500	0.120	0.375	6.02	55.85	29.96	95.87	2.887	
790	D11	24.0	0.500	0.120	0.375	7.87	54.97	30.11	52.47	1.840	
791	D11	24.0	0.500	0.120	0.375	8.80	56.86	30.07	46.22	1.676	
792	D11	24.0	0.500	0.120	0.375	13.24	54.80	29.70	21.44	1.512	(2)
793	D11	24.0	0.500	0.120	0.375	8.28	55.60	30.46	103.12	3.105	
794	D11	24.0	0.500	0.120	0.375	6.23	99.94	14.24	50.29	1.523	(7)
795	D11	24.0	0.500	0.120	0.375	8.14	56.02	30.14	128.27	3.094	(4)
796	D12	24.0	0.500	0.120	0.375	8.72	56.05	30.63	99.85	3.116	
797	D12	24.0	0.500	0.120	0.375	6.38	56.07	30.60	95.42	2.878	
798	D12	24.0	0.500	0.120	0.375	8.25	56.14	30.60	86.27	2.651	
799	D12	24.0	0.500	0.120	0.375	8.14	55.90	30.57	79.45	2.437	
800	D12	24.0	0.500	0.120	0.375	8.59	56.10	30.61	103.99	3.118	
801	D12	24.0	0.500	0.120	0.375	16.82	56.01	45.95	91.33	3.627	
802	D12	24.0	0.500	0.120	0.375	16.53	56.32	45.92	84.53	3.366	
803	D12	24.0	0.500	0.120	0.375	16.29	56.53	45.91	77.83	3.128	
804	D12	24.0	0.500	0.120	0.375	16.17	56.29	45.87	70.99	2.903	
805	D12	24.0	0.500	0.120	0.375	15.86	56.39	46.08	64.60	2.646	
806	D12	24.0	0.500	0.120	0.375	15.93	55.95	46.06	57.15	2.432	
807	D12	24.0	0.500	0.120	0.375	8.72	55.71	30.21	108.79	3.121	(3)
808	D12	24.0	0.500	0.120	0.375	8.14	56.07	30.20	109.22	3.020	(3)
809	D12	24.0	0.500	0.120	0.375	16.53	50.34	29.06	13.82	1.508	(3)
810	D12	24.0	0.500	0.120	0.375	3.06	29.91	15.31	68.09	1.337	(3)
811	D12	24.0	0.500	0.120	0.375	2.94	29.34	15.06	60.59	1.190	(3)
812	D12	24.0	0.500	0.120	0.375	3.38	29.39	14.89	48.96	1.058	(3)
813	D12	24.0	0.500	0.120	0.375	8.12	55.66	30.04	110.27	3.026	(3)
814	D12	24.0	0.500	0.120	0.375	2.80	94.65	14.77	66.89	1.508	(3)
815	D12	24.0	0.500	0.120	0.375	2.60	95.40	14.41	60.53	1.368	(3)
816	D12	24.0	0.500	0.120	0.375	3.24	98.47	15.15	42.41	1.220	(3)
817	D12	24.0	0.500	0.120	0.375	8.17	55.78	30.02	117.29	3.118	(3)
818	D13	24.0	0.500	0.120	0.375	8.54	55.65	30.47	96.71	3.092	

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN		HEATER			COOLANT CHANNEL	PRESSURE	LOCAL COOLANT CONDITIONS AT BURNOUT			CRITICAL	COMMENTS
NUMBER	ID	LENGTH IN.	DIA. IN.	THICK. IN.	EQUIV. DIA. IN.	DROP PSI	PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	HEAT FLUX 10^6 BTU/HR-SQFT	
819	D13	24.0	0.500	0.120	0.375	8.30	55.44	30.53	90.05	2.871	
820	D13	24.0	0.500	0.120	0.375	8.18	54.75	30.51	83.14	2.655	
821	D13	24.0	0.500	0.120	0.375	8.00	55.28	30.49	74.70	2.435	
822	D13	24.0	0.500	0.120	0.375	16.79	56.21	46.17	85.55	3.609	
823	D13	24.0	0.500	0.120	0.375	16.57	56.20	46.08	80.71	3.366	
824	D13	24.0	0.500	0.120	0.375	16.89	56.56	46.13	74.18	3.098	
825	D13	24.0	0.500	0.120	0.375	16.15	56.73	46.11	68.78	2.887	
826	D13	24.0	0.500	0.120	0.375	15.91	56.71	45.76	62.24	2.642	
827	D13	24.0	0.500	0.120	0.375	8.45	55.87	30.21	103.73	3.110	
828	D13	24.0	0.500	0.120	0.375	8.50	55.77	30.21	104.65	3.110	
829	D13	24.0	0.500	0.120	0.375	8.25	55.29	30.46	102.02	3.092	
830	D13	24.0	0.500	0.120	0.375	2.70	54.84	15.42	96.75	2.036	
831	D13	24.0	0.500	0.120	0.375	2.63	55.18	15.33	87.79	1.843	
832	D13	24.0	0.500	0.120	0.375	2.70	55.33	15.06	79.07	1.670	
833	D13	24.0	0.500	0.120	0.375	2.78	54.66	14.97	66.29	1.505	
834	D13	24.0	0.500	0.120	0.375	2.92	55.43	14.95	58.37	1.345	
835	D13	24.0	0.500	0.120	0.375	3.51	55.48	15.16	47.47	1.204	
836	D13	24.0	0.500	0.120	0.375	8.08	54.90	29.97	108.58	3.094	(3)
837	D14	24.0	0.500	0.120	0.375	6.09	56.05	30.33	98.62	3.038	
838	D14	24.0	0.500	0.120	0.375	7.81	56.13	30.38	98.10	2.813	
839	D14	24.0	0.500	0.120	0.375	7.69	56.05	30.54	87.88	2.592	
840	D14	24.0	0.500	0.120	0.375	7.51	56.16	30.61	79.20	2.392	
841	D14	24.0	0.500	0.120	0.375	7.61	95.45	30.28	107.42	3.060	
842	D14	24.0	0.500	0.120	0.375	7.36	95.19	30.25	86.44	2.637	
843	D14	24.0	0.500	0.120	0.375	2.55	55.70	15.36	96.53	1.998	
844	D14	24.0	0.500	0.120	0.375	2.43	54.78	14.59	91.17	1.825	
845	D14	24.0	0.500	0.120	0.375	2.61	55.89	14.94	75.67	1.652	
846	D14	24.0	0.500	0.120	0.375	15.92	56.95	46.75	77.11	3.069	
847	D14	24.0	0.500	0.120	0.375	15.27	56.04	46.09	69.98	2.815	
848	D14	24.0	0.500	0.120	0.375	24.29	57.29	15.12	119.45	2.407	
849	D14	24.0	0.500	0.120	0.375	2.35	55.53	14.95	111.44	2.203	
850	D14	24.0	0.500	0.120	0.375	2.38	55.64	14.95	97.31	2.014	
851	D14	24.0	0.500	0.120	0.375	2.53	55.97	14.92	88.54	1.829	
852	D14	24.0	0.500	0.120	0.375	7.76	55.71	30.09	108.27	3.060	
853	D15	24.0	0.500	0.120	0.375	8.04	55.94	30.13	102.35	3.323	
854	D15	24.0	0.500	0.120	0.375	7.82	56.27	30.11	95.81	3.091	
855	D15	24.0	0.500	0.120	0.375	7.63	56.03	30.10	86.08	2.842	
856	D15	24.0	0.500	0.120	0.375	7.58	55.91	30.08	77.53	2.612	
857	D15	24.0	0.500	0.120	0.375	7.46	55.91	30.07	71.28	2.421	
858	D15	24.0	0.500	0.120	0.375	7.70	56.03	30.04	63.13	2.210	
859	D15	24.0	0.500	0.120	0.375	2.85	55.75	15.04	99.43	2.210	
860	D15	24.0	0.500	0.120	0.375	2.77	55.64	14.94	94.59	2.038	
861	D15	24.0	0.500	0.120	0.375	2.80	55.80	15.00	82.03	1.836	
862	D15	24.0	0.500	0.120	0.375	3.11	56.41	14.87	80.48	1.661	
863	D15	24.0	0.500	0.120	0.375	8.04	55.94	30.12	107.78	3.339	
864	D15	24.0	0.500	0.120	0.375	7.85	54.98	30.11	99.14	3.083	
865	D15	24.0	0.500	0.120	0.375	14.51	56.36	45.67	80.98	3.346	
866	D15	24.0	0.500	0.120	0.375	15.13	56.59	45.73	74.34	3.091	
867	D15	24.0	0.500	0.120	0.375	14.92	56.40	45.60	67.09	2.851	
868	D15	24.0	0.500	0.120	0.375	14.92	56.05	45.52	59.40	2.628	

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE* DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
869	D15	24.0	0.500	0.120	0.375	7.75	95.14	30.22	111.02	3.341	
870	D15	24.0	0.500	0.120	0.375	7.63	95.25	30.09	119.21	3.600	(3)
871	D15	24.0	0.500	0.120	0.375	7.44	95.00	30.12	113.38	3.355	(3)
872	D15	24.0	0.500	0.120	0.375	2.58	55.63	14.96	117.20	2.416	(3)
873	D15	24.0	0.500	0.120	0.375	2.48	55.28	14.87	109.82	2.203	(3)
874	D15	24.0	0.500	0.120	0.375	7.66	56.03	30.08	109.57	3.083	(3)
875	D15	24.0	0.500	0.120	0.375	14.46	63.41	45.07	46.89	2.210	(3)
876	D15	24.0	0.500	0.120	0.375	9.48	37.44	45.46	20.61	2.210	(3)
877	D15	24.0	0.500	0.120	0.375	25.19	56.68	30.21	36.38	1.507	(3)
878	D16	24.0	0.500	0.120	0.375	8.44	55.87	30.56	114.01	3.292	
879	D16	24.0	0.500	0.120	0.375	8.12	55.62	30.57	100.57	3.073	
880	D16	24.0	0.500	0.120	0.375	8.00	55.84	30.57	90.40	2.842	
881	D16	24.0	0.500	0.120	0.375	7.78	55.67	30.15	81.09	2.614	
882	D16	24.0	0.500	0.120	0.375	7.75	55.90	30.46	73.42	2.414	
883	D16	24.0	0.500	0.120	0.375	7.75	55.60	30.43	64.87	2.203	
884	D16	24.0	0.500	0.120	0.375	2.63	55.32	14.88	93.08	2.025	
885	D16	24.0	0.500	0.120	0.375	2.58	55.52	14.87	83.30	1.840	
886	D16	24.0	0.500	0.120	0.375	2.60	55.53	15.26	76.43	1.667	
887	D16	24.0	0.500	0.120	0.375	3.41	56.31	15.38	63.02	1.492	
888	D16	24.0	0.500	0.120	0.375	3.29	55.69	30.09	113.44	3.312	
889	D16	24.0	0.500	0.120	0.375	15.88	56.37	45.83	90.79	3.555	
890	D16	24.0	0.500	0.120	0.375	15.61	56.12	45.74	82.35	3.308	
891	D16	24.0	0.500	0.120	0.375	15.36	56.11	45.96	74.90	3.080	
892	D16	24.0	0.500	0.120	0.375	15.12	56.32	45.84	69.43	2.842	
893	D16	24.0	0.500	0.120	0.375	15.12	56.30	45.73	61.61	2.615	
894	D16	24.0	0.500	0.120	0.375	7.90	95.62	30.20	128.79	3.587	
895	D16	24.0	0.500	0.120	0.375	7.75	95.38	30.34	118.44	3.344	
896	D16	24.0	0.500	0.120	0.375	22.55	57.02	29.85	110.38	3.080	
897	D16	24.0	0.500	0.120	0.375	15.68	56.70	45.96	93.87	3.586	
898	D15	24.0	0.500	0.120	0.375	21.86	58.35	45.49	29.00	2.209	(1)
899	D16	24.0	0.500	0.120	0.375	7.51	55.58	29.99	56.43	1.832	
900	D16	24.0	0.500	0.120	0.375	8.12	55.51	29.81	47.57	1.652	
901	D16	24.0	0.500	0.120	0.375	13.03	54.79	29.58	22.09	1.487	(6)
902	D16	24.0	0.500	0.120	0.375	4.32	55.85	14.74	36.65	1.195	(1)
903	D16	24.0	0.500	0.120	0.375	14.65	56.27	45.55	64.48	2.428	(3)
904	D16	24.0	0.500	0.120	0.375	14.67	56.08	45.82	55.75	2.196	(3)
905	D16	24.0	0.500	0.120	0.375	24.32	56.67	45.56	25.60	2.014	(3)
906	D16	24.0	0.500	0.120	0.375	7.73	55.13	30.05	52.70	1.663	(3)
907	D16	24.0	0.500	0.120	0.375	8.69	55.97	29.95	45.20	1.562	(3)
908	D16	24.0	0.500	0.120	0.375	8.74	56.66	29.96	45.90	1.465	(5)
909	D16	24.0	0.500	0.120	0.375	12.76	52.70	29.32	19.73	1.337	(3)
910	D16	24.0	0.500	0.120	0.375	3.02	55.89	14.86	62.06	1.327	(3)
911	D16	24.0	0.500	0.120	0.375	3.83	55.79	14.55	46.75	1.192	(5)
912	D17	24.0	0.500	0.120	0.375	8.30	54.98	30.50	104.94	3.317	
913	D17	24.0	0.500	0.120	0.375	7.64	54.97	30.57	98.32	3.051	
914	D17	24.0	0.500	0.120	0.375	7.40	55.36	30.55	92.47	2.970	
915	D17	24.0	0.500	0.120	0.375	7.27	54.91	30.60	87.35	3.028	
916	D17	24.0	0.500	0.120	0.375	7.84	54.95	30.55	116.01	3.319	
917	D17	24.0	0.500	0.120	0.375	8.62	55.00	30.40	41.94	1.643	(1)
918	D17	24.0	0.500	0.120	0.375	13.56	54.80	30.38	20.09	1.485	(2)

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER   SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
919	D17	24.0	0.500	0.120	0.375	15.62	55.93	46.13	92.72	3.562	
920	D17	24.0	0.500	0.120	0.375	13.90	55.83	45.30	54.49	2.394	
921	D17	24.0	0.500	0.120	0.375	19.86	55.25	45.08	31.99	2.201	(2)
922	D18	24.0	0.500	0.120	0.375	8.39	57.47	30.28	92.25	3.132	
923	D18	24.0	0.500	0.120	0.375	11.04	53.44	29.56	18.99	1.370	(2)
924	D18	24.0	0.500	0.120	0.375	8.34	55.29	30.19	91.04	3.116	
925	D18	24.0	0.500	0.120	0.375	8.14	55.48	30.10	95.18	3.116	
926	D18	24.0	0.500	0.120	0.375	9.63	55.18	29.74	37.58	1.611	(1)
927	D18	24.0	0.500	0.120	0.375	15.12	51.03	29.67	14.54	1.526	(2)
928	D18	24.0	0.500	0.120	0.375	8.36	55.74	30.27	96.75	3.145	
929	D18	24.0	0.500	0.120	0.375	8.14	56.87	30.33	86.98	2.864	
930	D18	24.0	0.500	0.120	0.375	9.63	56.06	30.23	37.73	1.687	(1)
931	D18	24.0	0.500	0.120	0.375	14.14	54.27	29.97	14.89	1.534	(2)
932	D18	24.0	0.500	0.120	0.375	8.39	55.89	30.34	98.77	3.110	
933	D18	24.0	0.500	0.120	0.375	24.67	48.29	44.97	13.39	2.056	(2)
934	D18	24.0	0.500	0.120	0.375	24.67	54.25	46.07	21.01	2.263	(1)
935	D18	24.0	0.500	0.120	0.375	9.12	54.70	29.60	37.78	1.703	(1)
936	D18	24.0	0.500	0.120	0.375	16.79	50.03	29.17	8.71	1.539	(2)
937	D18	24.0	0.500	0.120	0.375	3.98	55.55	14.48	53.24	1.382	(3)
938	D19	24.0	0.500	0.120	0.375	8.25	56.91	30.34	106.45	3.395	
939	D19	24.0	0.500	0.120	0.375	8.11	55.54	30.35	96.79	3.159	
940	D19	24.0	0.500	0.120	0.375	9.62	54.91	30.00	36.70	1.699	(1)
941	D19	24.0	0.500	0.120	0.375	8.20	56.08	30.35	98.28	3.152	
942	D19	24.0	0.500	0.120	0.375	3.43	55.75	15.12	62.64	1.692	
943	D19	24.0	0.500	0.120	0.375	8.24	57.92	30.38	110.92	3.148	(3)
944	D19	24.0	0.500	0.120	0.375	7.66	98.29	29.30	55.48	2.074	(3)
945	D19	24.0	0.500	0.120	0.375	7.26	30.83	29.65	60.16	2.072	(3)
946	D19	24.0	0.500	0.120	0.375	8.64	30.65	30.13	37.33	1.872	(3)
947	D19	24.0	0.500	0.120	0.375	9.47	30.85	30.35	29.23	1.674	(3)
948	D20	24.0	0.500	0.120	0.375	7.90	56.86	30.46	116.55	3.352	
949	D20	24.0	0.500	0.120	0.375	7.70	57.29	30.46	109.85	3.100	
950	D20	24.0	0.500	0.120	0.375	7.16	29.85	30.11	71.87	2.198	
951	D20	24.0	0.500	0.120	0.375	7.02	30.14	29.80	64.57	2.009	
952	D20	24.0	0.500	0.120	0.375	7.02	30.14	29.95	54.47	1.823	
953	D20	24.0	0.500	0.120	0.375	10.60	31.06	29.64	26.80	1.654	(1)
954	D20	24.0	0.500	0.120	0.375	7.56	44.27	30.40	95.06	3.089	
955	D20	24.0	0.500	0.120	0.375	2.45	29.85	15.29	88.24	1.834	
956	D20	24.0	0.500	0.120	0.375	2.31	29.84	15.29	76.79	1.660	
957	D20	24.0	0.500	0.120	0.375	2.45	29.35	15.28	68.42	1.485	
958	D20	24.0	0.500	0.120	0.375	2.60	30.05	15.10	59.81	1.339	
959	D20	24.0	0.500	0.120	0.375	3.43	56.36	14.86	64.04	1.350	
960	D20	24.0	0.500	0.120	0.375	7.46	57.17	14.23	119.00	3.082	
961	D20	24.0	0.500	0.120	0.375	6.82	57.53	30.10	82.26	2.218	
962	D20	24.0	0.500	0.120	0.375	17.37	57.84	30.06	63.43	1.831	
963	D20	24.0	0.500	0.120	0.375	10.94	56.64	29.90	56.68	1.660	
964	D20	24.0	0.500	0.120	0.375	7.26	58.02	29.75	24.05	1.501	(2)
965	D20	24.0	0.500	0.120	0.375	6.97	33.00	29.54	22.48	1.501	(2)
966	D20	24.0	0.500	0.120	0.375	6.87	31.13	29.99	60.35	1.579	(6)
967	D21	24.0	0.500	0.120	0.375	6.39	57.15	30.48	116.28	3.316	(4)
968	D21	24.0	0.500	0.120	0.375	7.85	57.58	30.13	112.00	3.058	(4)

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	LENGTH IN.	DIA. IN.	THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6BTU/HR-SQFT	COMMENTS
969	D21	24.0	0.500	0.120	0.375	7.75	57.37	30.14	106.63	2.837	(4)
970	D21	24.0	0.500	0.120	0.375	8.10	57.40	30.14	124.00	3.310	(4)
971	D21	24.0	0.500	0.120	0.375	7.80	57.30	30.23	58.00	1.818	(4)
972	D21	24.0	0.500	0.120	0.375	7.95	56.71	30.23	49.34	1.652	(4)
973	D21	24.0	0.500	0.120	0.375	12.07	55.00	29.96	23.99	1.483	(4)
974	D21	24.0	0.500	0.120	0.375	2.65	57.58	15.16	125.96	2.196	(4)
975	D21	24.0	0.500	0.120	0.375	2.55	56.77	15.08	115.36	2.005	(4)
976	D21	24.0	0.500	0.120	0.375	2.65	56.98	15.16	105.05	1.822	(4)
977	D21	24.0	0.500	0.120	0.375	2.65	56.98	15.15	93.58	1.638	(4)
978	D21	24.0	0.500	0.120	0.375	3.43	58.46	14.87	81.29	1.480	(4)
979	D21	24.0	0.500	0.120	0.375	3.78	58.35	15.25	69.61	1.334	(4)
980	D21	24.0	0.500	0.120	0.375	7.85	57.43	30.11	121.16	3.060	(4)
981	D21	24.0	0.500	0.120	0.375	14.87	57.99	45.71	63.79	2.390	(4)
982	D21	24.0	0.500	0.120	0.375	14.87	57.99	45.83	56.50	2.194	(4)
983	D21	24.0	0.500	0.120	0.375	14.87	57.25	45.81	49.52	2.007	(4)
984	D21	24.0	0.500	0.120	0.375	14.87	57.06	45.53	30.83	1.449	(4)
985	D21	24.0	0.500	0.120	0.375	19.88	81.35	45.46	51.57	1.822	(4)
986	D21	24.0	0.500	0.120	0.375	3.29	57.52	15.03	85.73	1.485	(4)
987	D21	24.0	0.500	0.120	0.375	3.34	58.14	14.94	73.80	1.328	(4)
988	D21	24.0	0.500	0.120	0.375	3.93	56.28	14.85	60.12	1.181	(4)
989	D21	24.0	0.500	0.120	0.375	3.19	30.25	14.85	81.45	1.480	(4)
990	D21	24.0	0.500	0.120	0.375	3.43	27.40	14.84	66.22	1.318	(4)
991	D21	24.0	0.500	0.120	0.375	3.29	31.12	14.89	65.56	1.179	(4)
992	D21	24.0	0.500	0.120	0.375	7.90	57.54	30.18	129.69	3.060	(4)
993	D21	24.0	0.500	0.120	0.375	7.36	57.68	30.13	66.58	1.814	(4)
994	D21	24.0	0.500	0.120	0.375	7.41	57.46	30.11	59.78	1.647	(4)
995	D21	24.0	0.500	0.120	0.375	15.31	49.28	29.95	16.34	1.483	(4)
996	D21	24.0	0.500	0.120	0.375	2.60	30.00	15.14	94.57	1.472	(4)
997	D21	24.0	0.500	0.120	0.375	2.90	30.42	15.13	83.27	1.319	(4)
998	D21	24.0	0.500	0.120	0.375	3.04	30.26	14.97	71.99	1.174	(4)
999	D21	24.0	0.500	0.120	0.375	7.85	57.56	29.97	142.18	3.044	(4)
1	D22	24.0	0.500	0.120	0.375	7.85	57.74	30.56	99.29	3.060	
2	D22	24.0	0.500	0.120	0.375	7.71	57.43	30.49	90.49	2.840	
3	D22	24.0	0.500	0.120	0.375	16.93	56.06	45.60	37.31	2.412	(1)
4	D22	24.0	0.500	0.120	0.375	14.48	57.91	45.59	58.27	2.614	
5	D22	24.0	0.500	0.120	0.375	7.70	57.26	30.18	102.49	3.071	
6	D22	24.0	0.500	0.120	0.375	8.83	55.75	30.16	46.22	1.822	
7	D22	24.0	0.500	0.120	0.375	9.72	56.21	29.99	37.49	1.652	(1)
8	D22	24.0	0.500	0.120	0.375	12.37	52.71	30.02	18.49	1.494	(2)
9	D22	24.0	0.500	0.120	0.375	7.80	57.26	30.34	103.01	3.067	
10	D22	24.0	0.500	0.120	0.375	2.35	57.04	15.26	105.34	2.207	
11	D22	24.0	0.500	0.120	0.375	2.80	57.50	14.92	76.97	2.020	
12	D22	24.0	0.500	0.120	0.375	3.93	59.23	14.64	62.05	1.485	
13	D23	24.0	0.500	0.120	0.375	8.10	57.92	30.04	96.30	3.087	
14	D23	24.0	0.500	0.120	0.375	17.30	58.33	30.11	90.50	2.860	
15	D23	24.0	0.500	0.120	0.375	7.51	57.41	29.93	47.99	1.832	
16	D23	24.0	0.500	0.120	0.375	8.44	56.87	29.92	36.94	1.665	(1)
17	D23	24.0	0.500	0.120	0.375	35.56	59.10	45.60	42.25	2.421	(1)
18	D23	24.0	0.500	0.120	0.375	7.90	57.23	30.04	98.21	3.083	
19	D23	24.0	0.500	0.120	0.375	2.65	57.83	14.97	99.72	2.216	

TABLE B-1 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	HEATER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
20	D23	24.0	0.500	0.120	0.375	2.70	58.58	14.73	73.30	1.656	
21	D23	24.0	0.500	0.120	0.375	15.85	58.07	45.58	80.57	3.353	
22	D23	24.0	0.500	0.120	0.375	15.41	57.94	45.54	65.70	2.862	
23	D23	24.0	0.500	0.120	0.375	15.16	58.02	45.60	58.54	2.632	
24	D23	24.0	0.500	0.120	0.375	15.95	57.18	45.13	46.40	2.414	(5)
25	D23	24.0	0.500	0.120	0.375	16.98	58.34	45.10	34.56	2.209	(1)
26	D23	24.0	0.500	0.120	0.375	7.71	54.93	30.15	48.04	1.832	
27	D23	24.0	0.500	0.120	0.375	8.44	57.57	30.23	40.41	1.665	(1)
28	D23	24.0	0.500	0.120	0.375	10.56	55.66	30.08	22.03	1.494	(5)
29	D23	24.0	0.500	0.120	0.375	2.61	57.58	15.02	72.95	1.660	
30	D23	24.0	0.500	0.120	0.375	2.61	57.62	14.72	66.55	1.494	
31	D23	24.0	0.500	0.120	0.375	8.25	57.33	30.26	104.54	3.096	(3)

TABLE B-2
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER COLUMBIA UNIVERSITY

RUN NUMBER	ID	HEATER LENGTH IN.	DIA. IN.	THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
213	S	24.0	0.750	0.020	0.308	12.00	64.70	30.16	98.28	2.295	(4)
139	R	24.0	2.125	0.0	0.332	11.00	64.70	30.01	136.80	3.020	(4)
140	R	24.0	2.125	0.0	0.332	11.50	64.70	30.06	135.00	3.182	(4)
141	R	24.0	2.125	0.0	0.332	11.50	64.70	29.90	82.80	2.464	(4)
142	S	24.0	2.125	0.0	0.332	11.30	64.70	30.01	138.60	3.251	(4)
143	S	24.0	2.125	0.0	0.332	10.50	64.70	30.01	91.80	2.412	(4)
144	S	24.0	2.125	0.0	0.332	11.50	64.70	30.01	135.00	3.128	(4)
145	S	24.0	2.125	0.0	0.332	12.00	64.70	30.01	79.20	2.077	(4)
146	S	24.0	2.125	0.0	0.332	11.50	64.70	30.01	79.20	2.083	(4)
147	S	24.0	2.125	0.0	0.332	10.50	64.70	29.85	140.40	2.803	(4)
148	S	24.0	2.125	0.0	0.332	10.80	64.70	29.90	144.00	2.779	(4)
149	T	24.0	2.125	0.0	0.332	12.50	64.70	30.01	135.00	3.616	
150	T	24.0	2.125	0.0	0.332	11.50	64.70	30.01	82.80	2.416	
151	T	24.0	2.125	0.0	0.332	12.50	64.70	30.01	138.60	3.605	
152	T	24.0	2.125	0.0	0.332	12.00	64.70	30.01	82.80	2.417	
153	T	24.0	2.125	0.0	0.332	23.50	64.70	44.99	79.20	3.112	
154	T	24.0	2.125	0.0	0.332	24.00	64.70	44.99	81.00	3.155	
155	T	24.0	2.125	0.0	0.332	12.30	64.70	30.01	135.00	3.773	
156	T	24.0	2.125	0.0	0.332	13.50	64.70	30.01	54.00	1.787	
157	T	24.0	2.125	0.0	0.332	25.30	64.70	44.40	59.40	2.605	
158	T	24.0	2.125	0.0	0.332	15.50	64.70	14.82	82.80	1.728	
159	T	24.0	2.125	0.0	0.332	16.00	64.70	15.09	48.60	1.336	
160	T	24.0	2.125	0.0	0.332	15.00	64.70	15.03	81.00	1.759	
161	T	24.0	2.125	0.0	0.332	16.00	64.70	15.00	54.00	1.480	
162	T	24.0	2.125	0.0	0.332	14.50	64.70	30.01	54.00	1.883	
163	T	24.0	2.125	0.0	0.332	25.50	64.70	44.99	55.80	2.421	
164	T	24.0	2.125	0.0	0.332	26.00	64.70	44.99	52.20	2.380	
165	T	24.0	2.125	0.0	0.332	12.00	64.70	30.01	138.60	3.724	
166	T	24.0	2.125	0.0	0.332	23.00	64.70	44.45	108.00	3.814	
167	T	24.0	2.125	0.0	0.332	24.00	64.70	44.99	111.60	3.931	
168	T	24.0	2.125	0.0	0.332	24.00	64.70	14.95	135.00	2.362	
169	T	24.0	2.125	0.0	0.332	24.70	64.70	14.82	124.20	2.216	(3)
170	T	24.0	2.125	0.0	0.332	5.50	64.70	15.00	135.00	2.372	(3)
171	T	24.0	2.125	0.0	0.332	11.50	64.70	29.90	135.00	3.389	(3)
173	V	24.0	2.125	0.0	0.332	7.50	64.70	14.58	41.40	1.390	(1)
174	V	24.0	2.125	0.0	0.332	7.00	64.70	14.56	61.20	1.852	
175	V	24.0	2.125	0.0	0.332	4.00	64.70	14.56	82.80	2.029	
176	W	24.0	2.125	0.0	0.332	11.50	64.70	29.14	136.80	3.073	(4)
177	W	24.0	2.125	0.0	0.332	11.50	64.70	29.27	136.80	3.143	(4)
178	W	24.0	2.125	0.0	0.332	11.50	64.70	29.38	90.00	2.718	(4)
179	W	24.0	2.125	0.0	0.332	12.00	64.70	29.17	142.20	3.400	(4)
180	W	24.0	2.125	0.0	0.332	11.00	64.70	29.27	84.60	1.892	(4)
181	W	24.0	2.125	0.0	0.332	10.50	64.70	29.22	90.00	1.852	(4)
224	W	24.0	0.750	0.0	0.308	18.50	64.70	30.08	108.18	3.062	
225	X	24.0	0.750	0.0	0.308	37.50	64.70	45.46	111.96	3.652	
226	X	24.0	0.750	0.0	0.308	38.50	64.70	45.46	108.18	3.665	
227	X	24.0	0.750	0.0	0.308	6.50	64.70	15.52	106.56	2.311	
228	X	24.0	0.750	0.0	0.308	6.00	64.70	14.86	106.20	2.333	
229	X	24.0	0.750	0.0	0.308	18.50	64.70	30.16	104.94	3.069	
230	X	24.0	0.750	0.0	0.308	0.0	64.70	30.16	90.00	2.362	

TABLE B-2 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER COLUMBIA UNIVERSITY

RUN		HEATER			COOLANT CHANNEL	PRESSURE	LOCAL COOLANT CONDITIONS AT BURNOUT			CRITICAL	COMMENTS
NUMBER	ID	LENGTH IN.	DIA. IN.	THICK. IN.	EQUIV. DIA. IN.	DROP PSI	PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	HEAT FLUX 10^6BTU/HR-SQFT	
231	Y	24.0	0.750	0.0	0.308	14.00	64.70	30.08	84.96	2.248	
232	Y	24.0	0.750	0.0	0.308	15.50	64.70	15.08	79.92	2.007	
233	Z	24.0	0.750	0.0	0.308	15.00	64.70	30.23	96.48	2.009	(6)
234	Z	24.0	0.750	0.0	0.308	16.00	64.70	30.23	86.40	2.304	
235	Z	24.0	0.750	0.0	0.308	31.00	64.70	44.42	110.88	2.509	(6)
236	Z	24.0	0.750	0.0	0.308	31.00	64.70	44.42	81.72	3.413	
237	Z	24.0	0.750	0.0	0.308	31.50	64.70	45.46	80.64	3.382	
238	Z	24.0	0.750	0.0	0.308	14.50	64.70	30.08	80.64	2.650	
239	Z	24.0	0.750	0.0	0.308	14.80	64.70	15.52	80.64	1.888	
240	Z	24.0	0.750	0.0	0.308	15.30	64.70	15.37	53.64	1.490	
241	Z	24.0	0.750	0.0	0.308	17.00	64.70	30.30	46.98	1.818	

TABLE B-3
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER   SAVANNAH RIVER LABORATORY

RUN	HEATER			COOLANT CHANNEL	PRESSURE	LOCAL COOLANT CONDITIONS AT BURNOUT			CRITICAL	COMMENTS
NUMBER ID	LENGTH IN.	DIA. IN.	THICK. IN.	EQUIV. DIA. IN.	DROP PSI	PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	HEAT FLUX 10^6BTU/HR-SQFT	
10	0.0	2.050	0.0	0.440	4.31	55.62	27.46	73.51	2.142	
11	0.0	2.050	0.0	0.440	3.96	55.25	27.22	75.38	2.146	
12	0.0	2.050	0.0	0.440	3.94	54.37	27.23	90.38	2.464	
13	0.0	2.050	0.0	0.440	4.08	54.37	27.12	77.00	2.146	
14	0.0	2.050	0.0	0.440	4.87	57.00	26.44	62.32	1.849	
15	0.0	2.050	0.0	0.440	8.51	56.63	27.06	40.14	1.462	(1)
16	0.0	2.050	0.0	0.440	8.31	52.75	32.73	106.92	2.993	
17	0.0	2.050	0.0	0.440	6.57	57.00	33.97	65.09	1.976	
18	0.0	2.050	0.0	0.440	5.68	52.87	34.02	77.49	2.290	
19	0.0	2.050	0.0	0.440	5.56	53.00	34.04	92.41	2.797	
20	0.0	2.050	0.0	0.440	7.45	52.75	34.05	110.00	2.965	
33	0.0	2.050	0.0	0.440	6.64	54.50	33.84	62.84	2.155	
35	0.0	2.050	0.0	0.440	7.55	56.50	32.11	75.91	2.605	
36	0.0	2.050	0.0	0.440	7.33	53.50	31.62	93.55	3.098	
37	0.0	2.050	0.0	0.440	7.16	54.00	31.47	97.60	3.188	
38	0.0	2.050	0.0	0.440	8.09	54.75	33.50	62.48	2.383	
39	0.0	2.050	0.0	0.440	9.08	54.13	33.41	50.29	2.169	
40	0.0	2.050	0.0	0.440	19.43	46.75	30.88	13.93	1.966	(1)
41	0.0	2.050	0.0	0.440	7.58	52.25	32.47	102.49	3.377	
42	0.0	2.050	0.0	0.440	24.60	56.00	42.65	16.22	2.383	(1)
44	0.0	2.050	0.0	0.440	14.96	54.75	46.71	56.66	2.621	
45	0.0	2.050	0.0	0.440	16.29	55.50	46.67	61.40	3.119	
46	0.0	2.050	0.0	0.440	16.38	53.25	46.73	77.92	3.667	
47	0.0	2.050	0.0	0.440	16.29	53.50	46.53	80.77	3.798	
48	0.0	2.050	0.0	0.440	17.78	56.00	46.43	44.82	2.633	(1)
49	0.0	2.050	0.0	0.440	17.79	57.12	46.67	51.70	2.378	
50	0.0	2.050	0.0	0.440	18.57	57.88	39.56	31.99	2.185	(1)
51	0.0	2.050	0.0	0.440	8.66	57.62	32.10	68.65	2.630	
52	0.0	2.050	0.0	0.440	8.66	54.50	32.11	86.24	3.116	
53	0.0	2.050	0.0	0.440	2.41	53.25	16.65	124.29	2.660	
54	0.0	2.050	0.0	0.440	3.08	51.25	17.99	75.60	1.946	
55	0.0	2.050	0.0	0.440	3.81	54.13	17.01	51.62	3.355	
56	0.0	2.050	0.0	0.440	5.34	50.12	16.12	27.56	1.402	(1)
57	0.0	2.050	0.0	0.440	5.78	54.13	16.87	24.61	1.314	(1)
58	0.0	2.050	0.0	0.440	3.30	53.25	17.71	66.83	1.957	
59	0.0	2.050	0.0	0.440	2.83	54.25	17.73	89.15	2.153	
60	0.0	2.050	0.0	0.440	8.86	55.62	33.49	55.55	2.362	
61	0.0	2.050	0.0	0.440	6.84	55.00	33.88	81.90	2.848	
62	0.0	2.050	0.0	0.440	6.42	55.12	34.09	104.27	3.379	
63	0.0	2.050	0.0	0.440	7.16	55.25	31.73	74.61	2.603	
64	0.0	2.050	0.0	0.440	6.69	56.63	31.90	75.80	2.601	
65	0.0	2.050	0.0	0.440	7.11	68.50	31.32	71.23	2.592	
66	0.0	2.050	0.0	0.440	7.26	52.87	32.17	72.58	2.581	
67	0.0	2.050	0.0	0.440	7.31	52.25	31.80	70.96	2.597	
68	0.0	2.050	0.0	0.440	7.16	53.75	31.26	74.32	2.662	
69	0.0	2.050	0.0	0.440	2.56	48.12	15.55	70.67	1.760	
70	0.0	2.050	0.0	0.440	3.27	55.50	16.41	63.04	1.746	
71	0.0	2.050	0.0	0.440	3.05	53.50	16.26	66.47	1.807	
72	0.0	2.050	0.0	0.440	3.22	54.75	16.11	65.47	1.784	
73	0.0	2.050	0.0	0.440	2.41	53.50	15.15	75.37	1.804	

TABLE B-3 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN		HEATER			COOLANT CHANNEL	PRESSURE	LOCAL COOLANT CONDITIONS AT BURNOUT			CRITICAL	COMMENTS
NUMBER	ID	LENGTH IN.	DIA. IN.	THICK. IN.	EQUIV. DIA. IN.	DROP PSI	PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	HEAT FLUX 10^6BTU/HR-SQFT	
74		0.0	2.050	0.0	0.440	2.66	56.12	16.18	72.29	1.818	
75		0.0	2.050	0.0	0.440	2.66	55.87	16.30	78.05	1.946	
76		0.0	2.050	0.0	0.440	2.46	54.37	16.49	93.58	2.191	
77		0.0	2.050	0.0	0.440	2.29	54.13	16.57	106.18	2.414	
78		0.0	2.050	0.0	0.440	2.29	53.50	16.42	119.70	2.644	
79		0.0	2.050	0.0	0.440	2.31	53.50	16.41	115.67	2.599	
80		0.0	2.050	0.0	0.440	2.66	56.63	15.91	70.69	1.766	
112		0.0	2.050	0.0	0.440	6.99	50.50	36.63	112.61	3.359	
113		0.0	2.050	0.0	0.440	7.31	54.13	29.74	95.31	2.713	
114		0.0	2.050	0.0	0.440	7.36	52.25	29.67	96.52	2.804	
115		0.0	2.050	0.0	0.440	7.77	54.37	29.30	69.52	2.266	
116		0.0	2.050	0.0	0.440	8.29	56.50	29.63	67.45	2.086	
117		0.0	2.050	0.0	0.440	7.58	49.87	27.09	104.92	2.970	
118		0.0	2.050	0.0	0.440	5.90	57.88	13.92	18.04	1.224	(1)
119		0.0	2.050	0.0	0.440	3.57	50.50	14.83	70.94	1.629	
128		0.0	2.050	0.0	0.440	7.33	54.13	28.93	49.14	1.897	
140		0.0	2.050	0.0	0.440	2.83	52.95	16.30	77.35	1.798	
141		0.0	2.050	0.0	0.440	2.53	53.86	16.25	96.39	2.200	
142		0.0	2.050	0.0	0.440	2.31	53.10	16.46	129.31	2.673	
143		0.0	2.050	0.0	0.440	2.53	53.87	16.33	104.18	2.214	
144		0.0	2.050	0.0	0.440	8.86	53.50	32.26	46.24	1.996	
145		0.0	2.050	0.0	0.440	6.72	52.87	31.50	81.20	2.687	
147		0.0	2.050	0.0	0.440	6.47	53.37	30.97	81.81	2.646	
148		0.0	2.050	0.0	0.440	14.15	52.87	46.53	55.01	2.635	
149		0.0	2.050	0.0	0.440	14.10	53.41	46.00	60.10	2.669	
150		0.0	2.050	0.0	0.440	14.22	53.75	46.21	74.99	3.181	
151		0.0	2.050	0.0	0.440	14.19	53.95	46.37	79.94	3.280	
152		0.0	2.050	0.0	0.440	13.92	54.16	46.39	92.45	3.679	
153		0.0	2.050	0.0	0.440	14.27	54.46	46.58	73.94	3.159	
154		0.0	2.050	0.0	0.440	9.89	55.63	30.32	55.19	2.005	
155		0.0	2.050	0.0	0.440	7.70	53.36	30.69	77.99	2.659	
156		0.0	2.050	0.0	0.440	7.60	53.36	31.16	108.94	3.438	
157		0.0	2.050	0.0	0.440	7.65	53.58	30.98	79.13	2.682	
158		0.0	2.050	0.0	0.440	3.27	53.16	15.41	66.96	1.807	
159		0.0	2.050	0.0	0.440	2.88	54.31	15.73	90.54	2.185	
160		0.0	2.050	0.0	0.440	2.61	51.11	15.79	119.45	2.633	
161		0.0	2.050	0.0	0.440	2.76	53.00	15.72	95.94	2.214	
162		0.0	2.050	0.0	0.440	2.71	52.95	15.95	108.41	2.473	
163		0.0	2.050	0.0	0.440	4.23	54.49	15.40	56.57	1.584	
167		0.0	2.050	0.0	0.440	14.51	52.72	45.34	79.29	3.247	
168		0.0	2.050	0.0	0.440	14.44	54.55	45.35	83.29	3.337	
169		0.0	2.050	0.0	0.440	18.23	54.13	43.83	40.05	2.083	(1)
170		0.0	2.050	0.0	0.440	19.02	53.37	41.58	44.68	2.232	(1)
171		0.0	2.050	0.0	0.440	21.00	58.71	43.73	47.23	2.389	
172		0.0	2.050	0.0	0.440	18.30	53.14	44.84	50.04	2.592	
173		0.0	2.050	0.0	0.440	15.99	53.50	29.06	16.38	1.634	(1)
174		0.0	2.050	0.0	0.440	11.51	56.98	29.93	52.49	2.014	
175		0.0	2.050	0.0	0.440	6.74	57.25	15.50	18.16	1.294	(1)
176		0.0	2.050	0.0	0.440	4.92	52.62	15.58	42.55	1.442	(1)
177		0.0	2.050	0.0	0.440	4.38	53.30	15.54	52.60	1.559	

TABLE B-3 (CONTINUED)
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -LIGHT WATER SAVANNAH RIVER LABORATORY

RUN NUMBER	ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
178		0.0	2.050	0.0	0.440	4.67	54.27	15.56	60.68	1.616	

TABLE B-4
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -HEAVY WATER SAVANNAH RIVER LABORATORY

RUN		HEATER			COOLANT CHANNEL	PRESSURE	LOCAL COOLANT CONDITIONS AT BURNOUT			CRITICAL	COMMENTS
NUMBER	ID	LENGTH IN.	DIA. IN.	THICK. IN.	EQUIV. DIA. IN.	DROP PSI	PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	HEAT FLUX 10^6BTU/HR-SQFT	
1		24.0	0.500	0.120	0.375	9.63	55.62	31.60	130.50	5.166	
2		24.0	0.500	0.120	0.375	9.66	55.57	31.74	138.28	5.202	
3		24.0	0.500	0.120	0.375	9.12	56.64	31.33	125.26	4.770	
4		24.0	0.500	0.120	0.375	9.68	54.53	31.08	160.96	6.102	
5		24.0	0.500	0.120	0.375	9.12	55.60	31.95	113.63	4.392	
6		24.0	0.500	0.120	0.375	9.61	54.16	30.80	177.32	6.102	
7		24.0	0.500	0.120	0.375	9.22	54.34	30.98	158.40	5.616	
8		24.0	0.500	0.120	0.375	9.27	54.93	31.18	140.54	5.220	
9		24.0	0.500	0.120	0.375	18.26	55.60	46.91	116.48	5.868	
10		24.0	0.500	0.120	0.375	9.44	54.24	30.80	156.40	5.634	
11		24.0	0.500	0.120	0.375	9.63	54.59	30.27	177.46	6.480	
12		24.0	0.500	0.120	0.375	9.76	54.39	30.58	156.24	6.030	
13		24.0	0.500	0.120	0.375	9.46	54.00	30.71	144.70	5.634	
14		24.0	0.500	0.120	0.375	9.39	54.34	30.87	134.75	5.166	
15		24.0	0.500	0.120	0.375	9.12	57.63	30.61	127.73	4.824	
16		24.0	0.500	0.120	0.375	19.12	56.72	47.55	126.13	6.300	
17		24.0	0.500	0.120	0.375	17.28	57.27	45.58	113.60	5.652	
18		24.0	0.500	0.120	0.375	3.01	54.07	15.52	194.40	4.410	(3)
19		24.0	0.500	0.120	0.375	3.03	54.44	15.18	179.08	4.068	(3)
20		24.0	0.500	0.120	0.375	3.25	55.06	15.66	159.41	3.834	(3)
21		24.0	0.500	0.120	0.375	3.01	55.49	15.64	148.91	3.420	(3)
22		24.0	0.500	0.120	0.375	9.12	55.01	30.17	161.15	5.724	(3)
23		24.0	0.500	0.120	0.375	10.00	55.61	31.31	156.94	6.048	
24		24.0	0.500	0.120	0.375	3.06	55.54	15.42	168.52	4.374	
25		24.0	0.500	0.120	0.375	3.08	54.56	15.41	193.52	4.752	
26		24.0	0.500	0.120	0.375	3.10	55.95	15.16	162.61	4.050	
27		24.0	0.500	0.120	0.375	10.00	55.47	30.88	146.86	5.580	
28		24.0	0.500	0.120	0.375	18.43	55.07	46.36	128.05	6.264	
29		24.0	0.500	0.120	0.375	17.25	58.55	45.06	113.00	5.598	
30		24.0	0.500	0.120	0.375	3.18	54.67	15.50	196.58	4.788	
31		24.0	0.500	0.120	0.375	9.56	55.27	30.81	141.07	5.580	
32		24.0	0.500	0.120	0.375	2.86	55.46	15.02	192.10	4.788	
33		24.0	0.500	0.120	0.375	2.96	55.48	15.49	177.84	4.410	
34		24.0	0.500	0.120	0.375	2.79	54.88	15.39	165.37	4.086	
35		24.0	0.500	0.120	0.375	9.22	55.10	30.62	152.15	5.634	
36		24.0	0.500	0.120	0.375	9.41	54.92	30.81	147.26	5.634	
37		24.0	0.500	0.120	0.375	17.89	55.41	45.30	124.51	6.390	
38		24.0	0.500	0.120	0.375	17.45	59.54	45.41	107.82	5.598	
39		24.0	0.500	0.120	0.375	9.22	54.91	30.65	142.79	5.634	
40		24.0	0.500	0.120	0.375	18.48	56.72	46.26	136.89	7.038	
41		24.0	0.500	0.120	0.375	17.35	56.86	45.34	107.41	5.742	
43		24.0	0.500	0.120	0.375	3.37	54.79	15.58	191,12	4.860	
44		24.0	0.500	0.120	0.375	10.79	54.66	30.37	105.53	2.826	(2)
45		24.0	0.500	0.120	0.375	8.50	54.49	30.42	54.85	2.844	(2)
46		24.0	0.500	0.120	0.375	20.85	55.43	45.00	57.83	3.762	(2)

TABLE B-5
CRITICAL HEAT FLUX DATA
STAINLESS STEEL -HEAVY WATER COLUMBIA UNIVERSITY

RUN NUMBER	ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	LOCAL COOLANT CONDITIONS AT BURNOUT VELOCITY FT/SEC	LOCAL COOLANT CONDITIONS AT BURNOUT SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
14		24.0	0.750	0.018	0.308	17.20	64.70	30.15	104.22	3.438	
121		24.0	0.750	0.018	0.308	20.50	65.20	29.91	104.22	3.658	(2)
123		24.0	0.750	0.018	0.308	20.10	64.20	29.93	90.00	2.979	(2)
125		24.0	0.750	0.018	0.308	6.60	64.70	14.90	108.00	2.594	(2)
126		24.0	0.750	0.018	0.308	6.60	66.20	15.00	88.56	2.236	(2)
127		24.0	0.750	0.018	0.308	6.40	65.70	15.01	70.56	1.863	(2)
141		24.0	0.750	0.018	0.308	30.30	65.40	45.00	55.62	2.785	
161		24.0	0.750	0.018	0.308	31.50	64.70	44.97	77.58	3.276	
171		24.0	0.750	0.018	0.308	28.60	64.70	44.78	99.36	3.852	
191		24.0	0.750	0.018	0.308	16.90	64.70	29.93	90.90	3.031	
211		24.0	0.750	0.018	0.308	39.50	65.20	44.76	141.30	6.457	
281		24.0	0.750	0.018	0.308	17.40	65.00	29.97	124.20	4.054	
124		24.0	0.750	0.018	0.308	20.10	64.70	30.11	72.36	2.614	(2)

TABLE B-6
CRITICAL HEAT FLUX DATA
ALUMINUM -LIGHT WATER COLUMBIA UNIVERSITY

RUN NUMBER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
184	24.0	0.750	0.035	0.308	6.00	64.70	15.23	70.20	1.998	
185	24.0	0.750	0.035	0.308	7.00	64.70	15.00	30.60	1.350	(1)
186	24.0	0.750	0.035	0.308	21.00	64.70	30.53	25.20	1.634	(1)
187	24.0	1.000	0.020	0.323	13.00	64.70	30.38	52.20	1.588	(4)
188	24.0	1.000	0.020	0.323	17.00	64.70	30.60	52.20	2.250	
189	24.0	1.000	0.020	0.323	15.00	64.70	30.60	88.20	2.905	(4)
190	24.0	1.000	0.020	0.323	5.00	64.70	14.81	83.70	2.077	(6)
191	24.0	1.000	0.020	0.323	4.00	64.70	14.91	106.20	2.846	
192	24.0	1.000	0.020	0.323	16.00	64.70	29.33	68.40	2.648	
193	24.0	1.000	0.020	0.323	29.50	64.70	45.35	63.00	2.889	(4)
195	24.0	1.000	0.020	0.323	16.00	64.70	30.16	88.20	3.341	
196	24.0	0.750	0.020	0.308	18.00	64.70	30.82	111.60	3.625	(6)
197	24.0	0.750	0.020	0.308	17.00	64.70	30.01	108.00	3.929	
198	24.0	0.750	0.020	0.308	7.00	64.70	15.00	118.80	3.157	
199	24.0	0.750	0.020	0.308	8.00	64.70	15.00	108.00	2.830	
200	24.0	0.750	0.028	0.308	34.00	64.70	45.31	41.40	3.071	(1)
201	24.0	0.750	0.028	0.308	40.00	64.70	45.31	77.40	3.411	(6)
202	24.0	0.750	0.020	0.308	19.00	64.70	30.16	109.80	3.888	
203	24.0	0.750	0.020	0.308	15.50	64.70	14.86	108.18	2.563	(4)
204	24.0	0.750	0.028	0.308	16.20	64.70	30.23	90.54	3.672	
205	24.0	0.750	0.020	0.308	16.50	64.70	14.86	87.30	2.151	
206	24.0	0.750	0.020	0.308	37.00	64.70	44.64	36.36	2.223	(1)
207	24.0	0.750	0.020	0.308	36.00	64.70	44.79	62.64	2.857	(6)
208	24.0	0.750	0.020	0.308	35.40	64.70	44.94	77.22	3.472	(6)
209	24.0	0.750	0.020	0.308	36.00	64.70	44.94	91.26	4.046	(6)
210	24.0	0.750	0.020	0.308	37.00	64.70	44.87	60.48	3.362	
211	24.0	0.750	0.020	0.308	38.00	64.70	44.94	45.38	2.873	
212	24.0	0.750	0.020	0.308	36.00	64.70	44.94	114.30	4.448	(3)
214	24.0	1.000	0.020	0.323	13.70	64.70	29.77	87.30	2.801	(4)
215	24.0	1.000	0.020	0.323	13.30	64.70	29.99	83.88	2.848	(4)
216	24.0	0.750	0.035	0.308	16.00	64.70	30.08	109.80	3.798	(6)
217	24.0	0.750	0.035	0.308	16.00	64.70	30.08	90.54	3.281	
218	24.0	0.750	0.035	0.308	15.50	64.70	30.23	80.64	3.033	
219	24.0	0.750	0.035	0.308	15.80	64.70	15.30	82.98	2.299	
220	24.0	0.750	0.035	0.308	15.20	64.70	15.00	98.64	2.594	
221	24.0	0.750	0.035	0.308	33.20	64.70	45.24	77.58	3.645	(6)
222	24.0	0.750	0.035	0.308	38.50	66.50	45.24	34.56	2.687	(1)
223	24.0	0.750	0.035	0.308	14.50	64.70	30.30	104.94	4.108	
242	24.0	0.750	0.035	0.308	4.50	64.70	15.30	109.98	2.299	(6)
243	24.0	0.750	0.035	0.308	5.00	64.70	15.08	71.64	2.241	
244	24.0	0.750	0.035	0.308	4.50	64.70	15.30	110.18	2.907	
245	24.0	0.750	0.035	0.308	4.50	64.70	15.30	110.88	3.146	
246	24.0	0.750	0.035	0.308	6.00	64.70	15.08	45.36	1.586	
247	24.0	0.750	0.035	0.308	6.00	64.70	15.00	45.36	1.656	
248	24.0	0.750	0.035	0.308	5.00	64.70	15.08	90.54	2.691	
249	24.0	0.750	0.035	0.308	6.00	64.70	15.00	62.64	2.119	
250	24.0	0.750	0.035	0.308	5.50	64.70	15.08	113.40	3.366	
252	24.0	0.750	0.028	0.308	49.00	64.70	60.31	89.64	4.304	(6)
253	24.0	0.750	0.028	0.308	48.50	64.70	59.35	71.64	3.836	(6)
254	24.0	0.750	0.028	0.308	50.00	64.70	44.55	73.44	3.733	

TABLE B-6 (CONTINUED)
CRITICAL HEAT FLUX DATA
ALUMINUM -LIGHT WATER COLUMBIA UNIVERSITY

RUN NUMBER ID	HEATER LENGTH IN.	DIA. IN.	THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
255	24.0	0.750	0.035	0.308	29.00	64.70	44.87	89.64	4.325	
256	24.0	0.750	0.035	0.308	29.50	64.70	44.72	70.74	3.814	
257	24.0	0.750	0.035	0.308	30.30	64.70	44.64	59.76	3.406	
258	24.0	0.750	0.028	0.308	14.00	64.70	29.86	73.08	3.157	
259	24.0	0.750	0.028	0.308	31.00	64.70	44.79	89.64	4.556	
260	24.0	0.750	0.028	0.308	33.00	64.70	44.42	56.52	3.366	
261	24.0	0.750	0.035	0.308	4.50	64.70	15.96	53.64	1.496	
262	24.0	0.750	0.028	0.308	5.00	64.70	14.95	78.84	2.074	
263	24.0	0.750	0.028	0.308	5.00	64.70	15.10	53.64	1.514	
264	24.0	0.750	0.028	0.308	4.80	64.70	15.03	106.20	2.570	(6)
265	24.0	0.750	0.028	0.308	14.00	64.70	30.05	53.64	2.119	
266	24.0	0.750	0.020	0.308	15.00	64.70	15.10	110.88	2.461	(4)
267	24.0	0.750	0.035	0.308	14.50	64.70	15.03	78.84	2.054	
268	24.0	0.750	0.035	0.308	14.50	64.70	14.95	107.64	2.637	
269	24.0	0.750	0.020	0.308	14.50	64.70	15.10	80.64	2.047	
270	24.0	0.750	0.020	0.308	14.50	64.70	15.03	53.64	1.505	
271	24.0	0.750	0.020	0.308	13.00	64.70	29.97	80.64	2.916	(6)
272	24.0	0.750	0.020	0.308	12.50	64.70	29.89	54.18	2.142	
273	24.0	0.750	0.200	0.308	30.00	64.70	30.28	109.08	3.739	(6)
274	24.0	0.750	0.020	0.308	27.50	64.70	44.99	80.64	3.929	
275	24.0	0.750	0.020	0.308	28.00	64.70	44.84	54.54	2.736	
276	24.0	0.750	0.020	0.308	4.50	64.70	15.18	108.18	2.628	
277	24.0	0.750	0.020	0.308	38.00	64.70	54.07	108.90	4.927	(6)
278	24.0	0.750	0.020	0.308	38.00	64.70	45.31	108.18	4.948	
279	24.0	0.750	0.020	0.308	5.00	64.70	14.95	53.64	1.553	
280	24.0	0.750	0.020	0.308	4.60	64.70	15.26	81.36	2.245	
281	24.0	0.750	0.020	0.308	4.50	64.70	15.34	107.64	2.729	
282	24.0	0.750	0.020	0.308	14.00	64.70	30.05	53.64	2.232	
283	24.0	0.750	0.020	0.308	13.50	64.70	29.89	80.64	3.085	
284	24.0	0.750	0.020	0.308	13.50	64.70	30.05	108.00	3.895	
285	24.0	0.750	0.020	0.308	27.80	64.70	44.68	54.18	2.938	
286	24.0	0.750	0.020	0.308	27.50	64.70	44.92	82.80	4.070	
287	24.0	0.750	0.020	0.308	28.00	64.70	45.07	115.20	5.107	
288	24.0	0.750	0.028	0.308	15.30	64.70	30.12	54.54	2.326	
289	24.0	0.750	0.028	0.308	15.00	64.70	29.97	83.34	3.123	
290	24.0	0.750	0.028	0.308	15.00	64.70	29.89	108.18	3.931	
291	24.0	0.750	0.028	0.308	31.50	64.70	44.99	54.00	2.893	
292	24.0	0.750	0.028	0.308	32.00	64.70	44.99	83.70	4.135	
293	24.0	0.750	0.020	0.308	12.50	64.70	30.28	80.64	3.134	

TABLE B-7
CRITICAL HEAT FLUX DATA
ALUMINUM OXIDE - COLUMBIA UNIVERSITY

RUN NUMBER ID	HEATER LENGTH IN.	DIA. IN.	THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
1	24.0	0.750	0.035	0.308	0.0	64.70	30.00	127.80	0.810	H_2O; 2.4 - 3.6 mil Al_2O_3
2	24.0	0.750	0.035	0.308	0.0	64.70	30.00	201.24	1.980	
3	24.0	0.750	0.035	0.308	0.0	64.70	30.00	198.36	2.518	
4	24.0	0.750	0.035	0.308	0.0	64.70	30.00	248.22	2.790	
251	24.0	0.750	0.020	0.308	22.50	64.30	30.16	187.02	5.452	D_2O; 1.4 mil Al_2O_3
261	24.0	0.750	0.020	0.308	18.00	63.70	30.08	178.20	5.890	
291	24.0	0.750	0.020	0.308	16.70	64.70	29.94	138.06	5.209	
311	24.0	0.750	0.020	0.308	19.30	65.20	30.05	90.36	4.484	
327	24.0	0.750	0.020	0.308	20.10	65.20	29.97	245.34	5.265	
372	24.0	0.750	0.020	0.308	5.80	66.70	15.09	137.34	3.492	

TABLE B-8
CRITICAL HEAT FLUX DATA
ALUMINUM -HEAVY WATER COLUMBIA UNIVERSITY

RUN NUMBER ID	HEATER LENGTH IN.	HEATER DIA. IN.	HEATER THICK. IN.	COOLANT CHANNEL EQUIV. DIA. IN.	PRESSURE DROP PSI	LOCAL COOLANT CONDITIONS AT BURNOUT PRESSURE PSIA	VELOCITY FT/SEC	SUBCOOLING DEG F	CRITICAL HEAT FLUX 10^6 BTU/HR-SQFT	COMMENTS
803	24.0	0.750	0.035	0.308	15.40	65.70	30.18	79.02	3.299	(2)
804	24.0	0.750	0.035	0.308	16.80	65.70	29.97	48.96	2.572	(2)
806	24.0	0.750	0.035	0.308	15.50	64.70	30.17	82.26	3.317	
151	24.0	0.750	0.020	0.308	18.60	64.70	30.10	75.24	3.391	
201	24.0	0.750	0.028	0.308	18.60	64.70	29.98	104.94	4.392	(2)
202	24.0	0.750	0.028	0.308	18.20	64.70	30.16	68.02	3.910	(2)
203	24.0	0.750	0.028	0.308	17.50	64.70	30.19	61.02	2.956	(2)
204	24.0	0.750	0.028	0.308	17.80	64.70	30.09	74.88	3.451	(2)
205	24.0	0.750	0.028	0.308	6.10	64.70	14.98	103.36	3.226	
221	24.0	0.750	0.028	0.308	20.90	64.70	30.15	94.68	4.403	
271	24.0	0.750	0.020	0.308	16.60	64.70	30.31	108.90	2.945	(4)
301	24.0	0.750	0.020	0.308	2.10	64.70	5.07	68.94	1.832	

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